

Animal Hygiene Research And Protocol Development

> **Bird Demonstration** Vogelpark Avifauna

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# Bird Demonstration Vogelpark Avifauna Alphen a/d Rijn

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Merel Boer Daan Versleijen

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## Summary

In 1999 Vogelpark Avifauna started with an educational bird show, which introduces the visitors of Avifauna to the natural behaviour of the most diverse bird species

One of the safety aspects of the birds that are used in the bird demonstration, as well as the people who handle the birds, is proper hygiene, particularly relating to food preparation, food storage and cleaning equipment. The current situation already shows measures present to improve hygiene; however a proper hygiene protocol is not present at this time.

Therefore a request from Avifauna came to provide a hygiene protocol for use at the bird Demonstration of Avifauna.

In order to create a hygiene protocol according to modern standards, the HACCP method has been selected.

Following the HACCP method, Vogelpark Avifauna has been visited several times in order to get a clear picture of the current hygiene situation at the bird demonstration. The next step is to determine the steps that are taken from the delivery of the food until the feeding of the birds at the demonstration. Since there are several different species of birds at the bird demonstration, the food consists of whole prey, fruit and pellets. Roughly, the steps taken are delivery, storage at the main kitchen, thawing, processing, temporary storage in the prep room and transport to the bird demonstration or the enclosures. Since pellets and fruit are not frozen and pellets are stored at several places before being fed, the steps are not exactly the same for every feed.

After determining the steps, the Critical Control Points for whole prey, fruit and pellets have to be determined for each step in the process. This results in several paragraphs in which every risk of every step of the process is explained.

The most important risks are (roughly) microbiological risks, chemical risks, physical risks and cross contamination risks. Microbiological risks can be described as contamination of the food with all kinds of micro organisms (bacteria, viruses, moulds, yeasts). Chemical risks are contaminations with chemicals (cleaning liquid, cooling fluid etc.). Physical risks are contaminations of the food with objects (jewellery, sand, rocks, keys, package-materials etc.).

Cross contamination can be described as direct or indirect transfer of a pathogen from one place, or food, to another (food that gets in contact with other food, or with tools, containers or human hands that may or may not have been in contact with other food).

Each of the CCPs is fully explained and measures to control the risks are given. These measures include proper cleaning and rinsing of tools and containers and sufficient personal hygiene, two measures that are thoroughly explained in the chapter about cleaning. Also, some measures require rooms or storage facilities to be kept at certain temperatures, in order to prevent or slow down bacterial growth.

A chapter has been written about the most common avian diseases, in which an explanation is given about the nature, transmission and consequences of the diseases. With this chapter, it is attempted to clarify what the biggest risks are when keeping several birds at one place and using them for a demonstration for the public.

There are some measures given in this report, which may encourage a discussion. The first is the measure where a member of the staff has to visually check another member of the staff during cleaning and transporting the containers. This might lead to a shortage of time, since every member of the staff is needed for a certain job. It could also lead to irritation among the personnel, since they are being commented on their work. The visual checks require consistency, mutual respect and communication skills from the personnel.

The second measure that may lead to a discussion is the cleaning of the gloves. According to the report, these should be cleaned after every bird demonstration and after every feeding session, which might be forgotten or neglected on a busy day.

The recommendations given to Vogelpark Avifauna, at the end of this research, include points of improvement for the current hygiene situation in both the kitchen as the prep room of the bird demonstration. Also the food processing recommendations are discussed in the recommendations chapter.

Next to the report 'Animal Hygiene Research and Protocol Development' two manuals have been written. Two manuals have been written since one manual is in English, while the other manual is a copy of the English version, but has been translated into Dutch.

The goal of these manuals is to create a clear and easy to read manual with information about the actions that need to be done in order to improve and maintain the hygiene quality of the food at Vogelpark Avifauna. Most actions involve taking measurements and making registrations, which need no further explanation. However, for some actions like cleaning, an action that requires an extended instruction, a reference is made to this report 'Animal hygiene research and protocol development'. In this report the actions that should be done, are given with argumentation and literature references.

# **Dutch Summary (Nederlands)**

In 1999 startte Vogelpark Avifauna met een educatieve vogeldemonstratie, waarbij de bezoekers werden geïntroduceerd met het natuurlijke gedrag van de meest uiteenlopende vogelsoorten. Een van de veiligheidsaspecten van de vogels die worden gebruikt bij de vogeldemonstratie, evenals het personeel dat met de vogels werkt, is hygiëne. Wanneer men spreekt over hygiëne bij de vogeldemonstratie dan worden o.a. voedselverwerking, voedselopslag en het schoonmaken en schoonhouden van gebruikersmiddelen bedoeld. In de huidige situatie bij de vogeldemonstratie zijn al bepaalde maatregelen aanwezig om een goede hygiëne te waarborgen. Van een hygiëneprotocol bij de vogeldemonstratie is momenteel echter nog geen sprake.

Om er voor te zorgen dat een hygiëneprotocol voor de vogeldemonstratie bij Vogelpark Avifauna aan de moderne eisen voldoet, is gekozen om een hygiëneprotocol volgens de HACCP methode op te zetten. De HACCP methode volgend, is Vogelpark Avifauna meerdere keren bezocht om een beeld te krijgen van de huidige hygiëne bij de vogeldemonstratie. De opvolgende stap is het bepalen van de stappen die genomen dienen te worden vanaf de levering van het voedsel tot het voeren hiervan tijdens de demonstratie of in de verblijven van de vogels. Aangezien er met verschillende soorten vogels wordt gewerkt bij de vogeldemonstratie, komen er verschillende soorten voer ter sprake, namelijk hele prooidieren, fruit en droogvoer. Grof gezien zijn de stappen die worden genomen: de levering van het voedsel, opslag in de hoofdkeuken, ontdooien, verwerken, tijdelijke opslag en het transport van het voedsel naar de demonstratie of de verblijven. Aangezien droogvoer en fruit niet bevroren hoeven te worden en het droogvoer op verschillende plekken wordt opgeslagen voordat het voedsel bij de vogels terecht komt, zijn de processtappen niet voor elk voersoort hetzelfde.

Na het bepalen van alle stappen in het proces, voor zowel de hele prooidieren, het fruit, als voor het droogvoer dienen de CCPs (kritische controle punten) te worden vastgesteld. Dit heeft geresulteerd in meerdere paragrafen in het verslag, waarin elk risico van elke stap in het proces worden besproken.

De risico's welke het meeste voorkomen zijn microbiologische verontreiniging, chemische verontreiniging, fysische verontreiniging en kruisbesmetting.

Microbiologische verontreiniging kan het beste worden omschreven als besmetting van het voedsel door alle soorten micro-organismen (bacteriën, virussen, schimmels en sporen). Chemische verontreiniging is verontreiniging door middel van chemicaliën zoals schoonmaakmiddelen en koelvloeistof. Fysische verontreiniging vindt plaats doordat vreemde objecten op het voedsel terecht komen (zand, sieraden, steentjes, sleutels, verpakkingsmateriaal etc). Kruisbesmetting kan worden beschreven als een directe of indirecte verplaatsing van een ziekteverwekker van de ene plek, of voedsel, naar het ander (voedsel dat in contact komt met ander voedsel, gereedschap, containers of handen van personeel welke wel of niet in contact zijn gekomen met ander voedsel).

Elke van de CCPs is volledig uitgelegd en de maatregelen welke genomen dienen te worden om dit CCP te verhinderen worden weergegeven. Deze maatregelen bestaan onder andere uit het goed schoonmaken en schoonspoelen van gereedschappen (bijvoorbeeld snijplanken en messen), persoonlijke hygiëne, twee maatregelen die uitgebreid beschreven worden in het hoofdstuk Cleaning. Tevens worden enkele maatregelen weergegeven die stellen dat opslagruimtes op een bepaalde temperatuur behouden moeten worden, om bijvoorbeeld bacteriële groei te verminderen.

In het verslag kan tevens een hoofdstuk over voorkomende ziektes bij vogels worden gevonden, waarbij een uitleg wordt gegeven over de eigenschappen, besmettingsrisico's en gevolgen van deze ziektes. In dit hoofdstuk is getracht uit te leggen wat de grootste risico's zijn wanneer meerdere soorten vogels op één plek gehouden worden en worden gebruikt voor een publiekelijke demonstratie.

In het verslag worden enkele maatregelen genoemd die een discussie zullen aanmoedigen. Één hiervan is de maatregel dat één lid van het personeel de andere personeelsleden dient te controleren op het voldoende schoonmaken en desinfecteren van de voedselcontainers. Dit kan leiden tot een tekort aan tijd, aangezien elk lid van het personeel momenteel al noodzakelijk is voor andere dagelijkse taken. Tevens is het risico aanwezig dat deze controles zullen leiden tot irritatie onder het personeel, aangezien zij telkens op hun werk worden gecontroleerd. De visuele controles dienen op een consistente manier te worden uitgevoerd waarbij duidelijke communicatie met het personeel erg belangrijk is.

Het tweede discussiepunt is het schoonmaken van de handschoenen welke worden gebruikt om de roofvogels te hanteren en te voeren. Volgens dit verslag dienen deze handschoenen na elke demonstratie en voeding schoon te worden gemaakt. Dit kan echter gemakkelijk worden vergeten, gezien de strakke planning op een normale werkdag.

De aanbevelingen welke worden gegeven aan Vogelpark Avifauna voor verbetering van de hygiëne, bevatten onder andere aandachtspunten voor zowel de huidige keuken als de prep room van de vogeldemonstratie. Tevens zijn de voedselverwerking aanbevelingen behandeld in het hoofdstuk Recommendations.

Naast dit verslag 'Animal Hygiene Research and Protocol Development' zijn er twee handleidingen geschreven (een origineel en een vertaling naar het Nederlands). Het doel van deze handleidingen is het creëren van een duidelijke en eenvoudige handleiding waarin informatie voor het verbeteren en behouden van de hygiëne kwaliteit van het voedsel te vinden is. Het grootste gedeelte van de handelingen beschrijven maatregelen en het bijhouden van registratie, welke geen verdere uitleg nodig hebben (zie bijlagen handleiding). Echter, voor sommige handelingen zoals het schoonmaken, een handeling waarbij duidelijke regels gevolgd dienen te worden, wordt verwezen naar dit verslag 'Animal Hygiene Research and Protocol Development.' In dit verslag worden alle handelingen uitvoerig beschreven en onderbouwd met argumentatie en bekende literatuur.

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# 1. Introduction

In 1999 Vogelpark Avifauna started with an educational bird show, which introduces the visitors of Avifauna to the natural behaviour of the most diverse bird species (*Van Der Valk & De Hoon, 2003*). One of the safety aspects of the birds that are used in the bird demonstration, as well as the people who handle the birds, is proper hygiene, particularly relating to food preparation, food storage and cleaning equipment. The current situation already shows measures present to improve hygiene; however a proper hygiene protocol is not present at this time.

Therefore a request from Avifauna came to provide a hygiene protocol for use at the bird Demonstration of Avifauna.

Quality assurance in general, and in particular veterinary and zoo technical care, are nowadays an integral part of the policy of zoos. Modernization and renovation of zoos is taking place rapidly. Nevertheless, and quite unfortunately, the importance of the production and preparation of safe food (as part of the quality) with regard to the health of the animals, as well as with regard to establishing good hygiene through food quality assurance is sometimes underestimated (*Bijker et al, 2007*).

A thorough understanding of avian nutrition is essential to secure the health and well being of the birds used in the demonstration and also to secure the health of the people working closely with these birds.

Next to good nutritional values another important component is the microbiological quality of the feed. Many bacteria species can be pathogenic, for example *Salmonella* spp. and *Escherichia coli*. Absence of these bacteria is important in order to prevent related diseases. (*Knipscheer & Kocsis, 2007*)

At this time there is no proper hygiene protocol for use at the Bird Demonstration of Avifauna. A proper hygiene protocol should reduce or eliminate disease and contamination of birds and people with efficiency and effectiveness.

In all stages of food production and food preparation, contamination of the food can take place. This implies that all stages of the production line should be controlled by means of a quality assurance system (*Bijker et al., 2007*).

To meet the animal feed quality control requirements, the Product Board Animal Feed (The Netherlands) developed the GMP standard Animal Feed in 1992, a quality management system for the animal feed industry. This GMP standard is one of the main points in the animal feed quality programme. Despite the participation being voluntary, in 2003 more than 95% of the Dutch suppliers of mixed and simple feeds to livestock farmers had certified. For the next decade, the system had been adapted and extended on the basis of practical experience and ongoing insights. Mad cow disease, dioxin contamination of Brazilian citrus pulp (1998) and the Belgian dioxin affair (1999) were particularly important impulses for drastic changes. The GMP standard Animal Feed at that time was mainly focussed on known risk factors, like pesticides, heavy metals, aflatoxin and salmonella. The quality assurance system for animal feed appeared to be insufficiently suited to avoiding unforeseen sources of contamination. For that reason, in June 1999, the Product Board Animal Feed decided to enhance the GMP-quality assurance system for animal feed production chain with HACCP as part of the quality system. By using the HACCP approach, the Dutch animal feed sector has opted for a quality assurance system which is also applied in the European food industry. (*Den Hartog, 2002*)

The Hazard Analysis and Critical Control Point (HACCP) monitoring system has been used traditionally to increase quality control in human food production operations. HACCP is a pro-active, preventative system aimed at identifying checkpoints where potential hazards can enter the food production pathway. These predetermined checkpoints, referred to as Critical Control Points (CCP), are defined as "a point, step, or procedure at which control can be applied and a food-safety hazard can be prevented, eliminated or reduced to acceptable levels" (*Schmidt, Travis & Williams, 2006*). Recently, the concept of HACCP monitoring has extended to food fed to domestic animals. Captive wildlife facilities, such as zoos and aquaria, would benefit from a well-organized, food safety and nutritional monitoring system. (*Schmidt, Travis & Williams, 2006*)

At the demonstration of Avifauna both fruit eating birds and whole prey eating birds are handled by the same persons during the show and after the show. By feeding for example whole prey to a Harrier, followed by feeding fruit to a Macaw, there is a chance of cross contamination: the handler first holds the whole prey in his hand, which might leave micro organisms on his hand. Then, the fruit is being held, transferring the micro organisms to the fruit eating bird. This creates a potential health hazard of cross species and/or human contamination. The consequences are not necessarily lethal, but can cause a serious health risk for the animals and the personnel. It has long been known that infectious agents can be transmitted to animals through contaminated feed. For example, al early as in 1948, workers in the UK demonstrated that non-Typhi serotypes of *S. enterica* could be transmitted to checks through feed contaminated by the faeces of infected rodents (*Wilson, 1948*) Although it is less well documented, bacteria that can cause human infections but may not cause illness in animals can also be readily transmitted to food animals via contaminated feed and appear on animal carcasses destined for human consumption. (*MacKenzie and Bains, 1976*)

The goal of this research program is to provide a hygiene protocol for use at the Bird Demonstration of Avifauna. This protocol will reduce or eliminate the risks of disease and contamination of birds and people with efficiency and effectiveness.

In this report, certain areas in Vogelpark Avifauna are mentioned. Also, some words are used that might need further explanation. For this, at the end of the report a list can be found, the so called "Explanation of words", where some words or locations are clarified.

# 2. Materials and Methods

This chapter will describe how the research has been done. The research questions, research design and type, research population, data collection and data processing methods will be discussed in this chapter.

# 2.1 Research questions

For this research program the following research questions have been set:

Main Research question:

What hazard analyses and hygiene recommendations should be implemented in a hygiene protocol, which contains directions for hygiene at the bird demonstration?

Sub – questions:

- 1.a. Which steps does the feed take from processing the feed till it reaches the bird?
- 1.b. What are the risks of each step mentioned in sub question 1.a.?
- 1.c. What measures can be taken to control the risks mentioned in sub question 1.b.?
- 1.d. What are infection related risks for birds and personnel during maintenance and show procedures?
- 1.e. What are the CCPs that are necessary in order to control the risks mentioned before?
- 1.f. How can be determined that the CCPs are within acceptable limits?

1.g. What is an accurate and thorough record keeping system for use at the bird demonstration? (Schmidt, Travis & Williams, 2006)

2.a. What cleaning and disinfectant products are suitable for use?

## 2.2 Research design and type

The research design is one of several parts. The first important part will be a situation analysis on the current hygiene, contamination risks, HACCP and feed processing at the bird demonstration. In order to get a HACCP protocol a literature research will suffice.

This research project is a qualitative research. The reason that this research is a qualitative research is the fact that primarily, the steps taken in producing the feed by the personnel are evaluated. The opinion and the experiences of the people that work with the birds are also taken into account.

An analysis of the current food preparation methods in the kitchen of Avifauna will take place, as well as an evaluation of the show procedures, regarding food hygiene.

# 2.3 Research population

The research project will take place at the bird demonstration of Vogelpark Avifauna. At the bird demonstration there are 5 full-time employees, who are all in contact with the food and the birds. The entire research population can be researched, because it is limited to 5 employees. However, on a regular basis, interns are present at the bird demonstration as well. This should be held in consideration.

There are a number of species of birds used for the bird demonstration. An overview of all the bird species and number of birds used at the bird demonstration can be found in <u>Appendix II</u>.

The birds which are used at the demonstration have separate enclosures, which are located at a separate part of the bird park. A map of the enclosures can be found in <u>Appendix III</u>. The Outside

cages of the Macaws are built from steel, with wooden inside enclosures for shelter from wind and rain. All the other enclosures are built from wood, with either steel wiring or wooden bars.

## 2.4 Data Collection Methods

The data collection methods will be discussed for each sub-question.

To answer question 1.a., the working methods of the personnel will be observed. The observing method is the only suitable way to determine which steps are used in processing the food, because risks can be seen directly by the observer. The risk of a subjective interpretation by the observer is reduced because of the use of two observers. Collecting this data with two persons will enhance the reliability. However, there is an increased risk which will be the lack of experience in observing of both researchers. Therefore, information about recognizing risks in these situations (literature research) will be gathered before using these observing methods. The answer to this research question can be found in <u>Appendix IV</u>.

To answer question 1.b., the risks mentioned in sub-question 1.a. will be analysed using information obtained by literature research. This includes HACCP methods and previous researches in different settings. The answers to this research question can be found in paragraph <u>6.2</u>, <u>7.2</u> and <u>8.2</u>.

To answer question 1.c., 1.d. and 1.e., literature is used to determine measures that can be taken to control the risks mentioned in sub-question 1.b. For sub-question 1.d. and 1.e. the HACCP methods are used. The answers for sub-question 1.c. and 1.e. can be found in paragraph <u>6.2</u>, <u>7.2</u> and <u>8.2</u>. The answer for sub-question 1.d. can be found in <u>Chapter 3</u>.

To answer question 1.f., literature research will be used to determine acceptable limits for this particular setting. By use of these limits, overviews can be created which can help the staff check up on the acceptable limits on a regular basis. The answers for sub-question 1.f. can be found in paragraph <u>6.2</u>, <u>7.2</u> and <u>8.2</u>.

To answer question 1.g., literature research is used to gain background information. For using the record keeping system, it is important that it is acceptable and realistic for use during the bird demonstration. Therefore common sense and consultation with the personnel are crucial for answering this question. The answer to this sub-question can be found in the manual 'Food processing and hygiene protocol'.

To answer question 2.a., literature research will provide information about disinfectant products. More information about disinfectant products can be gained by contacting companies that deliver such products. The knowledge of the providers of the disinfecting products will be used. The answer to this question can be found in the recommendations chapter, <u>chapter 10</u>.

## 2.5 Data processing

By using a decision tree (*Forsyth& Hayes, 1998*), the CCPs will be determined. These will be used to determine preventative measures for each CCP according to HACCP methods. This will result in an overview which can be used by the personnel of the demonstration in order to minimize risks. The end result will be a report with a description of the measures that should be taken to minimize risks in food infection and health risks for the birds as well as the personnel. This report can also be used as an example for similar settings in different zoos. Next to the report, two manuals will be written (English and translated to Dutch) in order to get a clear view of all the measures that should be taken at the bird demonstration of Vogelpark Avifauna.

# 3 Avian diseases

It is necessary to consider forms of food poisoning and food-borne hazards since these are a concern of serious health hazards for both birds and personnel.

Some of the food-borne hazards are *Escherichia coli*, salmonellas and Aspergillosis. These hazards are a risk for both personnel and birds. This chapter will provide a description of six of the most common diseases in birds, which can also often be transmitted by the feed. This chapter also provides a short paragraph on bumble foot and how its treatments are in their effectiveness.

When proper treatment is mentioned in this chapter, the experience of a veterinarian specialised in exotic birds and birds of prey is required (and strongly advised).

### 3.1 Escherichia coli

#### Description

*Escherichia coli* - commonly referred to as *E. coli*, this Gram-negative bacterium is a member of the Enterobacteriacae species. While many harmless or beneficial strains of *E. coli* occur widely in nature, including the intestinal tracts of humans and other vertebrates, birds and reptiles, pathogenic types are a frequent cause of both enteric and urogenital tract infections. Birds, especially psittacines, are less dependent on *E. coli* and rely on a more Gram-positive gut flora. However, softbills such as the passerines (finches, jays, songbirds), columbiforms (pigeons and doves), galliforms (chicken-like birds), raptors (hawks, falcons, owls), and ratites (emus and ostriches), have a high incidence of normal Gram-negative gut flora of many varieties including *E. coli*. (*Avian Biotech International 2005*)

The distribution of *E. coli* in psittacines varies one species to another. It is less common in Amazons and macaws, sometimes found in greys, and common in cockatoos and Eclectus. In fact, *E. coli* can compose as much as 30 percent of the gut flora of some psittacines and others like cockatiels and budgies carry somewhat less.

#### Transmission

The bacteria are shed from an infected bird in the faecal material as well as nasal and or ocular secretions. The organism remains stable outside the host body and may dry as a dusty substance. This dust contaminates the air in the form of aerosols. These aerosols are then inhaled by another possible host. Susceptibility as well as the amount of contamination determines whether or not the new host becomes infected with the disease. Other forms of transmission include infected hens feeding their young with contaminated crop contents, as well as contaminated feed and drinking water. (*Avian Biotech International 2005*)

Vertical transmission (transmission of the bacteria to an egg) can occur, subsequently chicks hatch and spread salmonella by direct contact. The embryo may die if bacteria levels become too high.

The disease has a greater chance of spreading in overcrowded conditions, stale air environments, nest-boxes, and brooders. Pet shops, bird marts, and quarantine stations are also high risk areas.

#### Symptoms

Ruffled feathers - diarrhoea - listlessness - weakness - shivering - vent picking. The severity of the illness can depend on the age of the bird, the virulence of the bacteria, the immune system, stress and the degree of contamination. Affected birds can also become carriers showing no disease symptoms. These carriers can spread the disease to their offspring and may later become ill as a result of stress. Baby birds, with less developed immune systems, are more susceptible to disease and frequently die. Chronic infections in adult birds may form abscesses, fail to hatch eggs, have changes in eating habits and may intermittently pass contaminating bacteria. (*Avian Biotech International 2005*)

#### Prevention

Keep water and feed bowls free of faecal material. Identify carrier birds and properly treat them. Careful disposal of contaminated materials. Minimize stress in the aviary. People working with

contaminated material should practice good hygiene (Avian Biotech International, 2005). This will be discussed in more detail in Chapter 5.

### 3.2 Salmonella

#### Description

Salmonella species are gram negative, aerobic, rod-shaped, zoonotic bacteria that can infect people, birds, reptiles, and other animals. Most vertebrates can be infected with Salmonella however; the host susceptibility and development of carrier states vary widely among species. Free-ranging birds can be sub-clinical carriers and serve as a reservoir of bacteria. In addition to free-ranging birds, flies, rats, and other vermin may also serve as vectors of Salmonella. The incidence of various Salmonella species seems to vary with geographic location and the types of food consumed. Imported birds and animals may serve to introduce different Salmonella species to the local area that can cause new and devastating outbreaks. (*Avian Biotech International, 2005*)

#### Transmission

Transmission of this organism from one host to another is primarily through the air. The bacteria are shed from an infected bird in the nasal and or ocular secretions, faecal material, and feather dust. The organism remains stable outside the host body and dries as a dusty substance. This dust or aerosol contaminates the air that is then inhaled by another possible host. Susceptibility as well as the amount of contamination determines whether or not the new host becomes infected with the disease. Other forms of transmission include infected hens feeding their young with contaminated crop contents, as well as contaminated feed and drinking water. (*Avian Biotech International, 2005*)

Vertical transmission (transmission of the bacteria to and egg) can occur, subsequently chicks hatch and spread salmonella by direct contact. The embryo may die if bacteria levels become too high.

The disease has a greater chance of spreading in overcrowded conditions, stale air environments, nest-boxes, and brooders. Pet shops, bird marts, and quarantine stations are also high risk areas. (*Avian Biotech International, 2005*)

#### Symptoms

General symptoms of Salmonella include lethargy, anorexia, and diarrhoea. In chronic cases, arthritis (particularly in pigeons) may be present. With high dose infections excessive thirst, conjunctivitis along with indications of liver, spleen, kidney or heart damage can occur.

Some individual avian species have unique clinical symptoms. Outbreaks in lories (*Loriidae*) are associated with an acute disease and high flock mortality. African Grey Parrots are also very susceptible, but they develop a more chronic disease showing symptoms such as mucus discharge from the beak/nasal area, arthritis, excessive thirst, and dermatitis. Droppings are coloured a sulphur yellowish green which is very much a diagnostic sign for this micro-organism. (*Avian Biotech International, 2005*)

#### Prevention

Proper hygiene is the best way to prevent outbreaks of Salmonella. Effective control of flies, rodents and other vermin are also essential eliminate in preventing Salmonella outbreaks. Strains of Salmonella present in companion birds are generally not considered to be of any danger to a healthy human being. They may however, threaten infants, the elderly, or those with immunosuppressive diseases. Humans carrying Salmonella can infect their companion birds. Such human-to-animal interactions have been shown to occur, especially with African Greys, Amazons, Cockatoos and Macaws (*Avian Biotech International 2005*). Proper personal hygiene will be discussed more in detail in Chapter 5.

### 3.3 Aspergillosis

#### Description

The genus Aspergillus includes a variety of related fungi which cause Aspergillosis. An important member of these genera is *Aspergillus fumigatus*. This fungus produces endotoxins which are generally responsible for the disease known as Aspergillosis. Aspergillus species are common in the environment. Spores often become airborne in dry windy weather spreading from one location to another. Spores can enter an individual and develop in the respiratory system, lungs, eyes, and ears. Sick Building Syndrome is a condition caused by continuous fungal growth in areas of buildings and ventilation systems. Growth leads to the release of more spores. This can potentially lead to large scale respiratory infections and distress associated with Aspergillosis. (*Avian Biotech International, 2005*)

Aspergillosis can be fatal, especially to those with immunodeficiency. This opportunistic pathogen is common among domesticated and cage birds.

#### Transmission

Inhalation of conidia (spores) from contaminated feed, faecal material, and soil. The spores are often present in the environment and healthy unstressed birds are generally resistant to even high levels of spores. However, young and old birds, birds on antibiotics, and those birds whose immune systems are suppressed by surgery, reproduction, environmental changes, capture, shipping, or age are frequently infected.

Aspergillus can also infect the developing embryo by penetrating the egg while the embryo is developing. Infected eggs may develop a slightly greenish tint when candled. Well developed lesions may appear on infected embryos after they hatch. (*Avian Biotech International, 2005*)

#### Symptoms

Symptoms range from respiratory distress, gasping, accelerated breathing, voice changes, abnormal droppings, emaciation, regurgitation, poor appetite, diarrhoea, anorexia, gout, increased thirst, nasal discharge, conjunctivitis, dyspnoea, neuromuscular disease, somnolence, lesions (yellow or grey nodules and/or plaques in the lungs, air sacs, or trachea; less often in the peritoneal cavity, liver or other sites). (*Avian Biotech International, 2005*)

#### Prevention

Minimize stress and overcrowding. Provide proper ventilation. Reduce contact with mould or spore contaminated nesting materials. Prevent malnutrition with a proper diet. Make sure feed is properly stored and is free of fungal growth. Aspergillus spores may be present in corn and grain products as well as manufactured pellets or extruded food and may develop into fungal growth if conditions are favourable (*Avian Biotech International, 2005*). This will be discussed more in detail in Chapter 5.

### 3.4 Avian Influenza virus

#### Description

Influenza viruses are 80-120 nm diameter, segmented RNA viruses, with a helical symmetry. Influenza virus can be classified into two groups (A and C). Influenza A subtypes isolated from birds, pigs, horses, seals, whales, people and other animals are all closely related. Type C influenza is usually restricted to humans, but there have been documented exceptions.

Influenza virus has a high rate of genetic recombination meaning that new serological and pathological subtypes frequently appear. This makes it extremely difficult to develop reliable assays that can detect all types of Influenza virus. (*Avian Biotech International, 2005*)

#### Transmission

AIV is distributed world wide primarily by migration of different avian species. Many species of waterfowl are asymptomatic carriers of AIV. Waterfowl are believed to be the primary reservoirs for influenza A, serving as a source of infection for other birds within their migratory path.

Infected birds can shed the virus via their respiratory system, ocular secretions and faeces. There are no known incidences of vertical transmission.

Although direct transmission of AIV from birds to humans is very rare AIV is considered a zoonotic disease, meaning it is capable of being passed from birds and animal to humans. It is also quite possible that humans can infect birds with AIV; however this has not been documented. (*Avian Biotech International 2005*)

#### Symptoms

Symptoms vary dramatically depending species infected, the age, environmental factors, and the virulence of the viral subtype. Some birds may die with out developing any clinical signs of illness, while others develop depression, loss of appetite, congestion, sneezing, and drop in egg production. Psittacine birds may develop these symptoms as well as loss of balance or a twisted neck. Mortality rates in psittacines are as high as 30% with some virulent strains. (*Avian Biotech International 2005*)

#### Prevention

Clean and disinfect all surfaces and quarantine all new and infected birds. It is best to keep all freeranging birds away from companion birds, domestic poultry, and fowl. A vaccine is available, but does not protect against many different subtypes of AIV (*Avian Biotech 2005*).

### 3.5 Avian tuberculosis

#### Description

Mycobacterium (ATB) - Straight or slightly curved, non motile rods, 0.2-0.6 x 1.0 µm. Although difficult to stain, rods are Gram positive. After staining with basic fuchsine, cells resist decolorization with acidic ethanol and are therefore termed acid-alcohol-fast bacilli (AFB). This characteristic is due to the high level of lipid in mycobacterial cell walls.

There are seventy-one validly named species of Mycobacterium and an additional three sub-species The principal pathogens in the genus are M. bovis, M. leprae and M. tuberculosis but, in all, thirty-two species are known to be pathogenic to humans or animals. Species of Mycobacteria other than those above are often referred to as "atypical mycobacteria". The most commonly encountered pathogens among the atypical mycobacteria are species of the Mycobacterium avium complex. The M. avium complex (MAC) is considered to contain M. avium, M. avium subspecies paratuberculosis, M. avium subspecies silvaticum and M. intracellulare. However, poorly identified strains which show some similarity to M. avium are also frequently, and incorrectly, allocated to the complex. There are over 20 recognized serotypes within the M. avium complex. (*Avian Biotech International, 2005*)

Most birds including parrots, parakeets, cranes, sparrows, starling, emus, waterfowl raptors and softbills, have shown susceptibly to M. avium. It is believed that favourable conditions virtually all species of birds are susceptible to avian tuberculosis. It is most prevalent where there is a high population density, such as in zoos, or collections of birds.

#### Transmission

M. avium infections are considered to be "open" meaning infected birds consistently shed large amounts of organism into the environment.

M. avium is transmitted by ingestion and inhalation of aerosolised infectious organisms from faeces. Incubation in birds is weeks to years. Oral ingestion of food and water contaminated with faeces is the most common method of infection. Once ingested, the organism spreads throughout the bird's body and is shed in large numbers in the faeces. If the bacterium is inhaled, pulmonary lesions may

develop. Skin invasion may occur as well. The spread via infected eggs can occur, but it is not common.

The transmission of M. avium from human to human has not been convincingly demonstrated and all infections are thought to be of environmental origin. (*Avian Biotech International, 2005*)

#### Symptoms

In some cases sudden death can occur in a bird with normal body weight and outer appearance. However, in most cases a bird with TB will develop symptoms such as progressive weight loss in spite of a good appetite, depression, diarrhoea, increased thirst, and respiratory difficulty. A decreased in egg production often occurs in birds that were laying eggs. Once the disease appears, it is virtually impossible to eradicate it. Eventual death is the usual outcome

Birds with the intestinal form often present with chronic wasting disease - and Proventricular Dilatation Syndrome is often one of the suspected possible diseases. In addition to weight loss, depression, diarrhoea, increased urination (polyuria), abdominal distention, lameness and difficulty in breathing may be present. (*Avian Biotech International, 2005*)

#### Prevention

Preventing M. avium is best done by minimize stress and overcrowding; Provide proper ventilation; Prevent malnutrition with a proper diet. Controlling an M. avium outbreak in zoos, bird gardens and private aviaries can be especially difficult to eradicate. New additions to the aviary should be quarantined for a minimum of 1-2 months. Testing new additions for M. avium is also a good way to prevent possible outbreaks. (*Avian Biotech International, 2005*)

#### Treatment

All M. avium isolates that have been tested up to now are totally resistant to the antituberculous drugs currently used in humans ATB is extremely difficult to treat, and in many cases treatment is not considered a viable option. (*Avian Biotech International, 2005*)

### 3.6 Chlamydia Psittaci

#### Description

Chlamydia psittaci - also referred to as Psittacosis, Parrot Fever or chlamydiosis. The word Psittacosis comes from the Greek word Psittakos, meaning parrot. Chlamydia are gram negative, spherical, (0.4-0.6 micron diameter), intracellular parasites that people sometimes referred to as "energy parasites" because they use ATP (a crucial energy containing metabolite) produced by the host cell, hence, the term "energy parasites.

Incubation periods in caged birds vary from days to weeks and longer. Most commonly this period is approximately 3 to 10 days. Latent infections are common and active disease may occur several years after exposure. The incubation period of this disease is however difficult to assess due to these chronically infected birds that develop persistent, asymptomatic infections.

In birds, C. psittaci may manifest itself as an upper respiratory infection with nasal, and or ocular discharge, diarrhea, or a combination of all three. In some cases, birds may be infected but show no signs. These cases are of concern because these birds may become carriers and shed the organism.

A major concern with C. psittaci is the zoonotic potential of the organism. A zoonotic disease is an infection which can be transmitted from animals to humans. C. psittaci is also one of the major causes of infectious abortion in sheep and cattle.

#### Transmission

Transmission of this organism from one host to another is primarily through the air. The bacteria is shed from an infected bird in the nasal and or ocular secretions, fecal material, and feather dust. The organism remains remarkably stable outside the host body and dries as a dusty substance. This dust

or aerosol contaminates the air that is then inhaled by another possible host. Susceptibility as well as the amount of contamination determine whether or not the new host becomes infected with the disease. Vertical transmission through the egg has been shown in domesticated ducks.

The disease has a greater chance of spreading in overcrowded conditions, stale air environments, nest-boxes, and brooders. Pet shops, bird marts, and quarantine stations are also high risk areas.

#### Symptoms

In young birds clinical sings can include rough plumage, low body temperature, tremor, lethargy, conjunctivitis, dyspnea, emaciation, sinusitis, yellow to greenish droppings or grayish watery droppings may also be displayed. Adult birds may develop symptoms such as tremors, lethargy, ruffled feathers, progressive weight loss, greenish diarrhea, occasional conjunctivitis, and high levels of urates in droppings. Birds infected with Chlamydia may develop one or several of these symptoms as the disease progresses.

Clinical changes associated with a Chlamydia infection include WBC elevated 2-3 times, Hct decreased 25-40%, SGOT elevated at least 2-3 times the normal levels, LDH elevated by at least 20%, and AST elevated by at least 2-3 times the normal limit. Other, more slight changes can occur in blood hematology and chemistry.

#### Prevention

Preventing the organism from entering your facility is the best method of prevention. Test and quarantine all new birds before entering them in your aviary; avoid bird marts and bird fares where the disease can spread. Commonsense hygiene includes the removal of fecal material, and quality air circulation,

#### Treatment

Most treatments involve the use of tetracycline and its derivatives such as Vibramycin, Doxycycline, Oxytetracycline. The antibiotic can be given by intravenous or intramuscular injections. Antibiotics can also be given orally or mixed with palatable food. Treatment periods generally last about 45 days varying slightly depending on the treatment. \*Calcium should be withheld because tetracycline binds to calcium. Citric acid in the bird's drinking water can increase the levels of antibiotics in the blood.

### 3.7 Clostridium

#### Description

Clostridium - Clostridia are anaerobic (meaning unable to grow in the presence of free oxygen), gram positive, spore-forming, bacteria. Members of this genus resemble large, straight or slightly curved rods with rounded ends.

Spores do not germinate and growth does not normally proceed unless a suitable environment exists. In their active form, these bacteria secrete powerful exotoxins that are responsible for such diseases as tetanus (lockjaw), botulism, PDD syndrome, and gas gangrene. When the environment becomes less suitable for growth the bacteria begin producing spores that are able to tolerate much greater extremes than the active bacteria. The four most notable species of Clostridium are Clostridium tetani, Clostridium difficile, Clostridium perfringens, and Clostridium botulinum. (*Avian Biotech International, 2005*)

Members of this genus produce some of the most potent toxins discovered by scientists. The toxins are relatively heat stable but may be destroyed by boiling. There are different types of the toxin; types A and C cause the disease in birds while type B frequently produces the disease in humans.

Clostridium botulinum - The organism that causes botulism is common in nature and is widely present in soils. Ingestion of the organism is not harmful. It becomes dangerous only when conditions are favorable for its growth and subsequent toxin formation. The toxin produced by C. botulinum, the causative agent of botulism, is considered one of the most potent poisons known.

The organism grows best under high humidity and relatively high temperature and in an environment containing decaying organic material (plant or animal). The organism requires an environment in which all atmospheric oxygen is eliminated. C. botulinum cannot multiply in the presence of free oxygen.

Botulism results after the decaying animal or plant material containing the toxin is consumed. Decaying carcasses are a frequent source of the toxin, as are many insects feeding in the same tissue. The insects may contain enough toxins to cause the disease in any bird that ingests it. Since the toxin is water soluble, water sources may become contaminated and provide a reservoir for the disease. (*Avian Biotech International, 2005*)

Vultures seem to be able to tolerate this and other similar toxins remarkable well.

Clostridium perfringens - This organism is capable of producing type (A, B, C, D, and E) toxins that can cause necrosis of the surrounding tissue including muscular tissue. The bacteria themselves produce gas that leads to bubbly deformations of the infected tissue. C. perfringens is capable of necrotizing intestinal tissue and can release an enterotoxin that may lead to severe diarrhea. These symptoms are sometimes mistakenly identified as being the result of Proventicular Dilation Disease or PDD infection in birds.

Clostridium tetani - This bacterium causes tetanus (lockjaw) in humans. Spores enter the body through any type of skin trauma. If and anaerobic (absence of oxygen) environment is present, the spores will germinate and eventually form an active bacterial infection. The bacteria then release an exotoxin called tetanospasmin that affects the nervous system. One of the effects includes skeletal muscle contraction due to blockage of interneurons that regulate muscle contraction. If not treated early, mortality rates of this disease are high. Immunization is available for children and adults. (*Avian Biotech International, 2005*)

#### Transmission

Ingestion and wound infection contracted by spores from contaminated dirt. Inhalation of spores or bacteria from contaminated feed, water, fecal material, air, soil, and nesting material.

#### Symptoms

Symptoms vary depending on the type of Clostridial infection. Disease is generally caused by type-C strains of C. perfringens producing toxin in the small intestines of birds, resulting in rapped loss of condition and weight loss, lethargic behavior, decreased appetite, and blood stained or undigested food. The toxin, and its effects may remain in the system for extended periods of time even after the original bacterial infection has been treated.

#### Prevention

Minimize stress and overcrowding; Provide proper ventilation; Prevent malnutrition with a proper diet. Make sure feed is properly stored and is free of bacterial growth. Spores may be present in corn and grain products as well as manufactured pellets or extruded food and may develop bacterial growth if conditions are favorable. (*Avian Biotech International, 2005*)

### 3.8 Newcastle Disease

#### Description

Newcastle disease virus (NDV) - A type strain for avian paramyxoviruses. Members of this family have a single stranded, linear, RNA, with an elliptical symmetry. The total genome is roughly 16,000 nucleotides. Replication of the the virus takes place in the cytoplasm of the host cell.

NDV is a contagious and fatal viral disease affecting most species of birds. Clinical signs are extremely variable depending on the strain of virus, species and age of bird, concurrent disease, and preexisting immunity. Four broad clinical syndromes are recognized by scientists. They are Viscerotropic velogenic, Neurotropic velogenic, Mesogenic, and Lentogenic. NDV is so virulent that many birds die without showing any clinical signs. A death rate of almost 100 percent can occur in unvaccinated poultry flocks. NDV can infect and cause death even in vaccinated poultry. Fortunately NDV has not infected domestic chicken flocks in the United States since the last outbreak was eradicated in 1974.

#### Transmission

NDV is spread primarily through direct contact between healthy birds and the bodily discharges of infected birds. The disease is transmitted through infected birds' droppings and secretions from the

nose, mouth, and eyes. NDV spreads rapidly among birds kept in confinement, such as commercially raised chickens.

High concentrations of the NDV are found in birds' bodily discharges; therefore, the disease can be spread easily by mechanical means. Virus-bearing material can be picked up on shoes and clothing and carried from an infected flock to a healthy one.

NDV can survive for several weeks in a warm and humid environment on birds' feathers, manure, and other materials. It can survive indefinitely in frozen material. However, the virus is destroyed rapidly by dehydration and by the ultraviolet rays in sunlight.

Smuggled pet birds, especially Amazon parrots from Latin America, pose a great risk of introducing NDV into the US. Amazon parrots that are carriers of the disease but do not show symptoms are capable of shedding NDV for more than 400 days.

#### Symptoms

NDV affects the respiratory, nervous, and digestive systems. Symptoms are very variable depending on the strain of virus, species of bird, concurrent disease and preexisting immunity. The incubation period for the disease ranges from 2 to 15 days. An infected bird may exhibit the following signs:

- Respiratory: sneezing, gasping for air, nasal discharge, coughing
- Digestive: greenish, watery diarrhea
- Nervousness, depression, muscular tremors, drooping wings, twisting of head and neck, circling, complete paralysis
- Partial to complete drop in egg production and thin-shelled eggs
- Swelling of the tissues around the eyes and in the neck
- Sudden death

#### Prevention

Although often not recognized as such Exotic Newcastle is a threat to the caged-bird industry. Birds illegally smuggled into the United States are not quarantined and tested by the US Department of Agriculture (USDA) and therefore may carry the exotic Newcastle virus. Owners of pet birds should:

Maintain records of all sales and shipments of flocks.

Isolate all newly purchased birds for at least 30 days. Restrict movement of personnel between new and old birds.

Amazon parrots are difficult to raise domestically. Anyone who is offering to sell a large number of young parrots could be suspected of smuggling or purchasing smuggled birds.

#### Treatment

There is no known treatment for Newcastle Disease.

### 3.9 Bumblefoot

#### Description

Bumblefoot is a degenerative foot condition found primarily in raptors and occasionally in other birds, most notably water-fowl. Though common in captive raptors, bublefoot is a by-product of captive management and is not an infectious disease. Bumblefoot is rarely encountered among wild birds and typically is associated with pre-existing injury to one or both feet.

#### Symptoms

The condition is initiated by abnormal pressures placed on the feet by improperly shaped perches, inappropriate perching substrate, and by housing arrangements in which raptors traumatize the metatarsal pad in jumping from perch to perch. In rare instances, the condition may result from self-inflicted puncture wounds or from bite wounds from prey or other trauma. In all cases, trauma to the bottom of the foot or toe is the inciting factor; infection, usually with *Escherichia coli* or *Staphylococcus* 

spp., is secondary. Some specialists liken the pathogenesis to that of a bedsore. Others tend to emphasize the microbiological component, whereas others, regard the cause as a disorder involving disruption of the integrity of the epithelium on some portion of the plantar surface that is secondarily invaded by opportunistic bacteria. This disorder is graded in five categories, depending on severity and prognosis: type I: a nondisrupting hyperemic or hyperkeratotic devitalization of the plantar epithelium carries a good prognosis, whereas type V, characterized by deep infection of the soft tissues and osteomyelitis, and is most often treated by euthanasia. (*Zoo and Wild animal medicine*, *2003*)

#### Treatment

The treatment of bumblefoot involves removal of underlying cause(s) and management of the wound. In early type I cases where the papillae of the plantar epithelium are flattened and slight reddening of the skin has occurred, application of skin tougheners (camphor and benzoin) along with alteration of perch size or covering material will suffice. In types II and III, where ulceration, swelling, and inflammation have occurred, treatment involves application of good wound management principles, consisting of surgical debridement, establishing and maintaining drainage, protective bandaging, and time. Culture and determination of antibiotic sensitivity for systemic antibiotic selection is essential. The course of treatment typically involves surgically removing the scab, gently remocing lose tages, of exudate and inflammatory tissue and irrigating the wound with sterile saline or 0.5% chlorhexidine (not iodine-containing solutions). A sterile strip of gauze or umbilical tape (seton) is inserted into the wound (to maintain drainage; alternatively a latex drain may be used), and the foot is bandaged into a ball bandage is changed daily with continued irrigation, replacement of the seton and application of a ball bandage for 7 to 10 days (longer if necessary), depending on severity of the intitial state.

The ball bandage is maintained with weekly changes until the wound has closed by secondary intention healing. The foot then is protected with a custom-made polypropylene foam shoe for several weeks until the integrity of the tissue has progressed to the point of allowing normal use. (*Zoo and Wild animal medicine*, 2003)

Because the causes of bumblefoot are management –related and the course of treatment is complicated and protracted, prevention is unequivocally important. Five elements are key:

- 1. providing a nutritious, balanced diet suitable for the species of raptor held captive,
- 2. Providing perches that are sized, shaped, and covered appropriately for the species and sex
- 3. Providing adequeate maneuvering space for free-lofted birds so they land normally
- 4. Avoiding overweight conditions
- 5. Providing adequate exercise and observing the condition of the feet (including talon length) regularly

### 3.10 Avian and Food-borne diseases and its relation to human illness

Zoonoses are diseases that can be transmitted from animals to humans. The causative agents are bacteria, viruses, parasites, and fungi. Possible zoonotic exposure can be eliminated by good personal hygiene and handling of animals in a prescribed manner. Frequent hand and glove washing with an approved disinfectant such as NOLVASAN surgical scrub must be a priority that is strictly adhered. Good hygiene will also prevent cross-contamination of non-zoonotic diseases from animal to animal. Do not have hand-to-eye or hand-to-mouth contact while working with animals or soiled animal caging, bedding, and accessories. Handling animals in the prescribed manner for that species can prevent zoonotic exposure through bites, scratches, and abrasions. (*Angelfire.com*)

The next paragraphs will give an overview of important diseases that can be transmitted from birds or birdfeed to humans. In addition, <u>Appendix XI</u> will give a short overview of some avian diseases which can be transmitted from birds to humans, along with information about prevention.

## 3.10.1 Escherichia coli O157:H7

E. coli O157:H7 is one of hundreds of strains of the bacterium Escherichia coli. Although most strains are harmless, this strain produces a powerful toxin that can cause severe illness. E. coli O157:H7 has been found in the intestines of healthy cattle, deer, goats, and sheep.

E. coli O157:H7 was first recognized as a cause of illness in 1982 during an outbreak of severe bloody diarrhea; the outbreak was traced to contaminated hamburgers. (The combination of letters and numbers in the name of the bacterium refers to the specific markers found on its surface and distinguishes it from other types of E. coli). (*Center for disease control and prevention*)

Escherichia coli O157:H7 is a leading cause of food borne illness. Based on a 1999 estimate, 73,000 cases of infection and 61 deaths occur in the United States each year.

Infection with E. coli often leads to bloody diarrhea, and occasionally to kidney failure. People can become infected with E.coli O157:H7 in a variety of ways. Though most illness has been associated with eating undercooked, contaminated ground beef, people have also become ill from eating contaminated bean sprouts or fresh leafy vegetables such as lettuce and spinach. Person-to-person contact in families and child care centers is also a known mode of transmission. In addition, infection can occur after drinking raw milk and after swimming in or drinking sewage-contaminated water. Because the organism lives in the intestines of healthy cattle, preventive measures on cattle farms, during meat processing, and during the growth, harvest and processing of produce are being investigated. (*Center for disease control and prevention*)

The organism can be found on most cattle farms, and it is commonly found in petting zoos and can live in the intestines of healthy cattle, deer, goats, and sheep. Meat can become contaminated during slaughter, and organisms can be accidentally mixed into meat when it is ground. Bacteria present on the cow's udders or on equipment may get into raw milk. In a petting zoo, E.coli O157:H7 can contaminate the ground, railings, feed bins, and fur of the animals.

People generally become ill from E. coli O157:H7 two to eight days (average of 3-4) after being exposed to the bacteria. Escherichia coli O157:H7 infection often causes severe bloody diarrhea and abdominal cramps. Sometimes the infection causes non-bloody diarrhea or no symptoms. Usually little or no fever is present, and the illness resolves in 5 to 10 days.

In some persons, particularly children under 5 years of age and the elderly, the infection can also cause a complication called hemolytic uremic syndrome (HUS), in which the red blood cells are destroyed and the kidneys fail. About 8% of persons whose diarrhoeal illness is severe enough that they seek medical care develop this complication. In the United States, HUS is the principal cause of acute kidney failure in children, and most cases of HUS are caused by E. coli O157:H7. (*Center for disease control and prevention*)

Infection with E. coli O157:H7 is diagnosed by detecting the bacterium in the stool. About one-third of laboratories that culture stool still do not test for E. coli O157:H7, so it is important to request that the stool specimen be tested on sorbitol-MacConkey (SMAC) agar for this organism. All persons who suddenly have diarrhea with blood should get their stool tested for E. coli O157:H7.

Most people recover without antibiotics or other specific treatment within 5 to 10 days. Antibiotics should not be used to treat this infection. There is no evidence that antibiotics improve the course of disease, and it is thought that treatment with some antibiotics could lead to kidney complications. Antidiarrheal agents, such as loperamide (Imodium®), should also be avoided.

In some people, E. coli O157:H7 infection can cause a complication called hemolytic uremic syndrome (HUS), a life-threatening condition that is usually treated in an intensive care unit. Blood transfusions and kidney dialysis are often required. With intensive care, the death rate for hemolytic uremic syndrome is 3%-5%.

Persons who only have diarrhea usually recover completely.

A small proportion of persons with hemolytic uremic syndrome (HUS) have immediate complications with lifelong implications, such as blindness, paralysis, persistent kidney failure, and the effects of having part of their bowel removed. Many persons with hemolytic uremic syndrome have mild abnormalities in kidney function many years later. (*Center for disease control and prevention*)

Cattle are the principal source of E. coli O157 infection; they carry E. coli O157 in their intestines. Changes in the preparation of animals for slaughter and in slaughter and processing methods could decrease the contamination of carcasses with E. coli O157 and the subsequent contamination of meat. Testing ground beef for E. coli O157 and withholding it from the market until the test is negative, as many meat producers began doing in 2002, is probably partly responsible for the subsequent decrease in illnesses.

Cattle manure is an important source of E. coli O157. Manure can contaminate the environment, including streams that flow through produce fields and are used for irrigation, pesticide application, or washing. Collaborative efforts are needed to decrease environmental contamination and improve the safety of produce. (*Center for disease control and prevention*)

### 3.10.2 Salmonellosis

Salmonella live in the intestinal tracts of humans and other animals, including birds. Salmonella are usually transmitted to humans by eating foods contaminated with animal feces. Contaminated foods usually look and smell normal. Contaminated foods are often of animal origin, such as beef, poultry, milk, or eggs, but all foods, including vegetables may become contaminated. Many raw foods of animal origin are frequently contaminated, but fortunately, thorough cooking kills Salmonella. Food may also become contaminated by the unwashed hands of an infected food handler, who forgot to wash his or her hands with soap after using the bathroom. (*Centre for disease control and Prevention*)

Salmonella may also be found in the feces of some pets, especially those with diarrhea, and people can become infected if they do not wash their hands after contact with these feces. Reptiles are particularly likely to harbor Salmonella and people should always wash their hands immediately after handling a reptile, even if the reptile is healthy. Adults should also be careful that children wash their hands after handling a reptile.

Salmonellosis is an infection with bacteria called Salmonella. Most persons infected with Salmonella develop diarrhoea, fever, and abdominal cramps 12 to 72 hours after infection. The illness usually lasts 4 to 7 days, and most persons recover without treatment. However, in some persons the diarrhoea may be so severe that the patient needs to be hospitalised. In these patients, the Salmonella infection may spread from the intestines to the blood stream, and then to other body sites and can cause death unless the person is treated promptly with antibiotics. The elderly, infants, and those with impaired immune systems are more likely to have a severe illness. (*Centre for disease control and Prevention*)

The Salmonella germ is actually a group of bacteria that can cause diarrhoeal illness in humans. They are microscopic living creatures that pass from the faeces of people or animals, to other people or other animals. There are many different kinds of Salmonella bacteria. Salmonella serotype Typhimurium and Salmonella serotype Enteritidis are the most common in the United States. Salmonella has been known to cause illness for over 100 years. They were discovered by an American scientist named Salmon, for whom they are named.

Many different kinds of illnesses can cause diarrhoea, fever, or abdominal cramps. Determining that Salmonella is the cause of the illness depends on laboratory tests that identify Salmonella in the stools of an infected person. These tests are sometimes not performed unless the laboratory is instructed specifically to look for the organism. Once Salmonella has been identified, further testing can determine its specific type, and which antibiotics could be used to treat it. (*Centre for disease control and Prevention*)

Salmonella infections usually resolve in 5-7 days and often do not require treatment unless the patient becomes severely dehydrated or the infection spreads from the intestines. Persons with severe diarrhoea may require rehydration, often with intravenous fluids. Antibiotics are not usually necessary unless the infection spreads from the intestines, then it can be treated with ampicillin, gentamicin, trimethoprim/sulfamethoxazole, or ciprofloxacin. Unfortunately, some Salmonella bacteria have become resistant to antibiotics, largely as a result of the use of antibiotics to promote the growth of feed animals.

Persons with diarrhoea usually recover completely, although it may be several months before their bowel habits are entirely normal. A small number of persons, who are infected with Salmonella, will go on to develop pains in their joints, irritation of the eyes, and painful urination. This is called Reiter's syndrome. It can last for months or years, and can lead to chronic arthritis which is difficult to treat. Antibiotic treatment does not make a difference in whether or not the person later develops arthritis.

### 3.10.3 Avian Influenza

Avian influenza A (H5N1) first infected humans in 1997, in Hong Kong. The virus was transmitted directly from birds to humans. Eighteen people were admitted to hospitals and 6 died. In 2003, 2 cases of avian influenza A (H5N1) infection occurred among members of a Hong Kong family, 3 of who had traveled to mainland China. One person died. How or where these 2 persons became infected was not determined. (*Lessenger, 2003*)

Influenza A has the potential to cross species and has been implicated in the 3 flu pandemics in the 20<sup>th</sup> century (1918, 1957 and 1968). Pandemics occur when 3 conditions are met:

- 1. The emergence of influenza A virus with a hemagglutinin subtype is completely different from that of strains circulating in humans for many preceding years.
- 2. There are a high proportion of susceptible people in the community (i.e., a population with low antibody titers to the new strain).
- 3. Efficient person-to-person transmissibility of the new virus is possible with accompanying human disease.

The reported signs and symptoms of avian influenza in humans include:

- 1. Typical flu-like symptoms as fever, cough, sore throat, and muscle aches.
- 2. Eye infections
- 3. Pneumonia
- 4. Acute respiratory distress syndrome (ARDS)
- 5. Multiple organ failure
- 6. Lymphopenia
- 7. Elevated liver enzyme levels
- 8. abnormal clotting profiles

Physicians are advised to isolate the patient, initiate droplet precautions, and contact their local medical officer for further discussions if an epidemiological link is suspected. The World Health Organization (WHO) is moving to rapidly produce a new influenza vaccine capable of protecting people against the H5N1 strain of avian influenza A.

The WHO has recommended urgent, rapid culling of infected and exposed bird populations to eliminate the reservoir of the H5N1 strain. In addition, WHO has discouraged the practice of marketing live poultry directly to consumers in areas currently experiencing outbreaks of avian influenza A (H5N1). Some countries have introduced trade restrictions to protect animal health. However, available data do not suggest that processed poultry products (i.e., refrigerated or frozen carcasses and products derived from them) or eggs from affected areas pose a public health risk. The virus is killed by cooking. (*Capua, Alexander, 2004, Weir, Wong, Gemmill, 2004*)

### 3.10.4 Newcastle Disease

Newcastle disease is caused by virulent strains of APMV. Death rates among native bird populations can exceed 50%. The virus responsible for Newcastle disease has been known to cause conjunctivitis and upper respiratory infections in humans since the 1940s. The disease is self-limiting and does not have any permanent consequences. (*Pedersen, Senne, Woolcock, Kinde, King, Wise, et al, 2004*)

### 3.10.5 West Nile Virus

In 2002, Wisconsin public health officials were notified of two cases of febrile illness in workers at a commercial turkey breeder farm. A high prevalence of West Nile virus antibody was found among workers and turkeys. An associated high incidence of febrile illness among farm workers also was observed. Possible non-mosquito transmission among birds and subsequent infection of humans was postulated, but the mode of transmission was unknown. (*Center for disease control and prevention*)

### 3.10.6 Chlamydia psittaci

*Chlamydiphila (Chlamydia) psittaci, C. trachomatis,* and *C. pneumoniae* can be passed from birds of all species to humans. Wild pigeons and pheasants have been demonstrated to be a source. Wild birds in captivity, pets (usually cockatiels, parakeets, parrots, and macaws), and production animals can infect workers, and there are reports of customs and health inspection workers becoming infected. Infection is through contact with feces, urine, and oral secretions (*Elliot, 2001*). Mild infections produce a tracheobronchitis with flu-like symptoms of cough, congestion, myalgias, fatigue, and fever. In severe infections, untreated workers, and immunocompromised workers, pneumonia, sepsis, shock and death can occur. (*Elliot, 2001*)

C. psittaci is related to Chlamydia trachomatis, the most common human STD, and Chlamydia pneumonia, a cause of human pneumonia. Chlamydia pneumonia is also being investigated as possibly being associated with cardiovascular disease in humans.

Transmission of the Chlamydial organism from birds to humans has been confirmed in a number of cases. Although psittacosis infection in humans is rare it is potentially dangerous for persons who are sick, elderly, immunosuppressed (e.g., HIV patients) or pregnant. These people should consult their doctor for more information concerning Chlamydia psittaci.

In humans tetracycline and its derivatives are generally an effective treatment for Chlamydia.

### 3.10.7 Campylobacter Jejuni

Raising poultry at home is common in low-income countries. Studies demonstrate that proximity to free-range domestic poultry increases children's risk of infection with diarrhea-causing organisms such as *Campylobacter jejuni*. Corralling might reduce the risk, but research on the socioeconomic acceptability of corralling is lacking. Many people report that home-grown poultry and eggs taste better and are more nutritious. They enjoy living around animals and want to teach their children about raising animals. To prevent theft, some residents shut their birds in provisional enclosures at night but allege that birds are healthier, happier, and produce better meat and eggs when let loose by day. Many rural peoples view bird feces in the house and garden as dirty, but few see a connection to illness. Residents consider chicks and ducklings more innocuous than adult birds and are more likely to allow them inside the house and permit children to play with them. Additional food and water costs with corralling are a significant obstacle for some. Adequate space and corral hygiene must also be addressed to make this intervention viable. Developing a secure acceptable and affordable corral remains a challenge for rural populations. (*Butzler, 2004, Karmali, Fleming, 1979*)

# 4. HACCP

The HACCP monitoring system is used for the analysis of the food processing and is the basis on which this whole research was set up. Therefore, this chapter will describe the HACCP monitoring system.

### 4.1 Hazard Analysis and Critical Control Point

HACCP is an abbreviation for Hazard Analysis and Critical Control Point. The idea of the HACCP monitoring system is that it increases quality control in food production operations. The HACCP program was designed by the Pillsbury Company in the early 1960s while manufacturing food for the United States space program (*National Seafood HACCP Alliance, 1997*). For assuring the quality and microbiological safety of the food, an extensive quantity of the finished product was required, leaving little for the space flight itself. This situation led to the development of the HACCP plan, a preventative system aimed at identifying checkpoints where potential hazards can enter the food production pathway (*Schmidt, Travis & Williams, 2006*). By controlling the production process, the quality of the end product is guaranteed.

The number of (humane) food infections and food poisoning in The Netherlands and Europe has not decreased over the last decades, in spite of improved processes of food production, food manufacturing and food preparation and improved knowledge about hygiene. In order to decrease the amount of illness, there was a search for a preventive system which could give a better warrant for food safety. When a preventative system like HACCP is used, problems can be recognized in an early stage and action can be taken immediately to prevent unnecessary costs (*Postmus & Guldemeester*, *1995*).

Food concerns are, since 1995, obligated to have a system with HACCP implemented in their manufacturing process for controlling food safety (*Postmus & Guldemeester, 1995*).

## 4.2 The seven principles of HACCP

In order to obtain a systematic analysis of the food processing, the seven principles of HACCP (Table 1) have to be addressed.

#### Table 1. The seven principles of HACCP

- 1. Conduct hazard analysis and identify preventative measures for each
- 2. Identify Critical Control Points
- 3. Establish critical limits
- 4. Monitor each Critical Control Point
- 5. Establish corrective action to be taken when a critical limit deviation occurs
- 6. Establish a record-keeping system
- 7. Establish verification procedures

(Schmidt, Travis & Williams, 2006)

#### Principle one

The first step is to identify places in the food system where new hazards can be introduced or where existing hazards can continue. Since discussion often arises when determining what constitutes a "significant hazard", it is important to remember that it is not possible to eliminate all risks. Therefore the HACCP system focuses mainly on the hazards that are likely to occur and likely to result in an unacceptable risk to the consumer. At this time a flow chart is created (see Figure 1) which identifies all the steps where the hazards can occur. After identifying the significant hazards, the next step is to determine the most appropriate preventative measure for each hazard. These preventative measures

can be actions and activities or adjustments that prevent or eliminate hazards or reduce it to an acceptable level. (*Schmidt, Travis & Williams, 2006*)



#### Figure 1. Flow diagram of a food handling pathway

#### Principle two

The second principle involves the identification of the steps in the production process which are essential for the elimination or significant reduction of the identified hazards from principle one. These 'Critical Control Points' (CCPs) can be identified by the use of a decision tree, which will be explained in the next paragraph (*Schmidt, Travis & Williams, 2006*).

#### Principle three

The third principle involves establishing critical limits (CL) for every hazard within each CCP. These critical limits are boundaries set to make a difference between safe and unsafe products at the CCP. Factors constituting a critical limit can be: temperature, time, pH, moisture etc (*Schmidt, Travis & Williams, 2006*).

#### Principle four

The fourth principle, monitoring CCPs, involves routine checks to determine if a CCP is within acceptable limits. The monitoring frequency and identifiable person for individual CCPs depends on the specific situation. The preferred methods for monitoring are physical and chemical testing, because these types of tests provide rapid results (*Schmidt, Travis & Williams, 2006*).

#### Principle five

This principle focuses on corrective actions, taken when measurements fall outside the critical limits. If the critical limit is not attained, action must be taken to correct the situation. It is necessary to determine what action should be taken and by whom, before the incident happens. Also, a decision needs to be made with regard to the acceptability of the product that passed the CLs (*Schmidt, Travis & Williams, 2006*).

#### Principle six

Principle six is about establishing effective record-keeping procedures that document the HACCP system. Accurate and thorough record keeping is an essential part of a working HACCP program. Records must be kept to demonstrate safe product manufacture and that appropriate action has been taken for any deviations from the critical limits (*Schmidt, Travis & Williams, 2006*).

#### Principle seven

The final principle focuses on verification that the HACCP system is working correctly. There are multiple factors in verification. The first factor of verification involves supervisory review of CCP monitoring and calibration checks. A supervisor needs to routinely review the monitoring records to insure they are being done correctly and at the appropriate times. This factor also includes periodically checking the reliability of the testing equipment (e.g. thermometers) by comparing it to standardized equipment (e.g. certified thermometers). The second factor focuses on HACCP system verification. This can include auditing the records to verify that the routine regulatory checks are completed accurately. It can also include testing of the products on arrival at the zoo and again just before feeding. Testing at these two intervals will reflect changes within the food items (e.g. bacterial populations, bacterial concentrations or nutritional parameters) that occur along the zoo food handling pathway. Significantly different values between receiving the product and just before being fed would indicate a serious breach in the HACCP system. The third factor relies on regulatory agencies or outside auditors to verify that the HACCP program is effective and is being followed appropriately (*Schmidt, Travis & Williams, 2006*).

## 4.3 The decision tree

When deciding whether a control point is a CCP a decision tree (Figure 2) has to be used. The questions used in the decision tree will be explained here.

- 1. Do preventive measures exist for the identified hazard?
- The question is if there are measures for this risk, or if the process should be adjusted.
  <u>Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?</u> Here the question is if the process step itself eliminates or reduces the hazard. For an example if the process step is 'heating', in which the product is freed from micro organisms, there is no possibility for a microbiological contamination.
- Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could this increase to unacceptable level(s)? Is the contamination serious in such that it could cause serious damage for human or animal? If the damage is not this serious, there is no need to take measures against these hazards.
- 4. Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an unacceptable level? Is there a process step following this step, that could eliminate the hazard or reduce it to an acceptable level? For an example, if whole prey for human consumption is microbiologically contaminated, but is fried later on in the process, this is not a serious hazard, since the frying causes the micro organisms on the whole prey to die.



## 4.4 HACCP application to zoological institutions

Food safety applied to a zoological setting is not a new idea. There are several reports that discuss specific issues related to food safety for captive, exotic animals (*Oftedal and Bones, 1983; Stoskopf, 1986; Crissey et al., 1987, 2001; Crissey, 1998; Rindler, 1999*). This study places those food safety principles within the larger framework of HACCP.

Each segment in the flow diagram pictured in Figure 1 schematically represents a point where hazards could occur that either affect the animal health of diminish the nutritive value of the food. This generic pathway applies to many products including raw whole prey, products, hay and manufactured feeds. Hazards along this pathway inherently come in two major forms, cross contamination of a clean product or increased growth of micro organisms already present in a contaminated product. Keep in mind that the elimination of all bacteria is not a reasonable goal; the concern relates to the presence of pathogenic bacteria at levels high enough to cause infection. *(Schmidt, Travis & Williams, 2006)* 

By creating and implementing HACCP systems it is attempted to enhance the safety of zoos. An analysis to see if the zoo is compatible for use of a HACCP system is followed by translating the HACCP system to the working place. This is done by use of working schedules and handbooks. Some adjustments may be necessary in the production process of the feeds. In most cases, only minor adjustments are needed in order to improve safety significantly. (*HACCP in de dierentuin, 2004*) Manuals can be helpful for quickly looking up how things are done. New personnel can read the manual, which will ensure that every person of the staff works according to the same methods. This also decreases the time it takes to get to know the organisation and it decreases the chance of taking over familiarised (wrong) behaviour from other personnel. The implementation of a food quality assurance system will be able to change the attitude of zoo personnel towards better hygiene standards, lower the risk of infection of animals, personnel and public and improve the quality of food. (*Bijker et al., 2007*)

# 5. Cleaning and disinfection

There is more to cleaning than rinsing and disinfecting. Cleaning is a constant process in which the company stays as tidy and neat as possible all through the day. This asks for a large dosage of discipline, to keep cleaning constantly. The result is a better guarantee for hygiene. Besides this, cleaning, disinfecting and hygienic working, behaviour plays an important part in the daily battle against micro organisms that cause disease and deterioration. Important in cleaning are the order of working, the products used and the planning. (*Verschuur and Dijkstra, 2003*)

### 5.1 Cleaning

The operations of cleaning and disinfecting are essential parts of food preparation, bird handling and demonstration procedures and the efficiency with which these operations are performed greatly affects bird and staff health.

The surfaces of the equipment used in the manufacture and processing of foods inevitably become soiled and require cleaning. If not continuous, cleaning must at least be performed at regular and frequent intervals so that a consistently good quality of product is maintained. How this cleaning is done depends principally on: (1) the nature of the soil (Soil: Any unwanted food residue, organic or inorganic matter remaining on equipment and other surfaces) or contamination to be removed; (2) the type of surface to be cleaned; (3) the materials used for cleaning; (4) the degree of water hardness; and (5) the standard of cleanliness required.

The basic steps in cleaning can be summarized as: (1) the removal of gross soil or dirt; (2) the removal of any residual soil with detergent; and (3) rinsing to remove detergent and soil (*Forsythe and Hayes, 1998*).

### 5.1.1 Removal of Soil

It could be argued that since the main function of a detergent is to facilitate soil removal, a preliminary operation in conventional cleaning is unnecessary and perhaps wasteful in terms of labour utilization. Balanced against this, however, is the fact that if the bulk of the debris can be removed in a preliminary cleaning process a much reduced and more accurately assessable amount of detergent can be used to remove the residual soil; this latter approach is recommended where feasible and it should be initiated as soon as possible after processing has stopped.

Before starting the actual cleaning, the area that will be cleaned should be sufficiently lighted, in order to be able to see if there is dirt left somewhere. Then, the area should be tidied. Trash that is lying around only blocks the view on dirty places in the area. After tidying, first the gross dirt is removed by sweeping it together, picking it up and throwing it n the waste bin. (*Verschuur and Dijkstra, 2003*)

The preliminary cleaning of smaller items of equipment may involve pre-soaking in warm or cold water to remove loosely adhering debris. The more tenacious food debris can then be brushed or scraped off by hand in water at *c*. 45 °C (113 °F). Brush bristles should be as hard as possible but should not cause damage to the surfaces to be cleaned. In this respect abrasives such as steel wool and wire brushes should not be used; not only do they damage many surfaces, including stainless steel, but metal particles may pass into foods and be a cause of animal injuries or illness (*Forsythe and Hayes, 1998*).

Any cleaning aid causing damage to stainless steel and other food contact surfaces must be avoided since crevices can be formed if unsuitable materials such as steel wool are employed. These crevices and other surface discontinuities are more likely to retain bacteria than unaffected areas (*Holah and Thorpe, 1990*).

High pressure water jets can be used for certain items of equipment although care must be taken to see that the dislodged dirt is contained and that the temperature of the water is suitable; for example,

with raw whole prey too high a temperature will cause protein denaturing and make cleaning more difficult.

The sole use of high pressure water jets for cleaning must be regarded as inadequate; only gross dirt is removed and even that can be ineffective when machines are poorly designed resulting in large aggregates of food debris being retained behind for example inaccessible ledges (*Forsythe and Hayes, 1998*).

To finish the cleaning, the mix of dirt, cleaning agent and water should be removed by rinsing with tap water. The next step, disinfecting, kills the micro organisms and should be done only if necessary. Disinfecting is of no use if the cleaning has not been done sufficiently, since the leftover dirt will inactivate the disinfectant. Proper cleaning will kill or remove most bacteria. To work efficiently, the disinfectants should have some time to do their work. The disinfecting should <u>always</u> be followed by rinsing with clean tap water. Cleaning agent leftovers can harm human and animal health. The instructions of the cleaning agents should always be followed. (*Verschuur and Dijkstra, 2003*)

### **5.1.2 Desirable properties of detergents**

Detergents must be capable of removing many different types of soil under a variety of conditions; the list of properties is required for a good detergent is therefore an extensive one. Thus, ideally, detergents should be:

- 1. Readily soluble in water at the desired temperature,
- 2. Non-corrosive to equipment surfaces,
- 3. Non-irritating to the skin and eyes and non-toxic,
- 4. Odourless
- 5. Biodegradable; detergents have created foaming problems in effluent disposal systems but such troubles have now been overcome by the use of detergents which are degraded by sewage bacteria,
- 6. Economical in use; the lowest price per unit volume may not necessarily prove to be the most economical in use,
- 7. Readily risible; detergent solutions should be easily washed away so that none remains adhering to the cleaned surface,
- 8. Stable during prolonged periods of storage,
- 9. Effective cleaners of all types of soil. Because of the broad spectrum of substances to be removed by detergents the latter must have the ability to:

a) Wet the surface of the soil, that is lower the surface tension of the water so that the latter is able to penetrate the soil more readily and remove it from the surface to be cleaned.

b) Disperse insoluble materials that might otherwise form aggregates and in so doing keep them in suspension so that they are rinsed away before they can be redeposited on the cleaned surface.

c) Dissolve soluble soils, both organic and inorganic; the more rapid the solution the better the detergent.

d) Emulsify fats and oils, that is break up fats and oils into smaller globules and disperse them so that they remain suspended in solution.

e) Saponify fats, that is convert fat into soluble soaps.

f) Sequester (i.e. remove or inactivate) calcium and magnesium salts dissolved in hard waters so that their precipitation is prevented and cleaning efficiency is not impaired. This precipitation is exemplified by the scum formed when soap is used for washing with hard water. In essence, therefore, detergents should be able to soften hard water where necessary although it would be anticipated that in hard water areas water softening systems would be installed. (*Forsythe and Hayes, 1998*)

It will be noted that detergents are not expected to possess bactericidal properties although in practice some of them do. However, detergents do physically remove a large number of bacteria during cleaning and this makes subsequent disinfections that much easier. Since, as, yet, no one chemical possesses all the above properties it is necessary to blend different chemicals together to create detergent for mutations of the correct balance for a particular cleaning need. (*Forsythe and Hayes, 1998*)

## 5.1.3 Classification of detergents

Detergents may be conveniently classified as:

- 1. Inorganic alkalis caustic and non caustic,
- 2. Inorganic and organic acids,
- 3. Surface active agents
- 4. Sequestering agents inorganic and organic

#### 1. Inorganic alkalis

Many detergents incorporate an alkali as one of the principal ingredients. Sodium hydroxide (caustic soda) is the strongest of the alkalis and is cheap. It has excellent dissolving properties, is a very strong saponifier (i.e. the making of soap) and has the added advantage of being strongly bactericidal. It is, however, highly corrosive to metals especially aluminium and extreme care must be taken when handling this detergent as it can cause severe burns to the skin; for this reason, protective clothing must be worn together with goggles and heavy-duty rubber gloves when working with this detergent. As with all the alkali detergents sodium hydroxide precipitates (a substance separated from a solution or suspension by chemical or physical change) insoluble calcium and magnesium salts from hard water so that sequestering (solitary) agents need to be incorporated with alkali cleaners in any detergent formulation. Sodium metasilicate, although a strong alkali, is non-caustic and therefore much less corrosive than sodium hydroxide. In fact sodium metasilicate suppresses the corrosive activity of sodium hydroxide and the two are often combined in detergents for this reason. It is, however, a good cleaning compound in its own right having good dispersive and emulsifying powers and it is readily rinsable; it suffers somewhat by being relatively expensive. Sodium orthosilicate and sodium sesquisilicate are two substances which have good saponification (the reaction of an ester with a metallic base and water, i.e. the making of soap) powers and both are effective cleaners of protein material. Unfortunately both, but especially sodium orthosilicate, suffer by being corrosive to aluminium. Turning to non-caustic alkalis, sodium carbonate and trisodium phosphate are the major examples. Sodium carbonate is a relatively weak detergent, is somewhat corrosive and precipitates calcium and magnesium salts from hard water. However, it is cheap and has a good buffering capacity (i.e. stabilizes pH) and is frequently included in detergents for this reason. Trisodium phosphate (TSP) is a good emulsifier and saponifier, has strong dispersive properties and has the ability to soften water by precipitating the salts as floccules rather than as scale. Although again somewhat corrosive, it is often incorporated in detergents. (Forsythe and Hayes, 1998)

2. Inorganic and organic acids.

Acids are not widely used in the food industry as they are corrosive to a greater or lesser extent and they lack versatility as cleaners; furthermore, many are dangerous and can cause severe skin burns so that protective clothing must be worn. Of the inorganics, hydrochloric, sulphuric and nitric acids have been used in the past by the dairy industry to remove hard water scale and other mineral deposits (e.g. 'milkstone', a deposit of protein, calcium carbonate and other salts which builds up in pasteurizers when milk films are not completely removed) but, due to the extremely corrosive nature of these acids, they have been largely replaced by milder acids. Amongst these are phosphoric and sulphamic acids which are less corrosive than those mentioned above and, when coupled with a corrosion inhibitor, can be very effective. However, low levels of stronger acids may be used where deposit build up is excessive.

Organic acids, which are bactriostatic in action, are much milder than the inorganic acids and are therefore safer to handle. Amongst the organic acids which have been incorporated in detergent formulations one may find gluconic, hydroxyacetic, citric and tartaric acid. Acid detergents usually incorporate corrosion inhibititors and wetting agents and as such can be employed in the removal of inorganic deposits and milkstone, and in bottle washing. (*Forsythe and Hayes, 1998*)

#### 3. Surface active agents

Surface active agents reduce the surface tension of water to facilitate wetting. The classical surface active agent is soap which is usually composed of sodium or potassium salts of fatty acids such as

stearic, palmitic and oleic acids. Soaps are reasonably effective in soft water but their reduced solubility in cold water constitutes a disadvantage; in addition, soaps form precipitates with calcium in hard water to give insoluble deposits. For these reasons they have been largely replaced by synthetic detergents. Many sulfactants produce copious amounts of foam especially where considerable turbulence is generated during cleaning. To control the extent of foaming, anti-foaming agents are often incorporated in formulations to give the relatively low foaming detergents required in most cleaning operations in the food industry. (*Forsythe and Hayes, 1998*)

4. Sequestering agents.

A truly soft water has inherent cleaning properties which are progressively weakened as more calcium and magnesium salts are dissolved in it; that is, the water gets harder and this is associated with an increasing tendency for salts to precipitate out forming scale. Sequestering agents are added to detergents to prevent salt precipitation although in the long term it is often far cheaper to soften a hard water supply than to add high concentrations of sequestrants to detergents. Obviously the amount of sequestrant that is added depends on the extent of water hardness and the overall detergent formulation. (*Forsythe and Hayes, 1998*)

### 5.1.4 Factors affecting efficiency of detergents

The importance of the control of hardness by water softening or by the addition of sequestering agents to detergents has already been stressed but other factors also affect the efficiency of detergents. These include the concentration and temperature of the detergent solution, the time that solution is applied and the force with which it is applied. For any detergent there is a minimum concentration necessary for effective cleaning under a guven set of conditions; increasing the concentration above this minimum improves the cleaning action but at ever-decreasing rates and at increasing cost so that, on balance, there is an optimum concentration which should be aimed for under commercial conditions.

As the temperature is increased the reaction rate between the soil and the detergent is also increased as is the solubility of soluble materials and this means that soils can be more readily removed from surfaces; another advantage of higher temperatures is that viscosities are generally decreased resulting in increased turbulence, a feature of expecial importance in CIP. Time effects are similar to concentration effects in that there are minimum and optimum times for contact between soils and detergents.

Obviously it is possible to effect cleaning merely by applying force (e.g. using brushes in manual cleaning) but this is extremely inefficient. Detergents are employed partly to lessen the need for force although, in practive, the two components are often combined. (*Forsythe and Hayes, 1998*)

### 5.1.5 Desirable properties of disinfectants

Disinfectants for use on food contact surfaces should ideally have the following properties:

- 1. Capable of rapidly killing micro organisms and, in particular, equally effective against both Gram positive and Gram negative bacteria. The majority of mould spores should be killed and the destruction of bacterial spores would be an added advantage.
- 2. Reasonably stable in the presence of organic residues and, if necessary, effective in the presence of hard water salts.
- 3. Non-corrosive and non-staining to plant surfaces of whatever type.
- 4. Odourless or have an inoffensive odour.
- 5. Non-toxic and non-irritating to the skin and eyes.
- 6. Readily soluble in water and readily rinse able.
- 7. Stable during prolonged storage in concentrated form and stable during short-term storage in dilute form.
- 8. Competitively priced and cost-effective in use

#### (Forsythe and Hayes, 1998)

The disinfectants used should be allowed by the law (the Dutch Bestrijdingsmiddelenwet) and should have a number of access of the packaging. The proof that a certain product is allowed for use by the law, is a number on the packaging followed by the letter N. Products without the letter N are forbidden

for use. Also, the packaging should mention that the product is allowed for the food industry. The packaging for disinfecting products should always have instructions for use. Products that claim to clean and disinfect at the same time should only be used for cleaning. Disinfecting is efficiently only when food and dirt leftovers are already removed by cleaning. If disinfecting is necessary, the cleaning and disinfecting should happen separately. (*Verschuur and Dijkstra, 2003*)

### **5.1.6 Practical application**

Cleanliness as applied to food plants embraces physical, chemical and microbiological factors. Physical cleanliness implies the absence of visible soils on surfaces but for food contact surfaces chemical cleanliness (i.e. absence of residual chemicals including cleaning agents and disinfectants) and microbiological cleanliness (i.e. residual micro organisms so low in numbers that they could not significantly affect the quality of foods coming into contact with those surfaces) are also demanded. Any standards laid down must be achieved unfailingly because if there is any deviation from the standards an insidious build up of bacteria and other micro organisms may occur over a period of time. In such a situation an increasing residuum of bacteria can be left unnoticed on food contact surfaces; as a result there is a tendency for an indigenous flora of bacteria to be created which is associated with items of equipment which have been inadequately cleaned. This in turn, causes the bacteriological quality of the food to deteriorate progressively over a number of days from the commencement of substandard cleaning. Even with an inadequate cleaning programme bacterial numbers will eventually stabilize in the food but the quality of the final product may be far inferior to that which can be achieved with an effective cleaning programme (*Forsythe and Hayes, 1998*).

In certain more hazardous processes a build up if bacteria on food contact surfaces (e.g. cutting blades) is inevitable during production runs but such increases should be restricted by frequent cleaning of the affected surface so that the desired uniformity of the product, so important in quality assurance, can be maintained.

### 5.2 Cleaning of necessities and tools

For preparation, treatment, packing, storing or transporting food, only objects, tools or materials should be used that are well maintained and clean. It is recommended to clean and disinfect these after every use! In some cases, a big bowl of disinfectant can be used to place dirty (and therefore contaminated) tools inside. Hereby, the tools should always be rinsed well with tap water before placing them in the bowl. After cleaning and disinfecting the tools should also be well rinsed to prevent chemical products from staying on the material.

When using a dishwasher, washing at a temperature of 60 °C (140 °F) or warmer, using a cleaning product, is sufficient. Disinfecting the machine is then not necessary.

If cloths are used during work, these should be replaced after every use by clean ones. Only clean cloths should be used. Also, all the brushes and wipers that are used to clean the kitchen (tools as well as the room itself) should be cleaned. (*Verschuur and Dijkstra, 2003*)

#### **Cleaning schedules**

Cleaning schedules (view 'Manual Food Processing and Hygiene protocol' for new cleaning schedules) should be prepared to cover every item of equipment and all areas where birds and people live and work. Kitchen, prep room, backdrop and animal enclosures should be included in the cleaning programme. The cleaning schedules should contain the following essential information: (1) the method of cleaning which should include details (and possible hazards) of the cleaning and disinfecting agents to be used, together with the quantities and dilutions required and the exact method, time and temperature to be used when applying the solutions; (2) the sequence of cleaning which should be so arranged that recontamination of the previously cleaned equipment is avoided; (3) the extent to which equipment should be dismantled; (4) details of likely 'trouble spots' where extra care should be taken, such as the prep table and gloves (5) the time which should be taken over individual cleaning tasks; (6) the frequency of cleaning; and (7) the person responsible for each cleaning task and the person whose responsibility it is to see that all the tasks have been properly performed. (*Forsythe and Hayes*, *1998*)
Sufficient time must always be allowed for cleaning so that it can be performed properly. Efficient cleaning is filled with a multitude of difficulties many of which have been discussed already. These include: (1) the faulty design and incorrect siting of food processing equipment; (2) recontamination of equipment that has been previously cleaned; (3) inadequate time for cleaning or cleaning too infrequently; (4) insufficient or poor-quality labour employed; (5) misuse of cleaning and disinfecting agents by gross variation from the recommended concentrations; and (6) wrong mental attitudes of management and operatives to an important operation. (*Forsythe and Hayes, 1998*)

# 5.3 Personal hygiene

In the case of food equipment contact surfaces, it is always possible to so reduce the numbers of contamination micro organisms that any remaining will not undermine the quality of the processed food (i.e. disinfection of food contact surfaces is possible). Unfortunately it is impossible to disinfect skin to the same degree and hands are therefore a potentially important means of distributing micro organisms. Such distribution may involve the transfer of organisms from hands to food or their transfer from food to food via the hands; special care must therefore be taken to ensure that these transmission routes are minimized. Conventional but thorough hand washing using soap and water removes the transient flora; that is micro organisms, mainly bacteria, picked up temporarily from the environment. Thus enteric bacteria, including *Escherichia coli* in abundance and salmonellas if present, may get transferred on to the hands but such organisms should be removed by thorough washing. Tablet soap is not recommended although it has been shown that such soaps, with or without added antibacterial, only harbour a light transient and rapidly changing flora (*Mcbride, 1984*). It is virtually impossible to remove the indigenous flora on the hands although some reduction can be effected by using bactericidal soaps and creams. (*Forsythe and Hayes, 1998*)

Personnel must be encouraged to develop an attitude where hand washing becomes a virtually automatic response to certain situations. Thus hands, and wrists, should be thoroughly washed: (1) before starting work; (2) before and after lunch and breaks; (3) after using the toilet; (4) when leaving or returning to the processing area (Kitchen, prep room, backdrop, animal enclosures etc) for any other reason; (5) when changing jobs within the processing area; (6) when the hands become unexpectedly soiled or contaminated in any way such as after handling equipment or food which may be of a substandard quality. General advice on the care of hands and fingernails should be available; nail varnish should not be permitted and nail-biting employees should be discouraged to the extent of redeploying them in areas where they cannot come into direct contact with the food. (*Forsythe and Hayes, 1998*)

The regular washing of hands in warm water with non-medicated soaps, which should, of course, be dispensed as a liquid or powder, may be perfectly adequate in many situations. However, it is often preferable, particularly where more hazardous foods are being prepared, to include a bactericide in the cleaning solution and/or to introduce a hand dip disinfectant to be used at the end of the wash, by these means even the resident bacterial flora can be substantially reduced.

Many germicides which have been shown to reduce progressively the resident skin flora have been incorporated into soaps, hand wash solutions and 'barrier' hand creams; one such germicide, hexaclorophane, which was very popular some years ago has been found to have toxic side-effects and is no longer used. A germicide that is widely used today in hand washes is chlorhexidene (also view <u>Appendix VII</u> for the use of clorhexidene on disinfecting gloves) which is prepared as a solution in ethyl alcohol and can induce an immediate 98% reduction in bacterial counts on the hands following a conventional light wash; chlorhexidene also has a considerable residual effect on the bacterial flora and it becomes even more effective after it has been applied several times. (*Forsythe and Hayes, 1998*)

It is also advised to replace the 'Etos desinfecteer middel' with a disinfectant which can be diluted in water. The reason for this is that the 'Etos desinfecteer middel' stays on the hands and can be transferred to the feed afterwards. Therefore it is advised to use a disinfectant that can be diluted in water and after cleaning the hands should be dried using paper towels or by using clean cloths.

Barrier creams are widely used for skin protection and if correctly formulated are surprisingly effective in reducing the release of bacteria from fingers; some creams incorporate QACs as disinfectants which can further enhance their effectiveness. Liquid soaps can occasionally become infected by *Pseudomonas* spp. particularly when the dispensers are 'topped up' rather than cleaned out and disinfected between runs; this practice should be avoided but a further protection against infection is afforded by the incorporation of disinfectant in the soap. The final drying of hands should be by means of disposable paper towels or warm-air driers, although with the latter regular maintenance is necessary. (*Forsythe and Hayes, 1998*)

Washing hands should be done accordingly:

The hands, wrists and nails should be cleaned with flowing water and soap (from a dispenser). Soap leftovers should be rinsed with sufficient flowing water. No communal towel should be used, paper disposable towels are preferred. (*Peters, 2004*)

If necessary, wounds and cuts should be covered with a band aid. (*Peters, 2004*) Coloured band aids are preferred, especially blue ones, since no food is blue. If the band aids come off and end up in the product, they are easy to find. Wearing gloves may prevent band aids from ending up in the product. (*Verschuur and Dijkstra, 2003*) Wearing plastic disposable gloves when working with meat or fish should be a constant activity and should be checked daily if regulations are folowed (*Peters, 2004*)

For sufficient cleaning of hands and wrists, it is necessary to take off jewellery and watches during work. Jewellery provides the best place for micro organisms to pile up. (*Verschuur and Dijkstra, 2003*)

Personal possessions should be kept out of the areas where food products are stored or being processed, as much as possible. (*Peters, 2004*)

The personnel require suitable working clothes that should be cleaned at least at the end of every day of use. White or light coloured clothes are preferred. Personnel that are involved with processing should have clean hair that is covered up. (*Verschuur and Dijkstra, 2003*)

During preparing of food, the personnel should not smoke, since there is a chance that ashes of cigarette buds end up in the food. (*Verschuur and Dijkstra, 2003*)

Nail polish is unwanted, since this could peel off and parts of it may end up in the product. (*Verschuur and Dijkstra, 2003*)

Cleaning products are widely avaivable. Since the restaurant at Vogelpark Avifauna already uses 'Ecolab' products, it is advised to use Ecolab products, with proper dispensers. A catalogue should be ordered to obtain the correct cleaning agents with the proper dispenser equipment. Clothing used on the work floor should be washed on a daily basis. Clothing should be in a good state of repair with no temporary repairs involving the use of safety pins, for example should be permitted. Loose items such as pens, pencils, paper clips and drawing pins should not be carried in open pockets, even by management. Suitable footwear should also be provided for employees working in the processing areas. (*Forsythe and Hayes, 1998*)

# 6. Critical Control Points for Whole Prey

In this chapter the results for the appliance of the HACCP method on whole prey will be given. First, the whole prey processing will be explained in paragraph 6.1 and a flowchart is presented (6.1.1) and explained (6.1.2) to clarify the steps in whole prey processing.

In paragraph 6.2 the contamination risks per step are given and in paragraph 6.3 the risks and measures are discussed.

## 6.1 Whole prey processing

Before a description of all the risks in the processing of the bird feed can be given, an evaluation of all the steps in the processing of the feed is necessary. This way the processes are divided in kind of feed and in the steps the feed takes. Each of these steps can cause certain risks of contamination in the feed, which will be analysed at paragraph 6.2.

### 6.1.1 Flowchart whole prey processing

A flowchart of the whole prey processing at Vogelpark Avifauna can be found in figure 3. This flowchart shows all the steps or processes the whole prey takes from delivery to the central kitchen to the actual feeding of the bird in either the enclosure or during the bird demonstration at Vogelpark Avifauna. Each of these steps, or processes, have their own risks and will be discussed accordingly in this report.



# 6.1.2 Steps in whole prey processing

Each segment in the flowchart in Figure 3 schematically represents a point where hazards could occur that either affect animal health or diminish the nutritive value of the food (*Schmidt, Travis and Williams, 2006*). This generic pathway applies to different products including day old chicks, mice, rats, and quail. Hazards along this pathway inherently come in two major forms, cross contamination of a clean product or increased growth of micro organisms already present in a contaminated product. The elimination of all bacteria is not a reasonable goal; the concern relates to the presence of pathogenic bacteria at levels high enough to cause infection.

Within whole prey processing several steps are taken before the whole prey actually arrives at the bird. These steps have been included within table 2.

Table	2. Ste	ps in	whole	prey	processing	
Nbr	Drog	0000				

Nbr.	Process
1.	Whole prey delivery
2.	Whole prey storage before processing
3.	Whole prey thawing
4.	Whole prey processing
5.	Whole prey temporary storage
6.	Whole prey transport to enclosure
7.	Whole prey transport to bird show

For each step, the current situation is now given. At some points the risk of contamination is mentioned. Further on in this chapter, the contamination risks and measures are given.

#### 1. Whole prey delivery

The delivery of whole prey means every action in the delivery of all the prey by Kiezebrink Putten BV. This includes taking the whole prey out of the delivery truck, transporting it to the freezer container and stacking it there. The whole prey is delivered frozen and carried by hand into the freezer immediately after arriving at Vogelpark Avifauna. The temperature of the prey (which could cause a risk) is not measured on arrival of the food. The whole prey is delivered in cardboard boxes with small holes in the sides, however the lids of these boxes cover these wholes, so there is no additional risk. There are different boxes for the mice, the rats, the day old chicks and the quail. Each box describes its contents and weighs about 10kg. These boxes have small holes in the sides where day old chicks sometimes stick out of which can possibly be a contamination risk for the feed. However, according to supplier products are packed according to 'Regeling Dierlijke Bijproducten', which is a law for animal by-products, and is active since 2005 (*Staatscourant 31 augustus 2005, nr. 168 / pag. 17*). According to the supplier, they also suffice according to European Law EU 2002/1774 by NL 7025. This law regulates since 2003 the collection, transport, storage, processing and using animal by-products, with the goal of preventing animal by-products of becoming a health hazard for humans and/ or animals (*Verordening (EG) Nr. 1774/2002 van het Europees Parlement en de raad*)

#### 2. Whole prey storage before processing

The whole prey is stored in the freezer in the unopened boxes, this way there is no contact with other food. The boxes are carried in to the freezer (which is kept at a temperature of -18° C, or 0,4° F) by hand and piled up along the sides of the fridge, immediately after delivery to Vogelpark Avifauna by the contractor. The different sorts of whole prey are stocked together, which makes it easier to find what is needed. By storing the food this way there is a 'walk path' from the front to the back of the fridge and all the food can be reached easily. The food is taken from the front and the fridge is filled up from the back. This FIFO (First In-First Out) method ensures that no food is left in storage too long. Boxes are stored on the floor and accordingly stacked onto each other. The freezer only contains

boxes with whole prey and some crates with fish, which are not covered but do not get in contact with the whole prey.

#### 3. Whole prey thawing

Every morning after processing the food, a bucket is filled with day old chicks for the following day and the necessary rats and mice are taken from the main freezer container as well. This bucket is taken to the kitchen (the one that is used only by the personnel of the bird demonstration). This bucket is cleaned regularly after use. The whole prey is transferred to a large flat plastic bowl. After this the entire bowl is put into a large bin bag and wrapped up. The entire bag is then left in the kitchen so that the whole prey can thaw. This method causes a risk and is therefore not preferred in thawing. This whole prey is used the next day. This way, the whole prey stands to thaw about 20 hours and at the time of processing it is fully thawed. The maximum amount of time the food is standing before being fed is (from processing at 9am until the last feeding at max. 5pm) eight hours. The maximum time out of the freezer is 28 hours. If the food is standing longer than 28 hours, when for example too much prey has been thawed, the prey will be fed to the vultures, since vultures are able to digest older food without increased health risk

#### 4. Whole prey processing

After thawing the day old chicks are put into a bucket and the mice and quail are put into separate food containers. The whole prey processing takes about 60 to 90 minutes. Before starting the processing, hands are cleaned using hand soap and clean utensils (cutting board, knife, scissors and containers) are used. The whole prey is processed on a separate table, while the fruit is processed on the kitchen sink (view Appendix X for pictures of the whole prey processing table and the kitchen sink). There are two cutting boards: a green one for the fruits and a red one for the whole prey. Each bird has its own plastic container with his name written on it and the lids for the fruit containers have "Fruit" written on it. The containers for the fruit eating birds are stored in the upper kitchen cupboard on the right side and the containers for the whole prey-eating birds are kept on the left side. The two cupboards in between are used for tools and food for fledglings. This way the containers and lids for fruit and whole prey are never mixed up and the chances of cross-contamination are decreased. The prey is separated into food and waste: the intestines are removed, the tail is removed and most feathers are removed (only applied on quail) and all this is put into a separate bowl. Each bird has its own diet, so the food is being weighed to fit the needs of all the birds. There are two different scales: one for fruit and one for whole prey. A tin bowl is used to weigh the food. The big pieces of whole prey are cut into smaller ones using a pair of scissors. As a supplement, carmix is often added to the food, which is a vitamin and mineral supplement to compensate the loss of vitamins and minerals in the whole prey caused by freezing, thawing and time. After dividing all the food over the containers, all the lids (separate lids for whole prey and fruit) are put on and the containers are placed into an open crate (fruit containers on one side, whole prey containers on the other side). The waste (intestines) whole prey is put into a plastic bag that is tied shut and put into the waste bin, usually immediately after processing. After placing all the containers into the crate and putting the whole prey and fruits that are not used, back in the fridge, both the working table and the kitchen sink are cleaned thoroughly with warm water and dishwashing detergent and a sponge. The cutting boards and tools (knife and scissors) are cleaned in the same way and afterwards the hands are cleaned again. After all the cleaning is done, the hands are cleaned again before leaving the processing room.

#### 5. Whole prey temporary storage

After all the bird diets are made for the individual birds, the open crate is taken to the prep room. In the prep room the containers that contain the bird diets are placed on the table. Before the shows, the pieces needed for the individual birds are taken out of the containers. Before and after use these containers are closed. Diets that are not used for the show are placed in a fridge that is designated for prey use only and kept at a temperature of 6 °C (43 °F).

The bucket with day old chicks and the fish is also put in this fridge and covered with a towel (view <u>Attachment IX</u> for pictures). All this prey is used the same day. The prey that is used for the show and

is put on the table in the containers is used within 7 hours. On warm days, the containers with food are all stored inside the fridge until used for processing. The fact that the containers are not stored in the fridge at all time causes a risk. Whole prey that is left at the end of the day is put in the fridge and used to feed the vultures the next day, since vultures are able to digest older food without increased health risk.

#### 6. Transport whole prey to enclosure

When the birds that are not used in the demonstration are fed, several steps take place. For the birds that have individual diets, the containers are taken from the fridge and the lid is taken of. The diet is then transported in to the bird's enclosure in the same container. This takes about 2 minutes, so transport is extremely short. At arrival the food is given either directly, or put on a stump or feeding tray. The feeding trays are cleaned every once in a while, when they look dirty or when scraps of food are left.

#### 7. Transport whole prey to bird demonstration

Outside the main season there are two bird demonstrations each day. In the high season (June – August) there are three shows each day. For each show some birds are pre-bated (the food is placed on a stump or in the skull on stage before the bird is on stage) and whole prey from the containers is used during the show. The prey that is given to the bird on stage, is placed on a small plate, that fits inside the box (hidden in a tree trunk) on stage. The plate has a paper sheet on it, on which the names of the bird's name. The prey that is given from behind the scenes is taken directly from the containers. The containers are placed in a box outside, so that food is available for personnel during the show. The lids are kept on the containers at all times. When prey is needed it is taken from the container and placed at the pre-bate position or the food is given on the glove. The prey is taken out of the fridge just before the show starts and is therefore outside the fridge maximum for about an hour before it is being fed.

This description of the current situation at Vogelpark Avifauna, shows that there are some risks in the methods currently used. In the following paragraphs, the risks are described and some measures will be given that may be useful for Vogelpark Avifauna in order to reduce the risks and create a safer situation for the animals as well as the personnel.

# 6.2 Contamination risks

In this chapter, the risks in each of the steps taken in the food processing of whole prey will be discussed. The steps in whole prey processing are shown in paragraph 6.1.2 in table 2.

The potential hazards that could be present in basic materials or occur during preparation, treatment, packing and transport of food can be divided into 3 categories:

- (Micro)biological: Damaging fungi or matters produced by fungi, mycotoxins, damaging viruses, bacteria like *Salmonella* or *Listeria* that cause diseases.
- Chemical: Residues from for example disinfectants, insecticides, oil, lubricants.
- Physical: Glass, stone, sand, paper, rope, metal.

Besides these three categories, there are more risks, which will be further explained when the risk is present.

# 6.2.1 Whole prey delivery

Within the process step 'whole prey delivery' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 1. Thawing during transport
- 2. Chemical contamination during transport
- 3. Microbiological contamination during transport
- 4. Bad quality of whole prey
- 5. Shelf life exceeded

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey delivery. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In whole prey delivery, many risks can be prevented by selecting a good supplier. When selecting a supplier, attention should be paid to how the supplier sees to the delivery of fresh whole prey at the right temperature. Besides that, the supplier is obliged to follow legislation. The steps preceding the delivery are very important to Avifauna, as the quality of the food can be affected during this time. It is advisable that Vogelpark Avifauna has proper agreements with the supplier about the quality of the food. Therefore, the manual 'Food processing and hygiene protocol' describes the steps that should be taken when choosing a supplier and the demands that can be made towards the supplier.

#### 1. Thawing during transport

The supplier delivers the whole prey in frozen packages in a truck that is cooled at -18 °C. Bacterial growth is thwarted by low temperatures. If the whole prey is thawed during transport and then frozen again in the freezer at Avifauna, the quality of the whole prey is affected. Some bacteria in whole prey like Salmonella ssp., Escherichia coli and Staphylococcus acromonas can survive freezing temperatures and will resume growth when thawed. If the prey has been thawed during transport and is then frozen and thawed again, there can be large numbers of bacterial colonies present on the whole prey. (Crissey et al. 2001) A general rule of freezing at a temperature of -18 °C (0 °F)or lower, will slow down or stop the growth of micro organisms and chemical processes. Temperature fluctuations can negatively influence the quality of the food, even if the temperature stays well below 0 °C (32 °F). During temperature fluctuations, small ice crystals are reshaped to bigger crystals. As a consequence, damaging of the cell-walls and quality loss occurs. The quality loss increases as the temperature increases and the fluctuations occur more often. Especially whole prey products are very sensitive to fluctuations. (Consumentenbond, 1996) Since it is impossible for Vogelpark Avifauna to control the temperature inside the truck, agreements should be made between the supplier and the client (Avifauna) about the temperature limits during transport. Fluctuations inside the truck can always occur, and in order to limit the number of fluctuations, it is important to try to transport the product from the truck to the freezer as fast as possible.

In table 3 the decision tree questions are answered and explained for the risk of thawing during transport. This table shows that thawing during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The transport of the whole prey should happen under the right temperature conditions
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Thawing the whole prey during transport can have serious consequences for the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk

#### Norms

Optimum freezer temperatures range from -30 to -18 °C (-22 to 0 °F). Therefore it is recommended that whole prey is transported at a temperature of -18 °C (0 °F) or lower.

#### Monitoring

Every time a load of whole prey is delivered at Vogelpark Avifauna, the temperature of the load should be measured, using a well-calibrated thermometer. The temperature should be measured by sticking the thermometer between two boxes of whole prey. The temperature in the middle of the truck and along the sides of the truck should be measured, in order to see if the temperature varies when measured further away from the freezing unit. Some trucks have a temperature gauge in the storage area of the vehicle, which indicates the temperature of the vehicle's contents. This can also be used for measuring the temperature. If there is any question concerning appropriate shipping temperature of the whole prey, use a calibrated portable thermometer to check the temperature inside several of the boxes. If the temperature is over -18 °C (0 °F), it is possible to reject the load.

A visual check of the load is enough to see if the whole prey has been thawed and was then frozen again. This is quite easy to see as, when the whole prey is thawing, the cardboard boxes get wet from the fluids (body fluids and ice crystals) coming from the whole prey. The cardboard is discoloured and moist or slimy and the surface gets irregular and bumpy because of the fluids. There can also be water or ice builds up on the boxes or floor beneath the boxes. The prey will have soft flesh upon thawing and a sour odour. When in doubt, <u>Attachment V</u> (quality control standards for whole prey) can be used to decide whether the quality of the prey still suffices. (*Crissey et al. 2001*) If there are signs of thawing it is recommended to reject the load (even if it is frozen again at arrival).

Monitoring the delivery this way is useful only when it is done every single time a load is brought in. The form "Whole prey delivery" (view manual Food Processing and Hygiene protocol) should be filled in every time.

#### Registration

The filled in "Whole prey delivery" forms should be put into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 2. Chemical contamination during transport

Chemical contamination of the whole prey can take place if products, other than whole prey, are transported in the cargo space of the truck. Sometimes shippers transport other food and non-food items in the same truck as the whole prey order to save freight costs. There should be no non-food items shipped with the whole prey. Chemical products that are transported in the same space as the whole prey, at the same time, can get in contact with the product, e.g. if a bottle falls over or breaks

and leaks on to the boxes. (*Crissey et al. 2001*) Chemical contamination can also occur when the freezer inside the truck is defect and cooler fluids are leaking on the product. Coolants like these, but also maintenance products (lubricants) and disinfectants can endanger human and animal health. The absorbing characteristic of the cardboard boxes cause fluids to leak onto the whole prey quite easily. Agreements with the supplier should be made that no chemical products will be transported in the same space as the whole prey. Agreements should be made about the consequences of freezer failure. In case the coolants get in contact with the food, the delivery should be rejected.

In table 4 the decision tree questions are answered and explained for the risk of chemical contamination during transport. This table shows that chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be transported in the same space as the whole prey, no coolants should leak onto the prey boxes.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the whole prey quality. If chemical products get onto the whole prey, they cannot be removed and the toxins can harm the health of humans (who get in contact with the prey) and animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk. Once the chemicals are in contact with the whole prey, the toxins cannot be removed.

#### Table 4. Decision tree for whole prey delivery, chemical contamination during transport

#### Norms

Chemical products should not be transported in the same space that is used to transport whole prey. The freezer inside the truck should be functioning well; no coolant should be leaking out.

#### Monitoring

A visual check should be done at every delivery of whole prey and the results should be filled in on the form "Whole prey delivery" (view manual Food Processing and Hygiene protocol). The presence or absence of chemical products should be checked, as well as the functioning or malfunctioning of the freezer. If there are chemical products present in the cargo space of the truck or if coolant is leaking onto the product, a decision should be made whether to accept or reject the delivery. If there are no open or broken bottles of chemical products in the truck, the load can be accepted. If there is any doubt about the quality of the whole prey, it is recommended to reject the load. An agreement should be made with the supplier that a load will be rejected when chemical products are present in the truck or when the freezer is malfunctioning.

#### Registration

The form "Whole prey delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 3. Microbiological contamination during transport

The whole prey is delivered in cardboard boxes with small holes in the sides and a lid on top that fully covers the holes. This way, the whole prey is fully covered and cannot get in contact with the

surroundings. If the packing material of the whole prey is opened or damaged in any way, micro organisms can get on the whole prey. These micro organisms can come from walls and floors that were not cleaned properly, flies and other pests in the cargo space and other products that are transported in the cargo space. This risk can be reduced by not accepting damaged packing materials or boxes from where the lid is missing. Agreements with the supplier should be made on this point.

In table 5 the decision tree questions are answered and explained for the risk of microbiological contamination during transport. This table shows that microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Damaged or opened packing materials should be rejected at delivery
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences. If there are holes in the packing material, microbiological contamination can take place, which affects the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

If a box is damaged or opened, the whole prey might be contaminated. Since it cannot be seen at the whole prey it self if microbiological contamination has taken place, the quality of the whole prey cannot be guaranteed if the packing material is damaged. The norm is that damaged boxes do not suffice.

#### Monitoring

A visual check on the load should be done at every delivery, to see if there are no packing materials damaged and no boxes are opened. This should be registered on the form "Whole prey delivery" (view manual Food Processing and Hygiene protocol).

If the load does not fit requirements at this point, it is advisable to reject the damaged or opened boxes. The remainder of the load (if not damaged) can be accepted.

#### Registration

The form "Whole prey delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 4. Bad quality of prey

Bad quality prey is unusable because it is unpalatable, a health hazard and may cause a significant economic loss due to the illness or death of the animals or those handling the product (*Crissey et al. 2001*). Even after selecting a decent supplier, it is possible that the supplier delivers whole prey that does not weigh up to the quality standards. A proper HACCP system in Avifauna will not work if the supplied food is of bad quality. This risk can be minimized by selecting a decent supplier (see also Attachment ? about choosing a supplier), however, there is still a chance of this risk occurring.

In table 6 the decision tree questions are answered and explained for the risk of bad quality of whole prey during transport. This table shows that the delivery of bad quality of prey is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Selecting a decent supplier and checking the delivery at arrival
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the whole prey does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bad quality prey is a risk for the health of the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 6. Decision tree for whole	prey delivery	y, bad c	uality	y of	prey	y
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#### Norms

Good quality prey has, when thawed, clear eyes and firm, elastic flesh. Bad quality prey will have dull, cloudy eyes and soft flesh: finger impressions are easily made and remains formed in the meat after making the impression into the meat. When whole prey is frozen solid, it is almost impossible to determine the quality. (*Crissey et al. 2001*)

#### Monitoring

At delivery, the food quality should be visually checked. Microbiological research can point out if the prey quality is affected, however, it takes time and the costs are considerable. Therefore it is recommended to have a certified supplier, which will minimize the risk of receiving products of an insufficient quality.

Therefore, a visual check of the load is recommended for Vogelpark Avifauna. This gives a good (but not 100% certain) idea about the quality of the food. Since this is possible only on thawed prey, it is advisable to thaw one box of prey (this box is a sample taken at random and counts for the whole load) immediately after delivery. After thawing the prey can be inspected on quality with use of the norms mentioned before. The results should be filled in on the form "Whole prey delivery" (view Manual Food Processing and Hygiene protocol). Since thawing takes some time, the load should be accepted if it looks acceptable. If, after thawing, the contents of the box do not weight up to the quality standards, the supplier should be made aware of this. A new load can be ordered and this load can be sent back, or (if the load is inferior and not unacceptable) the load can be fed. Even if it is decided to feed this load, the supplier should still be contacted and informed about the inferior quality of the whole prey. This way, the supplier will know that more care should be given to the products. By checking the load this way, it is possible that a lot of extra work has to be done (if a load is send back). However, this extra work should not be a reason to keep a delivery that does not weight up to the standards. Agreements should be made with the supplier about the quality of the whole prey.

#### Registration

The form "Whole prey delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 5. Shelf life exceeded

If the shelf life is missing or is unreadable for any reason, there is no possibility to check if a box of whole prey is still perishable after storage. After passing the shelf life the whole prey is not necessarily degenerated, but the quality is lower than that of a box that has not surpassed the shelf life. Every box must contain the date of manufacture or processing.

If the shelf life is written on the box, preferably the storage temperature should be written on it too, because one is dependent of the other. To help ensure freshness, always use feed on a First In-First

Out (FIFO) basis: any older whole prey stocks remaining in the freezer should be placed so they will be used before the new whole prey stocks. (*Crissey et al. 2001*)

In table 7 the decision tree questions are answered and explained for the risk of exceeding the shelf life of whole prey during transport. This table shows that exceeding the shelf life of prey is a CCP.

Table 7.	Decision	tree for	whole p	rev deliv	erv. exceedi	na shelf life
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Shelf life present on each box, working on a FIFO basis
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the whole prey does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Whole prey that has passed the shelf life is of decreased quality and may be degenerated
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

The shelf life of the whole prey should be present on every box. This date represents the latest date on which the whole prey in the box can still be processed. After this date the whole prey should not be processed, since the quality of the whole prey is affected.

#### Monitoring

At delivery every box should be visually checked to see if the shelf life is present. This should be written down on the form "Whole prey delivery" (view Manual Food Processing and Hygiene protocol). Since all the boxes of whole prey are placed in storage by hand, every box can be visually checked. If the shelf life is missing from a box, it can be written down on the box using a permanent marker. The date can be copied from other boxes from the same delivery. If none of the boxes from the load have a shelf life written on it, the load may be rejected. It is not clear if the boxes have been stored before being transported to Vogelpark Avifauna, which makes it impossible to find out how old the load is. Agreements with the supplier should be made that every load should have a shelf life present on every box.

#### Registration

The form "Whole prey delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

# 6.2.2 Whole prey storage before processing

Within the process step 'whole prey storage before processing' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 6. Temperature in storage too high
- 7. Chemical contamination in storage
- 8. Microbiological contamination in storage
- 9. Shelf life exceeded
- 10. Insufficient circulation of cold air
- 11. Insufficient closing of storage

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey storage before processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In whole prey storage, many risks can be prevented by making sure the storage facility meets demands. The storage facility should be designed to adequately protect supplies. It is crucial that the length and conditions of storage minimizes contamination and ensure the product retains its nutritive value and wholesome quality (*Crissey et al. 2001*). <u>Attachment I</u> describes the properties of freezing and some of the product changes that can occur.

#### 6. Temperature in storage too high

Whole prey should not thaw during the storage in the freezer. This is because once the prey has thawed after freezing it for the first time, it cannot be frozen again. This would reduce the quality of the prey, since bacterial growth is temperature bound. (see 6.2.1. thawing during transport) Temperatures above –9 °C (16 °F) but below the average freezing point for foods of –2 °C (28 °F) causes loss of nutrients. (*Crissey et al. 2001*) Temperature fluctuations can negatively influence the quality of the food, even if the temperature stays well below 0 °C (32 °F). The quality loss increases as the temperature increases and the fluctuations occur more often. Especially whole prey products are very sensitive to fluctuations. (*Consumentenbond, 1996*) The freezer temperature should always be kept well under –18 °C (0 °F).

In table 8 the decision tree questions are answered and explained for the risk of too high temperatures during storage. This table shows that storage of prey under the wrong temperature conditions is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Adjust the freezer to the right temperature
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of whole prey does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Thawing (and re-freezing) during storage can seriously affect the quality of the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 8. Decision tree for whole prey storage, temperature too high

#### Norms

Optimum freezer temperatures range from -30 to -18 °C (-22 to 0 °F). It is recommended that whole prey stored for prolonged periods should be in a freezer with temperatures maintained at -23 °C (-10 °F) or lower. (*Crissey et al. 2001*) Since the food at Vogelpark Avifauna is stored in the freezer for no longer than two months, the maximum temperature for the freezer at Avifauna should be set at -18 °C (0 °F). A lower temperature however, is preferred.

#### Monitoring

There is a temperature gauge at the outside of the freezer, which indicates the temperature of the freezer. This temperature gauge should be checked several times daily and the temperature should be written down on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). It is possible that because of air circulation or opening the door of the freezer for a certain time, the temperature gauge can show incorrect temperature values. Therefore the temperature inside the freezer should be measured by hand, using a calibrated portable thermometer, once a week. This should also be done when the temperature gauge indicates a temperature above – 18 °C (0 °F), as a check up. Measuring can be done by sticking the thermometer in between some boxes in the freezer. The temperature in the middle of the freezer and along the sides of the freezer should be measured, in order to see if the temperature varies when measured further away from the freezing unit. These measurements should also be written down on the form "Whole prey storage before processing".

The most important measure for this risk is to install an alarm which goes off when the temperature of the freezer increases to above -18 °C (0 °F). This alarm should be hooked up to a cell phone of the person responsible for the storage, so that this person automatically gets a signal on his cell phone when the alarm sounds. There should be a note present with emergency measures in case the alarm rings and the person responsible is not around. This note should describe exactly what to do when the alarm sounds, step by step and should preferably be written by the person responsible for the storage, since this person knows what measures should be taken and how the machines work. If the temperature of the freezer exceeds -18 °C (0 °F), a decision should be made whether to use the whole prey in the freezer for feeding, or to discard the product. When the temperature is beneath -9 °C (16 °F), the whole prey can still be fed. However, if the temperature is higher, the food should not be used anymore.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right conditions, is possible.

#### 7. Chemical contamination in storage

Chemical contamination of the whole prey can take place if non-food products are stored in the freezer. Chemical products that are stored in the freezer can get in contact with the whole prey e.g. if a bottle falls over or breaks and leaks on to the boxes or to the prey in the boxes that are already opened. The absorbing characteristic of the cardboard boxes cause fluids to leak onto the whole prey quite easily.

Dedicated freezers must be used only for perishable food to be fed to animals. No substances known to be toxic or harmful to animals should be stored or maintained in the animal food storage areas. (*Crissey et al. 2001*)

In table 9 the decision tree questions are answered and explained for the risk of chemical contamination during storage. This table shows that chemical contamination during storage is a CCP.

Table 9. Decision tree for whole	prev deliverv.	chemical contamination	during transpo	ort
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be stored in the freezer where the whole prey is stored
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the quality of the whole prey. If chemical products get onto the whole prey, they cannot be removed completely and the toxins can harm the health of animals and

		humans (who get in contact with the prey).
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk. Once the chemicals are in contact with the whole prey, the toxins cannot be removed.

#### Norms

Chemical products should not be stored in the freezer that is used to store the whole prey.

#### Monitoring

A weekly visual check should be done to see if there are chemicals stored in the freezer. In case there are chemicals present in the freezer, this should be filled in on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). If there are chemical products present in the freezer, these should be removed immediately and it should be investigated who put them there and why. An explanation should also be given to this person as to why the chemicals cannot be stored in the freezer.

If there are chemical products present in the freezer, a decision should be made whether or not to use the whole prey from the freezer. If there are no open or broken bottles of chemical products in the freezer, the load can be accepted. If there are any doubts about the quality of the whole prey, it is recommended not to use the whole prey for processing or feeding. If there are doubts about the quality of the whole prey, it should not be used for feeding.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right conditions, is possible.

#### 8. Microbiological contamination in storage

If the packing material of the whole prey is opened or damaged in any way, micro organisms can get on the whole prey. Quality loss of frozen products can also occur when water disappears from the product locally (dehydration). If whole prey dehydrates, it is clearly visible by the dark, hard spots. The surface of the tissue gets rough and large pores develop. This allows oxygen from the air to affect the product (oxidation). It changes the taste (goes rancid), the colour and the construction of the whole prey. This is called 'freezer burn'. To prevent freezer burn, a sufficient, closed packing is necessary. (*Consumentenbond, 1996*) Micro organisms can come from walls and floors that were not cleaned properly, flies and other pests and other products that are stored in the freezer. Personnel that are handling the damaged or open boxes with dirty hands can also cause a microbiological contamination. All of this will cause the quality of the whole prey to decrease.

This risk can be reduced by handling the boxes with care when moving them in the storage, to prevent damaging. Agreements should be made about this with the personnel handling the boxes.

In table 10 the decision tree questions are answered and explained for the risk of microbiological contamination during storage. This table shows that microbiological contamination during storage is a CCP.

# Table 10. Decision tree for whole prey storage before processing, microbiological contamination during storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Care should be taken not to damage or open boxes when moving them
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences. If the packing material is opened or damaged, microbiological contamination can take place, which affects the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

Handling and moving the boxes should be done with care, so that the boxes are not damaged or opened in storage.

#### Monitoring

A weekly visual check should be done to see if there are boxes damaged or opened in storage. If this is the case, this should be filled in on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). It should be investigated who damaged or opened the boxes and why. An explanation should also be given to this person as to why the boxes need to be handled with care. If there are damaged or opened boxes in storage, a decision should be made whether or not to use the whole prey in those boxes. The risk of microbiological contamination should be taken in consideration, when making this decision. If there is any doubt about the quality of the whole prey, it is advised not to use it.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right circumstances, is possible.

#### 9. Shelf life exceeded

If the shelf life of the whole prey is exceeded, the quality of the prey will be affected. The whole prey may even be degenerating. The whole prey should be used before the shelf life has been exceeded. Agreements should be made at this point with the personnel. By working on a FIFO basis, it is prevented that boxes which have a longer shelf life, are used before the boxes which are exceeding their shelf life sooner. When ordering a load of whole prey, the speed at which the whole prey is used should be taken into consideration. If the order is too big, it cannot be used before exceeding the shelf life. (*Crissey et al., 2001*) At a temperature of -18 °C (0 °F) or lower, the whole prey products can be stored for three months (*Consumentenbond, 1996*).

In table 11 the decision tree questions are answered and explained for the risk of exceeding the shelf life during storage. This table shows that exceeding the shelf life during storage is a CCP.

Table 11. Decision tree for whole prey storage before processing, shelf life exceeded during storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Make sure the whole prey is processed before the shelf life is exceeded
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	If the shelf life is exceeded, the quality of the prey could be affected. The whole prey may be degenerating.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

After exceeding the shelf life, the whole prey should not be processed.

#### Monitoring

Putting the boxes of whole prey in storage should be done on a FIFO basis. The shelf life of the new load should be compared with that of the boxes still in storage, to make sure the boxes which reach the shelf life first, are used first.

When taking a box of whole prey from storage, a visual check should be done to see if the whole prey has not exceeded the shelf life. If this is the case, the box should not be used and it is advisable at this point to check the rest of the boxes in storage to see if there are more boxes of whole prey that have exceeded the shelf life. It should also be filled in on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). when one or more boxes have exceeded the shelf life.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right circumstances, is possible.

#### 10. Insufficient circulation of cold air

Insufficient circulation of cold air in the freezer can cause the risk of insufficient cooling of the products. This may affect the quality of the whole prey. The ventilator in the freezer should be checked weekly. If the ventilator is malfunctioning, the cold air in the freezer is not circulated enough to cool the all products at a sufficient rate. Furthermore, the boxes should not be packed to close together and the piles of boxes should not be too high, since this could cause insufficient cooling of the whole prey. It is recommended to leave a gap of ten centimetre between the piles of boxes, to allow the cold air to circulate through. This should be held in consideration when a new load of boxes is brought in. (*den Boer and de Bruin, 2004*)

In table 12 the decision tree questions are answered and explained for the risk of insufficient circulation of cold air during storage. This table shows that insufficient circulation of cold air during storage is a CCP.

# Table 12. Decision tree for whole prey storage before processing, insufficient circulation of cold air during storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Make sure the boxes are piled up with a 10 cm. gap in between to allow circulation and check the ventilator weekly.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	If the whole prey is not cooled properly, it can cause the quality of the whole prey to decrease.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

The cold air in the freezer should be sufficiently circulated along and in between the piles of boxes in order to have the whole prey in the boxes properly cooled.

#### Monitoring

The ventilator in the freezer should be checked weekly, by feeling in front of the ventilator opening if there is a stream of air flowing through and if this is strong enough. Also the boxes should be checked to make sure if they are not piled up too close together. This should be registered on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). If the circulation of cold air is insufficient a mechanic should be arranged who is able fix this. If there is insufficient space in between the piles of boxes, the personnel should be advised about how to store the boxes when they are delivered. The boxes should then be piled up again in the correct way.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right circumstances, is possible.

#### 11. Insufficient closing of storage

Insufficient storage could cause the risk of the whole prey not being cooled properly, which will cause the quality of the whole prey to decrease. The door of the freezer should be checked, whether it was closed properly by the last person who entered. Also the rubber door strips should be checked. If these do not function properly because they are worn out or broken they should be replaced. When the rubber door strips do not function, cold air can escape from the storage and it will cost more energy (and money) to keep the freezer cold. (*den Boer and de Bruin, 2004*) This will cause the temperature to fluctuate which causes the quality of the whole prey to decrease.

In table 13 the decision tree questions are answered and explained for the risk of insufficient closing of storage. This table shows that insufficient closing of storage is a CCP.

Table 13. Decision tree for whole prey storage before processing, insufficient closing of storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The rubber door strips should be checked regularly to see if they are still functioning and it should be checked if the door is closed properly.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	If the storage is not closed sufficiently it will cause temperature fluctuations, which will affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

It should be possible to close the storage properly to prevent cold air from escaping. The rubber door strips should not be broken and/or worn out.

#### Monitoring

The rubber door strips should be checked monthly to see if they are not worn out or damaged. This should be filled in on the form "Whole prey storage before processing" (view Manual Food Processing and Hygiene protocol). The personnel should be instructed not to leave the door of the storage open unnecessarily and to close the door properly every time. A useful reminder to the personnel to close the door properly can be a note on the door. If the rubber door strips are worn out or broken they should be replaced.

#### Registration

The form "Whole prey storage before processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was stored under the right circumstances, is possible.

### 6.2.3 Whole prey thawing

Within the process step 'whole prey thawing' there are a few risks to be identified. The following risks will be discussed in this paragraph:

- 12. Temperature too high
- 13. Chemical contamination during thawing
- 14. Microbiological contamination during thawing

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey thawing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

The thawing process is crucial to the product's final quality. Therefore, it must be carefully controlled. Many risks can be prevented by making sure the right thawing methods are used.

(*Crissey et al. 2001*). Physical contamination during thawing could occur when the whole prey is removed from the boxes in which it has been delivered. However, in the current situation in Vogelpark Avifauna the whole prey was placed in the boxes when already frozen and therefore the cardboard does not stick to the prey. It is easy to remove the prey from the boxes and there is no risk of staples or plastic getting in the product, since these materials are not used in the packing material. Therefore, there is no risk of physical contamination during thawing. There is no risk of the temperature during thawing being too low, if the right method of thawing is used for thawing (which will be described in 12. Temperature too high).

#### 12. Temperature too high

Freezing tends to break down tissues, making the food much more susceptible to bacteria after thawing. If the surrounding temperature during thawing is too warm, the outer part of the prey is already thawed while the inner part is still frozen. This causes a risk because the micro organisms can start growing on the outer part of the whole prey, while the inner part has not even started thawing. This risk can be prevented by choosing the right method of thawing. Whole prev should never be thawed at room temperature. (Crissey et al. 2001) Whole prey and whole prey products should be thawed slowly, and therefore always refrigerated. The whole prey will then stay tender and contains more fluids, because it loses little moist (drip). The safest and most preferable way to thaw whole prey is at a temperature that does not exceed 6 °C (43 °F) (Consumentenbond, 1996, Schmidt et al., 2005). Depending on the size of the whole prey and the temperature in the refrigerator, the thawing will take 5 to 24 hours. Ideally, during thawing, whole prey should be kept in a container that provides insulation and allows the whole prey to thaw uniformly. (Crissey et al. 2001, Consumentenbond, 1996) The whole prey should be taken from the box and put into a container. The whole prey should be separated from the bulk, to allow every prey to thaw uniformly. A container big enough to spread out the whole prey without the individual prey covering each other is preferred. By using this method for thawing, the thawing process is steadier and the risk of the temperature being too high can be prevented. There are a lot of bacteria in thawing fluids, but since the whole prey for Avifauna is blast frozen, no thawing fluids emerge from the thawed prey. If there is thawing fluid coming from the prey, this should be separated as fast as possible and disposed of properly.

In table 14 the decision tree questions are answered and explained for the risk of the temperature being too high. This table shows that whole prey thawing at a high temperature is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Thawing in a refrigerated space, in a closed container. Separate thawed prey from the bulk before and during thawing.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The thawing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	If the temperature is too high during thawing, micro organisms can start growing on the thawed outside of the prey, while the inner part is still frozen. This decreases the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 14. Decision tree for ten	perature being too	hiah durina	thawing
	iperature being toe	/ mgn aarmy	j unawing

#### Norms

The whole prey should be separated from the bulk when taken from the freezer at 11 am every day. The prey is then put into a container into the refrigerator to thaw. The thawed whole prey should stay refrigerated until it is used for processing.

#### Monitoring

Once every two weeks an inspection should be done to check if the personnel are working according to the method described before. The inspection should take place unannounced. If this method of thawing is not used, an explanation should be given to the personnel responsible as to why it is important to thaw according to this method and that this method should be used every time. Also, the temperature inside the refrigerator should be checked with a portable calibrated thermometer once a month, to see if the thermometer in the fridge is reliable. If the manually measured temperature deviates from the temperature at the fridge, the thermometer in the fridge is not reliable anymore. This thermometer should be repaired or the temperature should be measured by hand daily. All the results should be filled in on the form "Whole prey thawing" (view Manual Food Processing and Hygiene protocol). A decision should then be made whether or not to use the whole prey that has been thawed already. If there are any doubts about the quality of the whole prey, it is advisable not to use it.

#### Registration

The form "Whole prey thawing" should be input into an Excel-file, so that later check-up, to see if the whole prey was thawed under the right circumstances, is possible.

#### 13. Chemical contamination during thawing

Chemical contamination can be caused by the presence of cleaning agents on the tools. During the thawing process there can be chemical contamination e.g. through cleaning agents that were used to clean the containers where the whole prey is stored in. If the containers are not rinsed properly after cleaning, leftovers of cleaning agents can stay behind in the containers. This risk can be prevented by cleaning following the instructions of cleaning agents stored in the same place as the whole prey, in the refrigerator. The cleaning agents may get in contact with the whole prey, which could decrease the quality of the whole prey. Therefore, no cleansing agents should be stored in the refrigerator space where the whole prey is being thawed (not even if there is no whole prey in there at that time). (*Crissey et al., 2001*)

In table 15 the decision tree questions are answered and explained for the risk of chemical contamination during thawing. This table shows that chemical contamination during whole prey thawing is a CCP.

Table 15. Decision tree for chemical contamination durin	g whole	prey thawing
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning and rinsing of the containers after cleaning. Also, no cleaning agents should be kept in the refrigerator where the whole prey is thawed in.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The thawing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the whole prey quality. If chemical products get onto the whole prey, they cannot be removed and the toxins can harm the health of humans (who get in contact with the prey) and animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

After cleaning and disinfecting, the containers should be rinsed sufficiently with clean tap water. Also, there should be no cleaning agents stored in the refrigerator where the whole prey is being thawed.

#### Monitoring

During the daily cleaning and disinfecting of the containers, someone other than the person doing the cleaning, should check if the containers are rinsed properly. This is filled in on the form "Cleaning" (view Manual Food Processing and Hygiene protocol). Someone else checking up on the cleaning will help prevent carelessness on the long run. If the containers are not rinsed sufficiently the person inspecting can ask the person cleaning to rinse the containers again.

#### Registration

The form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the cleaning was done properly, is possible.

#### 14. Microbiological contamination during thawing

Micro organisms can come from walls and floors that were not cleaned properly, flies and other pests and other products that are kept in the refrigerator. During the thawing process, microbiological contamination can take place by handling the whole prey with dirty hands, not covering the container properly or by insufficient cleaning of the thawing containers. Micro organisms from the hands can be passed on to the whole prey when the preys are taken from the boxes and placed into the containers or when there is contact with the prey to check if it is thawing properly. Therefore, disposable gloves should always be worn when handling the whole prey. Even with exact care in handling, most uncooked foods will harbour some micro organisms. Wearing disposable gloves will not only prevent micro organisms passing from dirty hands to the whole prey, but also the other way around. This way, no micro organisms can get into the body through smalls cuts or wounds and cause illnesses. This measurement will only have effect if the gloves are indeed disposable and are only used for this action and thrown out immediately after. If the containers are not covered properly, micro organisms from the refrigerator walls, floors and racks and from flies or other products in the refrigerator can get on the whole prey. Therefore, the containers should always be closed properly when not in use. Microbiological contamination could come from the whole prey that was in the container the day before, if the container and lid were not cleaned properly. All of this will cause the quality of the whole prey to decrease. (*Crissey et al. 2001*)

This risk can be reduced by thawing according to the method described earlier in this paragraph at risk nr. 12. Temperature too high. Sufficient cleaning the containers and lids and wearing disposable gloves during handling the whole prey can also help prevent contamination.

In table 16 the decision tree questions are answered and explained for the risk of microbiological contamination during thawing. This table shows that microbiological contamination during thawing is a CCP.

	Yes/No	
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and proper closing of the containers and wearing gloves during whole prey handling can help prevent this hazard.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The thawing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences. If microbiological contamination takes place, this affects the quality of the whole prey and can have consequences for human and animal health.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 16. Decision tree for whole prey thawing, microbiological contamination during thawing

#### Norms

The containers used for thawing should be cleaned properly and should be closed at all times when whole prey is thawing inside. Disposable gloves should be worn at all times when handling the whole prey.

#### Monitoring

A daily visual check should be done to see if the container lid is closed properly. This is written down on the form "Whole prey thawing" (Attachment ?). A visual check should also be done during the check up on the used thawing method, on the use of disposable gloves during the handling of the whole prey. This is also registered on the form "Whole prey thawing" (view Manual Food Processing and Hygiene protocol), as well as the cleaning and disinfecting of the containers and lids.

If the lid is not closed or the disposable gloves were not worn during handling, a decision should be made whether or not to use the whole prey. If there are any doubts about the quality of the whole prey, it is recommended not to use it.

#### Registration

The form "Whole prey thawing" should be input into an Excel-file, so that later check-up, to see if the whole prey was thawed under the right circumstances, is possible.

## 6.2.4 Whole prey processing

Within the process step 'whole prey processing' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 15. Temperature in processing room too high
- 16. Chemical contamination during processing
- 17. Microbiological contamination through environment
- 18. Microbiological contamination through personnel
- 19. Physical contamination during processing

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

#### 15. Temperature in processing room too high

Bacterial growth is influenced by temperature. Bacterial growth can take place faster at higher temperatures. In order to keep the bacterial growth down, whole prey should be cooled to temperatures of 4 °C (39 °F) or lower (*Crissey et al. 2001*). Since there is no cooled processing room, it is inevitable that the whole prey will be exposed to higher temperatures than 4 °C (39 °F). During processing, the whole prey can shortly be exposed to a temperature no higher than 20 °C (68 °F), but should be chilled again immediately after processing. The processing time should be kept as short as possible. If the whole prey is processed in a room that is not cooled, the temperature in the room can increase on warm days to above 20 °C (68 °F). If the processing room gets too warm due to weather conditions (especially in the summer), air-conditioning should be installed. When the air-conditioning is working, all windows and doors should be kept closed, so no warm air can get into the room. Keeping windows or doors opened would be a waste of energy and money, since the air-conditioning would have to run more often to keep the room chilled.

In table 17 the decision tree questions are answered and explained for the risk of a too high temperature in the processing room during processing. This table shows that a high environmental temperature during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Air-conditioning should be installed in the processing room.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth can be accelerated by high temperatures. This can affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 17. Decision tree for whole prey processing, temperature too high in processing room

#### Norms

The processing of the whole prey should happen at a low temperature. Taking the working temperature for the personnel into account, the temperature in the processing room should not be higher than 20  $^{\circ}$ C (68  $^{\circ}$ F). The processing should take as little time as possible and the whole prey should be chilled as fast as possible after processing.

#### Monitoring

There should be an easily readable thermometer present in the processing room. This thermometer should be placed where the reading is a reliable average temperature of the whole room, e.g. not

close to the air-conditioning or a heath source. This thermometer should be read daily for an efficient temperature check. Inefficiency of the thermometer should be taken into account. Therefore, the temperature in the processing room should be measured weekly by using a well calibrated portable thermometer. The temperature should be measured in the middle of the room, as well as close to the walls to get a good vision of the temperature in the room. The results of the daily temperature check should be written down on the form "Whole prey processing" (view Manual Food Processing and Hygiene protocol). If whole prey is found which was not processed under the right temperature conditions, a decision should be made whether or not to use the whole prey. If there are any doubts about the quality of the whole prey, it is advised not to use it.

#### Registration

The form "Whole prey processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was processed under the right circumstances, is possible.

#### 16. Chemical contamination during processing

Chemical contamination during processing can take place if cleaning agents are present on tools and food containers. Bottles with chemical substances can fall over on the whole prey. Inexpert use of cleaning agents can also cause chemical contamination. Chemical contamination can cause a health hazard for the animals. Chemical products should not be stored in the same space as where the whole prey processing takes place. In the current situation at Vogelpark Avifauna (see <u>Appendix IV</u>), the chemical products like cleaning liquids are stored in the cupboards below the sink. This way, the chemical products can never leak onto the food or tools used for processing, if a bottle falls over or a package is broken. This way of storing is acceptable if the only chemical products stored here are the ones that are actually used in the processing room. However care must be taken when using the chemical products in the processing room, in order to keep the chemical products from getting in contact with the food or tools. Also, tools and containers should be rinsed well after cleaning, to wash away all cleaning substances. The personnel should be informed about the cleaning methods (see Chapter 5 Cleaning and disinfecting). (*Crissey et al. 2001*)

In table 18 the decision tree questions are answered and explained for the risk of chemical contamination during processing. This table shows that chemical contamination during processing is a CCP.

	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be present in the processing room. Tools and containers should be rinsed properly after cleaning.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination of the prey affects the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 18. Decision tree for whole prey processing, chemical contamination during processing

#### Norms

No chemical products should be stored in the space where the food is being processed. Storing in the cupboards below the food and tools is allowed, but care must be taken to always store the products here again immediately after use. After cleaning and rinsing the tools and containers, there should be no cleaning agent leftovers left.

#### Monitoring

A visual check should be done weekly to see if there are any chemical products stored in the room where the whole prey is processed, that do not belong in the processing room. Chemical products that are used in this room should be stored in the cupboards below the sink; this should be checked weekly as well. All of this should be written down on the form "Whole prey processing" (view Manual Food Processing and Hygiene protocol). Any chemical products present in the processing room should then immediately be stored where they belong and it should be investigated who put them there and why. An explanation should also be given as to why the products should be stored where they belong, every time immediately after use. If chemical products are found in the processing room, outside the cupboards, a decision should be made whether or not to use the whole prey in the processing room. If there are no broken or open bottles in the processing room, the whole prey can still be used.

#### Registration

The form "Whole prey processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was processed under the right circumstances, is possible.

#### 17. Microbiological contamination through environment

Microbiological contamination can come from objects that were not cleaned properly, flies and other pests and other products that are present in the room where the whole prey is being processed. Microbiological contamination can have serious consequences for the quality of the whole prey. This risk can be reduced by proper cleaning and disinfecting (see Chapter 5 Cleaning and disinfecting) of the objects that get in contact with the whole prey. Measures should be taken to control pests such as flies. The whole prey should be kept separated from other products in the processing room, such as fruits and pellets. Immediately after processing, when the whole prey is divided over the food containers, the containers should all be closed properly with clean lids.

In table 19 the decision tree questions are answered and explained for the risk of microbiological contamination through the environment during processing. This table shows that microbiological contamination through the environment during processing is a CCP.

# Table 19. Decision tree for whole prey processing, microbiological contamination through the environment during processing

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of tools and containers and pest control.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the whole prey affects the quality of the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

An environment in which microbiological contamination is prevented by proper cleaning and pest control suffice.

#### Monitoring

Tools and containers should be cleaned properly and kept strictly separated from dirty materials. This may mean the dirty materials are on the left side of the sink and the cleaned materials on the right side of the sink. Clean materials should be stored in a clean place (closet or drawer which is cleaned regularly).

Pests like flies should be prevented from entering the processing room by blocking their access routes. This can be done by placing insect screens in front of the windows, keeping doors shut and closing all gaps in the walls and underneath doors. Prevent pests that have entered the room from surviving and reproducing by keeping the room clean and free from (accessible) rubbish. Insecticide should only be used in case there is a pest problem.

Whole prey should be kept strictly separate from other food products. Tools can only be used after they have been properly cleaned. The pest prevention (whenever there is one) and separating of the clean from dirty objects (weekly) should be registered on the form "Whole prey processing". The cleaning of other objects in the room should be registered weekly on the form "Cleaning" (view Manual Food Processing and Hygiene protocol).

#### Registration

The form "Whole prey processing" and the form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the whole prey was processed and the room was cleaned under the right circumstances, is possible.

#### 18. Microbiological contamination through personnel

If the personnel are working unhygienic, this could cause microbiological contamination of the whole prey. The micro-organisms may come from clothing or hands that were not cleaned properly. All of this decreases the quality of the whole prey.

This risk can be reduced by regular cleaning of clothes and hands. Personal hygiene of the personnel is also very important. This includes not smoking in the processing room and not wearing nail polish on the fingernails. Jewellery can also be a source of contamination, especially rings, which can not be cleaned properly every time the hands are cleaned. Hands should be cleaned according to Chapter 5, Cleaning and disinfecting, and should be dried using disposable towels. When handling the whole prey, disposable gloves should be worn and wounds or cuts should be covered using brightly coloured band-aids, preferably blue (because no food is coloured blue) so that they can easily be recognized in the whole prey. (*den Boer and de Bruin, 2004*)

In table 20 the decision tree questions are answered and explained for the risk of microbiological contamination through personnel during processing. This table shows that microbiological contamination through personnel during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of clothing and hands, personal hygiene and wearing disposable gloves when handling whole prey.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the whole prey affects the quality of the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 20. Decision tree for whole prey processing, microbiological contamination through personnel during processing

#### Norms

All the personnel should apply normal personal hygiene. This includes not smoking in the processing room, not wearing nail polish, not wearing jewellery, cleaning hands according to the instructions,

wearing disposable gloves when handling the whole prey and covering up wounds with coloured band-aids if necessary.

#### Monitoring

The personnel should be inspected to see if they apply the personal hygiene regulations properly. A visual check should be done to see if the personnel do not smoke in the processing room, if the personnel do not wear nail polish or jewellery and if the personnel clean their hands according to the instructions. A visual check should also be done to see if the personnel wears disposable gloves while handling the whole prey and if they cover up wounds with coloured band-aids (preferably blue). This should all be registered on the form "Personal hygiene" (view Manual Food Processing and Hygiene protocol). To obtain unbiased information, the check should be done by someone other than the personnel processing the whole prey. If the personal hygiene is not sufficient, the personnel responsible should be instructed as to what the rules are and why they should be followed.

#### Registration

The form "Personal hygiene" should be input into an Excel-file, so that later check-up, to see if the whole prey was processed under the right circumstances, is possible.

#### 19. Physical contamination during processing

Physical contamination can be jewellery, wrapping leftovers or other objects which get stuck on to the whole prey. These objects can cause a hazard for the health of the animals. During processing, care must be taken to prevent objects to get stuck on the whole prey. Personnel should not wear jewellery and should not have polished fingernails in order to prevent physical contamination. Agreements should be made about this with the personnel. Also, the working area must be cleaned of small objects that could get stuck on the whole prey. Small litter should be thrown out and the cutting board should be cleaned properly. (*den Boer and de Bruin, 2004*)

In table 21 the decision tree questions are answered and explained for the risk of physical contamination during processing. This table shows that physical contamination during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No jewellery or nail polish should be worn by personnel. Processing area should be cleaned, no small objects may lie around in the processing area.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects in or on the whole prey can cause a serious health hazard when eaten by the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 21. Decision tree for whole prey processing, physical contamination during processing

#### Norms

No unwanted objects should get stuck in or on the whole prey during processing.

#### Monitoring

Before processing, the personnel that will do the processing should take off jewellery. A visual check should be done daily to see if there are any objects in the whole prey that do not belong there. During

processing care should also be taken that no objects get in or on the whole prey. If there are one or more objects found in the whole prey, this should be written down on the form "Whole prey processing" (view Manual Food Processing and Hygiene protocol).

If the contamination that is found in the whole prey cannot be removed fully from the whole prey, the whole prey is not usable and should be thrown out. This could happen if for an example, a glass breaks on the whole prey. The scattered pieces of glass can never all be found and taken from the whole prey. The pieces of glass can have serious consequences for the health of the animals. If this happens, it should also be written down on the form.

#### Registration

The form "Whole prey processing" should be input into an Excel-file, so that later check-up, to see if the whole prey was processed under the right circumstances, is possible.

## 6.2.5 Whole prey temporary storage

Within the process step 'Whole prey temporary storage' there is one risk to be identified. The following risk will be discussed in this paragraph:

20. Temperature in storage too high

This is not a complete list of all the possible risks. This is a selection of the most important risks in temporary storage of whole prey. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When the whole prey is in temporary storage, many risks can be prevented by making sure the containers are all closed properly and the containers are always cleaned properly after each use. By cleaning the containers properly after each use, chemical and microbiological contamination from residues is prevented. By keeping the containers closed at all times during storage, there is no risk of physical, chemical and microbiological contamination. The cleaning of the containers should be checked daily by someone other than the person doing the cleaning and should be registered on the form "Cleaning". The form "Temporary storage" can be used to register if a container has been found open in the temporary storage. This should also be checked daily.

#### 20. Temperature in storage too high

If the temperature of the temporary storage gets too high, the whole prey can start to deteriorate faster than normal, since bacterial growth increases at higher temperatures. At Vogelpark Avifauna, the whole prey that has been processed is only stored in the refrigerator on warm days (see <u>Appendix III</u> about the current hygiene situation at Vogelpark Avifauna). On other days, the containers with whole prey are kept inside the prep room, but not inside the refrigerator. If the food is not stored in a refrigerated place, (4 to 6 °C (39 to 43 °F) maximum temperature), microbial build-up can cause the quality of the whole prey to decrease fast. (*Crissey et al. 2001, Consumentenbond, 1996*) Therefore the whole prey should be stored in the refrigerator after every use. There should be a thermometer present in the refrigerator which can be read from the outside. The personnel should be instructed about these measures.

In table 22 the decision tree questions are answered and explained for the risk of temperature in storage being too high. This table shows that the temperature in temporary storage being too high is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Always keep whole prey in temporary storage refrigerated. Take care to close refrigerator door properly.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The temporary storage of the whole prey does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth increases at high temperature. This affects the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 22. Decision tree for temporary storage, temperature in storage too high

#### Norms

Whole prey should be stored at a maximum temperature of 4 to 6 °C (39 to 43 °F).

#### Monitoring

A visual check should be done weekly to see if the personnel store the whole prey in the refrigerator in the prep room. If the whole prey containers are not stored in the refrigerator, an investigation should

be done to find out who did this. An explanation should then be given to this person as to why the whole prey should always be stored in the refrigerator. Also, a decision should be made whether or not to use the whole prey. Appendix V (Whole prey quality control standards) can be used to determine whether the whole prey is still acceptable for use. If there is any doubt about the quality of the whole prey, it is advised not to use it. A visual check should be done daily to see what the temperature inside the refrigerator is. This, and the weekly visual check, should be registered on the form "Temporary storage". If the temperature in the refrigerator is over 6 °C (43 °F), this should also be written down. It is advisable therefore, to check the refrigerator temperature several times a day, especially after it has been opened for a while. If the temperature in the refrigerator is over 6 °C (43 °F) at a certain time, the refrigerator should be kept closed until the temperature is back to the acceptable level. Once a month, the rubber door strips of the refrigerator should be checked, to see if they are not damaged or worn out, and the temperature inside the refrigerator should be checked with a portable calibrated thermometer, to see if the thermometer in the fridge is reliable. These two monthly checks should also be registered on the form "Temporary storage". If the manually measured temperature deviates from the temperature at the fridge, the thermometer in the fridge is not reliable anymore. This thermometer should be repaired or the temperature should be measured by hand daily. If the temperature inside the fridge has been above 6 °C (43 °F) for a long time, Appendix V can be used to determine whether or not to use the whole prey.

#### Registration

The form "Temporary storage" should be input into an Excel-file, so that later check-up, to see if the whole prey was temporarily stored under the right circumstances, is possible.

### 6.2.6 Whole prey transport to enclosure

Within the process step 'temporary storage' there are a few risks to be identified. The following risks will be discussed in this paragraph:

- 21. Chemical contamination during transport
- 22. Microbiological contamination during transport
- 23. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey transport. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the whole prey to the enclosure, many risks can be prevented by making sure the transport is not delayed. When the transport to the enclosure has started, it should be finished before doing anything else. This way, there is no risk of the temperature during transport being too high or the transport taking too long, two risks that could both cause an increased bacterial growth.

#### 21. Chemical contamination during transport

Chemical contamination during transport could occur if the whole prey is transported to the enclosure in a container which was not rinsed properly after cleaning. If a glove is used to present the whole prey to the animal, this glove could contain leftovers from cleaning agents, which could end up on the whole prey. The risk of chemical contamination can be reduced by cleaning the gloves properly (An advice about how this is given in <u>attachment VII</u>) and by cleaning and rinsing the transport container (and lid) properly after each use. (*Crissey et al., 2001*)

In table 23 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the birds enclosure. This table shows that the risk of chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the gloves and proper rinsing of the transport container.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the enclosure does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 23. Decision tree for transport to enclosure, chemical contamination

#### Norms

No chemical products should end up on the whole prey during transport to the enclosures.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view Manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again. Also, a weekly check should be done to see if the gloves are cleaned properly after every feeding session. This should be registered on the form "Transport".

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 22. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport container was not cleaned properly. Micro-organisms from the whole prey that was in the container before, could then remain in the container and contaminate the whole prey for the next feeding. Contamination can also take place if the glove that is used for presenting the whole prey to the animals, is not cleaned properly. Since whole prey is held in the glove, micro-organisms get on the glove. If the glove is not properly cleaned, bacterial growth can take place easily (especially on warm days) and the whole prey that is fed next, will be contaminated, too. It is impossible to clean the glove after every feeding (this takes too much time). Microbiological contamination can also come from pests like flies. The risk of microbiological contamination can be reduced by cleaning the container properly after every feeding. Also, cleaning the glove after every feeding session can reduce the risk: if the feeding is done in the morning and afternoon, the glove should be cleaned twice: after the morning feeding and after the afternoon feeding. Pests like flies can be kept away from the whole prey during transport, by keeping the containers fully closed.

In table 24 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the birds enclosure. This table shows that the risk of microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the gloves after every feeding session and the container after every single feeding. Container should be kept closed.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 24. Decision tree for transport to enclosure, microbiological contamination

#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning of the transport container and the gloves. The lid on the container should be kept closed during transport.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the container and lid are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view Manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again. A weekly check should be done to see if the container for transport is kept fully closed during transport. Also, a weekly check should be done to see if the gloves are cleaned properly after every feeding session. Those weekly checks should be registered on the form "Transport". If the gloves are not properly cleaned (this should be checked the same way as the cleaning of the containers is checked), the observer can ask

the person responsible to clean them again. If necessary, an explanation about the cleaning should be given (for more information see <u>attachment VII</u>). If the container was not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important.

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 23. Physical contamination during transport

During transport of the whole prey to the enclosures of the animals, physical contamination can take place if objects stick on or in the whole prey. This could happen if the whole prey is transported with bare hands (jewellery or nail polish could end up in prey) or if the whole prey is accidentally dropped during transport (objects from the dirty ground could end up in prey). This could have serious consequences for the health of the animals. (*den Boer and de Bruin, 2004*) This risk can be prevented by transporting the whole prey to the enclosures in a closed container. When handling the whole prey, the feeding gloves should always be worn. The whole prey should never be touched with bare hands.

In table 25 the decision tree questions are answered and explained for the risk of physical contamination during transport to the birds enclosure. This table shows that the risk of physical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport whole prey to the enclosures in a closed container.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the enclosure does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in or on the whole prey can cause health damage to the animals who eat the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 25. Decision tree for transport to enclosure, physical contamination

#### Norms

No objects should end up in or on the whole prey during transport to the enclosures.

#### Monitoring

During processing, the whole prey has been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination on the whole preys before transport. In order to prevent physical contamination during transport to the enclosures, every day it should be checked whether the whole prey is being transported to the enclosures in a closed container. All of this is registered on the form "Transport". If the containers were not closed properly the whole prey should be visually checked for physical contamination. If there is any doubt about the quality of the whole prey, it is advised not to use the whole prey.

#### Registration

The form "Transport" should be input into an Excel-file, so that later check-up, to see if the whole prey was transported to the enclosure under the right circumstances, is possible.

# 6.2.7 Whole prey transport to bird demonstration

Within the process step 'transport' there are a few risks to be identified. The following risks will be discussed in this paragraph:

- 24. Chemical contamination during transport
- 25. Microbiological contamination during transport
- 26. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in whole prey transport. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the whole prey to the bird demonstration, many risks can be prevented by making sure the transport is not delayed. The whole prey should be transported to the backdrop and the stage as short as possible before feeding. The bird demonstration takes about 30 minutes maximum, as can be seen in <u>Appendix IV</u> for the current situation at the bird demonstration. This way, there is no risk of the transport taking too long and there is no risk of the temperature during transport being too high, two risks that could both cause an increased bacterial growth.

#### 24. Chemical contamination during transport

Chemical contamination during transport could occur if the whole prey is transported to the bird demonstration in a container which was not rinsed properly after cleaning. If a glove is used to present the whole prey to the animal, this glove could contain leftovers from cleaning agents, which could end up on the whole prey. The risk of chemical contamination can be reduced by cleaning the gloves properly (An advice about how this is given in <u>attachment VII</u>) and by cleaning and rinsing the transport containers (and lids) properly after each use. (*Crissey et al., 2001*)

In table 26 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the bird demonstration. This table shows that the risk of chemical contamination during transport is a CCP.

#### Table 26. Decision tree for transport to bird demonstration, chemical contamination

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the gloves and proper rinsing of the transport containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the bird demonstration does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No chemical products should end up on the whole prey during transport to the bird demonstration.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view Manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse it again. Also, a weekly check
should be done to see if the gloves are cleaned properly after every feeding session. This should be registered on the form "Transport" (Attachment ?).

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 25. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport containers were not cleaned properly. Micro-organisms from the whole prey that were in the containers before, could then remain in the containers and contaminate the whole prey for the next feeding. Contamination can also take place if the glove that is used for presenting the whole prey to the animals, is not cleaned properly. Since whole prey is held in the glove, micro-organisms get on the glove. If the glove is not properly cleaned, bacterial growth can take place easily (especially on warm days) and the whole prey that is fed next, will be contaminated, too. It is impossible to clean the glove after every feeding (this takes too much time and can therefore not be done during the demonstration). Microbiological contamination can be reduced by cleaning the containers properly after every feeding. Also, cleaning the glove after every bird demonstration can reduce the risk. Pests like flies can be kept away from the whole prey during transport, by keeping the containers fully closed at all times, except when taking food from the containers.

In table 27 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the bird demonstration. This table shows that the risk of microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the gloves and the containers after every bird demonstration. Containers should be kept closed.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the whole prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 27. Decision tree for transport to bird demonstration, microbiological contamination

#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning of the transport containers and the gloves. The lids on the containers should be kept closed as much as possible.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view Manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse it again. A weekly check should be done to see if the containers for transport are kept fully closed during transport. Also, a weekly

check should be done to see if the gloves are cleaned properly after every bird demonstration. Those weekly checks should be registered on the form "Transport". If the gloves are not properly cleaned (this should be checked the same way as the cleaning of the containers is checked), the observer can ask the person responsible to clean them again. If necessary, an explanation about the cleaning should be given (for more information see attachment ?). If the containers were not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important.

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 26. Physical contamination during transport

During transport of the whole prey to the bird demonstration, physical contamination can take place if objects stick on or in the whole prey. This could happen if the whole prey is transported with bare hands (jewellery or nail polish could end up in prey) or if the whole prey is accidentally dropped during transport (objects from the dirty ground could end up in prey). This could have serious consequences for the health of the animals. (*den Boer and de Bruin, 2004*) This risk can be prevented by transporting the whole prey to the bird demonstration in a closed container. The containers should be kept closed at all times and only be opened when whole prey needs to be taken out. When feeding the whole prey to the birds with a pre-bating method (where the food is placed on a stump before arrival of the bird: the bird then flies to the stump and eats the food), care must be taken that the stump is free from objects that could stick to the whole prey. The restrictions for the personnel to wear jewellery or nail polish have been discussed in paragraph 6.2.6. already and shall therefore not be repeated.

In table 28 the decision tree questions are answered and explained for the risk of physical contamination during transport to the bird demonstration. This table shows that the risk of physical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport whole prey to the bird demonstration in closed containers. Clear the pre-bating spot form all objects when placing food.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the whole prey to the bird demonstration does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in or on the whole prey can cause health damage to the animals who eat the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 28. Decision tree for transport to bird demonstration, physical contamination

#### Norms

No objects should end up in or on the whole prey during transport to the bird demonstration.

#### Monitoring

During processing, the whole prey has been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination on the whole preys before transport. In order to prevent physical contamination during transport to the bird demonstration, every day it should be checked whether the whole prey is being transported to the bird demonstration in closed containers. All of this is registered on the form "Transport" (view Manual Food Processing and Hygiene protocol).

If the containers were not closed properly the whole prey should be visually checked for physical contamination. If there is any doubt about the quality of the whole prey, it is advised not to use the whole prey. The personnel should be instructed to always clear the pre-bating spots from objects before placing whole prey there. A visual check can be done weekly to see if the personnel inspect the pre-bating spot before placing whole prey there. If the personnel do not check the pre-bating spot, the person responsible should be addressed to this and an explanation should be given as to why this is important and should be done every single time.

#### Registration

The form "Transport" should be input into an Excel-file, so that later check-up, to see if the whole prey was transported to the bird demonstration under the right circumstances, is possible.

# 7. Critical Control Points for Fruit

In this chapter the results for the appliance of the HACCP method on fruit will be given. First, the fruit processing will be explained in paragraph 7.1 and a flowchart is presented (7.1.1) and explained (7.1.2) to clarify the steps in fruit processing. In paragraph 7.2 the contamination risks per step are given and in paragraph 7.3 the risks and measures are discussed.

# 7.1 Fruit processing

Before a description of all the risks in the processing of the bird feed can be given, an evaluation of all the steps in the processing of the feed is necessary. This way the processes are divided in kind of feed and in the steps the feed takes. Each of these steps can cause certain risks of contamination in the feed, which will be analysed in paragraph 7.2.

### 7.1.1 Flowchart fruit processing

A flowchart of the fruit processing at Vogelpark Avifauna can be found in figure 4. This flowchart shows all the steps or processes the fruit goes through from delivery to the central kitchen to the actual feeding of the bird either in the enclosure or during the bird demonstration at Vogelpark Avifauna. Each of these steps, or processes, has their own risks and will be discussed accordingly in this report.



# 7.1.2 Steps in fruit processing

Each segment in the flowchart in Figure 4 schematically represents a point where hazards could occur that either affect animal health or diminish the nutritive value of the food (*Schmidt, Travis and Williams, 2006*). The fruits in this flowchart apply to different products including apples, bananas, kiwis, carrots, melons etc. Hazards along this pathway inherently come in two major forms, cross contamination of a clean product or increased growth of micro organisms already present in a contaminated product. The elimination of all bacteria is not a reasonable goal; the concern relates to the presence of pathogenic bacteria at levels high enough to cause infection.

Within fruit processing several steps are taken before the fruit actually arrives at the bird. These steps have been included within table 29.

Nbr.	Process
1.	Fruit delivery
2.	Fruit storage before processing
3.	Fruit processing
4.	Fruit temporary storage
5.	Fruit transport to enclosure
6.	Fruit transport to bird show

#### 1. Fruit delivery

In 'Fruit delivery', every action in the delivery of all the fruit products by the supplier is meant. This includes taking the fruit out of the delivery truck, transporting it to the refrigerator container and stacking it there. There is one food supplier for the fruit, called G. Kramer & Zonen B.V. The fruit that is brought in is the same that is used for human consumption. Sometimes however, some fruit that is over date (and therefore cannot be sold in the supermarkets anymore) is brought in. This is food that is just one day over date and it is fed at the latest one day after being brought in. The fruit is delivered in crates. The different fruit is separated: one crate for apples, one for kiwi's etc, bananas are mostly brought in, in cardboard boxes. There are many different fruits like apples, bananas, kiwi's, carrots, melons etc.

#### 2. Fruit storage before processing

The fruits stay in these crates in storage and are that way stored together, without getting in contact with other food. The crates are carried in to the refrigerator by hand and piled up along the sides of the fridge, immediately after delivery to Vogelpark Avifauna by the supplier. By storing the food this way there is a 'walk path' from the front to the back of the fridge and all the food can be reached easily. The food is taken from the front and the fridge is filled up from the back. This FIFO (First In-First Out) method ensures that no food is left in storage too long. The fridge also stores small amounts of whole prey, which are probably the whole prey used by the rest of Vogelpark Avifauna (not the bird demonstration) and some trays of mealworms. Although the whole prey should not get in contact with the fruit, it is not uncommon that fruit comes into contact with whole prey or fish and could still form a contamination risk as the whole prey and fruit is not covered or sealed off in the fridge.

#### 3. Fruit processing

The fruits are picked up from the central kitchen fridge every morning just before starting the food processing. This way the fruit is always freshly processed. Before starting the processing, hands are

cleaned using hand soap and clean utensils (cutting board, knives and containers) are used. The whole prey is processed on a separate table, while the fruit is processed on the kitchen sink (view Appendix X for pictures of the whole prey processing table and the kitchen sink). There are two cutting boards: a green one for the fruits and a red one for the whole prey. Each bird has his own plastic container with his name written on it and the lids for the fruit containers have "Fruit" written on it. There is one big separate bowl for all the Macaws. The containers for the fruit eating birds are stored in the upper kitchen cupboard on the right side and the containers for the whole prey-eating birds are kept on the left side. The two cupboards in between are used for tools and food for fledglings. This way the containers and lids for fruit and whole prey are never mixed up and the chances of crosscontamination are decreased. Each bird has its own diet, so the food is being weighed to fit the needs of all the birds. There are two different scales: one for fruit and one for whole prey. A tin bowl is used to weigh the food. The fruit is cut into ready-to-eat pieces (not rinsed with water) and put into the containers. If there is fruit rotten it is picked out and thrown out in the waste bin. The fruits are not always washed before use, but the kiwi and bananas are always peeled. When choosing which fruits to feed, the contents of vitamins and minerals in the fruits are taken into account (e.g. a bird cannot have too much kiwi because of the big amounts of vitamins and iron). The fruit is cut using a knife (this knife is for the fruits only). After dividing all the food over the containers, all the lids (separate lids for whole prey and fruit) are put on and the containers are placed into an open crate (fruit containers on one side, whole prey containers on the other side). When there is fruit left over (after carefully weighing each bird's food), it is stored in the fridge in the prep room (view Attachment IX). This fruit is then used up first the next day. The fruit waste is thrown out in the waste bin and ends up as compost. The fruit processing takes about 60 to 90 minutes. After placing all the containers into the crate and putting the whole prey and fruits that are not used, back in the fridge, both the working table and the kitchen sink are cleaned thoroughly with warm water and dishwashing detergent and a sponge. The cutting boards and tools (knife and scissors) are cleaned in the same way and afterwards the hands are cleaned again. After all the cleaning is done, the hands are cleaned again before leaving the processing room.

#### 4. Fruit temporary storage

The containers with fruit are piled up in a large crate and carried by hand through the park to the prep room. Here the containers are stored in the refrigerator until used for the animals. This refrigerator is set on a temperature of 6 °C (43 °F). The refrigerator is a table size-model (about 60 x 80 x 40) and with all the containers inside, it is still not completely full.

#### 5. Transport fruit to enclosure

For the birds that have individual diets, the containers are taken from the fridge and the lid is taken of. The diet is then transported in to the bird's enclosure in the same container. This takes about 2 min, so transport is extremely short. At arrival the food is given either directly, or put into the food bowl inside the enclosure. These bowls are cleaned at the end of every day, when all the food is eaten.

#### 6. Transport fruit to bird show

The fruit that is used during the bird demonstration is put into a small porcelain bowl. This bowl is placed onto a slightly bigger plate. The plate has a paper sheet on it, on which the names of the birds that will be used in the demonstration are written down. The food for each bird is piled up next to the bird's name. This way, there are piles of whole prey lying on the paper sheet closely together. The fruit is on this sheet as well, but is held in a porcelain cup to prevent it from touching the other food. The porcelain fruit bowl is not covered. This plate full of food is prepared before the show starts and is placed into one of the two storage boxes on the stage.

This description of the current situation at Vogelpark Avifauna, shows that there are some risks in the methods currently used. In the following paragraphs, the risks are described and some measures will be given that may be useful for Vogelpark Avifauna in order to reduce the risks and create a safer situation for the animals as well as the personnel.

# 7.2 Contamination risks

In this chapter, the risks in each of the steps taken in the food processing of fruit will be discussed. The steps in fruit processing are shown in paragraph 7.1.2 in table 29.

The potential hazards that could be present in basic materials or occur during preparation, treatment, packing and transport of food can be divided into 3 categories:

- (Micro)biological: Damaging fungi or matters produced by fungi, mycotoxins, damaging viruses, bacteria like *Salmonella* or *Listeria* that cause diseases.
- Chemical: Residues from for example disinfectants, insecticides, oil, lubricants.
- Physical: Glass, stone, sand, paper, rope, metal.

Besides these three categories, there are more risks, which will be further explained when the risk is present.

### 7.2.1 Fruit delivery

Within the process step 'Fruit delivery' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 27. Wrong temperature at delivery
- 28. Chemical contamination during production and transport
- 29. Shelf life exceeded
- (Productschap Tuinbouw, 2005)

This is not a complete list of all the possible risks. This is a selection of the most important risks in fruit delivery. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In fruit delivery, many risks can be prevented by selecting a certified supplier. When selecting a supplier, attention should be paid to how the supplier sees to the delivery of fresh fruit at the right temperature. Besides that, the supplier is obliged to follow legislation. If the supplier works following HACCP methods, Vogelpark Avifauna can assume the fruit is as clean as possible at the moment of delivery. The steps preceding the delivery are very important to Avifauna, as the quality of the food can be affected during this time. It is advisable that Vogelpark Avifauna has proper agreements with the supplier about the quality of the food. Therefore, the manual 'Food processing and hygiene protocol' describes the steps that should be taken when choosing a supplier and the demands that can be made towards the supplier.

When considering microbiological contamination during transport there are no risks (e.g. pathogenic bacteria, viruses and parasites) which would need direct action. However, there have been cases where under extreme circumstances, bacteriological contamination has taken place. This contamination was caused by infected rain water (during production) and contamination by contaminated animal fertilizer (*Productschap Tuinbouw, 2005*). Since there are no measures that can be taken to prevent this risk, this is not a CCP.

#### 27. Wrong temperature at delivery

Fruit goes through a natural process called ripening, which causes the fruit to turn soft. Very ripe fruit is easily affected by micro organisms, which causes the fruit to deteriorate. This deterioration process can be slowed down by storing fruit in a cool, dark and not to dry place. (*Consumentenbond, 1996*) A wrong temperature can increase the growth of micro organisms and spores, which decreases the quality of the fruit. Feeding food of an inferior quality can cause a health hazard for the animals. All transport vehicles which are used for the transport of produce should be working correctly and should be clean at all times. Present thermometers should be used in such a way that contamination is prevented. Transport vehicles should have a maximum temperature of 7 °C (45 °F). The temperature should be measured at random (in the centre of the truck and along the walls) to have an overview of the temperature in the transport vehicles. If the temperature is too high, the load should be rejected, in order to prevent feeding food of a bad quality. Agreements should be made between the supplier and the client (Avifauna) about the temperature limits during transport. If there are vegetables or fruits that are sensitive for low temperatures (e.g. aubergines, cucumbers, tomatoes) a different temperature

should be applied for these specific kinds of produce (*Productschap Tuinbouw, 2005*). Tropical fruits like pineapple, banana, mango and papaya are very sensitive for temperatures below 12 °C (54 °F). After storing these fruits at this temperature for a few days, the so called low-temperature deterioration occurs. Therefore, these fruits should never be refrigerated/should be stored at a different temperature.

In table 30 the decision tree questions are answered and explained for the risk of wrong temperature at delivery. This table shows that a wrong temperature during delivery is a CCP.

	<u> </u>	
Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The transport of the fruit should happen under the right temperature conditions (7 °C (45 °F) maximum).
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	A wrong temperature can increase the growth of micro organisms and spores.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 30. Decision tree for fruit delive	ery, wrong temperature at delivery
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#### Norms

The temperature of the transport vehicle should be no higher than 7 °C (45 °F). (*Productschap Tuinbouw, 2005*). When products are sensitive for deterioration at low temperatures, they should be kept at a temperature of 12-15 °C (54-59 °F). Examples of fruits that start deterioration at a low temperature are pineapple, banana, mango and papaya. (*Consumentenbond,* 1996) If the supplier recommends a lower temperature, it is recommended to follow this advice (*Productschap Tuinbouw, 2005*).

#### Monitoring

Every time a load of fruit is delivered at Vogelpark Avifauna, the temperature of the load should be measured, using a well-calibrated thermometer. The temperature should be measured by sticking the thermometer between two boxes of fruit. The temperature in the middle of the truck and along the sides of the truck should be measured, in order to see if the temperature varies when measured further away from the cooling unit. Some trucks have a temperature gauge in the storage area of the vehicle, which indicates the temperature of the vehicle's contents. This can also be used for measuring the temperature. If there is any question concerning the functioning of this temperature gauge, a calibrated portable thermometer should be used to check the temperature inside several of the boxes. If the temperature is over 7 °C (45 °F), it is possible to reject the load. For tropical fruits, a different temperature should be set. These fruits should be transported at a temperature of 12 - 15 °C (54 - 59 °F). (*Consumentenbond, 1996*)

A visual check of the load is enough to see if the fruit is of a bad quality and if the fruit is already deteriorating. This is quite easy to see since the fruit is transported in open crates. The fruit can be of a different colour, have dark spots or fungus on it or can be damaged. Monitoring the delivery this way is useful only when it is done every single time a load is brought in. The form "Fruit delivery" (view manual Food Processing and Hygiene protocol) should be filled in every time.

#### Registration

The filled in "Fruit delivery" forms should be put into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 28. Chemical contamination during transport

Chemical contamination of the fruit can take place if products, other than fruit, are transported in the cargo space of the truck. Sometimes shippers transport other food and non-food items in the same truck as the fruit order to save freight costs. It is allowed to transport other eatables in the same transport vehicle, however when contamination risks are present, the transport vehicle should be disinfected. Transport of non eatable is also allowed, but only if there is no contamination risk for the produce. Some products, for example maintenance products (lubricants), disinfectants and coolants, can endanger human and animal health (*Food-info*). Chemical products that are transported in the same space as the fruit, at the same time, can get in contact with the product, e.g. if a bottle falls over or breaks and leaks on to the crates. When fruit is transported in plastic or wooden open crates, liquids can easily come into contact with the fruit. If chemical products get onto the fruit, they cannot be removed and the toxins can harm the health of humans (who get in contact with the fruit) and animals that eat the fruit.

Agreements with the supplier should be made that no chemical products will be transported in the same space as the fruit (*Productschap Tuinbouw, 2005*).

Residues of pesticides on the fruit are also a part of the chemical contamination risk. Even though risks of pesticide residue are become smaller every year because of improved hygiene, strong rules should be applied to assure clean fruit (*Productschap Tuinbouw, 2005*).

In table 31 the decision tree questions are answered and explained for the risk of chemical contamination during transport. This table shows that chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be transported in the same space as the fruit.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the fruit quality. If chemical products get onto the fruit, they cannot be removed and the toxins can harm the health of humans (who get in contact with the fruit) and animals that eat the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk. It is often not visible if fruit is contaminated with chemicals.

#### Table 31. Decision tree for fruit delivery, chemical contamination during transport

#### Norms

Chemical products should not be transported in the same space that is used to transport fruit.

#### Monitoring

A visual check should be done at every delivery of fruit and the results should be filled in on the form "Fruit delivery" (view manual Food Processing and Hygiene protocol). If there are chemical products present in the cargo space of the truck, a decision should be made whether to accept or reject the delivery. If there are no open or broken bottles of chemical products in the truck, the load can be accepted. If there are any doubts about the quality of the fruit, it is recommended to reject the load. An agreement should be made with the supplier that a load will be rejected when chemical products are present in the truck. Residue analyses for acute toxic pesticides can be done on a regular basis in order to confirm the fruit is 'pesticide free'. However, since high costs are involved, this is not recommended. By selecting a certified supplier, the risk of pesticide residue on the fruit is reduced.

#### Registration

The filled in "Fruit delivery" form should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 29. Shelf life exceeded

If the shelf life is missing or is unreadable for any reason, there is no possibility to check if a crate of fruit is still perishable after storage. After passing the shelf life the fruit is not necessarily deteriorating, but the quality is lower than that of a crate before the shelf life. Every crate should contain the shelf life of the fruit inside.

If the shelf life is written on the crate, preferably the storage temperature should be written on it too, because one is dependent of the other. A certified supplier will be able to give information about the shelf life at different temperatures.

In table 32 the decision tree questions are answered and explained for the risk of exceeding the shelf life of fruit during transport. This table shows that exceeding the shelf life of fruit is a CCP.

Table	32. Decision	tree for fruit	deliverv.	shelf life	exceeded
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Shelf life present on each crate, working on a FIFO basis.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Fruit that has passed the shelf life is of decreased quality and there is a risk of deterioration present.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

The shelf life of the fruit should be present on every crate. This date represents the latest date on which the fruit in the crate can still be processed. After this date the fruit should not be processed, since the quality of the fruit may have decreased, or it might be deteriorating, causing a health risk for the animals.

#### Monitoring

At delivery every crate should be visually checked to see if the shelf life is present, or if deterioration is already started. This should be written down on the form "Fruit delivery" (view manual Food Processing and Hygiene protocol). Since all the crates of fruit are placed in storage by hand, every crate can be visually checked. If the shelf life is missing from a crate, it can be written down on the crate using a permanent marker. The date can be copied from other crates from the same delivery. If none of the crates from the load have a shelf life written on it, the load may be rejected. It is not clear if the crates have been stored before being transported to Vogelpark Avifauna, which makes it impossible to find out how old the load is. Agreements with the supplier should be made that every load should have a shelf life present on every crate.

#### Registration

The form "Fruit delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

# 7.2.2 Fruit storage before processing

Within the process step 'Fruit storage before processing' there are several risks identified. The following risks will be discussed in this paragraph:

- 30. Wrong temperature in storage room
- 31. Chemical contamination during storage
- 32. Microbiological contamination through surroundings
- 33. Cross contamination of the fruit
- 34. Shelf life exceeded

This is not a complete list of all the possible risks. It is a selection of the most important risks in fruit storage before processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When fruit and vegetables are not processed any further, it is not obligatory to store the fruit in a cooled room. However, when fruits will be processed at a certain point, it is obligatory to store the fruit in a cooled room. (*Productschap Tuinbouw, 2005*)

#### 30. Wrong temperature in storage room

All areas that are used for storing fruit and vegetables (produce) should be working correctly and should be clean at all times. Present thermometers should be used in such a way that contamination is prevented. The storage room should have a maximum temperature of 7 °C (45 °F). A sample of the temperature should be taken at random (in the middle of the room and close to the walls) to have an overview of the temperature in the storage rooms. If the temperature is too high, the stored fruit should be processed as soon as possible, in order to prevent deterioration. If there are vegetables or fruits that are sensitive for low temperatures (e.g. aubergines, cucumbers, tomatoes) a different temperature should be applied for these specific kinds of produce (*Productschap Tuinbouw, 2005*). The wrong temperature can increase the growth of micro organisms and spores, which cause a health hazard for the animals.

In table 33 the decision tree questions are answered and explained for the risk of wrong temperature during storage before processing. This table shows that a wrong temperature during storage before processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The storage of the fruit should happen under the right temperature conditions (7 °C (45 °F) maximum).
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The wrong temperature can increase the growth of micro organisms and spores.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk

#### Table 33. Decision tree for fruit storage, wrong temperature during storage

#### Norms

The temperature of the large cooling cell at Avifauna should be no higher than 7 °C (45 °F). (*Productschap Tuinbouw, 2005*). When products are sensitive for deterioration at low temperatures, they should be kept at slightly higher temperatures. Examples of deterioration at low temperature fruits are aubergines, cucumbers and tomatoes. If the supplier recommends a lower temperature, it is recommended to follow this advice (*Productschap Tuinbouw, 2005*).

#### Monitoring

The temperature of the cooling cell should be measured once every week. The temperature should be measured near the cooling element, between the crates of fruit and in the crates themselves. This should be done in order to see if there are temperature differences within the cooling area. Some cooling cells have a temperature gauge on the outside of the cooling cell which indicates the temperature of the cooling cell's contents. This can also be used for measuring the temperature. If there is any question concerning the functioning of the temperature gauge, a calibrated portable thermometer should be used to check the temperature inside several of the crates. If the temperature is over 7 °C (45 °F), a decision should be made whether to process the fruit the same day or even feed the fruit the same day. (*Productschap Tuinbouw, 2005*)

A visual check of the load is enough to see if the fruit is of a bad quality and if the fruit is already deteriorating. This is quite easy to see since the fruit is stored in open crates. The fruit can be of a different colour, have dark spots or fungus on it or can be damaged. All of this should be filled in on the form "Fruit storage" (view manual Food Processing and Hygiene protocol).

#### Registration

The filled in "Fruit storage" forms should be put into an Excel-file, so that later check-up, to see if the fruit is stored under the right circumstances, is possible.

#### 31. Chemical contamination during storage

Chemical contamination of the fruit can take place if products, other than fruit, are stored in the same storage room where fruit is stored. Sometimes other products are stored in the cooled part of the storage room. It is allowed to store other eatables in the same cooling area, however when contamination risks are present, the storage room should be disinfected. Storage of non eatable is also allowed, hence there is no contamination risk for the produce. Some products, for example maintenance products (lubricants), disinfectants and coolants, can endanger human and animal health. (*Food-info*) Chemical products that are stored in the same space as the fruit, at the same time, can get in contact with the product, e.g. if a bottle falls over or breaks and leaks on to the crates. When fruit is stored in plastic or wooden open crates, liquids can easily come into contact with the fruit (*Productschap Tuinbouw 2005*). If chemical products get onto the fruit, they cannot be removed and the toxins can harm the health of humans (who get in contact with the fruit) and animals that eat the fruit.

In table 34 the decision tree questions are answered and explained for the risk of chemical contamination during storage before processing. This table shows that chemical contamination during storage before processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be stored in the same space as the fruit.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the fruit quality. If chemical products get onto the fruit, they cannot be removed and the toxins can harm the health of humans (who get in contact with the fruit) and animals that eat the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk. It is often not visible if fruit is contaminated with chemicals.

# Table 34. Decision tree for fruit storage before processing, chemical contamination during storage

#### Norms

Chemical products should not be stored in the same space that is used to store fruit.

#### Monitoring

The fruit storage should be checked visually once every week, to see if chemical products are present in the storage. The results should be filled in on the form "Fruit storage" (view manual Food Processing and Hygiene protocol). If there are chemical products present in the storage room, a decision should be made whether or not to use the fruit for feeding. If there are no open or broken bottles of chemical products in the truck, the fruit can still be used. If there are any doubts about the quality of the fruit, it is recommended not to use the fruit.

#### Registration

The filled in "Fruit storage" form should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 32. Microbiological contamination through surroundings

Fruits are bound to natural deterioration. This causes that a lot fruit is already deteriorating when they arrive, which creates microbiological contamination hazards for the other fruit in the storage area. If microbiological contamination has taken place it can cause disease in the animals and also increase the risk of cross contamination.

In order to prevent cross-contamination, the different products should not come into contact with other products present in the storage room.

In table 35 the decision tree questions are answered and explained for the risk of chemical contamination during storage before processing. This table shows that chemical contamination during storage before processing is a CCP.

# Table 35. Decision tree for fruit storage before processing, microbiological contamination during storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Deteriorating fruit should be removed from the load to prevent cross- contamination and further deterioration.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the fruit quality. If microbiological contamination has taken place it can cause disease in the animals and also increase the risk of cross contamination.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

In order to prevent cross contamination, different products should be kept separated if stored in the same storage room (view 33). Fresh or raw products should therefore be kept separated from processed or clean products. Products that are sensitive to deterioration should be kept in a closed packaging and not be stored directly on to the floor.

#### Monitoring

Fruits should be kept in a dry storage room. If the storage room has wet spots, these should be cleaned. Fruit should not be stored directly on the floor.

A visual check of the load is enough to see if the fruit is of a bad quality and if the fruit is already deteriorating. This is quite easy to see since the fruit is transported in open crates. The fruit can be of a different colour, have dark spots or fungus on it or can be damaged. The fruit in storage should be checked visually every week and deteriorating fruit should be removed, The form "Fruit storage" (view manual Food Processing and Hygiene protocol) should be filled in once a week.

#### Registration

The filled in "Fruit storage" forms should be put into an Excel-file, so that later check-up, to see if the fruit is stored under the right circumstances, is possible.

#### 33. Cross contamination of the fruit

Cross contamination is contamination of different kinds of bacteria from one product to the other. Cross contamination can cause products to deteriorate faster than usual when products do not get in contact with each other (*Wikipedia.com*). Fruit goes through a natural process called ripening, which causes the fruit to turn soft. During this process almost every fruit produces ethylene. Ethylene can accelerate the ripening process of other, surrounding fruit. Very ripe fruit is easily affected by micro organisms, which causes the fruit to deteriorate. It is therefore recommended to store ripening fruit separately (without having the fruit touching each other). (*Consumentenbond, 1996*)

In order to prevent cross contamination, different products such as raw materials en semi finished products should not get into contact with other products present in the storage room.

Fresh or raw products should be separated from processed or clean products. Clean products should be stored above other or processed products and processed products should be kept above raw unprocessed products (*Productschap Tuinbouw, 2005*). Cross-contamination can have serious consequences for the fruit quality. When cross contamination has occurred, the deteriorating fruit should be removed immediately and the other fruit (that is in contact with the deteriorating fruit) should be processed immediately.

In table 36 the decision tree questions are answered and explained for the risk of cross-contamination during storage before processing. This table shows that cross-contamination during storage before processing is a CCP.

	Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Deteriorating fruit should be removed from the shipment to prevent cross-contamination.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the fruit quality.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 36. Decision tree for fruit storage before processing, cross-contamination during storage

#### Norms

In order to prevent cross contamination different products should be kept separated if stored in the same storage room. Fresh or raw products should therefore be kept separated from processed or clean products. Products that are sensitive to deterioration should be kept in a closed packaging and not be stored directly on to the floor.

#### Monitoring

In order to prevent cross contamination, different products such as raw materials en semi finished products should not get into contact with other products present in the storage room.

Fresh or raw products should be separated from processed or clean products. Clean products should be stored above other or processed products and processed products should be kept above raw unprocessed products (*Productschap Tuinbouw*, 2005).

A visual check of the load is enough to see if the fruit is of a bad quality and if the fruit is already deteriorating. This is quite easy to see since the fruit is stored in open crates. The fruit can be of a different colour, have dark spots or fungus on it or can be damaged (*Productschap Tuinbouw, 2005*). All of this should be filled in on the form "Fruit storage" (view manual Food Processing and Hygiene protocol).

#### Registration

The filled in "Fruit storage" forms should be put into an Excel-file, so that later check-up, to see if the fruit is stored under the right circumstances, is possible.

#### 34. Shelf life exceeded

If the shelf life is missing or is unreadable for any reason, there is no possibility to check if a crate of fruit is still perishable after storage. After passing the shelf life the fruit is not necessarily deteriorating, but the quality is lower than that of a crate before the shelf life. Since every crate contains the shelf life of the fruit inside (this is checked already during delivery), the date of each crate can be checked before use.

To help ensure freshness, always use feed on a First In-First Out (FIFO) basis: any older fruit stocks remaining in the storage cooler should be placed so they will be used before the new fruit stocks. (*Crissey et al. 2001*)

In table 37 the decision tree questions are answered and explained for the risk of exceeding the shelf life of fruit during storage. This table shows that exceeding the shelf life of fruit is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Shelf life of the crate should be checked before use, working on a FIFO basis.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Fruit that has passed the shelf life is of decreased quality and there is a risk of deterioration present.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 37. Decision tree for fruit delivery, shelf life exceeded

#### Norms

The shelf life of the fruit should be checked before use. This date represents the latest date on which the fruit in the crate can still be processed. After this date the fruit should not be processed, since the fruit might be deteriorating, causing a health risk for the animals (*Productschap tuinbouw, 2005*)

#### Monitoring

When taking fruit from the storage, the date on the crate should be checked to see if the fruit has not exceeded the shelf life jet. If the crate of fruit has exceeded the shelf life, this crate should be removed from storage and should not be used for feeding. This should be written down on the form "Fruit storage" and the rest of the crates should be checked too, since there may be several crates with the same shelf life. All crates that have passed the shelf life should be removed from storage. Also, a weekly check should be done to see if the crates are placed in storage on a FIFO basis. If not, the

crates should be piled up again the right way (fruit that will pas shelf life first, should stand at the front) and the person responsible should be addressed to this. An explanation should be given why the crates should be piled up the right way.

#### Registration

The form "Fruit storage" should be input into an Excel-file, so that later check-up, to see if a load was stored under the right circumstances, is possible.

# 7.2.3 Fruit processing

Within the process step 'Fruit processing' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 35. Temperature in processing room too high
- 36. Chemical contamination during processing
- 37. Microbiological contamination through environment
- 38. Microbiological contamination through personnel
- 39. Physical contamination during processing

This is not a complete list of all the possible risks. This is a selection of the most important risks in fruit processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

#### 35. Temperature in processing room too high

Bacterial growth is influenced by temperature. Bacterial growth can take place faster at higher temperatures. In order to keep the bacterial growth down, fruit should be chilled to temperatures of 7 °C (45°F) or lower (*Productschap Tuinbouw*, 2005). During processing, the fruit can shortly be exposed to a temperature no higher than 20 °C (68 °F), but should be chilled again immediately after processing. If the fruit is processed in a room that is not cooled, the temperature in the room can increase on warm days to above 20 °C (68 °F). If the processing room gets too warm due to weather conditions (especially in the summer), air-conditioning should be installed. When the air-conditioning is working, all windows and doors should be kept closed, so no warm air can get into the room. This would be a waste of energy and money, since the air-conditioning would have to run more often to keep the room chilled.

In table 38 the decision tree questions are answered and explained for the risk of a too high temperature in the processing room during processing. This table shows that a high environmental temperature during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	If the temperature in the processing room increases to higher than 20 °C (68 °F), air-conditioning should be installed.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth can be accelerated by high temperatures. This can affect the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 38. Decision tree for fruit processing, temperature in processing room too high

#### Norms

The processing of the fruit should happen at a low temperature. Taking the working temperature for the personnel into account, the temperature in the processing room should not be higher than 20 °C (68 °F). The processing should take as little time as possible and the fruit should be chilled as fast as possible after processing.

#### Monitoring

There should be an easily readable thermometer present in the processing room. This thermometer should be placed where the reading is a reliable average temperature of the whole room, e.g. not close to the air-conditioning or a heath source. This thermometer should be read daily (during processing) for an efficient temperature check. Inefficiency of the thermometer should be taken into account. Therefore, the temperature in the processing room should be measured weekly by using a well calibrated portable thermometer. The temperature should be measured in the middle of the room, as well as close to the walls to get a good vision of the temperature in the room. All the results should be filled in on the form "Fruit processing" (view manual Food Processing and Hygiene protocol). If fruit is found which was not processed under the right temperature conditions, a decision should be made whether or not to use the fruit. If there are any doubts about the quality of the fruit, it is advised not to use it.

#### Registration

The form "Fruit processing" should be input into an Excel-file, so that later check-up, to see if the fruit was processed under the right circumstances, is possible.

#### 36. Chemical contamination during processing

Chemical contamination during processing can take place if cleaning agents are present on tools and food containers. Bottles with chemical substances can fall over on the fruit. Inexpert use of cleaning agents can also cause chemical contamination. Chemical contamination can cause a health hazard for the animals. Chemical products should not be stored in the same room as where the fruit processing takes place. In the current situation at Vogelpark Avifauna (see <u>Appendix IV</u>), the chemical products can never leak onto the food or tools used for processing, if a bottle falls over or a package is broken. This way of storing is acceptable if the only chemical products stored here are the ones that are actually used in the processing room. However care must be taken when using the chemical products in the processing room, in order to keep the chemical products from getting in contact with the food or tools. Also, tools and containers should be rinsed well after cleaning, to wash away all cleaning substances. The personnel should be informed about the cleaning methods (see Chapter 5 Cleaning and disinfecting).

In table 39 the decision tree questions are answered and explained for the risk of chemical contamination during processing. This table shows that chemical contamination during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be present in the processing room, outside the cupboards. Tools and containers should be rinsed properly after cleaning.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the fruit does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination of the fruit affects the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 39. Decision tree for fruit processing, chemical contamination during processing

#### Norms

No chemical products should be stored in the space where the food is being processed. Storing in the cupboards below the food and tools is allowed, but care must be taken to always store the products here again immediately after use. After cleaning and rinsing the tools and containers, there should be no cleaning agent leftovers left.

#### Monitoring

A visual check should be done weekly to see if there are any chemical products stored in the room where the fruit is processed, that do not belong in the processing room. Chemical products that are used in this room should be stored in the cupboards below the sink, this should be checked weekly as well. All of this should be written down on the form "Fruit processing" (view manual Food Processing and Hygiene protocol). Any chemical products present in the processing room should then immediately be stored where they belong and it should be investigated who put them there and why. An explanation should also be given as to why the products should be stored where they belong, every time immediately after use. If chemical products are found in the processing room, outside the cupboards, a decision should be made whether or not to use the fruit in the processing room. If there are no broken or open bottles in the processing room, the fruit can still be used.

#### Registration

The form "Fruit processing" should be input into an Excel-file, so that later check-up, to see if the fruit was processed under the right circumstances, is possible.

#### 37. Microbiological contamination through environment

Microbiological contamination can come from objects that were not cleaned properly, flies and other pests and other products that are present in the room where the fruit is being processed. Microbiological contamination can have serious consequences for the quality of the fruit.

This risk can be reduced by proper cleaning and disinfecting (see Chapter 5 Cleaning and disinfecting) of the tools and containers that get in contact with the fruit. Measures should be taken to control pests such as flies. The fruit should be kept separated from other products in the processing room, such as whole prey and pellets. Immediately after processing, when the fruit is divided over the food containers, the containers should all be closed properly with clean lids.

In table 40 the decision tree questions are answered and explained for the risk of microbiological contamination through the environment during processing. This table shows that microbiological contamination through the environment during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of tools and containers and pest control. Keep fruit separated from other food.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the fruit does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the fruit affects the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

# Table 40. Decision tree for fruit processing, microbiological contamination through the environment during processing

#### Norms

Proper cleaning of tools and containers, pest control and keeping fruit separated from other food, will prevent microbiological contamination.

#### Monitoring

Tools and containers should be cleaned properly and kept strictly separated from dirty materials. This may mean the dirty materials are on the left side of the sink and the cleaned materials on the right side of the sink. Clean materials should be stored in a clean place (closet or drawer which is cleaned regularly).

Pests like flies should be prevented from entering the processing room by blocking their access routes. This can be done by placing insect screens in front of the windows, keeping doors shut and closing all gaps in the walls and underneath doors. Prevent pests that have entered the room from surviving and reproducing by keeping the room clean and free from (accessible) rubbish. Insecticide should only be used in case there is a pest problem.

Fruit should be kept strictly separated from other food products. Tools can only be used after they have been properly cleaned (Productschap Tuinbouw 2005). The pest prevention (whenever there is a pest problem) and separating of the clean from dirty objects (check weekly) should be registered on the form "Fruit processing". The cleaning of other objects in the room should be registered weekly on the form "Cleaning" (view manual Food Processing and Hygiene protocol).

#### Registration

The form "Fruit processing" and the form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the fruit was processed and the room was cleaned under the right circumstances, is possible.

#### 38. Microbiological contamination through personnel

If the personnel is working unhygienic, this could cause microbiological contamination of the fruit. The micro organisms may come from clothing or hands that were not cleaned properly. All of this decreases the quality of the fruit.

This risk can be reduced by regular cleaning of clothes and hands. Personal hygiene of the personnel is also very important. This includes not smoking in the processing room and not wearing nail polish on the fingernails. Jewellery can also be a source of contamination, especially rings, which can not be cleaned properly every time the hands are cleaned. Hands should be cleaned according to Chapter 5, Cleaning and disinfecting, and should be dried using disposable towels. When handling the fruit, disposable gloves should be worn and wounds or cuts should be covered using brightly coloured band-aids (preferable blue, since no food is blue), so that they can easily be recognized in the fruit (*Productschap Tuinbouw, 2005*).

In table 41 the decision tree questions are answered and explained for the risk of microbiological contamination through personnel during processing. This table shows that microbiological contamination through personnel during processing is a CCP.

auring processing		
Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of clothing and hands, personal hygiene and wearing disposable gloves when handling fruit.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the fruit does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the fruit affects the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 41. Decision	tree for fruit processing,	microbiological	contamination	through p	ersonnel
during processing	]	-			

#### Norms

All the personnel should apply normal personal hygiene. This includes not smoking in the processing room, not wearing nail polish, not wearing jewellery, cleaning hands according to the instructions, wearing disposable gloves when handling the fruit and covering up wounds with coloured band-aids if necessary.

#### Monitoring

The personnel should be inspected to see if they apply the personal hygiene regulations. A visual check should be done to see if personnel do not smoke in the processing room, if personnel do not wear nail polish or jewellery and if the personnel clean their hands according to the instructions. A visual check should also be done to see if personnel wear disposable gloves while handling the fruit and if they cover up wounds with coloured band-aids. This should all be checked monthly and should be registered on the form "Personal hygiene" (view manual Food Processing and Hygiene protocol). To obtain unbiased information, the check should be done by someone other than the personnel processing the fruit. If the personal hygiene is not sufficient, the personnel responsible should be instructed as to what the rules are and why they should be followed.

#### Registration

The form "Personal hygiene" should be input into an Excel-file, so that later check-up, to see if the fruit was processed under the right circumstances, is possible.

#### 39. Physical contamination during processing

Physical contamination can be jewellery, wrapping leftovers or other objects, which get stuck on to the fruit. These objects can cause a hazard for the health of the animals. During processing, care must be taken to prevent objects from getting stuck on the fruit. Personnel should not wear jewellery or nail polish on the fingernails in order to prevent physical contamination. Agreements should be made about this with the personnel. Also, the working area must be cleaned of small objects that could get stuck on the fruit. Small litter should be thrown out and the cutting board should be cleaned properly.

In table 42 the decision tree questions are answered and explained for the risk of physical contamination during processing. This table shows that physical contamination during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No jewellery or nail polish should be worn by personnel. Processing area should be cleaned, no small objects may lie around in the processing area.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects in or on the fruit can cause a serious health hazard when eaten by the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 42. Decision tree for fruit processing, physical contamination during processing

#### Norms

No unwanted objects should get stuck in or on the fruit during processing.

#### Monitoring

Before processing, the personnel that will do the processing should take off jewellery. A visual check should be done daily to see if there are any objects in the fruit that do not belong there. During processing care should also be taken that no objects get in or on the fruit. If there are one or more objects found in the fruit, this should be written down on the form "Fruit processing" (view manual Food Processing and Hygiene protocol).

If the contamination that is found in the fruit cannot be removed fully, the fruit is not usable and should be thrown out. This could happen if for an example, a glass breaks on the fruit. The scattered pieces of glass can never all be found and taken from the fruit. The pieces of glass can have serious consequences for the health of the animals. If this happens, it should also be written down on the form.

#### Registration

The form "Fruit processing" should be input into an Excel-file, so that later check-up, to see if the fruit was processed under the right circumstances, is possible.

### 8.2.4 Fruit temporary storage

Within the process step 'Fruit temporary storage' there is one risk. The following risk will be discussed in this paragraph:

40. Temperature in storage too high

This is not a complete list of all the possible risks. This is a selection of the most important risks in temporary storage of fruit. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer. When the fruit is in temporary storage, many risks can be prevented by making sure the containers are all closed properly and the containers are always cleaned properly after each use. By cleaning the containers properly after each use, chemical and microbiological contamination from residues is prevented. By keeping the containers closed at all times during storage, there is no risk of physical, chemical and microbiological contamination. The cleaning of the containers should be checked daily by someone other than the person doing the cleaning and should be registered on the form "Cleaning". The form "Temporary storage" can be used to register if a container has been found open in the temporary storage. This should also be checked daily.

#### 40. Temperature in storage too high

If the temperature of the temporary storage gets too high, the fruit can start to deteriorate faster than normal, since bacterial growth increases at higher temperatures. If the food is not stored in a refrigerated place (7 °C (45 °F) maximum temperature), microbial build up can cause the quality of the fruit to decrease fast (*Productschap Tuinbouw, 2005*). Therefore it is recommended to store the fruit in the refrigerator in temporary storage at all times. Care must also be taken to sufficiently close the door of the refrigerator after every use. There should be a thermometer present in the refrigerator which can be read from the outside. The personnel should be instructed about these measures.

In table 43 the decision tree questions are answered and explained for the risk of temperature in storage being too high. This table shows that the temperature in temporary storage being too high is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Always keep fruit in temporary storage refrigerated (7 °C (45 °F) maximum). Take care to close refrigerator door properly.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The temporary storage of the fruit does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth increases at high temperature. This affects the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 43. Decision tree for temporary storage, temperature in storage too high

#### Norms

Fruit should be stored at a maximum temperature of 7 °C (45 °F) (*Productschap Tuinbouw, 2005*). The refrigerator door should be kept closed at all times.

#### Monitoring

A visual check should be done weekly to see if the personnel store the fruit in the refrigerator in the prep room. If the fruit containers are not stored in the refrigerator, an investigation should be done to find out who did this. An explanation should then be given to this person as to why the fruit should always be stored in the refrigerator. Also, a decision should be made whether or not to use the fruit. If

there is any doubt about the quality of the fruit, it is advised not to use it. A visual check should be done to see what the temperature inside the refrigerator is. This, and the weekly visual check, should be registered on the form "Temporary storage". If the temperature in the refrigerator is over 7 °C (45 °F), this should also be written down. It is advisable therefore, to check the refrigerator temperature several times a day, especially after it has been opened for a while. If the temperature in the refrigerator is over 7 °C (45 °F) at a certain time, the refrigerator should be kept closed until the temperature is back to the acceptable level. Once a month, the rubber door strips of the refrigerator should be checked, to see if they are not damaged or worn out, and the temperature inside the refrigerator should be checked with a portable calibrated thermometer, to see if the thermometer in the fridge is reliable. These two monthly checks should also be registered on the form "Temporary storage" (view manual Food Processing and Hygiene protocol). If the manually measured temperature deviates from the temperature at the fridge, the thermometer in the fridge is not reliable anymore. This thermometer should be repaired or the temperature should be measured with the portable thermometer daily.

#### Registration

The form "Temporary storage" should be input into an Excel-file, so that later check-up, to see if the whole prey was temporarily stored under the right circumstances, is possible.

# 7.2.5 Fruit transport to enclosure

Within the process step 'Transport fruit to enclosure' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 41. Chemical contamination during transport
- 42. Microbiological contamination during transport
- 43. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in fruit transport. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the fruit to the enclosure, many risks can be prevented by making sure the transport is not delayed. When the transport to the enclosure has started, it should be finished before doing anything else. This way, there is no risk of the temperature during transport being too high or the transport taking too long, two risks that could both cause an increased bacterial growth.

#### 41. Chemical contamination during transport

Chemical contamination during transport could occur if the fruit is transported to the enclosure in a container which was not rinsed properly after cleaning. Cleaning product residue could then be present on the containers, which could end up on the fruit. Chemical contamination can seriously affect the quality of the fruit, which causes a health hazard for the animals. (*Crissey et al., 2001*)

In table 44 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the birds enclosure. This table shows that the risk of chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and rinsing of the transport container.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 44. Decision tree for transport to enclosure, chemical contamination

#### Norms

No chemical products should end up on the fruit during transport to the enclosures.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the container and lid are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again.

#### Registration

The form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 42. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport container was not cleaned properly. Micro organisms from the fruit that was in the container before could then remain in the container and contaminate the fruit for the next feeding.

The risk of microbiological contamination can be reduced by cleaning the container properly after every feeding. Pests like flies can be kept away from the fruit during transport, by keeping the containers fully closed.

In table 45 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the bird's enclosure. This table shows that the risk of microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the container after every single feeding. Container should be kept closed during transport.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 45. Decision tree for transport to enclosure, microbiological contamination

#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning and rinsing of the transport container. The lid on the container should be kept closed during transport.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the container and lid are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again. A weekly check should be done to see if the container for transport is kept fully closed during transport. If the container was not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important. This should be written down on the form "Transport".

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 43. Physical contamination during transport

During transport of the fruit to the enclosures of the animals, physical contamination can take place if objects stick on or in the fruit. This could happen if the fruit is transported with bare hands (jewellery or nail polish could end up in fruit) or if the fruit is accidentally dropped during transport (objects from the dirty ground could end up in fruit). This could have serious consequences for the health of the animals. This risk can be prevented by transporting the fruit to the enclosures in a closed container. When placing the fruit in the enclosure, this should be done without touching the fruit, e.g. by turning the

container upside down on the feeding place. Sometimes it is necessary to touch the fruit, for an example if the animal in the enclosure is used to taking the food from hand. This is why agreements should be made with the personnel that wearing jewellery or nail polish on the fingernails is not allowed when working with the fruit.

In table 46 the decision tree questions are answered and explained for the risk of physical contamination during transport to the bird enclosure. This table shows that the risk of physical contamination during transport is a CCP.

Table 46.	<b>Decision tree</b>	for trans	port to enclos	ure, phys	sical contamination
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport fruit to the enclosures in a closed container. Take care that no objects end up in or on the fruit.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in or on the fruit can cause health damage to the animals that eat the prey.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No objects should end up in or on the fruit during transport to the enclosures.

#### Monitoring

During processing, the fruit has been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination on the fruit before transport. In order to prevent physical contamination during transport to the enclosures, every day it should be checked whether the fruit is being transported to the enclosures in a closed container. All of this is registered on the form "Transport". If the containers were not closed properly the fruit should be visually checked for physical contamination. If there is any doubt about the quality of the fruit, it is advised not to use the fruit.

#### Registration

The form "Transport" should be input into an Excel-file, so that later check-up, to see if the fruit was transported to the enclosure under the right circumstances, is possible.

### 7.2.6 Fruit transport to bird demonstration

Within the process step 'Transport fruit to bird demonstration' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 44. Chemical contamination during transport
- 45. Microbiological contamination during transport
- 46. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in fruit transport. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the fruit to the bird demonstration, many risks can be prevented by making sure the transport is not delayed. The fruit should be transported to the backdrop and the stage as short as possible before feeding. The bird demonstration takes about 45 minutes max, as can be seen in <u>Appendix IV</u> for the current situation at the bird demonstration. This way, there is no risk of the transport taking too long and there is no risk of the temperature during transport being too high, two risks that could both cause an increased bacterial growth.

#### 44. Chemical contamination during transport

Chemical contamination during transport could occur if the fruit is transported to the bird demonstration in a container which was not rinsed properly after cleaning. The risk of chemical contamination can be reduced by cleaning and rinsing the transport containers (and lids) properly after each use. (*Crissey et al., 2001*)

In table 47 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the bird demonstration. This table shows that the risk of chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and rinsing of the transport containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 47. Decision tree for transport to bird demonstration, chemical contamination

#### Norms

No chemical products should end up on the fruit during transport to the bird demonstration.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse it again.

#### Registration

The form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the cleaning and is done under the right circumstances, is possible.

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#### 45. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport containers were not cleaned properly. Micro organisms from the fruit that were in the containers before could then remain in the containers and contaminate the fruit for the next feeding. Microbiological contamination can also come from pests like flies. The risk of microbiological contamination can be reduced by cleaning the containers properly after every feeding. Pests like flies can be kept away from the fruit during transport, by keeping the containers fully closed at all times, except when taking food from the containers.

In table 48 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the bird demonstration. This table shows that the risk of microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning of the containers after every bird demonstration. Containers should be kept closed during the bird demonstration and only opened when necessary.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 48. Decision tree for transport to bird demonstration, microbiological contamination

#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning of the transport containers. The lids on the containers should be kept closed as much as possible.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse it again. If necessary, an explanation about the cleaning should be given (for more information view <u>Chapter 5</u>). A weekly check should be done to see if the containers for transport are kept fully closed during transport. If the containers were not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important. This should be filled in on the form "Transport" (view manual Food Processing and Hygiene protocol).

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 46. Physical contamination during transport

During transport of the fruit to the bird demonstration, physical contamination can take place if objects stick on or in the fruit. This could happen if the fruit is transported with bare hands (jewellery or nail polish could end up in fruit) or if the fruit is accidentally dropped during transport (objects from the dirty ground could end up in prey). This could have serious consequences for the health of the animals.

This risk can be prevented by transporting the fruit to the bird demonstration in a closed container. The containers should be kept closed at all times and only be opened when fruit needs to be taken out. The restrictions for the personnel to wear jewellery or nail polish have been discussed in paragraph 7.2.5. already and shall therefore not be repeated.

In table 49 the decision tree questions are answered and explained for the risk of physical contamination during transport to the bird demonstration. This table shows that the risk of physical contamination during transport is a CCP.

Table 49. Decision tree for trans	port to bird demonstration,	physical contamination
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Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport fruit to the bird demonstration in closed containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the fruit to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in or on the fruit can cause health damage to the animals that eat the fruit.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No objects should end up in or on the fruit during transport to the bird demonstration.

#### Monitoring

During processing, the fruit has been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination on the fruit before transport. In order to prevent physical contamination during transport to the bird demonstration, every day it should be checked whether the fruit is being transported to the bird demonstration in closed containers. All of this is registered on the form "Transport" (view manual Food Processing and Hygiene protocol). If the containers were not closed properly the fruit should be visually checked for physical contamination. If there is any doubt about the quality of the fruit, it is advised not to use the fruit.

#### Registration

The form "Transport" (view manual Food Processing and Hygiene protocol) should be input into an Excel-file, so that later check-up, to see if the fruit was transported to the bird demonstration under the right circumstances, is possible.

# 8 Critical Control Points for Pellets

In this chapter the results for the appliance of the HACCP method on pellets will be given. First, the pellet processing will be explained in paragraph 8.1 and a flowchart is presented (8.1.1) and explained (8.1.2) to clarify the steps in fruit processing. In paragraph 8.2 the contamination risks per step are given and in paragraph 8.3 the risks and measures are discussed.

## 8.1 Pellet processing

Before a description of all the risks in the processing of the bird feed can be given, an evaluation of all the steps in the processing of the feed is necessary. This way the processes are divided in kind of feed and in the steps the feed takes. Each of these steps can cause certain risks of contamination in the feed, which will be analysed in paragraph 8.2.

### 8.1.1 Flowchart pellet processing

A flowchart of the pellet processing at Vogelpark Avifauna can be found in figure 5. This flowchart shows all the steps or processes the whole prey takes from delivery to the central kitchen to the actual feeding of the bird either in the enclosure or during the bird demonstration at Vogelpark Avifauna. Each of these steps, or processes, has their own risks and will be discussed accordingly in this report.



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## 8.1.2 Steps in pellet processing

Each segment in the flowchart in Figure 5 schematically represents a point where hazards could occur that either affect animal health or diminish the nutritive value of the food (*Schmidt, Travis and Williams, 2006*). This generic pathway applies to different products including Nutribird P19, Anseres floating, sunflower seeds, pigeon pellets, mixed grains etc. Hazards along this pathway inherently come in two major forms, cross contamination of a clean product or increased growth of micro organisms already present in a contaminated product. The elimination of all bacteria is not a reasonable goal; the concern relates to the presence of pathogenic bacteria at levels high enough to cause infection.

Within pellet processing several steps are taken before the pellets actually arrive at the bird. These steps have been included within table 50.

Table 50. Steps in pellet processing

Nbr.	Process
1.	Pellet delivery
2.	Pellet storage before processing
3.	Pellet storage prep room
4.	Pellet processing
5.	Pellet temporary storage
6.	Pellet transport to enclosure
7.	Pellet transport to bird demo

For each step, the current situation is now given. At some points the risk of contamination is mentioned. Further on in this chapter, the contamination risks and measures are given.

#### 1. Pellet delivery

The delivery of pellet means every action in the delivery of all the pellets by the supplier. This includes taking the pellet out of the delivery truck, transporting it to the storage room and stacking it there. The pellets are delivered in paper bags of 25 Kg. each and come from the food subcontractor "Versele". This supplier follows HACCP and GMP regulations. Anseres floating is usually delivered in bags that weigh 15 Kg. The bags are made of cardboard paper and are piled up together on a wooden pallet. When the pellets and seeds are delivered, a fork-lift truck is used to transport the pallets full of bags onto the attic. On the attic, the pallets full of bags are placed alongside the walls, leaving enough space for the people to walk around.

#### 2. Pellet storage before processing

On the attic, the pallets full of bags are located alongside the walls, leaving enough space for the people to walk around and manoeuvre the bags towards the food dispensers. The bags are emptied into the silos of the food dispenser. The bags are emptied in the silos using a FIFO method. The silo's are always fully emptied and swept clean before filling them up again, to prevent the food from forming clutches and clogging up the chutes. There used to be a pest problem in the attic (mice), but this problem was solved using little machines that transmit high frequency sound waves, that scare off the mice. Since the use of this product, there is no longer a pest problem. There are some bags that are not emptied in the silo all at once (some bags are open, these are used to fill up the buckets that are taken to the prep room), these bags are closed using clamps. There are no lids on the silo's, this could create a contamination risk. However, the room is fully closed from the outdoors (there is one door leading outside, which is open during the stocking of new products and one door leading to the stairway towards the kitchen, which is closed all the time). There are no problems with flies here. Therefore the risk of contamination is very small.

#### 3. Pellet storage prep room

The pellets that are used for the birds at the bird demonstration are kept in buckets under the 'preparation table', which is used for preparing whole prey for the bird demonstration (View <u>Appendix</u> <u>IX</u> for pictures of the buckets and the prepping table). When these buckets are empty they are filled at the storage at the central kitchen. Proper hygiene says the buckets should be disinfected before use. Management does imply this, although this is not always being done. There is no lid or towel that covers the buckets. This causes an increased risk for cross contamination from the fruit and most important from the different kinds of prey. There is one cup used for the pellets but the pellets are also often scooped from the bucket by hand. It is also not uncommon that birds are temporarily held in the prep room, which also causes the risk of faeces or feathers and mites getting into the pellet buckets.

#### 4. Pellet processing

The diets for the birds that need pellets (e.g. the macaws) are put into plastic cups by hand or by using a scoop, while the plastic cups is standing on a weighing scale, in order to get the correct diet for the birds. There are lids for these cups; however, the cups are usually stacked up after the diets are made, leaving the top cup open. The diets for the macaws are made before the first show. The pellets for the red ibises are made just before they are trained or after the third show, when they receive their entire diet for the day. The only difference with making the macaw diets is the fact that water is added to soak the pellets for the ibises. As soon as the pellets are soaked, the cups are closed with fitting lids and are stacked up on the prepping table.

#### 5. Pellet temporary storage

The macaw diets are stacked up on the prepping table until they are used. The top cup is not closed since there is no lid on this one. The ibis diets are soaked just before the ibises are trained. Lids are used to close the cups while the pellets are soaking. There is no lid that covers the cups. This causes an increased risk for cross contamination from the fruit and most important from the different kinds of prey (*Productschap Diervoeder, 2005*).

#### 6. Transport pellets to enclosure

After the three shows, the macaws are separated into different cages, in order to give the macaws their individual diets. These pellets are weighed in plastic cups and used during the shows. When the macaws are fed, the pellets are put into metallic cups and three pieces of fruit are added to the diet. Immediately after this process the macaws are fed.

The ibises are fed after the training and receive their diet from the same plastic cups that were used to soak the pellets. The doves get their diets in three feeding trays, which are cleaned regularly when they are almost empty.

#### 7. Transport pellets to bird demonstration

During the bird demonstration pellets are used for the macaws, the ducorps cockatoo, and the sunbirds. The Nutri-bird is prepared on lids and kept in the box outside. These lids are stacked on top of each other, so the top one has no lid. The macaws are fed by hand during the show, so clean hands are important. The cockatoo and sunconures get sunflower seeds during the show, which are kept in the pockets of personnel for convenience. The cockatoo also gets his diet on the podium. When switching between whole prey or fruit and pellets, the hands are cleaned on stage using a disinfection product diluted in water.

This description of the current situation at Vogelpark Avifauna, shows that there are some risks in the methods currently used. In the following paragraph, the risks are described and some measures will be given that may be useful for Vogelpark Avifauna in order to reduce the risks and create a safer situation for the animals as well as the personnel.

### 8.2 Contamination risks

In this chapter, the risks in each of the steps taken in the food processing of pellets will be discussed. The steps in pellet processing are shown in paragraph 8.1.2 in table 50.

The potential hazards that could be present in basic materials or occur during preparation, treatment, packing and transport of food can be divided into 3 categories:

- (Micro)biological: Damaging fungi or matters produced by fungi, mycotoxins, damaging viruses, bacteria like *Salmonella* or *Listeria* that cause diseases.
- Chemical: Residues from for example disinfectants, insecticides, oil, lubricants.
- Physical: Glass, stone, sand, paper, rope, metal.

Besides these three categories, there are more risks, which will be further explained when the risk is present.

At this time there is no hygiene protocol available for pellets and/or seeds in zoos. The reason that there currently is no hygiene protocol for pellets is because of a renewing of the protocol, since new laws have been established in 2006 (93/43/EEG) (*Voedselveiligheid, ketens en toezicht op controle*) Because of this, the appraisal directive of 'Productschap granen, zaden en peulvruchten' has been used. This directive is closest comparable to pellets. Literature has been used from '*Productschap Diervoeder*' as well. '*Productschap Diervoeder*' has GMP rules for poultry farms, which is closest to pellet processing in a bird park.
## 8.2.1 Pellet delivery

Within the process step 'pellet delivery' there are a few risks to be identified. The following risks will be discussed in this paragraph:

47. Chemical contamination during transport

48. Microbiological contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet delivery. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In pellet delivery, many risks can be prevented by selecting a certified supplier. The steps preceding the delivery are very important to Avifauna, as the quality of the food can be affected during this time. It is advisable that Vogelpark Avifauna has proper agreements with the supplier about the quality of the food. Therefore, the manual 'Food processing and hygiene protocol' describes the steps that should be taken when choosing a supplier and the demands that can be made towards the supplier.

#### 47. Chemical contamination during transport

Chemical contamination of the pellets can take place if products, other than pellets, are transported in the cargo space of the truck. Sometimes shippers transport other food and non-food items in the same truck as the pellets in order to save freight costs. There should be no non-food items shipped with the pellets (*Crissey et al. 2001*). Some products, for example maintenance products (lubricants), disinfectants and coolants, can endanger human and animal health (*Food-info*). Chemical products that are transported in the same space as the pellets, at the same time, can get in contact with the product, e.g. if a bottle falls over or breaks and leaks on to the bags. The absorbing characteristic of the cardboard bags cause fluids to leak onto the pellets quite easily.

Agreements should be made with the supplier that no chemical products will be transported in the same space as the pellets.

In table 51 the decision tree questions are answered and explained for the risk of chemical contamination during transport. This table shows that chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be transported in the same space as the pellets.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the pellet quality. If chemical products get onto the pellets, they cannot be removed and the toxins can harm the health of humans (who get in contact with the pellets) and animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk. Once the chemicals are in contact with the pellets, the toxins cannot be removed.

#### Table 51. Decision tree for pellet delivery, chemical contamination during transport

#### Norms

Chemical products should not be transported in the same space that is used to transport pellets.

#### Monitoring

A visual check should be done at every delivery of pellets and the results should be filled in on the form "Pellet Delivery" (view manual Food Processing and Hygiene protocol). The bags should all be dry and show no cracks. If there are chemical products present in the cargo space of the truck, a decision should be made whether to accept or reject the delivery. If there are no open or broken bottles of chemical products in the truck and no signs of chemical products on bags (like wet spots), the load can be accepted. If there are any doubts about the quality of the pellets, it is recommended to reject the load. An agreement should be made with the supplier that a load will be rejected when chemical products are present in the truck (*Productschap Diervoeder, 2005*).

#### Registration

The form "Pellet delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

#### 48. Microbiological contamination during transport

The pellets are delivered in double paper bags, meaning they have two separate layers. This way, the pellets are fully covered and cannot get in contact with the surroundings. If the packing material of the pellets is opened or damaged in any way, micro organisms and moisture will have access to the pellets (*Productschap diervoeder, 2005*). These micro organisms can come from walls and floors that were not cleaned properly, flies and other pests in the cargo space and other products that are transported in the cargo space. Microbiological contamination of the food can cause a serious health risk for the animals. This risk can be reduced by not accepting damaged packing materials. Agreements with the supplier should be made on this point.

In table 52 the decision tree questions are answered and explained for the risk of microbiological contamination during transport. This table shows that microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Damaged or opened packing materials should be rejected at delivery.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The delivery and receiving of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences. If there are holes or cracks in the packing material, microbiological contamination can take place, which affects the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 52. Decision tree for pellet delivery, microbiological contamination during transport

#### Norms

If a bag is damaged or opened, the pellets might be contaminated. Since it cannot be seen at the pellets itself if microbiological contamination has taken place, the quality of the pellets cannot be guaranteed if the packing material is damaged. The norm is that damaged bags do not suffice.

#### Monitoring

A visual check on the load should be done at every delivery, to see if there are no packing materials damaged and no bags are opened. This should be registered on the form "Pellet delivery" (view manual Food Processing and Hygiene protocol).

If the load does not fit the requirements at this point, it is advisable to reject the damaged or opened bags. The rest of the load (if not damaged) can be accepted.

#### Registration

The form "Pellet delivery" should be input into an Excel-file, so that later check-up, to see if a load was delivered under the right circumstances, is possible.

## 8.2.2 Pellet storage before processing

Within the process step 'Pellet storage before processing' there is only one risk identified. The following risk will be discussed in this paragraph:

49. Microbiological contamination during storage

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet storage before processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In pellet storage before processing, a lot of risks can be prevented by making sure the storage facility meets the demands. The storage facility should be designed to adequately protect supplies. It is crucial that the length and conditions of storage minimizes contamination and ensures the product retains its nutritive value and wholesome quality. (*Crissey et al. 2001*). The risk of exceeding shelf life can be prevented by emptying the bags of pellets into the silos of the food dispenser using the FIFO method. In the current hygiene situation, the FIFO method is already used (Appendix IV?) The silo's are always fully emptied and swept clean before filling them up again, to prevent the food to form clutches and clog up the chutes. Chemicals are never stored in this room, the room is strictly used for storing pellets and seeds, and therefore there is no chemical contamination risk in the storage room. There used to be a pest problem in the attic (mice), but this problem was solved using little machines that transmit high frequency sound waves, that scare off the mice. Since the use of this product, there is no longer a pest problem.

#### 49. Microbiological contamination through surroundings

The bags of pellets at Vogelpark Avifauna are emptied in the silos. These silos have no lids on them. This way, the pellets in the silos are exposed to the air in the storage room. The pellets can get moist from the surroundings (especially in the warm summer days when there is a high humidity), which can cause fungal growth on the pellets. (*Productschap diervoeder, 2005*) If a door of the storage room is left open for a while, e.g. during delivery, flies can enter the room and can get to the pellets quite easily. The fact that there are currently no insect problems, does not guarantee it will not happen in the future. Microbiological contamination can have serious consequences for the quality of the pellets. This risk can be prevented by putting lids on the silos. The lids should be covering the silos properly (no flies or insects should be able to get in). If pellets are found in storage or in the silos that have fungal growth on it, the pellets should be removed and should not be fed. This might mean throwing out one or more bags of pellets or emptying the entire silo.

In table 53 the decision tree questions are answered and explained for the risk of chemical contamination during storage before processing. This table shows that chemical contamination during storage before processing is a CCP.

 Table 53. Decision tree for pellet storage before processing, microbiological contamination during storage

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The silos should be covered by a lid. Deteriorating pellets should be removed from the shipment to prevent any further infection of the load.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of pellets does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can have serious consequences for the pellet quality. Feeding pellets of bad quality can cause a health problem for the animals
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

In order to prevent microbiological contamination, different products should be kept separated if stored in the same storage room. The pellets and seeds should be placed in the correct silos. Furthermore, the pellet silos should always be kept closed. For Vogelpark Avifauna, this means lids should be made that fit on the silos and cover them completely.

#### Monitoring

Once a week, a visual check should be done to see if the pellets are stored in a dry storage room. If the storage room has wet spots or moisture of any kind, these should be cleaned. Pellet bags should not be stored directly on the floor (*Productschap Diervoeder, 2005*).

Fungal growth or deterioration can easily be detected by sight and smell. Opening one bag for use of small amounts, allows for a quality check. The pellets can be of a different colour, have dark spots or fungus on it or there can be moisture on the pellets. The form "Pellet storage" (view manual Food Processing and Hygiene protocol). should be filled in once a week.

#### Registration

The filled in "Pellet storage" forms should be put into an Excel-file, so that later check-up, to see if the fruit is stored under the right circumstances, is possible.

### 8.2.3 Pellet storage in prep room

Within the process step 'Pellet storage in prep room' there are a few risks identified. The following risks will be discussed in this paragraph:

- 50. Temperature in prep room too high
- 51. Chemical contamination during storage in prep room
- 52. Microbiological contamination through environment
- 53. Microbiological contamination through personnel
- 54. Physical contamination during storage in prep room

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet storage in prep room. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

In pellet storage in the prep room, a lot of risks can be prevented by making sure the storage facility meets the demands. The storage facility should be designed to adequately protect supplies. It is crucial that the length and conditions of storage minimizes contamination and ensures the product retains its nutritive value and wholesome quality. (*Crissey et al. 2001*)

#### 50. Temperature in processing room too high

Bacterial growth is influenced by temperature. Bacterial growth can take place faster at higher temperatures. In order to keep the bacterial growth down, pellets should be kept at room temperature and in dry areas, since moisture also increases bacterial growth. During storage in the prep room, the pellets can be exposed to a temperature no higher than 20 °C (68 °F) (*Productschap Diervoeder, 2005*). Dry, manufactured feeds also have the potential for vitamin and fat degradation at increased temperatures and humidity (*Villwock and Hartfiel, 1982; Combs, 1992*). Vitamin and fat degradation means a decrease in pellet quality. If the pellets are stored in a room that is not cooled, the temperature in the room can increase on warm days to above 20 °C (68 °F). If the prep room gets too warm due to weather conditions (especially in the summer), air-conditioning should be installed. When the air-conditioning is working, all windows and doors should be kept closed, so no warm air can get into the room. This would be a waste of energy and money, since the air-conditioning would have to run more often to keep the room chilled.

In table 54 the decision tree questions are answered and explained for the risk of a too high temperature in the prep room during storage. This table shows that a too high temperature in prep room during storage is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Air-conditioning should be installed in the prep room when the temperature increases to over 20 °C (68 °F).
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth can be accelerated by high temperatures. This can affect the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 54. Decision tree for pellet storage in prep room, temperature too high in prep room

#### Norms

The storage of the pellets should happen at the right temperature conditions. Taking the working temperature for the personnel into account, the temperature in the prep room should not be higher than 20  $^{\circ}$ C (68  $^{\circ}$ F).

#### Monitoring

There should be an easily readable thermometer present in the prep room. This thermometer should be placed where the reading is a reliable average temperature of the whole room, e.g. not close to the air-conditioning or a heat source. This thermometer should be read daily for an efficient temperature check. Inefficiency of the thermometer should be taken into account. Therefore, the temperature in the prep room should be measured weekly by using a well calibrated portable thermometer. The temperature should be measured in the middle of the room, as well as close to the walls to get a good vision of the temperature in the room. The results of the daily temperature check should be written down on the form "Pellet Storage" (view manual Food Processing and Hygiene protocol). If pellets are found which were not stored under the right temperature conditions, a decision should be made whether or not to use the pellets. If there are any doubts about the quality of the pellets, it is advised not to use it.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 51. Chemical contamination during storage in prep room

Chemical contamination during storage in the prep room can take place if cleaning agents get into the buckets with pellets. Bottles with chemical substances can fall over onto the pellets. Insufficient cleaning and rinsing of the storage buckets or inexpert use of cleaning agents can also cause chemical contamination. Chemical contamination can cause a health hazard for the animals. Chemical products should not be stored in the same room where the food is stored (*Crissey et al., 2001*). In the current situation at Vogelpark Avifauna (see <u>Appendix IV</u>), the chemical products like cleaning liquids are stored in the cupboards below the sink. This way, the chemical products can never leak onto the food or tools used for processing, if a bottle falls over or a package is broken. This way of storing is acceptable if the only chemical products stored here are the ones that are actually used in the processing room. However care must be taken when using the chemical products in the processing room, in order to keep the chemical products from getting in contact with the food or tools. The risk can be prevented by cleaning and rinsing the buckets used for storage properly before refilling them. The use of lids can also prevent chemical contamination.

In table 55 the decision tree questions are answered and explained for the risk of chemical contamination during storage in prep room. This table shows that chemical contamination during storage in the prep room is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be present in the prep room, outside the cupboard. A lid should be placed on the buckets and the buckets should be properly cleaned and rinsed before refilling.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	The hazard can have serious consequences for the pellet quality. If chemical products get onto the pellets, they cannot be removed and the toxins can harm the health of

# Table 55. Decision tree for pellet storage at prep room, chemical contamination during storage in prep room

		humans (who get in contact with the pellets) and animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No chemical products should be stored in the space where the food is being stored. Storing in the on the other side of the prep room on the shelves is allowed, but care must be taken to always store the products here again immediately after use. After cleaning and rinsing the buckets, there should be no cleaning agent leftovers left.

#### Monitoring

A visual check should be done weekly to see if there are any chemical products stored in the room where the pellets are processed, that do not belong in the processing room. Chemical products that are used in this room should be stored in the cupboards below the sink, this should be checked weekly as well. All of this should be written down on the form "Pellet storage" (view manual Food Processing and Hygiene protocol). Any chemical products present in the processing room should then immediately be stored where they belong and it should be investigated who put them there and why. An explanation should also be given as to why the products should be stored where they belong, every time immediately after use. If chemical products are found in the processing room, outside the cupboards, a decision should be made whether or not to use the pellets in the processing room. If there are no broken or open bottles in the processing room, the pellets can still be used.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 52. Microbiological contamination through environment

Microbiological contamination can come from objects that are not cleaned properly, flies and other pests and other products that are present in the room where the pellets are stored. Microbiological contamination can have serious consequences for the quality of the pellets.

This risk can be reduced by proper cleaning and disinfecting (see Chapter 5 Cleaning and disinfecting) of the objects that get in contact with the pellets and closing the buckets after each use. Measures should be taken to control pests such as flies. The pellets should be kept separated from other products in the prep room, such as prey and fruits. Immediately after use, when the pellets are divided over the food containers, the buckets should all be closed properly with clean lids or the buckets should even be replaced by a system of boxes, such as in <u>Appendix VI</u>. In the current situation at Vogelpark Avifauna (<u>Appendix IV</u>) it is not uncommon that birds are temporarily held in the prep room, which also causes the risk of faeces or feathers and mites getting into the pellet buckets.

In table 56 the decision tree questions are answered and explained for the risk of microbiological contamination through the environment during storage in the prep room. This table shows that microbiological contamination through the environment during storage at prep room is a CCP.

Table 56. Decision tree for	r pellet storage at prep roon	m, microbiological contamination through
the environment during st	torage in prep room	

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of scoops and buckets, closing buckets after each use. Pest prevention (flies). Keep pellets separated from other food.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets in the prep room does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the pellets affects the quality of the pellets and causes a health risk for the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

An environment in which microbiological contamination is prevented by proper cleaning, pest control and sufficient closing of pellet buckets suffices (*Productschap Diervoeder, 2005*).

#### Monitoring

Pests like flies should be prevented from entering the prep room by blocking their access routes. This can be done by placing insect screens in front of the windows, keeping doors shut and closing all gaps in the walls and underneath doors. Prevent pests that have entered the room from surviving and reproducing by keeping the room clean and free from (accessible) rubbish. Insecticide should only be used in case there is a pest problem.

Pellets should be kept strictly separated from other food products. Tools can only be used after they have been properly cleaned. The pest prevention (whenever there is a pest problem) should be registered on the form "Pellet storage". The cleaning of other objects in the room should be registered weekly on the form "Cleaning" (view manual Food Processing and Hygiene protocol). The buckets should always be closed after use.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 53. Microbiological contamination through personnel

If the personnel is working unhygienic, this could cause microbiological contamination of the pellets. The micro organisms may come from clothing or hands that were not cleaned properly. Microbiological contamination decreases the quality of the pellet and may cause a health risk for the animals.

This risk can be reduced by regular cleaning of clothes and hands. (*Forsythe and Hayes, 1998*) Personal hygiene of the personnel is also very important. This includes not smoking in the processing room and not wearing nail polish on the fingernails. Jewellery can also be a source of contamination, especially rings, which can not be cleaned properly every time the hands are cleaned. Hands should be cleaned according to Chapter 5, Cleaning and disinfecting, and should be dried using disposable towels.

In table 57 the decision tree questions are answered and explained for the risk of microbiological contamination through personnel during storage at prep room. This table shows that microbiological contamination through personnel during storage is a CCP.

Table 57. Decision tree for pellet storage in prep room, microbiological contamination through personnel during storage in prep room

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of clothing and hands, personal hygiene and no smoking in the prep room, no jewellery and no nail polish.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the pellets affects the quality of the pellets and causes a health risk for the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

All the personnel should apply normal personal hygiene. This includes not smoking in the prep room, not wearing nail polish, not wearing jewellery, cleaning hands according to the instructions, using scoops when processing pellets and covering up wounds with coloured band-aids (preferably blue) if necessary.

#### Monitoring

The personnel should be inspected to see if they apply the personal hygiene regulations. A visual check should be done to see if personnel do not smoke in the prep room, do not wear nail polish or jewellery and if the personnel clean their hands according to the instructions. A visual check should also be done to see if personnel use scoops for the pellets instead of using their hands. This should all be registered on the form "Pellet storage" (view manual Food Processing and Hygiene protocol). To obtain objective information, the check should be done by someone other than the personnel processing the pellets. If the personal hygiene is not sufficient, the personnel responsible should be instructed as to what the rules are and why they should be followed.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 54. Physical contamination in storage at prep room

Physical contamination can be jewellery, wrapping leftovers or other objects, which fall in the buckets of pellets. These objects can cause a hazard for the health of the animals. During storage in the prep room, care must be taken to prevent objects to fall in the buckets, since there are no lids on the buckets with pellets. Agreements should be made about this with the personnel. Also, the working area in the prep room must be cleaned of small objects that could get into the buckets. Small litter should be thrown out every day.

In table 58 the decision tree questions are answered and explained for the risk of physical contamination during storage in prep room. This table shows that physical contamination during storage in prep room is a CCP.

Table 58. Decision tree for pellet storage at prep room, physical contamination during storage at prep room

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The prep room area should be cleaned, no small objects may lie around in the working area.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storing of the pellets in the prep room does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects in the pellets can cause a serious health hazard when eaten by the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No unwanted objects should be present in the pellets during storage in the prep room.

#### Monitoring

Before the pellets are put into the bucket for storage at the prep room, the bucket should be disinfected. A visual check should be done daily to see if there are any objects in the pellets that do not belong there. During storage in the prep room care should also be taken that no objects get in or on the pellets. If there are one or more objects found in the pellets, this should be written down on the form "Pellet storage" (view manual Food Processing and Hygiene protocol).

If the contamination that is found in the pellets cannot be removed fully from the pellets, the pellets are not usable and should be thrown out. This could happen if for an example, other food, such as prey parts from the processing table, falls in to one of the buckets. The pieces of prey are often wet with body fluids, which can contaminate a large area of the pellets. If this happens, it should also be written down on the form. A large improvement would be to replace the current buckets, which have no lids, with boxes that can be closed (*Productschap Diervoeder, 2005*). An example of such a system can be found in <u>Appendix VI</u>.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

### 8.2.4 Pellet Processing

Within the process step 'Pellet processing' there are only a few risks identified. The following risks will be discussed in this paragraph:

- 55. Microbiological contamination through environment
- 56. Microbiological contamination through personnel
- 57. Physical contamination during processing

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet processing. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

The diets for the birds that need pellets are put into plastic cups by hand or by using a scoop. The pellets are then put into the cups, while the cups are standing on a weighing scale. There are lids for these cups; however, the cups are usually stacked up after the diets are made, leaving the top cup open. The diets for the macaws are made before the first show. For every show some pellets are taken from the cup for use in the bird demonstration. These pellets are kept on the lid during the show, mostly for convenience of use during the demonstration. During the show there is risk of cross contamination with whole prey, since there is not always time to clean hands properly during the show. The pellets for the red ibises are made just before they are trained or used in the demonstration (once or twice a day) mostly the same way as the macaw diets. However different is the fact that (tap)water is added to soak the pellets. As soon as the pellets are soaked, the cups are closed with fitting lids and are stacked up on the prepping table.

#### 55. Microbiological contamination through environment

Microbiological contamination can come from objects that were not cleaned properly, flies and other pests and other products that are present in the room where the pellets are processed. Microbiological contamination can have serious consequences for the quality of the pellets. This risk can be reduced by proper cleaning and disinfecting (see Chapter 5 Cleaning and disinfecting) of the objects that get in contact with the pellets and closing the lids of the food containers after each use. Measures should be taken to control pests such as flies. The pellets should be kept separated from other products in the processing room, such as prey and fruits. Immediately after usage, when the pellets are divided over the food containers, the food containers should all be closed properly with clean lids.

In table 59 the decision tree questions are answered and explained for the risk of microbiological contamination through the environment during processing. This table shows that microbiological contamination through the environment during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of scoops and food containers after each use
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the pellets does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the pellets affects the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

## Table 59. Decision tree for pellet processing, microbiological contamination through the environment during processing

#### Norms

An environment in which microbiological contamination is prevented by proper cleaning, pest control and sufficient sealing of food containers suffice (*Productschap Diervoeder, 2005*).

#### Monitoring

Pests like flies should be prevented from entering the prep room by blocking their access routes. This can be done by placing insect screens in front of the windows, keeping doors shut and closing all gaps in the walls and underneath doors. Prevent pests that have entered the room from surviving and reproducing by keeping the room clean and free from (accessible) rubbish. Insecticide should only be used in case there is a pest problem.

Pellets should be kept strictly separated from other food products. Tools can only be used after they have been properly cleaned. The pest prevention (whenever there is a pest problem) and separating of the clean from dirty objects (weekly) should be registered on the form "Pellet processing". The cleaning of other objects in the room should be registered weekly on the form "Cleaning" (view manual Food Processing and Hygiene protocol). The buckets should always be closed after use.

#### Registration

The form "Pellet processing" should be input into an Excel-file, so that later check-up, to see if the pellets were processed under the right circumstances, is possible.

#### 56. Microbiological contamination through personnel

If the personnel are working unhygienic, this could cause microbiological contamination of the pellet. The micro organisms may come from clothing or hands that were not cleaned properly. All of this decreases the quality of the pellet.

This risk can be reduced by regular cleaning of clothes and hands. (*Forsythe and Hayes*, 1998) Personal hygiene of the personnel is also very important. This includes not smoking in the processing room and not wearing nail polish on the fingernails. Jewellery can also be a source of contamination, especially rings, which can not be cleaned properly every time the hands are cleaned. Hands should be cleaned according to Chapter 5, Cleaning and disinfecting, and should be dried using disposable towels. When handling the pellets, disposable gloves should be worn and wounds or cuts should be covered using brightly coloured band-aids, so that they can easily be recognized in the pellets.

In table 60 the decision tree questions are answered and explained for the risk of microbiological contamination through personnel during processing. This table shows that microbiological contamination through personnel during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of clothing and hands, personal hygiene and wearing disposable gloves when handling pellets.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the pellets does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the pellets affects the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 60.	Decision tree for pellet pr	rocessing, microbiolo	gical contamination	hrough personnel
during pro	ocessing	-	-	

#### Norms

All the personnel should apply normal personal hygiene. This includes not smoking in the prep room, not wearing nail polish, not wearing jewellery, cleaning hands according to the instructions, using scoops when processing pellets and covering up wounds with coloured band-aids if necessary.

#### Monitoring

The personnel should be inspected to see if they apply the personal hygiene regulations. A visual check should be done to see if personnel do not smoke in the prep room, if personnel do not wear nail polish or jewellery and if the personnel clean their hands according to the instructions. A visual check should also be done to see if personnel use scoops for the pellets instead of using their hands. This should all be registered on the form "Personal hygiene" (view manual Food Processing and Hygiene protocol). To obtain unbiased information, the check should be done by someone other than the personnel processing the pellets. If the personal hygiene is not sufficient, the personnel responsible should be instructed as to what the rules are and why they should be followed.

#### Registration

The form "Personal hygiene" should be input into an Excel-file, so that later check-up, to see if the pellets were processed under the right circumstances, is possible.

#### 57. Physical contamination during processing

Physical contamination can be jewellery, wrapping leftovers or other objects, which fall in the buckets or cups of pellets. These objects can cause a hazard for the health of the animals. During processing in the prep room, care must be taken to prevent objects to fall in the cups, since there are not always lids on the cups. Also, objects that might have fallen into the bucket before processing started is a risk that has to be taken into account (paragraph 8.2.3). Agreements should be made about this with the personnel. Also, the working area in the prep room must be cleaned of small objects that could get into the cups (e.g. the hanging feathers on the ceiling, dust, day old chick feathers etc). Small litter should be thrown out every day.

In table 61 the decision tree questions are answered and explained for the risk of physical contamination during processing. This table shows that physical contamination during processing is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The prep room area should be cleaned, no small objects may lie around in the working area or be present in the buckets or cups.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The processing of the pellets in the prep room does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects in the pellets can cause a serious health hazard when eaten by the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 61. Decision tree for pellet processing, physical contamination during processing

#### Norms

Pellet processing should be done on a separated table with no fruit or whole prey on the same table, or any other small objects for that matter, in order to prevent physical contamination.

#### Monitoring

Before the pellets are put into the cups (small food containers) during processing at the prep room, the cups should be cleaned and rinsed properly. A visual check should be done daily to see if there are any objects in the pellets that do not belong there. During processing in the prep room care should also be taken that no objects get in or on the pellets. If one or more objects are found in the pellets, these should be removed and this should be written down on the form "Pellet processing" ((view manual Food Processing and Hygiene protocol). If the contamination that is found in the pellets cannot be removed fully from the pellets, the pellets are not usable and should be thrown out. This could happen if for example, other food, such as prey parts from the processing table, gets into one of the cups. The pieces of prey are often wet with body fluids, which can contaminate a large area of the pellets. If this happens, it should also be written down on the form.

#### Registration

The form "Pellet processing" should be input into an Excel-file, so that later check-up, to see if the pellets were processed under the right circumstances, is possible.

## 8.2.5 Pellet temporary storage

Within the process step 'Pellet temporary storage' a few risks are identified. The following risks will be discussed in this paragraph:

- 58. Temperature in prep room too high
- 59. Chemical contamination during storage in prep room
- 60. Microbiological contamination through environment
- 61. Physical contamination during storage in prep room

This is not a complete list of all the possible risks. This is a selection of the most important risks in temporary storage of pellets. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

#### 58. Temperature in processing room too high

Bacterial growth is influenced by temperature. Bacterial growth can take place faster at higher temperatures. In order to keep the bacterial growth down, pellets should be kept at room temperature and in dry areas, since moisture also increases bacterial growth. During storage in the processing room, the pellets can be exposed to a temperature no higher than 20 °C (68 °F) (*Productschap Diervoeder, 2005*). Dry, manufactured feeds also have the potential for vitamin and fat degradation at increased temperatures and humidity (*Villwock and Hartfiel, 1982; Combs, 1992*). Vitamin and fat degradation means a decrease in pellet quality. If the pellets are stored in a room that is not cooled, the temperature in the room can increase on warm days to above 20 °C (68 °F). If the prep room gets too warm due to weather conditions (especially in the summer), air-conditioning should be installed. When the air-conditioning is working, all windows and doors should be kept closed, so no warm air can get into the room. This would be a waste of energy and money, since the air-conditioning would have to run more often to keep the room chilled.

In table 62 the decision tree questions are answered and explained for the risk of a too high temperature in the processing room during temporary storage. This table shows that a high environmental temperature during storage in prep room is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Air-conditioning should be installed in the prep room when storing pellets
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Bacterial growth can be accelerated by high temperatures. This can affect the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

# Table 62. Decision tree for temporary pellet storage in prep room, temperature too high in prep room

#### Norms

The storage of the pellets should happen at the right temperature conditions. Taking the working temperature for the personnel into account, the temperature in the prep room should not be higher than 20  $^{\circ}$ C (68  $^{\circ}$ F).

#### Monitoring

There should be an easily readable thermometer present in the prep room. This thermometer should be placed where the reading is a reliable average temperature of the whole room, e.g. not close to the

air-conditioning or a heat source. This thermometer should be read daily for an efficient temperature check. Inefficiency of the thermometer should be taken into account. Therefore, the temperature in the prep room should be measured weekly by using a well calibrated portable thermometer. The temperature should be measured in the middle of the room, as well as close to the walls to get a good vision of the temperature in the room. The results of the daily temperature check should be written down on the form "Pellet storage" (view manual Food Processing and Hygiene protocol). If pellets are found which were not stored under the right temperature conditions, a decision should be made whether or not to use the pellets. If there are any doubts about the quality of the pellets, it is advised not to use it.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 59. Chemical contamination during storage in prep room

Chemical contamination during storage in prep room can take place if cleaning agents get into the food containers by accident or when the food containers are not rinsed properly after cleaning. Bottles with chemical substances can fall over onto the pellets. Inexpert use of cleaning agents can also cause chemical contamination. Chemical contamination can cause a health hazard for the animals. Chemical products should not be stored in the same room as where the pellets are stored.

In table 63 the decision tree questions are answered and explained for the risk of chemical contamination during temporary storage in prep room. This table shows that chemical contamination during temporary storage at prep room is a CCP.

## Table 63. Decision tree for pellet storage at prep room, chemical contamination during storage at prep room

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	No chemical products should be present in the prep room. Lids should be placed on the food containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination of the pellets affects the quality of the pellets and can cause health risks for the animals
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No chemical products should be stored in the processing room. After cleaning and rinsing the tools and containers, there should be no cleaning agent leftovers left.

#### Monitoring

A visual check should be done weekly to see if there are any chemical products stored in the room where the pellets are stored. If this is the case, it should be written down on the form "Pellet storage" (view manual Food Processing and Hygiene protocol). The chemical products should then immediately be removed and it should be investigated who put them there and why. An explanation should also be given as to why the products cannot be stored in this room. If chemical products are found in the prep room, a decision should be made whether or not to use the pellets in the prep room. If there are no broken or open bottles in the prep room, the pellets can still be used.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 60. Microbiological contamination through environment

Microbiological contamination can come from objects that were not cleaned properly, flies and other pests and other products that are present in the room where the pellets are stored. Microbiological contamination can have serious consequences for the quality of the pellets.

This risk can be reduced by proper cleaning and disinfecting (see Chapter 5 Cleaning and disinfecting) of the objects that get in contact with the pellets and closing the buckets after each use. Measures should be taken to control pests such as flies. The pellets should be kept separated from other products in the prep room, such as prey and fruits. Immediately after usage, when the pellets are divided over the food containers, the food containers should all be closed properly with clean lids.

In table 64 the decision tree questions are answered and explained for the risk of microbiological contamination through the environment during temporary storage in the prep room. This table shows that microbiological contamination through the environment during temporary storage at prep room is a CCP.

# Table 64. Decision tree for pellet storage at prep room, microbiological contamination through the environment during storage at prep room

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Proper cleaning of scoops and closing food containers after making diets
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storage of the pellets in the prep room does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination of the pellets affects the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

An environment in which microbiological contamination is prevented by proper cleaning, pest control and sufficient sealing of food containers suffice (*Productschap Diervoeder, 2005*).

#### Monitoring

Pests like flies should be prevented from entering the prep room by blocking their access routes. This can be done by placing insect screens in front of the windows, keeping doors shut and closing all gaps in the walls and underneath doors. Prevent pests that have entered the room from surviving and reproducing by keeping the room clean and free from (accessible) rubbish. Insecticide should only be used in case there is a pest problem.

Pellets should be kept strictly separated from other food products. Tools can only be used after they have been properly cleaned. The pest prevention (whenever there is a pest problem) and separating of the clean from dirty objects (weekly) should be registered on the form "Pellet storage". The cleaning of other objects in the room should be registered weekly on the form "Cleaning" (view manual Food Processing and Hygiene protocol). The buckets should always be closed after use.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

#### 61. Physical contamination in temporary storage at prep room

Physical contamination can be jewellery, wrapping leftovers or other objects, which fall in the buckets of pellets and into the food containers. These objects can cause a hazard for the health of the animals. During storage in the prep room, care must be taken to prevent objects to fall in the buckets and food containers, since there are no lids on the buckets and food containers with pellets. Agreements should be made about this with the personnel. Also, the working area in the prep room must be cleaned of small objects that could get into the buckets and food containers. Small litter should be thrown out every day.

In table 65 the decision tree questions are answered and explained for the risk of physical contamination during temporary storage in prep room. This table shows that physical contamination during temporary storage in prep room is a CCP.

Table 65. Decision tree for pellet storage at prep room,	physical contamination during storage
at prep room	

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	The prep room area should be cleaned; no small objects may lie around in the working area.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The storing of the pellets in the prep room does not reduce the risk
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects in the pellets can cause a serious health hazard when eaten by the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

No unwanted objects should be present in the pellets during storage in the prep room.

#### Monitoring

Before the pellets are put into food containers at the prep room, the food containers should be disinfected. A visual check should be done daily to see if there are any objects in the pellets that do not belong there. During storage in the prep room care should also be taken that no objects get in or on the pellets. If there are one or more objects found in the pellets, this should be written down on the form "Pellet storage" (view manual Food Processing and Hygiene protocol).

If the contamination that is found in the pellets cannot be removed fully from the pellets, the pellets are not usable and should be thrown out. This could happen if for an example, other food, such as prey parts from the processing table, falls in to one of the buckets. The pieces of prey are often wet with body fluids, which can contaminate a large area of the pellets. If this happens, it should also be written down on the form.

#### Registration

The form "Pellet storage" should be input into an Excel-file, so that later check-up, to see if the pellets were stored under the right circumstances, is possible.

### 8.2.6 Pellet transport to enclosure

Within the process step 'Transport' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 62. Chemical contamination during transport
- 63. Microbiological contamination during transport
- 64. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet transport (*Productschap Diervoeder, 2005*). A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the pellets to the enclosure, many risks can be prevented by making sure the transport is not delayed. When the transport to the enclosure has started, it should be finished before doing anything else. This way, there is no risk of the temperature during transport being too high or the transport taking too long, two risks that could both cause an increased bacterial growth.

#### 62. Chemical contamination during transport

Chemical contamination during transport could occur if the pellets are transported to the enclosure in a container which was not rinsed properly after cleaning. The risk of chemical contamination can be reduced by cleaning and rinsing the transport containers (and lids) properly after each use. (*Crissey et al., 2001*)

In table 66 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the birds enclosure. This table shows that the risk of chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and rinsing of the transport container.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 66. Decision tree for transport to enclosure, chemical contamination

#### Norms

The containers used for transporting the pellets to the enclosures, should be cleaned and rinsed properly after each use.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the container and lid are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again.

#### Registration

The form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the cleaning was done under the right circumstances, is possible.

#### 63. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport container was not cleaned properly. Micro organisms from pellets that were in the container before could then remain in the container and contaminate the pellets for the next feeding.

The risk of microbiological contamination can be reduced by cleaning the container properly after every feeding. Pests like flies can be kept away from the pellets during transport, by keeping the containers fully closed.

In table 67 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the bird's enclosure. This table shows that the risk of microbiological contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and rinsing of the container after every single feeding. Container should be kept closed.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 67. Decision tree for trans	sport to enclosure,	microbiological	contamination
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#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning of the transport container. The lid on the container should be kept closed during transport.

#### Monitoring

During cleaning of the transport container, a second person (who is not doing the cleaning) should visually check weekly if the container and lid are rinsed properly. By having a second person observing, the chance of a objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the container is not rinsed properly, the observer can ask the person responsible to rinse it again. A weekly check should be done to see if the container for transport is kept fully closed during transport. If the container was not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important. This should be filled in on the form "Transport" (view manual Food Processing and Hygiene protocol).

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 64. Physical contamination during transport

During transport of the pellets to the enclosures of the animals, physical contamination can take place if objects fall in the pellets. This could happen if the pellets are transported with bare hands (jewellery or nail polish could end up in pellets) or if the pellets are accidentally dropped during transport (objects from the dirty ground could end up in pellets). This could have serious consequences for the health of the animals. This risk can be prevented by transporting the pellets to the enclosures in a closed container.

In table 68 the decision tree questions are answered and explained for the risk of physical contamination during transport to the bird enclosure. This table shows that the risk of physical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport pellets to the enclosures in a closed container.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the enclosure does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in the pellets can cause health risk for the animals that eat the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 68. Do	ecision tree for	or transpo	ort to enclosure,	phy	sical contamination
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#### Norms

No objects should end up in the pellets during transport to the enclosures.

#### Monitoring

During processing, the pellets have been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination in the pellets before transport. In order to prevent physical contamination during transport to the enclosures, a weekly check should be done to see whether the pellets are being transported to the enclosures in a closed container. All of this is registered on the form "Transport" (view manual Food Processing and Hygiene protocol). If the containers were not closed properly the pellets should be visually checked for physical contamination. If there is any doubt about the quality of the pellets, it is advised not to use the pellets.

#### Registration

The form "Transport" should be input into an Excel-file, so that later check-up, to see if the pellets were transported to the enclosure under the right circumstances, is possible.

### 8.2.7 Pellet transport to bird demonstration

Within the process step 'Transport' there are several risks to be identified. The following risks will be discussed in this paragraph:

- 65. Chemical contamination during transport
- 66. Microbiological contamination during transport
- 67. Physical contamination during transport

This is not a complete list of all the possible risks. This is a selection of the most important risks in pellet transport. A risk is important when it is likely to occur and when it is likely to result in an unacceptable risk for the consumer.

When transporting the pellets to the bird demonstration, many risks can be prevented by making sure the transport is not delayed. The pellets should be transported to the backdrop and the stage as short as possible before feeding. The bird demonstration takes about 30 minutes maximum, as can be seen in <u>Appendix III</u> for the current situation at the bird demonstration. This way, there is no risk of the transport taking too long and there is no risk of the temperature during transport being too high, two risks that could both cause an increased bacterial growth. (*Crissey et al., 2001; Consumentenbond, 1996*)

#### 65. Chemical contamination during transport

Chemical contamination during transport could occur if the pellets are transported to the bird demonstration in a container which was not rinsed properly after cleaning. The risk of chemical contamination can be reduced by cleaning and rinsing the transport containers (and lids) properly after each use. (*Crissey et al., 2001*)

In table 69 the decision tree questions are answered and explained for the risk of chemical contamination during transport to the bird demonstration. This table shows that the risk of chemical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning and rinsing of the transport containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Chemical contamination can seriously affect the quality of the pellets and cause a health hazard to the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Table 69. Decision tree for transport to bird demonstration, chemical contamination

#### Norms

The containers used for transporting the pellets to the enclosures, should be cleaned and rinsed properly after each use.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse it again.

#### Registration

The form "Cleaning" should be input into an Excel-file, so that later check-up, to see if the cleaning is done under the right circumstances, is possible.

#### 66. Microbiological contamination during transport

Microbiological contamination during transport can take place if the transport containers were not cleaned properly. Micro organisms from the pellets that were in the containers before could then remain in the containers and contaminate the pellets for the next feeding. Microbiological contamination can also come from pests like flies. The risk of microbiological contamination can be reduced by cleaning the containers properly after every feeding. Pests like flies can be kept away from the pellets during transport, by keeping the containers fully closed at all times, except when taking food from the containers.

In table 70 the decision tree questions are answered and explained for the risk of microbiological contamination during transport to the bird demonstration. This table shows that the risk of microbiological contamination during transport is a CCP.

#### Table 70. Decision tree for transport to bird demonstration, microbiological contamination

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Sufficient cleaning the containers after every bird demonstration. Containers should be kept closed during the bird demonstration and only opened when necessary.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Microbiological contamination can seriously affect the quality of the pellets and cause a health hazard to the animals.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

#### Norms

Microbiological contamination during transport should be prevented by sufficient cleaning of the transport containers. The lids on the containers should be kept closed as much as possible.

#### Monitoring

During cleaning of the transport containers, a second person (who is not doing the cleaning) should visually check weekly if the containers and lids are rinsed properly. By having a second person observing, the chance of an objective judgement is increased. The observations should be registered on the form "Cleaning" (view manual Food Processing and Hygiene protocol). If the containers are not rinsed properly, the observer can ask the person responsible to rinse them again. A weekly check should be done to see if the containers for transport are kept fully closed during transport. This should be written down on the form "Transport" (view manual Food Processing and Hygiene protocol). If the containers were not kept fully closed during transport, the person responsible should be addressed to this and an explanation should be given why this is important.

#### Registration

The form "Cleaning" and the form "Transport" should be input into an Excel-file, so that later check-up, to see if the cleaning and the transport were done under the right circumstances, is possible.

#### 67. Physical contamination during transport

During transport of the pellets to the enclosures of the animals, physical contamination can take place if objects fall in the pellets. This could happen if the pellets are transported with bare hands (jewellery or nail polish could end up in pellets) or if the pellets are accidentally dropped during transport (objects from the dirty ground could end up in pellets). This could have serious consequences for the health of the animals. This risk can be prevented by transporting the pellets to the enclosures in a closed container.

In table 71 the decision tree questions are answered and explained for the risk of physical contamination during transport to the bird demonstration. This table shows that the risk of physical contamination during transport is a CCP.

Decision tree question	Answer Yes/No	Explanation
Do preventive measures exist for the identified hazard?	Yes	Transport pellets to the bird demonstration in closed containers.
Does this step eliminate or reduce the likely occurrence of a hazard to an acceptable level?	No	The transport of the pellets to the bird demonstration does not reduce the risk.
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could these increase to unacceptable level(s)?	Yes	Objects that end up in or on the pellets can cause health risk for the animals that eat the pellets.
Will a subsequent step, prior to consuming the food, eliminate the identified hazard(s) or reduce the likely occurrence to an acceptable level?	No	There is no subsequent step that eliminates this risk.

Table 71. Decision tree for transport to bird demonstration, physical contamination

#### Norms

No objects should end up in the pellets during transport to the bird demonstration.

#### Monitoring

During processing, the pellets have been inspected for physical contamination. Therefore, it can be assumed that there is no physical contamination in the pellets before transport. In order to prevent physical contamination during transport to the enclosures, a weekly check should be done to see whether the pellets are being transported to the enclosures in a closed container. All of this is registered on the form "Transport" (view manual Food Processing and Hygiene protocol). If the containers were not closed properly the pellets should be visually checked for physical contamination. If there is any doubt about the quality of the pellets, it is advised not to use the pellets

#### Registration

The form "Transport" should be input into an Excel-file, so that later check-up, to see if the pellets were transported to the bird demonstration under the right circumstances, is possible.

## 9. Discussion

After completing the critical control points for all the different kinds of feed, there are some points under discussion, which will be described in this chapter.

The visual checks that have to be done, according to the measures given in this chapter, require one person to visually check another person of the staff while cleaning tools and containers or transporting containers with whole prey. This is a point of discussion since, especially on busy days; every member of the staff is needed for a certain job. If the measures require one person of the staff to watch other personnel clean and transport containers, this could lead to a bigger time pressure at the end of the day.

Besides that, it could lead to minor collisions between members of the staff, when one is commenting the other person on his or her work. Even if every member of the staff realises that these visual checks are the best way to prevent carelessness in the long run and therefore provides a safer situation for the animals, it can still lead to irritation between the personnel, which is the last thing we want for people working together.

Another aspect about these measurements, is that different members of the staff may define 'proper rinsing' different. One may think this means rinsing a container until no more foam or cleaning liquid is present, while the other may require 30 seconds of rinsing as a standard. Measurements like these require consistency, mutual respect and communication skills from the personnel.

The most important part of the discussion is if the measures given for the cleaning of the gloves is feasible. It is easier said that done to clean the gloves after every bird show and after every feeding session. On a busy day there is a chance that more important things come up or that the gloves are just forgotten. Although working with the schedules ensures that the gloves are cleaned at least once a day (since the schedules are checked at least once a day), it does not ensure glove cleaning as often as required for proper hygiene.

In chapter five, different cleaning methods are described, using the best method possible that minimizes the risk of contamination in any possible way. However, since not every situation can be dealt with in a similar way, different rules should be applied. For example, the use of hair nets while processing the food is not a goal that can be reached at the bird demonstration of Avifauna. The use of the buckets with the diluted disinfectant on stage might prove to be difficult to apply during a demonstration.

## 10. Recommendations

In this chapter, the recommendations that follow from the CCP analysis in the previous chapters will be pointed out. For details in each recommendation, we are referring to the previous chapters.

## **10.1.** Recommendations following the HACCP protocol development

After the analysis of the CCPs described in the previous chapters, the following recommendations can be made:

#### Delivery and storage

- Measure the truck temperature at every delivery;
- Visually check for signs of thawing, deterioration, ripped or damaged boxes of bags or leaking cooling fluids;
- Store food using FIFO (First In-First Out) principle;
- Install an alarm which sounds when the temperature in storage gets too high;
- This alarm should be linked to the cell phone of the person responsible for the main storage room, so that this person is contacted immediately when the temperature increases too much;
- A note with the measures that should be taken when the alarm sounds (step by step) should be made and hung up near the storage;
- Personnel should be made aware of the note;
- Deteriorating fruit in storage, should be removed from the crate or box immediately and should be thrown out;
- Use a schedule for regular cleaning and self-defrosting and write down when this was done and by whom;
- When there are several products in storage (for example fruit as well as whole prey in the refrigerator), make sure cross contamination is prevented: since the fruit crates are not covered, make sure the whole prey is placed in closed containers;
- Never keep chemical products in the same space as the food;

#### Thawing (only for whole prey)

- Write down the amount of whole prey taken from the freezer every day;
- At the end of the day, fill in how much whole prey is leftover (this way, calculate how much whole prey is needed every day, to prevent the risk of whole prey being thawed and then stored too long);
- Always keep the whole prey refrigerated in closed containers;

#### The kitchen

- Remove birds from the kitchen to minimize risk for cross contamination;
- The kitchen (including the floor) should always be kept clean of objects that can cause contamination, like feathers, pellets or other rubbish and fluids;
- Close the holes beneath the entrance door (enough for ventilation but accessible for vermin e.g. mice, rats) to keep vermin out **and** create ventilation shafts at higher places;
- Change use of fridges; fruit in the upper one, meat in the lower one to minimize risk of cross contamination (by leaking thawing fluids);
- Never keep two fridges above each other, opened at the same time (cross contamination);
- Write down the refrigerator and freezer temperatures daily and check monthly with a portable thermometer if the correct temperature is given;
- Always use lids (for every bucket, cup and container) and keep the lids closed;
- Keep kitchen clear of objects that do not belong there (feathers, transport box for birds etc);
- Change the metal bowl for macaw fruit to a bowl with a lid;
- Put lids on the buckets with pellets on top of freezer;

- Clean the food crate (used for transport of food containers) on a regular basis;
- Install air-conditioning if the room gets warmer then 20 °C (68 °F);
- Install a dishwashing machine to clean containers and tools properly;
- Meat should be thawed in the refrigerator in a closed container or bucket;
- Processing of food, cleaning and personal hygiene should happen according to the directions given in the report;
- Fruit should always be washed before processing;
- Tools (including knives, scissors and gloves) should be cleaned immediately after use;
- Tools (including knives, scissors and gloves) should be stored in a set place (preferably in a cupboard or drawer) immediately after cleaning;
- The waste bins that are currently used (lids opened by hand) should be replaced by waste bins that can be opened with your foot;
- The freezer in the kitchen (used for storing meat) should be emptied monthly, to prevent food from being stored for too long;
- The dates (when this freezer is emptied and when it is refilled) should be written down on a sheet;
- This freezer should be cleaned every time before refilling;
- The refrigerators should be cleaned weekly and whenever they seem dirty;
- Never keep chemical products in the same space as the food;
- The cleaning products that are used for cleaning the kitchen, should be stored in the lower cupboards (beneath the sinks) immediately after use;

#### Prep room

- Create different working areas for whole prey handling, pellet handling and fruit handling;
- Use lids for all bowls and cups (for each whole prey, fruit and pellets);
- Create box for pellets (one that is closed when not in use);
- The prep room (including the floor) should always be kept clean of objects that can cause contamination, like feathers, pellets or other rubbish and fluids;
- Build roof over outside backdrop sinks that covers both sinks and the person using them (large and high enough), to minimize risk of contamination from wild birds;
- Always clear the sinks from objects or droppings before and after using them;
- Make hot flowing water accessible to backdrop sinks (if this is not possible, the dishwashing machine in the kitchen is crucial for proper cleaning);
- Never keep two fridges above each other, opened at the same time (cross contamination);
- Write down the refrigerator temperatures daily and check monthly with a portable thermometer if the correct temperature is given;
- Always use lids (for every bucket, cup and container) and keep the lids closed;
- Keep prep room clear of objects that do not belong there (feathers, transport box for birds etc);
- Tools (including knives, scissors and gloves) should be cleaned immediately after use;
- Tools (including knives, scissors and gloves) should be stored in a set place (preferably in a cupboard or drawer) immediately after cleaning;
- The waste bins that are currently used (lids opened by hand) should be replaced by waste bins that can be opened with your foot;
- Food (fruit and whole prey) should always be stored in the refrigerator in closed containers;
- The refrigerators should be cleaned weekly and whenever they seem dirty;
- Cleaning and personal hygiene should happen according to the directions given in the report;
- Never keep chemical products in the same space as the food;

#### Show procedures

- Always keep the containers closed during transport;
- Keep pre-bating spots and food clear of objects;
- The transport should happen without delays;
- Use disinfectant at backdrop (every time after switching between handling fruit, pellets or whole prey);
- Keep whole prey, fruit and pellets separated;
- Clean gloves after each show and after every feeding session;
- Clean gloves and grease gloves regularly, according to directions given in the report;

- Use a small bucket with diluted disinfectant to clean hands during the show (on stage the second box can be used to store this bucket;

## 10.2. Cleaning detergents and disinfectants

- Containers and tools should be cleaned after every use;
- Cleaning should happen according to instructions given in the report;
- Care must be taken to properly rinse the tools and containers after cleaning, to prevent chemical contamination of the food;
- Kitchen, prep room and other area's that are used for storing, processing or handling food, should be cleaned regularly, following directions given in the report;

For cleaning detergents and disinfectants, the following Ecolab products have been selected: (Ecolab is recommended since the restaurant at Avifauna already uses Ecolab products, therefore it will be easier to order these products).

- For cleaning the food containers we recommend DISHGUARD 71 (handafwas/allesreiniger). This product should be ordered along with a dispenser system. When using this detergent the food containers should be soaked for 1-5 minutes in warm water. After cleaning the food containers should be rinsed properly so that no detergent gets left behind on the container.
- For disinfection of the processing tables and other necessities it is recommended to purchase DESGUARD 20NL (reinigende disinfectant). This product should be ordered along with a dispenser system and a nebulizer. Products should be soaked for 5 minutes and should afterwards be rinsed so that no detergent gets left behind.
- As far as personal hygiene is concerned, EPICARE 4 (handenreiniger) can be used for cleaning hands. This product should be used along with warm water. The hands should be soaked in EPICARE 4 diluted with water for about 20 seconds. Afterwards the hands should be rinsed with water in such a way that no detergent gets left behind.
- After cleaning the hands, but also for use during and after the bird demonstration, SPITAGEL (handendesinfectant) can be used for disinfecting the hands. A small amount should be used and the hands should be rubbed in it until the hands are dry.

Furthermore: Always follow and fill in the schedules provided in the Manual. Insert them in a excel-file and store these, to allow for later use. It can be very useful to be able to look back when something went wrong, to see what went wrong at that certain time and how this can be prevented in the future.

### **10.3.** Recommendations for future projects

Effective implementation is absolutely imperative for the HACCP Protocol. The best plan will not be worth the paper it is written on without transforming it into effective actions on the work floor. Implementation involves a significant commitment of the employees and continuing involvement and direction from the management.

In order to succeed in the effective implementation of the developed HACCP Protocol, several subsequent researches should be done. The following researches are recommended:

- Introducing the developed HACCP protocol in an effective and efficient way. This includes a description of the responsibilities of the staff. One of the questions in this research should be if personnel have quality control certificates. If this is not the case, it should be looked into if additional staff training is necessary.
- For a next research it is recommended to perform a check on HACCP effectiveness at the bird demonstration at Avifauna. This would include checking bacterial growth at delivery of the food and before feeding the birds. If a significant difference in number of bacteria is found, the HACCP protocol should be adjusted.

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## **12. Explanation of words**

Abrasions	Wearing away of the skin through rubbing or friction.
Aerobic	Living or occurring only in the presence of oxygen.
Aerosol	A collection of very small particles suspended in air, the particles can be liquid (mist) or solid (dust or fume).
Aflatoxins	A kind of toxin or poison produced by the mold Aspergillus flavus which is toxic to both birds and humans. It is a particular problem for stored grain and peanuts.
Arthritis	Inflammation of a joint(s) causing pain, swelling and stiffness.
Backdrop	This is the name for the space behind the scenes at the bird demonstration. There are bird enclosures, buildings (like the prep room) and there is a big space beneath the seats where the visitors of the bird demonstration are seated, which are all part of the backdrop.
Bactericide	A pesticide that is used to kill or inhibit bacteria in plants or soil.
Bacteriostatic	Description of an agent that stops the growth (reproduction) of bacteria, but does NOT kill them
Caustic	Any strongly alkaline material that produces either corrosion or irritation to living tissue.
ССР	Critical Control Point. A point, step, or procedure at which control can be applied and a food-safety hazard can be prevented, eliminated or reduced to acceptable levels.
Conjunctivitis	Also known as pink eye. An infection and inflammation of the conjunctiva, the membrane that lines the inner surface of the eyelids. Usually from an allergy, virus or bacterium.
Corralling	Grouping together of animals.
Cross contamination	Direct of indirect transfer of a pathogen by vectors such as manure, feed, water, insects, etc.
Debridement	The surgical removal of foreign material and/or dead, damaged, or infected tissue from a wound or burn.
Deterioration	A gradual wearing away of a structure through use or exposure to the elements, rather than a sudden destruction
Dispersive	Spreading by diffusion.
Dyspnea	Shortness of breath, difficult or labored breathing.
Emaciation	The severe loss of body weight. Bonyness, extreme leanness (usually caused by starvation or disease.
Endotoxins	A bacterial toxin composed of protein, lipid, and polysaccharides.

Eradicate	To destroy or remove a pest or pathogen after disease
Exoroxins	An exotoxin is a soluble chemical excreted by a microorganism, including bacteria, fungi, algae, and protozoa.
Fatigue	Fatigue is a feeling of excessive tiredness or lethargy, with a desire to rest, perhaps to sleep.
Food-borne	Carried by food into the body.
Germicides	A broad category of usually synthetic bacteriacides.
GMP	Good Manufacturing Practice. A quality management system first developed in 1992 that has been adjusted and improved since then.
Gram-negative	A classification of bacteria based upon their lack of retention of a certain stain in the laboratory. The staining quality is based on the structure of the cell wall surrounding the bacteria. This structure of the cell wall influences which antibiotics will kill the bacteria.
HACCP	Hazard Analysis and Critical Control Points. As part of the GMP quality system, it is a preventative system aimed at identifying checkpoints where potential hazards can enter the food production pathway. After the analysis, CCPs can be controlled which enhances food safety.
Immunodeficiency	The decreased ability of the body to fight infection and disease.
Kitchen	The kitchen, or "processing room" is a room that is used only by the personnel from the bird demonstration. Here, the food is thawed and processed before being transported to the prep room for temporary storage.
Lesions	Tissue with impaired function as a result of damage disease or wounding.
Lethargy	A feeling of tiredness, drowsiness or lack of energy.
Lipid	The main type of fat found in the body
Listlessness	A feeling of lack of interest or energy.
Main kitchen	The zoo kitchen where all the food for Vogelpark Avifauna is delivered and stored. Most of the food is processed here before being transported to the enclosures.
Micro organisms	Bacteria, yeasts, simple fungi, algae, protozoans, and a number of other organisms that are microscopic in size.
Pathogens	Microorganisms that can cause disease in other organisms (humans, animals, and plants)
Peritoneal cavity	The space within the abdomen that contains the intestines, the stomach, and the liver. It is bound by thin membranes.
Pre-bating spot	Set locations (e.g. on a tree stump) where the food is placed prior to the birds arrival to the spot.
Precipitates	To separate materials from a solution by the formation of insoluble matter by chemical reaction. The material which is removed.

Prep Room	The prep room is a small garden house that is located at the backdrop of the bird demonstration. Here, the food is temporarily stored and processed further before feeding the birds at the bird demonstration or in the enclosures.
Regurgitation	Food already swallowed is ejected from the mouth.
Residue	Matter that remains after something has been removed.
Respiratory	Refers to the lungs or to the act of breathing.
Saponify	Become converted into soap by being hydrolized into an acid and alcohol as a result of being treated with an alkali.
Sequester	A chemical reaction in which certain ions are bound into a stable, water soluble compound, thus preventing undesirable action by the ions.
Serological	The branch of medical science that deals with serums; especially with blood serums and disease
Soil	Any unwanted food residue, organic or inorganic matter remaining on equipment and other surfaces.
Somnolence	Sleepiness, the state of feeling drowsy, ready to fall asleep.
Surfactants	Surfactants, also known as wetting agents, lower the surface tension of a liquid, allowing easier spreading, and the interfacial tension between two liquids.
Transient flora	Microbial flora only temporarily associated with a particular niche.

## **Appendix I: Properties of freezing and infections and toxins of foods**

#### Properties of freezing

High microbial counts in whole prey may be caused by improper thawing. Delays in freezing, slow rates of freezing, and inadequate freezer temperatures also affect quality. The physical, chemical and biological changes that occur during freezing are complex and not fully understood.

The freezing point of a substance is "that temperature at which the liquid is in equilibrium with the solid". Many foods, including whole prey, have a high water content and freeze between temperatures of 0 to 3  $^{\circ}$ C (27 to 32  $^{\circ}$ F).

There are several methods of freezing, including cold air blasts, direct immersion in a cooling medium, contact with refrigerated plates in a freezing chamber and freezing with liquid air, nitrogen or carbon dioxide.

Changes in flavour, colour and texture, as well as losses in nutrients occur fairly rapidly at temperatures above 9 °C (48 °F). Because of the physical nature of whole prey, the method of freezing affects quality and nutrient loss upon thawing. Whole prey frozen rapidly to 0 °C (32 °F) has less "drip" (nutrient loss due to water loss from cells) when thawed. Length of time for whole prey to freeze is dependent on temperature of the freezing chamber, temperature of food upon entering the freezing chamber and type, shape and size of packaging.

Freezer burn due to dehydration can be reduced by method of packaging. Unprotected items are subject to a constant moisture loss as water is removed through circulating air. Damage caused by freezer burn is irreversible and results in changes in colour, texture, flavour and nutritive values.

Freezing kills some microbes. Those not killed will grow upon thawing. Although most micro organisms do not grow well at temperatures below 0 °C (32 °F), some yeasts and moulds can grow in unfrozen foods with temperatures as low as 9 °C (48 °F). Growth of micro organisms can be greatly influenced by the temperatures at which the food is thawed.

Some nutrients can be affected by freezing. Although there s little change in the nutritive value of proteins, they can be denatured by freezing, altering the appearance and quality of the product. Proteolysis can occur while animal tissue is frozen if the enzymes are not inactivated, Freezing only slows enzyme activity, which is usually optimum at higher temperatures.

At a temperature of about 2 °C (36 °F) there is a reduction in rancidity of fatty tissue. Rancid fats cause a lower nutritive value. Antioxidants, such as vitamin E, are utilized during fat breakdown and are therefore deficient in rancid fats. Also, processing of foods, including the exposure of tissue to air and heat, allows oxidation and destruction of vitamins and the build-up of microbes.

Freezing temperatures may destroy parasites. Moulds and yeasts may grow at freezing or slightly below freezing temperatures. Some bacteria in whole prey (*Salmonella ssp., Escherichia coli* and *Staphylococcus acromonas*) can survive freezing temperatures and will resume growth when thawed. At temperatures of 3 °C (37 °F) or above, spores of *E. clostridium botulinum* can survive, grow and produce toxins.

#### Infections and toxins of foods

Food infections and intoxications, often referred to as food poisonings, have largely gone undetected in zoo animals because investigations have been limited. Such infections can be caused by natural toxins found on the whole prey, improper handling of foods and exposure to microbes.

Whole prey is categorized as a perishable food item and must be handled carefully to prevent spoilage. Whole prey is included in "Potentially hazardous food, ...in a form capable of supporting rapid and progressive growth of infectious or toxigenic micro organisms."

There are a variety of causes for spoilage of foods, including one or more of the following:

- Growth and activity of micro organisms (or occasionally higher forms) present; often a succession of organisms are involved
- Insects or parasites

- Action of the enzymes naturally found in whole prey
- Purely chemical reactions, that is, those not catalysed by enzymes of the tissues or micro organisms
- Physical changes, such as those caused by freezing, burning, drying, pressure etc.

The type and number of micro organisms on the whole prey, in the storage area, in the preparation area, on the utensils, or transferred by the handler will determine the type and extent of spoilage. Several types of bacteria can be found on or transferred by human carriers, including *Salmonella* spp, *Staphylococcus aureus*, *Clostridium perfringens*, *Campylobacter jejuni*, *Clostridium botulinum*, *Listeria monocytogenes*, *E. coli* and Yersinia enterocolitica. Competition occurs among bacteria, yeasts, fungi and moulds-one organism outgrowing another due to the environmental conditions. Not all micro organisms are antagonistic. Some may be symbiotic or synergistic. Micro organisms can also be metabiotic, with one organism making conditions favourable for growth of the second.

The difference between food infections and intoxications is that infections are caused by the ingestion of the organism, while food intoxications are caused by the ingestion of toxins produced by bacteria, moulds, plants and insects. In healthy adult humans, infections are usually not fatal, but they can be in weakened individuals. Intoxications occur less frequently, but reactions may be more severe and result in gastroenteritis, paralysis and possibly death.

Exposure to live insects and rodents may increase the micro-organism load or introduce new micro organisms to the whole prey. Live insects and other pests also can carry micro organisms to utensils, buckets, tables and so forth, which can then contaminate the whole prey. Environmental conditions will govern the fungus, yeast and bacteria that will flourish.

All foods and possibly utensils should be kept covered in containers that are rodent- and insect proof to prevent contamination. Good hygiene by the staff preparing the whole prey is equally as important.

Chemical properties of the whole prey also may affect spoilage. Properties of food that will influence spoilage include pH (hydrogen-ion concentrations), nutrient content, moisture availability, oxidation potential and presence of inhibitory substances.

The physical state of the food -frozen, heated, moistened or dried- can influence whether it will spoil and the type of spoilage. Organisms need water to grow. Salt dissolved in water draws water from the cells and freezing it may damage tissue, causing a release of juices when thawed. The emulsions of fat and water caused by the breakdown of tissue and denatured protein are readily available to support the growth of micro organisms.

Prevention of food borne illnesses begins at slaughter with appropriate killing techniques used on good-quality specimens. Proper and sanitary processing at the manufacturer is also essential. Zoos can help prevent food related illnesses with proper handling when storing and processing whole prey and prey. Whole prey should be kept frozen until 24 hours before preparation and use. Proper procedures and validation processes will help ensure contamination does not occur and growth of those contaminants is kept to a minimum.

(Crissey et al. 2001)
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Vogelpark Avifauna, 2007, den Boer, M



# Appendix III: Map of bird-enclosures and Kitchen



## Appendix IV: Current hygiene situation at the bird demo of Vogelpark Avifauna

#### In storage

When the food is delivered at Vogelpark Avifauna, it is brought to the central kitchen, which is the storage place for all the animal food in the park. The central kitchen has a refrigerator for the fruits and a freezer for the whole prey products. Both the fridge and freezer have a surface of 4 by 3 meters and the height is about 3 meters. There is sufficient lighting and the inside walls are smooth and easy to clean. When the freezer and fridge are full, it is still possible to walk through and reach all the food, because of the way the food is stored. The freezer has a thermometer at about 1 meter height on the inside, which can be read at the outside of the freezer. The normal temperature in the freezer is around -18 °C (0 °F). The temperature in the fridge is around 6 °C (43 °F). The temperature is checked on a regular basis, but not written down. There is no alarm that sounds in case the temperature changes to a dangerous level. These last two notes can cause a serious risk for the quality of the food. The fridge and freezer do not have descending floors (towards a drainage system), but they are swept empty on a regular basis. This may also cause a risk, as melt water (possibly caused by malfunction of the freezer) could damage the food in storage. The freezer has a self-defrost function, which is used from time to time, but not on a regular basis. Point of improvement here is to have a cleaning and self-defrosting schedule and a schedule to write down the temperatures. Also there should be an alarm when the temperature changes to a dangerous level. There are no traces of ice in the freezer (these could indicate an interruption of the freezing process). There is a different food supplier for the fruit and for the whole prey. When the food products arrive, only a simple visual check is done before bringing the food inside (e.g. when the boxes with whole prey feel soft and mushy, the products are not at the right temperature, depending on the situation this could mean that the delivery is not accepted). The temperature of the food that is delivered is never measured. Point of improvement here could be to measure the temperature of the food when it arrives every time. The food can be in the fridge and freezer for a maximum of two months, but more often it is all fed to the animals within around three weeks.

The attic of the central kitchen is used as storage for the seeds and pellets. There is a large wooden food dispenser in the attic. This food dispenser has different silo's on the attic, with a chute leading to the main kitchen. In the main kitchen there is a latch, which can be opened to get the pellets from the silos.

There is one food supplier for the fruits, called G. Kramer & zonen. The fruit that is brought in is the same fruit that is used for human consumption. Sometimes however, some fruit that is over date (and therefore cannot be sold in the supermarkets anymore) is brought in. This is food that is just one day over date and it is fed at the latest one day after being brought in. The fruits are delivered in crates. The different fruits are separated: one crate for apples, one for kiwi's etc, bananas are mostly delivered in cardboard boxes. There are many different fruits like apples, bananas, kiwi's, carrots, melons etc. The fruits stay in these crates in storage and are that way stored together, without getting in contact with other food. The crates are carried in to the refrigerator by hand and piled up on the sides of the fridge, immediately after delivery to Vogelpark Avifauna by the contractor. By storing the food this way there is a 'walk path' from the front to the back of the fridge and all the food can be reached easily. The food is taken from the front and the fridge is filled up from the back. This FIFO (First In-First Out) method ensures that no food is left in storage too long. The fridge also stores small amounts of whole prey, which is the whole prey used by the rest of Vogelpark Avifauna (not the bird demonstration) and some trays of mealworms. Although the whole prey does not get in contact with the fruit, is could still form a contamination risk as the whole prey and fruit is not covered or sealed off in the fridge.

The whole prey is delivered frozen by Kiezebrink Putten BV and carried by hand into the freezer immediately after arriving at Vogelpark Avifauna. Kiezebrink Putten BV applies to the newest European Law about "Trade in animal by products" (EU 2002/1774), which is in use since 2003. The temperature of the whole prey is not measured on arrival of the food. The whole prey is delivered in cardboard boxes. There are different boxes for the mice, the rats, the one day old chicks and the quail. Each box describes its contents and weighs about 10kg. The whole prey is stored in the freezer in these boxes, this way there is no contact with other food. At the time of visiting, there were two dead birds stored in the freezer. These had passed away by natural causes and will be fed to the vultures later on. These birds were put into a plastic bin bag and put into a crate, but the legs and some of the

feathers were sticking out. The crate was put on top of a pile of boxes. There was no direct contact with the food in the freezer, but it has to be noted that this could cause a contamination risk.

There is one supplier for the pellets, called 'Versele'. This supplier follows HACCP and GMP regulations. When the pellets and seeds are delivered, a fork-lift truck is used to transport the pallets full of bags onto the attic. The bags are 25kg each and come from several, all well-established food subcontractors. On the attic, the pallets full of bags are placed alongside the walls, leaving enough space for the people to walk around and manoeuvre the bags towards the food dispensers. The bags are made of cardboard paper. The bags are emptied into the silo's of the food dispenser. Because the silo's are filled up from the top and emptied (via the latch) from the bottom, the pellets and seeds are used with the FIFO method as well as the fruits and whole prey. The silo's are always fully emptied and swept clean before filling them up again, to prevent the food to form clutches and clog up the chutes. There used to be a pest problem in the attic (mice), but this problem was solved using little machines that transmit high frequency sound waves, that scare off the mice. Since the use of this product, there is no longer a pest problem. There are some bags that are not emptied in the silo all at once (some bags are open, these are used to fill up the buckets that are taken to the prep room), these bags are closed using clamps. There are no lids on the silo's, this could create a contamination risk. However, the room is fully closed from the outdoors (there is one door leading outside, which is open during the stocking of new products and one door leading to the stairway towards the kitchen, which is closed all the time). There are no problems with flies here. Therefore the risk of contamination is very small.

#### The kitchen (Processing room)

The kitchen is a small room with two separated working places. On one side of the room there is a kitchen sink with two washbasins and on the other side is a large worktable. The worktable is used for preparing the whole prey and the kitchen sink is used for preparing the fruits. Above the kitchen sink there are 4 cupboards, as well as underneath the sink. There is a concrete floor which is about 30 cm lower that the doorway and has a small ramp up towards the door (which causes no problems with heavy rains). The kitchen has one door leading outside and 4 doors leading directly towards bird residences (no extra door between the kitchen and the bird residence), see Appendix III for a map. Inside the kitchen there are two open bird cages that house 3 cockatoos at the time of visiting. Normally these are empty. There is one window that cannot be opened and there are two fridges (size about 60x80x60cm) at a temperature of 6 °C (43 °F) and one freezer (same size as fridge) at a temperature of about -20 °C (68 °F). There is a thermometer in the freezer with a display on the outside. There is no alarm when the temperature changes to a dangerous level and the temperature is never checked. The freezer has four drawers, one for rats, one for mice, one for quails and one for one day old chicks. These are all stored in the drawers without any packing material. The whole prey in this freezer is an emergency supply, in case there is no more whole prey in the freezer in the central kitchen or if all this whole prey is for some reason not usable for feeding. The whole prey in this freezer is used up regularly and the freezer refilled, to prevent the whole prey from getting too old. Point of improvement here is to write down when the freezer has been emptied and refilled in order to make sure it is regularly refilled and the food inside has not been in there for too long. The quails are not fed to the birds used in the show. The fridges stand on top of each other and the bottom one is for fruits and the top one for whole prey. Some food is kept in the fridge in open bowls (no lids). At the time of observing, there was a transport box standing in the middle of the room that was not clean and the floor was not clean (straws), and there was an open bag of California Walnuts on the floor, which was not closed properly (clamp on it or some other way).

The outside door has a 3 cm wide opening underneath. (P.a. Linda: Enough for ventilation but also for getting pests (mice) inside). The food is therefore kept in closed containers and bags all the time, but it still causes a contamination risk.

There are two cutting boards in the kitchen: a green one for the fruits and a red one for the whole prey. Each bird has his own plastic container with his name written on it and the lids for the fruit containers have "Fruit" written on it. The Macaws have one big bowl of their own for their fruits. The containers for the fruit eating birds are kept in the upper kitchen cupboard on the right side and the containers for the whole prey -eating birds are kept on the left side. The two cupboards in between are not in use. The bottom cupboards (below the sink) are used for cleaning products and cleaning utensils. Buckets with seeds and pellets stand on top of the freezer (no lids). There are some bird feathers hanging on the wall above the freezer. The fruits are picked up from the central kitchen fridge every morning just before starting the food processing. This way the fruit is always freshly processed. In the kitchen, the fruits are cut into ready-to-eat pieces (not rinsed with water) and put into the containers. If there is fruit rotten it is picked out and thrown out in the waste bin. The fruits are not always washed before use, but the kiwi and bananas are always peeled. When choosing which fruits to feed, the contents of vitamins and minerals in the fruits are taken into account (e.g. a bird cannot have too much kiwi because of the big amounts of vitamins and iron). Taking the bird's behaviour, weight and feeding history (over past few days) into account, the amount of food for each bird is determined. When there is fruit left over (after carefully weighing each bird's food), it is stored in the fridge in the kitchen. This fruit is then used up first the next day. The fruit waste is thrown out in the waste bin and ends up as compost.

The whole prey is taken from the storage every day after preparing the food for that day. The frozen whole prey is then placed onto a large plastic bowl and a large bin bag is put around and tied shut. This way, the food stands to thaw one day and one night and it is processed the next morning. Thawing the whole prey this way causes the risk of bacterial growth on the whole prey. The whole prey is left to defrost about 20 hours and at the time of processing it is fully defrosted. The maximum amount of time the food is defrosted before being fed is (from processing at 9am until the last feeding at max. 5pm) eight hours. To estimate how much whole prey is needed every day, there is a schedule present on which the amount of whole prev taken from the freezer is written down. The amount of food that is left over at the end of the day however, is not written down. By using this list, every day the same amount of whole prey is taken out and there is a possibility that there is too much whole prey taken out each day. Point of improvement is to use the schedule to write down how much whole prey is left over at the end of each day. That way, in the morning, the amount of food taken could be adjusted to the needs of the animals. The whole prey that is defrosted is never frozen again. The whole prey is separated into food and waste: the intestines are taken out, the tail is removed and most feathers are removed and all this is put into a separate bowl. Each bird has its own diet, so the food is being weighed to fit the needs of all the birds. There are two different scales: one for fruit and one for whole prey. A tin bowl is used to weigh the food. The big pieces of whole prey are cut into smaller one using a pair of scissors. There are no supplements added to the food. After dividing all the food over the containers, all the lids (separate lids for whole prey and fruit) are put on and the containers are placed into an open crate (fruit containers on one side, whole prey containers on the other side). The waste whole prey is put into a plastic bag that is tied shut and put into the waste bin.

After placing all the containers into the crate and putting the whole prey and fruits that are not used, back in the fridge, both the working table and the kitchen sink are cleaned thoroughly with warm water and dishwashing detergent and a sponge. The cutting boards and tools (knife and scissors) are cleaned in the same way and afterwards the hands are cleaned again. The crate with food is then carried through the park by hand towards the preparation room (behind the scenes at the bird show).

#### The Prep Room

The prep room is a small garden house, which has three tables, some shelves and two refrigerators. One table is used for preparing whole prey and pellets. The other two tables are used for paper work and other activities. There is only little room to move around in here and especially when working with all the personnel (5 people), people are often getting in each others way. There are two opening doors, but most often only one of them is open and there is a small window that can be opened. There are fly catching strips present in the prep room.

The two fridges are placed on top of each other; the upper one is used for fruit storage (as well as mealworms) and the lower one for whole prey and fish storage. The whole prey fridge contains a bucket with day old chicks, mice and quail. It also contains fish for the ibises. The bucket with day old chicks is only covered with a towel. At the time of visiting the fridge was dirty and there was a cup with mice lying in the door.

The upper fridge which is being used for fruit and mealworms contains two scales with fruit and a bucket with mealworms. These scales and bucket are not covered with a lid or towel. Alongside with these scales and bucket there are some individual cups with bird diets, which do have a lid. Also this fridge does not look very clean. Point of improvement would be to clean these refrigerators on a regular basis (e.g. once a week).

On warm days the food containers are kept inside the fridge until used for further processing. Point of improvement would be to keep containers with food inside fridge every day, always.

Below the table that is used for whole prey and pellets (point of attention on its own) there are several buckets with pellets for the fruit eating birds. These buckets are refilled when empty at the storage in the central kitchen. Important here is that there is a high risk of cross contamination, since these buckets do not have a lid. Also, there are no cups used for the pellets but the pellets are often scooped from the bucket by hand. Point of improvement would be to have these buckets closed at all time (using lids) and to have a scoop or cup for each bucket that is always kept inside the bucket.

The diets for the birds that need pellets are put into plastic cups by hand. There are lids for these cups; however, the cups are usually stacked up after the diets are made, leaving the top cup open. The diets for the macaws are made before the first show. For every show some pellets are taken from the cup for use in the bird demonstration. These pellets are kept on the lid during the show, mostly for convenience of use during the demonstration. During the show there is risk of cross contamination with whole prey, since there is not always time to clean hands properly during the show.

The pellets for the red ibises are made just before they are trained mostly the same way as the macaw diets. However different is the fact that water is added to soak the pellets. As soon as the pellets are soaked, the cups are closed with fitting lids and are stacked up on the prepping table.

There is a risk of cross contamination between clean and dirty materials, since the whole prey and pellets and fruits are all prepared on the same table. The tools used for preparing the whole prey are a pair of scissors. The whole prey is cut into smaller pieces here just before the demonstration. The fruit is cut using a knife (this knife is for the fruits only), and the pellets are kept in separate cups or in pockets. Point of improvement is to give personnel instructions for how often to wash the working clothes and to have cutting boards here too, for both whole prey and fruit. The waste bin in this room, underneath the table, next to the buckets with seeds, is closed with a lid (which has to be opened by hand, possible contamination risk) and emptied regularly. Point of improvement is to keep the waste bin further away from the food and to have a waste bin that is operated by using your foot.

If there is whole prey left over from the feedings, it is kept inside the fridge and fed to the vultures the next day. The amount of time the food is kept defrosted, before feeding to the vultures is maximum 9am until 5pm the next day, which is (8hours + 24 hours) 32 hours. For the vultures however, this does not cause any risk, since these animals are naturally used to eating old whole prey. The food containers are cleaned at the end of the day, after all the feedings have finished. For cleaning, there are two loose kitchen sinks hanging outside, with cold running water. There is no rooftop or cover over the sinks. The sinks are operated by turning the handle by hand. The left sink is used for whole prey and the sink on the right for fruit containers. There is a wooden dividing wall between the two sinks, which prevents cross-contamination by splashing. Cleaning is done with separate brushes and with disinfecting cleaning liquid (Addex Pro). After cleaning, the containers are put upside down into the crate and left to dry. The fact that these sinks are not covered means there is a risk of contamination (for example by droppings of wild birds). Point of improvement is to either have a rooftop over the sinks and hot water running here or to get a dishwashing machine for cleaning the food containers and tools. With the use of this machine all the containers and tools will be cleaned properly and it can be used overnight: place the containers and tools in at the end of the day, turn the machine on and the next morning, as the food processing starts, get the containers out. They are already dry at that time.

#### During show, observed from public:

The gloves used during the show are left-handed. This glove is used for the birds of prey, owls and vultures.

The glove is not cleaned in between different birds; caused by lack of time during show. When fruit eating or seed eating birds are on stage the glove is put away, seeds are used. When switching between birds, the person on stage disinfects hands with 'Etos desinfecteer middel'.

On stage there is a fake tree log with a built in box, which is used for temporary storage of food, glove and disinfectant. The whole prey is put in a small box (no lid) on a paper with names of the birds. On top the eagle glove is kept while fruit or pellet eating birds are on stage. Next to this small box there is a little cup with fruit (also no lid). The reason that there is no lid on these boxes is convenience and lack of time during show.

During the show, at one point a Griffon vulture is demonstrating how it eats whole prey from a large skull that is laying on stage. The whole prey is put inside the skull just before the show starts. After the

show the money box is used by one of the show people and Casper, the ducorps cockatoo. This is a fruit and seed eating bird. On stage it gets fed sunflower seeds.

The glove used for the Macaws is kept inside the pocket where the seeds for the Macaws are also kept. By keeping the glove here instead of in the box where the food is kept, there is no risk of cross-contamination.

#### During show, at the backdrop:

The food is kept in individual plastic cups (with lids) for each individual bird. These cups are put in two boxes during the show. The upper box is used for fruit and seeds, while the lower box is used for whole prey.

At the backdrop there is currently no disinfectant available for use. Because of lack of time during the show, hands are only quickly cleaned with tap water, which is insufficient for proper disinfecting: this is a major point for improvement (e.g. disinfectant towels, disinfectant water with a towel etc).

#### Personnel

Most of the staff is wearing clothes of their own and a T-shirt from Vogelpark Avifauna. Only the personnel that are on stage during the demonstration have a complete outfit (blouse and pants) from Avifauna. There are no disposable gloves used during food processing or during the show. The (leather) gloves that are used are mainly for protection against the sharp claws of the birds. No aprons are used during food processing. (p.a. Mafalda: Find out what is the best way to properly clean the leather gloves that are used in the demonstration. At this moment the gloves are cleaned with water and a brush and are then lubricated in order to keep the leather flexible)

## Appendix V: Whole prey quality control standards

Quality control factors are used to determine whole prey quality during inspection and preparation. Although there is no ultimate test to determine the quality of prey, below is a compilation of descriptions of acceptable, inferior and unacceptable whole prey, with suggestions for prey inspection.

Factor	Acceptable	Inferior	Unacceptable
General appearance	Shine of luster to skin,	Some loss of sheen	Luster gone, lumpy
	no breaks in skin, no		
	bloating or protrusion of		
	viscera, no dehydration		
Eyes	Translucent, full, may	Dull or cloudy, slightly	Dull, sunken, cornea
	be slightly sunken	sunken	opaque (white), red-
			bordered eyes
Odour	Fresh odour	Mild sour odour	Medium to strong
			odour, putrid odour
Feel	Firm and elastic, whole	Moderately soft, slight	Soft, spongy and flabby,
	prey does not stay	indentation left when	exudes juice and easily
	indented when touched	touched	indented when handled,
			may break open or skin
			may split when handled





### **Appendix VII: Glove maintenance**

The gloves that are used to handle the birds and to feed whole prey to the birds at the bird demonstration of Vogelpark Avifauna should be cleaned at least daily. Preferable however, is to clean the gloves (especially on warm summer days when there are a lot of flies around) after every bird demonstration and after every feeding session.

Spray some Nolvasan (chlorahexiderm) dilution on the glove and rub off the prey leftovers, feathers etc. This is a fast and easy way to remove all prey leftovers and this product can be used after every show.

Nolvasan (chlorhexidine diacetate), the only EPA-registered chlorhexidine disinfectant, works against at least 60 different bacteria, fungi, yeasts, and viruses. Nolvasan is non-corrosive, has minimal to no skin irritation, and retains antimicrobial activity in the presence of organic matter. Nolvasan's unique binding to skin proteins provides residual activity for as long as 2 days (*Petvetsupply.com, 2007*).

In The Netherlands chlorahexiderm is known as chloorhexidine and is available under the names Hibitane, Hibiscrub, Sterilon and the brandless Chloorhexidine (*Wetenschappelijk Instituut Nederlandse Apothekers, 2002*). For practical use it would be best to use a product which is available as a spray.

To keep the gloves clean and neat and keep the leather flexible, the gloves should be greased regularly (every couple of weeks, depending on how much the gloves are used). For this, the product "Hide rejuvenator" can be used. This product can be found in equestrian stores, since it is often used for saddles and bridles. The product "Kiwi outdoor Mink oil" can also be used for greasing. Kiwi Mink Oil contains a rich blend of mink oil, silicone, and lanolin which conditions and waterproofs smooth leather (*kiwishoeproducts.com, 2004*).

This product is not available in The Netherlands; however there are several similar products available for use.

The product should be rubbed into the leather extensively and the gloves should then be left over night for the grease to work on the leather. The next morning the excess grease may have to be rubbed off before use. The grease should not be coming off anymore when using the gloves again for feeding, since it may end up on the prey or on the feathers of the birds. (Courtesy of *Natural Encounters Inc, W. Stellaard*)

## **Appendix VIII: Pest Prevention**

Pest prevention, as the name says, should always be preventive. If vermin is discovered in a company, it means something has gone wrong.

Prevention of vermin starts at the build and decoration of a building. Pipes and grates should be easily accessible for cleaning, but should not be accessible form the outside. That is why windows that open to the outside should have insect screens in front. If vermin cannot find food inside, they will not stay for long. The best way of pest prevention is a tidy and clean company.

Meat leftovers and garbage will attract mice and rats. That is why waste bins should be closed. After emptying, the waste bins should be cleaned properly.

Further preventive measures, like placing traps etc. are not obligatory. Only when pests are present, poison and traps should be used. These should be used following instructions, to prevent accidents. It is clear that poison should never get in contact with the food.

Insects can be controlled using different products. One example is the UV light that attracts flying insects and kills them. The reservoir below the light should be cleaned and cleared from dead insects regularly.

If, despite these measures, there is still a pest problem, a plan should be made to control them. Expert advise may be needed to determine which corrective measures should be taken. The pest prevention can then be put in the hands of a specialist, who will determine which measures were taken. (*Verschuur and Dijkstra, 2003*)

#### Measures

Prevent pests from entering by blocking their passageways (like gaps, windows and doors). Make sure pests will not survive and multiply, by keeping the company clean and tidy and free of (accessible) waste.

# **Appendix IX: Prep room pictures**



Processing table for fruit in the prep room

Processing table for whole prey in the prep room. The white buckets are the storage buckets for the pellets



Whole prey refrigerator in prep room

Fruit refrigerator in prep room

# Appendix X: Kitchen pictures



Kitchen sink, cupboards and processing table for fruit



Processing table for whole prey

## Appendix XI: Avian-borne diseases and its relation to human illness

On the next pages some common diseases which can be transmitted from birds to humans are given along with the symptoms and prevention, which can prove to be important for this research. The diseases that are mentioned can either be transmitted by the birds (faeces or secretion) or by the prey fed to the birds. (*Centre for disease control and Prevention*)

### BACTERIA

#### TULAREMIA ("rabbit fever"): Scientific name: Francisella tulerensis Transmission: -Through broken skin. -Undercooked infected meat. -Inhalation. -Bite of mosquito, tick, and horsefly. -Eve conjunctiva touched by contaminated hands. Host animals: Predominately rabbits and to a lesser extent over 100 mammals and 25 avian species. Incubation period: One - 10 days **Clinical symptoms:** -Through broken skin: flu-like in nature with skin ulceration at point of organism entry. -Ingestion: diarrhea and vomiting. -Inhalation: pneumonia. Treatment: Tetracyclines or dihydrostreptomycin. Prognosis: Ranges from complete cure to rare but possible death. **Prevention:** -Exam gloves when exposed to animal blood, particularly that of rodents and lagamorphs. -Tick control. -Properly cooked contaminated meat. -Avoid urine contaminated water. -Good personal hygiene. (Angelfire.com) LYME DISEASE: Scientific name: Borrelia spp. Transmission: Bite of nymph-stage tick. Host animals: All, including domestics. Incubation period: One or more weeks. (Exception is a visual ring-shaped lesion or "bull's-eye" which appears at site of bite within 48 hours in approximately 30% of exposures. **Clinical symptoms:** -Fever with chills, sweating, headaches, vertigo, fatigue, and diminished concentration. -Chronic, reoccurring arthritis. -Neurologic or cardiac problems. Treatment: Megadoses of prescribed antibiotics, orally or intravenous. Prognosis: Good with early intervention; Chronic symptoms possible with delayed treatment. Prevention: -Lyme vaccine protection. -Tick control in animals as well as in the environment. -Avoid bite wounds and saliva of tick infested animals. -Personal tick inspections. -Immediate medical consultation if exposed.

(Angelfire.com)

#### CHLAMYDIOSIS (psittacosis or ornithosis):

Scientific name: Chlamydia psittaci.

Transmission: Inhalation of aerosolized feces.

Host animals: Over 100 avian species including pigeons, raptors, and finches.

Incubation period: Four to 15 days.

Clinical symptoms: Flu-like symptoms which can develop into bronchopneumonia. May be severe in

persons over 50. **Treatment:** Chlortetracycline. **Prognosis:** Good; very low mortality rate. **Prevention:** Control of avian fecal matter.

#### SALMONELLOSIS (A common, worldwide zoonose):

Scientific name: Salmonella spp. Transmission: -Fecal-oral. -Fecal contaminated food and water. Host animals: Common in opossums but can be found in all vertebrates. Incubation period: Six to 48 hours. Clinical symptoms: Diarrhea, vomiting, dehydration, and low-grade fever. Treatment: Supportive care, bed rest, and electrolytic fluids. Antibiotics are contraindicated unless salmonella group is identified. Prognosis: Recovery in two-four days. Prevention: Personal hygiene to prevent fecal-oral exposure. (*Angelfire.com*)

*Campilobacter jejuni* and *C. coli* have recently become recognized as common bacterial causes of diarrhea. Infection can occur at any age. Sources of infection are typically mammalian and avian hosts. The usual incubation period of campylobacter enteritis is 2 to 5 days. Fever, diarrhea and abdominal pain are the most common clinical features. The stools frequently contain mucus and, a few days after the onset of symptoms, frank blood. Significant vomiting and dehydration are uncommon. A rapid presumptive laboratory diagnosis may be made during the acute phase of the illness by direct phase-contrast microscopy of stools. Isolation of the organism from stools requires culture in a selective medium containing antibiotics and incubation under reduced oxygen tension at 42 °C. The organism persists in the stools of untreated patients for up to 7 weeks following the onset of symptoms. Erythromycin may produce a rapid clinical and bacteriologic cure and should be used to treat moderately to severely ill patients as well as patients with compromised host defences. (*Lessenger,2003*)

### **MYCOSES (Fungi)**

ASPERGILLOSIS: Scientific name: Aspergillus fumigatus. Transmission: Inhalation of fungal spores. Host animals: Captive birds, mainly waterfowl and raptors. Incubation period: Undetermined. Clinical symptoms: Respiratory disorder. (Except for persons debilitated by disease, illness, or on long term medication, most persons are resistant to infection.) Treatment: Antifungal drugs. Prognosis: Good with proper treatment. Prevention: -Personal hygiene. -Do not house waterfowl on wood shavings. -Dispose of moldy waterfowl food or bedding.

-Use of masks during necropsies of suspect animals.

#### HISTOPLASMOSIS (Not zoonotic but worthy of mention):

Scientific name: Histoplasma capsulatum.

Transmission: Inhalation of spores.

Host animals: Indirectly through avian feces.

Incubation period: Undetermined

**Clinical symptoms:** Mild, self-limited respiratory infection. <u>If severe:</u> fever, anemia, enlargement of spleen and liver, leukopenia, pulmonary distress, adrenal necrosis, and ulcers of the gastrointestinal tract.

Treatment: Intravenous medication.

**Prognosis:** Good except occasionally in debilitated elderly or pulmonary patients. **Prevention:** Routine disposal of bird droppings in roost areas. (Histoplasmosis occurs naturally in the soil. Long term accumulation of avian feces can enrich the soil to favor development of the airborne spores.) (*Angelfire.com*)