

Equine Joint Health Supplements and the Knowledge Behind all

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Equine Joint Health Supplements and The Knowledge Behind All

Thesis

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Preface

I am Nikki Jantzen, a fourth year student 'International Equine Business Management' at the Aeres University of Applied Sciences in Dronten, The Netherlands. To finish my final year of the study I have to write a research report, also known as my final thesis. The research is focussed on supplements in the equine industry, with a specific focus on joint health supplements for sport horses.

I decided to work on this subject by passion and because of my internship at Synovium, a supplement brand in the equine industry. I have a passion for horses, but also a big interest in supporting the horses as much as we can these days. Horses haven't always been bred for sports and since we use them for the sport we have to help them as much as we can in my opinion. The equine market is an innovative market with a big trend for special feeding and supplements. The focus of this report will be on the young professionals in the equine business.

I would like to thank Synovium for their supporting information and advices I received.

In addition, I would like to thank Mrs. Kathalijne Visser for the coaching during the process of writing my thesis.

Kind Regards,

Nikki Jantzen

Dronten, May 24th 2018

Summary

English

The information provided about supplements for the horse joints is hard to gain access to for the daily user/competitive rider. The list of ingredients is incomprehensible for someone without the background knowledge about scientific studies of the ingredients. This results in spending money on an equine joint health supplement, without being sure if the equine joint health supplement will have a positive effect on the equine joint. The goal of this study is to gain understanding about what is needed to improve the usage of equine joint health supplements in order to make the usage of equine joint health supplements more effective on the equine joints. Therefore, this research focussed on the following main question: *“What is needed to improve the usage of equine joint health supplements, in specific the usage of Glucosamine, Chondroitin, Collagen and Methylsulfonylmethane (MSM), in order to make the usage of equine joint health supplements more effective on the equine joints?”*

In order to answer the main question four sub questions have been set up. The first question focussed on the current equine studies regarding equine joint health supplements, which is done by literature study, with a focus on the scientifically proven dosage for the active ingredients glucosamine, chondroitin, collagen and methylsulfonylmethane. Second, the different supplements on the market and the recommended usage per active ingredient per day have been researched through a comparison. Third, the daily practice of professional riders using equine joint health supplements is researched through in-depth interviews. Last, the knowledge of the providers of equine joint health supplements, retailers and veterinarians, are researched through in-depth interviews.

From this study, it can be concluded that there is a lack of pharmacokinetic studies into the effect of health supplements on the equine joint. Consequently, veterinarians lack the objective information to advise clients on which product to use according to the efficacy of the ingredients and the claims stated on product labels. Also, there is a lack of transparency in the equine joint health supplement market. In order to improve the usage of equine joint health supplements to make it more effective on the equine joints, there needs to be more research into the active ingredients, also to find out what the long term effects are for equine joint health supplements. Secondly, equine joint health supplements need to be more transparent about the active ingredients. Thirdly, riders need to be able to read product labels in order to choose the right supplement. Lastly, it is important for riders to consult their veterinarian in using an equine joint health supplements, as they have more background knowledge about the supplements as well as the horse's medical history, age, discipline and other treatments.

Nederlands

Voor de gebruiker van gewrichtssupplementen voor paarden is het lastig om toegang te krijgen tot de beschikbare informatie over gewrichtssupplementen. De ingrediëntenlijst is onbegrijpelijk voor iemand met een gebrek aan achtergrondkennis over de wetenschappelijke onderzoeken met betrekking tot gewrichtssupplementen voor paarden. Dit resulteert in het onnodig uitgeven van geld aan gewrichtssupplementen, zonder zeker te weten dat dit gewrichtssupplementen een positief effect zal hebben op het gewricht van het paard. Het doel van dit onderzoek is om meer te weten te komen over wat er nodig is om het gebruik van gewrichtssupplementen voor paarden te verbeteren, zodat gewrichtssupplementen effectiever toegepast kunnen worden voor de gezondheid van het paardengewricht. Daarom is de volgende hoofdvraag onderzocht: *“Wat is er nodig om het gebruik van gewrichtssupplementen voor paarden te verbeteren, specifiek het gebruik van glucosamine, chondroïtine, collageen en methylsulfonylmethaan (MSM), zodat het gebruik van gewrichtssupplementen voor paarden effectiever toegepast kan worden op de gewrichten van paarden?”*

Om de hoofdvraag te beantwoorden is er gebruik gemaakt van vier verschillende deelvragen. De eerste deelvraag had betrekking op de huidige wetenschappelijke onderzoeken over gewrichtssupplementen voor paarden en is onderzocht door middel van literatuurstudies, waarbij voornamelijk gekeken is naar de wetenschappelijk bewezen dosering van de actieve ingrediënten glucosamine, chondroïtine, collageen en methylsulfonylmethaan per dag. Als tweede zijn de verschillende gewrichtssupplementen op de huidige markt en de aanbevolen hoeveelheden van de actieve ingrediënten per dag onderzocht door middel van een vergelijking. Als derde is het dagelijkse gebruik en de toepassing van gewrichtssupplementen voor paarden door professionele ruiters onderzocht door middel van diepte-interviews. Als laatste is er onderzoek gedaan naar de kennis van de verkopers van gewrichtssupplementen en hoe deze kennis overgebracht wordt, dit is onderzocht door middel van diepte-interviews met ruitersportwinkelmedewerkers en dierenartsen.

Uit de resultaten van dit onderzoek kan geconcludeerd worden dat er een gebrek aan wetenschappelijk onderzoek is over het effect van gewrichtssupplementen voor paarden. Voor dierenartsen is hierdoor een gebrek aan objectieve informatie over welke producten aan te bevelen aan klanten op basis van de werkzaamheid van de actieve ingrediënten en claims vermeld op het etiket. Ook is er een gebrek aan transparantie in de gewrichtssupplementen markt voor paarden. Om het gebruik van gewrichtssupplementen doeltreffender te maken moet er meer onderzoek gedaan worden naar de werkzame ingrediënten, ook om uit te vinden wat de langetermijneffecten zijn van gewrichtssupplementen voor paarden. Ten tweede, moet de gewrichtssupplementen markt transparanter worden over de actieve ingrediënten in de producten. Als laatste, is het belangrijk voor ruiters om hun dierenarts te raadplegen over het gebruik van gewrichtssupplementen voor hun paard, aangezien dierenartsen meer achtergrondkennis hebben over de supplementen en de medische historie, leeftijd, discipline en andere behandelingen van het paard.

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Chapter 1 | Introduction

1.1. Broader context

According to the Federation Equestre Internationale (FEI) the equine sector generates over 100 billion euros a year in the EU and there are about 7 million horses located in the EU (van Hal, Timmers, & de Koning, 2017). The Dutch equine sector has an economic value of 1,2 billion euros, the Netherlands holds about 450.000 horses and the number of equine oriented businesses is estimated at 6,600 (van Hal, Timmers, & de Koning, 2017). This number includes all equestrian businesses such as, breeding stables, livery stables, equestrian retailers and many more. Producers of nutritional supplements for horses are part of those businesses. The supplement market for horses has been growing a lot lately. With the development of the modern horse and the expectations professional riders have from horses these days, individual needs of horses are growing. Therefore, riders want to support their horses with the best feeding and supplements on the market, which suit their horses' capabilities and needs. One of those supplements can be for joints, given either to prevent injuries or to support the horses when problems already occurred in the joints (van Hal, Timmers, & de Koning, 2017). According to English statistics, supplements play a big role in the equine business. The study shows that in 2015 over 171,400 supplements were sold with an average spending of £198 per horse owner, per year. Noticeable is that of all horse owners in England 94,6% adds nutritional supplements to their horses daily feeding (Agar, Gemmill, Hollands, & Freeman, 2016).

The information provided about supplements for the equine joints is hard to gain access to for the daily user/competitive rider. A lot of supplement producers pretend that their products have a lot of effects on the horse joints, which aren't always based on scientific studies, but are based on commercial purposes. Therefore, it is important to find out what needs to be known about the supplements for the horses' joints, what information is known by professional riders these days and what the suppliers (veterinarians and retailers) know about the effects.

This issue is relevant for all users of equine joint health supplements. The users of equine joint supplements, also known as the daily users or competitive riders, might have difficulties choosing a supplement. The list of ingredients is incomprehensible for someone without the scientific background knowledge of the ingredients. This results in spending money on an equine joint health supplement, without being sure if the equine joint health supplement will have a positive effect on the equine joint. If users are provided with the correct information about the usage and effects of equine joint health supplements, they can choose the supplement which fits their horses' needs best.

1.2. Theoretical framework

Horse owners use more and more supplements because they are not satisfied with the health and performance of the horse. The horse owner is responsible for the horses' health and wellbeing. Therefore, he or she has to decide what the horse gets and what could be useful to add to the daily feedings. The supplement market for animals is enormous and for each disorder there is either a powder, tablet, liquid or all of them available. A lot of horse owners go by the phrase 'there is no harm in trying', which is wrong, because vitamins and minerals can actually do harm by overdosing (Slijkerman, 2013). In order to get a good background perspective on the equine joint health supplements, the Dutch supplement regulations, anatomy and physiology of equine joints, damage to joints and joint injections and an introduction into equine joint health supplements is provided in the following subsections.

1.2.1. Dutch supplement regulations

Joint pain is one of the major causes of horse lameness and lost training. Approximately 60% of lameness and lost training days in horses is caused by joint pain (Beckstett, 2012). Each horse owner wants the best for his or her animal and adds supplements in the belief that those have positive effects for the animal (Agar, Gemmill, Hollands, & Freeman, 2016). The placebo effect is present, horse owners see an improvement after conducting a supplement, only because they want to see the effect or because they are convinced that the improvement is related to feeding the supplements. The ignorance of the knowledge about supplements makes consumers believe that both riding techniques, behavioural problems and physical problems can be solved by the use of the correct supplement.

In the Netherlands, the NVWA (Netherlands Food and Consumer Product Safety Authority) has an important role in food and consumer product safety. Dutch The NVWA examines whether there are banned substances in nutritional supplements and herbal preparations. They check the production, composition and labelling. A nutritional supplement contains vitamins, minerals and/or bioactive substances such as glucosamine. An herbal preparation only contains parts of herbs and plants. Both nutritional supplements and herbal preparations are intended as additional feeding on top of the daily feedings (Rijksoverheid NL, 2017).

The NVWA works by a regulation which states that nutritional claims and health claims can only be placed on the product label under certain conditions. Important to note is that medical claims are not allowed on nutritional supplements and other food (Europese Unie, 2006). Producers are allowed to describe what the ingredient can do for the horse, for example: *"MSM is recommended for horses used for sports. Sulphur plays a role in the normal production of collagen, which is the key component of connective tissue and cartilage. These tissues are composed of proteins, which are bonded by sulphur compounds. These flexible compounds ensure that connective tissue and cartilage retain their elasticity"* (PharmaHorse, 2013). However, the horse owner cannot check if, what is stated, is based on sound scientific research or on the experience or believes of the producer. Therefore, it is important for users to be able to read the list of ingredients and find out if the amount of Methylsulfonylmethane (MSM) is present in such quantity according to the scientific studies, would it have effects for the horse.

1.2.2. Anatomy and physiology of equine joints

As mentioned before, a lot of horse owners use supplements these days. If looking into supplements specified for the equine joints it is important to know why it would be a good addition to the normal feeding. First of all, professional riders keep on asking more and more from their horses these days and they would like to maintain their (competition) horse as fit as possible. The repeated motion during training and competitions causes the most wear and tear on the horses' joints. Therefore, it is important to gain perspective on how a joint is structured and how it functions, also known as the anatomy and physiology of equine joints.

Within the whole skeleton system of the horse a joint allows the limbs to bend and the back to flex. Equine joints can be categorized into three different categories. First of all, the fibrous joints, second the cartilaginous joint and third the synovial joints (Carlson & Weisbrode, 2012).

The fibrous joints are nearly immovable and united by fibrous tissue (Kainer & McCracken, 1994). The fibrous tissue ossifies as the horse matures, also described as the fibrous tissue hardening into bone.

Second, the cartilaginous joint, which are limited in movement or even immovable, depending on the joint. Cartilaginous joints are bones connected by either fibrocartilage or hyaline cartilage. Cartilaginous joints are joints of the pelvis, vertebrae as well as growth plates, where the cartilage ossifies and extends the length of the bones during growth (Kainer & McCracken, 1994).

Last, the synovial joints, which are the most movable joints and therefore, of most interest as they are the easiest to get damaged. A typical synovial joint exists out of Articular cartilage, synovial membrane, fibrous joint capsules and collateral ligaments (McIlwraith, 2016). As can be seen in figure 1 the two bone ends of the synovial joint are covered by articular cartilage. The articular cartilage, which is usually hyaline cartilage, is smooth and resilient, it also enables frictionless movement in the joint. The synovial fluid absorbs compression by filling up the space between the bones and around the articular cartilage. The stability of the joint is maintained by the fibrous joint capsule, which is mostly found on the sides of the joint. The fibrous joint capsule is attached to both bones and the collateral ligaments. The ligaments surrounding joints maintain the stability as well as supporting the integrity of the joints (Budras, Sack, Röck, Horowitz, & Berg, 2011).

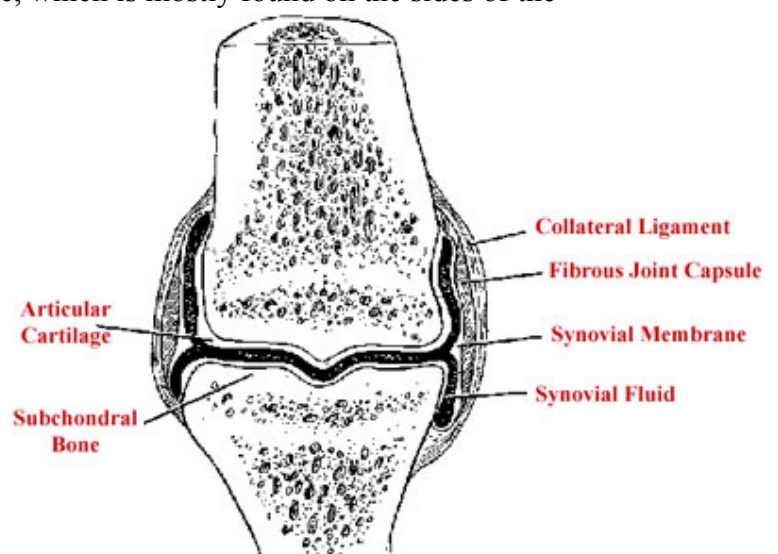


Figure 1: Synovial Joint (McIlwraith, 2016)

1.2.3. Damage to joints and joint injections

Joint damage can usually be noticed from the outside by a swelling, which is due to an increased production of synovial fluid (Kainer & McCracken, 1994). The swelling of the synovial fluid can either be caused by injury to articular cartilage or injury to the synovial membrane and the fibrous joint capsule.

When horses have damage to the joints they need to be treated by a veterinarian. As mentioned before, the synovial joints have an articular cartilage surrounding the bones to protect the joint from friction. The fibrous capsule is lined by a membrane, which is made to maintain healthy joint functions. Hyaluronic acid is a component and manufactured by the synovial joint fluid as well as by the cells that manufacture cartilage and therefore it is used a lot as joint injection by veterinarians. There are four commonly used injections for equine joints: corticosteroids (1), hyaluronic acid (2), polysulfated glycosaminoglycan's/PSGAGs (3) and antibiotics (4) (Tait, 2014).

Corticosteroids, hyaluronic acid and PSGAGs though they all have a different mechanism of action, in practical sense they all have the same result, which is controlling the inflammation and improving the joint mobility. If joints are infected antibiotics are used for treatment of the infection and kill bacteria. Antibiotics are also often added in small amounts with a combination of the products before, to prevent and control infection (Blood-Horse Publications, 2009).

Injections cannot be given on a daily basis and veterinarians have to be careful with injections, since you do not want the injections to do any harm to the horse. Therefore, supplements to support the joints are commonly given these days.

1.2.4. Joint Health Supplements

Equine Joint supplements are a more common way in maintaining the health of the equine joints these days. As the injections are given by veterinarian experts with the scientific knowledge behind it all, the oral supplements are usually chosen by the horse owner if not advised by their veterinarian. The market is so enormous that it can be difficult for a horse owner to separate the qualitative, effective and safe supplements from others (Loving, 2009).

A lot of joint health supplements are produced claiming to contain important ingredients for the health of the joint, but joint supplements are not created equal, which means the quality between different equine joint health supplements can differ a lot. Joint supplements can contain poor-quality ingredients, which are more difficult to absorb for the horse, but are labelled under the same name as high quality products.

Studies into joint health supplements for both human and equine joint health supplements have shown that label claims are not met. A study for human joint supplements in 2000 showed that from the 32 products tested, only 5 met the label claims, which means it contained the level of active ingredients stated on the label (Adebawale, Cox, Liang, & Eddington, 2000). The study for equine joint health supplements is more recent, published in 2006, the study showed that from the 23 glucosamine products, 9 failed to meet the label claims (Oke, Aghazadeh-Habashi, Weese, & Jamali, 2006).

Equine joint health supplements contain different ingredients which have shown a positive effect on the joints either alone or in combination with other ingredients, published in scientific equine studies. There are other ingredients used in joint health supplements,

claiming to support and benefit the health of the joint, but those haven't been proven in scientific equine studies. Ingredients proven to have a positive effect on the health of the equine joints are Glucosamine, Chondroitin, Collagen (Gupta, et al., 2009) and Methylsulfonylmethane/MSM (Marañón, et al., 2008). Even with those ingredients it doesn't immediately mean that the supplements have a positive effect on the joint. It all depends on the amount given and the sort of the ingredient, because absorption, especially for Chondroitin can vary (Du, White, & Eddington, 2004).

1.3. Main research question & sub questions

1.3.1. Main research question

So far, it has been revealed that young professionals in the equine business need to be able to rely on the information stated on equine joint health supplements regarding its ingredients and effects on the horse, for the horse's health, performance and wellbeing. For this reason, the current research study will focus on equine joint health supplements with the following main research question:

What is needed to improve the usage of equine joint health supplements, in specific the usage of glucosamine, chondroitin, collagen and methylsulfonylmethane (MSM), in order to make the usage of equine joint health supplements more effective on the equine joints?

1.3.2. Sub Questions

In order to answer the main research question, the following sub questions have been formulated:

- *What are the scientifically proven effects of equine joint health supplements, in specific, glucosamine, chondroitin, collagen and methylsulfonylmethane (MSM) on equine joints?*
- *To which extent do the producers of equine joint health supplements meet the scientific requirements for equine joint health supplements?*
- *What is the daily practice of professional riders in the equine business using equine joint health supplements?*
- *Which information of the current knowledge on the functioning of equine joint health supplements is provided to the customers by veterinarians and retailers?*

1.4. Thesis goal

The goal of this study is to gain understanding about what is needed to improve the usage of equine joint health supplements in order to make the usage of equine joint health supplements more effective on the equine joints. This means, information needs to be gained about how the knowledge of equine joint health supplements is implemented in the equine business these days. This research can contribute to a better understanding of equine joint health supplements and make the usage of the equine joint health supplements more effective on the equine joint.

Chapter 2 | Approach

The approach includes the set of methods and procedures used to collect and analyse data specified in the research question. This thesis research is a qualitative research, this means that the research was set up to gain understanding about equine joint health supplements and reasons and motivations behind using them. The approach was subdivided into three different methods of qualitative research. It was important to start with the literature research to gain more understanding about the equine joint health supplements. Second, it was important to gain more understanding about different equine joint health supplements and compare these based on the list of ingredients and the scientific studies used in the literature study. After gaining more understanding about the equine joint health supplements individual in-depth interviews were held.

2.1. Literature study

The sub-question “*what are the scientifically proven effects of equine joint health supplements, in specific, glucosamine, chondroitin, collagen and methylsulfonylmethane (MSM) on equine joints?*” was answered by literature research.

The literature research needed to be accomplished using four steps. In the preparation phase, recent publications about equine joint health supplements were studied, as well as selecting important search terms. Second, relevant information needed to be collected, with the use of Google Scholar, Pubmed, Science Direct, Aeres library Dronten and the company Synovium, which supplied in the equine studies that they have used for their products. The search terms that were used in the literature research can be found in table 1. In the third phase, literature was judged on quality, reliability and relevance. This means that reviews and case reports were excluded from the research report and only scientific equine studies were included into the literature study. Studies without a placebo group were also excluded from the literature research. Last, the literature was processed into the final thesis report in the chapter results.

Table 1: Search Engine Terms

General Search Terms	Supplements Ingredients Search Terms
Supplements	Glucosamine
Joint	Chondroitin (Sulfate)
Health	(Bioactive) Collagen (Peptides)
Joint disease	Methylsulfonylmethane / MSM
Nutrition	
Veterinarian	

*For all search terms the words equine, equine research, equine studies, scientific studies or horse could have been added to find information about the right sector.

2.2. Comparative Analysis

The sub-question *“to which extent do the producers of equine joint health supplements meet the scientific requirements for equine joint health supplements?”* was answered using a comparative analysis. The frame of reference is a comparison between different equine joint health supplements with one or more of the following ingredients:

- Glucosamine
- Chondroitin
- Collagen
- Methylsulfonylmethane (MSM)

The grounds of comparison were, to which extent the equine joint health supplements and the advised dosage per day meet the scientific requirements found in the literature studies.

In order to make a good comparison the analysis was put into a table where the amounts of the advised dosage per product is listed, subdivided per active ingredient.

The list of ingredients was gained through the websites of the producers and was usually found on the labels of the products. If not, the list of ingredients was asked for by mail or phone contact with the producer. The products listed were all mentioned during the interviews with veterinarians, equestrian stores and the professional riders and therefore looked into for this research.

2.3. In-depth interviews

The sub-questions *“what is the daily practice of professional riders in the equine business using equine joint health supplements?”* and *“which information of the current knowledge on the functioning of equine joint health supplements is provided to the customers by veterinarians and retailers?”* was answered through individual in-depth interviews.

The first question was answered using individual in-depth interviews with professional riders in the equine business. For this research the professional riders that were interviewed had to compete or had competed on international level. They had to ride at least 4 horses a day and were based in the Netherlands, but they did not have to be Dutch. They had to use or had used equine joint health supplements in order to have a connection with the subject of the research. The individual in-depth interviews were held with three professional riders, from which one was a dressage rider and two were jumping riders. The goal of these interviews was to gain more understanding about what the riders know about equine joint health supplements and what their objective is regarding equine joint health supplements.

The second question was answered by individual in-depth interviews with veterinarians and retailers selling and/or prescribing equine joint health supplements. The veterinarians that were interviewed needed to have an active license to treat horses. They had to treat at least twenty horses a year with joint pain and prescribe equine joint health supplements to their clients. The veterinarians were based in the Netherlands and practiced at an equine veterinarian clinic. There were five interviews held with veterinarians throughout the Netherlands.

The retailers selling and/or prescribing equine joint health supplements needed to be based in the Netherlands. They needed to have equine joint health supplements in their product range. There was one interview with a retailer from an equestrian store, which had four affiliates or more throughout the Netherlands and two interviews with retailers from a private equestrian store, with only one affiliate in the Netherlands. There were three individual in-depth interviews held with retailers from equine joint health supplements.

It was important to set up the interview questions regarding what is already known and what needs to be known. For an in-depth interview there wasn't a standard question list, the goal of an in-depth interview was to lead the interview into a certain direction, with as much interaction with the interviewer and respondent as possible. Therefore, three different lists with discussion points were set up for both the professional riders, the veterinarians and the retailers. The list with discussion points can be found in the first, second and third appendix (Moventum, 2017).

Before the in-depth interview was held, there was contact with the respondent either by phone or by email. The respondents were provided with general information and a short introduction about what the interview was going to be about and why the interview was held. If an appointment was made the in-depth interview took place at a set location, formal and face-to-face, with a certain structure. First of all, the opening, the interview was introduced and the respondent was asked if he or she allowed the interview to be recorded. The introduction included asking if the respondent wanted to have their interview processed anonymous, explaining who the interviewer is, why the interview was held and what the goal of the interview was. Second, profile questions were asked, in order to find out how much knowledge and experience the respondent had in the equine business. Third, the discussion points were introduced and discussed. The last phase included asking if there were any questions or comments. If questions occurred at a later stage, the respondent needed to be able to ask those questions. Therefore, contact details needed to be available for the respondent. If the respondent would like to receive a summary of the interview this needed to be sent as soon as possible. The respondent was thanked for the time and effort put into the interview (Baarda, et al., 2013).

Before the start of the first interview a test interview was held. During this test interview, observations needed to be noted in a notebook. Part of the observations was the audio-recording, which was done with a smartphone. The focus of the observations was on where the interview was held, what happened around the interview location, how did the respondent act towards different questions, what were the facial expressions (non-verbal communication) and how was the respondent dressed. Based on the results of the observations of the test interview the following interviews were planned (Baarda, et al., 2013).

The analysis of the data gained in the research was approached by directed coding. Direct coding means that information from the interview was reviewed according to its relevance to the sub questions. The following steps were followed (Dingemanse, 2017):

1. Transcription
2. Orientation on coding
3. Open coding
4. Axial coding
5. Selective coding

The interview needed to be transcribed, so an interview transcript is available for the analysis. Second, the orientation on coding meant going through the gained data and creating codes. For each segment of the interview the relevant information and quotes were coded during the open coding phase. The codes were based on the sub-questions. During the axial coding phase cohesion between codes needed to be found and put into one category. Last, during the selective coding phase an overall picture was created and the core variable of the data was found (Baarda, et al., 2013, p. 271).

When all the interviews were analysed, the important data, which gives an answer to the sub questions were placed in the results of the thesis report. Important quotations of the respondents were included into the thesis report and interpretations were excluded from the thesis report.

Chapter 3 | Results

3.1. Literature study

In order to answer the following sub question “*what are the scientifically proven effects of equine joint health supplements, in specific, glucosamine, chondroitin, collagen and methylsulfonylmethane (MSM) on equine joints?*” the scientifically proven effect of glucosamine, chondroitin, collagen and methylsulfonylmethane are discussed in the following paragraphs. The literature study is about equine joint health supplements and its ingredients regarding pharmacological information, such as absorption, distribution, metabolism, recommended dosages and safety information.

3.1.1. Glucosamine

Glucosamine is a product used to ease joint pain and to keep the health of the cartilage used in both human and equine supplements, as it is an essential component of normal, healthy articular cartilage (Oke, Aghazadeh-Habashi, Weese, & Jamali, 2006).

There are three types of Glucosamine; glucosamine hydrochloride, glucosamine sulfate and N-acetyl-d-glucosamine. In the stomach of the horse, glucosamine is generated into glucosamine free base, which is absorbed and incorporated into the synthesis of cartilage glucosaminoglycans and more biosynthetic pathways in the equine body. However, Glucosamine Hydrochloride has been proven more extensively over a period of time through study and research for its effectiveness. This is because approximately 80% of the administered glucosamine hydrochloride is generated into glucosamine free base, while only 50 to 60% of glucosamine sulfate is generated into glucosamine free base.

Studies with mice and rats have shown that glucosamine is very safe to feed, as no mice or rats showed mortality after administration of very high levels of glucosamine (>5000 mg/kg) (Thorne Research, 1999). Also no adverse events with horses have been noted after administration of glucosamine (Lavery, Sandy, & Celeste, 2005).

A recent study in horses has shown a significant improvement of range of joint motion, stride length and swing duration after giving horses a compound containing 5.00 grams glucosamine hydrochloride, 2.00 grams chondroitin sulfate and 10.00 grams N-acetyl-D-glucosamine compound orally. It was concluded that the oral chondroprotective offered symptomatic relief to veteran horses, evidenced by improved stride characteristics. Recommended therapeutic dosages from for glucosamine are 15 grams per day (Forsyth, Bridgen, & Northrop, 2006). Another well set up study states that 20mg/kg of glucosamine has a positive effect on the equine joint, as this supports the synthesis and production of cartilage glucosaminoglycans. This amount results in a daily dosage of 10 grams for a 500kg horse and 12 grams for a 600kg horse (Lavery, Sandy, & Celeste, 2005).

There are three major effects of feeding 10 up to 15 grams of glucosamine to horses which have a positive effect on the equine joint (Forsyth, Bridgen, & Northrop, 2006):

- Support cartilage production
- Improves joint comfort
- Inhibits inflammatory mediators (this also contributes to slow the cartilage breakdown and to reduce joint pain)

3.1.2. Chondroitin

Chondroitin is usually administered to horses in combination with glucosamine and with its chondroprotective properties known to be a major structural component of cartilage, bone and tough connective tissues in the equine body (Forsyth, Bridgen, & Northrop, 2006).

Chondroitin for horses is usually gained from the cartilage of sharks and bovines, which is very expensive and results can be seen in quantity and quality (Trumble, 2005). Chondroitin is quickly absorbed and stimulates the grow of cartilage (Du, White, & Eddington, 2004).

Chondroitin is proven to be effective on the equine joint if given orally with a minimum amount of 2 grams up to 6 grams per day (Forsyth, Bridgen, & Northrop, 2006). This amount is scientifically proven on a horse with a weight of about 500 kilograms. The study concluded that the oral condroprotective fed to the horses offered symptomatic relief to veteran horses. The study also showed improved stride characteristics to the horses, such as range of joint motion, increased stride length and increased swing duration.

Especially for the ingredient Chondroitin absorption can vary a lot. As user of Chondroitin in equine joint supplements it is important to choose a sort of Chondroitin which is proven to be absorbable in horses (Du, White, & Eddington, 2004). A bioavailability of 22% was reported by Du et al. (2004) after administering 3 grams via nasogastric intubation. Studies with mice and rats have shown that chondroitin is considered safe to feed, as the lethal dose of chondroitin in mice is >10,000 mg/kg (Science Lab.com, 2013). Also no adverse events with horses have been noted after administration of chondroitin (Oke S. , 2009).

There are four major effects on the equine joints of feeding Chondroitin as supplementation to horses (Forsyth, Bridgen, & Northrop, 2006):

- Supports production of cartilage
- Slows the breakdown of cartilage
- Improves joint comfort
- Inhibits inflammatory mediators

Chondroitin & glucosamine compound

Chondroitin is mainly used in combination with glucosamine, because by combining the two ingredients the glucosamine stimulates the glucosaminoglycan production, while the chondroitin inhibits the matrix degradation (Goodrich & Nixon, 2006). Table 2 shows the effect of a supplementation of 15 grams glucosamine and 2 grams of chondroitin, performed in a study with 20 veteran horses. A significantly increased range of joint motion occurred in the elbow, stifle and hind fetlock of the horses after treatment of 8 weeks, as well as a significantly increased stride length. After 12 weeks a significantly increased result was seen in the swing duration (Forsyth, Bridgen, & Northrop, 2006).

Table 2: Effects of chondroitin & glucosamine compound (Forsyth, Bridgen, & Northrop, 2006)

	Range of joint motion			Stride length	Swing duration
	Elbow	Stifle	Hind fetlock		
Significantly increased	P<0.05	P<0.01	P<0.01	P<0.05	P<0.05

3.1.3. Collagen

Collagen is mainly used for arthritic horses. Collagen is found in the extracellular space in the various connective tissues in equine bodies as the main structural protein (Gupta, et al., 2009). A loss of collagen can result in stiffness, swollen joints and moving with less ease for the horse. There have been many human studies into supplementing with collagen for people with osteoarthritis joint pain. Bone deformation, synovitis, shrinking joint capsules and muscular atrophy occur during loss of cartilage, which is the most critical point of osteoarthritis (Donnell & Frisbie, 2014). Collagen makes up 50% of all protein in cartilage and 85-90% of collagen of articular cartilage. The undenatured form of glycosylated type-II collagen is found to be significantly more effective than denatured type-II collagen (Gupta, et al., 2009).

A study into Bioactive Collagen Peptides as supplement for horses with osteoarthritis proved a significant decrease in cartilage degeneration. The goal of treatment with bioactive collagen peptides is to improve the quality of life of horses with osteoarthritis, by slowing down the progression of joint degeneration. More than 60% of lameness in horses is based on osteoarthritis (Caron & Genovese, 2003). To counteract the wear and tear processes of equine osteoarthritis, stimulation of joint cartilage metabolism and an increased production of extracellular matrix are used as treatment by the use of bioactive collagen peptides (Dobenecker, et al., 2018).

Studies show that significant positive results are gained in the lameness grade and flexion test of horses with osteoarthritis by supplementing 50 grams of bioactive collagen peptides per day for a minimum period of six weeks. The bioactive collagen peptides used are commercially available by Gelita, producer of collagen for both human and animal supplements (Dobenecker, et al., 2018).

In the group of 50 grams of bioactive collagen peptides, eight out of sixteen items including the crucial questions for degree in lameness were evaluated moderate (cohen's $r = 0.3 - 0.5$) and the other eight items were evaluated with a strong positive effect (cohen's $r > 0.5$). In all cases of 50 grams per day of bioactive collagen peptides significant results were seen for all parameters after twelve weeks. In the group of 25 grams of bioactive collagen peptides a medium effect was seen after twelve weeks in nine out of sixteen items, a significant positive effect in the post hoc test in four items. No cases in the placebo group showed significant effects (Dobenecker, et al., 2018).

The study also focussed on the owners of the horses by making the owners evaluate and score the progress of the osteoarthritis every week in comparison with the previous week. The scores for lameness improved significantly over the period over the supplement period when both the 25 grams and 50 grams of bioactive collagen peptides were compared to the placebo group. The owners saw the mobility and willingness to move, as well as the lameness grade improve for the horses with supplementation of 50 grams as well as supplementation of 25 grams of bioactive collagen peptides per day. The differences between the placebo group and groups receiving 25 grams or 50 grams of bioactive collagen peptides per day are substantial enough to conclude that a clear effect of the bioactive collagen peptides used in this study have a positive effect on the equine joint (Dobenecker, et al., 2018).

Hydrolysed collagen has one major effect on the equine joints:

- Provides strength to the joint tissue

3.1.4. Methylsulfonylmethane (MSM)

Methylsulfonylmethane, further described as MSM, is an organic sulfur-containing compound, which can be used by the equine body to synthesize various connective tissues (Kim, Axelrod, & Howard, 2006) and is also well known for its antioxidant properties (Marañón, et al., 2008). MSM is the best absorbable and biologically available source of sulfur, which is important for muscles, joints, cartilage, bones and the blood. Also, studies with mice and rats have shown that MSM is considered safe to feed, as the lethal dose of MSM in mice is >20 mg/kg (Parcell & Cand, 2002).

Marañón et al. (2008) has shown that MSM was responsible for positive results on oxidative stress biomarkers after jumping exercises. The study was conducted with 24 jumping horses which were involved in a show jumping competition. There were three groups, first of all a placebo group, second a group of horses which received 8 mg/kg of MSM and a group which received a combination of 8 mg/kg MSM and 5 mg/kg Vit-C. The effect of administering MSM and the combination of MSM and Vit-C showed a reduced glutathione and a decreased antioxidant enzyme activity. It was concluded that “jumping exercise could induce harmful effects on horses. Probably due to an increase in oxidative damage and pro-inflammatory molecules. In addition, we have demonstrated that MSM could exert some protective effect on oxidative and inflammatory exercise-induced injury” (Marañón, et al., 2008).

There are two major effects of MSM on the equine joints if feeding 4.8 grams of MSM:

- Anti-inflammatory activity in the joint
- Antioxidant benefits in the bloodstream

3.1.5. Active ingredients

The results of the above mentioned studies are summarised in table 3, showing the amounts of supplementation per ingredients which have shown to have a positive effect on the equine joint health with reference to the specific studies.

Table 3: Active ingredients

	Amount	Study
Glucosamine	15 gram	Forsyth, Bridgen and Northrop (2006)
	12 gram*	Laverty (2005)
Chondroitin	2 gram	Forsyth, Bridgen and Northrop (2006)
Collagen	25 - 50 gram	Dobenecker et al. (2018)
MSM	4,8 gram*	Marañón et al. (2008)

* for a horse of 600kg

3.2. Comparison supplements

In this paragraph different supplement brands are compared. Noticeable is that some products contain exactly the same ingredients, but go by a different name. For example, Epplejeck owns the Horsefitshop and has the same products, with almost the same names, containing exactly the same ingredients. Furthermore, it was noticeable that product labels are usually not very transparent. For some products it isn't clear how much of the active ingredient can be found in the supplement.

Table 4 shows the recommended usage per active ingredient in products of different brands. The table shows a section of the equine joint health supplements on the Dutch market and also how many differences there are in dosage of active ingredients per day.

Table 4: Recommended usage per product per day

	Glucosamine Sulfate	Chondroitin Sulfate	Collagen	Methylsulfonylmethane (MSM)
<i>Audevard Ekyflex Arthro</i>	6.8 gr	0.5 gr	5.5 gr	4.6 gr
<i>Cavalor Arti Tec</i>	Unknown	Unknown	Unknown	unknown
<i>Cavalor Arti-Base</i>	unknown	Unknown	Unknown	Unknown
<i>Cavalor Arti-Matrix</i>	Unknown	Unknown	Unknown	Unknown
<i>Epplejeck Glucosamine complex</i>	0.1 – 0.2 gr	0.35 – 0.7 gr	-	0.4 – 0.8 gr
<i>Epplejeck Souplesse</i>	0.7 – 1.4 gr	0.3 – 0.6 gr	-	0.6 – 1.2 gr
<i>Equi Flex HA Liquid</i>	2.64 gr	0.03 gr	0.3 gr	1.2 gr
<i>Equi Mobility Plus</i>	8.5 gr	0.75 gr	-	10.75 gr
<i>Equivital Souplesse</i>	1 – 2 gr	Unknown	-	Unknown
<i>Global Medics Arti-Base</i>	3.00 gr	-	21.00 gr (hydrolysed collagen)	3.00 gr
<i>Global Medics Arti-Gold</i>	9.00 gr	0.90 gr	7.50 gr (HCL type II)	4.50 gr
<i>Global Medics Arti-Sport</i>	8.66 gr	1.43 gr	4.10 gr (HCL type II)	5.00 gr
<i>Glucosamine Complex Groene Os Paard</i>	1.8 gr	1.5 gr	-	1.5 gr
<i>Horsefitshop Glucosamine Complex</i>	0.1 – 0.2 gr	0.35 – 0.7 gr	-	0.4 – 0.8 gr
<i>Horsefitshop Souplesse</i>	0.7 – 1.4 gr	0.3 – 0.6 gr	-	0.6 – 1.2 gr
<i>NAF Glucosamine 10,000 PLUS With MSM</i>	5 – 10 gr	-	-	Unknown
<i>NAF Superflex</i>	5 gr	0.012 gr	-	5 gr
<i>Newmarket Joint Supplement</i>	15 gr –hydrochloride***	-	-	-
<i>Pavo Mobility</i>	8.5 gr	2.00 gr	12.5 gr (Hydrolysed Collagen)	
<i>Pharmahorse Glucosamine - MSM</i>	12 gr	-	-	12 gr
<i>Phytonics Joint Comp</i>	1.2 gr	Unknown	-	1.4 gr
<i>Primeval Gelatinaat</i>	-	-	14,8 gr (Hydrolysed Collagen) 0,0023 gr (HCL type II)	-
<i>Puur Glucosamine</i>	1.6 – 3.2 gr	1.22 – 2.44 gr	-	1.36 – 2.71 gr
<i>Synovium Agility</i>	-	-	25 gr	-
<i>Synovium Motion JMT</i>	14.90 gr	2.40 gr	-	9.95 gr

*This table does not show any research into the absorbability of the ingredients in the compared products.

** products may contain other important ingredients which are not listed in the table above.

*** for a horse of over 500kg

3.3. Current background knowledge professional riders

To answer the sub question “*what is the daily practice of professional riders in the equine business using equine joint health supplements?*” three professional riders in the equine business were interviewed, who were all using equine joint health supplements for their own horses. The aspects which were discussed during the in-depth interviews were the knowledge behind equine joint health supplements, the opinions about preventive use of equine joint health supplements, the reason for choosing a brand and the place of purchase, including whom riders ask for advice if it comes to purchasing equine joint health supplements and their experiences with equine joint health supplements. In order to keep the riders anonymous, the names will be changed to rider 1, rider 2 and rider 3 in the following paragraphs.

Current knowledge

All three riders were interested in the knowledge behind the equine joint supplements and noticeable was that they would all ask for advice of their veterinarian. The knowledge about the active ingredients in the products for all three riders in general is small. They know what the active ingredients are and they do know that those are the ingredients supposed to help for the equine joints, but why or how much is needed is unknown.

Notable was that overall rider 1 had a lot more knowledge than the other riders, due to experience at his/her own stables but also due to a lot of contact with veterinarians and working closely together with a veterinarian.

Rider 2 did not know what the active ingredients were in the equine joint health product given to the horses and said “it is actually really bad to not know what you are feeding exactly, but due to close cooperation with my veterinarians I without a doubt trust what they say, also because it is scientifically substantiated. Nevertheless, I am the one responsible for what my horses receive” (private communication, January 29th 2018).

For rider 3, who feeds supplements both on own initiative as well as in consultation with the veterinarian said “I know that the ingredients glucosamine, MSM, collagen and chondroitin are the effective ingredients in the product I feed, but I do not know the exact functioning of the ingredients” (personal communication, February 7th 2018).

All three professional riders knew exactly when and how to use the products they have at the stables, but why and how it exactly works is mainly unknown. A lot of decisions are made together with their veterinarians, whom also do a check up on all the horses at least twice a year and for the rider 3 even four times a year.

Preventive use

Noticeable differences between the riders were their opinion about preventive treatment of the equine joints. Equine joint injections are commonly used in the equestrian sports these days, but not all riders agree with the use of equine joint injections preventive. Rider 1 and 3 did strongly disagree with using equine joint injections for healthy joints. Their main reason behind not using equine joint injections preventive is because they agree on, why try to fix something that isn't broken. For the use of equine joint supplements preventive their opinions were less strong, but still noticeable that for the two riders whom also disagreed with using equine joint injections preventive they thought that using equine joint supplements preventive was not needed.

Rider 1 was not a big fan of using equine joint injections or supplements preventive, but did use preventive treatment: “we do not use joint supplements preventive, but we do use a laser, for some horses even twice a day. It is a level 4 laser, which can prevent or help cure problem in a really early stage” (personal communication, January 26th 2018).

Rider 2 did use equine joint health supplements as a preventive use for her grand prix horses, mainly because the horses work quite hard and it is better to prevent joint damage than to cure joint damage.

Brand commitment

If it comes to choosing the right brand supplement for their horses, one out of the three interviewed riders did have financial advantages of using a particular brand as rider 2 is sponsored by a supplement brand. Noticeable was that the brand was recommended in consultation with the veterinarian and the supplement brand became a sponsor of the rider due to the recommendations of the veterinarian.

Rider 3 is also very committed to one brand, as this brand is being used since the start of the training stables and there a good results gained with this supplement brand, as well as close cooperation with the veterinarian who also uses this brand.

Notable was that rider 1 did not have one particular brand which was always used. If good results are gained with a certain brand, usually other products of this brand are bought if problems occur. Also, close consultation with the veterinarian is used if a horse has joint problems and a lot of contact with other professional riders and their experiences plays a role in the decision of which supplement to buy.

Brands which were mentioned during the interviews were mainly Synovium and Global Medics.

Place of purchase

The place where the riders get their equine joint health supplements differ a lot from each other. Rider 3 sticks to one particular brand, which is bought straight from the manufacturer. Rider 2 always gets the equine joint supplements through the sponsor, also straight from the manufacturer and last rider 1 either gets the equine supplements from the equestrian store, veterinarian or online. According to rider 1 the place of purchase changed through the years, a veterinarian is consulted if questions occur, but due to experience from other riders and veterinarians you get so much information that you do know what works or what doesn't.

Experience

Experiences with equine joint health supplements are positive for all three riders. For rider 1 it was notable that supplements are given to the horses, but also mentioned was that “if you add to much supplements it might do one thing but it's bad in another way” Also “you can end up using everything and if you start looking you get too carried away with that” (personal communication, January 26th 2018).

For the rider 2, positive results are gained with the supplements used. Also one of the horses who showed signs of arthroses in the fetlock joint is now getting an equine joint health supplement. According to rider 2 the horse has been very stable since then and has not gotten any worse. With other horses more suppleness was noted at the start of the training since using an equine joint health supplement.

For the rider 3 equine joint health supplements are mainly a product used for a horse which is working on top level and can be a bit stiff at the start of the training. If a horse really starts showing any problems a veterinarian will always be consulted. According to rider 3 “there are many riders which have very high competition interests” (personal communication, February 7th 2018) and also veterinarians will help the horses just so they can perform on the highest level, while rider 3 thinks it is very important to give a horse the time to recover, even it is just something small. In that way you can prevent big injuries and keep your horses fit and healthy.

3.4. Information provided about functioning equine joint health supplements

To answer the sub question “*which information of the current knowledge on the functioning of equine joint health supplements is provided to the customers by veterinarians and retailers?*” in-depth interviews are held with both veterinarians and retailers.

3.4.1. Veterinarians

There were five veterinarians interviewed, from which two worked as equine surgeons and three as equine orthopaedics. To answer the sub question, relevant information, which is gained through the interviews is divided into different subjects. First, the reason behind the different supplement brands used is answered. Second, the use of preventive supplementation is either substantiated by veterinarians or refuted. Third, the improvement due to equine joint health supplements is substantiated. Fourth, there is more information about the influence of the client into choices made by veterinarians if it comes to the use of equine joint health supplements. Last, the general knowledge about the scientific studies into equine joint health supplements is gained during the interviews. In order to keep the veterinarians anonymous, the names will be changed to veterinarian 1, veterinarian 2, veterinarian 3, veterinarian 4 and veterinarian 5 in the following paragraphs.

Supplement brands

All veterinarians said that they keep looking into the improvements made in the supplement market. They either go to a conference, read studies or have meetings with their team to discuss the innovations on the supplement market. Three out of the five veterinarians stick to one or two particular brands for their supplements which they think are scientifically substantiated, while others do change their range of products more often. Depending on the costs, innovations on the market and the usage of their clients.

According to veterinarian 4 “there are several important factors why we have certain products in our product range. First of all, the need from the clients, because in the end we are a company. Second, we check the compound of a product, what are the ingredients of different supplements” (personal communication, February 21st 2018). Notable is that financial aspects do play a role in the decision of a supplement brand.

For veterinarian 3 the decision to only work with the brand Audevard is because technically these products are seen as good and contain exactly what is on the label. Audevard is also a laboratory which produces enough scientific studies into their products. Nevertheless, it is important to stay critical on products which are tested by their own manufacturer.

All veterinarians find it most important that equine joint health supplements are well substantiated and have positive outcomes from clients and colleagues. A few of the supplement brands used by the veterinarians are Audevard, Synovium, Zoetis, Primeval and Newmarket.

Preventive use

Out of all five of the veterinarians two of them were clearly against the use of preventive supplements, while the other three either thought it could be a benefit for older horses or horses which were used on higher levels in the sport. Veterinarian 4 thought preventive use of equine joint health supplements can be a benefit for horses which are competing on higher levels in the equine sports, as studies from Maarten Oosterlinck has shown that equine joint health supplements did have a positive effect on preventing damage in equine joints.

According to veterinarian 3, preventive use of equine joint health supplements is not the right way. If there are any clues to joint damage then the cause should be taken away instead of using preventive supplements.

Improvement due to supplements

All veterinarians find it difficult to say if a horse is improving because of the help of an equine joint health supplement, because the treatment is usually a combination between several treatments such as the farrier, movement management, feeding and therapists. Usually they refer on the experiences of the customers and their colleagues, because usually if a horse is doing well veterinarians will not see the horse back at the clinic.

Clients

According to veterinarians it is noticeable that sport stables usually have a certain product line which they stick to, as it has proven to be effective for their horses. If it comes to private horse owners, veterinarians also have to discuss with the client what fits into the budget of the client if treating the horse. In some cases, it can be more effective to treat the horse directly into the joint according to veterinarian 4, therefore, he can advise the client to preferably use a joint injection if there is a limited budget.

According to veterinarian 3 changes in the equestrian sports should be made, because a horse has a lot more benefit from an earlier diagnostic instead of trying to solve problems with supplements, because the sooner you find the problem, the better it is to cure.

All veterinarians try and advice the clients as best as they can, although some find it hard to scientifically substantiate some of the products. They rather have the clients using the products they have had positive experiences with, mainly because of the known composition of the products. Veterinarians do try and advice the clients in which supplements to feed because they should rather go for meaningful supplements instead of cheaper ones, which do not contain the right compositions.

Knowledge

All veterinarians agree on the fact that there is a lack of pharmacokinetic studies in equine joint health supplements. Veterinarian 4 does a lot of literature research into the equine joints and also into equine joint health supplements, and reads a lot about possible positive ingredients for equine joint health, but also mentions that it can be hard to set up a study to prove the effectiveness. According to veterinarian 4 even though there is written about those ingredients, you should still be very critical on the products containing those ingredients. There is a lot of overlapping products in the equine joint health supplement market.

The veterinarians did mention that it is hard to check for a veterinarian if the biological availability and absorption from a product is well. Also, studies have shown that not all products contain what they claim to contain, which is also hard to check for a veterinarian.

As mentioned before veterinarians either read studies, go to conferences or meetings and learn about new publications. Based on the information gained they try and sell products to their clients which can be well substantiated by equine studies.

3.4.2. Equestrian stores

To find out what retailers know about the functioning of equine joint health supplements and how they provide this information to their customers three in-depth interviews were held. These interviews were held with store employees, whom are seen as competent enough to advise the clients about equine supplements. There were two owners of equestrian stores interviewed, and one employee of an affiliate of an equestrian retail chain.

The aspects which were discussed during the in-depth interviews were the supplement brands, clients, advices given, knowledge of the employees and the financial aspects of selling equine supplements.

Supplement brands

Both stores of the smaller retailers contained only one supplement brand, the bigger equestrian retailer, with more than five affiliates contained approximately eight different supplement brands, with products for the equine joint health.

Table 5 shows the differences in store size and different brand ranges. In the following paragraphs there will be referred to store or retailer 1, 2 and 3 as can be seen in table 5.

Table 5: Store size

Store /retailer	Number of different equine joint supplement brands	Private label	Size
#1	8 - 10	Yes	Big store
#2	1 - 2	No	Small store
#3	1 - 2	No	Medium store

The product range from store 1 included products from NAF, Puur, Synovium, Sectolin, Pharmahorse, Excellent, and more. Store 2 only worked with the brand Excellent, while store 3 is loyal to the brand NAF.

The brands in the product range of store 1 are decided at the headquarters, the employees in the store barely participate in their decision. The store employees do send a list with client experiences about brands to the headquarters, where they decided if the information is being used or not.

Both store 2 and 3 are very loyal to the one brand they have in their product range. Both stores stick to their brand because customer experiences are positive, products are pure and clean and last both brands have a wide range of supplement products. The reason store number 3 chose to work with NAF is because they got the opportunity to test the products, which makes it easier to advise.

Clients

For all three of the stores it was notable that if it comes to equine joint health supplements most customers specifically ask for products for

- older horses;
- horses that are a bit stiff or;
- horses that have start-up issues in the training.

Other aspects mentioned by the retailers if it comes to clients were either a veterinarian that had spoken about joint supplements or on advice of friends at the stables which made the client come to the store for equine joint health supplements.

Also notable is that retailer 2 often noticed that clients ask for glucosamine and MSM, without them knowing what the product exactly does, but they do know that they need those ingredients. All three stores noticed that their loyal clients do come back for repeat purchases.

Advice

According to retailer 1 it can be quite difficult to advice clients in which supplement will be useful for their horse as mentioned during the in-depth interview: “there are so many different brands, but also supplements containing only glucosamine or only MSM, and the supplements containing combinations, which are supposed to be good for the muscles, joints and also for the intestines. Overall, I think it is just a lot, which makes it difficult to advice customers” (personal communication, February 13th 2018). Notable was that private labels from stores are not selling as good as the well-known brands.

All the retailers try and stay up to date, by organising information meetings with representatives from the brands which they have in their product range. It is more difficult for the bigger store (store 1) to keep all the employees up to date, due to constant changes in the team.

Retailer 3 did mention that if he/she is not competent enough to advice a customer he/she usually sends them to their veterinarian to ask for advice. Also, he/she thought that equestrian stores shouldn't be selling equine supplements, it should be a task only for veterinarians or nutritionists.

Knowledge

The knowledge differs between the interviewees of the equestrian stores, but notable was that glucosamine was one of the more known ingredients in equine joint health supplements. What information the products are based on is unknown and all retailers rely on the information provided by the supplement brands.

Retailer 1 said not to know much about the equine joint health supplements and noticed that usually after an information meeting with different representatives from supplement brands that all the employees in the store became more motivated and active in advising customers about supplements.

Retailer 2 did know which ingredients were present in the joint supplements in the store and also what joint supplements do for the equine joint health. Percentages are unknown by the retailer and also which scientific information goes behind the products is unknown.

Financially

Discount promotions are not done on any supplement brand by all three of the stores. Mainly because the margins on supplements isn't big. Retailer 3 also mentioned that promotions on supplements are not wanted as it is not meant to be bought when a horse doesn't need the supplement.

For retailer 1, price was not seen as a big issue in supplements. As mentioned before, customers tend to not like the private label and as the prices usually only differ a few euro's they tend to go for the more expensive one, hoping that one will give the best results.

Chapter 4 | Discussion

This study describes what is needed to improve the usage of equine joint health supplements in order to make the usage of equine joint health supplements more effective on the equine joints. The study produced interesting information even though it had weaknesses.

Literature weaknesses

The studies used for the literature research contain weaknesses, such as imperfect blinding of the scorers, parameters are not always ranked as truly objective, small sample sizes, and the lack of long-term effects and safety trials. Even though equine joint health supplements lead the way in nutritional supplement sales (Kentucky Equine Research Staff, 2017) there are still not enough pharmacokinetic studies into equine joint health supplements to really conclude what the best dosage is for some of the active ingredients. For example, there aren't many published studies into the use of collagen for equine joint health. Many supplement brands therefore do their own research into the use of collagen or use studies set up for human use. This is also a difficulty for the veterinarians as they try to find out which product will be most effective on the equine joints. Another issue is the vague label claims on products, which makes it difficult to determine what the exact function of the supplement is, instead of what function one of the ingredients can have on an equine joint. There is a need for more high-quality clinical trials, with a large set up, to either confirm or deny the efficacy of equine joint health supplements and the active ingredients. Often published literature researches are biased, as they are often conducted under a confidentiality agreement, which means that if the studies do not have a positive outcome, they will not be published. The studies that are published are done with ingredients of a pharmaceutical-grade, while commercial products may or may not use the same quality ingredients and could be from a lower grade, which can produce different results than shown in the studies.

Products and comparison

The comparison between equine joint health supplements is not totally objective, because some products also contain other ingredients which are not looked into during this study. Also, products do not always have straight guidelines in recommended dosage per day, as this can also be written as 1 or 2 scoops a day, which makes a lot of difference in feeding a supplement. There are even equine joint health supplements on the market which only show the active ingredients in the product, without stating the levels of the ingredients. This resulted in insufficient information about supplement brands. With equine joint health supplements there is also the doubt about absorption of the ingredient. At first, it is important to feed the right amount which will have a positive effect on the joint. Second, it is also very important that the ingredients are from good quality and will be absorbed by the horses. And even if the ingredients will be absorbed by the horses, they still need to get to the joint, where the body must utilize it for repair function. In combination with the little reliable scientific researches into equine joint health supplements, this makes the use of equine joint health supplements debatable (Duren, 2005).

Target group

For the in-depth interviews it is hard to get in contact with the target group. The professional riders are usually busy and plan the interviews during working hours at the stables. For the veterinarians the interviews were seen as interesting and also scheduled into their working hours, which could result in a last minute cancellation due to an emergency case. Last, the equestrian stores were the hardest to schedule an interview with as they did not want to make the time to talk about their product range. Also, a lot of retailers said not to have the knowledge to participate in a study like this. Unfortunately, not more riders, veterinarians and

equestrian stores in the Netherlands could be interviewed due to a small timeframe and low resourcing costs, which made it impossible to travel throughout the whole country. Socially disadvantaged groups are usually better reached if timeframes are extended, higher resourcing costs or applicable and if the research is operated via community partnerships (Bonevski, et al., 2014).

Approach of study

In the preliminary research one of the sub questions was *“what is the current background knowledge of professional riders in the equine business using equine joint health supplements?”* and it has been changed to *“what is the practical approach of professional riders in the equine business using equine joint health supplements?”* It turned out that knowledge about the equine joint health supplements was very little, which makes the sub question to narrow and therefore it has been changed during this research.

Another debatable research question is *“which information of the current knowledge on the functioning of equine joint health supplements is provided to the customers by veterinarians and retailers?”*. After the in-depth interviews it turned out that the information provided by veterinarians and retailers is not only based on the knowledge, but also on their experience. Therefore, the research design would have been better if the the focus of this research question was not only on the knowledge of the veterinarians and retailers, but also their experience with equine joint health supplements and how this influences their advice for the customers.

Due to small sample sizes, the reliability of the results gained through in-depth interviews is lower than if high sample sizes were met. If this research was set up as a quantitative research instead of a qualitative research, it could have been done with surveys which could result in more response and a high reliability of data. However, this would not give any insight into the reason behind the choices made by the target group (LUMS effective Learning, 2016). Instead of choosing only for professional riders, this research may have had more insight into the users if a quantitative research was conducted amongst the amateur riders and added to the qualitative research. The amateur riders are most likely to be the ones who buy the equine joint health supplements in the equestrian stores.

During this study, especially during the in-depth interviews it was hard to stay objective to the subject. If this study would be done again it would be better to start with the in-depth interviews, which would make it easier to stay objective.

Chapter 5 | Conclusion

To answer the main question, the research was divided into four sub questions which will first be answered with the use of the results of this research.

The first question “*what are the scientifically proven effects of equine joint health supplements, in specific, glucosamine, chondroitin, collagen and methylsulfonylmethane (MSM) on equine joints?*” is answered by literature work. The effects of glucosamine, chondroitin, collagen and MSM are:

- Anti-inflammatory activity in the joint
- Antioxidant benefits in the bloodstream
- Provides strength to the joint tissue
- Supports production of cartilage
- Slows the breakdown of cartilage
- Improves joint comfort
- Inhibits inflammatory mediators (this also contributes to slow the cartilage breakdown and to reduce joint pain)

The specific effects of each ingredient and the proven dosage for these effects can be found in chapter 3.1. of the results.

Second, for the question “*to which extent do the producers of equine joint health supplements meet the scientific requirements for equine joint health supplements?*” the conclusion is that there is a lot of overlapping in products, but also a lot of differences in the amount of recommended dosing in active ingredients. For all the active ingredients more than half of them do not meet the proven dosage which showed a significant effect based on the literature used in this study.

Third, the question “*what is the daily practice of professional riders in the equine business using equine joint health supplements?*” is answered by in-depth interviews held with professional riders in the equine business. The most important result is that the knowledge of the riders is small and the feeding of equine joint health supplements is often decided in consultation with their veterinarian.

As last, the question “*which information of the current knowledge on the functioning of equine joint health supplements is provided to the customers by veterinarians and retailers?*” is answered by in-depth interviews with veterinarians and retailers in the equine business. In the results can be seen that veterinarians have a lot more background knowledge into the equine joint health supplements than retailers do. Nevertheless, they still find that there is a lack of pharmacokinetic studies into equine joint health supplements, which makes it hard to scientifically substantiate some of the products. Both veterinarians and retailers try and advice the client as much as possible, although it is more easy to do for a veterinarian as they know the horse better than a retailer and also have more knowledge into scientific studies. They rather have the clients using the products they have had positive experiences with, mainly because of the known composition of the products

From this study, it can be concluded that there is a lack of pharmacokinetic studies into the effect of health supplements on the equine joint. Consequently, veterinarians lack the objective information to advise clients on which product to use according to the efficacy of the ingredients and the claims stated on product labels. Also, there is a lack of transparency in the equine joint health supplement market.

To give an answer on the main question “*what is needed to improve the usage of equine joint health supplements, in specific the usage of Glucosamine, Chondroitin, Collagen and Methylsulfonylmethane (MSM), in order to make the usage of equine joint health supplements more effective on the equine joints?*” there are several things which needs to be improved. First of all, there needs to be more research into the active ingredients, also to find out what the long term effects are for equine joint health supplements. Secondly, equine joint health supplements need to be more transparent about the active ingredients. Thirdly, riders need to be able to read product labels in order to choose the right supplement. Lastly, it is important for riders to consult their veterinarian in using an equine joint health supplements, as they have more background knowledge about the supplements as well as the horse’s medical history, age, discipline and other treatments.

Chapter 6 | Recommendations

The focus of this study was on young professionals in the equine business. Young professionals in the equine business need to be able to rely on the information stated on equine joint health supplements regarding its ingredients and effects on the horse's joint, for the horse's health, performance and wellbeing. Unfortunately, not all brands state the needed information on their products. Therefore, it is important for people without sufficient knowledge about equine joint health supplements to consult a veterinarian, whom can advise which supplement suits the horses' needs best.

Preferably the joint health supplement market should become more transparent. Product labels should become easier to read and include the exact amounts of the active ingredients used in the supplement. Also, the advice for brands is to become more transparent about the studies used to develop their product. Showing the knowledge behind a product can result in more trust from clients, veterinarians and retailers.

As joint health supplements are not created equal it is important to make a well-thought decision if buying a joint health supplement for your horse. If buying an equine joint health supplement, the advice is to first do research into the products and carefully read the ingredient list. You should always be able to read the amount of active ingredient given by the recommended dosage per day. If possible, try and choose a product which can offer you educational information about their product. Preferably choose a company which has studies into their equine joint health products, with positive results. Also note that label claims should not contain statements saying that the product can cure the joint, as a joint health supplement is only able to support the joints. Many supplements contain Lot numbers and expirations dates, which guarantee the quality of the product. After purchasing an equine joint health supplement one should always follow the directions stated on the product and although supplements may take time before they are effective try to evaluate your horse's progress. If in doubt, always consult your veterinarian as he or she knows your horse's treatment history. Your veterinarian can also advise you in which supplement or particular ingredient to invest, as not all the ingredients have the same effect on the joints.

In view of the results of this study, it may be worthwhile to further investigate the long term effects of glucosamine, chondroitin, methylsulfonylmethane and collagen as a supplementation for the equine joint health. This because there is a lack of pharmacokinetic studies into equine joint health supplements to really conclude what the best dosage is and how much effect this has on the equine joint. During these long term studies it is important to use big sample sizes and include a placebo group into the study.

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Appendix 1 | Interview professional rider

Start with a brief opening about who I am, why I am doing this research and if I am allowed to record the interview. Also ask if the respondent wants to stay anonymous.

Try and get a profile of the professional rider, general questions:

- Amount of riding years
- Background knowledge with horses
- Study
- Amount of riding horses each day
- How many own horses
- Competitive results

Discussion points:

1. Knowledge about equine joint health supplements
2. Usage of equine joint health supplements, what, why, etc.
3. Different brands in the equine supplement business
4. Active ingredients for equine joints
 - Glucosamine
 - Chondroitin
 - Collagen
 - Methylsulfonylmethane / MSM
5. Where are supplements bought
6. Influence of sponsors
7. Influence of veterinarian
8. Reason of feeding equine joint health supplements
 - Preventive
 - Problems occur
 - Advice of ...
 - Sponsor maybe?

Thank you for your time and effort. Do you have any questions or comments? If questions occur at a later stage you can either, ask those by email or phone contact.

Would you like to receive a summary of the interview? Yes, how would you like to receive the summary (mail or printed).

(Leave contact details)

Appendix 2 | Interview Veterinarian

Start with a brief opening about who I am, why I am doing this research and if I am allowed to record the interview.

Try and get a profile of the veterinarian, general questions:

- Background with horses
- Graduated since...
- Own horses
- Riding horses themselves? (competitive, discipline, etc.)

Discussion points:

1. Equine joint health supplements opinion
2. Different brands in the supplement business
3. Active ingredients for equine joints
 - Glucosamine
 - Chondroitin
 - Collagen
 - Methylsulfonylmethane / MSM
4. Prescribing supplements
5. Preventive supplements
6. Supplements and joint injection in combination with each other
7. Scientific research regarding equine joint health supplements
8. Quality of different supplements
9. Brands in assortment

Thank you for your time and effort. Do you have any questions or comments? If questions occur at a later stage you can either, ask those by email or phone contact.

Would you like to receive a summary of the interview? Yes, how would you like to receive the summary (mail or printed).

(Leave contact details)

Appendix 3 | Interview Retailer

Start with a brief opening about who I am, why I am doing this research and if I am allowed to record the interview.

Try and get a profile of the retailer, general questions:

- Background knowledge with horses
- Own horses
- Riding (competitive, discipline, etc.)
- Study

Discussion points:

1. Equine joint health supplements opinion
2. Different brands in the supplement business
3. Active ingredients for equine joints
 - Glucosamine
 - Chondroitin
 - Collagen
 - Methylsulfonylmethane / MSM
4. Advice supplements
5. Price of supplements
6. Quality of supplements
7. Reading ingredient list
8. Amount what needs to be given of active ingredients / scientific research

Thank you for your time and effort. Do you have any questions or comments? If questions occur at a later stage you can either, ask those by email or phone contact.

Would you like to receive a summary of the interview? Yes, how would you like to receive the summary (mail or printed).

(Leave contact details)

Appendix 4 | Example E-mail product

Dear sir/madam,

For my final thesis for the study 'International Equine Business' I am doing a research about the efficiency and active ingredients used in equine joint health supplements. My focus is on products containing the ingredients glucosamine, methylsulfonylmethane/MSM, collagen and chondroitin. I think it is very important that supplements are based on scientific research and are supported by veterinarians.

I have visited several veterinarian clinics through the Netherlands and I have found out that the Product X is a popular product amongst veterinarians. Therefore, I was wondering if you could help me with my research and provide me with the necessary information. If possible I would like to receive the ingredient list of the Product X and I am also very interested in the scientific studies behind the product. In my thesis I would like to show different products with the active ingredients and the scientific studies behind the products in order to get a good understanding about the different products and their efficiency.

I look forward to hearing from you.

Kind Regards,

Nikki Jantzen

International Equine Business student

nikkijantzen@live.nl

+31 6 41406336

Beste meneer/mevrouw,

Naar aanleiding van een paard met gewrichtsproblemen ben ik voor mijn afstudeerwerkstuk voor de opleiding 'International Equine Business' onderzoek gaan doen naar de werking van gewrichtssupplementen en actieve ingrediënten. Hierbij kijk ik vooral naar producten die gebaseerd zijn op wetenschappelijke onderzoeken en de ingrediënten glucosamine, methylsulfonylmethaan/MSM, collageen type II en chondroïtine bevatten. Daarnaast vind ik het ook belangrijk dat dierenartsen achter de producten staan, wat bij uw product het geval is, aangezien dit bij meerdere dierenartspraktijken in Nederland aanbevolen wordt.

Ik zag dat u onder andere de producten Product X en Product Y in uw assortiment heeft. Ik ben erg benieuwd naar de ingrediënten lijsten van bovenstaande producten en daarnaast ook naar de werking van bovenstaande producten. Welk van deze producten zouden eerder preventief aanbevolen worden en welke producten hebben meer effect bij paarden waarbij al gewrichtsproblemen opgetreden zijn? Daarnaast ben ik geïnteresseerd in de onderzoeken waarop uw producten gebaseerd zijn. Ik wil graag in mijn scriptie duidelijk naar voren laten komen op welke wetenschappelijke achtergrond een product gebaseerd is en hiermee ook een duidelijk verschil tussen producten laten zien.

Ik hoop dat u mij verder kunt helpen in mijn onderzoek en mij meer informatie kunt geven over uw producten.

Ik hoop van u te horen en alvast bedankt!

Met vriendelijke groeten,

Nikki Jantzen

International Equine Business student
nikkijantzen@live.nl
+31 6 41406336

Appendix 5 | Example E-mail veterinarian

Beste meneer/mevrouw,

Zoals besproken over de telefoon hieronder een uitleg over het onderzoek wat ik doe over gewrichtssupplementen.

Om het laatste jaar van de opleiding 'International Equine Business Management' af te ronden, doe ik een onderzoek naar gewrichtssupplementen voor paarden. Tegenwoordig wordt er steeds meer van de paarden gevraagd en verwacht, daarom vinden veel ruiters het belangrijk om hun paarden (preventief) te ondersteunen door gebruik te maken van gewrichtssupplementen. Nu zijn er veel verschillende supplementen merken op de markt en voor de gebruiker is het lastig om te zien welke voldoen aan de hoeveelheden aangegeven in wetenschappelijke onderzoeken.

Om de vraag van mijn onderzoek te beantwoorden ben ik daarom als eerste opzoek gegaan naar wetenschappelijke onderzoeken en achtergrondkennis over de gewrichten van paarden en de supplementen die beschikbaar zijn op de huidige markt. Om mijn onderzoek compleet te maken ben ik opzoek naar meningen en ervaringen van dierenartsen die te maken hebben met paarden met gewrichtsproblemen en deze bijvoorbeeld behandelen door gebruik te maken van gewrichtsinjecties of het voorschrijven van bepaalde voedingssupplementen.

Dit wil ik uitvoeren door middel van een interview waarbij vragen gesteld zullen worden aan de dierenarts over onder andere gewrichtssupplementen, de actieve ingrediënten, gewrichtsinjecties, de kwaliteit van verschillende producten en dergelijke. Het interview kan, mits dit gewenst is door de desbetreffende dierenarts, anoniem verwerkt worden in mijn onderzoek.

Ik hoor graag of u mee wil helpen aan mijn onderzoek.

Met vriendelijke groeten,

Nikki Jantzen

International Equine Business student

nikkijantzen@live.nl

+31 6 41406336

Appendix 6 | Example E-mail Retailer

Beste meneer/mevrouw,

Zoals besproken over de telefoon hieronder een uitleg over het onderzoek wat ik doe over gewrichtssupplementen.

Om het laatste jaar van de opleiding 'International Equine Business Management' af te ronden, doe ik een onderzoek naar gewrichtssupplementen voor paarden. Tegenwoordig wordt er steeds meer van de paarden gevraagd en verwacht, daarom vinden veel ruiters het belangrijk om hun paarden (preventief) te ondersteunen door gebruik te maken van gewrichtssupplementen. Nu zijn er veel verschillende supplementen merken op de markt en voor de gebruiker is het lastig om te zien welke voldoen aan de hoeveelheden aangegeven in wetenschappelijke onderzoeken.

Om de vraag van mijn onderzoek te beantwoorden ben ik daarom als eerste opzoek gegaan naar wetenschappelijke onderzoeken en achtergrondkennis over de gewrichten van paarden en de supplementen die beschikbaar zijn op de huidige markt. Om mijn onderzoek compleet te maken ben ik opzoek naar meningen en ervaringen van dierenartsen, ruiters en daarnaast ook ruitersportzaken die te maken hebben met gewrichtssupplementen.

Dit wil ik uitvoeren door middel van een kort interview waarbij vragen gesteld zullen worden over onder andere verschillende gewrichtssupplementen, op basis waarvan er gekozen wordt welke er in het assortiment zijn en ook wat er aanbevolen wordt aan de klanten wat betreft verkoop. Het interview kan, mits dit gewenst is, anoniem verwerkt worden in mijn onderzoek.

Ik hoor graag of u mee wil helpen aan mijn onderzoek.

Met vriendelijke groeten,

Nikki Jantzen

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