

# Dutch white wine distribution: An empirical study of temperature exposure, consumer awareness and preferences.

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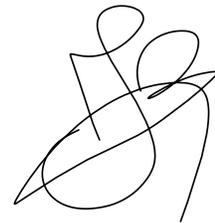
## Preface and acknowledgement

This thesis was written by Juriaan Blommaert for the course European food and business at the Aeres University of applied sciences. As a former pastry chef, working in fine dining and Michelin star restaurants, I decided to expand my knowledge by learning more about aspects in the agricultural/food business administration. The last four years, I learned a lot about the entire food chain and all entities involved. With my minors in food safety management and food supply chain management, I decided to combine both expertise and find a thesis topic of interest. By studying abroad in France and Italy, I learned a lot about wines and especially the temperature exposure and duration in the supply chain. This led me to examine what guidelines are in place in the Dutch market, and what possibilities there are to guarantee optimum quality of white wines produced in the Netherlands.

As I never wrote a thesis report before in my life, coming up with the right topic was challenging and took some time. The guidance from my thesis coach Emmanuel Anom and my girlfriend, helped me in writing this thesis. I would like to thank them from the bottom of my heart.

Based on the given feedback of both assessors, changes have been made throughout chapter one and two. The research design and methodology section was changed, minor grammar errors were resolved, at least 10 different references of less than 10 years old, and Appendix 2 was adjusted.

Yours sincerely,

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke at the bottom.

Juriaan Blommaert

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## List of abbreviations

<b>Abbreviation</b>	<b>Explanation</b>
AAWE	American Association of Wine Economists
AWRI	The Australian Wine Research Institute
ANZAM	Australian and New Zealand Academy of Management
CBI	Centrum tot Bevordering van Import uit ontwikkelingslanden <i>Ministry of Foreign affairs (the Netherlands)</i>
CBS	Centraal Bureau voor de Statistiek Central Bureau for Statistics (the Netherlands)
KNMI	Royal Dutch Meteorological Institute <i>Koninklijk Nederlands Meteorologisch Instituut</i>
OIV	Organisation Internationale de la Vigne et du Vin <i>International Organization of Vine and Wine (France)</i>
RVO	Rijksdienst voor Ondernemend Nederland <i>The Netherlands Enterprise Agency</i>
VIVC	Vitis International Variety Catalogue

## Summary

The Netherlands has an active wine production with the production of circa 1,250,000 bottles of wines. Although Dutch wines compete in national and international competitions and win many awards, the export is very small and mainly focused on local on-trade.

The main research question is: How is the national distribution of Dutch white wines managed in terms of temperature-controlled transportation and storage? In order to answer the research question, two important objectives in the Dutch wine supply chain were analysed: the wine handling methods carried out by Dutch wine producers, and the awareness of temperature exposure that can affect the white wine quality during distribution and storage along with the preference of time-temperature indicators by Dutch millennials.

The first objective involved an interview conducted under 36 wine producers in the Dutch provinces Gelderland, Limburg and North Brabant. This accounts for roughly 40% of wine producers in the Netherlands and  $\approx 62\%$  in the three provinces. During the distribution and storage of wine the right temperature condition is important. Many different researches indicate that temperatures above  $20\text{ }^{\circ}\text{C}$  can change the physical, organoleptic and chemical composition of wines. To prevent and guarantee temperature exposure during transportation, different measures are available. Such as temperature-controlled transport, material insulation(thermal covers) and time-temperature indicators.

The second objective involved an online survey conducted under 70 Dutch millennials. Similar research was conducted on the general knowledge to a large population group, however not specified to a specific target group. The survey was sent by email to university students with a food knowledge background and through social media channels to approach a larger market.

These two objectives lead to the following findings. The use of temperature-controlled transport is relatively scant due to the higher cost involved. Especially small vineyards do not have the resources to do so. However once seasonal changes occur above  $20\text{ }^{\circ}\text{C}$ , there is a higher number of vineyards that take protective measures. Still, large numbers of wines are exposed to warmer temperatures. More than half of the millennials have none to little knowledge of the effects on wine during distribution and storage. However, when the participants knew wines are exposed to higher temperatures, they prefer either not to buy that wine or still purchase depending on the price. Also, there is a large preference for a time-temperature indicator on bottles, or case of wine where most consumers are willing to pay more for it.

In conclusion, distribution distances in the Netherlands are relatively short where there might be a chance that white wines are minimally affected or not affected by high temperature exposure. It can be recommended that further research is conducted on the compositional changes of the grape varieties grown in the Netherlands and the use of material insulation.

## 1. Introduction

Wine is a complex product where different classification methods are used worldwide. The mostly used classifications are by place of origin (appellation), the methods used to produce the wine (vinification), vintage or varietal (type of grape used), and the year it was produced (Wine Facts, 2019). The Vitis International Variety Catalogue (VIVC) is an encyclopaedic database where the different grapevines are collected by working together with 23,000 cultivators in 45 countries, and 130 institutions. Over 10,000 different grape varieties are known worldwide (Julius Kühn-Institut, 2019).

Each grapevine has its own preference for soil conditions and climate. Some vines grow on high altitude and others grow on hanging slopes. The production of wine is very labour intensive, and a wine producer is year-round busy maintaining the grapevines in optimum condition. A lot of the work is carried out in spring, where the pruning of the vineyard starts and, in the summer, where the cluster thinning begins. In between the fertilization and quality control of the grapevines is carried out (Boulton, Singleton, Bisson, & Kunkee, 1996).

A lot of things can be planned in advance that influence the taste of the wine. For example, the use of different types of barrels for the fermentation process, the duration of maturation, and the blends of different grapes. Every year the taste can be different as the grape ripening process can be influenced by environmental factors such as climate change, the amount of rainfall and soil conditions (Goode, 2018). Moreover, the quality of wine in general can be affected by rough handling, impact shocks during (large) transportation distances, or surrounding environmental conditions such as temperature, light exposure, and humidity. The right shipment and storage of wines, contributes largely to the flavour of wine and should be taken into close consideration (Butzke, Vogt, & Chacón-Rodríguez, 2012).

Wine can undergo a long route from where it was bottled to where it was consumed, sometimes on opposite hemispheres (Mac Cawley, 2014). What is known from the different studies, is that higher temperature exposure affects the wine quality but little research has been done to quantify the number of wines that is indeed affected by temperature change.

Robert M. Parker, a renowned wine critic, advocate and arguably one of the most influential writer and assessor in the wine industry state:

*“It is a frightening thought, but I have no doubt that a sizable percentage (between 10% and 25%) of the wines sold in America have been damaged because of exposure to extremes of heat” (Parker, 2008).*

This research focuses on the Dutch white wine market, since there has not been any research done about how the wine supply chain is arranged within the country. Information will be provided about transportation methods used by wine producers and raise the awareness of Dutch consumers. Moreover, the aim of this research is to inform Dutch people about the effects of temperature exposure.

### 1.1. Wine supply chain

Commonly, wines are shipped abroad in containers by rail, vessel or train. Special shipments can also be transported by air but due to the high cost this is commonly not an option. There are two types of transportation containers: normal and refrigerated containers, also called reefers.

The transportation contains different phases (figure 1) from the winery to the importer/distributor (Mac Cawley, 2014).

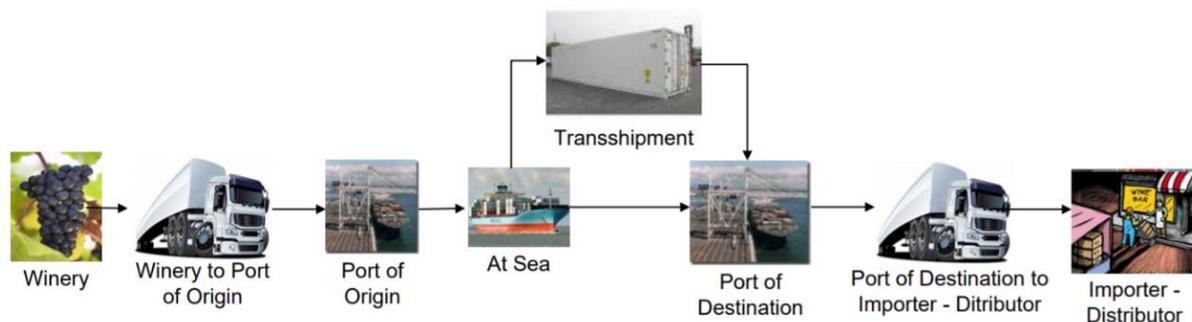


Figure 1. Stages in international wine trade (Mac Cawley, 2014).

From the winery, the international shipment is loaded into the truck and shipped to the port of origin. Either the container is loaded at the winery, or at a cross-docking/freight consolidation point where more smaller shipments are combined with the same destination. When the importer decides to use a reefer, the container is cooled and positioned in the belly of the ship where the power outlets are based. This way contact with the outside temperature and direct sunlight is minimized (Mac Cawley, 2014). If the importer decides to use a normal container, it is only a guess where it will be placed on the ship. Wineries often request the shipping company to place the container below the buoyancy line or under the deck. But this rarely happens (Wooder, 1991).

Once the ship arrives at the port of destination, the container is unloaded from the ship and placed in the yard of the port until the transportation company collects the freight. This sometimes take days or weeks before it is collected. All this time, the container is exposed to the outside climate factors (Mac Cawley, 2014).

The last stage involves the shipment to the importer or distributor, and from there the client is supplied to sell their wine to consumers or businesses. The wine supply chain is large and at different stages there are possibilities that high temperature exposures can occur, if it is not shipped in a reefer. This mostly depends on the outside climate conditions of where the container is at that point.

Although it is commonly known by distributors, wine producers and other stakeholders, that high temperature exposure affects the wine quality, but mostly, normal containers are used during transportation of wine to keep the distribution cost as low as possible. Also, the scarcity of available refrigerated containers during the bottling period (production) and export period of wines contributes a lot to the decision of transportation. The price of a reefer can be more than three times the shipping costs compared to a normal container (Butzke, Vogt, & Chacón-Rodríguez, 2012). Once the winemaker sells the products to the customer, transportation decisions are mostly driven by the buyer. But it also depends on the cost per bottle and total shipping cost (Butzke, Vogt, & Chacón-Rodríguez, 2012).

In the food chain, the use of refrigerated containers is commonly used. Such as long continental shipments of fruits and vegetables, as well as dairy and horticulture products. These products have specific climate control shipping conditions and will spoil fast when these conditions are not met.

Wine consists of individual components such as water, sugars and organic acids which continually interact with one another (Marquez, Dunstall, Bartholdi, & Mac Cawley, 2012). Wine has a synergistic effect of ethanol, organic acids and a low pH value which protects the wines from spoilage by pathogens (Reeves, 2009). As it will not spoil by pathogens, the risks of foodborne illnesses are not likely to occur and the risk for the seller is low. Therefore, most of the wines are shipped in common unrefrigerated containers.

#### 1.1.1. Wine quality during distribution

There have been many studies about the factors that can lead to wine spoilage and change the organoleptic characteristics. As the supply chain is complex due to where the wine was produced, climate factors involved and decision-making based on transportation, many errors can occur. Mainly humidity, vibration, light exposure and temperature fluctuation.

Humidity affects the screw caps, corks and synthetic closures of the bottles during storage and distribution. As the closure of the bottle can weaken through time, higher amounts of oxygen can enter in the bottle (Lopes, Saucier, Teissedre, & Glories, 2006).

During distribution, wines undergo a large amount of vibration which increases the propanol and isoamyl alcohol in wines. This may cause the wine to become too sweet, less aromatic, and produce high levels of acetone (Chung, Son, Park, Kim, & Lim, 2008).

Another research was conducted where wines were exposed to ultraviolet visible light to determine if any browning occurred during the process. The results showed that wines exposed to higher amounts of ultraviolet light, had an increased ratio of visual browning properties and losses in polyphenolic compounds (Benitez, Castro, & Barroso, 2003).

Wine experts and oenologists concluded based on the aging rates of wines, the optimum storing temperature of red wines is between 10 °C to 20 °C, and white wines between 13°C to 15°C. Any temperature above 20 °C will change the chemical reactions in the wine (Boulton, Singleton, Bisson, & Kunkel, 1996). For example, the thermal expansion increases the volume of wine and can cause more pressure in the closure of the bottle which then can obtain air by creating a small airflow that offsets the wine, the so called "piston effect". A mix of refermentation, acidity changes and increasing ratios of sediments can take place. This leads to cloudiness (protein hazes) of the wine and sensory taste difference (e.g. stimulate the growth of dormant microbes, developing off-flavours and excess carbon dioxide). Moreover, as wines reach high temperatures, the protective free sulphur dioxide rapidly declines and changes the bottle aging characteristics (Butzke, Vogt, & Chacón-Rodríguez, 2012)

The effect of temperature fluctuations depends on temperature level and time of exposure. Several tests were carried out on Chilean white wines (cabernet sauvignon) where results showed significant colour decrease, increase in aging and changes in chemical aromas with temperatures above 23°C and at least 3 months of storage. But after 33 months of storage at a temperature of 23°C and 31°C, the wines were defined as oxidized and maderised. The longer a wine is exposed to higher temperatures, the worse the

results are (Sivertsen, Figenschou, Nicolaysen, & Risvik, 2001). Another study reported the effect of temperatures are less pronounced on red wines than in white (Robinson, et al., 2010).

One of the major comprehensive studies was done by Butzke, Vogt and Chacon-Rodriguez, who documented 26 commercial wine shipments within the United States of America. 47 temperature recording devices were used during transportation. After arriving at the location, the wines were opened to assess the ethyl carbamate (EC) formation, also known as urethane, which acts as a wine quality indicator. The results were that the aging of wine increases rapidly when exposed to heat. The aging process accelerates between 1 and 18 months compared to wine stored in a conventional wine cellar (Butzke, Vogt, & Chacón-Rodríguez, 2012).

Alejandro F. Mac Cawley went deeper into global wine distribution and placed 735 temperature recording devices in containers traveling 269 different routes in the world from Argentina, Australia, Chile, South Africa and the USA. This research applied a global perspective of the wine supply chain and the temperature fluctuations that occur. Results showed that 55.7% of the recordings (429,357 observations) were between 20 °C to 25 °C to be considered worrisome, 27% were between 25 °C and 30 °C to be dangerous, and 6.7% were above 30 °C until the maximum temperature of 67 °C, to be considered extremely dangerous (Mac Cawley, 2014).

The high temperatures and duration of exposure have a large effect on wine. The examples previously given, are just a few that can occur. Danie Meyer published an overview of physical, organoleptic, and chemical changes that can be associated with temperature fluctuations. It is shown in table 1 (Meyer, 2002).

*Table 1. Temperature impact of wine quality (Meyer, 2002).*

<b>Physical defects</b>	<b>Organoleptic defects</b>	<b>Chemical defects</b>
○ Sediment	○ Maderised (baked taste)	○ High volatile acidity
○ Cloudy	○ Oxidised	○ Re-fermentation
○ Protein haze formation – stabilisation process leads to solid waste generation	○ Lack of CO <sub>2</sub> (flat)	○ Oxygen uptake
○ Browning	○ Lack of fruit	○ Decline of free SO <sub>2</sub> in white wines
○ Leaking	○ Decrease in intensity of young wine bouquet	○ Tartrate stability – in cold weather
○ Raised corks	○ Increase in the intensity of the maturation bouquet	○ Faster release of monoterpene – giving the wine an older character
○ Broken bottles	○ Ageing – change in aroma components	○ Changes in total acid – not significant in white wines
○ Reduced shelf life	○ Decrease in overall wine quality	○ Acetate rapidly hydrolysed
	○ Subtle changes – leading to	○ Decrease in terpene alcohol

	misjudgement of true nature and quality	
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Numerous studies were conducted to investigate the temperature effects on the wine quality by physical, chemical and sensory tests. Physical defects do not necessarily imply that the wine taste bad or the quality is affected. It can change the buying behaviour of consumers, making it less attractive and less or sometimes not marketable (AWRI, 2009). Especially the physical defects are easily noticeable in white wines as it has a transparent colour. The organoleptic defects and chemical do change the taste of wines. For example, maderised taste (Sivertsen, Figenschou, Nicolaysen, & Risvik, 2001), decrease of fruity components (Linsenmeier, Rauhut, & Sponholz, 2010), and faster release of monoterpene giving the wine an older character (Di Stefano & Castino, 1983).

### 1.1.2. Ways of temperature control

A report published in 2008, stated that bulk wines are less prone to experience large temperature variation compared to bottled wine during transportation. The larger the volume size of the bulk shipment, the greater the thermal inertia. The effects of higher outside temperatures is therefore less severe (Hartley, 2008).

Below are some more ways to protect bottled wines from high temperatures. Most of them are not only applicable for wine distribution, but were already used for other field of distribution.

Temperatures can be monitored by the award winning eProvenance company who made a patented global network of monitoring among others wine shipments. Their Online Monitoring System (OMS) collected by the sensors inside the shipment, are uploaded to the cloud where the sender can track his goods. An optimal shipment profile is one where the temperature stays between the 10 °C and 20 °C. It can show the customer that the wine was shipped in good or bad conditions. The international shipment from London to Hong Kong was perfectly distributed in a reefer container where the temperature stayed stable (within the green horizontal bar) the entire time as shown in figure 2 (eProvenance, 2019).



Figure 2. eProvenance shipment profile London to Hongkong (eProvenance, 2019).

But also, domestic or European shipping is affected by high/or low temperature changes. Out of 9 shipments, 33% was kept within the acceptable transport temperatures (figure 3). The other remaining 6 shipments, came above, or under the set temperature values (eProvenance, 2019).

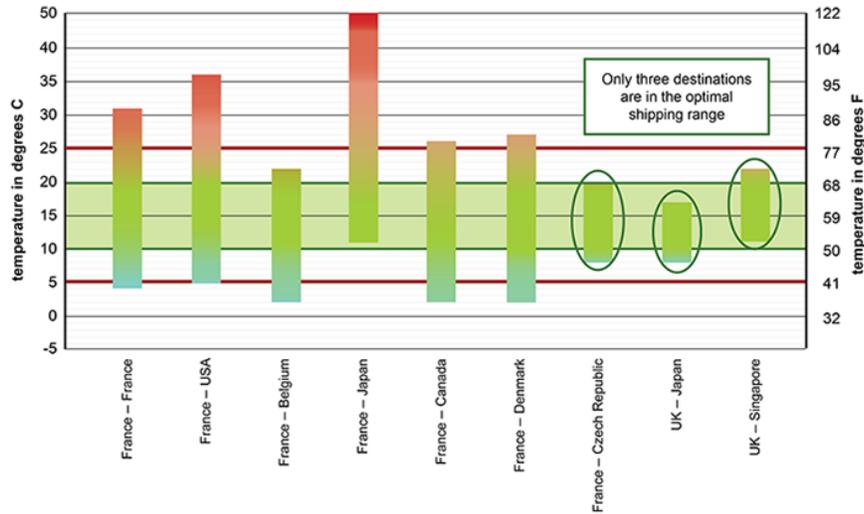


Figure 3. European and International shipment (eProvenance, 2019).

The use of thermal covers in the containers are used to prevent extreme temperature exposures to bottled and bulk wines, also called passive cooled insulated sea container. The heat from the outside is transferred by conduction to the inside of the container. The use of a thermal liner in the container or a pallet thermal cover are possibilities to reduce the exposure to warm climate conditions (figure 4 and 5). However, these thermal covers can hold the temperature for maximum 24 hours depending on the thickness of the material and quality, the deviation of temperature increase is different (Krautz, 2019).



Figure 4. Container thermal liner (Arivapak, 2019).



Figure 5. Pallet thermal cover (JF Hillebrand, 2019).

Within the Benelux (Belgium, the Netherlands and Luxembourg) the distribution of goods is mostly within 24 hours due to close partnerships and networks between leading, and medium size transport companies. For example, Tielbeke logistics uses cross-dock operations with partners and own assets to be as lean as possible (Tielbeke, 2019). Throughout Europe, multiple arrangements are established in similar ways as the mentioned Benelux partnership. In these cases, the thermal covers and insulation is a good option of maintaining a relatively steady temperature of the wines and it can be reused again by the transport companies.

Time-temperature indicator (TTI) is a small measuring label that can show a time-temperature relationship. It is on the market with different use of application such as freshness of fish and meat products. The simple label can show a colour indication based on duration and temperature exposure, once it reached a higher temperature for a certain period, the colour is irreversible. It can be fully customizable depending on the set standards of the product and application. For example, the label can be customized to indicate an average or maximum reached temperature during storage and distribution which so correlates to the quality loss of a specific product (Feliciano, 2009). The freshness indicator by Evigence is such an example of a TTI (figure 6). It uses a freshness key with three colours, white, dark grey and light grey to guarantee the quality. A white colour means the product is no longer in best quality, representing higher temperatures for a longer duration. Both dark and light grey indicate that the product is in optimal quality, leaving a small error of mistake that can still be tolerated (Evigence, 2019).



Figure 6. Temperature-time sensor (Evigence, 2019).

Moreover, this simple and relative cheap quality assurance for consumers would cost around the \$0,60 based on a research conducted in 2007 (Xie & Kissling, 2007). This could also imply that the price is different in 2019.

## 1.2. Wine production and consumption

In the following subsections, the global and the Dutch wine production and consumption is explained. This helps to create a better understanding of the current situation. Furthermore, a small market research based on buying motives, and knowledge in general of Dutch consumers will be elaborated.

### 1.2.1. Global

From the worldwide wine production, 43% is exported outside the country of origin with an export value of 30,4 billion euros (OIV, 2018). In the European Union (EU) almost half of the wines are exported outside EU mainly to the United States, China, Switzerland, Canada, Japan and Hong Kong (Eurostat, 2018).

A majority of the EU wines travel large distances (table 2). In 2018, 50% of the EU wine exports are shipped to the United States of America, China and Canada. The European wines are famous worldwide, and sometimes seen as a luxurious product or social status symbol like in China (ANZAM, 2013). Especially France is the top EU exporter with a 27% share (Eurostat, 2018).

*Table 2. Countries that import the most EU wines (Eurostat, 2018).*

Country	Shares of EU wine export market
United States	32%
China	10%
Switzerland	9%
Canada	8%
Japan	7%
Hong Kong	7%

In 2017, the worldwide wine consumption was estimated at 243 million hectolitres (mhl) while the global wine production was 250 mhl, excluding juice and musts. Europe as a continent contributes to 56% of the global wine production, with Italy (42,5 mhl), France (36,6 mhl) and Spain (32,5 mhl) leading the ranking of top producers (figure 7). The United states is the fourth largest wine producer (23,3 mhl), followed by Australia (13,7 mhl) Argentina (11,8 mhl), China and South Africa (10,8 mhl), and Chile (9,5 mhl) (OIV, 2018).

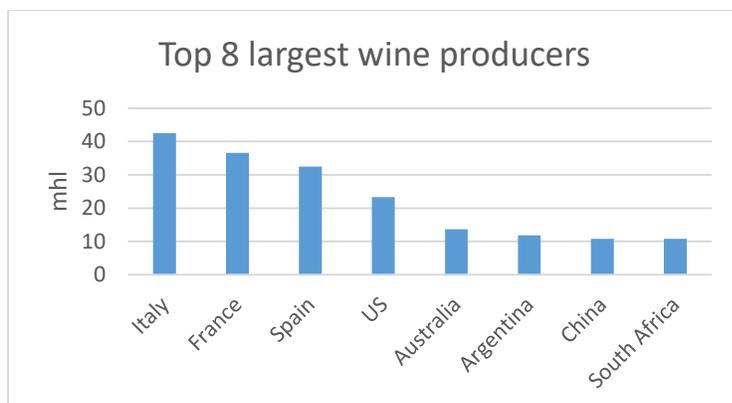


Figure 7. Top 8 largest wine producers (OIV, 2018).

### 1.2.2. The Netherlands

There are indications that the oldest Dutch vineyards date from the Middle Ages (1266 AD) in the southern part of the province of Limburg. In the centuries following, some vineyards were established in Gelderland, Utrecht and Brabant. Due to the climate, the grapes did not really mature and large production quantities never happened such as in France, Spain or Italy. Also, the taste and quality were very low and were considered as the cheapest wines in Europe. From the 1980's on, the number of Dutch vineyards grew rapidly, partly by rural and regional subsidies from the European Union (Beukers, 2017).

While the Dutch Central Bureau of Statistics (CBS) indicates there are 89 wine grape growing companies in the Netherlands in 2018 (CBS, 2019), the RVO states there were 139 commercial vineyards in the Netherlands in 2018 (RVO, 2019). Although it conflicts with another, it does state there is active wine production in the Netherlands. For this research, the number of the CBS will be applied.

The three provinces with the largest amount of wine producers (figure 8) are Gelderland, Limburg and North Brabant with a total of ≈65% share of the Dutch market (CBS, 2019).

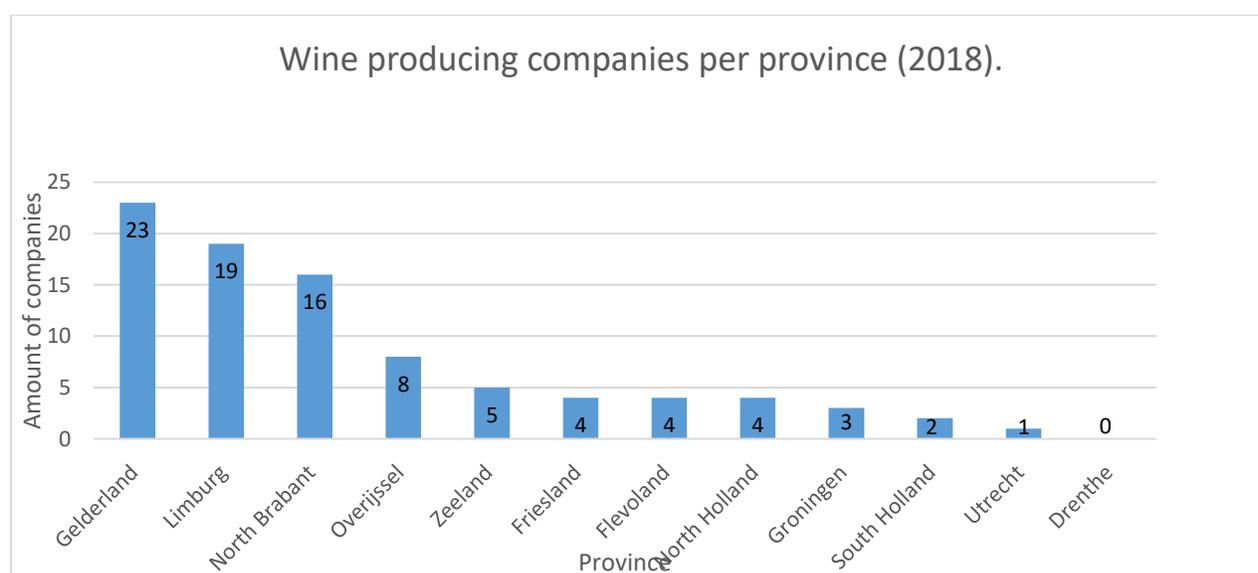


Figure 8. Wine producers per province (CBS, 2019).

In 2018, the Netherlands produced 9.500 hectolitres, equal to approximately 1,250,000 bottles of red, (sparkling) rose and white wines. Of the total wine production in the Netherlands, 30% were rose and red wines, and the majority of 70% were still white wines (RVO, 2019). Four Dutch wines currently have the Protected Designation of Origin (PDO) label (with 1067 hectolitres produced) and the majority of wines produced have a Protected Geographical Indication (PGI) label (with 6343 hectolitres produced) that is protected and registered for each Dutch province (RVO, 2019). As this is still a protection on national level and not European level, it is not published in the European Commission's DOOR website, but at the nation's Intellectual Property Office (IPO) (European IPR Helpdesk, 2019).

For a PDO, all the grapes from the wine come from a specific geographical area, with a PGI only 85% of the grapes must come from the area. The link between the wine and its geographical origin is greater with a PDO than with a PGI. It is shown as a quality indication and reputation of the area, and therefore play a large role for commercial and/or international trade (European IPR Helpdesk, 2016). The label of a PDO and PGI brings extra price premium to the wines, also in emerging economies. But also reflects higher cost of production as only limited resources can be used from the area (Agostino & Trivieri, 2015).

Moreover, the price of products with a geographical indication are sold 2,23 times higher than similar or non-geographical indication qualities products (European IPR Helpdesk, 2016).

Every year, Dutch vineyards compete in national and international competitions. For example, the PIWI International wine price award. An award focussing on sustainable wine production without pesticides, but also the organoleptic properties of the wine. The evaluations are carried out by qualified wine experts, based on measurable criteria such as aromas, acidity and sweetness (PIWI International, 2019).

In table 3, a few of the Dutch winners of gold and silver medals in 2018 are shown. In total, 2 big gold medals (96 points or more), 6 gold medals (90 to 95 points), 7 silver medals (83 to 89 points), and 1 recommendation (75 to 82 points) were handed over. The vineyards can use this medal (PIWI International, 2019) as a sticker on the bottle to promote and get the attention of consumers (figure 9).



Figure 9. PIWI International medals (PIWI International, 2019).

Table 3. Medals from Dutch vineyards, but not limited to (PIWI International, 2019).

Type of medal	Vineyard, variety and age
<b>Gold</b>	
94 out of 100 points (red)	<b>Betuws Wijndomein</b> - 2016 LingeRood Cuvee Signature - Regent, Cabernet Cortis – PGI.
90 out of 100 points (red)	<b>Betuws Wijndomein</b> - 2016 LingeRood Cuvee Barrique - Pinotin, Regent – PGI.
95 out of 100 points (white)	<b>Betuws Wijndomein</b> - 2017 LingeWit Blanc de Noir - Pinotin – PGI.

93 out of 100 points (white)	<b>Wijngaard Aan de Breede Beek</b> - 2017 Solaris – PGI.
91 out of 100 points (white)	<b>Betuws Wijndomein</b> - 2017 LingeWit Cuvee - Villaris, Solaris, Johanniter, Sauvignier Gris – PGI.
<b>Silver</b>	
88 out of 100 points (red)	<b>Wijndomein de Koen</b> - 2017 Langedijker Rode - Rondo, Marechal Foch – Landwein.
86 out of 100 points (red)	<b>Wijndomein de Koen</b> - 2016 Seed Rood - Cabernet Cortis, Rondo – Landwein.
99 out of 100 (dessert wine)	<b>Wijndomein de Koen</b> - 2017 Nagenieten - Muscaris, Solaris – Landwein.
95 out of 100 points (white)	<b>Betuws Wijndomein</b> - 2017 LingeWit Blanc de Noir - Pinotin – PGI.
93 out of 100 (white)	<b>Wijngaard Aan de Breede Beek</b> - 2017 Solaris – PGI.

Jancis Robinson is a wine expert and was surprised about the Dutch wine quality. She stated in an article the superior quality of 16 Dutch wines she tasted, are even more exceptional to most English still wines. Especially the Pinot Blanc produced by De Kleine Schorre's was outstanding, better than most Pinot Blanc's in the Alsace region in France (Robinson J. , 2010).

This shows the high level of wine produced in the Netherlands and it is only increasing with the knowledge and maturation of the vines. Also, climate change plays a large factor as the Dutch summers are longer and warmer (Driessen & Morren, 2015).

Not all grape varieties can grow in the Netherlands as the country cannot offer enough days of sunlight and warm climate such as in the south of Italy, France and Spain. In the 90s, new crossed varieties and hybrids were introduced with a better pest or disease resistance, but also to improve the organoleptic characteristics such as aromas, colour properties and yield. These crosses became more applicable for the cooler climates such as the Netherlands, Belgium and the United Kingdom. For example, a well-known crossed grape is Cabernet Sauvignon. The offspring comes from the Sauvignon Blanc grapes and Cabernet Franc (Desimone & Jenssen, 2018).

Some grapes that grow well in the Netherlands (Infonu, 2017), but not limited to, are shown in table 4. Most of the grape varieties used are crossed varieties (two European grapes crossed) or hybrids (North American grape crossed with an European grape) (De la Fuente Lloreda, 2018). Referring back to table 3,

it is noticeable that more combinations/blends are made by winemakers, leading to fine quality wine. For example, vineyard Betuws Wijndomein uses a blend of Regent and Cabernet Cortis grapes.

Table 4. Varieties used in the Netherlands (Infonu, 2017).

Grape variety	Area grown	Crossed variety and ancestor
Müller Thurgau	South-Limburg	Yes; Riesling and Madeleine Royale
Auxerrois Blanc	Limburg and Gelderland	Yes; Pinot Blanc and Heunisch Weiss
Pinot Noir	Southern parts of the Netherlands (NL)	No
Solaris	Commonly used by Dutch vineyards	Yes; Merzling and Gm 6493
Rondo	Commonly used by Dutch vineyards	Yes; Zarya Severa and St.Laurent
Pinotin	Commonly used by Dutch vineyards	Yes; Cabernet Blanc, Cabernet Noir, Cabertin and Cal 6-04
Regent	Commonly used by Dutch vineyards	Yes; Diana and Chambourcin

The wines from the Netherlands have little attention from international consumers. Therefore, the majority of wines is especially focussed on local on-trade (bars, restaurants and small specialities stores) and is predicted not to change in the coming years (CBI, 2016). Also, the average price of a Dutch bottle of wine is 10 euros, which is therefor relatively expensive. This is due to the expensive price of land and the expensive labour (Kleyngeld, 2018).

Over the last few decades, the Dutch wine consumption has increased significantly with 25,7 litres per capita (18+) in 2016 (WINO, 2017). Although the Dutch beer consumption per capita is still higher than the wine consumption, the consumption of beer and distilled liquors is structurally declining over the last decades (figure 10) (AAWE, 2018).

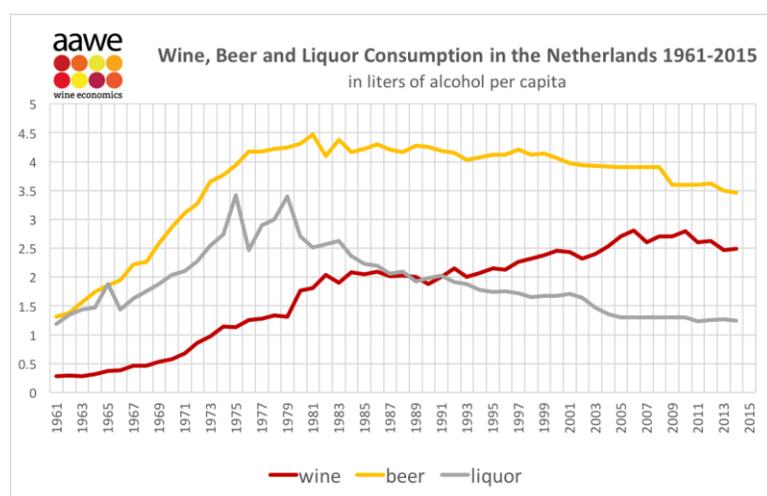


Figure 10. Wine, beer and liquor trend in the Netherlands 1961-2015 (AAWE, 2018).

In 2017, most of the import are bottled wines with an 84% share, 13 % bulk and >2 litres wines, and 3% sparkling wines of the Dutch market (figure 11). In comparison with other neighbouring countries such as Belgium (62%) and Germany(37%), the Dutch market exceeds above the rest (OIV, 2018).

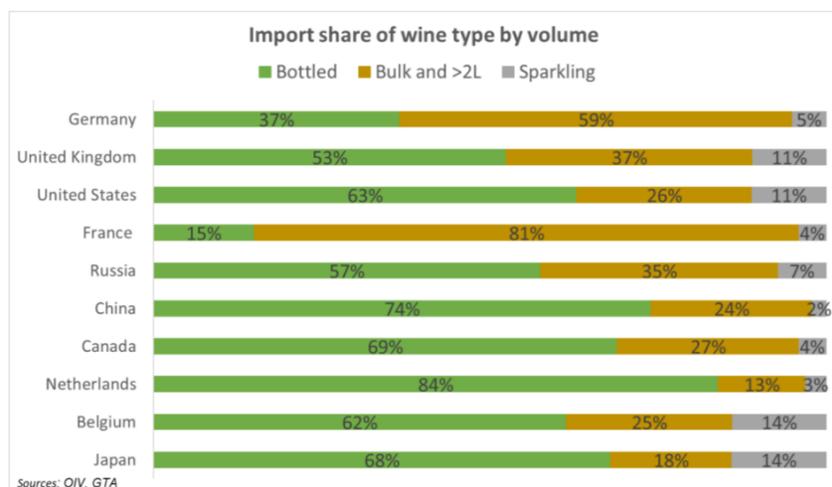


Figure 11. Import share of wine type by volume (OIV, 2018).

Most of the wines were imported from France (31%), South-Africa (20%) and Chilli (12%). This means that 32% of the wines sold in the Netherlands come from thousands of kilometres away (Driessen & Morren, 2015). Therefore, one can imply that a large majority of wine is affected by outside temperature. In South Africa, research indicated that refrigerated containers are used as low as 2% in all of their international shipments (Meyer, 2002).

The Dutch bank ABN-AMRO carried out an independent study, together with the Hospitality business school in The Hague Group LFE to assess the buying behaviour of Dutch consumers and hospitality organisations (551 number of participants: N=551). The Dutch consumers and the hospitality industry purchase on average lower priced ranged wines. On average, €3.44 is paid for a bottle of wine and 66% of wines are bought in supermarkets (figure 12). Wine specialty stores and liquor stores count for another 22% and though the internet and hospitality industry the remaining 7% (Driessen & Morren, 2015). In general, the higher the price of the wine, the higher the price-quality expectations are (Schnabel & Storchmann, 2010). As the average price of a Dutch bottle is 10 euros, it can be expected the expectations are higher than in relationship to cheaper wines which are on average consumed in the Netherlands.

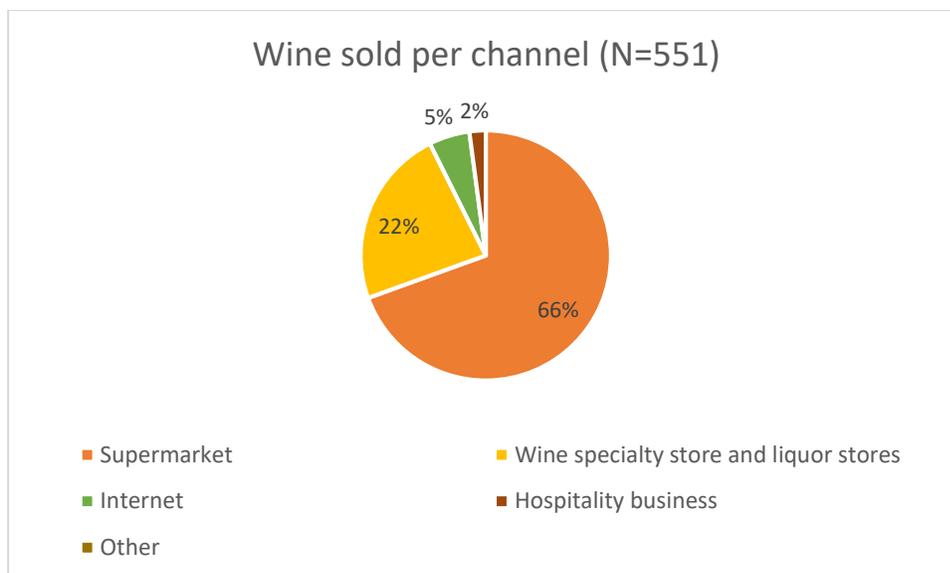


Figure 12. Wine sold per channel in the Netherlands (Driessen & Morren, 2015).

The knowledge of wine was also surveyed under the participants (N=551). 87% of the participants indicated they have little or limited knowledge of wine. Only 12% indicated they have good to excellent knowledge of wines and quality (figure 13). However, it is not clear whether their knowledge include the distribution and storage conditions of the wines.

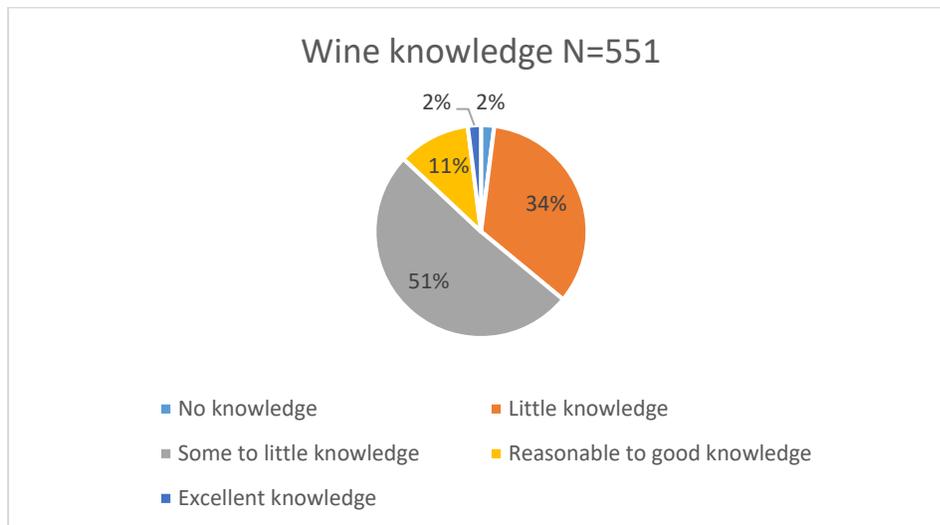


Figure 13. Knowledge of Dutch wine consumers (Driessen & Morren, 2015).

To summarize, in the wine supply chain wines can travel large distances and therefore exposed to the risk of high temperatures which affects the quality of wine. In the Netherlands, 70% of the total wine production are white wines and is therefore the focus area of this research. But how the distribution is arranged from producer to consumer within the Netherlands and under which conditions, is unknown. This led to the main research question: *How is the national distribution of Dutch white wines managed in terms of temperature-controlled transportation and storage?*

The sub-questions formulated contributes to how the distribution of Dutch white wines is managed by the producers, and the consumer's awareness of temperature exposure of Dutch white wines.

Sub-question 1; How is the current distribution process arranged by vineyards in the Netherlands?

Sub-question 2; How is wine shipment handled during the different season of the year?

Sub-question 3; To what degree are Dutch consumers aware of temperature exposure during transport and storage of a bottle of wine?

Sub-question 4; How much is a Dutch consumer willing to pay more for a bottle with a temperature control indicator?

## 2. Research design and methodology

This chapter explains the approach and methodology to answer the sub-questions of this research. What is unknown about the Dutch market is the extent of how wines are distributed during the year, and especially in the warm periods of the year. As temperature-controlled transport cost up to three times as much, it can be a crucial factor of decision making by vineyards in the Netherlands. This led to the main research question of this research: How is the national distribution of Dutch white wines managed in terms of temperature-controlled transportation and storage?

By answering the main question, the following sub-questions were formulated:

Sub-question 1; How is the current distribution process arranged by vineyards in the Netherlands?

Sub-question 2; How is wine shipment handled during the different season of the year?

Sub-question 3; To what degree are Dutch consumers aware of temperature exposure during transport and storage of a bottle of wine?

Sub-question 4; How much is a Dutch consumer willing to pay more for a bottle with a temperature control indicator?

The research involves two surveys. Firstly, an interview was conducted to identify how the wine distribution is handled by vineyards in the Netherlands. Secondly, the awareness of temperature exposure of wine during transport and storage and the preferences of a temperature indicator label on Dutch white wines.

### 2.1. Participants: Wine producers survey

To answer sub-questions one and two, 45 wine producers with more than one hectare of land were located (De wijn hoek, 2019) in the three largest wine producing provinces in the Netherlands (appendix 1). The three largest wine producing provinces are Gelderland, Limburg and North Brabant that have a significant market share of ~65% of wine production in the Netherlands (CBS, 2019).

The sample size of 45 with a 95% confidence level and a margin of error of 5% would reach 41 participants. The number was calculated through a sample size calculator (Survey Monkey, 2019). This is ~ 46% of wine producers in the Netherlands, and ~ 70% of the three provinces.

### 2.2. Participants: Dutch wine consumers questionnaire

The anonymous questionnaire was filled in by people between the 20 to 30 years of age, and about their knowledge of temperature exposure during wine transportation. Furthermore, if they find it necessary for temperature assurance throughout the wine supply chain by a label on the wine bottle.

The aim was to reach 100 people in the age from 20 to 30 years. Research showed that white wines are popular in this age group (Entree, 2009). Moreover, this young generation looks respectfully to the wine product and wants to increase their wine knowledge (Stichting Nationale Wijnweek, 2009).

The ideal sample size of 100 people with a 95% confidence level and a margin of error of 5% would reach 80 participants. The number was calculated through a sample size calculator (Survey Monkey, 2019).

### 2.3. Procedure: Wine producers survey

For sub-questions 1 and 2, a mixed method approach was conducted based on the interview. A mixed method approach is one where both quantitative and qualitative data are collected. This has the advantage that both types of research are combined, which increases the validity and reliability of the results (Shorten & Smith, 2017).

The approach was to contact vineyards in the provinces of Limburg, Gelderland and North Brabant personally by phone call (appendix 1). This way, the wine producers explained how they managed their distribution to the customer. Moreover, it will show patterns and frequencies of the outcome of the distribution methods. The data collection was stored in an excel file and was gathered in three days.

Any number lower than 1 hectare would be too small to participate in this research as the range of yield lies between 3558 to 17,791 bottles per hectare (Wine Spectator, 2016).

The interview was before the harvesting season of wine production, which starts in August. The chance was therefore higher that the winemakers could spare around 6 minutes to talk about their distribution. The duration of answering the questions (appendix 2) took around 3 minutes, but also taken into account the additional questions from the wine producer and brief introduction of the research. This was experienced by try-out phone calls with a group of three persons. The total time needed to conduct these interviews was 216 minutes (45 companies x 6 minutes), or 3,6 hours over a time period of three days.

The interview started with a number of questions about personal data, such as: what kind of work do you do, and how was the vineyard established? In this way, a pleasant atmosphere was created where the respondents feel at ease. In case the person is not available in the period of data collection, an online survey was sent to the wine producer's email address, in this way they can fill it out whenever it is convenient for them. Furthermore, this research will be made public through the university's data portal. This will give them more incentive to participate, since they could get information about what other wine makers are doing.

### 2.4. Procedure: Dutch wine consumers questionnaire

For sub-question 3 and 4, a questionnaire was made (appendix 3) to find out what the awareness is of Dutch consumers relating to the warm temperature exposure in the wine supply chain. First, short background information was provided to inform the participants about the effects on wine during warm period, since not everyone is aware of that problem. It will help them to understand the matter better and consequently make a choice on how much they are willing to pay more for a bottle of wine with a temperature indicator label. The label will guarantee the right quality and transparency throughout the supply chain.

The questionnaire was made by google forms, and send to students of the Aeres University of applied sciences following the study International food and business, and European food and business. Furthermore, the survey was published through social media channels, such as Facebook and LinkedIn to reach out to a larger target audience.

### 2.5. Sub-question one

Three questions were asked (Appendix 2, questions 1 to 3) to give insight on how the current distribution process is arranged by vineyards in the three provinces.

The outline of questionnaire for the wine producers can be found in appendix 2. The following questions were asked during the interview.

- *Question 1:* Through which channel do you sell your white wines in the Netherlands?

This question helps to obtain more insight into the sales channels. The most obvious ways of sales are through direct sales, business to business and internet. But also leaves the wine maker to formulate other possibilities of sales if needed. Appendix 4 specifies per vineyard the percentage per channel.

- *Question 2:* How much is that in size (%) divided?

To see the share in the market, the wine makers were asked to specify in percentages the share. This way, it shows how many wines are transported to the customer and how many are picked up from the vineyards by direct sales.

- *Question 3:* How do you transport your wine to the customer?

This question focusses on the ways of transportation. The ways could be either with an outsourced partner, done by themselves or other forms of collaboration with different companies.

## 2.6. Sub-question two

Four questions were asked to obtain information on how wines are shipped or handled during warm periods or the different season of the year (Appendix 2, questions 4 to 7).

- *Question 4:* Is the wine shipped in temperature-controlled conditions?

This question helps to identify the percentages of temperature-controlled wine shipments in the three provinces.

- *Question 5:* What are those conditions.

The specific conditions of transport were written down manually. This could be different for each vineyard. This could be either temperature related, or use of specific material.

- *Question 6:* In which period do you distribute the most white wines?

In summer, high temperatures (>20 °C) can be reached. This is the potential period that can (partially) offset the wine. However there might also be a possibility that businesses or other different channels buy white wines before the peak season. This question will answer in which period the most white wines are distributed.

- *Question 7:* Are there any specific measures in place during shipments in warm periods or seasonal changes?

It is not always necessary to transport the wine temperature-controlled when the outside temperature is between 10 °C to 20 °C. However, this question will specify, whether the vineyards implement protective measures against high temperature exposures in warm periods or seasonal changes.

## 2.7. Sub-question three

Four questions were formulated (appendix 3, questions 1 to 4) of to what degree Dutch consumers are aware of temperature exposure during transport and storage of a bottle of wine. Firstly, the age of the

participant was asked in order to filter out participants who does not fit the age profile. Secondly, the gender was asked.

- *Question 3: How would you rate your knowledge of wine in general?*

The general knowledge of the participants is asked. This helps to identify the average experience/knowledge of the participants and is split up into five categories. From no knowledge to excellent knowledge.

- *Questions 4: Are you aware about warm temperature exposures that can affect wines?*

Based on the general knowledge of the participants, the next question is their knowledge of warm temperature exposure that can affect the wine. This way, it is more specific based on the research topic. The consumer can choose out of four categories, from no knowledge to good knowledge.

## 2.8. Sub-question four

Questions 5 to 8 of appendix 2 were asked to identify the preferences whether a Dutch consumer is willing to pay more for a bottle of wine with a temperature-controlled indicator.

Before question 5 was asked, some additional information was given to the participants about how wines are influenced by warm temperatures. By giving this information, it is easier for the participant to understand what changes can happens during distribution or storage at temperatures above 20 °C.

“Wines should be distributed and stored between 10 °C to 20 °C. Any temperature above 20 °C, affects the physical properties (i.e. sediments, protein haze formation and browning), organoleptic properties (i.e. oxidation, baked taste and lack of fruit characteristics) and chemical properties (i.e. re-fermentation and high volatile acidity) of wines.

*Previous research showed that roughly 80% of the international wine export is affected by temperature exposure (Mac Cawley, 2014). And just 2% of the South African wines export are temperature-controlled shipped (Meyer 2002).”*

- *Question 5: Knowing that large amount of wines are significantly exposed to temperatures of 30 degrees or more for a significant amount of time (Parker, 2008 & Mac Cawley, 2014) , would you still buy that bottle of wine?*

This question examines the preference of the consumer as in would they still be interested in buying a bottle of wine that underdo organoleptic changes. The participant could fill in a quantitative answer such as yes, no, or depends on the price. But also, an open possibility to fill in what he or she believes.

- *Question 6: Considering that the average price of a Dutch bottle of wine is around 10 euros, do you think the wines should have a temperature indicator?*

Adding a temperature label to the wine can guarantee the wine was stored and distributed in the right condition. While a Dutch bottle of wine is relatively expensive (Kleyngeld, 2018), it can show whether Dutch consumers find it necessary that the wine contains a temperature indicator.

- *Question 7: Are you willing to pay more for a bottle with a temperature indicator that guarantees the right quality throughout the supply chain?*

This question will tell if a consumer is willing to pay more for a bottle for a bottle of wine with a temperature indicator or not. There might be a possibility that based on the price of the wine, it is preferred, or not.

- *Question 8:* Considering a bottle of Dutch wine costs 10 euros, how much are you willing to pay more that bottle with a temperature indicator?

In case the wine producer decides to add a temperature indicator on each individual, or case of wine, it will cost the owner money. Instead of simply increase the price of the wine, this question investigates how much a consumer is willing to pay more.

### 2.9. Limitation: Wine producer survey

This interview had potential limitations. Firstly, there was a possibility of insufficient access to data as wine producers may not like to talk about the issue in the wine supply chain. Secondly the given information might be socially desirable, however not true. Finally, the person in charge may not be available during the data collection period. However, to counterbalance these limitations, the interview was processed anonymously, and this was mentioned at the start of the interview. It was important that the respondent could speak freely for the results of this study.

### 2.10. Limitation: Dutch wine consumers questionnaire

This survey had some potential limitation. Firstly, the data collected will consist out of partial information of consumers between the age of 20-30 years. Therefore, the results of this study cannot conclude to a larger population, but rather be suggested. Secondly, there could be a possibility of insufficient access to data due to the lack of participation.

### 2.11. Data analyses

The statistical analysis for sub-questions 1,2,3,and 4 were done by Excel, as it offers a wide range of statistical functions. For this research, the quantitative data from the surveys was structured and tranformed to clear graphs by the use of Pivot tables, COUNT function, AVERAGE function and DSUM funtion. The qualitative were written down in Excel. Finally, graphs were created to provide a clear overview of the data collected.

The data will be analysed according to the following steps:

1. Data gathering; all data both through the online questionnaire and phone calls were gathered.
2. Data assessment; all data was verified and cleaned.
3. Organise data; all data was organised based on the given answers.
4. Data analyses; in Excel, the qualitative data was transformed into pivot tables and graphs.

### 3. Results

In this chapter, the results of Dutch wine consumers questionnaire and the wine producers survey were evaluated. The outcomes should answer the main question “How is the national distribution of Dutch white wines managed in terms of temperature-controlled transportation and storage?”. To create a clear overview, this chapter is divided in four sub-paragraphs. These sub-paragraphs correspond with the sub-questions mentioned in chapter two. Sub-paragraph 3.1 helps to answer the question how the distribution process is arranged by vineyards in the three provinces. Sub-paragraph 3.2 focuses on how the distribution is handled in the different seasons of the year. Sub-paragraph 3.3 examines how much Dutch consumers are aware of temperature exposure during transport and storage of a bottle of wine. And finally sub-paragraph 3.4 explains how much a Dutch consumer is willing to pay more for a bottle of wine with an temperature indicator.

During the data collection 36 out of 45 wine makers were reached by phone or email. The remaining 9 vineyards were either not interested of providing information for this research, or were not available during the time period of data collection. This rises the margin of error to 7,39% and therefore diminish the reliability of this study with a 95% confidence interval (Checkmarket, 2019). This decreased the number to  $\approx$  62% of the three provinces and  $\approx$  40% of the vineyards in the Netherlands. In case this study is repeated or reproduced for other provinces in the Netherlands, unexpected results may show up due to the increased margin of error.

The online questionnaire was filled in by a total of 70 participants. The questionnaire was online for 2 weeks and was filled in by 70 people. This raised the margin of error to 6,45% and therefore diminished the reliability of this study with a 95% confidence interval (Checkmarket, 2019). To represent this to a larger population of millennials, different knowledge levels and preferences may arise.

Furthermore, this chapter summarizes the obtained data and results from both surveys (Appendix 4 and 5). This is done by the data analyses methods described in chapter 2.11.

#### 3.1. How is the current distribution process arranged by vineyards in the Netherlands?

In the first section of the survey was asked through which channels wine producers sell their wines. The answers were divided into four categories. Business to business (B to B), business to consumer/direct sales (B to C), and through the internet.

Figure 14 displays the distribution of the sales per channel. The majority of the wines with 73% are sold business to business (N=36), business to consumers/direct sales (N=34) with 19%, and internet (N=19) sales of 8%. During the interview, the correspondents (<3ha) mentioned that the main sales are local restaurants, regional shops and markets. Larger size vineyards also sale through these channels, but extend their sale range at wine speciality stores and liquor stores and supermarkets. Also, the sales are more spread out over a larger distance.

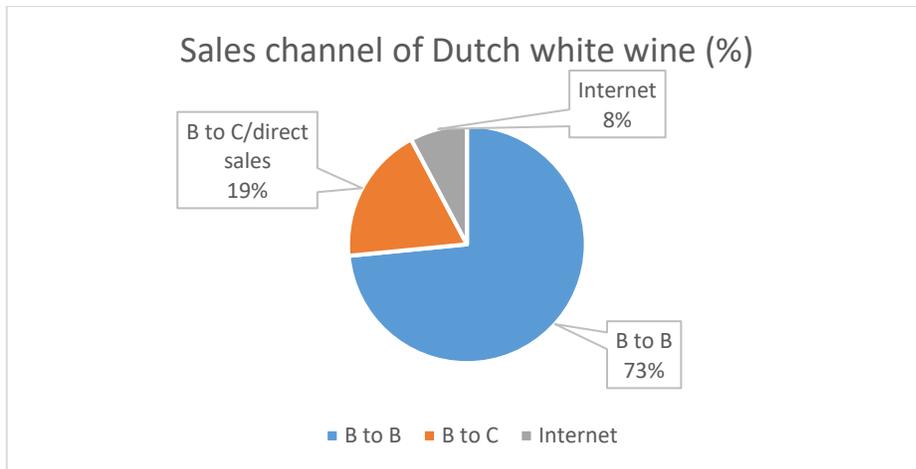


Figure 14. Sales channel of white wines.

The transportation process of the wines depends on the production size and the size of the vineyards. In total 47 answers were given as multiple combinations can occur. Figure 15 shows the mode of distribution of wines by vineyards in their sales channel. The results show that 47.9% (N=23) of the wine makers organizes their distribution by themselves, for example with a van. This is most common method for small vineyards. The larger sized vineyards (>3ha) mainly choose an outsourced logistic partner (26.6%, N=12) to handle the transport from business to business and internet sales. In 14.9% (N=7), the distribution is handled both by the vineyard, as well as by an outsourced partner, which depends on the distance. The remaining 10.6% (N=5) of the wine distribution is picked up directly by a local business in the area. Whenever possible the vineyards distribute the wines themselves, however when the distance become too large, an outsourced partner is hired.

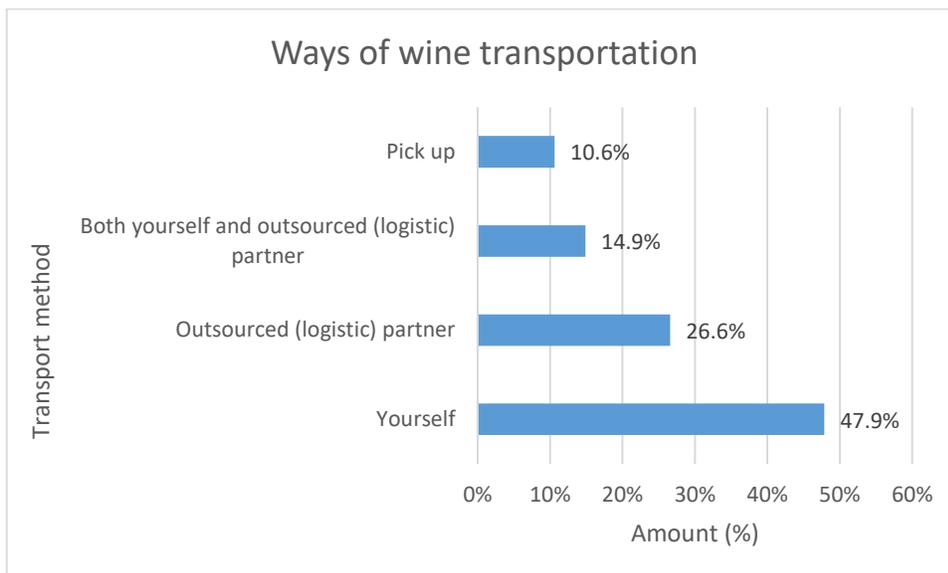


Figure 15. Ways of wine distribution.

### 3.2. How is wine shipment handled during the different season of the year?

Temperature-controlled distribution of wine is important for the quality of wine distribution. Wrong distribution methods and duration of the shipment can affect the wine's organoleptic properties.

Wine producers were asked if the wine is distributed in temperature-controlled conditions (figure 16). The results show that the majority of the producers, 69% (N=25) are not shipped under temperature-controlled conditions, 14% (N=5) are shipped in a temperature-controlled way, or at least measures were taken that the wines will not reach above 20 °C. Measures involve temperature-controlled vans or trucks, and the transport is outsourced through a logistic partner with temperature-controlled transport.

However, smaller size wine producers usually do not use temperature-controlled transport, because it is too expensive for them. Also, the short delivery time within an average range of 30 kilometres do not require extra arrangements. One vineyard explained that only shipments that cross the border are shipped in temperature-controlled conditions.

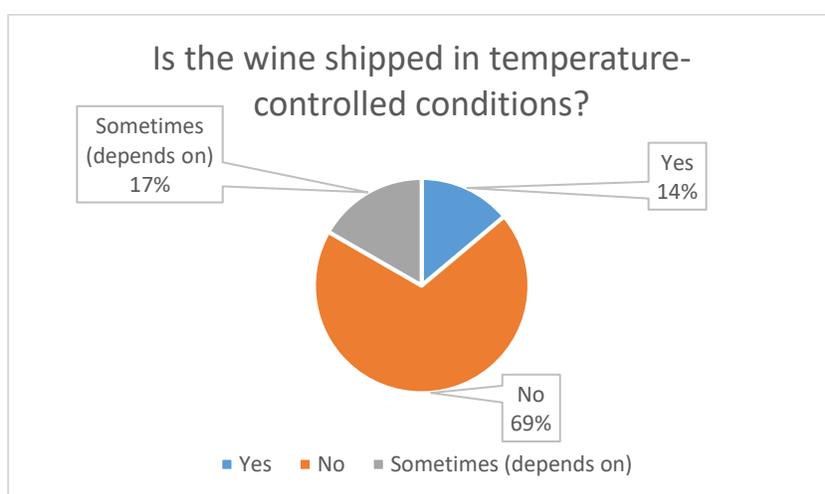


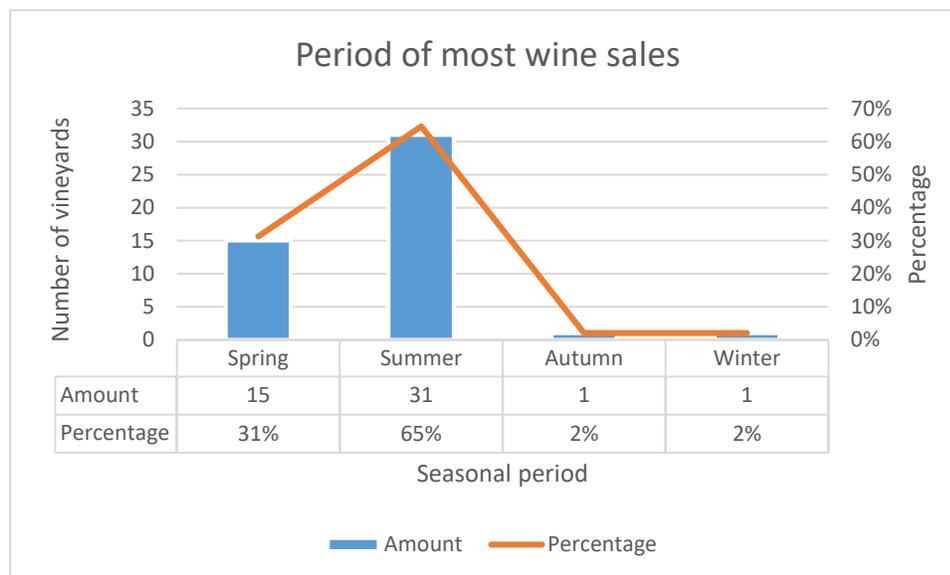
Figure 16. Temperature-controlled shipments of in the Netherlands.

Moreover, in 17% (N=6), the answer was sometimes and depends on certain factors, such as the distribution will be shipped temperature-controlled only in very warm period ( $\approx 30$  °C), some clients demand that the wine need to be shipped under specific temperature and due to pick up by (local) businesses (table 5).

Table 5. Open answers by participants.

Depends on:	Amount
Only in very warm periods	2
Depends on specific customer	2
Client sometimes puts it in temperature-controlled trucks	1
Not applicable (due to pick up by local businesses)	1

The next question was when most of the white wines are sold. In the spring and summer, accounting for 96% by the vineyards interviewed (figure 17). However, the sales of white wines are all year round. Especially in the months June, July and August, the temperatures can rise far above the 20 °C in the Netherlands. In 2018, a total of 76 warm days were recorded with temperatures above 20 °C and with the highest temperature of 38,2 °C (KNMI, 2019). These months are the warmest and can influence the wine the most. In spring 2018, a total of 13 warm days were recorded with temperatures above 20 °C (KNMI, 2019).



*Figure 17. Periods of most wine sales in the Netherlands.*

Although it is not always necessary that wines are shipped under temperature-controlled conditions, it might occur that wine makers take specific actions during these warm periods. But none of the wine producers interviewed, used material isolation for transport. Figure 18 shows that in 78% (N=28), no measures are taken to prevent high temperature exposure. In 22% (N=8), the wine producer take action to use temperature-controlled transport.

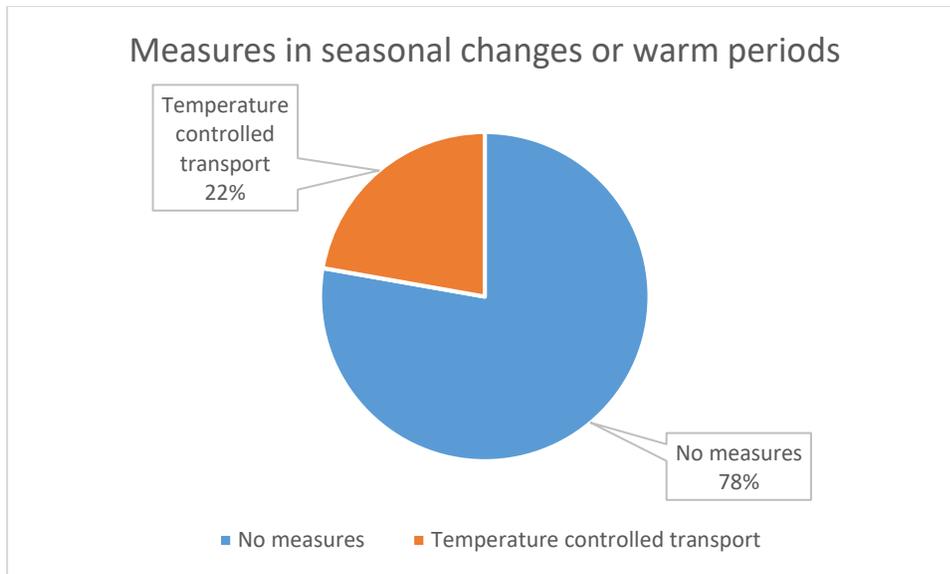


Figure 18. Measures during seasonal changes or warm periods.

### 3.3. To what degree are Dutch consumers aware of temperature exposure during transport and storage of a bottle of wine?

The online questionnaire was filled in by 70 persons. The survey started by asking the age of the participants. The largest group of participants were between 20 till 24 years old, accounting for 70% of the total participants (figure 19). The next question was to see the gender of the participant. The gender was equally divided, 50% were female (N=35), and 50% were male (N=35).

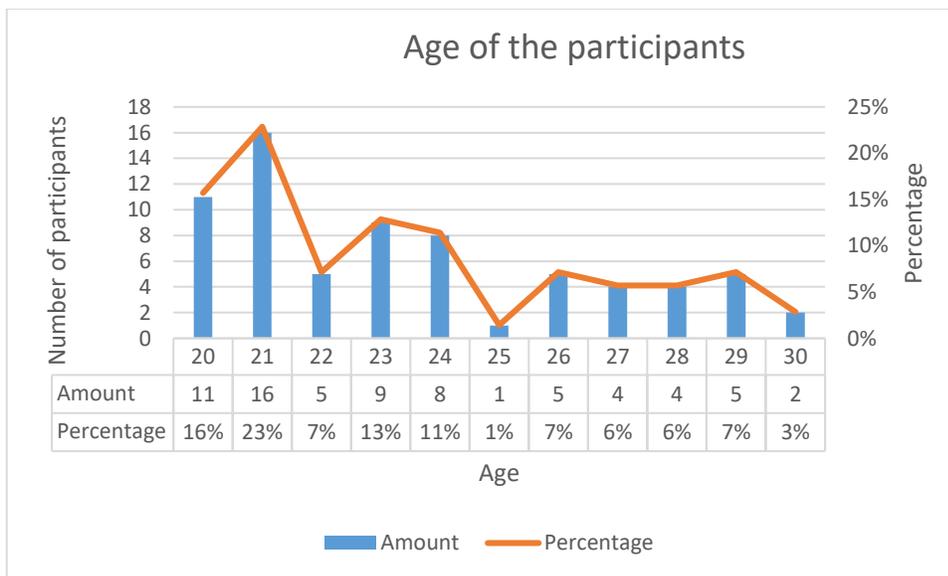


Figure 19. Age of the participants.

Figure 20 shows the knowledge of wine in general under the millennials. The majority of the participant have some to little knowledge of wine with 41%, 30% have little knowledge, 17% have reasonable to good knowledge, 9% have no knowledge, and 3 % have excellent knowledge.

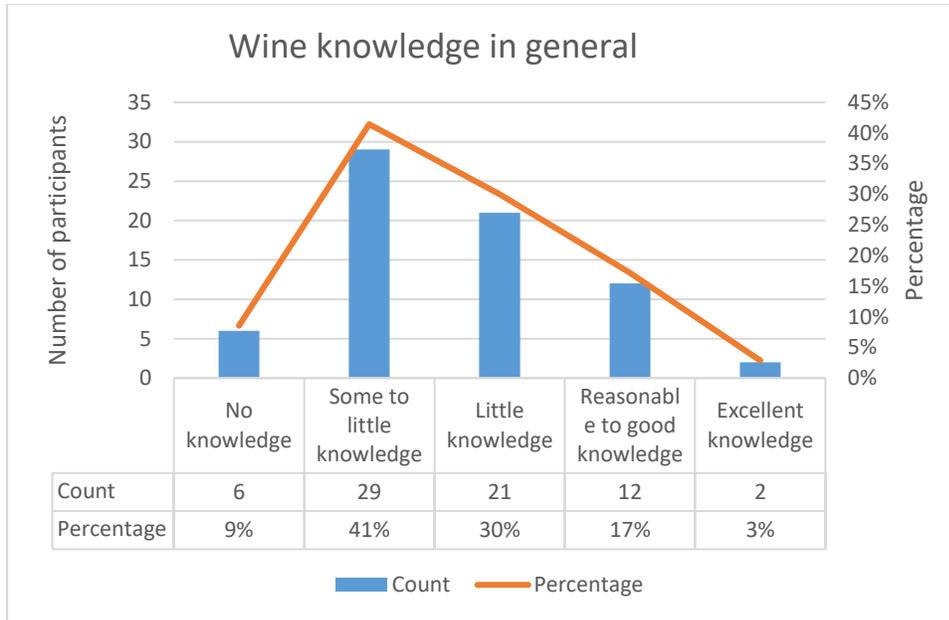


Figure 20. Wine knowledge in general of millennials.

The results on the awareness of temperature exposure are shown in figure 21 below. The awareness of temperature exposure is mainly a little under the participants with 44%. Following by reasonable knowledge with 33%, no knowledge of 13%, and 10% have good knowledge of temperature exposure.

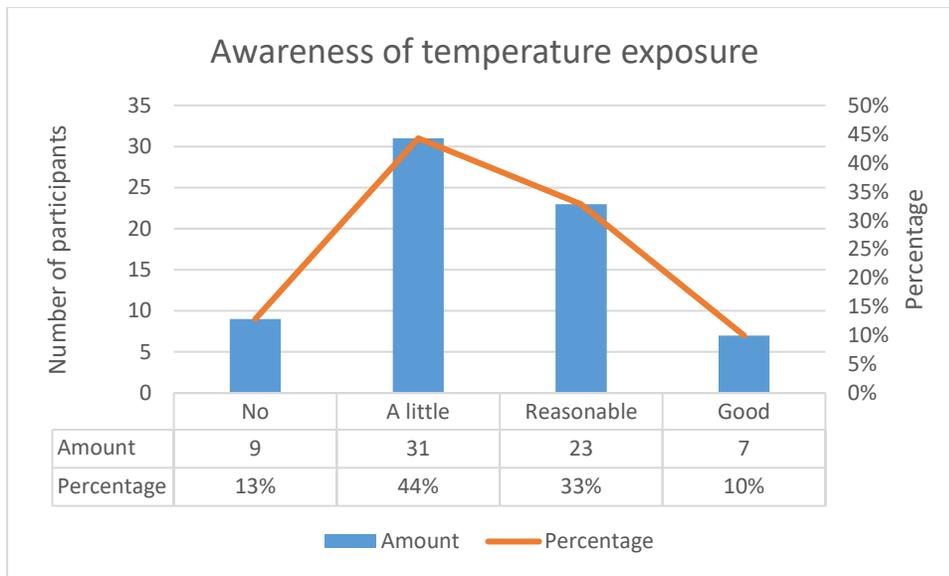


Figure 21. Awareness of temperature exposure.

### 3.4. How much is a Dutch consumer willing to pay more for a bottle with a temperature control indicator?

The questionnaire continued with the data collection of the preference of the 70 Dutch consumers on how much they are willing to pay more for a bottle of wine with a temperature control indicator. A brief introduction was given what happens to the organoleptically changes during warm temperature exposures. The explanation will help to create an understanding for the temperature indicator. Firstly, it is important to know if Dutch consumers would buy wines that were exposed to high temperatures. Figure 22 shows the results of this question. The results show that in 47% (N=33) it depends on the price followed by 43%(N=30) that indicated they would not buy that bottle. In 9%(N=6), the people still buy that bottle, and in 1%(N=1) it depends on the taste of the wine.

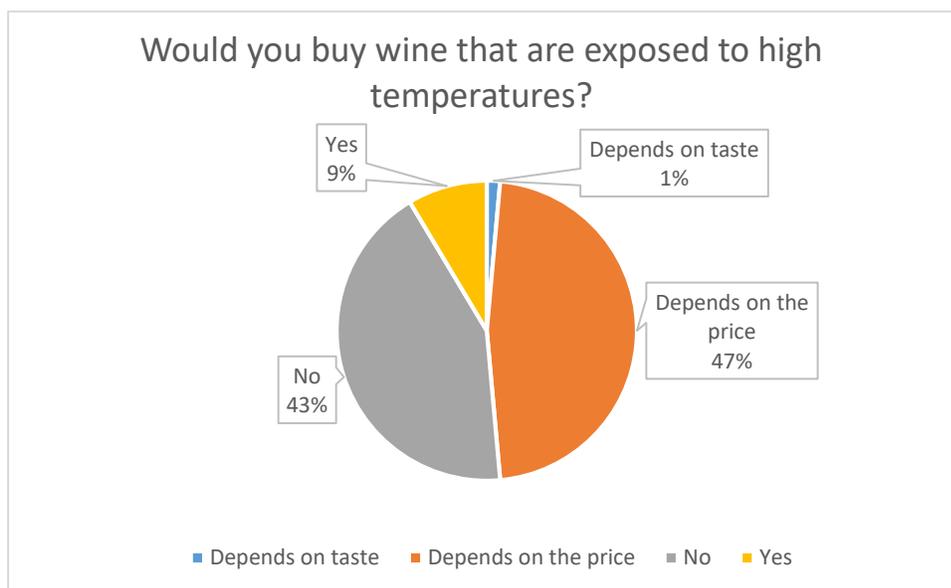


Figure 22. Would you buy wine that are exposed to high temperatures?

Secondly, the question was asked if the Dutch wines should have a temperature indicator on the bottle to guarantee the optimum condition. Considering the average bottle of white wine cost 10 euros, results show that 80% of the participants think it is important that the bottle have a temperature indicator (figure 23). Following by 13% that do not know, and 7% that said no.

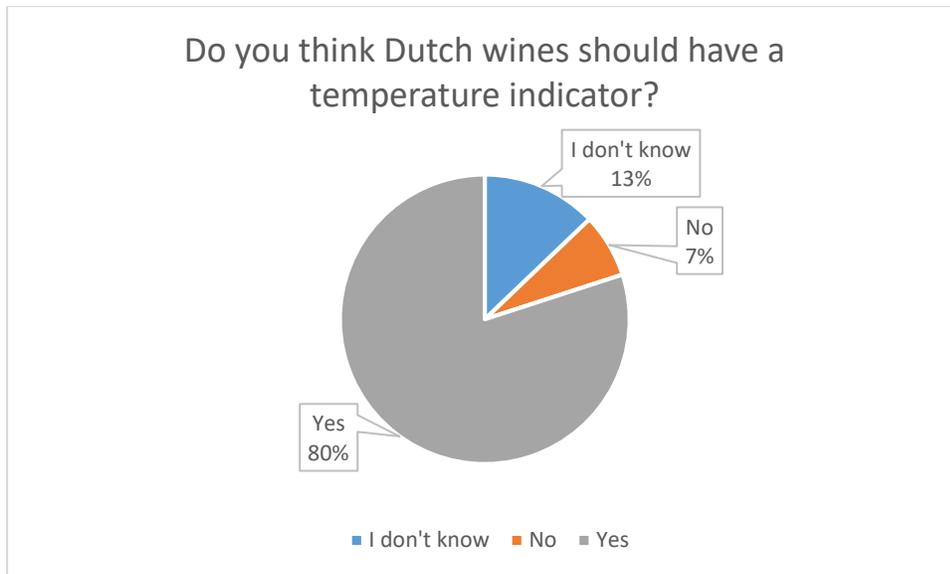


Figure 23. Do you think Dutch wines should have a temperature indicator?

The following question was about the willingness of the consumer to pay more for a bottle with a temperature indicator (figure 24). In 73%, consumers are willing to pay more for such an indicator followed by 16% that said no, and 11% that do not know.

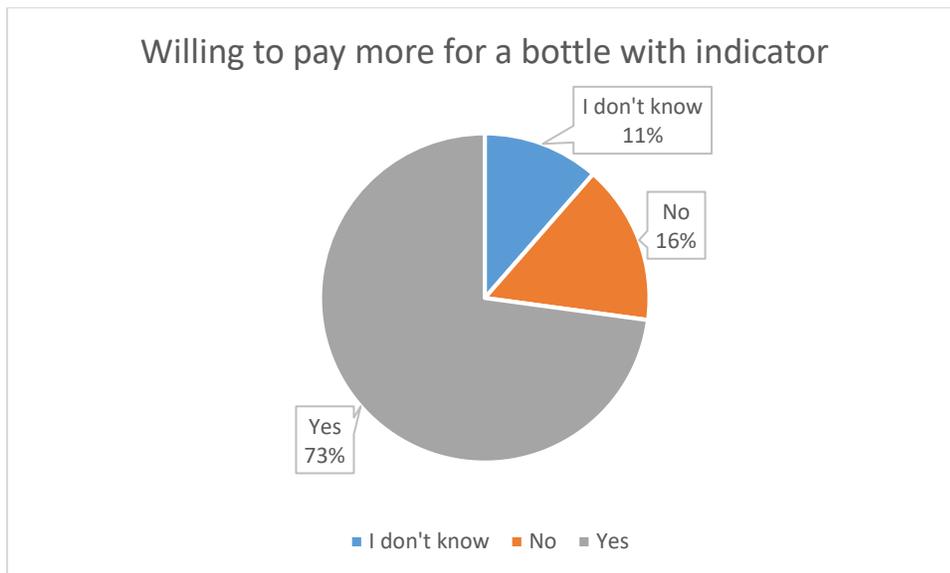
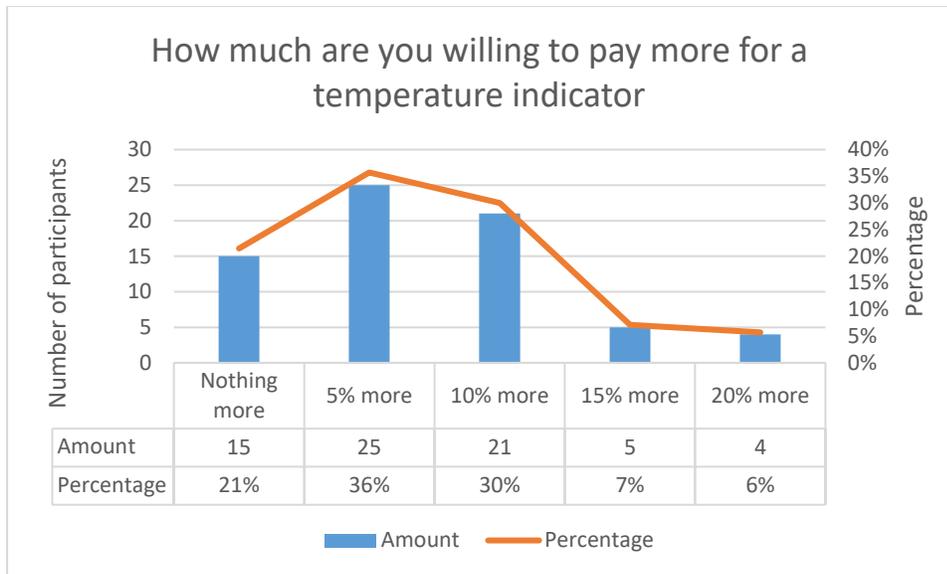


Figure 24. Willingness to pay more for a bottle of wine with an indicator.

The last question was how much more a consumer is willing to pay more for a bottle of wine with a temperature indicator (figure 25). 36% of the consumers are willing to pay 5% more for the indicator, following by 30% that is willing to pay 10% more, 21% that is willing to pay nothing more and the remaining 13% between the 15 and 20% more.



*Figure 25. How much is a Dutch consumer willing to pay more for a temperature indicator.*

## 4. Discussion of results

In this chapter, the most important results are discussed. It is commonly known by the wine producers, that high temperature exposure during transportation can harm the organoleptic quality of the wine. However, the use of temperature-controlled transport can be more than three times more expensive than normal transport. Therefore, little action is taken to prevent temperature exposure (Butzke, Vogt, & Chacón-Rodríguez, 2012). The outcomes of this study are relevant for the wine producers to have an overall idea how other vineyards handle their distribution and the willingness of consumers for a TTI (time-temperature indicator) on the wine bottle. For the Dutch wine consumer, it provides useful insights on temperature influences in the wine supply chain. Moreover, the wine knowledge levels by millennials were analysed as no research has been conducted on this age group to date.

With 89 vineyards located in the Netherlands (CBS, 2019), and 1,250,000 bottles produced (RVO, 2019), there was a high chance that the transportation condition can differ. Therefore, the first objective was to identify how the Dutch distribution is handled as no previous research has been conducted. Secondly, the general wine knowledge under Dutch millennials and awareness of temperature exposure during transport and storage was researched. The research proceeded further with the suggestion of a TTI on Dutch wine bottles.

Sub-question one and two focussed on the wine handling methods of Dutch wine producers. In the three provinces, the sales channels of 36 vineyards were analysed. It turned out that on average 73% of the white wines are sold to other businesses, 19% to consumers/direct sales and 8% through the internet. The majority of the wines need to travel (large) distances to reach the buyer. How long those distances are, was not specified in the questionnaire. Therefore, it cannot guarantee if there is any impact on the wines during the distribution process.

This research gave a clear answer if wines are shipped under temperature-controlled conditions. 14% of the wines are year-round shipped under temperature-controlled conditions, 69% are never under any protective measures, and 17% depends on specific factors. The shipments are either done by outsourced distribution partners or by the wine producer themselves. With a total production of 1,250,000 bottles a year in the Netherlands, it could imply that roughly 175,000 bottles arrive in optimum distribution conditions, but the majority could undergo organoleptic changes. However, Dutch wines travel relatively small distances and for a small duration of time due to the country's size. To what extent the quality of these wines are affected remains unknown.

It was to be expected that most white wine sales occur in the summer. During these warm days people rather prefer to drink a cold white wine instead of consuming white wine in the colder periods. Moreover, due to the global warming the spring and summer periods are also getting warmer where wines could be affected (Driessen & Morren, 2015). In the Netherlands mainly crossed and hybrid varieties are grown that are more resistant to colder temperatures (Infonu, 2017). The study where Chilean Cabernet Sauvignon wines were researched showed the observed organoleptic changes during different time duration and temperatures. This grape variety is grown in warmer climates and mature slowly (Sivertsen, Figenschou, Nicolaysen, & Risvik, 2001). Therefore, it is not grown in the Netherlands and it might be different compared to other crossed or hybrid varieties.

The results of the wine handling showed that there was an increase of temperature-controlled transport during seasonal changes or warm periods. From 14% of the wine producers who always transport their

wines under controlled conditions, to 22% of wine producers who do take preventive measures during warm periods of transports >20 °C, to avoid temperature exposure. The number raised by 8%. It is positive to see that this number increased, which implies that more wines arrive in good condition. However, the following step once it reached the business or consumer, is unknown. At the point of decoupling, buyers can still store the wine in wrong conditions and therefore be affected.

Sub-questions 3 and 4 focused on the awareness of temperature exposure during distribution and storage of wine and the preference of time-temperature indicator labels on wine bottles. The research continued with the consumers survey, focused on the Dutch millennials. First it was important to see the level of knowledge the millennials have in terms of wine knowledge and awareness of temperature exposure that may affect the quality. The research from ABN AMRO together with Groupe LFE showed the wine knowledge under 551 participants (Driessen & Morren, 2015). However, the age of that group was not specified. Table 6 shows a comparison of general knowledge difference between the ABN AMRO research and this research. Relatively there are small differences between the two. The most significant differences were that there was a higher level of no knowledge (+7%) under the millennials group, a decrease of some to little knowledge(-10%), and an increase of reasonable to good knowledge(+6%).

*Table 6. Difference between ABN AMRO study and millennials*

<b>Level of knowledge</b>	<b>General knowledge (N=551, (Driessen &amp; Morren, 2015).</b>	<b>General knowledge millennials (N=70)</b>	<b>Difference</b>
No knowledge	2%	9%	7%
Some to little knowledge	51%	41%	-10%
Little knowledge	34%	30%	-4%
Reasonable to good knowledge	11%	17%	6%
Excellent knowledge	2%	3%	1%

The awareness of temperature exposure during transportation and storage is mostly a little (44%) to reasonable (33%) known by participants of this study. The result shown in this age group is that 43% would not buy wines that were exposed to high temperatures. However, 47% would still consider to buy the wine depending on the price. How much the price difference would be decrease was not specified in this study.

The TTI can give consumers extra guarantee the wine was distributed in good conditions. While an average bottle of Dutch white wine costs 10 euros, 80% of the participants think the wine bottle, or case should contain a TTI. However, 7% said no and the reason was unknown. This might imply that relatively higher priced bottles do require a TTI by millennials, while cheaper priced wines may not require a label as expectations are not very high. Moreover, 73% of the participants are willing to pay more for a bottle of wine with a TTI, so the wine producer can cover its cost of purchasing and adding this label.

By adding a TTI on the wine bottle, or case of wine could increase the amount of unsold wines. Wine do not expire fast due to the synergistic effect of alcohol, organic acids and low pH (Reeves, 2009). Therefore, it can stay for a longer time in the customer shelf, or at the home of a consumer. If the wines at businesses will not sell due to the TTI, it can eventually lead to higher amounts of wines that are

discarded. This might also lead to less preference of Dutch wines as a growing wine producing country. In worst case scenario, wines that are not sold can lead to a business to go bankrupt.

## 5. Conclusion and recommendations

High temperature exposure during distribution and transport can change the quality of the wine. For example, physical defects (i.e. sediment development, protein haze formation, and raised corks), organoleptic defects (i.e. maderised taste, lack of fruit, and decrease in overall wine quality), and chemical changes (i.e. re-fermentation, high volatile acidity, and oxygen uptake). This research was aimed to identify the white wine distribution methods used by wine producers in the three largest wine producing provinces in the Netherlands and whether wines are exposed to high temperatures. Furthermore, this research focussed on the awareness and knowledge of temperature exposure during transport and storage under Dutch millennials and the preference for time-temperature indicator labels on the bottle of wine. The outcomes of this research helped to answer the main question how the national distribution of Dutch white wines is managed in terms of temperature-controlled transportation and storage.

### 5.1. Conclusions

In relation to sub-question one: 73% of the white wines are sold business to business which accounts for the most significant distribution channel in the three provinces. As outsourcing distribution is more expensive, commonly wine producers transport their wine themselves (47.9%). For larger sized vineyards, or vineyards who are not able to transport themselves or sale white wines over larger distances, used an outsourced distribution partner.

In relation to sub-question two, it can be concluded that Robert Parker was right in one point that can applied on the Dutch wine distribution: that a sizable percentage of wines sold are exposed to higher temperature in different periods of the year. This is the same case by the 36 vineyards interviewed. Results revealed that 69% of the transports are not distributed under temperature-controlled conditions. Just 14% of all participated wine producers ship their wines year-round under controlled conditions. Most of the wine sales occur in the spring and summer months. During these periods, more wine producers take action during warm periods or seasonal changes, raising the number of wine producers who take preventive action to 22%.

In relation to sub-question three: The largest group of this study was done by participants between the 20 to 24 years accounting for 70% of the results. While the gender of the participants was equally divided, the awareness of temperature exposure differed. 13% of the participants had no knowledge that temperature exposure affects wine, while 44% have little knowledge, 33% reasonable knowledge, and 10% good knowledge.

In relation to sub-question four: The data gathered showed that almost halve of the participants (47%) would still buy a bottle of wine that was exposed to higher temperatures with the chance of organoleptic defects. However, 43% of participants is not willing to buy wines that have been exposed, 9% would still buy the wine, and in 1% of the participants, it depends on the taste.

To conclude, the main question can be answered: how is the national distribution of Dutch white wines managed in terms of temperature-controlled transportation and storage? The results of this study show that the distribution of Dutch white wines in the right temperature conditions is scant.

Even though the awareness of temperature exposure is well-known under Dutch wine producers, there are still barriers to overcome. For example, the cost of a temperature-controlled shipment can be three

times as much as a normal shipment. Furthermore, as seen from the survey among the millennials, most of the people were not, or little aware of the temperature exposure that can influence of wines during transportation and storage.

## 5.2. Recommendations

The results of this study can contribute to possible follow-up studies to further examine the Dutch wine supply chain, and improvement to avoid direct temperature exposure.

The following short-term recommendations based on the outcomes of this study are described:

- Wine producers could apply thermal covers in the warm periods of transportation. The thermal cover is effective of keeping the temperature stable inside the secondary packaging. As the distribution distances within the Netherlands are relatively short (between 0-24 hours), direct exposure to higher temperatures can be prevented. Moreover, these thermal covers can be reused by the wine producers for multiple transportations.
- This researched focussed on a large part on what wine producers can do to prevent temperature exposure during transportation and storage. From adding time-temperature indicators on the bottles, to the use of thermal covers and temperature-controlled transport. But it is also important that the consumer became more aware how temperatures can affect the wine quality after the point of decoupling. By the use of flyers in retail stores this can be achieved.
- To be sure that wines are stored in the right conditions, the consumer could pick up the wines at the individual vineyards directly. It can guarantee the optimum wine quality as vineyards store them in proper conditions.

The following long-term recommendations are given:

- For a more accurate number and complete picture of the Dutch wine supply chain, the other provinces, where wines are produced, could be researched.
- As mentioned in chapter 4, there might be a difference of organoleptic changes in grapes that are grown in colder climates as they are more resistant to temperature changes and fungus. The Chilean study could be reproduced based on specific varieties of interest.
- Interesting to see in future studies is how the international shipments of Dutch wines will be handled. Currently, there is not a lot of international interest for Dutch wines and most wines are locally, or nationally sold. When the Dutch wines gain more interest from international buyers, more export will likely to happen.

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## Appendix 1 – List of companies to be contacted

Vineyards larger than 1 hectare in the provinces Gelderland, Limburg and North Brabant, retrieved from (De wijn hoek, 2019) and verified by the company's website.

<b>Gelderland</b>	Hectares
Biologische Wijnhoeve De Colonjes	13
Betuws Wijdomein	5,8
Domein Besselinkschans	4,5
Wijngoed Montferland	3
Wijngaard Eco Fields	2,7
Wijngaard Hesselink	2,5
Wijngaard Chateau Cinemec	2,5
Biologische Wijngaard Wageningse Berg	2,3
Wijdomein Erve Wisselink	2
Chateau Bejo	2
Wijngaard 't Heekenbroek	2
Biologische Wijdomein Oude Waalstroom	2
Domein Hof te Dieren	2
Wijnhoeve Kunneman	2
Wijnhoeve "De Veluwe"	1,5
Wijnhoeve de Heikant	1,5
Wijngoed de Reeborghesch	1,5
De kleine Heerlijkheid	1,5
Wijngoed Kranenburg	1,5
Wijngaard Valkeniersbulten	1,5
Wijnhoeve Elanova	1,5
Wijngaard Klein Amerika	1,35
Wijngoed de Hennepe	1,1
Wijngaard Gravendael	1,1
Wijngaard de Plack	1
Wijngaard de braoke	1
Wijngoed Avitera	1
Wijngaard Telgt	1
Wijngaard Duetinghem 838	1
<b>Limburg</b>	Hectares
Wijngaard St. Martinus	11
Apostelhoeve	10
Wijn Thorn	6,5
Wijngaard de Boekenderhof	4,5
Chateau Gilbert	3,2
Hoeve Nekum	3
Wijngoed Fromberg	3
Domein de Wijngaardsberg	2,5
Domein Aldenborgh	2
Domein Steenberg	2
Wijdomein de Planck	2
<b>North Brabant</b>	Hectares
Wijngaard Hof van Baarle	2,5
Domaine les Damianes	2
Domein De Linie	1,25
Wijngaard De Kreitsberg	1,2
Wijngaard de Daalgaard	1,2

## Appendix 2 - Survey questions wine makers

1. Through which channel do you sell your white wines in the Netherlands?
  - Business to business
  - Business to consumer/direct sales
  - Internet
  - Other:
  
2. How much is that in size (%) divided?
  - Business to business: .....%
  - Business to consumer/direct sales: .....%
  - Other.....%
  
3. How do you transport your wine to the customer?
  - Outsourced (logistic) partner
  - Yourself
  - Cooperation of wine makers
  - Other:.....
  
4. Is the wine shipped in temperature-controlled conditions?
  - Yes\*
  - No
  - Sometimes (depends on): .....
  
5. \*What are those conditions?
 

.....
  
6. In which period do you distribute the most white wines?
  - Spring
  - Summer
  - Fall
  - Winter
  
7. Are there any specific measures in place during shipments in warm periods or seasonal changes?
  - Material insulation
  - Temperature controlled shipment
  - No measures
  - Other: .....

## Appendix 3 - Questionnaire Dutch wine consumer

1. What is your age?  
.....
2. What's your gender?
  - Male
  - Female
3. How would you rate your knowledge of wine in general?
  - No knowledge
  - Some to little knowledge
  - Little knowledge
  - Reasonable to good knowledge
  - Excellent knowledge
4. Are you aware about warm temperature exposures that can affect wines?
  - No
  - A little
  - Reasonable
  - Good
5. Knowing that large amount of wines are significantly exposed to temperatures of 30 degrees or more for a significant amount of time (Parker, 2008 & Mac Cawley, 2014) , would you still buy that bottle of wine?
  - Yes
  - No
  - Depends on the price
  - Other.....
6. Considering that the average price of a Dutch bottle of wine is around 10 euros, do you think the wines should have a temperature indicator?
  - Yes
  - No
  - I don't know
7. Are you willing to pay more for a bottle with a temperature indicator that guarantees the right quality throughout the supply chain?
  - Yes
  - No
  - I don't know

8. Considering a bottle of Dutch wine costs 10 euros, how much are you willing to pay more that bottle with a temperature indicator?
- Nothing
  - 5% (€10,50)
  - 10% (€11,00)
  - 15% (€11,50)
  - 20% (€12,00)
  - Other: .....

## Appendix 4 – Raw data and output Dutch wine producers

Output of all seven questions ask to wine producers during the interview.

<b>Via welk kanaal verkoopt u uw witte wijnen in Nederland? (meerdere antwoorden mogelijk)</b>	<b>Hoeveel is dat in omvang (%) verdeeld?</b>	<b>Hoe vervoert u uw wijn naar de klant? (meerdere antwoorden mogelijk)</b>	<b>Wordt de wijn in temperatuur gecontroleerde omstandigheden verzonden?</b>
Van bedrijf naar bedrijf, Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 15% direct 15% internet	Uzelf	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	80% bedrijven 15% direct 5% internet	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	90% bedrijven 10% direct	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	75% bedrijven 15% consument 10% internet	Afhalen door bedrijven	nvt
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	60% bedrijven 30% direct 10% internet	Uzelf	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 20 % directe verkoop 10% internet	Via een (logistieke) partner	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	60% bedrijven 40% directe verkoop	Uzelf	Nee
Van bedrijf naar bedrijf (bijv., restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	80% bedrijven 20% consument	Uzelf	Nee

Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen)	100% bedrijven	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	70% bedrijven 30% direct	Via een (logistieke) partner	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	80% bedrijven 15% direct 5% internet	Via een (logistieke) partner	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	95% bedrijven 5% direct	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 20% direct 10% internet	Via een (logistieke) partner	Ja *
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	60% bedrijven 40% consument (wijn proeverijen etc )	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 25% consument en 5% internet	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	75% bedrijven 15% consument 10% internet	Via een (logistieke) partner	Soms
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	80% bedrijven 20% consument (streekmark eten, afhaal)	Uzelf, afhaal	Ja *, Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en	80% bedrijven	Uzelf	Nee

slijterijen), Bedrijf naar consument (directe verkoop)	20% consument		
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	90% bedrijven 10% consument	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	60% bedrijven 30% consument 10% internet	Uzelf	Ja *
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	90% bedrijven 10% direct	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	80% bedrijven 15% consument 5% internet	Uzelf	Alleen in hele warme periodes
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	65% bedrijven 25% consument 10% internet	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 25% consument 5% internet	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	85% bedrijven 15% consument	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	80% bedrijven 20% consument	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 25% consument 5% internet	Uzelf	Nee

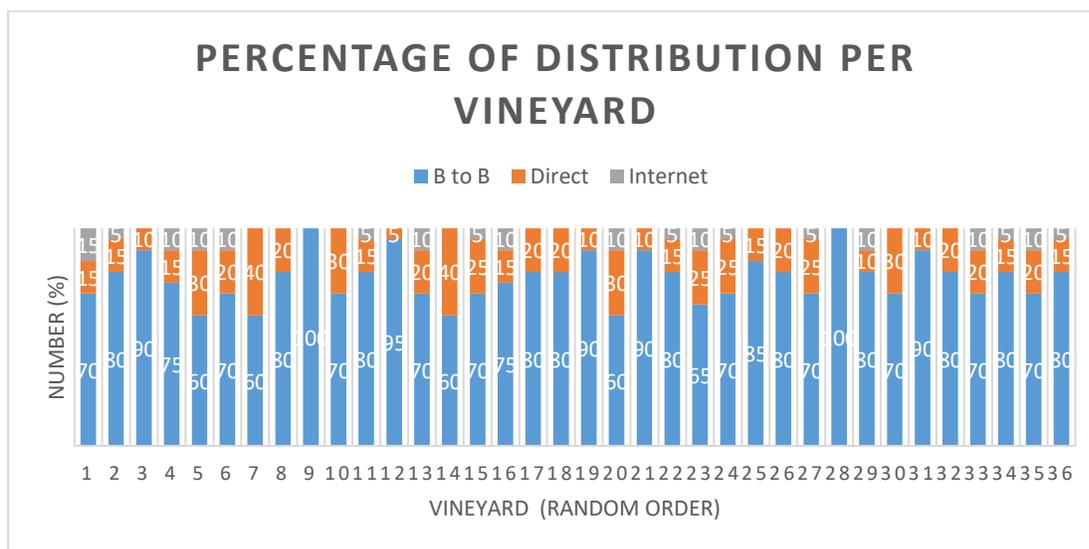
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen)	100% bedrijv en	Via een (logistieke) partner	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	60% bedrijven 20% consument 10% internet	Uzelf, Afhalen	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	70% bedrijven 30% consument	Uzelf	Ja *
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	90% bedrijven 10% consument	Uzelf, afhaal	Nee, Soms doet de klant het zelf in airco wagens
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop)	80% bedrijven 20% consument	Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 20% consument 10% internet	Via een (logistieke) partner, Uzelf	Nee
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	80% bedrijven 15% consument 5% internet	Via een (logistieke) partner	Ja *
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	70% bedrijven 20% consument 10% internet	Via een (logistieke) partner, Uzelf, Afhalen	Ja *, Hangt af van specieke klant
Van bedrijf naar bedrijf (bijv, restaurants, regionale winkels en slijterijen), Bedrijf naar consument (directe verkoop), Internet	80% bedrijven 15% consument 5% internet	Via een (logistieke) partner	Ja *

<b>* Wat zijn deze voorwaarden?</b>	<b>In welke periode verkoopt u de meeste witte wijn?</b>	<b>Zijn er specifieke maatregelen getroffen tijdens transporten in warme periodes of seizoenswisselingen? (meerdere antwoorden mogelijk)</b>
Distance between 30/40km	Zomer	Geen maatregelen
	Zomer, Herfst	Geen maatregelen
Korte levertijd,	Zomer	Geen maatregelen
	Voorjaar, Winter	Geen maatregelen
	Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen
	Zomer	Geen maatregelen
	Zomer	Geen maatregelen
korte afstand	Voorjaar	Geen maatregelen
	Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen
In warme periodes worden grote transporten gekoeld verzonden. Dit gaat via een logistiek partner die speciale trucks daarvoor heeft.	Voorjaar, Zomer	Temperatuur gecontroleerd transport
	Voorjaar	Geen maatregelen
	Zomer	Geen maatregelen
Hangt af van de temperaturen. Anders te duur	Voorjaar	Temperatuur gecontroleerd transport
Internationaal transport ja, lokaal nee	Zomer	Geen maatregelen
	Zomer	Geen maatregelen
	Zomer	Geen maatregelen
Gekoeld busje (15 graden)	Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen
Temperatuur controle transport	Zomer	Temperatuur gecontroleerd transport
	Voorjaar, Zomer	Geen maatregelen
	Zomer	Geen maatregelen
Wij zijn een kleine wijngaard	Zomer	Geen maatregelen
	Zomer	Geen maatregelen
Te duur	Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen

	Zomer	Geen maatregelen
Geclimatiseerd busje, lanere afstanden	Zomer	Temperatuur gecontroleerd transport
Soms doet de klant het zelf in airco wagens	Voorjaar	Temperatuur gecontroleerd transport, Geen maatregelen
	Zomer	Geen maatregelen
	Voorjaar, Zomer	Geen maatregelen
Rond de 15 graden zoals beschreven in het contract	Voorjaar, Zomer	Temperatuur gecontroleerd transport
Geclimatiseerde transport	Voorjaar, Zomer	Temperatuur gecontroleerd transport, Geen maatregelen
12-18 graden	Zomer	Temperatuur gecontroleerd transport

The following tables were made to separate the data per question.

Percentage of distribution per vineyard.



Output table of distribution method.

Distribution method	Percentage	Amount
Yourself	47,9%	23
Outsourced (logistic) partner	26,6%	12
Both yourself and outsourced (logistic) partner	14,9%	7
Pick up	10,6%	5

Output table, is wine shipped under temperature-controlled conditions.

Row Labels	Is the wine shipped in temperature-controlled conditions?
Alleen in hele warme periodes	1
Yes	5

Ja *, Hangt af van specifieke klant	1
Ja *, Nee	1
Nee	25
Nee, Soms doet de klant het zelf in airco wagens	1
Not applicable	1
Sometimes	1
<b>Grand Total</b>	<b>36</b>
<b>Depends on: answers</b>	<b>Amount</b>
Only in very warm periods	2
Depends on specific customer	2
Client sometimes puts it in temperature controlled trucks	1
Not applicable (due to pick up by local businesses)	1

Output table, separated in three categories

<b>Wine shipment (temperature controlled)</b>	
Yes	5
No	25
Sometimes (depends on)	6

Output table: in case the answer is yes, what are those conditions:

<b>What are these conditions?</b>
In warm periods large transports are sent chilled (around 15 degrees Celsius). Through a logistical partner who has special trucks for this.
Depends on the temperatures. Special trucks are rented that keeps the wine around 16 degrees Celsius. Otherwise it is too expensive
Only International transport (14-18 degrees Celsius).
Climate controlled van (around 15 degrees)
Temperature controlled shipment (around 13 degrees Celsius)

Output table, in which periods most white wines are sold.

<b>Season</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>	<b>Winter</b>	<b>Total</b>
Amount	15	31	1	1	48
Percentage	31%	65%	2%	2%	100%

Output table, measures in place during warm periods or seasonal changes.

<b>Measures in place during warm periods or seasonal changes</b>	<b>Amount</b>	<b>Percentage</b>
No measures	28	78%
Temperature controlled transport	8	22%

## Appendix 5 – Raw data and output questionnaire Dutch wine consumers

<b>What is your age?</b>	<b>What's your gender?</b>	<b>How would you rate your knowledge of wine in general?</b>	<b>Are you aware about temperature exposures that can affect wine?</b>
20	Male	Little knowledge	Reasonable
20	Male	Some to little knowledge	A little
20	Male	Reasonable to good knowledge	Reasonable
20	Male	Excellent knowledge	Good
20	Male	Some to little knowledge	A little
20	Male	No knowledge	No
20	Male	Some to little knowledge	Reasonable
20	Male	Little knowledge	A little
20	Female	Reasonable to good knowledge	Reasonable
20	Female	Reasonable to good knowledge	Reasonable
20	Female	Some to little knowledge	A little
21	Female	Reasonable to good knowledge	Good
21	Male	Some to little knowledge	Reasonable
21	Female	Some to little knowledge	No
21	Male	No knowledge	Reasonable
21	Male	Reasonable to good knowledge	Reasonable
21	Female	No knowledge	No
21	Female	Some to little knowledge	A little
21	Female	Some to little knowledge	A little
21	Female	Little knowledge	A little
21	Female	Some to little knowledge	No
21	Female	Little knowledge	A little
21	Female	Little knowledge	A little
21	Male	Some to little knowledge	A little
21	Female	Reasonable to good knowledge	Reasonable
21	Male	Some to little knowledge	A little
21	Male	Some to little knowledge	Reasonable
22	Female	Some to little knowledge	Good
22	Female	Some to little knowledge	Good
22	Female	Reasonable to good knowledge	Reasonable
22	Female	Little knowledge	A little
22	Female	Some to little knowledge	A little

23	Male	Little knowledge	A little	
23	Male	Some to little knowledge	No	
23	Male	Little knowledge	Good	
23	Male	Reasonable to good knowledge	Good	
23	Male	Little knowledge	Reasonable	
23	Male	Reasonable to good knowledge	Reasonable	
23	Female	Some to little knowledge	A little	
23	Female	No knowledge	A little	
23	Male	Little knowledge	A little	
24	Female	Some to little knowledge	A little	
24	Female	Little knowledge	A little	
24	Female	Little knowledge	A little	
24	Male	Some to little knowledge	No	
24	Female	Some to little knowledge	No	
24	Male	Little knowledge	Reasonable	
24	Female	Some to little knowledge	A little	
24	Male	Some to little knowledge	A little	
25	Female	Reasonable to good knowledge	Reasonable	
26	Male	Little knowledge	Reasonable	
26	Male	Reasonable to good knowledge	Good	
26	Male	Reasonable to good knowledge	Reasonable	
26	Male	No knowledge	No	
26	Female	Some to little knowledge	Reasonable	
27	Female	Little knowledge	A little	
27	Male	Some to little knowledge	A little	
27	Male	Some to little knowledge	A little	
27	Male	Little knowledge	A little	
28	Male	Some to little knowledge	A little	
28	Female	Little knowledge	Reasonable	
28	Female	Little knowledge	Reasonable	
28	Female	No knowledge	No	
29	Male	Some to little knowledge	A little	
29	Female	Excellent knowledge	Good	
29	Female	Little knowledge	A little	
29	Female	Some to little knowledge	A little	
29	Male	Little knowledge	Reasonable	
30	Male	Some to little knowledge	A little	
30	Female	Little knowledge	Reasonable	
<b>Knowing that large amount of wines are</b>		<b>Considering that the average price of a</b>	<b>Are you willing to pay more for a bottle with a</b>	<b>Considering a bottle of Dutch wine costs 10</b>

<b>significantly exposed to temperatures of 30 degrees or more, for a significant amount of time, would you still buy that bottle of wine?</b>	<b>Dutch bottle of wine is around 10 euros, do you think the wines should have a temperature indicator?</b>	<b>temperature indicator that guarantees the right quality throughout the supply chain?</b>	<b>euros, how much are you willing to pay more that bottle with a temperature indicator?</b>
No	Yes	Yes	10% (€11,00)
Depends on the price	I don't know	I don't know	Nothing more
No	No	No	Nothing more
No	No	Yes	5% (€10,50)
Depends on the price	Yes	Yes	10% (€11,00)
Depends on the price	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	10% (€11,00)
Depends on the price	Yes	No	Nothing more
No	Yes	Yes	10% (€11,00)
No	Yes	Yes	20% (12,00)
Depends on the price	Yes	Yes	10% (€11,00)
Depends on the price	Yes	No	5% (€10,50)
Depends on the price	No	Yes	10% (€11,00)
Yes	No	No	Nothing more
Depends on the price	Yes	I don't know	5% (€10,50)
No	Yes	Yes	15% (11,50)
Depends on the price	I don't know	No	Nothing more
Depends on the price	No	No	15% (11,50)
Depends on the price	Yes	Yes	5% (€10,50)
No	Yes	No	Nothing more
Depends on the price	Yes	Yes	10% (€11,00)
Depends on the price	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	15% (11,50)
Depends on the price	Yes	I don't know	10% (€11,00)
Depends on the price	Yes	Yes	10% (€11,00)
No	Yes	No	Nothing more
Yes	Yes	Yes	10% (€11,00)
No	Yes	Yes	10% (€11,00)
No	Yes	Yes	5% (€10,50)
No	Yes	Yes	10% (€11,00)
No	I don't know	No	Nothing more
No	Yes	Yes	15% (11,50)
No	Yes	Yes	10% (€11,00)
Depends on the price	Yes	Yes	10% (€11,00)
No	Yes	Yes	20% (12,00)
Depends on the price	I don't know	Yes	10% (€11,00)

No	Yes	Yes	20% (12,00)
Depends on the price	Yes	Yes	10% (€11,00)
No	Yes	Yes	5% (€10,50)
Yes	Yes	I don't know	10% (€11,00)
Depends on the price	Yes	Yes	5% (€10,50)
Yes	Yes	Yes	15% (11,50)
No	Yes	I don't know	5% (€10,50)
Depends on the price	Yes	Yes	10% (€11,00)
No	Yes	Yes	5% (€10,50)
No	Yes	Yes	10% (€11,00)
Yes	Yes	No	Nothing more
No	Yes	Yes	Nothing more
No	Yes	I don't know	Nothing more
Depends on the price	Yes	Yes	5% (€10,50)
No	Yes	Yes	20% (12,00)
Depends on taste ao	Yes	Yes	Nothing more
Depends on the price	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	5% (€10,50)
No	I don't know	I don't know	Nothing more
Depends on the price	Yes	No	Nothing more
No	I don't know	Yes	10% (€11,00)
Depends on the price	Yes	Yes	5% (€10,50)
No	Yes	Yes	5% (€10,50)
No	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	5% (€10,50)
No	I don't know	I don't know	5% (€10,50)
Depends on the price	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	5% (€10,50)
No	Yes	Yes	5% (€10,50)
Depends on the price	Yes	Yes	10% (€11,00)
Depends on the price	I don't know	Yes	5% (€10,50)
Yes	I don't know	Yes	Nothing more

Output table, age of the participants.

Row Labels	Count of What is your age?	Percentage
20	11	16%
21	16	23%
22	5	7%
23	9	13%
24	8	11%
25	1	1%
26	5	7%
27	4	6%

28	4	6%
29	5	7%
30	2	3%
<b>Grand Total</b>	<b>70</b>	<b>100%</b>

Output table, gender of the participants.

Gender	Count	Percentage
Female	35	50%
Male	35	50%

Output table, general level of knowledge.

Level of knowledge	Count	Percentage	Male	Female
No knowledge	6	9%	3	3
Some to little knowledge	29	41%	15	14
Little knowledge	21	30%	10	11
Reasonable to good knowledge	12	17%	6	6
Excellent knowledge	2	3%	1	1
<b>Grand total</b>	<b>70</b>	<b>100%</b>	<b>35</b>	<b>35</b>

Output table, awareness about temperature exposures that can affect wine.

Awareness of exposure	Amount	Percentage
No	9	13%
A little	31	44%
Reasonable	23	33%
Good	7	10%
<b>Grand total</b>	<b>70</b>	<b>100%</b>

Output table, would you still buy wine that are exposed to high temperatures, and for an significant amount of time?

Answer	Amount	Percentage
Depends on taste	1	1%
Depends on the price	33	47%
No	30	43%
Yes	6	9%
<b>Grand total</b>	<b>70</b>	<b>100%</b>

Output table, do you thin Dutch wines should have a temperature indicator?

Answer	Count	Percentage
--------	-------	------------

I don't know	9	13%
No	5	7%
Yes	56	80%
<b>Grand total</b>	<b>70</b>	<b>100</b>

Output table, are you willing to pay more for a temperature indicator?

Answer	Count
I don't know	8
No	11
Yes	51

Output table how much more is a consumer willing to pay more for a bottle of wine with a temperature indicator.

Answer	Count	Percentage
Nothing more	15	21%
5% more	25	36%
10% more	21	30%
15% more	5	7%
20% more	4	6%
<b>Grand total</b>	<b>70</b>	<b>100%</b>