Feeding management for dairy cattle in Iceland

Opportunities for improved production

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Acknowledgements

All students at the CAH Vilentum University in Dronten (The Netherlands) have to write a graduation thesis as a part of their study. This graduation thesis is a systematically structured, individual level of the study “animal husbandry”. In which the student demonstrates an innovative approach to solve a defined problem.

This graduation thesis is about opportunities in feeding management to improve the production of the Icelandic dairy farms. This degree thesis is commissioned by Landstólpi in Iceland. My internship at the animal nutrition department of Landstólpi has given me the chance to explore the Icelandic dairy production and to communicate with a lot of dairy farmers.

The topic of this research is "Feeding management for dairy cattle in Iceland: opportunities for improved production". This topic has been chosen after a period of working experience at Landstólpi in Iceland. During this internship I learned a lot about the Icelandic way of dairy farming. Besides that I found out that a lot of Icelandic dairy farmers would like to improve their production but without too much effort. The desire of the Icelandic farmers: “high profit low work effort ratio”.

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Myrthe Brabander
Dronten, December 2015

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Summary

The current situation of the Icelandic dairy production and the desire of the Icelandic farmers are the occasion of this study. The main objective of the study is to identify opportunities in feeding management to improve the production of the Icelandic dairy farms. The four important subjects within the Icelandic feeding are; grass silage, compound feed, barley and feed provision methods.

Dairy farming in Iceland faces many special challenges. The dairy breed is not productive, most concentrate is imported, no protein rich crop is cultivated and short summers limit profitable grazing systems. Long distances between farms impose high transport costs and limit the possibilities for active cooperation between farms.

The method of silage grass conservation does not influence voluntary intake or the animal production, according to the found literature (Vrotniakiene V. et al, 2006). According to the found literature the characteristics of the grass silage can be positive affected by microbial inoculants. These inoculants had a favorable effect in terms of higher lactic acid concentration, a low pH and a significant increase in milk production (Muck, 2010).

According to a research of Lawrence et al. (2014) the total quantity of concentrate included in the diet have a significant effect on milk production. But high-concentrate diets can also cause sub acute ruminal acidosis by high productive ruminants and off feed periods can be noticed (Nocek, 1997 and Desnoyers et al., 2009). The effect of three different concentrate buildup strategies in early lactation on production performance, health and fertility of high yielding dairy cows was addressed in an experiment at the Agri-food & Biosciences Institute (Law et al. 2012).

A research of Boss et al., 1996 and Van Barneveld et al., 1990 shows the large variation between separate barley samples concerning the available energy and animal performance. In the found literature positive effects were noticed in the milk composition, with a higher content of fat, a better milk energy efficiency and a lower milk urea nitrogen for cows fed the treated barley, with lactic acid and heat (Iqbal et al., 2012).

Recommendations for improved feeding management including grass silage, compound feed, barley and feeding methods can assist Icelandic dairy farmers, as well as future research goals were developed. The significant results of this study are used for the recommendations.

Summary in Dutch

De huidige situatie van de IJslandse zuivelindustrie en het verlangen van de IJslandse melkveehouders vormen samen de aanleiding van dit rapport. Het hoofddoel van dit rapport is het identificeren van kansen in het voermanagement om de productie op IJslandse melkveebedrijven te verbeteren. De vier meest belangrijke onderwerpen binnen het IJslandse voermanagement zijn; kuilgras, krachtvoer, gerst en methodes van voerverstrekking.

Het runnen van een melkveebedrijf in IJsland kent veel uitdagingen. Het IJslandse melkvee ras is niet productief, het meeste krachtvoer wordt geïmporteerd, het verbouwen van eiwitrijke gewassen is niet mogelijk en de korte zomers limiteren een winstgevend beweidingssysteem. De grote afstanden tussen de melkvee bedrijven zorgt voor hoge transport kosten en een gelimiteerde kans voor een actieve samenwerking tussen melkveebedrijven.

Volgens de gevonden literatuur heef de conserveringsmethode van kuilgras geen invloed op de vrijwillige voer opname of dier productie (Vrotniakiene V. et al, 2006). De karakteristieken van het gras kunnen positief beïnvloed worden door middel van microbiële inoculanten. Deze inoculanten hadden een positief effect in termen van hogere concentraties melkzuur, een lager pH en een significant hogere melkproductie bij het melkvee (Muck, 2010).

Volgens een onderzoek van Lawrence et al. (2014) heeft de totale hoeveelheid krachtvoer in het rantsoen een significant effect op de melkproductie. Echter kunnen rantsoenen met hoge hoeveelheden krachtvoer ook subklinische pensverzuring veroorzaken bij hoogproductief melkvee en periodes met minder voeropname kunnen worden opgemerkt.

Het effect van drie verschillende krachtvoer opbouw strategieën in het begin van de lactatie op de productie prestatie, gezondheid en vruchtbaarheid van hoog productieve koeien is onderzocht op de Agri-food & Biosciences Institute. Het gebruik van een langzame of intermediaire krachtvoer opbouw strategie in het begin van de lactatie verbeterde de ruwvoer opname in het begin van de lactatie en had geen nadelig effect op de totale productie (Law et al. 2012).

Een onderzoek van Boss et al., 1996 and Van Barneveld et al., 1990 geeft de grote variatie tussen verschillende gerst monsters weer. Het betreft variatie tussen de beschikbare energie en dier prestaties. In de gevonden literatuur blijkt dat positieve effecten waren gemeten in de samenstelling van de melk van koeien die gevoerd waren met behandelde gerst door middel van melk zuur en verhitting. Het melkvet gehalte in deze melk was hoger, er was een betere energie efficiëntie en een lager gehalte aan ureum in de melk (Iqbal et al., 2012).

Aanbevelingen voor verbeterde productie met de onderdelen graskuil, krachtvoer, gerst en methodes van voervertrekking kunnen de IJslandse melkveehouders assisteren en tevens zijn er toekomstige onderzoeksdoelen ontstaan. De significante resultaten van dit onderzoek van verwerkt in de aanbevelingen.

1. Introduction

This thesis is mainly directed to dairy farmers in Iceland which want to improve the revenue of their dairy farm with low work effort. As well as for the farmers the results are useful for advisers and consultants in Icelandic dairy herds. This report is also useful for producers and manufactures of concentrates.

The introduction provides information about the occasion, relevance, problem statement, purpose and consecution.

1.1. Occasion and relevance

This paragraph describes the occasion and the relevance of the research.

Research occasion:

The current situation of the Icelandic dairy production and the desire of the Icelandic farmers are the occasion of this graduation thesis.

Since 2012, people's consumption of dairy products that are higher in fat than protein has increased a lot in Iceland. The butter sales in Iceland rose by 26% between September 2012 and September 2013 (Björnsdóttir, 2015). The same goes for cream, full fat milk and fat cheeses. The explanation of this unusual development is the trend of the low carb/high fat diet lately in Iceland. The high demand for this full fat dairy products caused a shortage of milk fat in Iceland.

The Icelandic government made changes in the milk quota in November 2014. The milk quota is still in use, but there are no quantitative restrictions on the milk production in Iceland until 1st of January 2017. So the Icelandic farmers can milk as much as they want in 2015 and 2016. In this way Iceland wants to increase their milk production and the amount of produced milk-fat. The milk quota has not disappeared, but farmers get a percentage each year. In 2017 they will look how to continue. The milk-quota in Iceland has another function as in Europe. The dairy farmers gets a type of grant from the government, to make sure that the milk-price will stay low for the consumer. The function of the Icelandic milk-quota is mainly to keep the national milk production transparent. The dairy farmers have to wait and see for 2017.

There's certainly capacity in the domestic market for dairy products. Especially with the growth of tourism in Iceland. The milk consumption in Iceland is still increasing every year by several percentages. Icelanders themselves consume more dairy products, they consume on average 60 percent more milk than the inhabitants on the European mainland (Auðhumla, 2014). And especially the dairy products with a higher fat content are popular, such as butter and cream.

The most valuable nutrients in the milk are protein and fat. Protein and fat are important because of the high biological value of it. Protein and fat is well usable for the growth and maintenance of both the human and the animal body. Milk with a high content of fat and protein provide more opportunities for the factory to process it into other products. Many products derived from milk such as cheese and butter are made from the fat and protein from cow's milk. This is also the reason that the milk price in Iceland is determined on the fat and protein content in the milk.

Before January 2015 the Icelandic dairy farmers did get paid 25% for fat content and 75% for the protein content in their milk. Since January 2015 the farmers get paid 50% for their fat content and 50% for the protein content in their milk. The milk-cooperation hopes to decrease the milk-fat shortage by following this strategy.

The average Icelandic farmer prefers a "high profit low work effort ratio" on their dairy farm. Besides that the average Icelandic farmer really wants to make use of the current situation without quantitative restrictions on the milk production. Often the farmer's don´t have space to keep more livestock for more milk production. Besides that they do not want to invest in a new stable, because it is unsure what will happen after 2017. Opportunities in feeding management can improve the production without buying extra cattle.

Research relevance:

Social relevance relates to the importance of research for the client and possibly also for the society (Geurts, 1999). An improved Icelandic dairy production will partly contribute the rural economy of Iceland, now and in the future. The practical usability of the results of this study for Landstólpi also matters, besides the economic and social relevance. The research aims to provide this partly with insights that contribute to the solution of the issues around the dairy production in Iceland.

Scientific relevance concerns the importance of research for science (Geurts, 1999). This research is specifically focused on the dairy farmers in Iceland and also only focused on improving the production of Icelandic dairy farms through opportunities in feeding management. Therefore, this research will come to generalizable conclusions. The main objective of this research is to identify implementable opportunities within the feeding management to improve the production on the Icelandic dairy farms. Scientific relevance will therefore only be important for the dairy feed sector, because the research will provide insight into the efficiency of current feeding management in Iceland. It can also complement the existing theories and provocation for further research.

1.2. Problem statement

This section describes the problem state, based on the information above .

- The milk production on the Icelandic dairy farms is low. This low milk production is not only caused by the Icelandic dairy breed, but also due to the current feeding management on the Icelandic dairy farms.
- Iceland has a shortage on dairy products, especially with the growth of tourism in Iceland. And the milk consumption in Iceland is still increasing every year by several percentages.
- In addition, the Icelandic farmers are uncertain about the future after 2017. Often the farmers want to use the current situation without restrictions on the milk production. However, there is often no place for more cows in the

stable. And it is too risky to build a new barn, not knowing what will happen after 2017.

- The feeding management in average Icelandic dairy farm is not optimal and can be improved.

1.3. Objectives

The main objective of the study is to identify opportunities in feeding management to improve the production of the Icelandic dairy farms.

Sub-objectives are:

- To investigate the influence of grass silage on the milk production and milk content on Icelandic dairy farms.
- To investigate the influence of compound feed on the milk production and milk content on Icelandic dairy farms.
- To investigate the influence of barley on the milk production and milk content on Icelandic dairy farms.
- To investigate the influence of feeding-methods on the milk production and milk content on Icelandic dairy farms.

1.4. Research questions

Formulated research question: "What feeding management measures can improve the production of the Icelandic dairy farms?"

First there should be answered several sub-questions, before the main question can be answered. Formulated sub-questions:

1. What is the current situation of the feeding management in Iceland?
2. How does the grass silage influence* the milk content and milk production?
3. How does compound feed influence* the milk content and milk production?
4. How does barley influence* the milk content and milk production?
5. How do the feeding methods influence* the milk content and milk production?

* Influence = the power or capacity of causing an effect (Cambridge dictionary, 2014)

1.5. Consecution

This report has been prepared with on the first page a cover page, the second page a title page and the acknowledgements. After the acknowledgement a table of contents can be found, which includes the titles and chapters of this report. The first chapter contains an introduction with the occasion, relevance , problem statement, objectives, research question and consecution. Chapter two shows the theoretical overview of the study. This theoretical overview contains literature about dairy farming in Iceland and literature about the influence of feeding management on the production of dairy farms. The influence of feeding management on the production of dairy farms is divided into the sub paragraphs; grass silage, compound feed, barley and feeding methods. Chapter three is all about the research methods and contains paragraphs about the research area, data collection & collection effort and data analysis. Chapter four displays the results from the study in Iceland. Chapter five contains the discussion followed by the conclusion which belongs to chapter six. The final chapter (chapter seven) covers the recommendations. The references shows which sources are used during this research. Additional documents can be found in the appendices.

2. Theoretical overview

There has never done research on "the opportunities in feeding management to improve the production of the Icelandic dairy farms ". However, in the past there have been done a number of studies to feeding management from which useful information can be extracted for the thesis. This chapter consist the literature review of the thesis.

2.1. Dairy farming in Iceland

Iceland has only one dairy breed, which is original for Iceland and not found elsewhere (Adalsteinsson, 1981). The breed is related to North Scandinavian Cattle Breeds but genetic studies indicate that the divergence has happened around thousand years ago (Katanen et al., 2000). Since then, practically no import of foreign dairy breeds has occurred. The total number of Icelandic dairy cows is approximately 26.000 (Bændasamtök Íslands, 2010) and that number is relatively stable. The Icelandic dairy breed is unique in terms of biodiversity, because it has survived as an isolated population for a very long time (Helgadóttir, 2009). The average milk yield of an Icelandic cow is 5.300 kg/cow (Bondi, 2015) which is considerably less than in most common milk breeds in Europe. Despite this fact and comprehensive debate in the farming community, farmers have decided not to import genetic material for improvement of the Icelandic breed. This decision is supported by the majority of the population in Iceland according to a 2007 poll (Gallup, 2007).

The reasons for this are many but few of the most cited are linked to the ambition to protect the Icelandic dairy breed and its unique genetic traits but also the potential risk of disease distribution. Three genetic traits have been described as especially valuable for the Icelandic dairy breed:

1. The milk from the Icelandic dairy breed has unique combinations of a protein called beta casein. Scientific research have suggested a link between this trait and the risk for diabetes-I in children (Birgisdottir et al., 2006, Igmann et al., 2003, Birgisdottir et al., 2002).

2. The colour combinations of the Icelandic breed are diverse and in many ways unique, as it has never been subject to breeding on the basis of colour (Birgisdottir et al., 2002).

3. Adaption to harsh climate, rough fodder and uneven terrain (although this has not been proven in scientific research).

The general conditions in Iceland for dairy farming are not particularly favourable. One reason has already been mentioned; i.e. the Icelandic dairy-breed. Although a new breed could theoretically be introduced to the country, this is highly controversial amongst farmers and consumers as mentioned previously. As the Icelandic dairy breed only counts 26.000 cows, it would be difficult to maintain many separate breeds and the Icelandic breed, with its unique genetic makeup, would probably disappear. This would violate international obligations Iceland has undertaken through the UN Convention on Biological Diversity.

Harsh climate also puts severe strains on the dairy production. The combination of long winters and cold summers, and perhaps most importantly, the instability and sudden weather change results in low production security. Grazing periods can vary considerably from one year to the next and even in the middle of summer, cold storms can prevent outdoor grazing for days. According to Icelandic regulations dairy cattle must have access to outdoor area at least 8 weeks every summer (Reglugerðasafn, 2015). The grazing period, however, is normally from late May to early September, although some farmers choose a shorter period, especially farms with milking robots. The long housing period puts strain on the animals, making them more vulnerable to various production diseases.

As mentioned earlier, barley is the only grain produced in Iceland but there is no formal market for domestic grain due to the small volume of the production. Therefore, large part of concentrate for animal feed is imported and hence rather expensive. High concentrate price means farmers use minimal amounts which again influences milk yield. Small milk yield along with expensive housing and long housing periods result in high production price.

No protein rich crop is cultivated in Iceland so farmers are mostly dependent on imported soya as a protein source. In addition, fish meal is used as protein source for cows. Fish meal has proved to be an excellent protein source, but rather expensive.

The big spread of dairy farms imposes some important problems for dairy farmers. First, all transports costs are high, both on raw materials and the products. Secondly, service cost, e.g. veterinary cost, is expensive due to long distances and, thirdly, farmers have limited possibilities for partnership in ownership of the machinery. This last point leads to high capital cost on the farms as most farmers need to own a considerable amount of machinery.

Dairy farming in Iceland faces many special challenges. The dairy breed is not productive, most concentrate is imported, bedding material is expensive and short summers limit profitable grazing systems. Long distances between farms impose high transport costs and limit the possibilities for active cooperation between farms.

2.2. Influence of feeding management on the production of dairy farms

This chapter describes the influence of feeding management on the production of dairy farms. The feeding management in this research is divided into four parts; grass silage, compound feed, barley and feeding methods.

2.2.1. Grass silage

Dairy farming in Iceland is grass based. The winter season in Iceland lasts about eight months, thus it is essential to produce and preserve large amounts of roughage. Roughage is for at least four reasons important in feeding the dairy cattle:

- It is a high quality source of nutrients
- It is essential for the rumen microbes

- It is essential for the rumination
- It regulates the pH in the rumen

Roughage quality and nutritional value are influenced by numerous biological and technological factors, including: the crop species, stage of maturity and dry matter (DM) content at harvest, chop length, type of silo, rate of filling, forage density after packing, sealing technique, feedout rate, weather conditions at harvest and feedout and additive use (Pozdíšek et al., 2003).

In general, four types of storage systems are used for to storage of grass silage:

- Trench silo / bunker silo /clamp silo / silage pit
- Tower silo
- Bales

Trench silo´s and bales are meanly used to storage the grass silage in Iceland.

Clamping is usually the most cost-effective method of producing silage. But, if bales are prepared the ensiling process is quicker, resulting in more efficient use of available substrates (Fychan et al., 2002).

The fermentation quality of either trench or big bale silages is good. Both can have a high nutritive value. Method of conservation does not influence voluntary intake or the animal production. Therefore both baling and clamping are suitable methods for ensiling grass. The choice of which system to use can be based on the availability of equipment and facilities (Vrotniakiene V. et al, 2006). Research showed that both types of roughage can have a high, similar nutritive value. The live weight gains on the two treatments were not significantly different during a research (Zastawny J. et al, 1996).

Various additives can be used to improve the conservation of the grass silage. The most common are bacterial inoculants with enzymes, organic acids and sugars. Bacterial inoculants reinforce the natural process of fermentation (Muck, 2010).

The characteristics of the grass silage can be positive affected by microbial inoculants. These inoculants had a favorable effect in terms of higher lactic acid concentration, a low pH and a significant increase in milk production. The lactic to acid ratio in inoculated silages increased significantly. A recent research compared inoculated silage to control silage. The results of this research shows that the total concentration of acids (acetic, propionic, n-butyric, lactic acid) were 2-3 times higher in the inoculated silages (Muck, 2010).

2.2.2. Compound feed

Compound feed is a part of concentrate feeds. Concentrates are types of fodder that contain a high density of nutrients, usually low in crude fibre content (less than 18% of dry matter (DM)) and high in total digestible nutrients. Definitions of compound feed and their nutrient contents vary in the literature; terminology used in this report follows that of FAO (food and agriculture organization of the United Nations)

High-concentrate diets are often used to higher up the milk production of dairy cows (Yang and Beaouchemin, 2007 and Agle et al., 2010). According to a research of Lawrence et al. (2014) the total quantity of concentrate included in the diet have a significant effect on milk production. By increasing the total amount of concentrate offered, cows had higher total dry matter intake and energy intake, which resulted in increased milk production and reduced negative energy balance and body condition score loss.

Other research shows the same effects on the milk production. Increasing the concentrate feed input in diets based on grass silage (Agnew et al., 1996) has a positive effect on milk production and body condition score loss (Delaby et al., 2009). This perception is also known as a response to concentrate feeds (Bargo et al., 2003). However, ruminants do not respond the same to concentrate expansion due to variety within the flock, which is caused by variation in stage of lactation, parity, and genotype (Horan et al., 2005). Stage of lactation also has a large effect on the substitution rate and response to concentrate as the cow regulates her body fat reserves and the composition of milk changes (Leaver 1988).

Concentrate feeds does also influence the content of the milk. An increase in milk protein concentration and reduction in milk fat concentration was found by Andersen et al. (2003) when concentrate allowance was increased from 250 to 750 g/kg of dry matter intake. Agnew et al. (1996) reported that increasing the amount of concentrate from 280 to 480 g/kg of DMI also resulted in an increase in milk protein concentration and a reduction in milk fat concentration.

The milk yield response to concentrate found by Ferris et al. (2002)) was 0.6 kg of milk/kg of concentrate DM. The basal feed in the study of Ferris et al. (2002) was lower in digestibility than the base feed used in the study of Andersen, the energy values of the two diets were similar. However, cows in the study of Ferris et al. (2002) were of higher genetic merit (milk yield of 31.8 kg/cow per day) than cows included in study of Andersen, which Ferris et al. (1999) reported would influence the response to additional concentrate feeding. Increases in the proportion of concentrate in the diet has stimulated higher total DM intakes in dairy cows fed total mixed ration (Robinson et al 1997, Friggens et al. 1998)

High-concentrate diets can cause subacute ruminal acidosis (SARA) by high productive ruminants and off-feed periods can be noticed (Nocek, 1997 and Desnoyers et al., 2009).

Building up compound feed levels

The effect of three different concentrate buildup strategies in early lactation on production performance, health and fertility of high yielding dairy cows was addressed in an experiment at the Agri-food & Biosciences Institute (Law et al. 2012). Adopting a slow or intermediate concentrate build-up strategy in early lactation improved forage intake in early lactation and had no detrimental effect on overall production performance. Furthermore, adopting a slow or intermediate build-up strategy also improved rumen health as evidenced by the significantly lower proportion of animals treated for a “dilated abomasum” compared to animals on a rapid build-up of concentrates. However, there were no significant treatment effects on fertility, there was a trend for cows on the delayed build-up strategy to have improved fertility.

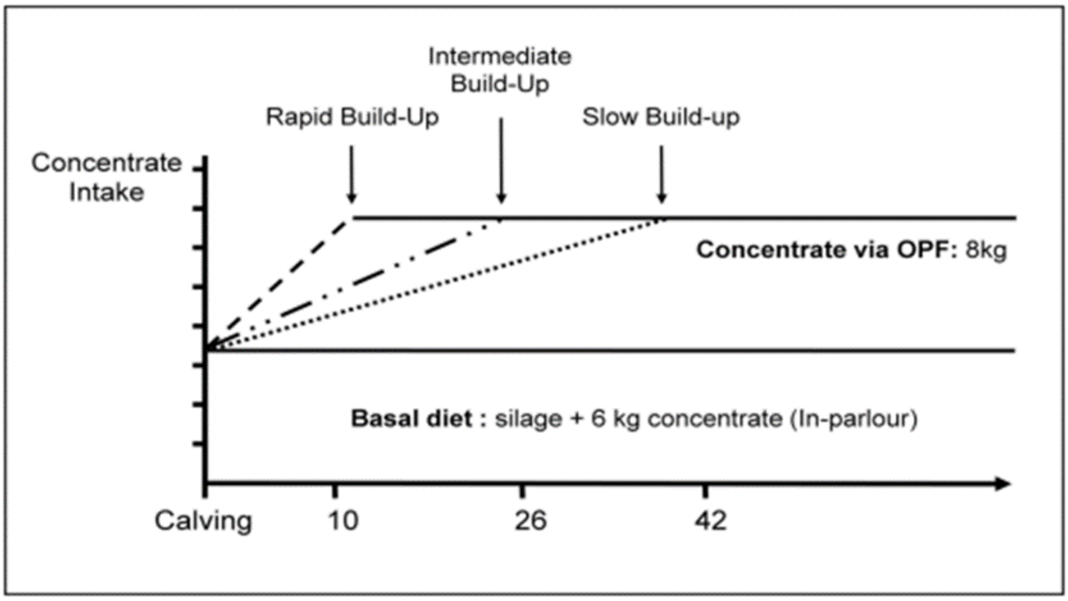


Figure 1: Schematic of concentrate build-up strategy within the rapid, intermediate and slow build-up treatments (Law, 2012)

2.2.3. Barley

Barley is part of compound feed.

There are many types of barley in the world, with different effects in terms of nutrients. For this reason it is important to know the type of barley being fed to the ruminants. Difference between some barley cultivars can be found in the starch content and rumen fermentation patterns (Silveira et al., 2007). Knowledge of differences between barley can help farmers select and feed the most suitable varieties that improves production without a negative effect on the rumen health.

Barley has a higher content of protein, methionine, cysteine lysine and trypophan in comparison with corn. This knowledge shows the potential contribution of barley in the shortage of protein in cattle feed (national research council 1996, national research council 2001). Barley contains the highest content of neutral and acid detergent fiber and the lowest contents of starch and fat, in comparison with other cereal grains. Research shows the large variation between separate barley samples concerning the available energy and animal performance (Boss et al., 1996 and Van Barneveld et al., 1990)

Feeding high amounts of rapidly fermentable starches, such as barley, to the cows can cause periods of sub acute rumen acidosis, well known as SARA. Sub acute rumen acidosis can increase the incidence of laminitis (Kelly et al. and Nocek, 1997).

Chemical treatment:

Treating high moisture grain with a chemical creates an acid environment within the grain mass that prevents mold development (Pomeranz 1982). The most common used chemicals are propionic acid and acetic acid. When these acids are mixed with grain, the field and storage molds are killed, the pH is lower to 4.0-4.5, and the viability of the seed is destroyed (Hall et al. 1974). There is evidence that the acids also provide digestible energy directly to ruminants and enhance the feed efficiency (Eckhoff 1985). The amount of acid to be applied to high-moisture grain depends on grain moisture content, storage temperature, acid type, and storage length. Chemicals are added liquid dorm to the grain as the freshly harvested product is conveyed to storage. (Donald et al. 1992)

Rumen fermentation patterns and a lowered risk of sub-acute rumen acidosis can be regulated by treatment of barley grain with lactic acid and heat. Positive effects were also noticed in the milk composition, with a higher content of fat, a better milk energy efficiency and a lower milk urea nitrogen for cows fed the treated barley. Though, further research would be deservedly to explore this treatment in dairy cows in other lactation stages, as well as to improve the lactic acid concentration and heating temperatures/ times (Iqbal et al., 2012).

2.2.4. Feeding methods

A feeding method is how the feed is offered to the cow. This can be mixed, separate, limited and unlimited. The systems for roughage provision that are collected during the literature study are: regular feed fence, the mixture wagon, the mobile feed fence and an automatic feeding system, these are the most applied systems in Iceland. The systems for compound feed provision that are studied during this literature review are programmed automatic feeding provision and provision in the milking parlour/ milking robot and at the feeding fence.

2.2.4.1. Methods roughage provision:

Cows take in their food ten to twelve times per day. Especially heifers and lower-ranking animals are vulnerable by competition for feed intake. Therefore, it is important that all the animals can take sufficient high quality feed. If that fails, the low ranking animals will get unbalanced ration. An unbalanced ratio can cause problems with the milk production and condition. The feeding system should provide for enough intake of good quality feed by each animal. If the feeding is limited, it is important that there is no additional occupancy at the feed fence. Feeding is limited when; during a day a period of time no feed is available, if less than two times a day feed is pulled, or if less than 10% remaining feed is left. With unlimited feed (for example a self-feeding system), overcrowding at the feeding is acceptable (Gezondheidsdienst voor Dieren, 2012).

Regular feed fence:

A feed fence with the right height for the cattle, gives them the opportunity to eat unobstructed. A too low a feed fence causes humps on the withers, in particular in large animals. Withers bumps affect the welfare of the cow. For milk production, it is important that all the animals are easily and quickly able to take in sufficient feed. If a too low feed fence obstructs the production, it is important to tackle this. (Gezondheidsdienst voor Dieren, 2012)

Mobile feed fence (Weelink):

The Weelink system is familiar to many Icelandic farmers. The Weelink system is an electrical feeding rack positioned in a free stall barn, so the cows are continuously disposed of fresh feed. The system provides a space saving of 30%. The advantage is the little labor for feeding the cows. A disadvantage is that the feed is not fresh at the end of the day and the cows can select in the feed. There no scientific research into the effects of the Weelink system on the milk. But commercial research on the F.A.L. research farm in Braunschweig (Germany) has proven that with the feeding system, the maximum roughage and maximum production is attained. The food is used more effectively than with mixed feeding and the systems causes low mechanical costs (Weelink Stalinnovatie, 2015).

Mixing wagon and automatic feeding system:

The systems for mixed feeding are emerging, due to the rapid development in mechanical feeding. More possibilities in the rations and more efficient minerals use, makes many farmers move on to mixed feeding with their roughage and concentrates (Hollander, o.fl., 2005).

2.2.4.2. Methods compound feed provision:

Provision concentrates in the parlor / robot and the feed fence:

Farmers can easily give each individual cow the concentrate in a tie stall barn. In the free stall barn it is more difficult to give the cows the right amount of compound feed. In many cases, the concentrate is then provided in the milking parlor or milking robot. In the milking parlor, the farmer can often not give more than 8 kg per day and in the milking robot not more than 6 kg. However, highly productive dairy cattle need more than 12 kg is needed per day. Another disadvantage is that not all of the concentrate is taken during the milking's. The most simple and cheapest way to provide less concentrate in the parlor / robot is to give a basic ration at the feed fence. But then the cows must be able to eat at the same at the feed fence (Hollander, o.fl., 2005).

Automatic feeding station:

Besides supplying concentrates in the parlor or milking robot, the concentrates can also be supplied by an automatic feeding box. This system works unless the dosage levels are not checked regularly. The cows are wearing a transmitter which is read by the automatic feeding box. Advantage of this method is that individual feeding and concentrate feeding are spread over the day. In addition, this system can save labor for the farmer, only the setting and checking the computer displays provides work (Hollander, o.fl., 2005).

3. Research methods

Prior to data collection in the field a comprehensive literature review was carried out in order to bring the research in context with current knowledge and existing studies.

3.1. The research area

The study was conducted in southern, western and northern Iceland (figure 2). This research to opportunities for improved production for Icelandic dairy farmers is focused at the feeding management in Iceland. Therefore, this study did only focus on dairy farmers in Iceland with milking cows. The study is independently processed in Iceland.

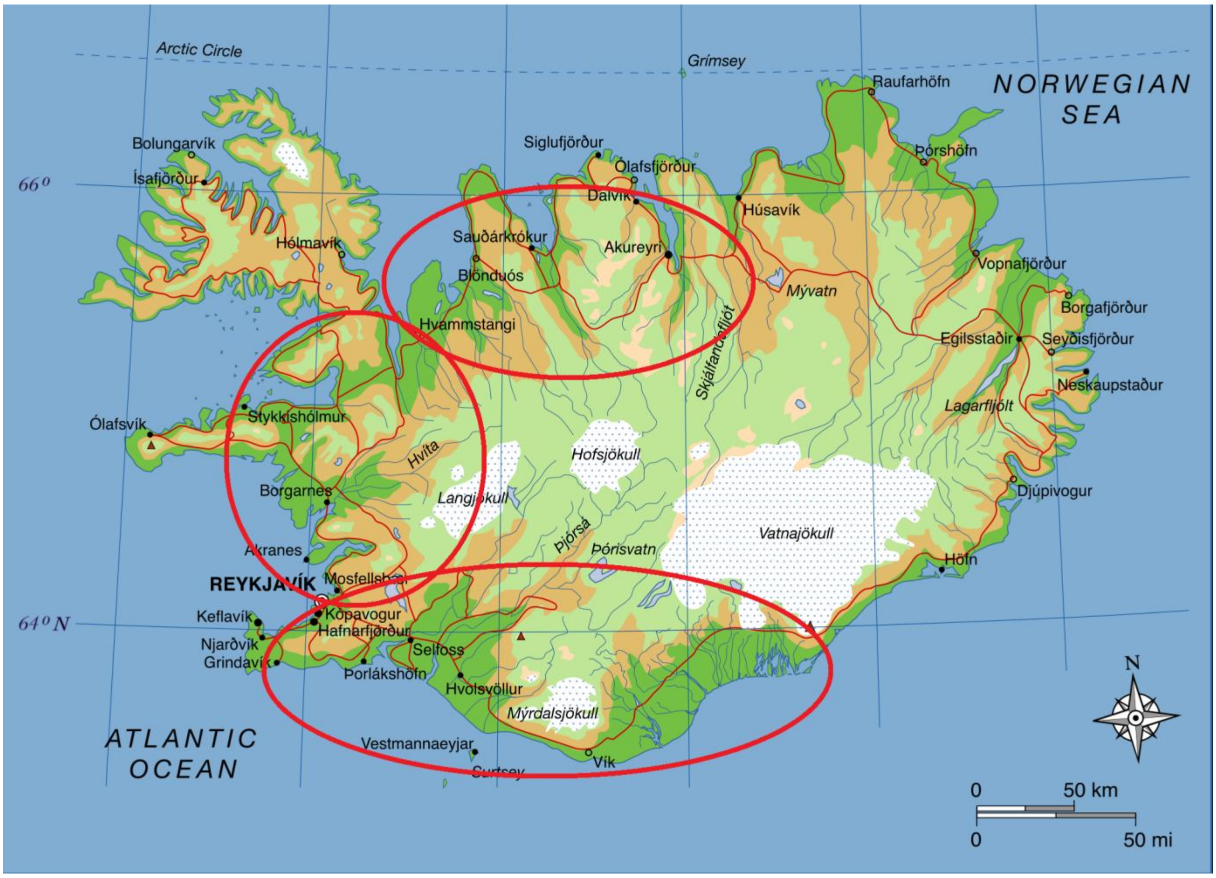


Figure 2; Topographic map of Iceland with the research area in the red circles (Naylor, 2007)

3.2. Data collection & collection effort

A dairy farm based online survey was conducted using SurveyMonkey. Farm visits were carried out between July 24th and October 2nd 2015.

613 dairy farmers in Iceland received an email invitation to participate the online survey. The survey was accessible from July 16th till October 2nd. 241 Icelandic dairy farmers completed the online survey. The survey included a request for further research through a farm visit. 105 farmers did indicate to be vacant to cooperate in further research through a farm visit. The online survey provided data about the current feeding management on the Icelandic dairy farms.

63 dairy farms in Iceland have been visited to collect more research data regarding the production. The research data from the farm visits contains the milk production data from 2014. These milk production data were taken from the website of Auðhumla in collaboration with the farmers during the farmvisits. Auðhumla is a cooperative owned by about 700 milk producers throughout Iceland. Auðhumla's role is to take the milk from their members and transform into milk products sold in the market at home and abroad. The farm visits did also gave another view on existing feeding management on the different dairy farms.

3.3. Data analysis

The data was analyzed by dividing the database into the required variables and comparing them using SPSS Statistics. SPSS Statistics is a software program used for statistical analysis.

The chi-square test for independence, also called Pearson's chi-square test or the chi-square test of association, is used to discover if there is a relationship between the feeding management and production on Icelandic dairy farms. The chi-square test is part of the SPSS Statistics software package.

All the categorical variables in the tests are nominal. The two variable in each test consist of two or more categorical, independent groups. The data analysis consist 35 chi-square tests. The following data is analyzed with the SPSS chi-square test.

<u>Progress of grass silage:</u>

- Relation between milk yield and progress of grass silage
- Relation between milk fat percent and progress of roughage
- Relation between milk protein percent and progress of roughage.
- Relation between produced kilograms fat and progress of roughage
- relation between kilograms protein and progress of roughage

<u>Use/ no use silage additives:</u>

- Relation between milk yield and use/ no use of silage additives
- Relation between fat percent and use/ no use of silage additives
- Relation between protein percent and use/ no use of silage additives
- Relation between produced kilograms of fat and use/ no use of silage additives
- Relation between produced kilograms of protein and use/ no use of silage additives

<u>Compound feed per 100 kilograms of milk:</u>

- Relation between milk yield and amount of compound feed per 100 kilograms of milk.
- Relation between fat percent and amount of compound feed per 100 kilograms of milk
- Relation between protein percent and amount of compound feed per 100 kilograms of milk
- Relation between produced kilograms of fat and amount of compound feed per 100 kilograms of milk

- Relation between produced kilograms of protein and amount of compound feed per 100 kilograms of milk

Feed/ no feed of barley:

- Relation between milk yield and feed / no feed of barley
- Relation between fat percent and feed/ no feed of barley
- Relation between protein percent and feed / no feed of barley
- Relation between produced kilograms of fat and feed / no feed of barley
- Relation between produced kilograms of milk protein and feed/ no feed of barley

Treatment method of the barley:

- Relation between milk yield and treatment method of the barley
- Relation between the fat percent and the treatment method of the barley
- Relation between protein percent and treatment method of the barley
- Relation between produced kilograms of milk fat and treatment method of barley
- Relation between produced kilograms of protein and treatment method of barley

Roughage feeding method:

- Relation between milk yield and roughage feeding method
- Relation between fat percent and roughage feeding method
- Relation between protein percent and roughage feeding method
- Relation between produced kilograms of fat and roughage feeding method
- Relation between produced kilograms of protein and roughage feeding method

Compound feed provision:

- Relation between milk yield and method of compound feed provision
- Relation between fat percent and method of compound feed provision
- Relation between protein percent and method of compound feed provision
- Relation between produced kilograms of fat and method of compound feed provision
- Relation between produced kilograms of protein and method of compound feed provision

4. Results

This chapter shows the results of the research. The data records can be found in the appendix 1. The chi-square tests of the various relations between the feeding management and production can be found in appendix 2.

4.1. Current feeding management in Iceland

This section shows different graphs to present the current situation of grass silage, compound feed, barley and feeding methods on the dairy farms in Iceland.

4.1.1. Current situation grass silage on Icelandic dairy farms

This paragraph contains the results of the current situation of the grass silage on Icelandic dairy farms. It represents the progress of roughage and the use of silage additives.

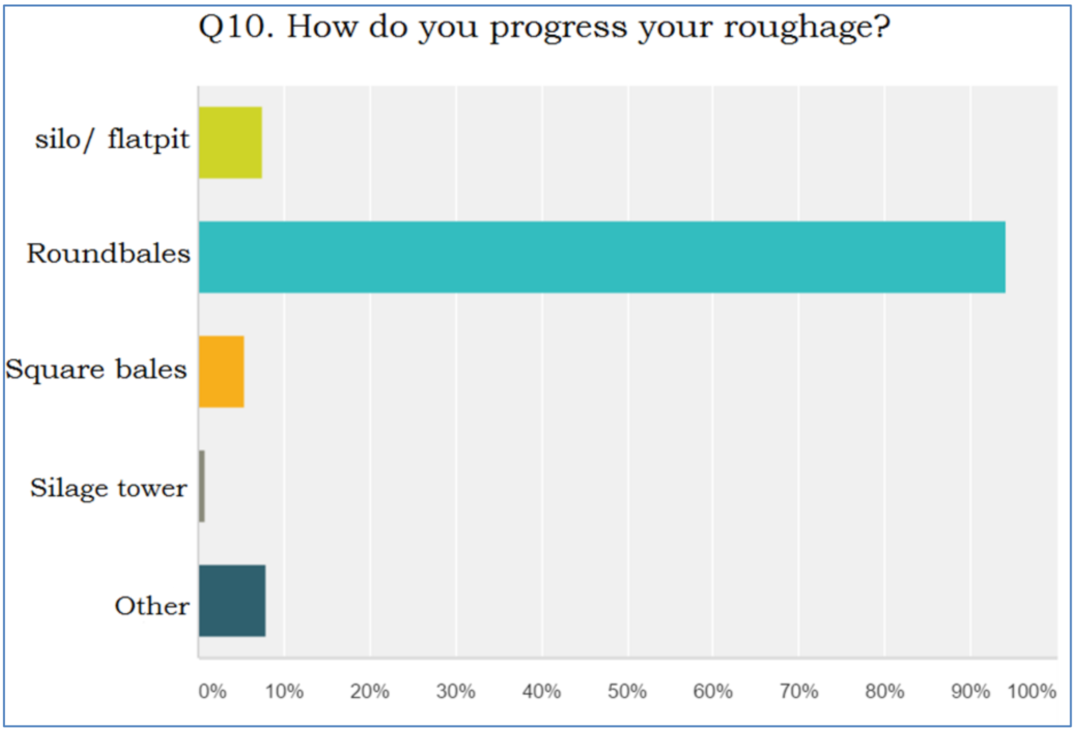


Figure 3: Current situation progress of roughage on Icelandic dairy farms

The bar graph above (figure 3) shows that 94,22 % of the respondents processes the roughage into round bales. 7,56 % processes the roughage into a silage pit. 5,33 % of the respondents processes the roughage into square bales and 0,98 % uses a silage tower for their roughage. 8,90% of the respondents are using another way of processing the roughage.

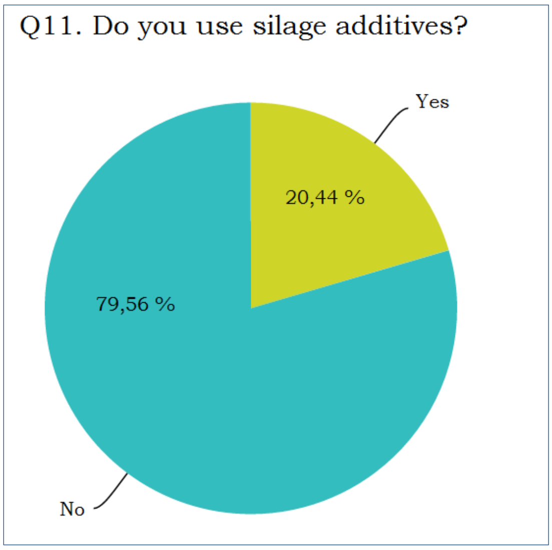


Figure 4; Current situation use of silage additives on Icelandic dairy farms

The pie chart above (figure 4) shows that 20,44 % of the respondents are using silage additives. 79,56 % of the respondents do not use silage additives.

4.1.2. Current situation of compound feed on Icelandic dairy farms

This paragraph includes the results of the current situation of the compound feed on the Iceland dairy farms.

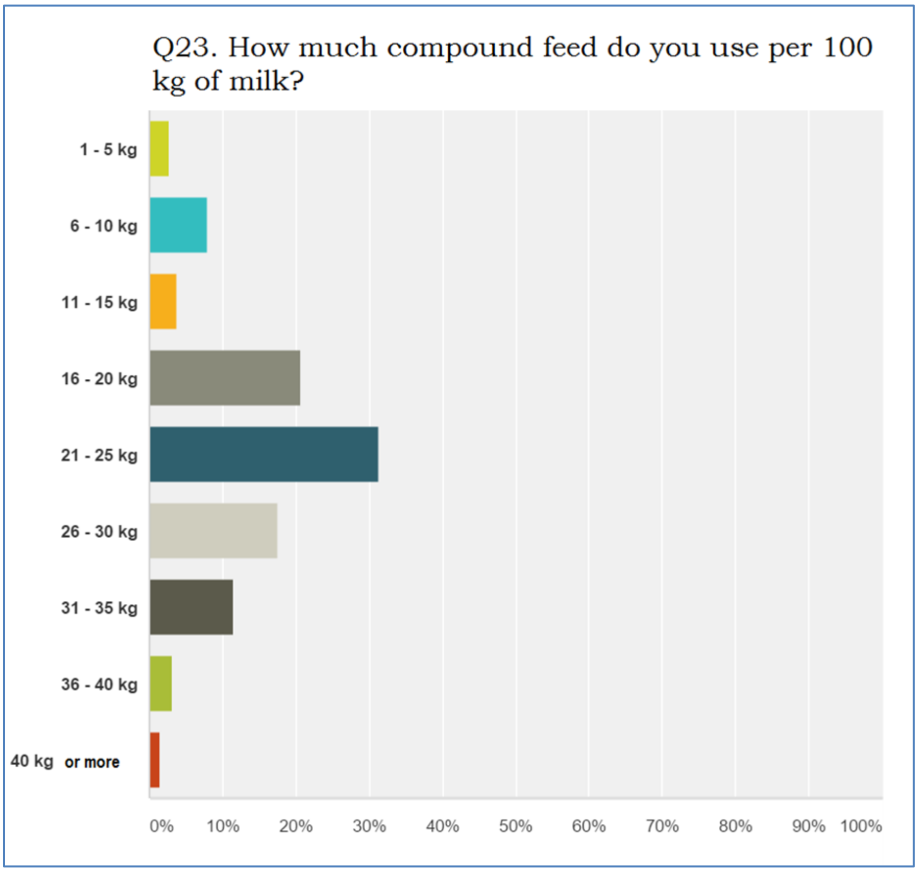


Figure 5; Current situation amount of compound feed per 100 kg of milk

The bar graph above (figure 5) describes that 31,34 % of the respondents are feeding 21 – 25 kilograms of compound feed per 100 kilograms of milk. 20,47 % of the respondents are in the range 16 – 20 kilograms of compound feed per 100 kilograms of milk. 17.51 % of the respondents are feeding 26- 20 kilograms of compound feed per 100 kilograms of milk. 11,52 % is in the range of 31- 35 kilograms of compound feed per 100 kilograms of milk. 7,83 % of the respondents provide the cows 6- 10 kilograms of compound feed per 100 kilograms of milk. 3,69 % of the respondents are in the range of 11-15 kilograms of compound feed per 100 kilograms of milk. 3,23 % of the respondents are feeding in between 36- 40 kilograms of compound feed per 100 kilograms of milk. 2,76 % gives 1-5 kilograms of compound feed per 100 kilograms of milk. And 1,38 % of the respondents provide their cows with more than 40 kilograms of compound feed per 100 kilograms of milk.

4.1.3. Current situation of barley on the Icelandic dairy farms

This paragraph includes the results of the current situation of barley on the Iceland dairy farms. It represents the use of barley and the treatment of the barley

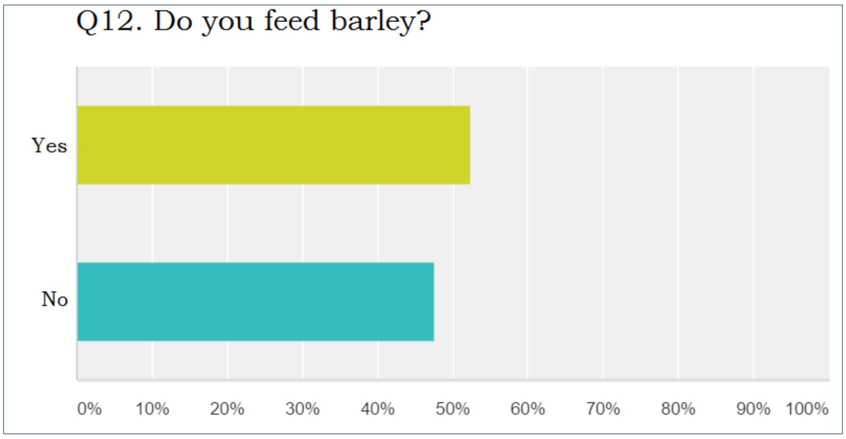


Figure 6: Current situation of feeding barley on Icelandic dairy farms

The bar graph above (figure 6) shows that 52,44 % of the respondents feed barley to their cattle. 47,56 % of the respondent do not feed barley to their cattle.

The bar graph below (figure 7) displays that 61 % of the respondent, who are feeding barley to their cattle, treat their with propionic acid. Dried barley as a treatment is used by 18,64 % of the respondents who are feeding their cattle with barley. 14,41 % of the respondents packed their barley without acid. And 5,93 % of the respondents buy the barley from the feeding company.

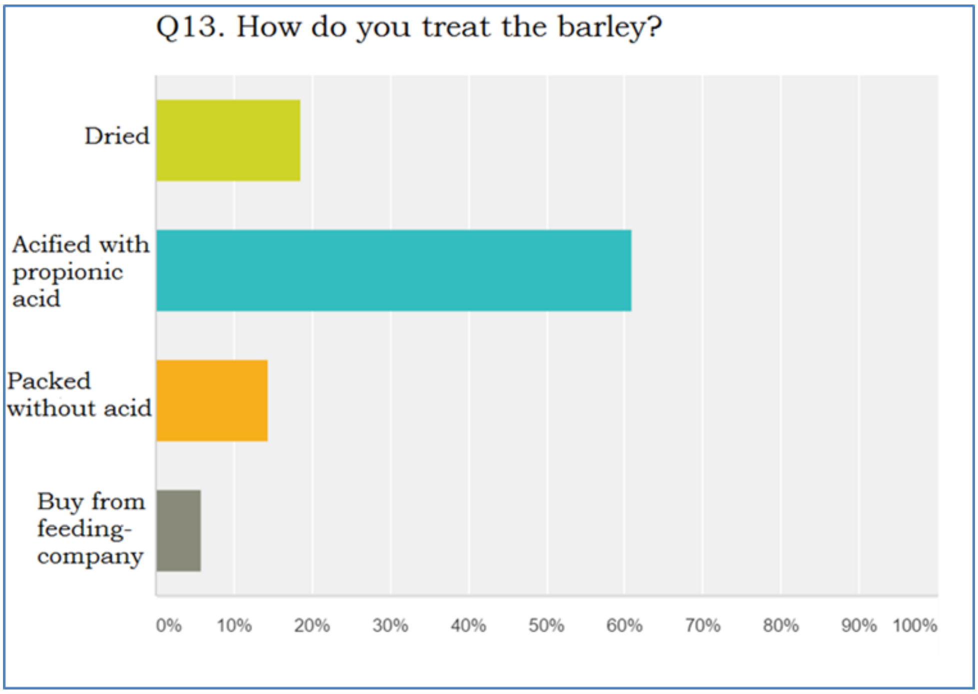


Figure 7: Current situation treatment of the barley in Icelandic dairy farms

4.1.4. Current situation of feeding methods on Icelandic dairy farms

This paragraph includes the results regarding the current situation of feeding methods on Icelandic dairy farms. It shows the current feeding technique for roughage provision and the current feeding technique for the compound feed provision.

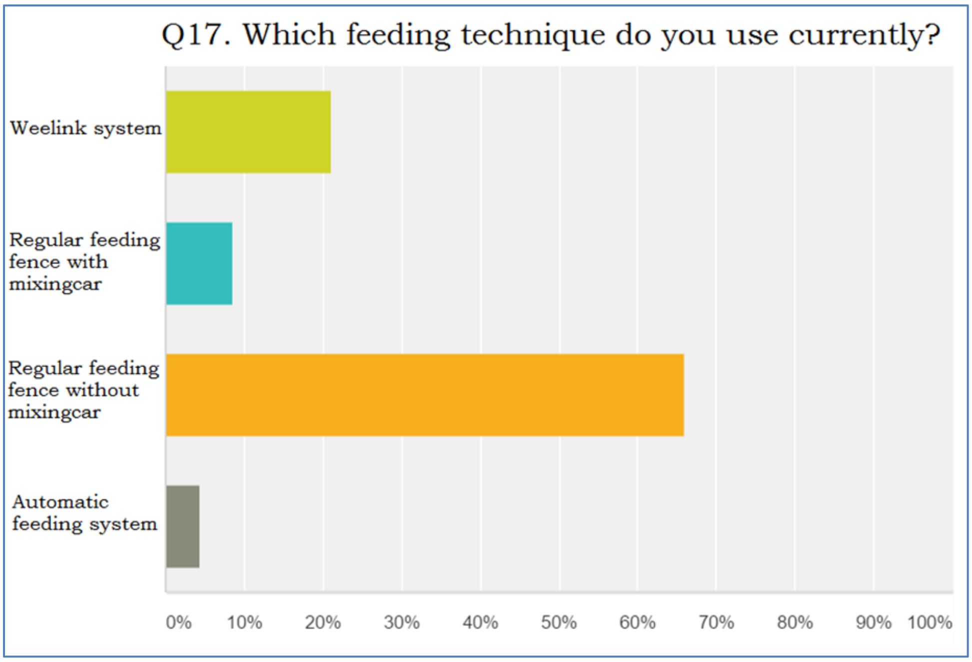


Figure 8: Current feeding technique roughage on dairy farms in Iceland

The bar graph above (figure 8) displays that 66,07 % of the respondents are using a regular feeding fence without a mixing car. 20,98 % of the respondents are using a Weelink system. A regular feeding fence without a mixing car is used by 8,48% of the respondents. And 4,46% of the respondents are using an automatic feeding system on their dairy farm.

The bar graph below (figure 9) shows that 47,51% of the respondents provides the compound feed with a concentrate feeding automat. 43,89% of the respondents provides the compound feed by hand. 24,43% of the respondents provides the compound in the milking robot. And 4,98% of the respondents gives the compound feed in the milking parlour. The respondents could give more than one answers at this question.

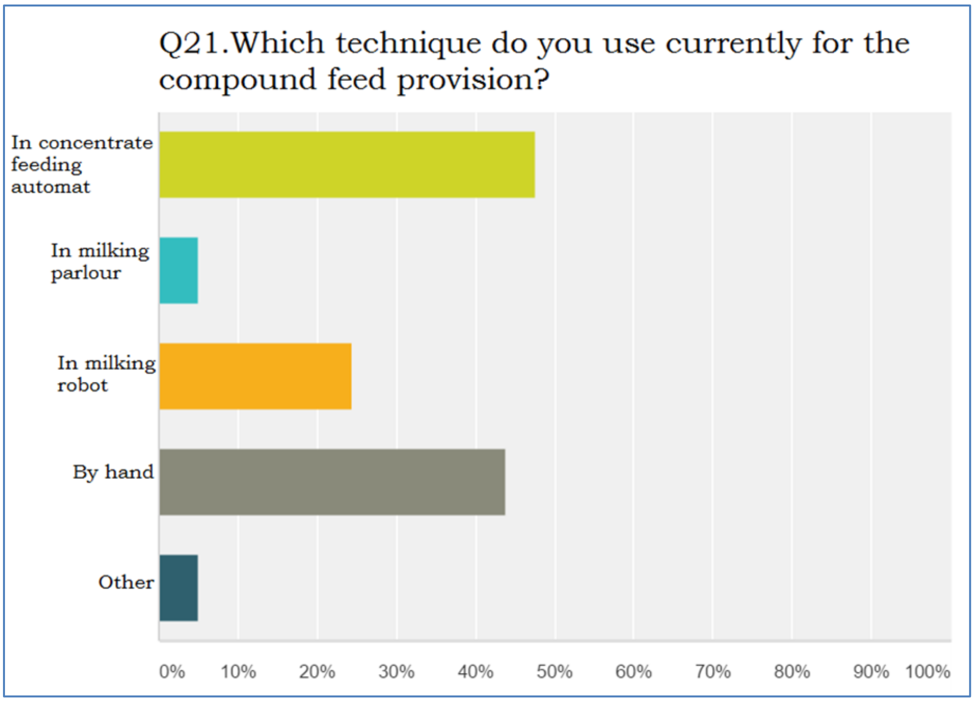


Figure 9: Current situation feeding technique for compound feed provision on Icelandic dairy farms

4.2. Influence of grass-silage on the production of Icelandic dairy farms

This section shows different graphs to present the cohesion between grass silage and the milk production on Icelandic dairy farms.

4.2.1. Progress of grass silage

This paragraph contains the relation between the milk production and progress of grass silage.

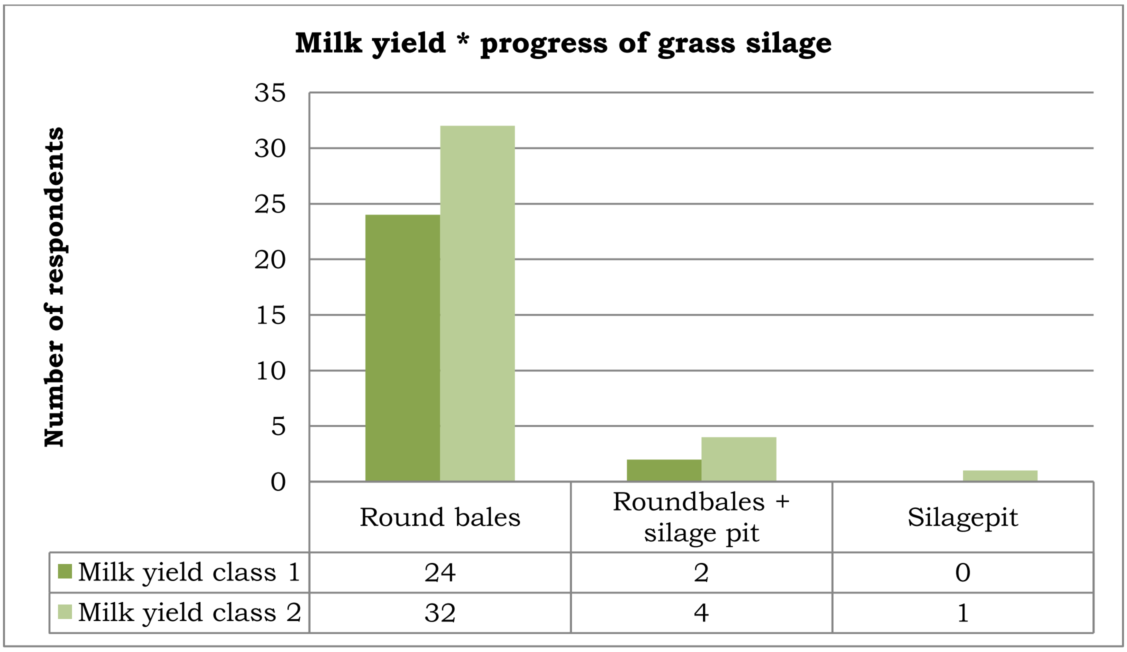


Figure 10: Relation between milk yield and progress of grass silage.

The figure above (figure 10) shows the relation between the milk yield and the progress of the grass silage. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The progress of grass silage is divided into three groups; round bales, round bales + silage pit and silage pit.

The level of statistical significance of this relation between milk yield and progress of grass silage is 0,632. This allows the relationship is not significant enough to be reliable.

The figure below (figure 11) shows the relation between the fat percent and the progress of the grass silage. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Fat percent class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The progress of grass silage is divided into three groups; round bales, round bales + silage pit and silage pit.

The level of statistical significance of this relation between fat percent and progress of grass silage is 0,252. This allows the relationship is not significant enough to be reliable.

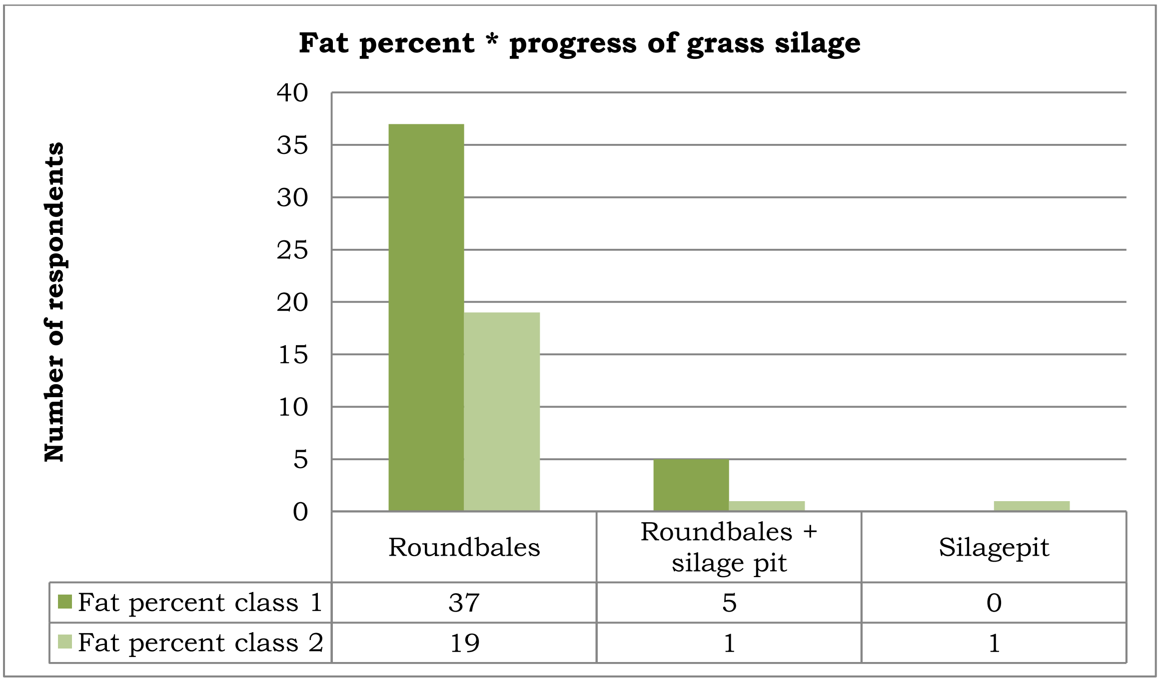


Figure 11: Relation between fat percent and progress of grass silage

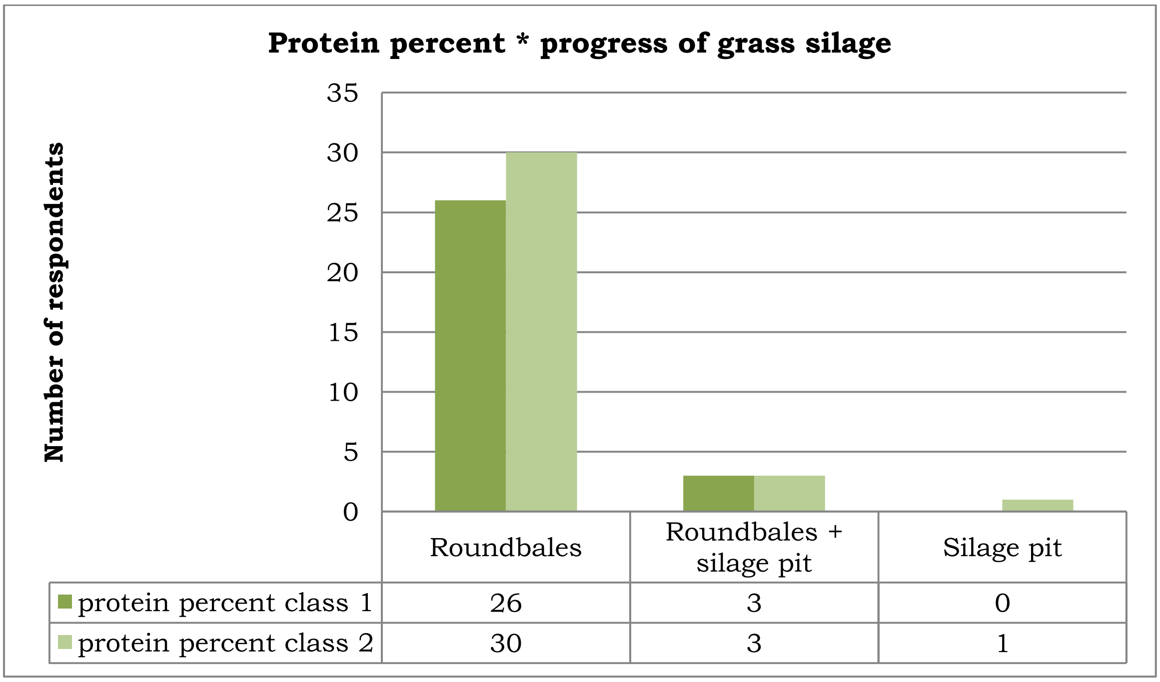


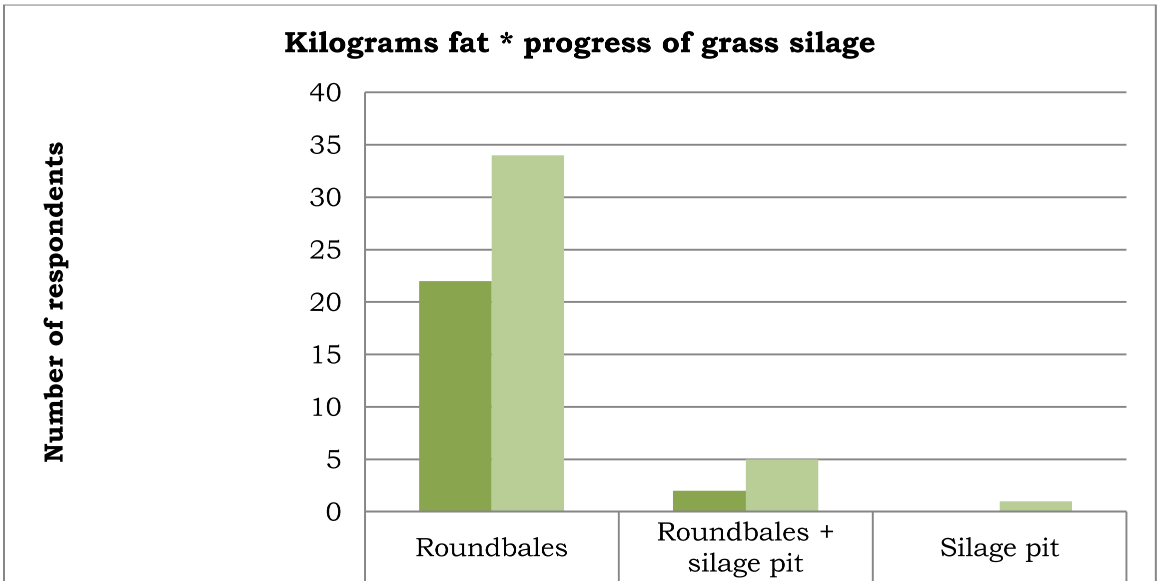
Figure 12: Relation between protein percent and progress of grass silage.

The figure above (figure 12) shows the relation between the protein percent and the progress of the grass silage. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The progress of grass silage is divided into three groups; round bales, round bales + silage pit and silage pit.

The level of statistical significance of this relation between protein percent and progress of grass silage is 0,639. This means the relationship is not significant enough to be reliable.

The figure below (figure 13) shows the relation between the kilograms of milk fat and the progress of the grass silage. The kilograms fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The progress of grass silage is divided into three groups; round bales, round bales + silage pit and silage pit.

The level of statistical significance of this relation between kilograms fat and progress of grass silage is 0,411. This means the relationship is not significant enough to be reliable.



	Roundbales	Roundbales + silage pit	Silage pit
Kilograms fat, class 1	22	2	0
Kilograms fat, class 2	34	5	1

Figure 13; Relation between produced kilograms fat and progress of grass silage

The figure below (figure 14) shows the relation between the kilograms of milk protein and the progress of the grass silage. The kilograms protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The progress of grass silage is divided into three groups; round bales, round bales + silage pit and silage pit.

The level of statistical significance of this relation between kilograms protein and progress of grass silage is 0,380. This means the relationship is not significant enough to be reliable.

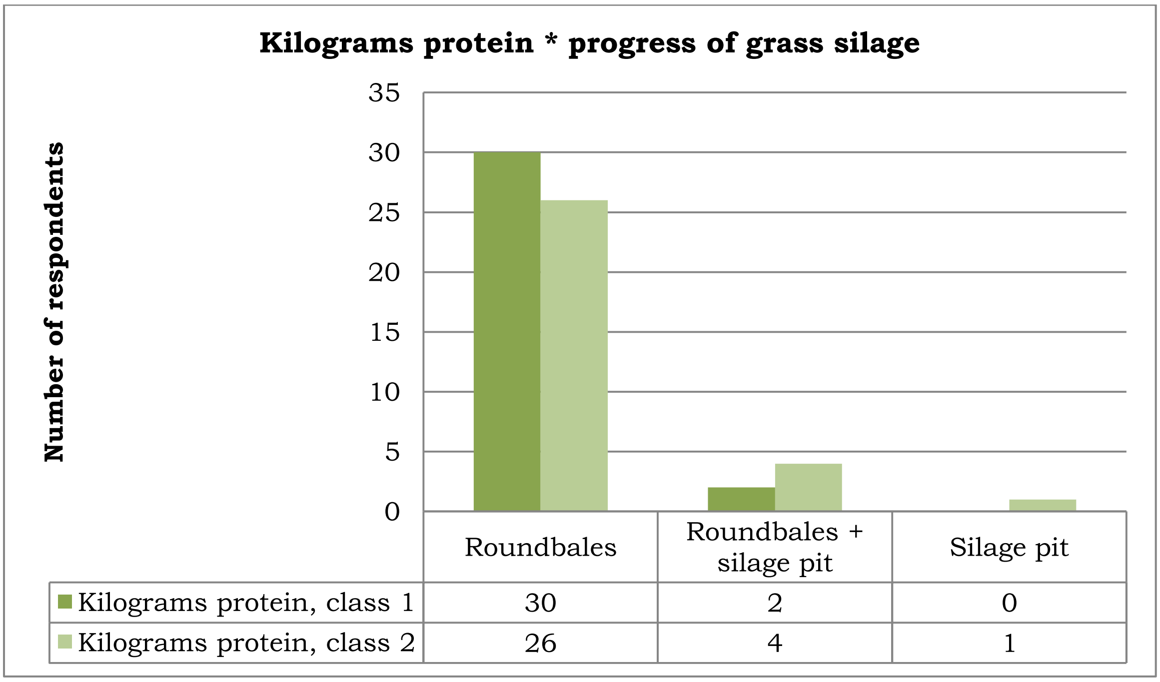


Figure 14; relation between kilograms protein and progress of grass silage

4.2.2. Use of silage additives

This paragraph contains the relation between the milk production and use/no use of silage additives.

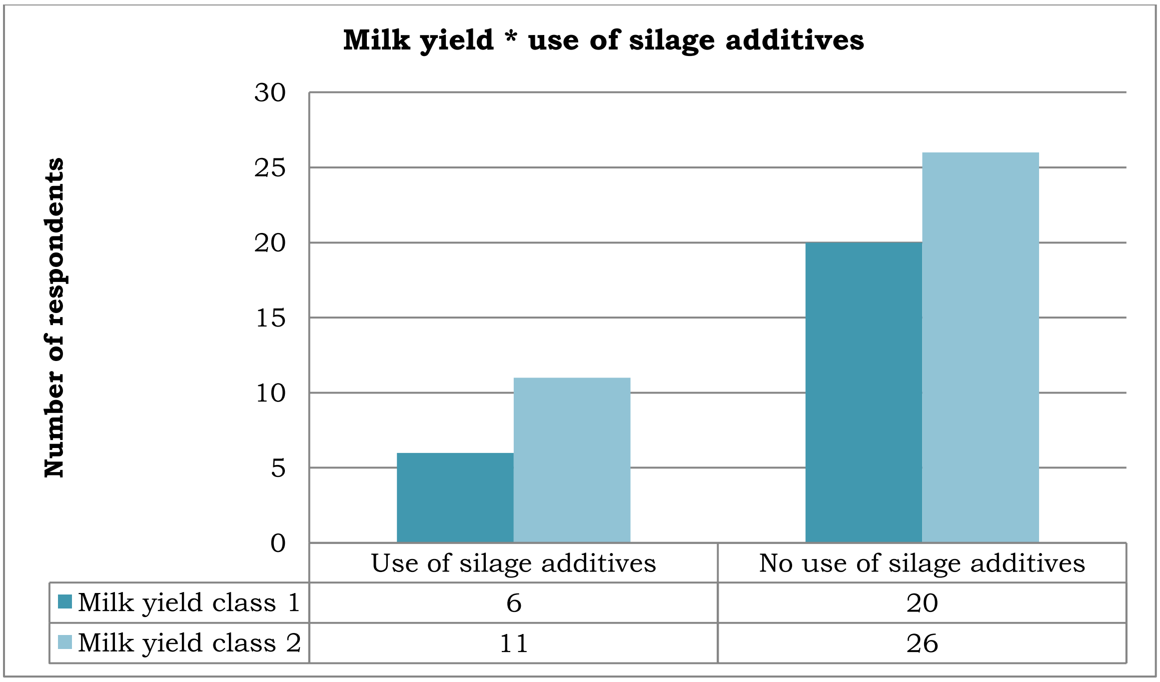


Figure 15; Relation between milk yield and use/ no use of silage additives

The figure above (figure 15) shows the relation between the milk yield and the use / no use of silage additives. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The use of silage additives is divided into two groups; Use of silage additives and No use of silage additives.

The level of statistical significance of this relation between milk yield and use / no use of silage additives is 0,386. This means this relation is not significant enough to be reliable.

The figure below (figure 16) shows the relation between the fat percent and the use / no use of silage additives. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Fat percent class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The use of silage additives is divided into two groups; Use of silage additives and No use of silage additives

The level of statistical significance of this relation between fat percent and use/ no use of silage additives is 0,304 (1-sided) and 0,549 (2-sided). This means the relation is not significant enough to be reliable.

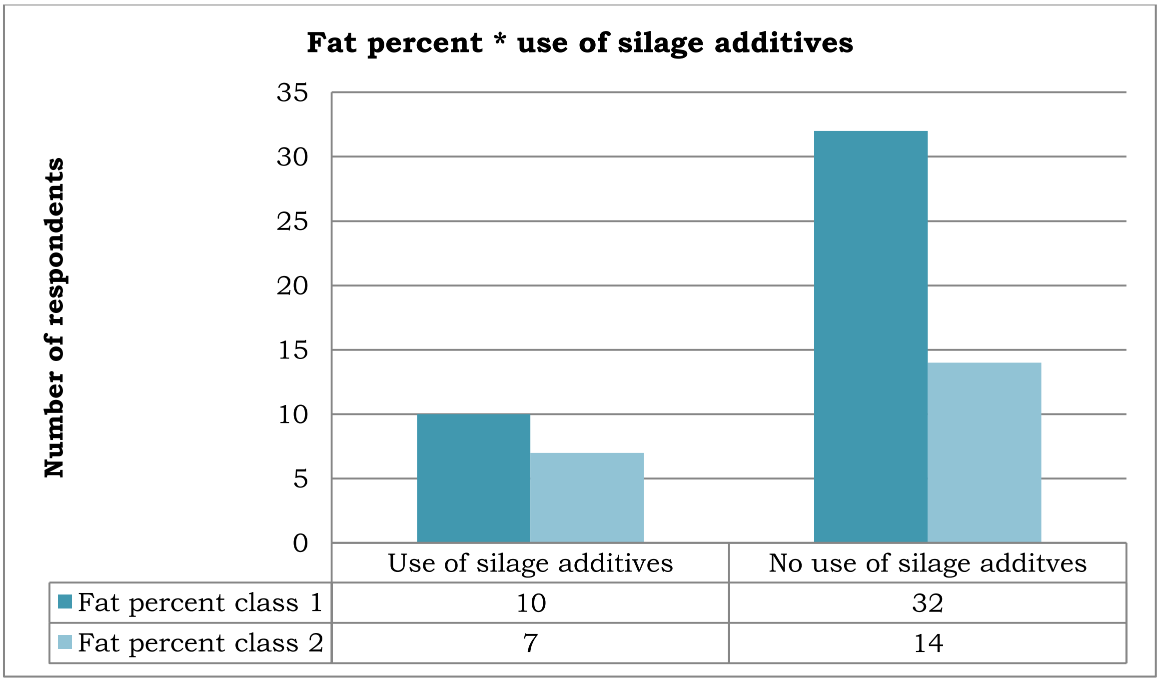


Figure 16; Relation between fat percent and use / no use of silage additives

The figure below (figure 17) shows the relation between the protein percent and the use / no use of silage additives. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The use of silage additives is divided into two groups; Use of silage additives and No use of silage additives

The level of statistical significance of this relation between protein percent and use/ no use of silage additives is 0,350. This means the relation is not significant enough to be reliable.

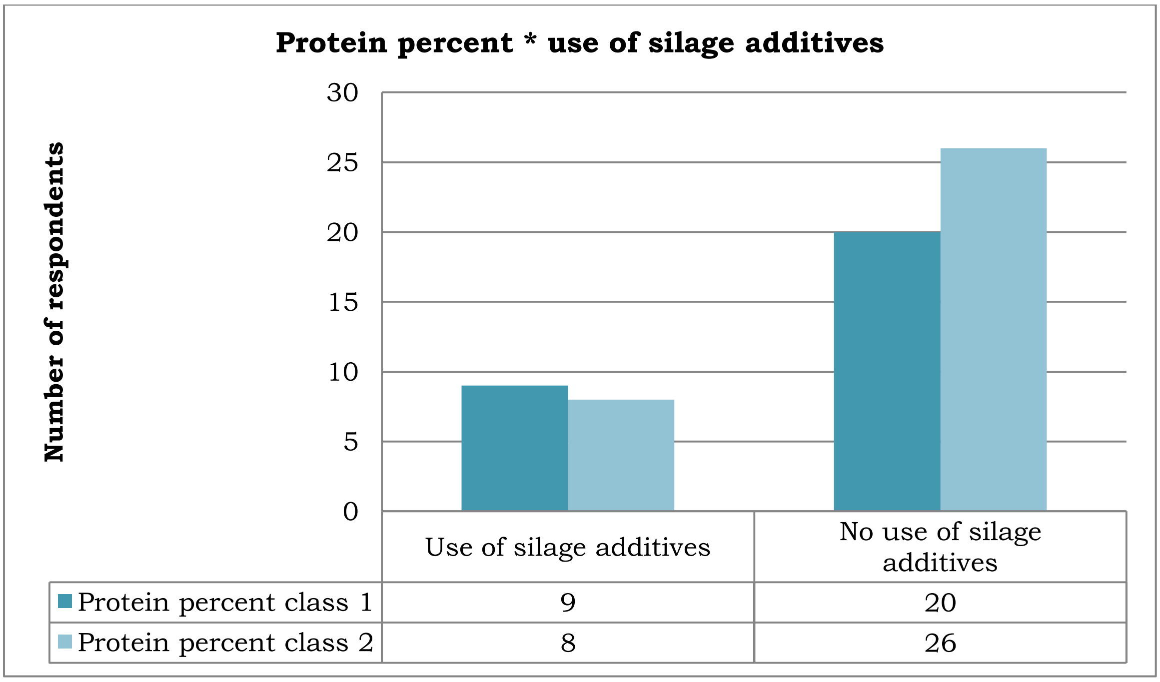


Figure 17; Relation between protein percent and use / no use of silage additives

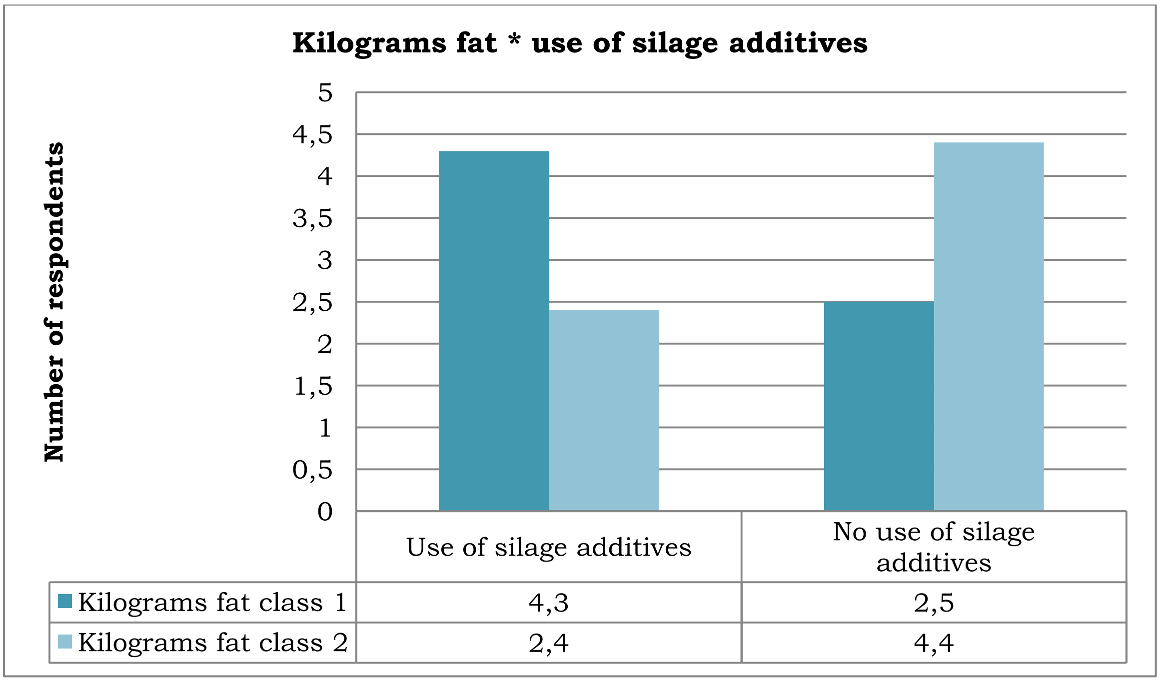


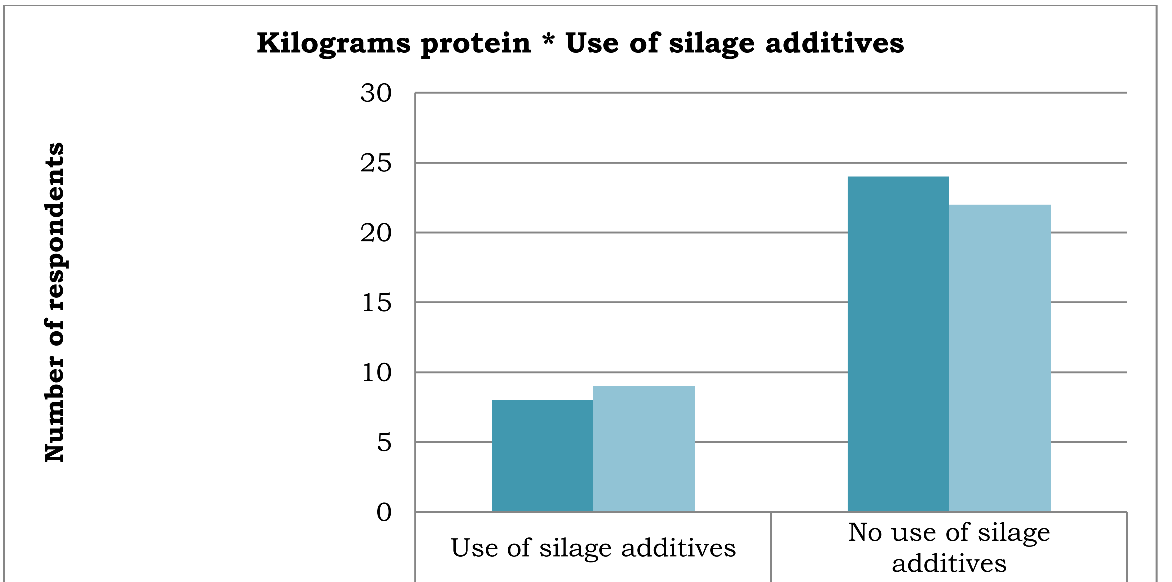
Figure 18; Relation between produced kilograms of fat and use / no use of silage additives

The figure above (figure 18) shows the relation between the produced kilograms of milk fat and the use/ no use of silage additives. The kilograms fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The use of silage additives is divided into two groups; Use of silage additives and No use of silage additives

The level of statistical significance of this relation between kilograms fat and use/ no use of silage additives is 0,343. This means the relation is not significant enough to be reliable.

The figure below (figure 19) shows the relation between the produced kilograms of milk protein and the use / no use of silage additives. The kilograms protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The use of silage additives is divided into two groups; Use of silage additives and No use of silage additives

The level of statistical significance of this relation between kilograms protein and use/ no use of silage additives is 0,350. This means the relation is not significant enough to be reliable.



	Use of silage additives	No use of silage additives
Kilograms protein class 1	8	24
Kilograms protein class 2	9	22

Figure 19; Relation between produced kilograms of protein and use / no use of silage additives

4.3. Influence amount of compound feed on the production of Icelandic dairy farms

This section shows different graphs to present the cohesion between amount of compound feed and the milk production on Icelandic dairy farms.

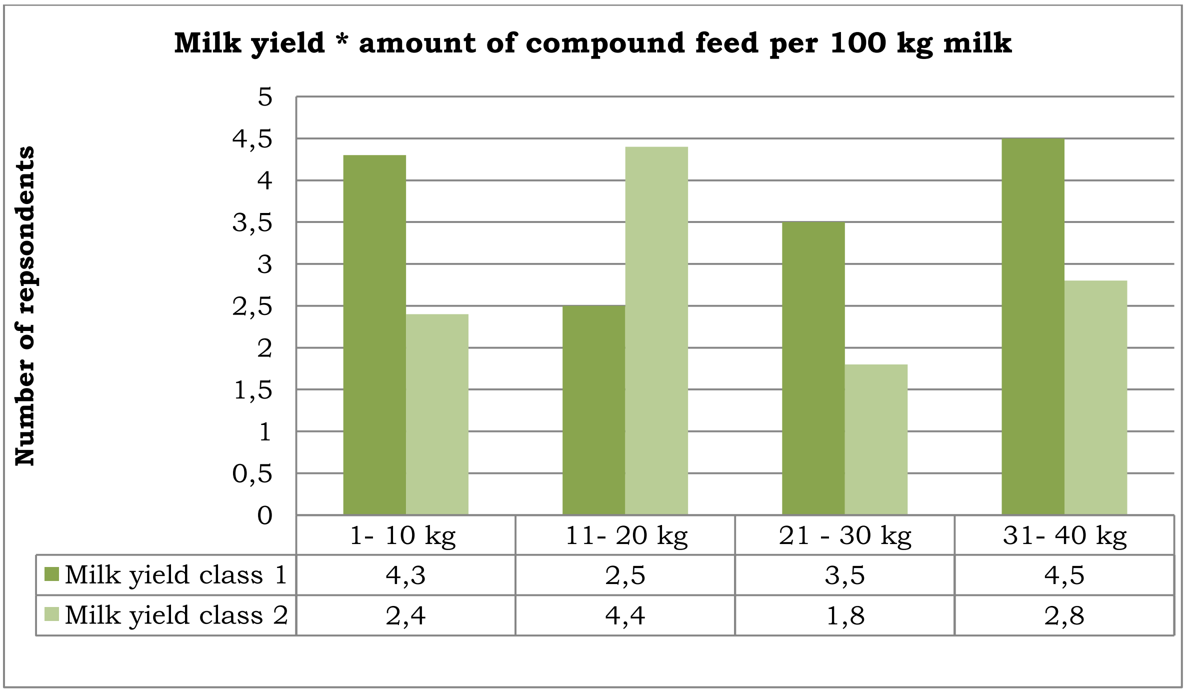


Figure 20; Relation between milk yield and amount of compound feed per 100 kilograms of milk.

The figure above (figure 20) shows the relation between the milk yield and amount of compound feed per 100 kg milk. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The amount of compound feed per 100 kg of milk is divided into four groups; 1- 10 kg, 11- 20 kg, 21- 30 kg and 31- 40 kg.

The level of statistical significance of this relation between milk yield and amount of compound feed is 0,330. This means the relation is not significant enough to be reliable.

The figure below (figure 21) shows the relation between the fat percent and the amount of compound feed per 100 kg milk. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Fat percent class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The amount of compound feed per 100 kg of milk is divided into four groups; 1- 10 kg, 11- 20 kg, 21- 30 kg and 31- 40 kg.

The level of statistical significance of this relation between the fat percent and amount of compound feed is 0,572. This means the relation is not significant enough to be reliable.

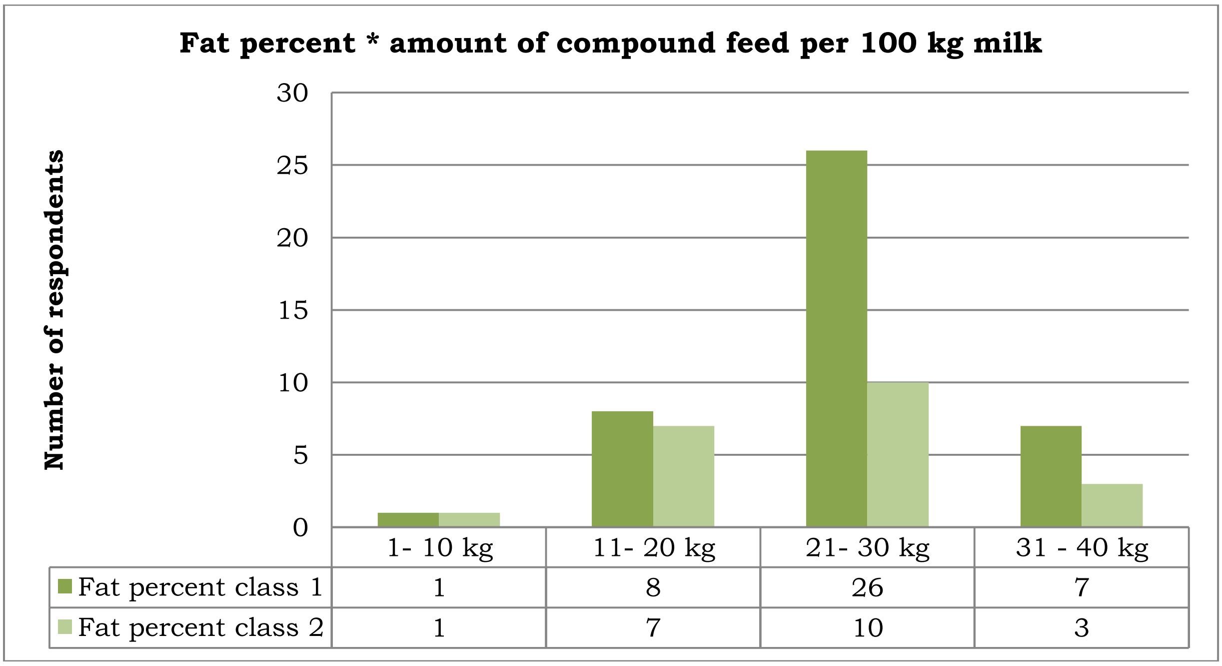
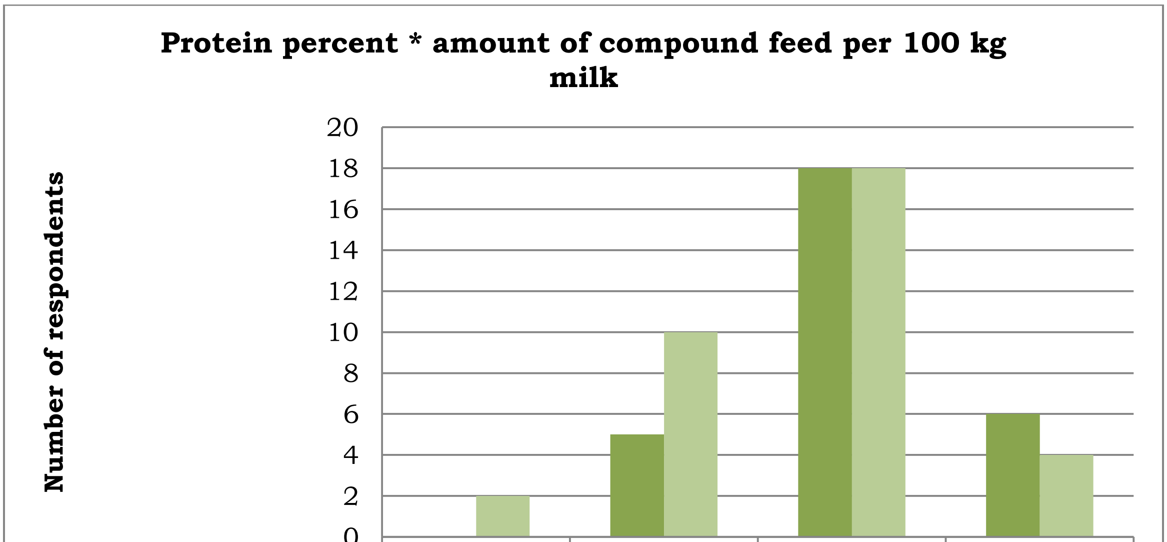


Figure 21; Relation between fat percent and amount of compound feed per 100 kilograms of milk

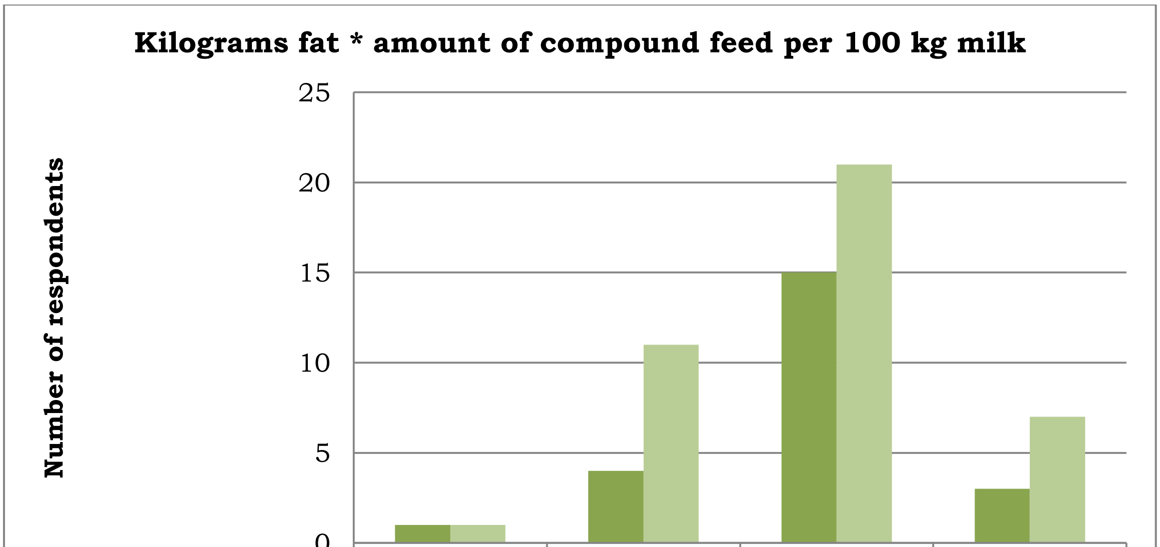
The figure below (figure 22) shows the relation between the protein percent and the amount of compound feed per 100 kg milk. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The amount of compound feed per 100 kg of milk is divided into four groups; 1- 10 kg, 11- 20 kg, 21- 30 kg and 31- 40 kg.

The level of statistical significance of this relation between the protein percent and amount of compound feed is 0,297. This means the relation is not significant enough to be reliable.



	1- 10 kg	11- 20 kg	21- 30 kg	31- 40 kg
Protein percent class 1	0	5	18	6
Protein percent class 2	2	10	18	4

Figure 22; Relation between protein percent and amount of compound feed per 100 kilograms of milk



	1- 10 kg	11- 20 kg	21- 30 kg	31 -40 kg
kilograms fat class 1	1	4	15	3
kilogram fat class 2	1	11	21	7

Figure 23; Relation between produced kilograms of fat and amount of compound feed per 100 kilograms of milk

The figure above (figure 23) shows the relation between the produced kilograms of milk fat and the amount of compound feed per 100 kilograms of milk. The kilograms milk fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The amount of compound feed per 100 kg of milk is divided into four groups; 1- 10 kg, 11- 20 kg, 21- 30 kg and 31- 40 kg.

The level of statistical significance of this relation between kilograms fat and amount of compound feed is 0,710. This means the relation is not significant enough to be reliable.

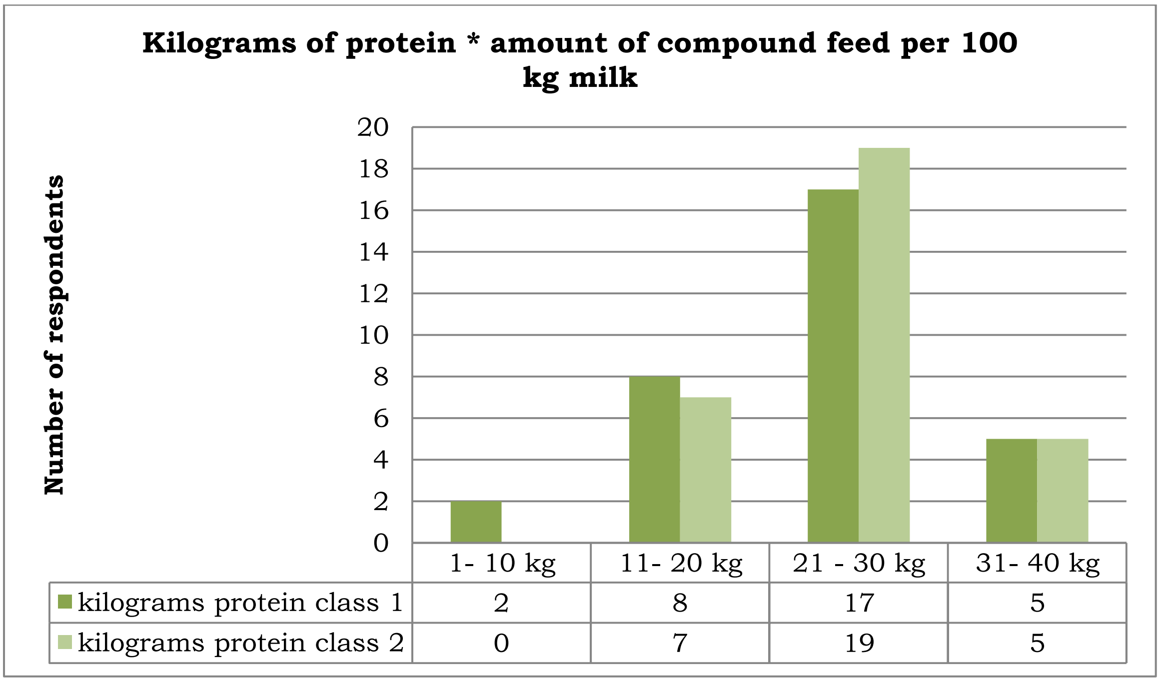


Figure 24; Relation between produced kilograms of protein and amount of compound feed per 100 kilograms of milk

The figure above (figure 24) shows the relation between the produced kilograms of milk protein and the amount of compound feed per 100 kilograms of milk. The kilograms protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The amount of compound feed per 100 kg of milk is divided into four groups; 1- 10 kg, 11- 20 kg, 21- 30 kg and 31- 40 kg.

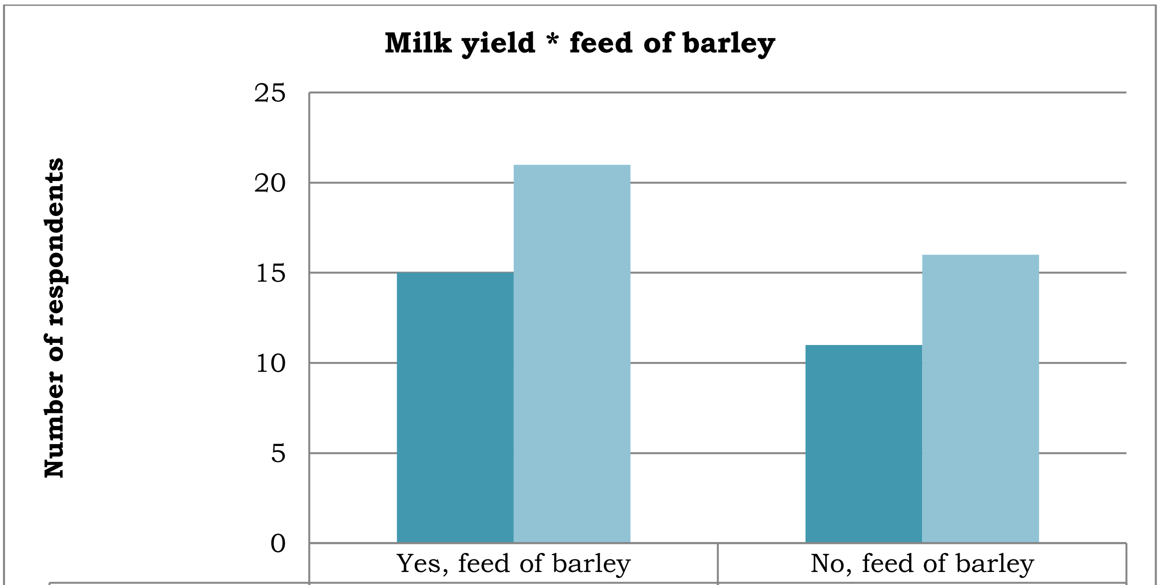
The level of statistical significance of this relation between kilograms protein and amount of compound feed is 0,539. This means the relation is not significant enough to be reliable.

4.4. Influence of barley on the production of Icelandic dairy farms

This section shows different graphs to present the cohesion between amount of compound feed and the milk production on Icelandic dairy farms.

4.4.1. Use of barley as feed

This paragraph contains the relation between the milk production and use/no use of barley as feed.

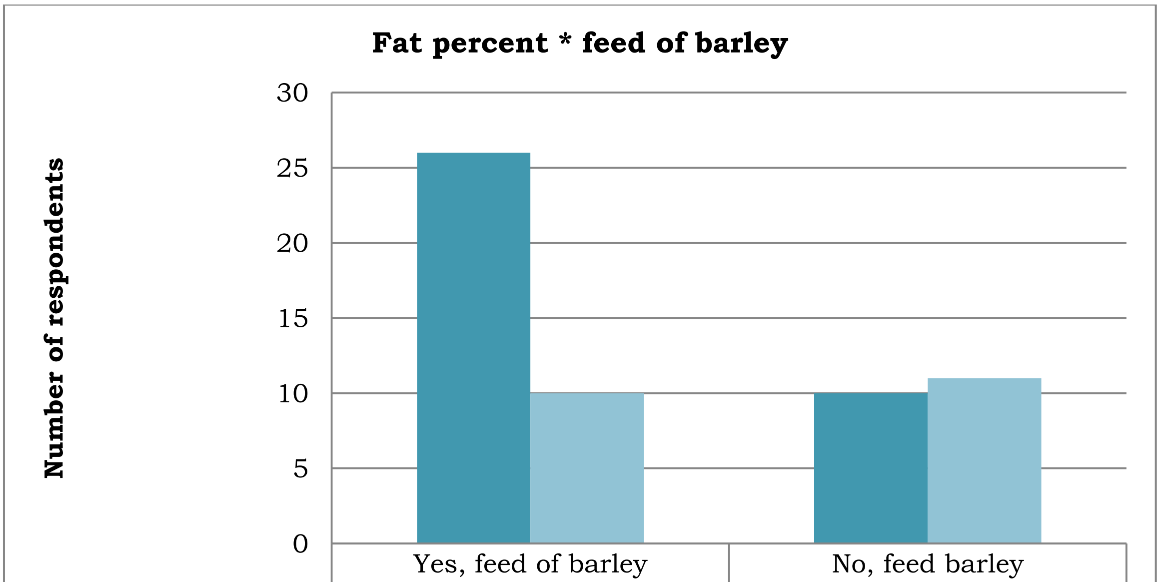


	Yes, feed of barley	No, feed of barley
Milk yield class 1	15	11
Milk yield class 2	21	16

Figure 25; Relation between milk yield and feed / no feed of barley

The figure above (figure 25) shows the relation between the milk yield and the use/ no use of barley. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The barley is divided into two groups; yes, feed of barley and no feed of barley.

The level of statistical significance of this relation between milk yield and use/ no use of barley is 0,574. This allows the relationship is not significant enough to be reliable.



	Yes, feed of barley	No, feed barley
Fat percent class 1	26	10
Fat percent class 2	10	11

Figure 26; Relation between fat percent and feed/ no feed of barley

The figure above (figure 26) shows the relation between the fat percent and the use/ no use of barley. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Fat percent class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The barley is divided into two groups; yes, feed of barley and no feed of barley.

The level of statistical significance of this relation fat percent and use/ no use of barley 0,209. This means the relation is not significant enough to be reliable.

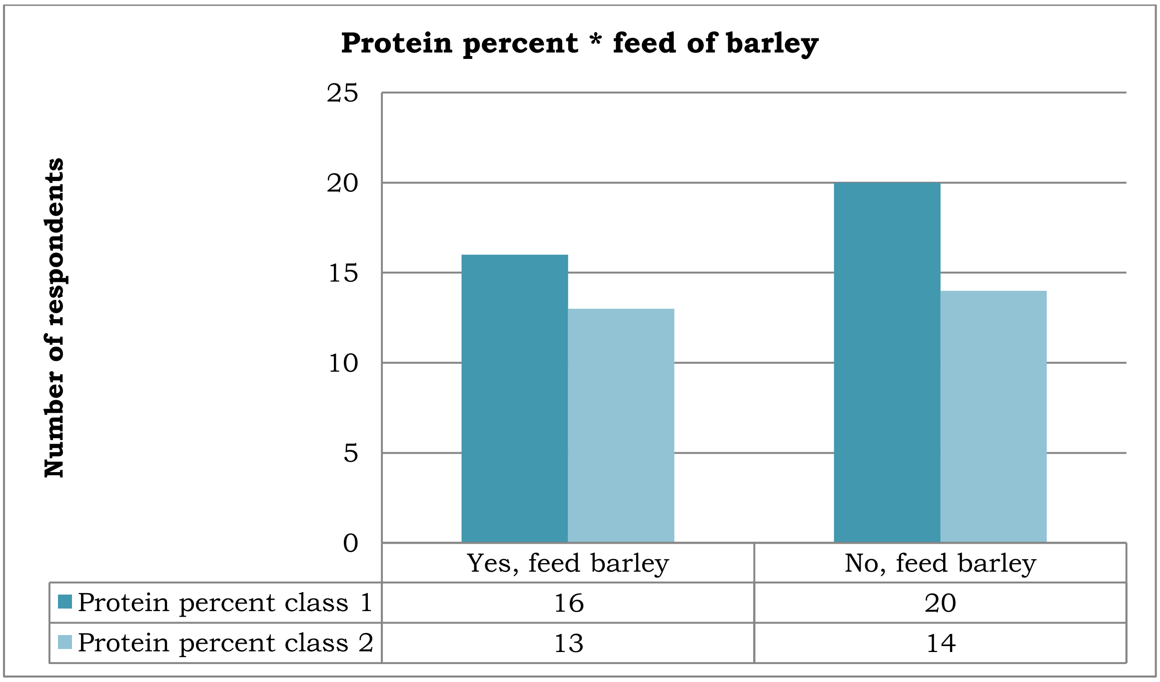
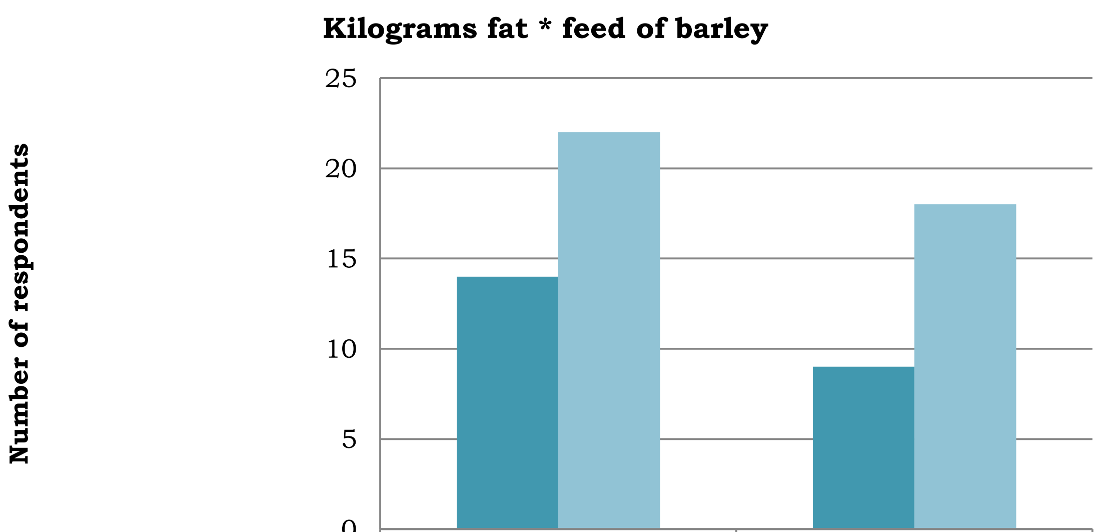


Figure 27; Relation between protein percent and feed / no feed of barley

The figure above (figure 27) shows the relation between the protein percent and the use/ no use of barley. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The barley is divided into two groups; yes, feed of barley and no feed of barley.

The level of statistical significance of this relation between protein percent and use/ no use of barley is 0,485. This means the relation is not significant enough to be reliable.



	Yes, feed of barley	No, feed of barley
Kilograms fat class 1	14	9
Kilograms protein class 2	22	18

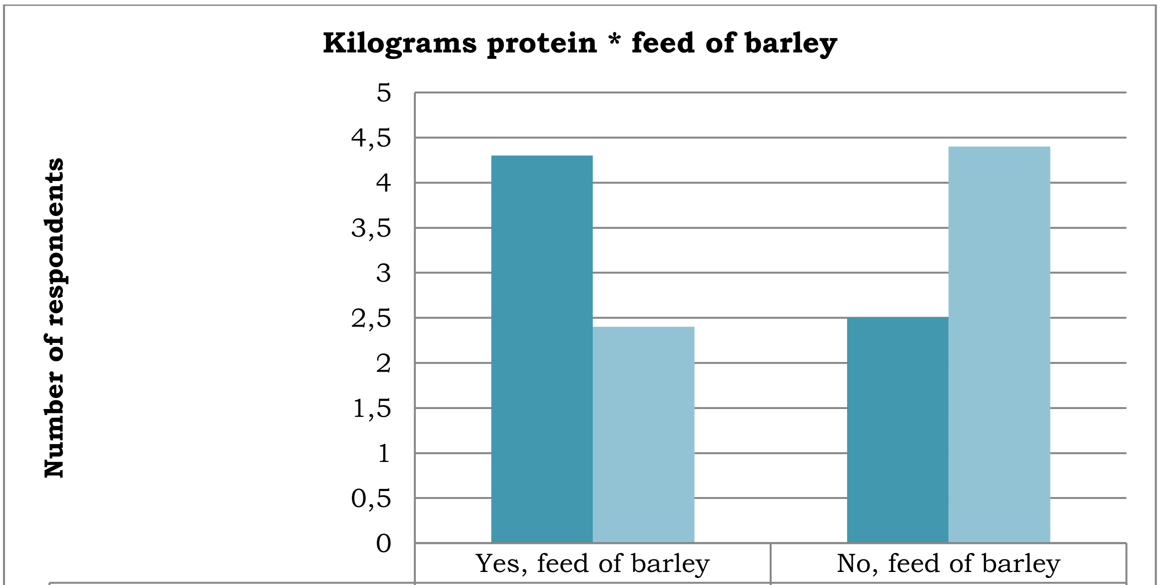
Figure 28; Relation between produced kilograms of fat and feed / no feed of barley

The figure above (figure 28) shows the relation between the produced kilograms of milk fat and the use/ no use of barley. The kilograms milk fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The barley is divided into two groups; yes, feed of barley and no feed of barley.

The level of statistical significance of this relation between kilograms fat and use/ no use of barley is 0,427. This means the relation is not significant enough to be reliable.

The figure below (figure 29) shows the relation between the produced kilograms of milk protein and the use/ no use of barley. The kilograms milk protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The barley is divided into two groups; yes, feed of barley and no feed of barley.

The level of statistical significance of this relation between kilograms protein and use/ no use of barley is 0,182. This means the relation is not significant enough to be reliable.

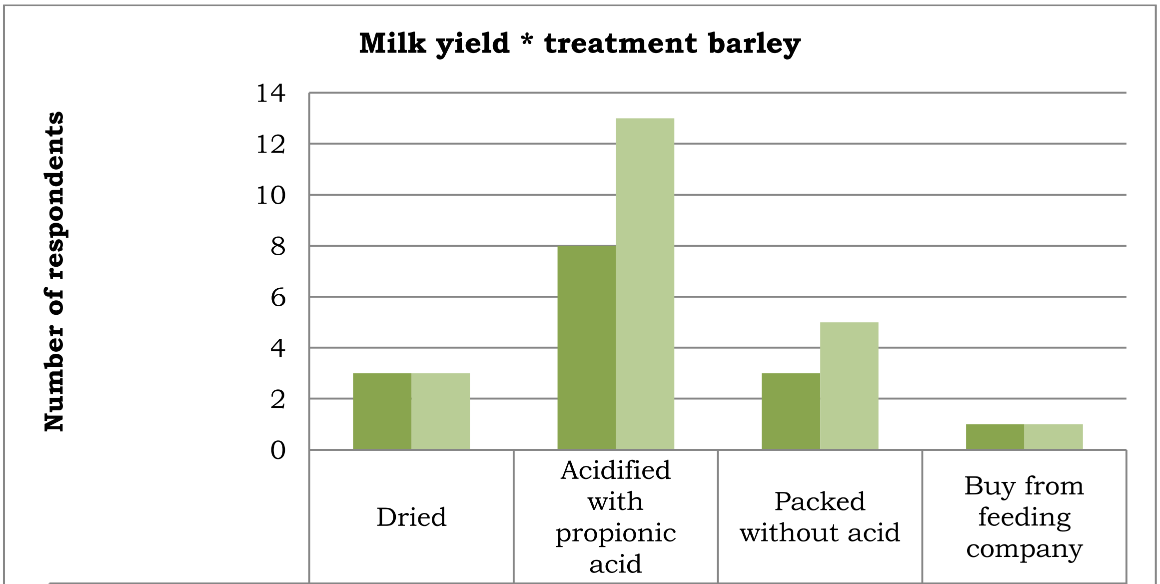


	Yes, feed of barley	No, feed of barley
Kilograms protein class 1	4,3	2,5
Kilograms protein class 2	2,4	4,4

Figure 29; Relation between produced kilograms of milk protein and feed/ no feed of barley

4.4.2. Treatment method of barley

This paragraph contains the relation between the milk production and treatment method. This section is only answered by the respondents who are feeding barley. 36 farmers were feeding barley in this test.

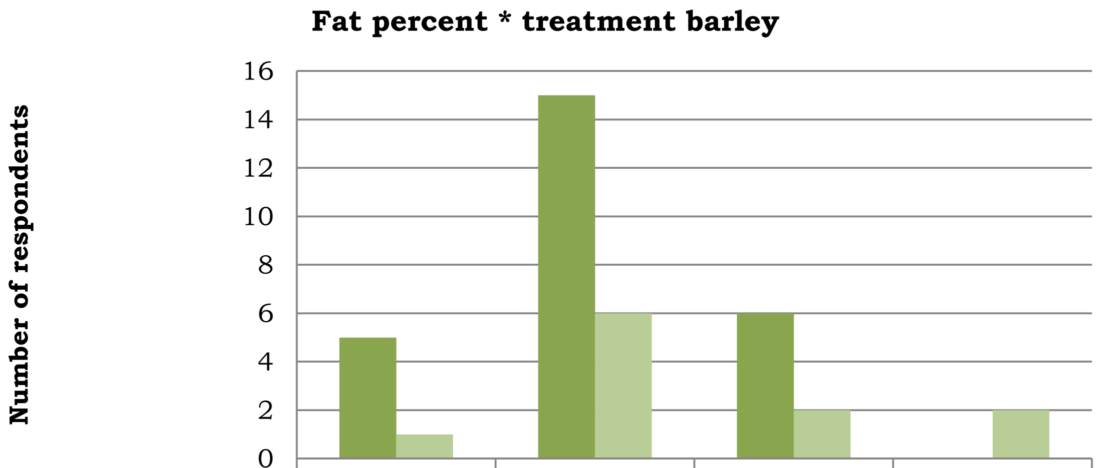


	Dried	Acidified with propionic acid	Packed without acid	Buy from feeding company
Milk yield class 1	3	8	3	1
Milk yield class 2	3	13	5	1

Figure 30; Relation between milk yield and treatment method of the barley

The figure above (figure 30) shows the relation between the milk yield and the treatment of barley. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The treatment of barley is divided into four groups; dried, acidified with propionic acid, packed without acid and Buy from feeding company.

The level of statistical significance of this relation between milk yield and the treatment of the barley is 0,983. This allows the relationship is not significant enough to be reliable.



	Dried	Acified with propionic acid	Packed without acid	Buy from feeding company
Fat percent class 1	5	15	6	0
Fat percent class 2	1	6	2	2

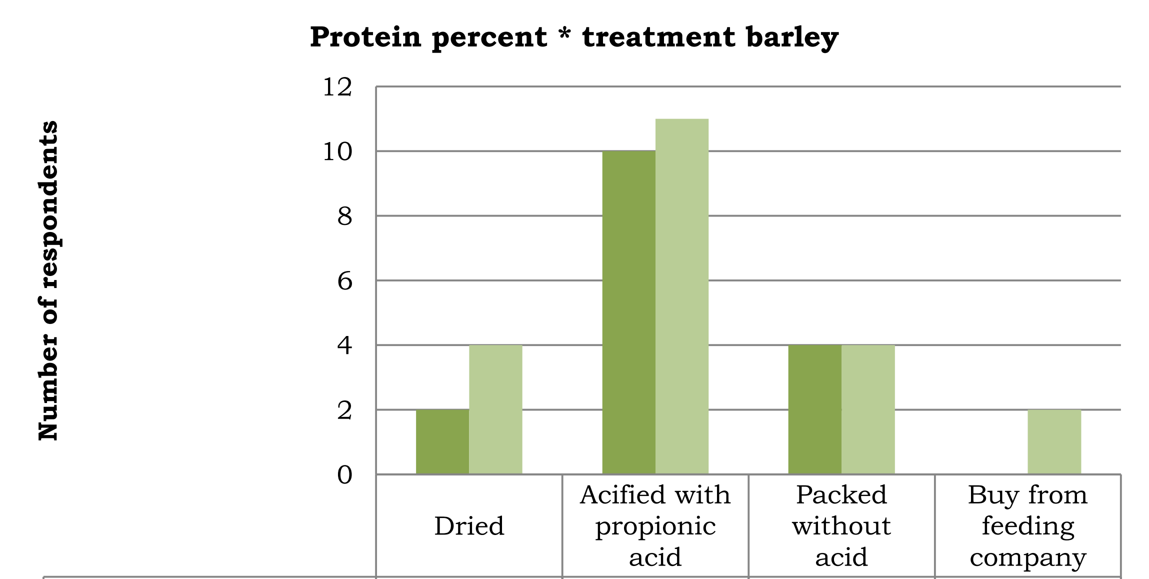
Figure 31; Relation between the fat percent and the treatment method of the barley

The figure above (figure 31) shows the relation between the fat percent and the treatment of barley. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Milk yield class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The treatment of barley is divided into four groups; dried, acidified with propionic acid, packed without acid and Buy from feeding company

The level of statistical significance of this relation between fat percent and treatment of barley is 0,238. This means the relation is not significant enough to be reliable.

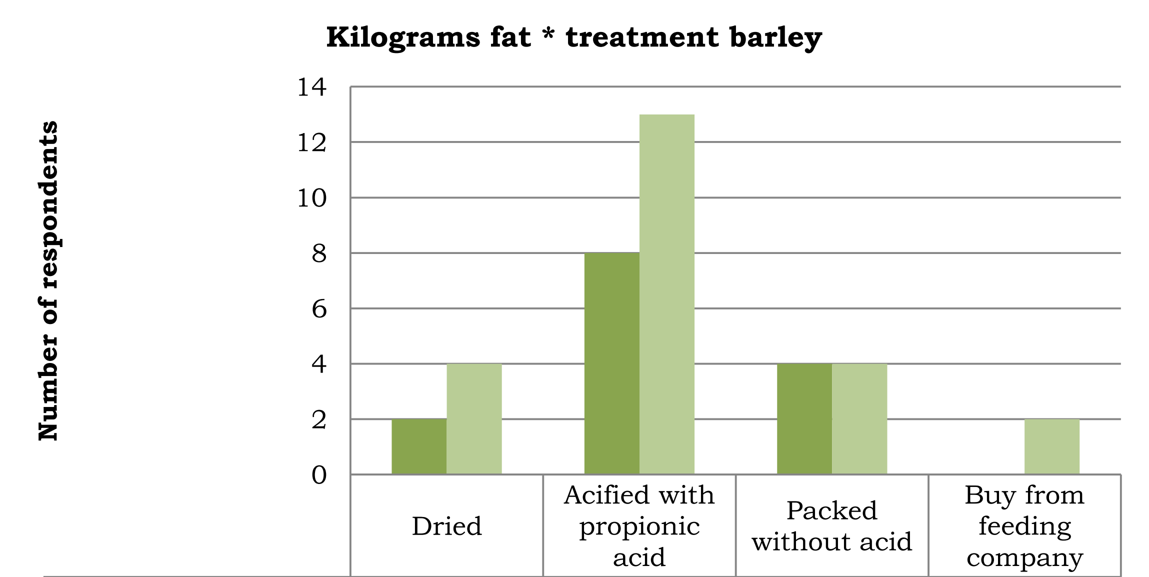
The figure below (figure 32) shows the relation between the protein percent and the treatment of barley. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The treatment of barley is divided into four groups; dried, acidified with propionic acid, packed without acid and Buy from feeding company

The level of statistical significance of this relation between protein percent and treatment of barley is 0,675. This means the relation is not significant enough to be reliable.



	Dried	Acified with propionic acid	Packed without acid	Buy from feeding company
Protein percent class 1	2	10	4	0
Protein percent class 2	4	11	4	2

Figure 32; Relation between protein percent and treatment method of the barley

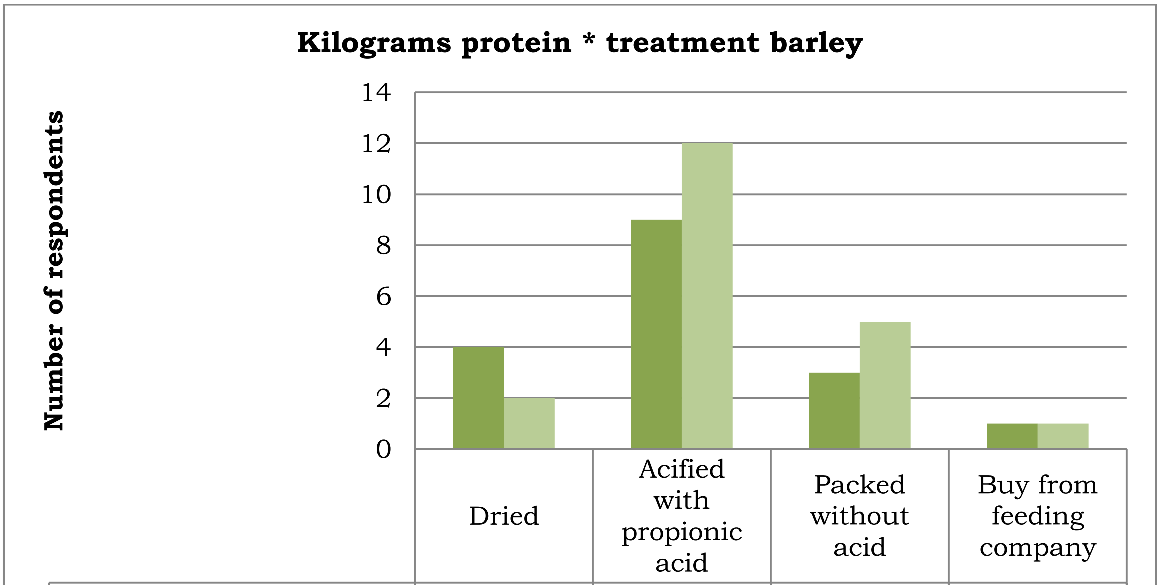


	Dried	Acified with propionic acid	Packed without acid	Buy from feeding company
Kilograms fat class 1	2	8	4	0
Kilograms fat class 2	4	13	4	2

Figure 33; Relation between produced kilograms of milk fat and treatment method of barley

The figure above (figure 33) shows the relation between produced kilograms of milk fat and the treatment of barley. The kilograms milk fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The treatment of barley is divided into four groups; dried, acidified with propionic acid, packed without acid and Buy from feeding company

The level of statistical significance of this relation between kilograms fat and treatment of barley is 0,760. This means the relation is not significant enough to be reliable.



	Dried	Acified with propionic acid	Packed without acid	Buy from feeding company
Kilograms protein class 1	4	9	3	1
Kilograms protein class 2	2	12	5	1

Figure 34; Relation between produced kilograms of protein and treatment method of barley

The figure above (figure 34) shows the relation between produced kilograms of milk fat and the treatment of barley. The kilograms milk protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein. Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The treatment of barley is divided into four groups; dried, acidified with propionic acid, packed without acid and Buy from feeding company.

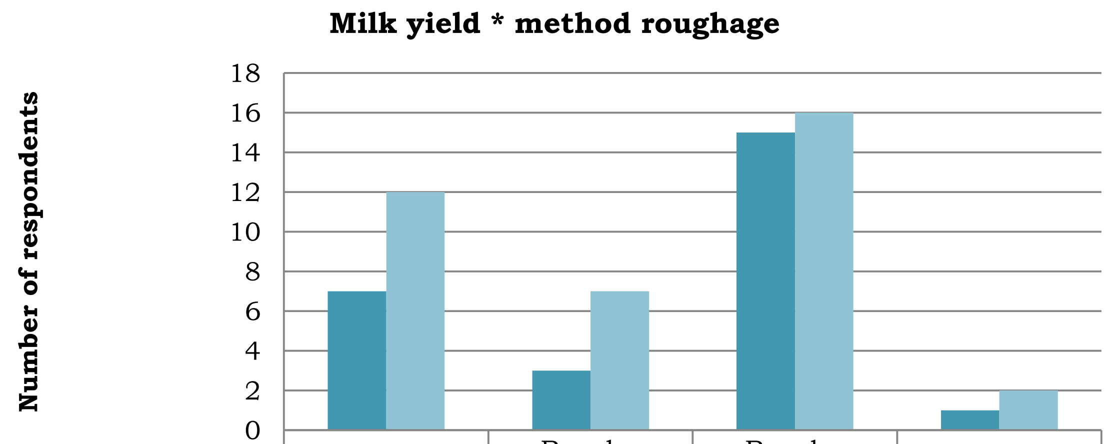
The level of statistical significance of this relation between kilograms protein and treatment of barley is 0,700. This means the relation is not significant enough to be reliable.

4.5. Influence of feeding method on the production of Icelandic dairy farms

This section shows different graphs to present the cohesion between amount of compound feed and the milk production on Icelandic dairy farms.

4.5.1. Roughage provision

This paragraph contains the relation between the milk production and the method of roughage provision.



	Weelink system	Regular feeding fence with mixing car	Regular feeding fence without mixingcar	Automatic feeding system
Milk yield class 1	7	3	15	1
Milk yield class 2	12	7	16	2

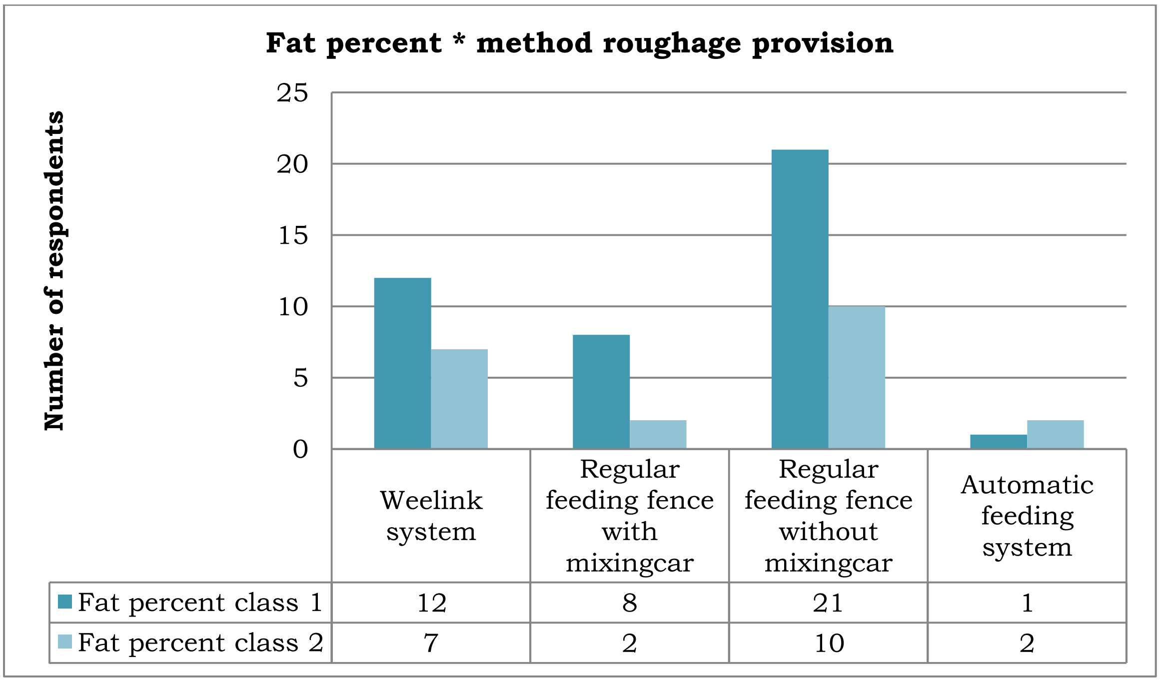
Figure 35; Relation between milk yield and roughage feeding method

The figure above (figure 35) shows the relation between the milk yield and the roughage feeding method. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The roughage feeding method is divided into four groups; Weelink system, Regular feeding fence with mixing car, Regular feeding fence without a mixing car and Automatic feeding system.

The level of statistical significance of this relation between milk yield and roughage feeding method is 0,705. This allows the relationship is not significant enough to be reliable.

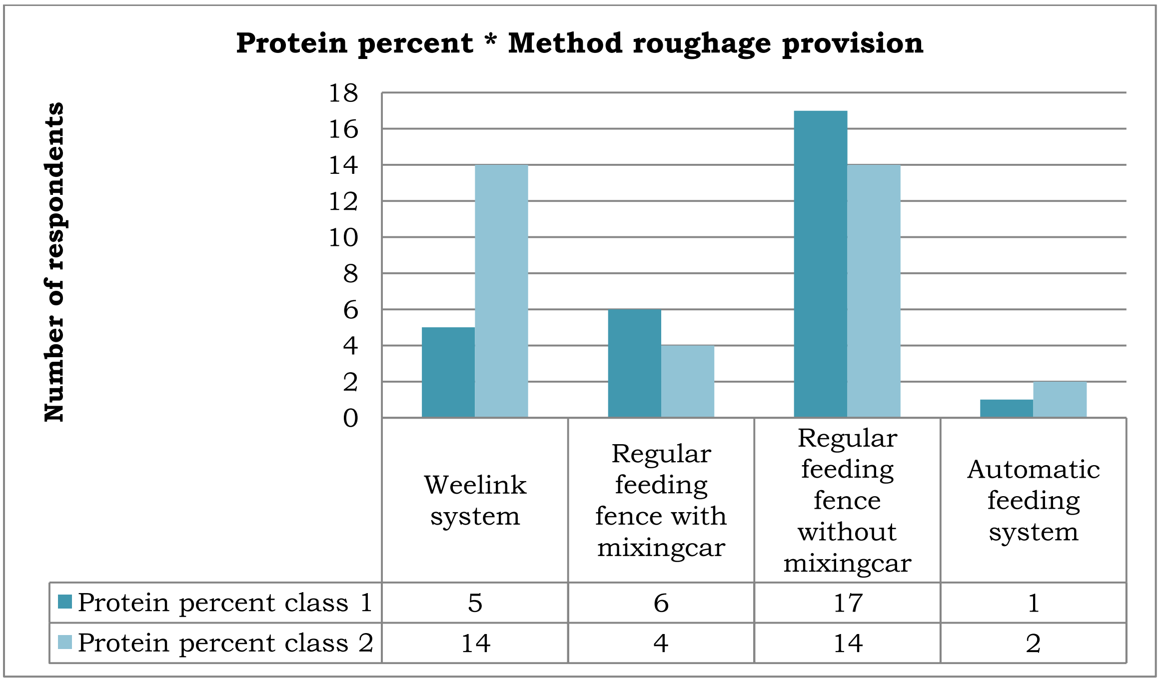
The figure below (figure 36) shows the relation between the fat percent and the roughage feeding method. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Milk yield class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The roughage feeding method is divided into four groups; Weelink system, Regular feeding fence with mixing car, Regular feeding fence without a mixing car and Automatic feeding system.

The level of statistical significance of this relation between fat percent and roughage feeding method is 0,490. This means the relation is not significant enough to be reliable.



	Weelink system	Regular feeding fence with mixingcar	Regular feeding fence without mixingcar	Automatic feeding system
Fat percent class 1	12	8	21	1
Fat percent class 2	7	2	10	2

Figure 36; Relation between fat percent and roughage feeding method



	Weelink system	Regular feeding fence with mixingcar	Regular feeding fence without mixingcar	Automatic feeding system
Protein percent class 1	5	6	17	1
Protein percent class 2	14	4	14	2

Figure 37; Relation between protein percent and roughage feeding method

The figure above (figure 37) shows the relation between the protein percent and the roughage feeding method. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The roughage feeding method is divided into four groups; Weelink system, Regular feeding fence with mixing car, Regular feeding fence without a mixing car and Automatic feeding system.

The level of statistical significance of this relation between protein percent and roughage feeding method is 0,179. This means the relation is not significant enough to be reliable.

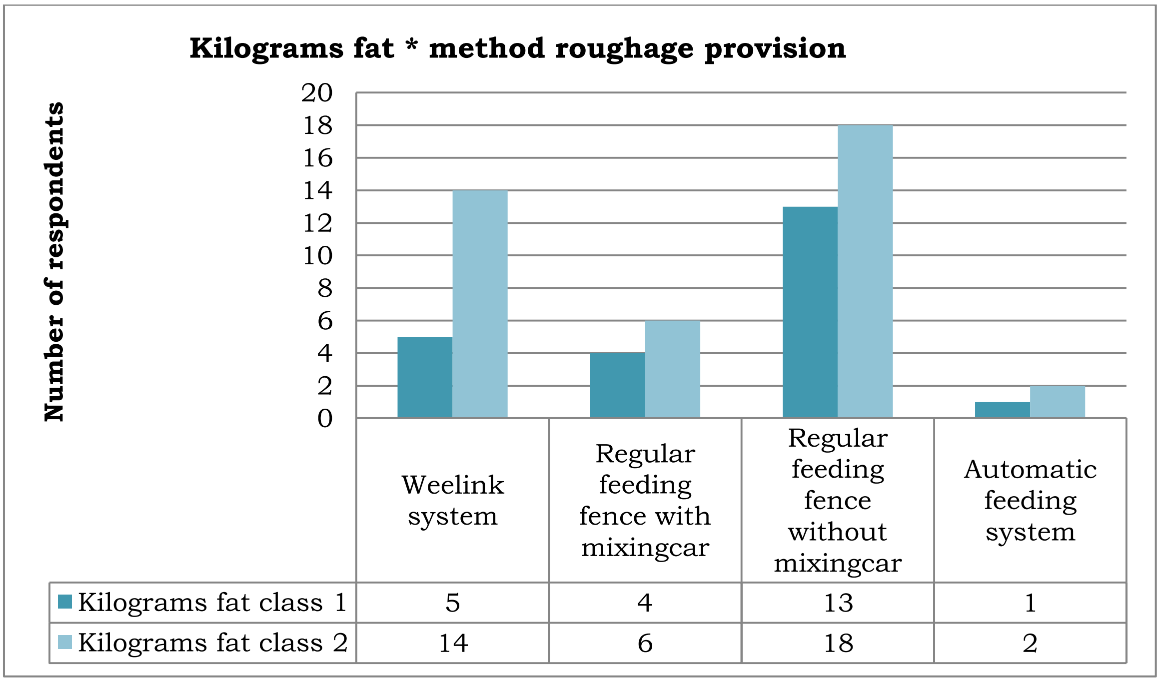


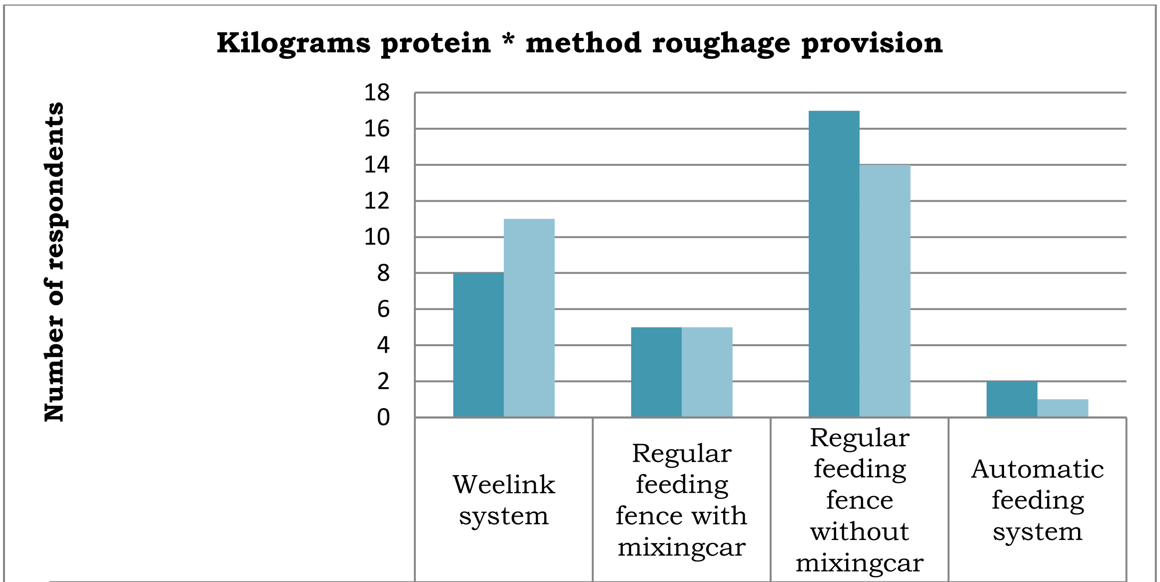
Figure 38; Relation between produced kilograms of fat and roughage feeding method

The figure above (figure 38) shows the relation between produced kilograms of milk fat and the roughage feeding method. The kilograms milk fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The roughage feeding method is divided into four groups; Weelink system, Regular feeding fence with mixing car, Regular feeding fence without a mixing car and Automatic feeding system.

The level of statistical significance of this relation between kilograms fat and roughage feeding method is 0,726. This means the relation is not significant enough to be reliable.

The figure below (figure 39) shows the relation between produced kilograms of milk protein and the roughage feeding method. The kilograms milk protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The roughage feeding method is divided into four groups; Weelink system, Regular feeding fence with mixing car, Regular feeding fence without a mixing car and Automatic feeding system.

The level of statistical significance of this relation between kilograms protein and roughage feeding method is 0,781. This means the relation is not significant enough to be reliable.



	Weelink system	Regular feeding fence with mixingcar	Regular feeding fence without mixingcar	Automatic feeding system
Kilograms protein class 1	8	5	17	2
Kilograms protein class 2	11	5	14	1

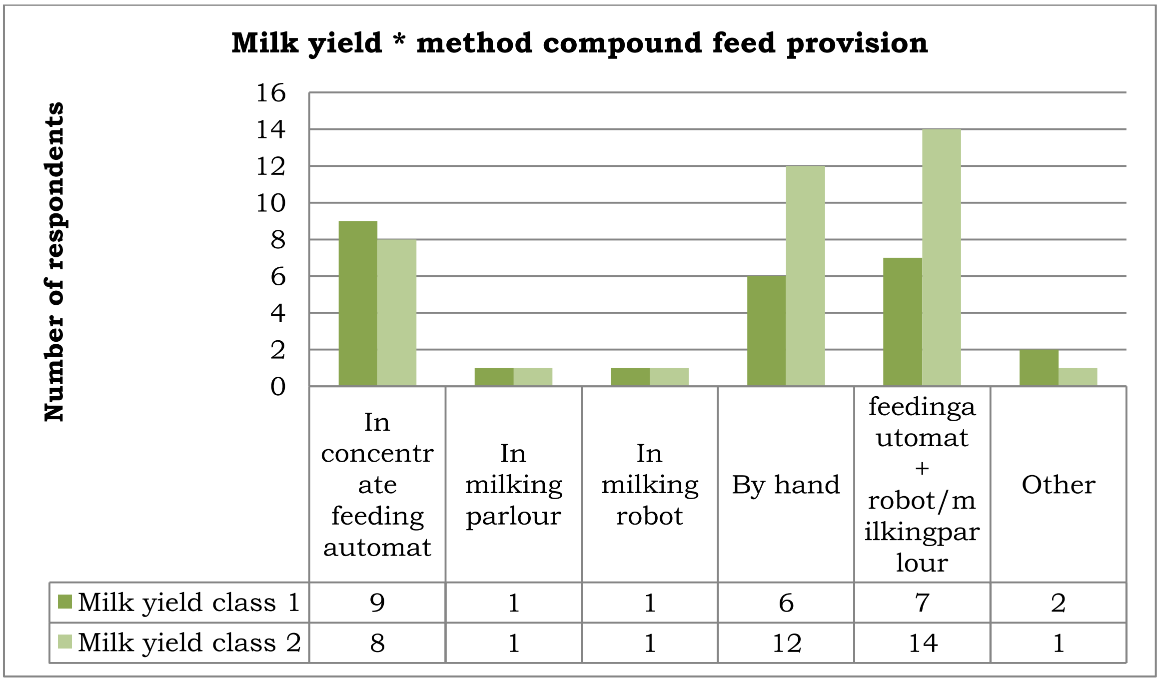
Figure 39; Relation between produced kilograms of protein and roughage feeding method

4.5.2. Compound feed provision

This paragraph contains the relation between the milk production and the method of compound feed provision.

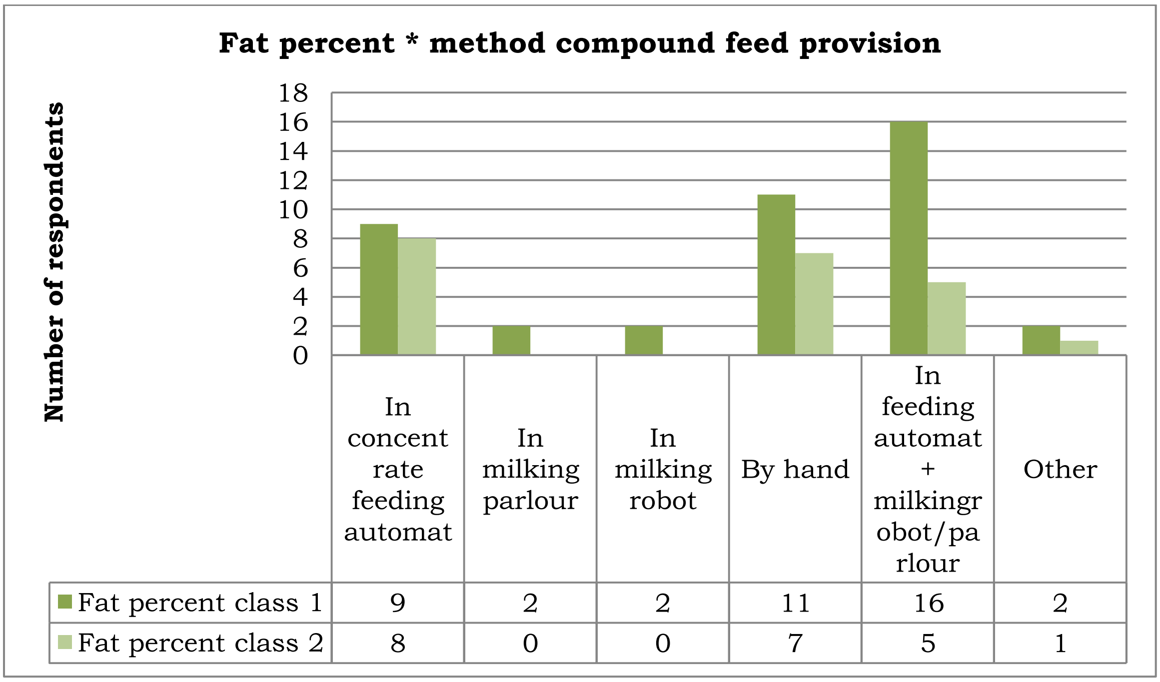
The figure below (figure 40) shows the relation between the milk yield and the method of compound feed provision. The milk yield is divided into two groups; Milk yield class 1 and Milk yield class 2. Milk yield class 1 consist a milk yield between 3500-5750 liters. Milk yield class 2 consist a milk yield between 5750- 8000 liters. The method of compound feed provision is divided into six groups; In concentrate feeding automat, In milking parlour, In milking robot, By hand, Feeding automat + robot/milking parlour and Other.

The level of statistical significance of this relation between milk yield and method of compound feed provision is 0,716. This allows the relationship is not significant enough to be reliable.



	In concentrate feeding automat	In milking parlour	In milking robot	By hand	feedingautomat + robot/milkingparlour	Other
Milk yield class 1	9	1	1	6	7	2
Milk yield class 2	8	1	1	12	14	1

Figure 40; Relation between milk yield and method of compound feed provision

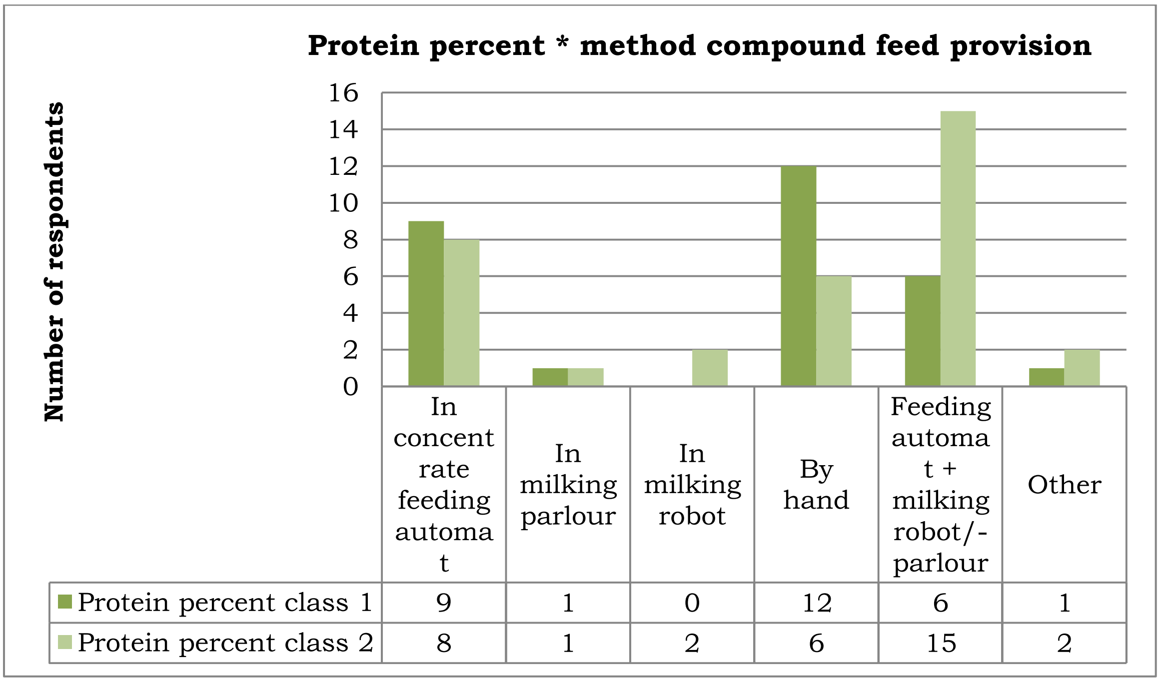


	In concentrate feeding automat	In milking parlour	In milking robot	By hand	In feeding automat + milkingrobot/parlour	Other
Fat percent class 1	9	2	2	11	16	2
Fat percent class 2	8	0	0	7	5	1

Figure 41; Relation between fat percent and method of compound feed provision

The figure above (figure 41) shows the relation between the fat percent and the method of compound feed provision. The fat percent is divided into two groups; Fat percent class 1 and Fat percent class 2. Milk yield class 1 consist a fat percent between 3,50 – 4,25 %. Fat percent class 2 consist a fat percent between 4,26 – 5,00 %. The method of compound feed provision is divided into six groups; In concentrate feeding automat, In milking parlour, In milking robot, By hand, Feeding automat + robot/milking parlour and Other.

The level of statistical significance of this relation between fat percent and method of compound feed provision is 0,473. This means the relation is not significant enough to be reliable.



	In concentrate feeding automat	In milking parlour	In milking robot	By hand	Feeding automat + milking robot/-parlour	Other
Protein percent class 1	9	1	0	12	6	1
Protein percent class 2	8	1	2	6	15	2

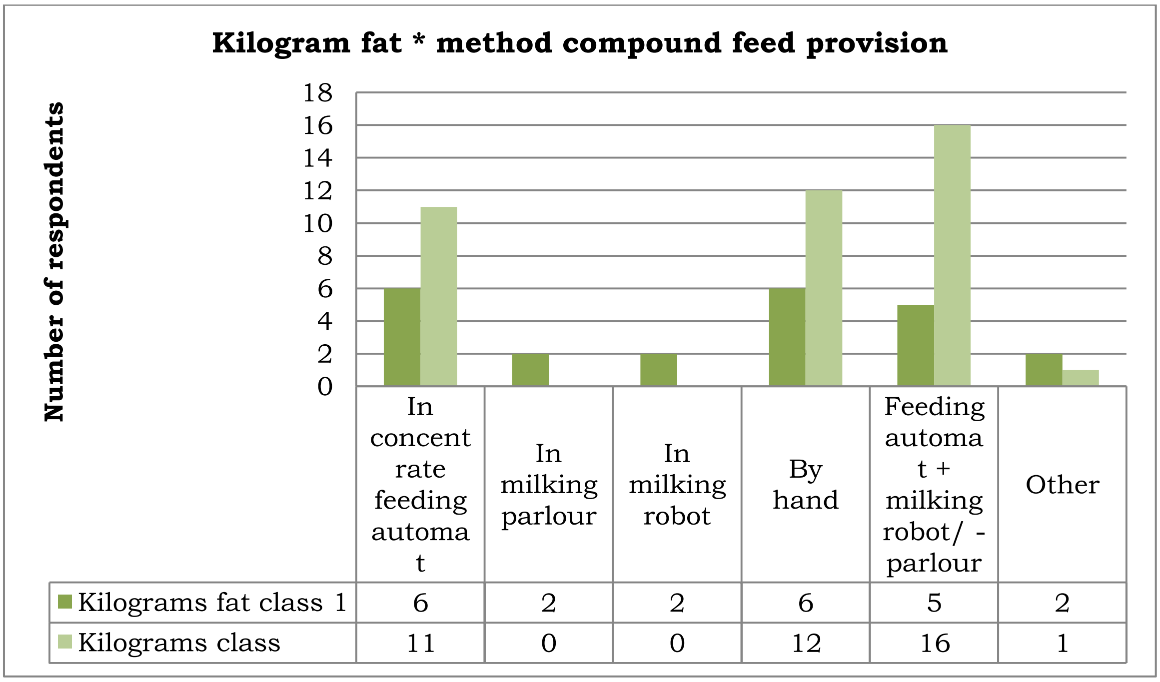
Figure 42; Relation between protein percent and method of compound feed provision

The figure above (figure 42) shows the relation between the protein percent and the method of compound feed provision. The protein percent is divided into two groups; Protein percent class 1 and Protein percent class 2. Protein percent class 1 consist a protein percent between 3,10 – 3,80 %. Protein percent class 2 consist a protein percent between 3,81 – 3,70 %. The method of compound feed provision is divided into six groups; In concentrate feeding automat, In milking parlour, In milking robot, By hand, Feeding automat + robot/milking parlour and Other.

The level of statistical significance of this relation between protein percent and method of compound feed provision is 0,162. This means the relation is not significant enough to be reliable.

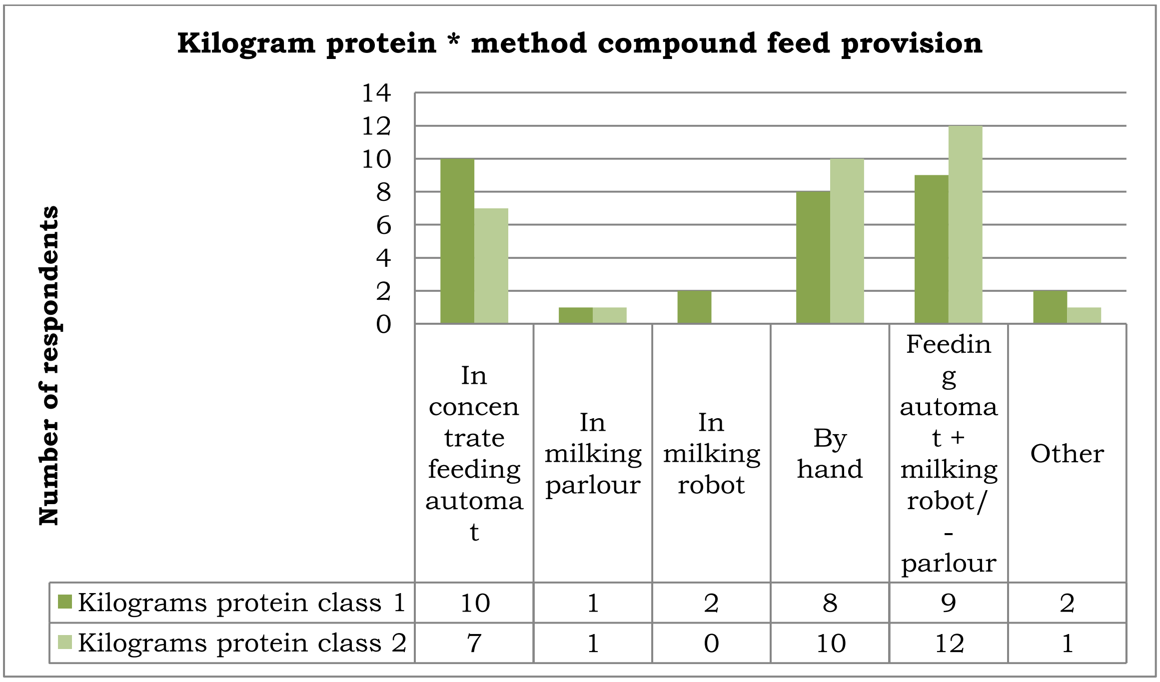
The figure below (figure 43) shows the relation between the produced kilograms of milk fat and the method of compound feed provision. The kilograms milk fat are divided into two groups; Kilograms fat class 1 and Kilograms fat class 2. Kilograms fat class 1 consist 150 – 233 kilograms of milk fat . Kilograms fat class 2 consist 234- 315 kilograms of milk fat. The method of compound feed provision is divided into six groups; In concentrate feeding automat, In milking parlour, In milking robot, By hand, Feeding automat + robot/milking parlour and Other.

The level of statistical significance of this relation between kilograms fat and method of compound feed provision is 0,085. This means the relation is not significant enough to be reliable. It has to be 0,05 to be reliable.



	In concentrate feeding automat	In milking parlour	In milking robot	By hand	Feeding automat + milking robot/ -parlour	Other
Kilograms fat class 1	6	2	2	6	5	2
Kilograms class	11	0	0	12	16	1

Figure 43; Relation between produced kilograms of fat and method of compound feed provision



	In concentrate feeding automat	In milking parlour	In milking robot	By hand	Feeding automat + milking robot/ -parlour	Other
Kilograms protein class 1	10	1	2	8	9	2
Kilograms protein class 2	7	1	0	10	12	1

Figure 44; Relation between produced kilograms of protein and method of compound feed provision

In the figure above (figure 44) the kilograms milk protein are divided into two groups; Kilograms protein class 1 and Kilograms protein class 2. Kilograms protein class 1 consist 125 – 197 kilograms of milk protein . Kilograms protein class 2 consist 198- 270 kilograms of milk protein. The method of compound feed provision is divided into six groups; In concentrate feeding automat, In milking parlour, In milking robot, By hand, Feeding automat + robot/milking parlour and Other.

The level of statistical significance of this relation between kilograms protein and method of compound feed provision is 0,624.

5. Discussion

This chapter provides a comparison of the literature and the results of the research. The discussion also includes aspects that have may have influenced the study. The different points of discussion of the research methods and results are described one by one.

- The method of silage grass conservation does not influence voluntary intake or the animal production, according to the found literature (Vrotniakiene V. et al, 2006). The results of this research hook up with the found literature. However, there were many more farmers with round bales than with silage pits during the research. This caused an imbalance in the crosstabs, which makes it hard to discover a relation between method of silage grass conservation and production.

- According to the found literature the characteristics of the grass silage can be positive affected by microbial inoculants. These inoculants had a favorable effect in terms of higher lactic acid concentration, a low pH and a significant increase in milk production (Muck, 2010). The results of this study do not match with the found literature. Several dairy farms were compared with each other in this study section to the effects of silage additives. The other management variables were not equal at these dairy farms, this may have influenced the results as well.

- According to a research of Lawrence et al. (2014) the total quantity of concentrate included in the diet have a significant effect on milk production. But high-concentrate diets can also cause sub acute ruminal acidosis by high productive ruminants and off feed periods can be noticed (Nocek, 1997 and Desnoyers et al., 2009). The results of this study do not match with the found literature . Also in this study section, several dairy farms were compared with each other. The other management variables were not equal at these dairy farms, this may have influenced the results as well.

- Experience during the farm visits; often a bad milk production was caused by incorrect milk robot settings were incorrect and/or an incorrect feeding table.

- A research of Boss et al., 1996 and Van Barneveld et al., 1990 shows the large variation between separate barley samples concerning the available energy and animal performance. The results of this study do not match with the found literature This research didn't ask for the barley variety, although the variety can have a big influence according to the literature.

- In the found literature positive effects were noticed in the milk composition, with a higher content of fat, a better milk energy efficiency and a lower milk urea nitrogen for cows fed the treated barley, with lactic acid and heat (Iqbal et al., 2012). The results of this study do not match with the found literature. Also in this study section, several dairy farms were compared with each other. The other management variables were not equal at these dairy farms, this may have influenced the results as well.

- The results of the research section to the effects of roughage provision methods were not significant. There were three farmers with an automatic feeding system in this research. This caused an imbalance in the crosstabs, which makes it hard to discover a relation between method of roughage provision and milk production.

- The results of the research section to the effects of compound feed provision were not significant. Also in this study section, several dairy farms were compared with each other. The other management variables were not equal at these dairy farms, this may have influenced the results as well.

- This research to opportunities for improved production for Icelandic dairy farmers was focused at the feeding management in Iceland. But other management factors like housing and milking system can have a big influence on the milk production as well.

6. Conclusion

This chapter provides answers to the questions that were asked at the beginning of the study. The conclusions are based on the results of this research.

Current situation of feeding management in Iceland:

Dairy farming in Iceland faces many special challenges. The dairy breed is not productive, most concentrate is imported, no protein rich crop is cultivated and short summers limit profitable grazing systems. Long distances between farms impose high transport costs and limit the possibilities for active cooperation between farms. Almost 95% of respondents are feeding round bales to their dairy cattle. Almost 20% of the respondents are using silage additives. 35% of respondents gives their cattle less than 21 kilograms of compound feed. Around 53% of the Icelandic dairy farmers provide their cows with barley. 61 % of the farmers who are feeding barley treated it with propionic acid. 66,07 % of the respondents are using a regular feeding fence without a mixing car.

Influence of grass silage on the milk content and milk production:

The method of silage grass conservation does not influence voluntary intake or the animal production, according to the found literature (Vrotniakiene V. et al, 2006). No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and progress of grass silage were found in the results of current study.

According to the found literature the characteristics of the grass silage can be positive affected by microbial inoculants. These inoculants had a favorable effect in terms of higher lactic acid concentration, a low pH and a significant increase in milk production (Muck, 2010). No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and use of silage additives were found in the results of the current study.

Influence of compound feed on the milk content an milk production:

According to a research of Lawrence et al. (2014) the total quantity of concentrate included in the diet have a significant effect on milk production. But high-concentrate diets can also cause sub acute ruminal acidosis by high productive ruminants and off feed periods can be noticed (Nocek, 1997 and Desnoyers et al., 2009). No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and amount of provided compound feed were found in the results of the current study.

The effect of three different concentrate buildup strategies in early lactation on production performance, health and fertility of high yielding dairy cows was addressed in an experiment at the Agri-food & Biosciences Institute. Adopting a slow or intermediate concentrate build-up strategy in early lactation improved forage intake in early lactation and had no detrimental effect on overall production performance (Law et al. 2012). This literature fits well with the experiences during the various farm visits. Often a bad milk production was caused by incorrect milk robot settings were incorrect and/or an incorrect feeding table.

Influence of barley on the milk content and milk production:

A research of Boss et al., 1996 and Van Barneveld et al., 1990 shows the large variation between separate barley samples concerning the available energy and animal performance. No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and use/ no use of barley were found in the results of the current study.

In the found literature positive effects were noticed in the milk composition, with a higher content of fat, a better milk energy efficiency and a lower milk urea nitrogen for cows fed the treated barley, with lactic acid and heat (Iqbal et al., 2012). No significant associations were found in on dairy farms with treated barley.

Influence of feeding methods on the milk content and milk production:

A feed fence with the right height for the cattle, gives them the opportunity to eat unobstructed. A too low a feed fence causes humps on the withers, in particular in large animals (Gezondheidsdienst voor Dieren, 2012). The advantage for the Weelink system is the little labor for feeding the cows. A disadvantage is that the feed is not fresh at the end of the day and the cows can select in the feed. A mixing wagon and an automatic feeding system provides more efficient use of minerals out of roughage and concentrates (Hollander, o.fl., 2005). No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and method of roughage provision were found in the current study.

Farmers can easily give each individual cow the concentrate in a tie stall barn. In the free stall barn it is more difficult to give the cows the right amount of compound feed (Hollander, o.fl., 2005). Advantage of a automatic feeding automat is that individual feeding and concentrate feeding are spread over the day. In addition, this system can save labor for the farmer, only the setting and checking the computer displays provides work (Hollander, o.fl., 2005). No significant relations between milk yield, milk fat percent, milk protein percent, kilograms fat, kilograms protein and method of concentrate provision were found in the current study.

7. Recommendations

In the following section, recommendations for future management and research will be made, based on the results of this research.

7.1. Recommendations for improved production

The results from the study were not significant enough to be considered as reliable. Therefore the results are not fully consistent with the found literature. However, the literature can be considered as highly reliable.

- *Both baling and clamping are suitable methods for ensiling grass.* The fermentation quality of either trench or big bale silages is good. Both can have a high nutritive value. Method of conservation does not influence voluntary intake or the animal production (Vrotniakiene V. et al, 2006).

- *Use of silage additives can improve the production on Icelandic dairy farms.* According to the found literature the characteristics of the grass silage can be positive affected by microbial inoculants. These inoculants had a favorable effect in terms of higher lactic acid concentration, a low pH and a significant increase in milk production (Muck, 2010).

- *A higher quantity of fed concentrate improves the production on Icelandic dairy farms.* According to a research of Lawrence et al. (2014) the total quantity of concentrate included in the diet have a significant effect on milk production.

- *A correct concentrate buildup improves the production on Icelandic dairy farms.* The effect of three different concentrate buildup strategies in early lactation on production performance, health and fertility of high yielding dairy cows was addressed in an experiment at the Agri-food & Biosciences Institute (Law et al. 2012).

- *Knowledge of differences between barley can help farmers select and feed the most suitable varieties that improves production without a negative effect on the rumen health.* A research of Boss et al., 1996 and Van Barneveld et al., 1990 shows the large variation between separate barley samples concerning the available energy and animal performance, according to the found literature.

- *Treated barley, with lactic acid and heat can improve the production of Icelandic dairy farmers.* In the found literature positive effects were noticed in the milk composition, with a higher content of fat, a better milk energy efficiency and a lower milk urea nitrogen for cows fed the treated barley, with lactic acid and heat (Iqbal et al., 2012).

7.2. Recommendations for future studies

This study was designed very broad and looked at many connected but widespread points. Several recommendations for future studies can be based on the findings.

- It is interesting to use more Icelandic dairy farms for the survey in further research, so the results will be more significant. In case of significant results, the study is reliable. It is also wise to involve farmers in eastern Iceland for field research, so the results will be related to entirely Iceland.

- Another option is to appoint one research farm for each sub research; progress of grass silage, silage additives, amount of compound feed, feed of barley, treatment method barley, compound feed provision and roughage feeding method. Each research farm should have two groups of dairy cows; a control group and a test group. The Latin square research method can be used within this future study. The selected cows for research should not have any health problems. In addition, the other circumstances should be the same in both groups, otherwise it would cause too many variables. Other circumstances are for example; the amount of light, air humidity, the quality of drinking water and moment and method of milking in etc. It is also important to keep the test groups as equal as possible in terms of age.

- This study did only focused on the effects of feeding management on the production of dairy cattle. For future research it would be good to involve the profit of the dairy farms as well. The profit is the revenue minus the cost. So there are two ways to improve the profit;
  1. Increase the revenue
  2. Decrease the cost.

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Appendices

Appendix I: Raw research data

Appendix II. SPSS chi-square tests

Appendix III. Checklist report writing CAH Vilentum

Appendix I: Raw research data

resp.nr	production per cow	fat %	fat kg	protein %	protein kg	Progress of the roughage	Sillage additivies	Feed barley?	Treatment barley	Amount of compound feed per 100 kg milk	Technique rouhage provision	Technique compound feed provision
147	5862	4,61	270	3,36	197	Roundbales	no	no	sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
132	4917	4,16	205	3,31	163	Roundbales + sillage	yes	yes	dried	26 - 30 kg	Weelink system	feeding automat + robot
15	7051	4,15	293	3,32	234	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
34	6227	3,86	240	3,42	213	Roundbales	no	no	nvt	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
26	6729	3,89	262	3,30	222	Roundbales + sillage	yes	yes	dried	26 - 30 kg	Weelink system	feeding automat + robot
81	6052	4,27	258	3,44	208	Roundbales	no	yes	bought	26 - 30 kg	Weelink system	feeding automat
116	5749	4,17	240	3,35	193	Roundbales + sillage	yes	yes	dried	31 - 35 kg	Weelink system	feeding automat + robot
176	6319	4,30	272	3,43	217	Roundbales	yes	yes	sýrt med própíonsýru	36 - 40 kg	Weelink system	feeding automat + robot
100	5817	4,53	263	3,18	185	Roundbales	no	no	nvt	21 - 25 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagns	feeding automat
203	5129	4,14	212	3,48	178	Roundbales	no	no	nvt	21 - 25 kg	Weelink system	feeding automat + robot
103	6496	4,00	260	3,33	216	Roundbales	no	no	nvt	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat + robot
122	4505	4,05	182	3,26	147	Roundbales	no	ja	Pakkað án sýru	21 - 25 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	feeding automat + robot
25	6411	4,32	277	3,34	214	Sillage	yes	yes	Pakkað án sýru	26 - 30 kg	Sjálfvirkt gjafakerfi	with feeding system
70	4576	4,43	203	3,22	147	Roundbales	yes	yes	Sýrt med própíonsýru	11 - 15 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
9	6023	4,18	252	3,50	211	Roundbales	no	yes	dried	16 - 20 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	feeding automat + robot
190	5756	4,26	245	3,34	192	Rúllubaggar + súrheysturn	yes	yes	dried	16 - 20 kg	Sjálfvirkt gjafakerfi	feeding automat + robot
55	5359	3,65	197	3,32	178	Roundbales	no	no	nvt	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
72	4986	3,65	182	3,25	162	Roundbales	yes	yes	Pakkað án sýru	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
33	6673	3,96	264	3,41	228	Roundbales	yes	yes	Sýrt med própíonsýru	21 - 25 kg	Weelink kerfi	feeding automat + robot
5	7287	3,98	290	3,36	245	Round bales + sillage	yes	yes	Sýrt med própíonsýru	31 - 35 kg	Weelink kerfi	feeding automat + robot
113	5604	3,98	223	3,40	191	Roundbales	no	yes	Sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat + robot
44	5516	4,38	242	3,29	181	Roundbales	no	no	nvt	26 - 30 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat + robot
145	6132	4,14	254	3,36	206	Roundbales	no	yes	Sýrt med própíonsýru	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
63	6129	4,64	284	3,51	215	Roundbales	no	yes	Pakkað án sýru	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
117	4431	3,99	177	3,34	148	Roundbales	no	no	nvt	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
104	5973	3,99	238	3,33	199	Roundbales	no	yes	Pakkað án sýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
157	5992	4,48	268	3,41	204	Roundbales + sillage	yes	no	nvt	21 - 25 kg	Weelink kerfi	feeding automat
49	5394	4,12	222	3,33	180	Roundbales	no	no	nvt	26 - 30 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Í mjaltabás
168	5492	4,87	267	3,45	189	Roundbales + þurrhey	no	yes	Sýrt med própíonsýru	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
73	6587	3,84	253	3,33	219	Roundbales	no	yes	Sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Handgefið
49	4104	3,91	160	3,36	138	Roundbales	no	yes	Pakkað án sýru	11 - 15 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Blandað í heilfóðri

resp.nr	production per cow	fat %	fat kg	protein %	protein kg	Progress of the roughage	Sillage additivies	Feed barley?	Treatment barley	Amount of compound feed per 100 kg milk	Technique rouhage provision	Technique compound feed provision
168	5492	4,87	267	3,45	189	Roundbales + þurrhey	no	yes	Sýrt med própíonsýru	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
73	6587	3,84	253	3,33	219	Roundbales	no	yes	Sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Handgefið
49	4104	3,91	160	3,36	138	Roundbales	no	yes	Pakkað án sýru	11 - 15 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Blandað í heilfóðri
38	5312	3,90	207	3,26	173	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Weelink kerfi	feeding automat
98	6564	4,02	264	3,31	217	Sillage + súrheysturn	yes	yes	Sýrt med própíonsýru	21 - 25 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	feeding automat + robot + mix
22	5594	3,83	214	3,52	197	Roundbales	no	yes	Þurrkað	21 - 25 kg	Weelink kerfi	feeding automat + robot
80	6349	3,92	249	3,31	210	Roundbales	no	yes	Pakkað án sýru	21 - 25 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Handgefið
79	5710	4,33	247	3,35	191	Roundbales	no	no	nvt	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
19	6011	3,95	237	3,37	203	Roundbales	no	no	nvt	1 - 5 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
197	6912	4,48	310	3,40	235	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Weelink kerfi	feeding automat + robot
184	5451	3,97	216	3,47	189	Roundbales	no	yes	sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	feeding automat
67	5778	4,18	242	3,42	198	Roundbales	no	no	nvt	21 - 25 kg	Weelink kerfi	feeding automat + robot
6	5542	4,38	243	3,50	194	Roundbales	no	yes	bought	6 - 10 kg	Weelink kerfi	feeding automat
181	3762	4,00	150	3,40	128	Roundbales	no	no	nvt	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	robot
2	3772	4,09	154	3,38	127	Roundbales	no	no	nvt	6 - 10 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
75	6908	4,30	297	3,43	237	Roundbales	no	no	nvt	26 - 30 kg	Weelink kerfi	feeding automat + robot
14	6166	4,39	271	3,32	205	Roundbales	yes	no	nvt	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
211	5567	4,00	223	3,28	183	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
140	3956	4,04	160	3,30	131	Roundbales	no	no	nvt	26 - 30 kg	Weelink kerfi	Sjáflvirkan kjarnfóðurbás
30	6198	4,95	307	3,30	205	Roundbales + smábaggar	no	no	nvt	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
148	5861	3,52	206	3,49	205	Roundbales	no	ja	Pakkað án sýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Í mjaltabás
204	4281	4,66	199	3,26	140	Roundbales	yes	no	nvt	36 - 40 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
111	5755	4,12	237	3,20	184	Roundbales	yes	no	nvt	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
158	5697	4,94	281	3,30	188	Roundbales	no	no	nvt	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
21	5488	4,11	226	3,20	176	Roundbales	yes	yes	Sýrt med própíonsýru	26 - 30 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
51	5815	3,98	231	3,34	194	Roundbales	no	no	nvt	26 - 30 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	robot
71	5836	4,16	243	3,45	201	Roundbales	yes	no	nvt	31 - 35 kg	Weelink kerfi	feeding automat + robot
23	5108	4,23	216	3,16	161	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Sjálfvirkt gjafakerfi	Sjálfvirkt gjafakerfi
89	6066	3,99	242	3,31	201	Roundbales	no	no	nvt	31 - 35 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
109	6650	4,09	272	3,38	225	Roundbales	no	yes	Sýrt med própíonsýru	16 - 20 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat + robot
185	5935	3,78	224	3,47	206	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	Handgefið
130	6731	4,38	295	3,14	211	Roundbales	no	no	nvt	16 - 20 kg	Hefðbundinn fóðurgang með fóðurblöndunarvagni	Handgefið
208	6656	4,60	306	3,30	220	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Weelink kerfi	feeding automat
213	6358	3,70	235	3,32	211	Roundbales	no	yes	Sýrt med própíonsýru	21 - 25 kg	Hefðbundinn fóðurgang án fóðurblöndunarvagns	feeding automat
17	7896	3,98	314	3,37	266	Roundbales	no	no	nvt	26 - 30 kg	Weelink kerfi	feeding automat + robot

Appendix II. SPSS chi-square tests

1. Production * progress roughage:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,917[a]	2	,632
Likelihood Ratio	1,282	2	,527
Linear-by-Linear Association	,766	1	,382
N of Valid Cases	63		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,41.

2. Production * use of silage additives:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,343[a]	1	,558		
Continuity Correction[b]	,088	1	,766		
Likelihood Ratio	,347	1	,556		
Fisher's Exact Test				,774	,386
Linear-by-Linear Association	,338	1	,561		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 7,02.

b. Computed only for a 2x2 table

3. Production * use of silage additives:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,005[a]	1	,941		
Continuity Correction[b]	,000	1	1,000		
Likelihood Ratio	,005	1	,941		
Fisher's Exact Test				1,000	,574
Linear-by-Linear Association	,005	1	,942		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 11,14.

b. Computed only for a 2x2 table

4. Production * treatment of barley

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,397[a]	4	,983
Likelihood Ratio	,395	4	,983
Linear-by-Linear Association	,003	1	,955
N of Valid Cases	63		

a. 6 cells (60,0%) have expected count less than 5. The minimum expected count is ,83.

5. Production class * amount of compound feed per 100 kg of milk

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,428[a]	3	,330
Likelihood Ratio	4,126	3	,248
Linear-by-Linear Association	1,382	1	,240
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,83.

6. Production class * roughage provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,404[a]	3	,705
Likelihood Ratio	1,419	3	,701
Linear-by-Linear Association	,472	1	,492
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,24.

7. Production class * compound feed provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,893[a]	5	,716
Likelihood Ratio	2,886	5	,718
Linear-by-Linear Association	1,342	1	,247
N of Valid Cases	63		

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,83.

8. Fatpercent * Progress of roughage:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,759[a]	2	,252
Likelihood Ratio	3,051	2	,217
Linear-by-Linear Association	,055	1	,815
N of Valid Cases	63		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,33.

9. Fatpercent * Use of silage additives

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,645[a]	1	,422		
Continuity Correction[b]	,252	1	,616		
Likelihood Ratio	,632	1	,427		
Fisher's Exact Test				,549	,304
Linear-by-Linear Association	,634	1	,426		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 5,67.

b. Computed only for a 2x2 table

10. Fatpercent * use barley

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,167[a]	1	,280		
Continuity Correction[b]	,656	1	,418		
Likelihood Ratio	1,161	1	,281		
Fisher's Exact Test				,296	,209
Linear-by-Linear Association	1,148	1	,284		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 9,00.

b. Computed only for a 2x2 table

11. Fatpercent * treatment of barley

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,522[a]	4	,238
Likelihood Ratio	6,023	4	,197
Linear-by-Linear Association	1,507	1	,220
N of Valid Cases	63		

a. 5 cells (50,0%) have expected count less than 5. The minimum expected count is ,67.

12. Fatpercent * amount of compound feed per 100 kg milk

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,000[a]	3	,572
Likelihood Ratio	1,943	3	,584
Linear-by-Linear Association	1,257	1	,262
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,67.

13. Fatpercent * roughage provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,421[a]	3	,490
Likelihood Ratio	2,380	3	,497
Linear-by-Linear Association	,078	1	,780
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,00.

14. Fatpercent * compound feed provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,548[a]	5	,473
Likelihood Ratio	5,764	5	,330
Linear-by-Linear Association	1,448	1	,229
N of Valid Cases	63		

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,67.

15. Proteinpercent * progress of roughage:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,895[a]	2	,639
Likelihood Ratio	1,275	2	,529
Linear-by-Linear Association	,205	1	,650
N of Valid Cases	63		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,46.

16. Proteinpercent * use of sillage additives:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,447[a]	1	,504		
Continuity Correction[b]	,148	1	,701		
Likelihood Ratio	,446	1	,504		
Fisher's Exact Test				,576	,350
Linear-by-Linear Association	,440	1	,507		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 7,83.

b. Computed only for a 2x2 table

17. Proteinpercent * feed barley:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,085[a]	1	,770		
Continuity Correction[b]	,001	1	,971		
Likelihood Ratio	,085	1	,770		
Fisher's Exact Test				,803	,485
Linear-by-Linear Association	,084	1	,772		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 12,43.

b. Computed only for a 2x2 table

18. Proteinpercent * treatment of barley:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,332[a]	4	,675
Likelihood Ratio	3,103	4	,541
Linear-by-Linear Association	,150	1	,699
N of Valid Cases	63		

a. 6 cells (60,0%) have expected count less than 5. The minimum expected count is ,92.

19. Proteinpercent * amount of compound feed per 100 kg of milk

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,693[a]	3	,297
Likelihood Ratio	4,477	3	,214
Linear-by-Linear Association	3,304	1	,069
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,92.

20. Proteinpercent * roughage provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,921[a]	3	,178
Likelihood Ratio	5,075	3	,166
Linear-by-Linear Association	2,275	1	,131
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,38.

21. Proteinpercent * compound feed:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7,902[a]	5	,162
Likelihood Ratio	8,798	5	,117
Linear-by-Linear Association	1,755	1	,185
N of Valid Cases	63		

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,92.

22. Fatkilograms * progress of roughage:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,780[a]	2	,411
Likelihood Ratio	2,244	2	,326
Linear-by-Linear Association	1,743	1	,187
N of Valid Cases	63		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,37.

23. Fatkilograms * use of silage additives:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,506[a]	1	,477		
Continuity Correction[b]	,173	1	,677		
Likelihood Ratio	,517	1	,472		
Fisher's Exact Test				,564	,343
Linear-by-Linear Association	,498	1	,480		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 6,21.

b. Computed only for a 2x2 table

24. Fatkilograms * feed barley:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,205[a]	1	,650		
Continuity Correction[b]	,036	1	,850		
Likelihood Ratio	,206	1	,650		
Fisher's Exact Test				,793	,427
Linear-by-Linear Association	,202	1	,653		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 9,86.

b. Computed only for a 2x2 table

25. Fatkilograms * treatment of the barley

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,867[a]	4	,760
Likelihood Ratio	2,511	4	,643
Linear-by-Linear Association	,082	1	,775
N of Valid Cases	63		

a. 5 cells (50,0%) have expected count less than 5. The minimum expected count is ,73.

26. Fatkilograms * amount of compound feed per 100 kg milk

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,380[a]	3	,710
Likelihood Ratio	1,403	3	,705
Linear-by-Linear Association	,011	1	,917
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,73.

27. Fatkilograms * Roughage provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,311[a]	3	,726
Likelihood Ratio	1,347	3	,718
Linear-by-Linear Association	,878	1	,349
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,10.

28. Fatkilograms * compoundfeed provision

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9,684[a]	5	,085
Likelihood Ratio	10,831	5	,055
Linear-by-Linear Association	,995	1	,319
N of Valid Cases	63		

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,73.

29. Proteinkilograms * progress of roughage

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,937[a]	2	,380
Likelihood Ratio	2,336	2	,311
Linear-by-Linear Association	1,866	1	,172
N of Valid Cases	63		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,49.

30. Proteinkilograms * use of silage additives:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,130[a]	1	,718		
Continuity Correction[b]	,006	1	,939		
Likelihood Ratio	,130	1	,718		
Fisher's Exact Test				,782	,469
Linear-by-Linear Association	,128	1	,721		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 8,37.

b. Computed only for a 2x2 table

31.Proteinkilograms * feed barley:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,355[a]	1	,244		
Continuity Correction[b]	,827	1	,363		
Likelihood Ratio	1,361	1	,243		
Fisher's Exact Test				,311	,182
Linear-by-Linear Association	1,333	1	,248		
N of Valid Cases	63				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 13,29.

b. Computed only for a 2x2 table

32. Proteinkilograms * treatment of the barley:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,195[a]	4	,700
Likelihood Ratio	2,217	4	,696
Linear-by-Linear Association	,304	1	,581
N of Valid Cases	63		

a. 6 cells (60,0%) have expected count less than 5. The minimum expected count is ,98.

33. Proteinkilograms * amount of compound feed per 100 kg milk

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2,162[a]	3	,539
Likelihood Ratio	2,935	3	,402
Linear-by-Linear Association	,732	1	,392
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,98.

34. Proteinkilograms * roughage provision:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1,082[a]	3	,781
Likelihood Ratio	1,090	3	,779
Linear-by-Linear Association	1,030	1	,310
N of Valid Cases	63		

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,48.

35. Proteinkilogram * compound feed provision:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,499[a]	5	,624
Likelihood Ratio	4,281	5	,510
Linear-by-Linear Association	,993	1	,319
N of Valid Cases	63		

a. 6 cells (50,0%) have expected count less than 5. The minimum expected count is ,98.

Appendix III: Checklist report writing CAH Vilentum

Checklist Schriftelijk Rapporteren

Naam: .... Klas: .... Datum: ....

Titel verslag/rapport: ....

Nadat **jij** je verslag/rapport hebt gecontroleerd met behulp van deze checklist, voeg je deze toe als bijlage. Zonder de ingevulde checklist vindt er geen beoordeling plaats. De assessor controleert met deze checklist je rapport/verslag. De beoordelingscriteria die met een * zijn aangegeven, zijn de zogenaamde *'killing points'*. Indien de assessor meer dan vijf *'killing points'* heeft aangekruist, dien je het rapport/verslag op alle onvoldoende onderdelen te verbeteren. Voor de herbeoordeling moet je ook de oude versie inleveren. In het afstudeerwerkstuk zijn geen *'killing points'* toegestaan! AANVINKEN WAT NIET IN ORDE IS!

1. Het taalgebruik:
- ☐ Bevat niet meer dan drie grammaticale, spel- en typefouten per duizend woorden*
  Bij meer dan drie fouten per duizend woorden is het rapport/verslag afgekeurd!
- ☐ Heeft een adequate interpunctie*
- ☐ Is afgestemd op de gekozen doelgroep (juiste stijl)*
- ☐ Laat een zakelijke en actieve schrijfstijl zien*
- ☐ Bevat geen persoonlijke voornaamwoorden*

2. Het rapport/verslag:
- ☐ Is ingebonden (hard copy)*
- ☐ Is vrij van plagiaat* (zie onderwijsexamenregeling)

3. De omslag:
- ☐ Bevat de titel
- ☐ Vermeldt de auteur(s)

4. De titelpagina/het titelblad:
- ☐ Heeft een specifieke titel*
- ☐ Vermeldt de auteur(s)*
- ☐ Vermeldt de plaats en de datum*
- ☐ Vermeldt de opdrachtgever(s)*

5. Het voorwoord:
- ☐ Bevat de persoonlijke aanleiding tot het schrijven van het rapport/verslag
- ☐ Bevat persoonlijke bedankjes (persoonlijke voornaamwoorden toegestaan)

6. De inhoudsopgave:
- ☐ Vermeldt alle genummerde onderdelen van het rapport/verslag*
- ☐ Vermeldt de samenvatting en de bijlage(n)
- ☐ Is overzichtelijk
- ☐ Heeft een correcte paginaverwijzing

7. De samenvatting:
- ☐ Is een verkorte versie van het gehele rapport/verslag
- ☐ Bevat conclusies
- ☐ Bevat geen persoonlijke mening
- ☐ Is gestructureerd
- ☐ Is zakelijk geschreven
- ☐ Staat direct na de inhoudsopgave

8. De inleiding (toelichting op intranet):
- ☐ Is hoofdstuk 1*
- ☐ Beschrijft het grotere kader en aanleiding
- ☐ Beschrijft inhoudelijke achtergrondinformatie*
- ☐ Formuleert het probleem/de onderzoeksvraag*
- ☐ Vermeldt het doel*
- ☐ Bevat een leeswijzer voor het rapport/verslag*

9. Materiaal en methode:
- ☐ Beschrijft de gevolgde onderzoeksmethode
- ☐ Past bij de onderzoeksvraag/vragen*
- ☐ Beschrijft de variabelen/eenheden
- ☐ Beschrijft de methode van data-analyse

10. De (opmaak van de) kern:
- ☐ Bestaat uit genummerde hoofdstukken en (sub)paragrafen (maximaal drie niveaus)*
- ☐ Deze zijn verschillend in opmaak*
- ☐ De hoofdstukken en (sub)paragrafen hebben een passende titel
- ☐ Een hoofdstuk beslaat ten minste één pagina
- ☐ Een nieuw hoofdstuk begint op een nieuwe pagina
- ☐ De zinnen lopen door (geen 'enter' binnen een alinea gebruiken)
- ☐ De figuren zijn (door)genummerd en hebben een passende titel (onder de figuur)*
- ☐ De tabellen zijn (door) genummerd en hebben een passende titel (boven de tabel)*
- ☐ Tabellen en figuren zijn zelfstandig te begrijpen
- ☐ In de tekst zijn er verwijzingen naar figuren en/of tabellen*
- ☐ De tekst bevat verwijzing naar de desbetreffende bijlage(n)
- ☐ De tekst is ook zonder verwijzingen te begrijpen
- ☐ De pagina's zijn genummerd*

11. De discussie:
- ☐ Bevat een vergelijking met relevante literatuur
- ☐ Geeft de valide argumentatie weer
- ☐ Evalueert de gebruikte onderzoeksmethode
- ☐ Bevat een kritische reflectie op de eigen bevindingen (zie toelichting op intranet)

12. De conclusies en aanbevelingen:
- ☐ De conclusies zijn gebaseerd op relevante feiten
- ☐ De aanbevelingen zijn gebaseerd op relevante feiten
- ☐ Bevatten geen nieuwe informatie*

13. De bronvermelding:
- ☐ In de tekst is conform de geldende APA-normen* (zie toelichting op intranet)

14. De literatuurlijst:
- ☐ Is opgesteld conform de geldende APA-normen* (zie toelichting op intranet)

15. De bijlagen:
- ☐ Zijn genummerd
- ☐ Zijn voorzien van een passende titel
- ☐ Bevatten geen eigen analyse