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STUDY OF ANIMAL WELFARE STATUS AND LAMENESS IN DAIRY COW HERDS IN HUNGARY

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STUDY OF ANIMAL WELFARE STATUS AND LAMENESS IN DAIRY COW HERDS IN HUNGARY

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in **Animal Science**

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Part 1. Dairy welfare

1. Introduction

Dairy farming is recognised as an image of animals chewing the grass with few, if any, negative effects on their welfare. It is understood as a traditional way of living in the countryside and dairy production is defined by the public as business which is relatively friendly to the environment **(EUROPEAN COMMISSION, 2005)**. Economic constrains on the dairy farmers over the last years have drove European dairy industry to look for greater efficiencies. Some believe that those significant changes in dairying have disturbed cow's welfare **(RUSHEN et al., 2008 and VON KEYSERLINGK et al., 2009)**. The deciding factor for incomes of dairy farmers is the ability to produce milk at the lowest cost per litre as possible, which is also limited by milk output obligated by quotas. The low profitability of dairy enterprises has, very likely, compromised investment and maintenance on many farms which in turn may neglect reducing the occurrence of lameness, mastitis and metabolic diseases. Farming nowadays is not an attractive occupation and the difficulty with finding dedicated workers is a cause for concern as well. There is evidence that production of high-yielding dairy cows have already passed the point where good cow welfare cannot be provided **(LIEVAART and NOORDHUIZEN, 2011).**

This study was focused on assessing if Hungarian dairy cows have acceptable welfare standards. The welfare of the cows was observed for the first time and results were discussed with farmers. One year later the same assessment was run again and compared with previous results to look for differences. The first hypothesis was tested: Hungarian Holstein-Friesian cattle have an acceptable standard of welfare. The other hypothesis tested claimed: voluntarily given advice about animal welfare will significantly improve specific, measurable, attainable, relevant and time-limited welfare measures in Hungarian Holstein-Friesian herds. To carry out this research, 25 Holstein-Friesian dairy farms were conducted in to the study in east and south-eastern Hungary between May 2010 and May 2011.

2. Literature review

2.1. Animal welfare

There is a wide range of definitions for understanding animal welfare **(DUNCAN and FRASER, 1997; ENTING et al., 1997; WEBSTER, 2005a)**. **BROOM (1988)** defined welfare as the state of animals regarding their attempts to cope with their environment. A more useful definition of well-being was provided by **HURNIK et al. (1995);** the researcher's state welfare is 'a condition in which physical and psychological harmony exists between the organism and its surroundings'. In the opinion of these authors the most reliable indicators of well-being are good health and manifestation of a normal behavioural repertoire. However, **FISHER et al. (2009)** reckon the most popular manifest of animal welfare is what animals feel and how well they perform. When performance is used as a measure, welfare is commonly accepted to be fine when animals produce or grow at a level typical for their environment and genetics. **BERRY et al. (2007)** believe positive status is also assumed when animals have normal behavioural functions, physiology, is reproducing well and live a relatively long life. What is more, **NORDENFELT (2006)** asserts animal welfare is also a social compound. Welfare status will differ between circumstances and animals (animal genetics, weather and parity) and people's perception of welfare level (feelings, performance of animals). A similar approach about feelings is claimed by **DUNCAN (2004)** when experiencing discomfort, pain, frustration and fear. An example of an increased risk of compromised animal welfare is extreme body condition scores (BCS) of dairy cows – either too fat or too thin. Following **BERRY et al. (2007)** cows with either a high or low BCS at calving contribute to reduced immune function, impaired reproduction and lower milk production. Obesity may also tend to an increase of metabolic disorders and thinness may increase discomfort in cold environments. Negative feelings are frequently described as suffering **(GREGORY, 2004)**. Animals react to their needs, for example a need for water and food is related to thirst and hunger; loneliness is related to lack of social contact. Moreover, performance and feelings might be related in some cases when feeling and being ill reduces welfare and health, respectively. Scientists have already studied occurrences of negative, protracted or severe feelings which lead to suffering **(REINER et al., 2009; ROCHE et al., 2009; SANDEM et al., 2002)**. Examples of suffering are torment, paranoia, anguish, sadness, nausea, depression, boredom, anxiety, fatigue, sickness and fear **(MARKUSFELD et al., 1997). WEBSTER (2005b)** concluded how a hungry cow with low BCS might feel, unbalanced diet and antagonistic desire to do something other than eat, such as ruminate or rest. In the opinion of the author, ‘her feelings may be defined, with brutal accuracy, as simultaneously hungry, tired, full up and feeling sick’. In addition, **D'SILVA (1998)** highlighted that a cow facing negative energy balance will very likely not be feeling ‘well’. Finally, commercially-accepted results are not always the best way for expressing animal welfare. Running animal welfare judgements in any production systems requires making choices of what is more and less important and what is better and what is worst for the animals **(FRASER, 1995)**. The animal might perform well, but still has some health and welfare issues **(WEBSTER, 2005a)**.

The differences between otherwise similar farms in the level of animal welfare may be due to different stock people. There are concrete examples of how poor stockmanship can lead to poor welfare and what the consequences of production are. **CRANSBERG et al. (2000)** found a higher mortality among broiler chicks on farms where the stock people moved quickly. On the other hand, mortality was lower the more time the stockperson stayed still in the coop. **HEMSWORTH and COLEMAN (1998)** reported that farrowing rate and number of piglets born was significantly related to the conditions the animals were kept in and to the routine animal care tasks. **WHAY et al. (2003)** evaluated that the difference between farms in the degree of welfare conditions account for the differences between farms in annual milk production, number of lactations and overall health.

The first and the most important welfare guiding principles were ‘Five Freedoms’ presented officially in 1979 by Farm Animal Welfare Council in the United Kingdom **(FAWC, 1993)**. The internationally-recognised declarations on animal welfare are also used by the World Organisation for Animal Health:

1. Freedom from hunger, thirst and malnutrition
2. Freedom from physical and thermal discomfort
3. Freedom from pain, injury and disease
4. Freedom to express normal behaviour
5. Freedom from fear and distress

FRASER (2008a) claims that from a scientific and ethical point of view there are four rules for good animal well-being:

1. Maintain basic health
2. Reduce pain and distress

3. Accommodate natural behaviours and affective states
4. Natural elements in the environment

A group of European researchers **(BOTREAU et al., 2007)** have suggested an alternative order for categorising animal welfare criteria:

1. Good feeding
2. Good housing
3. Good health
4. Appropriate behaviour

Public awareness about animal welfare

Over the last decades the awareness of customers about animal welfare has increased. Welfare is already known as an important aspect of animal food product imaging. Public health, food safety, animal health and welfare became more and more important among consumers, retailers and producers. The British market monitoring agency Talking Retail highlighted that customers rated animal welfare as a greater purchasing motivator than environmental issues **(TALKING RETAIL, 2008)**. Several food production sectors had already implemented quality control risk points at the plants, animal collecting warehouses and farms cooperating with them. Examples of those quality assurance schemes might be the cattle quality management programmes in Australia **(RYAN, 1997)** and Scandinavia **(KNUDSEN, 1997)**. Animal-welfare-friendly policies enable consumers to make an informed choice and, on the other hand, enable producers to benefit from market opportunities **(GAVINELLI et al., 2007)**. Companies dealing with animal products are interested in the welfare of animals to give consumers clear, trustworthy, and demanded information. **EDGE and BARNETT (2008)** believe there is need for establishing European standards for welfare assessment systems in order to facilitate intra-European trade and marketing. **BLOKHUIS et al. (2003)** claim the welfare of farm animals has a huge impact on market demands and there is still a need for developing science-based on-farm systems to assess the status of animal welfare. Over the last three decades the number of publications about animal welfare and animal well-being has increased significantly **(HORGAN and GAVINELLI, 2006)** and this is a worldwide issue **(FRASER, 2008b)**. Such an output globally reflects the economic demand for that information. The welfare of animals should be considered not only from the perspective of the producer, but also from that of the general public and even, what is the most important, the animal itself.

Importance of measuring the welfare of animals

Most people who are working with animals are only looking at their own animals during everyday activities. They rarely see other animals and seldom visit other farms to compare their animals. The best example of the lack of activity can be lameness in dairy cattle which increased slowly over a period of years. Many farmers failed to notice any problems because they were not measuring it. The professional animal welfare observer is more likely to see changes in some welfare measures because that person is dealing with thousands of animals on many different farms. The advantage of animal welfare assessment is that the comparison of many farms gives results which vary significantly from excellent to atrocious. Different conditions and practices are observed which can be useful in sorting farms according to their performance. Firstly, when farmers are showed the results, there are not only numbers, but also a ranking system that can help to imagine how the producers are performing among others. Many times farm managers on farms with the worst conditions (e.g. the worst 20%) do not realize how bad they are compared to the other 80%. **GRANDIN (2010)** reported that before one of the chicken retailers applied lameness control to the farms, there was a high percent of ill animals. There were significantly fewer lame chickens on farms, which joined the scheme, and all of them were in the top 20% best farms with very low number of lame birds. This confirms that if well-being assessment is routinely applied, in addition with comparison to other farms, welfare of farm animals can be improved rapidly. The method applies in conditions where significant variation is observed. If all farms are performing very well or very bad, it is very hard to rank farms and make comparisons. Similar measurement systems are applied in slaughterhouses during stunning and handling of animals. Evaluation is done by objective numerical scoring of every case when an animal is not properly stunned and when the handling method is causing stress or injury to the animals before slaughter. Welfare measurements are also useful tools when well-being is going to be monitored every week, month or year. The main aim is to observe if there are any changes in welfare standards among animals. This can be applied to quantify improvements, to do continuous audit, observe lameness, leg lesions and others. This can enable managers to determine if their veterinary, bedding or husbandry programs are improving or weakening. Additionally, if new equipment is introduced to the farm, the best way to measure how it affects animals is to run a welfare observation.

Animal-friendly-handling habits explained to the workers might get rougher and rougher over time. The person cannot notice the slow deterioration of the interaction with the animal because the regression into old handling methods is moving slowly over months or even years. Welfare assessment can estimate how welfare was influenced by the stockman's attitude to animals. For many people good health automatically means that animals have satisfactory welfare. This is half true because good health is just a component for an animal to represent good welfare. There are situations where animals are performing on satisfactory level, but their welfare may be poor. **FULWIDER et al. (2007)** confirmed that high-producing dairy cows had shorter productive lives and had more leg lesions. The same can be found with genetic lines of chickens that have been bred to grow quickly, but they are experiencing leg abnormalities. Another example of compromised animal welfare would be caged hens that are not able to lie down without being on top of each other. Groups of animals, like chickens, pigs or turkeys that are bred for rapid growth in some cases are not able to move because they are too weak. Well-performing, healthy animals may also have abnormal behaviour if they are housed in conditions that do not allow them to express their specific behaviours; these include bar biting, tail biting, pulling out feathers or hair.

Improving animal welfare

GRANDIN (2010) asserted that there is a need for implementing auditing programmes that will improve animal welfare. Leading restaurants and food retailers are able to lobby for requirements which their supplier will comply with animal welfare standards, for developed or developing countries. Non-governmental organisations also have an impact on popularising animal welfare when videos of animal abuse are seen around the world on the Internet. This makes consumers aware of the well-being of animals and they demand proof that the food comes from animals which did not suffer. There is a lot of information available how to improve animal welfare. This comes from the experience of farmers, animal welfare scientists and husbandry specialists. The key issue is to use this knowledge and translate into actions by those who are taking care of animals. Different groups of people are related to animal production. There are a vast number of farmers who are keen on make improvements, who are blaming the market, the weather, workers and who are struggling to run the business in general. Besides producers, there are farm advisers, sales representatives, standard-setting bodies, legislators, animal welfare scientists, retailers, vets and consumers. All of these groups have different motivations for making a change and different meaning of animal welfare.

2.2. Holstein-Friesian cattle in Hungary

Holstein-Friesian is a breed of dairy cattle originating in northern Holland and Friesland. The cattle are relatively large with white and black spots. Top producing Holsteins milked three times a day have been known to produce over 32.000 litres of milk in 365 days **(HOLSTEIN USA, 2012)**. Until the beginning of 1970's, Hungarian Simmental Cattle was the predominant cattle breed in Hungary. The first 35 Holstein-Friesian heifers were imported to Hungary in 1969. The government enactment (1025/1972 korm. sz.) in 1972 divided for the first time cattle records for milking and beef type purposes. Innovations were implemented to increase the number of milking type of cattle **(HORN, et al. 1995)**. Nowadays, 96% among all cattle breeds in Hungary are Holstein cows **(WHFF, 2010)** (Figure 1).

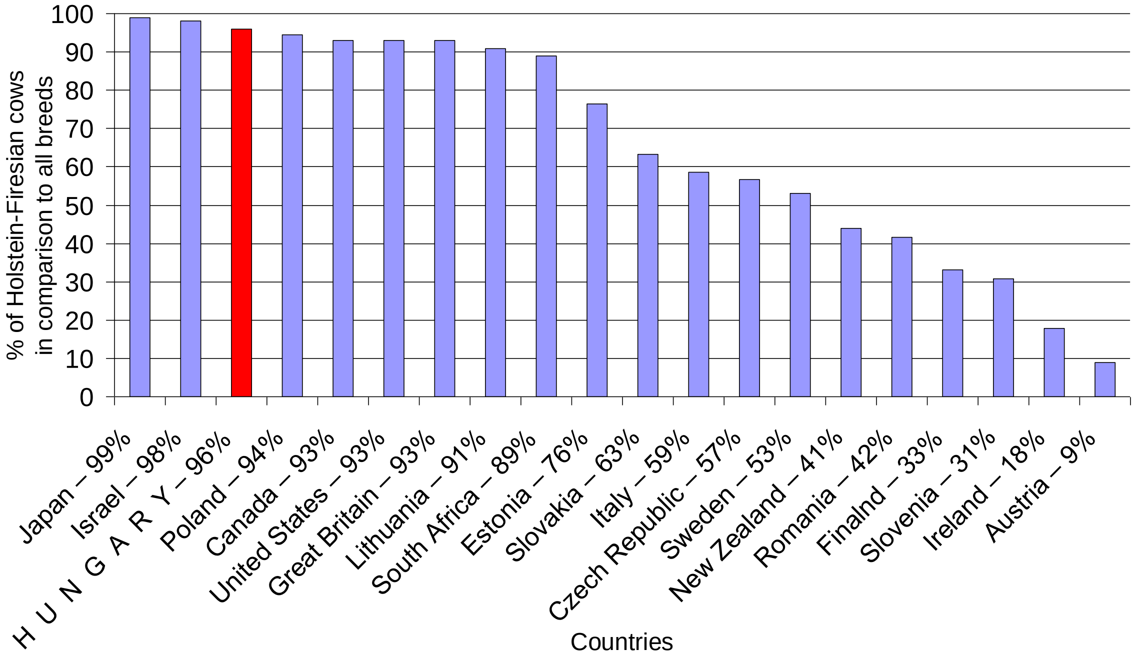

Figure 1. Percentage of Holstein-Friesian cows in comparison to all breeds in particular countries **(WHFF, 2010)**

Modern Holstein-Friesian cattle are producing the highest amount of milk among all breeds in the world. Cattle in Hungary, after cattle in the Czech Republic, average the highest milk yield in Central and Eastern Europe **(WHFF, 2010)** (Figure 2).

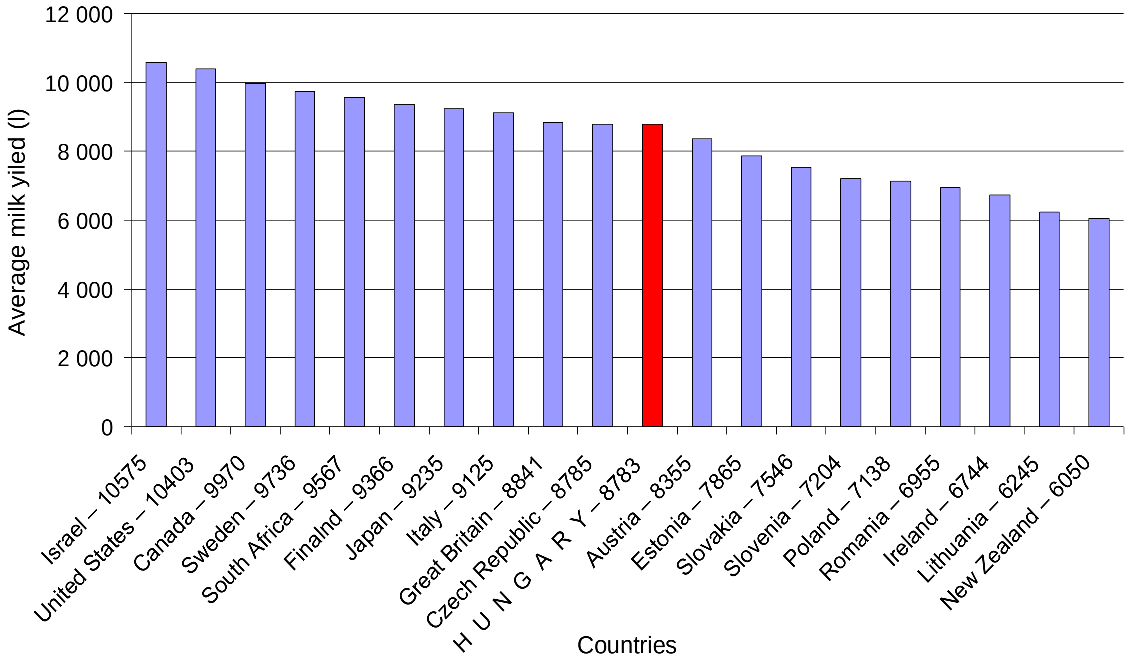

Figure 2. Average milk yields of Holstein-Friesian cows in particular countries **(WHFF, 2010)**

High yields can be observed in the highest herd milk yield average reported at the end of 2011 with 34.54 kg **(ATKFT, 2012)**. Since 1998 a rapid increase in milk yield has been observed with an average increase of 167 kg per year (Figure 3).

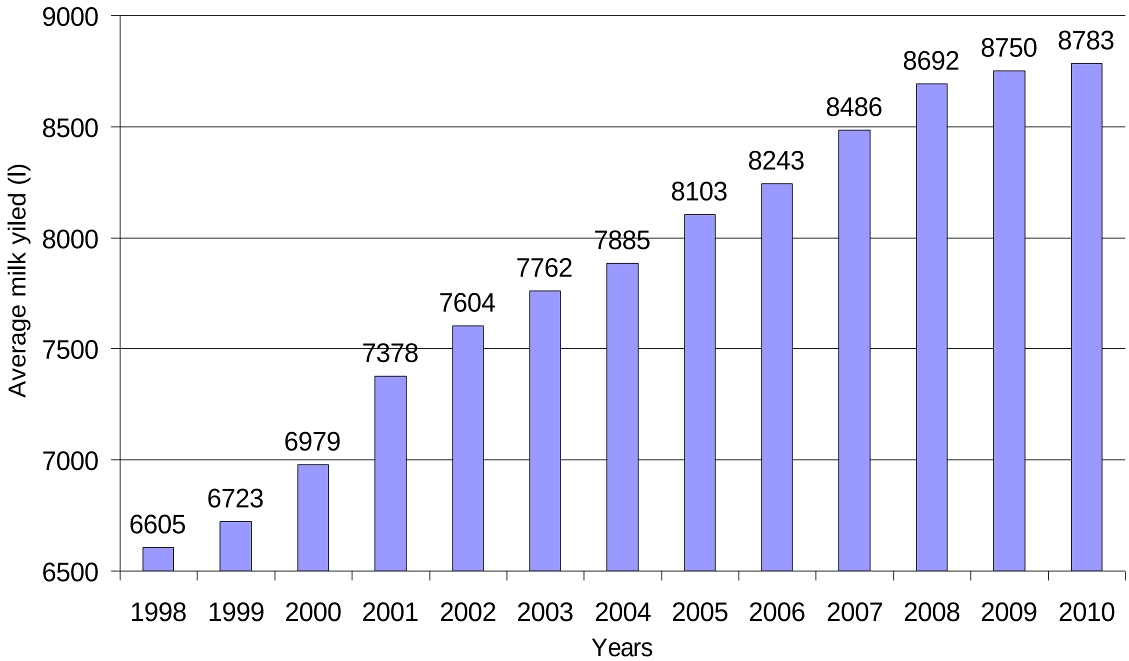

Figure 3. Average milk yields of Holstein-Friesian cows in 1998-2010 **(ATKFT, 2012)**

Significant increase of Holstein-Friesian cattle population, need for keeping herd-book records, independent classifications, maintaining National Breeding Program and organising progeny tests effected in establishing Hungarian Holstein Association in 1989.

2.3. The welfare of dairy cattle

The main idea followed by animal welfare experts and legislation authorities in Europe is to maintain higher-than-only-minimum standards for farm animals **(EFSA, 2009**). So far there are no specific rules established at the European Union level about the welfare of dairy cows. Several Member States also have national legislation for dairy cows (Germany, Sweden, United Kingdom and Denmark). There is no specific legislation in Hungary related to the welfare of dairy cows except European Union Council Directive 98/58/EC and its equivalent in Hungarian legislation (Act on the protection and humane treatment of animals 32/1999. (III. 31.) about keeping animals for farming purposes and their minimal requirements about well-being). In 2006, the European Food Safety Authority was asked to prepare a scientific opinion on the welfare of dairy cows. The main recommendation from this opinion was that the outcome should be incorporated into a code of practice and monitoring protocols that underline potential hazards for animal welfare **(EFSA, 2009)**. Similar codes of practice are already implemented in the UK, the USA and Australia. Consumers expect labelling to be included on the product in order to know more about animal welfare and related information on the products of animal origin. A major problem for any animal welfare labelling is that there are currently no harmonised, recognised and reliable measuring instruments for comprehensively assessing animal welfare across species, farming systems and supply chain stages available in European Union **(EUROPEAN COMMISSION, 2009)**.

How is dairy welfare affected?

For many years, the main objective of breeders was to increase milk production and feed conversion. Management procedures were gradually modified to increase productivity. The consequence of this is that cows are metabolising and consuming more feed which can be associated with a greater risk of mastitis, lameness, infertility and other production diseases. **VON KEYSERLINGK et al. (2009)** reported that most of modern cows are found with a life span of less than four lactations which in Hungary stands for less than three **(BRYDL, 2010)**. Cows forced to produce enormously high quantities of milk are prone to metabolic stress which effects lameness and leads to early culling. However, **D'SILVA (1998)** estimated that improvements just in cow comfort can increase milk yield by up to 500 litres per cow per lactation, reduce veterinary costs, less mastitis, lameness and other associated problems and reduce ration costs. **TREVISI et al. (2006)** also wrote that good management supports welfare and good performances. **KOSSAIBAT and ESSLEMONT (1997)** suggest that the dairy industry should increase efforts to improve animal welfare by itself to reduce the potential for misguided legislative laws. Additional research focused on dairy animal welfare is needed to identify areas where the cow's welfare truly is compromised. These research efforts should be helpful in establishing a realistic balance between public concerns and the reality and needs of the dairy industry.

In the last 20 to 30 years the influx of Holstein genetics has resulted in cows getting significantly larger. Larger cows are supposed to be given more space. As a consequence more cows are found with injuries such as hock and knee lesions and infectious diseases due to stress and more lameness due to standing in slurry. Intensive dairy production has a great chance to be incompatible with good animal welfare. In comparison on many Hungarian dairy farms are found old fashioned cubicles which were designed 30-40 years ago. Future studies could assess how cows are affected by those old husbandry systems.

Following a request from the European Commission, the European Food Safety Authority Panel was asked to deliver a scientific opinion on the welfare of dairy cows, considering whether current farming and husbandry systems comply with the requirements of welfare of dairy cows. The opinion of EFSA states that the risk estimate and magnitude values in straw yards are much lower than in cubicles **(EFSA, 2009)**. The assessment also showed that there is more risk for improper fibre traits (chemico-physical aspects), for total mixed ration, component feeding, behavioural problems, fear and pain associated with the housing/environment conditions in cubicles than in straw yards. However, there is greater chance for occurring udder infections if not enough attention is given to bedding hygiene. If a straw yard is overstocked, then this may cause teat-trampling. Development of behavioural disorders, fear and pain were associated with the highest-ranked hazards which were inadequate bedding, ventilation, temperature, humidity, lack of space, zero grazing and inadequate flooring where cows walk on. In conclusion, the design of cubicle houses and straw yards should allow all the cattle to have access to bedding, feeding and drinking areas without risk of injury or difficulty of social interactions.

Assessing the welfare of dairy cows

There are several methods for assessing the welfare of dairy cows and a few researchers have made an effort and have established dairy welfare assessments. **BARTUSSEK (2001)** measured the potential of a farm with providing mobility, social contact, good quality flooring, the correct climate and good care by the stockman to the animals. ‘The Dairy Welfare Evaluation Guide’ prepared by The California Dairy Quality Assurance Program **(CDQAP, 2004)** describes an area wider than animal health and behaviour. In this assessment pest control, sanitation and waste management, non-ambulatory animals, chapter or marketing and handling can be found. The assessment presented by **WHAY et al. (2003)** seems to be the most applicable for practical use for farmers or for research because focuses on the most important factors related to animal welfare and food safety. Measures were selected through a process of consultations with 50 experts. They were asked to choose observations important to the welfare of animals and that could be measured in a consistent way. The assessment has been based on the logic of the 'Five Freedoms' which provide a concise, comprehensive framework for assessing the welfare of any animal in terms of its state of nutrition, comfort, health, temperament and behaviour. Finally, scientists of the Welfare Quality research team presented in 2009 an assessment protocol for cattle. The systems combine a science-based methodology for assessing farm animal welfare with a standardised way of integrating this information to assign farms and slaughterhouses to one of four categories (from poor to excellent animal welfare). As a background and appendix – ‘Assessment of Animal Welfare Measures for Dairy Cattle, Beef Bulls and Veal Calves’ was presented in parallel testing and validating the possible measures of animal welfare which can be used in different ways depending on conditions and what aims are supposed to be achieved. Clear explanations about methods of assessing welfare of cattle are put together with repeatability and use in particular cases **(VEISSIER and EVANS, 2010)**.

Different assessments focus on different aspects, depending who is the final reader and what is the aim of the measure. There will be a different protocol for research, for the consumer, for legislative bodies, for the retailer or for the processing factory. As an example of protocol can be the conclusions in the study by **STULL et al. (2005)**. The comparison of three assessments found that they covered similar topics, but the outcomes reflected each programme’s design, purpose for assessment, certifying criteria, and differences in specific standards. The take-home message will be that it is definitely more difficult to measure the welfare of an animal by observing it directly than it is to measure the provision of good husbandry. Nevertheless, it is the welfare of the animals that matters and animal-based observations will always provide a more direct assessment of their welfare.

Investments

When investments are considered, the impact on animal welfare should be monitored and changes should promote improvement in the animal's welfare. It is important that any changes in dairy production consider animal welfare. Furthermore the facilities with stockmanship are adequately staffed for the total number of animals in the herd and for everyday activities. Stockmanship is considered as the most important factor anticipating and alleviating many potential welfare problems. The best welfare-friendly husbandry systems may fail if proper management practice and sound stockmanship are not provided **(FAWC, 1993)**. There were EU animal welfare and innovation programmes run on Hungarian dairy farms in 2009-2011. The changes included new milking parlours and swapping straw yards to cubicle husbandry systems. Those activities are giving opportunities to check how the new keeping systems are influencing the welfare of dairy cows.

Improving dairy welfare

TREVISI et al. (2006) concluded that the intensive dairy farming – especially when high yielding cows are utilised – needs an appropriate management skill, but it can coexist with good welfare conditions for animals. The same authors ran a study where an average yielding dairy farm affected by several problems was chosen for improving production performance and animal welfare. The milk yield increased by 25%, there was a decrease in open days, insemination index, somatic cell count and prevalence of lameness. Another successful project focused on calves and heifers which showed an increase in immediate calf identification, immediate navel disinfection, and improvement of checking colostrum immunity **(VASSEUR et al., 2010)**. If there is any possibility to show farmers that one cares about the welfare of their cows, then maybe there will be a chance to motivate them to increase the performance of their herds without affecting welfare. In Hungary dairy welfare issues are usually presented to farmers during professional trainings included in the EU partly-funded financing programmes for investments in dairying.

Social aspect of dairy farming

Social marketing is a tool which is widely used in advertising and marketing. **CLARKSON et al. (1996)** demonstrated that the same resources can be used in the dairy industry; the promotion of animal welfare, for example. In order to make a change in human behaviour to address an animal welfare problem, there is need to make an awareness that the problem exists together with knowledge about possible solutions. However, knowing a problem and its solution does not mean that change is going to take place.

WHAY and MAIN (2010) claimed that when a farmer wants to make an improvement in welfare he or she has to understand, for example, why lameness is bad for cows. Implementing an innovation works better if the farmer has an opportunity to discuss the issue with other farmers, rather than with a farm advisor only. On the other hand, farmers are spending their time mainly on the farms, so contact with other farmers or farm managers is limited. Advice given to the farmers is not always received because of many other people and tasks influencing the decision-making process. **GRANDIN (2010)** claims that farmers, when asked to show pictures of their farms to others, are more likely to make a good job of improving welfare because someone else will observe it. The reputation of the farmer might increase if the action was useful. Such framework for continuous improvement is known as benchmarking – 'first and foremost, a learning process structured so as to enable those engaged in the process to compare their performance in order to identify their comparative strengths and weakness as a basis for self improvement and/or self-regulation' **(JACKSON and LUND, 2000)**. Benchmarking in animal welfare is a useful tool in assessing industry performance, demonstrating and instilling trust in consumers that welfare standards are being met and protecting international markets. What is more, a signature under the action plan encourages outward display of commitment to the project. Social marketing requires one-to-one facilitation visits to all farmers. This method seems to be labour intensive which is usually related to high-cost interventions and radical changes in dealing with animal welfare.

People working with dairy cattle should be given appropriate training and should be tested by a recognised agricultural authority body. Knowledge about welfare and health cannot be learned from experienced dairymen **(FAWC, 1993)**. In reality, however, this is very interesting how many farm workers were trained to work with animals. On many farms in Hungary there are workers who, after losing a job not related to agriculture in a town or in a city, had the only option to find a job on a dairy farm. Changes in attitude to work were found when state farms were privatised and farm workers were also paid for the quality of work and were better monitored by new owners.

Another issue which arises from the social part of the production chain is the costumer-driven demand for products of known history and of known traceability. Already-working codes of practice or farm assurance schemes in the western hemisphere are the best examples when idea for better quality products comes from consumers through retailers to producers. An example is the UK where leading dairy retailers' suppliers must follow a written health and welfare plan to help review their approach to animal health on a regular basis and demonstrate commitment to planned and preventative health schemes **(TESCO FARMING, 2011)**. Farm hygiene and management programmes such as vaccination, appropriate animal husbandry and care should be used, as relevant, to reduce disease and the need for therapeutic intervention. It moves away from familiar lists of standards and focuses instead on a more simple set of measurable targets and absolute standards, which supplying dairy farms must comply with. There are absolute standards and measures for improvements, which can be recorded on all farms to help review progress. The captured data includes measures such as lameness, cleanliness and carbon reduction targets **(FARMERS GUARDIAN, 2011)**. In Germany, Belgium, Holland and Sweden, most of them concentrate on giving cows access to pasture for a particular minimum time per year. So far, only in France and in the UK some of the leading milk processors are paying extra money per litre premium above the market price, which is designed to reward farmers for good agricultural practice. In those countries farm assurance marks include over 95% of the countries' dairy production **(EUROPEAN DAIRY FARMERS – personal communication)**. What is, however, very interesting is the top priority of one of those retailers **(VEISSIER et al., 2010)**. A company statement said that the lameness occurrence average is in excess of 40% and the retailer aims to achieve 5% by 2012. If there has been no significant improvement in decreasing lameness in the last 20 to 30 years, it is very unlikely to achieve a reduction in two years.

Literature is missing in studies covering farm assurance schemes and their positive roles in improving animal welfare. The only available review of the farm welfare programme so far was done by **MAIN et al. (2003)**. The study compared various indicators of welfare on farms following and not following the RSPCA UK Freedom Food scheme. What is interesting, farms which took part in the scheme had better results for mastitis, non-hock injuries, cow cleanliness and body condition, and poorer welfare indicators for eight of the measures, including hock and knee injuries, lameness and restrictions in rising behaviour. Results of other commercial dairy farm assurance schemes are not available because retailers do not want to provide this information, even for scientific purposes **(MAIN – personal communication)**.

In conclusion, the welfare of dairy cattle has not been previously examined in Hungary to any great extent. The need for creating such a review is especially pertinent in the light of the increasing intensification of dairy farming, legislation’s obligations, increasing retailers' and consumers’ demands. Such a background can be useful to provide anyone of interest (academia, authorities or commercial companies) with transparent and reliable information. There is no available information about dairy welfare standards in Hungary, except for particular production and health issues. The majority of livestock farms in developed countries are raised according to the requirements of a farm assurance scheme. These types of programmes will likely play an increasingly important role in the dairy industry. If Hungarian farmers are considering running dairy business successfully, it is very likely that they also will have to cope with animal welfare standards expected by consumers and retailers. The aim of this part of the dissertation was to measure welfare of dairy cattle in Hungary and to share the conclusions with the farmers. Another aim was to estimate how cattle welfare can change after voluntarily given advice about improving animal welfare.

3. Materials and methods

3.1. Data collection

The project presumed dairy farm monitoring in Hungary. The farms were visited twice; the first time from May to December 2010 and the second time from May to December 2011. To make the project successful, there were 27 farms recruited for this study. After one year, two farms were excluded from the study because of lack of interest in further cooperation. There were, on average, 457 heads of lactating cows in the herds producing on average 9047.80 kg (min. 7390 kg and max. 10860 kg) in 2010 and 8984.36 kg (min. 7624 kg and max. 10621 kg) in 2011. There were approximately 4400 younger calves, 9900 older calves, 10350 heifers, 4300 dry cows and 11400 lactating cows involved in the survey in 2010 and similar number of animals in 2011. The selection was firstly created on a principle of searching for as many different farms as possible. The criteria for the farm selection included the maintenance of accurate records and the willingness to commit to the trial. No aspect of herd management was changed for the purpose of the study. Among the farms chosen were farms which are different in:

- ownership (private, state, cooperative)
- size (from 56 to 850 lactating cows)
- husbandry systems (free stall, straw yard)
- access to the pasture (yes, no)
- scraping system (automatic, tractor)
- age (modern, old)

Farms were visited in the same months in 2010 and in 2011. The purpose of the study was to observe animal welfare in 2010, to present the welfare assessment protocol to the farm managers and to explain neglected areas on the farms (Appendix 1). The next step included a second visit in 2011 and an assessment was performed to estimate if any improvements have been achieved after voluntarily-given suggestions.

3.2. Protocol development, training and preparations

Farmers are busy people and like any businesspeople they want to be sure their time is not wasted. There was a need for creating protocol setting specific, measurable, attainable, relevant and time-limited (SMART) measures **DORAN (1981)**. The sequence of the steps necessary for the development, testing and implementation of animal-based protocol for assessing on-farm welfare presented by **WEBSTER (2005a)** was followed:

(1) First review of expert opinion

(2) Relative importance of different welfare problems

(3) Approaches to measurement of welfare problems

(4) Development and testing of protocols for on-farm assessment of animal welfare

(5) Assessment of welfare on a statistically valid sample of farms

(6) Identification of strengths and weaknesses on individual farms

(7) Second review of expert opinion

(8) Needs for intervention to address specific welfare problems

(9) Development of action plan to address specific problems on individual farms

Farm visits were established for creating an animal welfare report summarising conditions on Hungarian dairy farms. Data collection was created according to already-existing assessment of **WHAY et al. (2003)**. The use of some measures from already-existing protocol was driven by the fact that they were selected through a process of consultations with experts (1). Measures should be important to the welfare of animals and could be measured in a consistent way. The project, however, needed the protocol to be established again, for in Hungarian conditions some of the points of the protocols would simply not work (for example – access to the pasture). A new welfare quality tool was created including all needed measures that could be important to the welfare of animals and could be comparatively simple, meaningful, time-efficient and usable on a farm (2). These aims were reached by avoiding a usage of complicated devices and gadgets, so the research (measure) could be repeated easily by another person, for example farm manager (3). The following items were used during every visit: Psion Workabout MX hand-held computer, laminate pages with lameness and body condition scores. There was also a tape measure for checking the barn and milking parlour dimensions and thermometer for checking the silage and extra notebook in use. Additionally, the protocol was created to have a minimal-as-possible impact on cows, so the daily routine was not disrupted and farmers could work normally. Following these priorities there was need for a test which the results could be meaningfully interpreted. In case of a discussion with the farmer, there was need for confident explanations, numbers and examples that results (good or bad welfare) actually mean something. Preparation for visiting farms included training with a professional dairy cow selection assessor judging cows for selection purposes. Training was run in parallel with the work of the expert. Oral judgement of the body condition and lameness scores was performed and any hesitations were discussed.

Cow observations started with creating a protocol covering all possible questions and measures which could be taken to express all desirable animal welfare critical points on the farms. When the draft paper was ready, every point was discussed with the supervisor and professionals in dairy husbandry working at the University of Debrecen and then compared with the works of other researchers. Then the table was taken to the nearest farm cooperating with the University and checked again if the specific questions and conditions were applicable with the reality on the farm (4). A new table considered importance of use and time needed for recording of each condition. After that, the list was successfully tried on four different in-housing and management farms, discussed with their managers and action was followed on all 25 farms (5).

During each visit, strong and weak welfare areas were discussed with farm managers and possible solutions were suggested (6). From this point it was up to farm manager to follow suggestions or to follow old methods of husbandry. When the farmer did not show interest, the identification of strengths and weaknesses (6) was the last step in dealing further with welfare. In case the farmer was interested in getting more information how welfare could be improved, more reliable opinions and suggestions for particular farm(er) were gathered (7). This was carried on either at University of Debrecen (discussions with co-workers), by contact with commercial companies (e.g. trimming, flooring, semen) or by sharing experiences with other farmers. In all cases specific welfare issues were addressed (8) and, either by phone or in person, sets of solutions were proposed to farmers if needed shortly after the first visit (e.g. professional trimming, concrete grooving) (9).

3.3. Details of observations

Observations included checking animals without disturbing them from approximately two to three meters. For each observation 25% of cattle from each pen in the barns were examined (Table 1). RISKA herd management software was explored for obtaining performance data.

Table. 1. Animal welfare measures taken for the different age groups

Welfare measure	Younger calves	Older calves	Heifers	Dry cows	Lactating cows
Water access and quality	X	X	X	X	X
Bedding-softness and cleanliness	X	X	X	X	X
Water – No./1m of trough	X	X	X	X	X
Obviously ill (%)	X	X	X	X	X
Dirty flanks (%)	X	X	X	X	X
Dirty hindlimbs (%)	X	X	X	X	X
Dirty belly (%)	X	X	X	X	X
Hair loss (%)	X	X	X	X	X
Non-hock injuries (%)	X	X	X	X	X
Hock and knee lesions (%)	X	X	X	X	X
Neck rail injuries (%)	X	X	X	X	X
Flight distance (cm)	X	X	X	X	X
Thin (BCS 1+2) (%)	X	X	X	X	X
Lameness (%)	X	X	X	X	X
Unlimited water (% farms)	X				
Diarrhoea (%)	X				
Reared together (% farms)	X				
Mortality (%)	X				
Unlimited water (% farms)		X			
Diarrhoea (%)		X			
Reared together (% farms)		X			
Adaptation period (% farms)			X		
Lifespan (No.)					X
Culling (%)					X
Mortality (%)					X
Idling (%)					X
Grooming brushes (% farms)					X

3.3.1. Animal welfare measures taken for all groups of cattle

Water access and quality

Definition: Water access: No. of animals per 1 m of available water surface. Quality: Score 1: Clean – drinkers and water clean at the moment of inspection; Score 2: Partly dirty – drinkers dirty, but water fresh and clean at moment of inspection; Score 3: Dirty – drinkers and water dirty at moment of inspection.

Reason: According to the 97/2/EC Directive by the Council of Europe **(EU COUNCIL, 1997)** access to water is one of the primary needs to guarantee animal welfare. Water serves two basic functions for all terrestrial animals: as a major component in body metabolism and as a major factor in body temperature control. Balls and bowls were also unified to 1 m of available water surface. Drinkers with bowls are usually accessible for 1 or to 2 individuals.

This limits access to water and increases competition which could lead to low intake or injuries.

Bedding – softness and cleanliness

Definition: Softness and thickness of the bedding (straw and corn stover only present on 25 farms) was based on subjective 3-score key: Score 1: Deep, clean and dry; Score 2: Uneven, soiled but dry; Score 3: Poor, soiled and wet.

Reason: The amount of straw has an impact on laying comfort in cubicles. Lameness is also affected by not providing enough time for hoof relief and standing in the muck outside of the box. Prolonged standing has been associated with the presence of sole ulcers **(COOK, 2003)** and increased foot lesions and lameness **(SINGH et al., 1994)**. Moreover, more straw in the cubicle decreases the chance for udders becoming dirty and mastitis development. This is important in the control of coliform bacteria, abundant in huge amounts in manure and wet bedding materials **(FIRAT, 1993)**.

Obviously ill animal and/or with dull coat

Definition: Percentage of animals with entire coat being dull and woolly, not shiny or glossy, sometimes with the coat additionally appearing as dry and long. Apathetic animals or animals showing hanging ears or body position indicating pain (e.g. rounded back). Any signs of coughing, abnormal breathing, nasal discharge and/or ocular discharge.

Reason: Assessing any signs of sickness **(WHAY et al., 2003)**.

Cleanliness

Measured as: dirty flanks (%), dirty hindlimbs (%), dirty udder (belly in calves) (%).

Definition: Degree on the body parts considered: splashing and plaques. In both cases layers of dirt amounting to the size of the palm of a hand and bigger considered as dirty.

Reason: Cleaner cows are less prone to mastitis by reducing contact with bacteria. Animals feel more comfortable in clean surroundings and milker comfort remains a possible benefit **FISHER et al. (2009)**.

Injuries

Definition: Hair loss (%) – any signs of hairless patches; non-hock injuries (%) – any signs of injuries other than on hocks and knees (e.g. brisket injuries or *tuber coxae* injury); hock and knee lesions (%) – any signs with integument alterations around tarsus and carpus; neck rail injuries (%) – any signs of neck injury on the dorsal aspect.

Reason: Skin lesions, other body injuries and swellings reflect the impact of the surrounding environment on the animal's body **(WECHSLER et al. 2000)**.

Flight distance

Definition: Getting closer in front of the cattle until signs of withdrawal or until touching the nose/muzzle – average distance (cm).

Reason: Studies had shown that animals are easier to handle and restrain when calmed than excited because shouting and yelling at cattle is very stressful **(WAYNERT et al., 1999)**. The flight zone is the animal's personal space which will cause alert and escape behaviour when a person penetrates the zone. The size of the flight distance depends how tame the animal is. When the animals turns and face the person, the herdsman is outside the flight zone. Flight distance shows the quality of the contact with people and how stressed the animal might be when being close to the stockman **(PAJOR et al., 2003)**. Calm handling of animals during milking, insemination, vaccination or during loading has significant benefits. **HEMSWORTH and COLEMAN (1998)** showed that negative handling influences milk production, reproduction shortly after breeding and animals are more susceptible to diseases **(GRANDIN, 2010)**.

Body condition score

Definition: Thin (1+2) (%), Fat (4+5) (%) – not applicable for calves (<70days>).

Score 1 – Deep shrunken left side; the skin on top of the diagonal protuberance of the lumbar vertebra is caved-in. The fold of skin goes clearly vertical down from the hip bone. The rumen pit behind the rib bow is more than a hand's width.

Score 2 – The skin over the diagonal protuberance of the lumbar vertebra is caved-in. The fold of skin from the hip bone bump folds slopes to the front, to the rib bow. The rumen pit behind the rib bow equals a hand's width.

Score 3 – The skin over the diagonal protuberance of the lumbar vertebra goes vertically down first and then curves to the outside. The fold of skin from the hip bone is not visible, but the rumen pit behind the rib bow can be seen.

Score 4 – The skin across the diagonal protuberance of the lumbar vertebra is curved directly to the outside. Behind the rib bow, no rumen pit can be seen.

Score 5 – The diagonal protuberance of the lumbar vertebra is not visible because of a well-filled rumen. The belly skin is strongly stretched. No transition from the side to the ribs can be seen **(ZAAIJER and NOORDHUIZEN, 2003)**.

For calves: Thin (lower condition) – the calf is around 25-50% below the average weight or condition of the batch. Assessed regarding quantity of muscles, estimated weight, visibility of ribs, size of the belly and comparison with the mean level of batch.

Reason: Body condition score is a management tool which helps to make the right decisions for feeding the cow and it gives information about fertility. The condition of the cow indicates energy utilisation for body maintenance and productivity.

Lameness

Definition: Applicable for lactating cows, dry cows and heifers. Clinically lame = Score 3+4+5 **(COOK, 2003; CLARKSON et al., 1996)**.

Score 1 – Stands and walks normally with a level back. Makes long confident strides.

Score 2 – Stands with flat back, but arches when walks. Gait is slightly abnormal.

Score 3 – Stands and walks with an arched back and short strides with one or more legs. Slight sinking of dew-claw in limb opposite to the affected limb may be evident.

Score 4 – Arched back standing and walking. Favouring one or more limbs, but can still bear some weight on them. Sinking of the dew-claws is evident in the limb opposite to the affected limb.

Score 5 – Pronounced arching of back. Reluctant to move, with almost complete weight transfer off the affected limb **SPRECHER et al. (1997)**.

At each visit, all lactating cows, dry cows and heifers were locomotion-scored. If possible, all animals were scored standing and walking in a straight line on a firm, flat walking surface (i.e. in a yard or field) uninterrupted by other cows or stock people and avoiding sharp turns.

For calves: Lame – reluctance to bear weight on a foot, standing on the edge of the claw, shifting weight from one limb to another, resting a foot.

Reason: Lameness is caused by reduced ability of moving one or more limbs in a normal way. Leg problems severely decrease animal welfare **(WEBSTER, 2001)** and are an important constraint to the dairy industry **(KOSSAIBATI and ESSLEMONT, 1997)**.

3.3.2. Animal welfare measures taken for younger and older calves (<70days>) only

Unlimited access to water

Definition: Unlimited access to water, limited (once or twice daily) or no access to water.

Reason: Calves up to 70 days except milk or milk replacer need to have access to water which is essential to calf growth. Water in a diet helps with earlier weaning, developing of the rumen and the digestion **(KERTZ et al., 1984)**.

Occurrence of diarrhoea

Definition: Percentage of animals with signs of liquid faeces.

Reason: Diarrhoea in calves is a symptom of a disease which can have serious financial and welfare implications. Infections can be mixed including Rotavirus and Coronavirus Enterotoxigenic *E. coli* (ETEC) *Salmonella spp*. *Cryptosporidium*.

Housing

Definition: Calves reared in individual hatches or 2 or more together.

Reason: The claimed advantage of individual housing up to 8 weeks is reduced transmission of diseases. Group housing is compulsory for calves older than 8 weeks by European Union regulations **(COUNCIL OF THE EUROPEAN UNION, 1997)**.

Mortality

Definition: Percentual rate of animal death including cases of euthanasia and emergency slaughter.

Reason: Checking performance of weaning and rearing calves. There are a lot of factors affecting survival of young calves: arrival weight, serum total protein, weaning weight, season and year of birth, immune system, gut microflora and calving ease **(HENDERSON et al., 2011)**.

3.3.3. Animal welfare measures taken for heifers only

Adaptation period

Definition: Period given to heifers in a separate barn or with older cows before calving.

Reason: Introducing heifers to new groups should be done carefully to minimise stress of settling and bullying by older cows.

3.3.4. Animal welfare measures taken for lactating cows only

Lifespan

Definition: Average number of lactations cows are kept on the farm obtained from milk records.

Reason: A long lifespan can indicate a good welfare.

Culling

Definition: Percentage of cows sold to the slaughterhouse for various reasons.

Reason: Represents level of health and management on the farm **(JOHANSON and BERGER, 2003)**.

Mortality

Definition: Percentage of uncontrolled death of animals as well as cases of euthanasia.

Reason: Measure expresses welfare of animals by percentage of cows removed because of diseases, illnesses, injuries, calving paralysis, slips, falls caused by oestrus mounting, transportation and facility problems.

Percentage of undisturbed cows not engaged in any activities

Definition: Straw yard: proportion of cows performing no activity, standing in dung, and not eating, drinking, ruminating, walking or resting, failed attempts at resting. Cubicles: animal is laying or standing with hind quarter on the edge of the cubicle (perching). Animal lies backwards in the cubicle with head at the position where the hind quarter is suppose to be. Diagonal laying or standing is observed, it means corner-to-corner position, stereotypic behaviour, dog sitting position and standing idle.

Reason: Idling behaviour in cattle was used by **CHAPLIN et al. (2000)** as an indicator of a reluctance to lie down in their resting area, possibly because it was uncomfortable.

Grooming brushes

Definition: Rotating brushes moving freely in all directions accessible for all cows. Percentage of farms providing that equipment.

Reason: Grooming brushes are cleaning the fur in places that are hard to reach by the cow and improving environmental enrichment by activating grooming behaviour.

3.4. Data handling

Data from the completed welfare assessments was gathered into Microsoft Excel 2007 and then transformed for use in SPSS 13.0 statistical package **SPSS (2004)**. Various statistical methods were used in the study (Table 2).

Table 2. Statistical methods used in the study assessing welfare of dairy cattle

Statistical method	Observation measured
Shapiro-Wilk test	Checking normality of animal welfare measures
Multiple factor analysis of variance (Univariate)	Differences in animal welfare measures between 2010 and 2011 (for normally distributed data).
Spearman Rank Correlation test	Correlations between animal welfare measures and environmental factors to determine strength of that relationship.
Chi-square test for relatedness or independence	Differences in animal welfare distributions on farms between 2010 and 2011. Comparison of categorical data for one or more variables.
Mann-Whitney test	Differences in animal welfare measures between 2010 and 2011 (for not normally distributed data). Analysis of significant differences between independent variables and dependent measures.

4. Results and discussion

4.1. All groups of cattle

Clean water for younger calves was offered on all farms except 4-8% of farms providing partly dirty or dirty water. Older calves had access to clean water on 68% of the farms and to worst quality of drinking conditions on 34% of the farms (Table 3). Heifers were supplied with clean water troughs on 48-56% of the farms and on the rest of the farms with partly-dirty or dirty water. Dry cows had access to clean water troughs on 32-36% of the farms and to partly-dirty or dirty water on the rest of the farms. Lactating cows were given clean water on the least number of farms (24-32%) and partly-dirty or dirty on the highest number of farms. There were no significance differences in water quality and number of cattle per 1m of trough between the observations in the years.

All cattle groups were provided with relatively soft and clean bedding. Younger calves had deep, even, clean and dry bedding on 88-92% of the farms. Older calves were provided deep, dry and clean bedding on 48-56% of farms. Heifers had access to 16-24% of deep, clean and dry bedding. Dry cows were provided with deep, clean and dry bedding on almost half of the farms. Lactating cows were offered deep, clean and dry bedding on 28% of the farms and uneven and poor bedding on 72% of the farms in 2010 and on 20% and 84% in 2011, respectively. There were no significant differences in bedding quality between 2010 and 2011 for all groups of cattle.

There were on average 13-15 younger calves, 56-58 older calves, 52-56 heifers, 34-36 dry cows and 42-44 lactating cows sharing 1 meter of available water trough (Tables 4-8). Any evidence of a dull demeanour or signs of sickness should alert the farm manager to take action. There are many factors that influence sickness of dairy cattle, but one of the most important is identifying the sick cattle and starting treatment early. Among young calves, older calves and heifers not more than 4% were found obviously ill. However, a 0.51% significant drop in average percentage of cattle with dull demeanour or signs of sickness was observed only in heifers with χ^2 (1, N = 10350) = 3.380 and $p < 0.05$. In the dry and lactating cows group the percentage of obviously sick animals was slightly higher reaching 4-5%. A similar result was observed by **WHAY et al. (2003)** who reported on average 3.4% of obviously ill lactating cows. A significant increase on average number of dull demeanour or signs of sickness of 1.4% between the two observations was estimated among dry cows with

χ^2 (1, N = 4307) = 5.863 and $p < 0.05$. A highly significant increase of 1.46% on average number of dull demeanour or signs of sickness was also observed in lactating cows with χ^2 (1, N = 22845) = 26.397 and $p < 0.001$.

Table 3. Water and bedding quality for all age groups in 2010 and 2011

Group of cattle	Measure	Category	Percentage of farms		Difference
			2010	2011	
Young calves (<70days)	Water quality	1 – Clean	88	92	+4
		2 – Partly dirty	8	4	-4
		3 – Dirty	4	4	0
	Bedding	1 – Deep, clean and dry	80	72	-8
		2 – Uneven, soiled but dry	12	20	+8
		3 – Poor, soiled and wet	8	8	0
Older calves (>70days)	Water quality	1 – Clean	68	68	0
		2 – Partly dirty	12	8	-4
		3 – Dirty	20	24	+4
	Bedding	1 – Deep, clean and dry	48	56	+8
		2 – Uneven, soiled but dry	28	16	-12
		3 – Poor, soiled and wet	24	28	+4
Heifers	Water quality	1 – Clean	48	56	+8
		2 – Partly dirty	28	24	-4
		3 – Dirty	24	20	-4
	Bedding	1 – Deep, clean and dry	16	24	+8
		2 – Uneven, soiled but dry	28	28	0
		3 – Poor, soiled and wet	56	48	-8
Dry cows	Water quality	1 – Clean	32	36	+4
		2 – Partly dirty	32	32	0
		3 – Dirty	36	32	-4
	Bedding	1 – Deep, clean and dry	40	48	+8
		2 – Uneven, soiled but dry	36	32	-4
		3 – Poor, soiled and wet	24	20	-8
Lactating cows	Water quality	1 – Clean	24	32	+8
		2 – Partly dirty	32	36	+4
		3 – Dirty	44	32	-12
	Bedding	1 – Deep, clean and dry	28	20	+8
		2 – Uneven, soiled but dry	48	60	+12
		3 – Poor, soiled and wet	24	20	+4

Cleanliness has been used in the dairy industry as a possible indicator of cow welfare and in studies of the influence of housing conditions on the incidence of mastitis **(WARD et al., 2002)**, the effects of tail docking, sub-clinical intra-mammary infection rates and the risk of bacterial contamination of milk **(SANAA et al., 1993)**. A high standard of cow cleanliness indicates limited exposure to environmental mastitis pathogens and is elementary to food safety, hygiene and quality assurance schemes.

Young calves were found to be the cleanest animals on the farms in 2010 with an average 10.86%, 7.41% and 6.93% of them having dirty flanks, hindlimbs and bellies, respectively. In 2011 a highly significant decrease in occurrence of dirty flanks, 1.56% with χ^2 (1, N = 4340) = 13.723 and $p < 0.001$, hindlimbs 1.65% with χ^2 (1, N = 4341) = 32.304 and $p < 0.001$, and bellies with χ^2 (1, N = 4339) = 78.115 and $p < 0.001$ was estimated.

On average 22.48%, 35.70% and 27.24% of older calves in 2010 were observed with dirty flanks, hindlimbs and bellies, respectively. One year later a highly significant decrease in frequency of dirty hindlimbs, 0.54% with χ^2 (1, N = 9869) = 14.880 and $p < 0.001$, and bellies, 1.46% with χ^2 (1, N = 9869) = 14.042 and $p < 0.001$ was measured (Table 5). Heifers were the dirtiest cattle in 2010 with an average 21.70%, 41.41% and 42.06% dirty flanks, hindlimbs and udders, respectively. During the second visit a highly significant decrease in occurrence of dirty hindlimbs, 5.80% with χ^2 (1, N = 10351) = 63.883 and $p < 0.001$, and udders, 5.72% with χ^2 (1, N = 10350) = 31.089 and $p < 0.001$ was reported (Table 6).

In 2010, on average 21.85%, 37.38 and 21.26% of dry cows with dirty flanks, hindlimbs and udders, were observed respectively. A highly significant decrease in occurrence of dirty flanks, 4.95% with χ^2 (1, N = 4309) = 10.797 and $p < 0.001$, and udders, 6.38% with χ^2 (1, N = 4306) = 36.111 and $p < 0.001$ was found (Table 7). The best improvement in cleanliness was noticed among lactating cows (Table 8). In 2010 there were on average 26.85%, 50.14% and 24.73% of lactating cows with dirty flanks, hindlimbs and udders, respectively. Almost the same results were reported by **WHAY et al. (2003)** with 10.7%, 47.4% and 22.2%, respectively, showing that during that research there were 50% less cows with dirty flanks. The distributions had significantly decreased in 2011 by 6.66% for dirty flanks with χ^2 (1, N = 22844) = 132.538 and $p < 0.001$, hindlimbs with χ^2 (1, N = 22487) = 62.411 and $p < 0.001$, and udders with χ^2 (1, N = 22844) = 126.247 and $p < 0.001$.

Harsh environments affect the well-being of the animal by causing pain and discomfort. Hair loss patches and hock injuries generally result from inadequate body space on stall beds, hard stall surfaces and inadequate bedding. Hair loss patches were noticed on average in only 2.5%, 3% and 4-5% of younger calves, older calves and heifers which is probably related to (not always clean and dry but deep) bedding. Among dry cows and lactating cows 10.51%-11.66% and 13.19-14.09% of the animals, respectively were found with hair loss (Table 7 and 8). The difference between the first three and the last two groups can be explained by the use of cubicles and a slightly compromised softness of bedding. In the analysis of hock hair loss by **WHAY et al. (2003)** 29.1% of lactating cows were with that injury. There were no significant differences in the distribution of cattle with hair loss between the two observations.

Hock lesions are more advanced and serious injuries than hair loss patches. Except for hock and knee lesions, other lesions were also found on the carpus and tarsus in cows kept in straw yards and in cubicles, which in some cases resulted in bleeding. On average only 2.46% in 2010 and 2.09% in 2011 of young calves were evaluated with hock and knee lesions, but this difference was not significant (Table 4). The difference in mean percentage of older calves with hock lesions between two years (7.06% and 8.19%, respectively) was highly significant with χ^2 (1, N = 9869) = 10.508 and $p < 0.001$. On average 8.38% in 2010 and 9.75% in 2011 of heifers were estimated with hock lesions and this difference was significant with χ^2 (1, N = 10351) = 4.211 and $p < 0.05$. The highest proportion of cattle with hock and knee lesions was evaluated in dry and lactating cows in 2010 and in 2011. There was a significant increase in the number of dry cows with hock and knee lesions between 2010 and 2011 from 15.28% to 16.75% with χ^2 (1, N = 4306) = 2.48 and $p < 0.048$. There was also an increase in the percentage of lactating cows with hock and knee lesions between two observations from 18.24% to 23.03% but this difference was highly significant with χ^2 (1, N = 22845) = 54.733 and $p < 0.001$. In comparison, a study on fifty-three dairy farms found 27.2% of lactating cows with hock and knee lesions **WHAY et al. (2003)**. In the current study the prevalence of hock and knee lesions was observed on an average 18-23% of lactating cows, in 28.8% of cows housed in free stalls and in 13.6% of cows housed in straw yards (data not shown). Different frequencies of hock and knee lesions were observed by **RUTHERFORD et al. (2008)** with 37.2%, 46.0% and 25.0%, respectively. Organic management was found to be beneficial for cow welfare because it reduced the damage of cow hock and knee lesions. **GRANDIN (2011)** suggested that the percentage of cows with severely swollen hock and knee lesions should not exceed 1%.

Physical restrictions at the feed barrier may cause skin lesions, especially on the necks of cows. Thus, some aspects of the functionality of feed barrier design can be assessed by observing skin lesions on the necks of dairy cattle. Among young calves, 9.40% in 2010 and 10.43% in 2011 were observed with neck-rail injuries and those averages were not significantly different. In the study 34.45% older calves had neck rail injuries in 2010 and this was significantly less than 36.76% in 2011 with χ^2 (1, N = 9872) = 37.189 and $p < 0.001$. A successful decrease in prevalence of neck rail injuries was reached among heifers with change from 35.74% to 33.42% and χ^2 (1, N = 10351) = 6.840 and $p < 0.005$, dry cows with a change from 43.56% to 38.79% and χ^2 (1, N = 22845) = 4307 and $p < 0.001$ and lactating cows with a change from 49.30% to 45.63% and χ^2 (1, N = 22845) = 47.494 and $p < 0.001$ (Table 4).

The presence of non-hock injuries give an idea about the general collisions of cattle with brisket boards, bars, passageways, cubicles, obstacles, neglected areas and other sharp objects. Younger calves (1.94% in 2010 and 1.97% in 2011), older calves (2.87% in 2010 and 2.86% in 2011) and heifers (5.57% in 2010 and 7.60% in 2011) were experiencing the least collisions with the facilities. The difference, however, was only observed in heifers with χ^2 (1, N = 10350) = 15.319 and $p < 0.001$. Dry cows and lactating cows were the most injured among cattle. There were on average 11.65% in 2010 and 12.93% in 2011 injured dry cows and this increase was significant with χ^2 (1, N = 4306) = 3.181 and $p < 0.05$. The same pattern was measured with 14.17% in 2010 and 14.35% in 2011 regarding lactating cows with no significant difference. **WHAY et al. (2003)** estimated 37.7% of lactating cows with that kind of injury. Estimations and understanding the factors causing injuries can help farmers reduce the level of such outbreaks. High curbs, not enough straw, short cubicles or wrongly-positioned brisket boards can be responsible for causing hock and knee lesions.

Younger calves were the least afraid of humans with an average flight zone of 72cm; next were lactating cows and heifers with an average distance of 86 cm and 85cm, respectively. **WHAY et al. (2003)** reported the average flight distance for lactating cows of 113.7 cm. Older calves with dry cows had the largest flight zone with an average 94 cm and 98 cm, respectively.

Cubicles are a key component of dairy free-stall housing and must allow enough room for the cows to freely enter the stall, lie down, rest comfortably and easily get up. If cows find rising or finding a position in the cubicle not comfortable they will be probably avoiding lying in the boxes spending more time standing **(GRAVES et al., 2009)**. In the study, rising, if all animal groups, was acceptable with younger calves, older calves and dry cows having, on average, rather unrestricted rising. Heifers and lactating cows had slightly mild restricted opportunities for raising their bodies. This can be explained by the fact that heifers and lactating cows were, on some farms, housed in cubicles which were not of the proper size for the animal.

WALL et al. (2007) concluded that body condition affects health and fertility. A cow with the ability for high milk production produces more milk partly because she is better predisposed for losing body condition to maintain milk production. High-yielding cows with negative energy balance in early lactation have weaker immune resistance and are more susceptible to some diseases. Those cows need careful management to provide good nutrition, to avoid extremes of body tissue loss and to be fertile.

There were 12.23% in 2010 and 10.59% in 2011 of calves (up to 70 days) which were thought to be with lower body condition. This drop was found to be very significant with χ^2 (1, N = 4339) = 5.543 and $p < 0.01$. In comparison, there were less older calves being thin with 6.21% in 2010 and 6.43% in 2011 and this change was not significant. An increase in the number of thin heifers from 5.16% to 7.20% have been noticed which was significant with χ^2 (1, N = 10351) = 4.845 and $p < 0.05$. A highly significant rise of 5.45% and 13.13% in number of thin dry cows with χ^2 (1, N = 4307) = 66.333 and $p < 0.001$ and lactating cows with χ^2 (1, N = 22845) = 288.680 and $p < 0.001$ was estimated. **GRANDIN's (2011)** welfare critical points report insists that less than 3% of lactating cows should be found with a BCS of less than 2. On 25 farms the following results were reported: 4.37% and 4.41%, mean of BCS 1 and standard deviation, respectively in 2010; 4.19% and 3.82%, mean of BCS 1 and standard deviation, respectively in 2011.

Only 1.26% less heifers were found to be fat in 2011 (11.52%) in comparison to 2010 (10.26%) and this difference was significant with χ^2 (1, N = 10351) = 2.977 and $p < 0.05$. On the other hand 4.46% of dry cows more were reported to be fat in 2011 than in 2010 with χ^2 (1, N = 4306) = 82.539 and $p < 0.001$. This is contrary to lactating cows with a 9.76% decrease in the number of fat cows with χ^2 (1, N = 22845) = 438.255 and $p < 0.001$. **GRANDIN (2011)** concludes that 90% of lactating cows should have a body condition score of more than 2. In the present study the distribution was as follows: 72.72% and 16.21%, mean of BCS 3-5 and standard deviation, respectively in 2010; 59.60% and 14.07%, mean of BCS 3-5 and standard deviation, respectively in 2011.

Lameness is caused by a combination of poor management and a failure to select breeding stock with good feet and legs. On average, in both years 2.8% of young calves, from 5.48% to 6.74% older calves and from 7.46% to 7.65% heifers had impaired locomotion but there were no differences between the years. An increase in poor locomotion was observed among dry cows (6.4%) and lactating cows (7.98%) with χ^2 (1, N = 4306) = 26.652, $p < 0.001$ and with χ^2 (1, N = 22844) = 154.492 and $p < 0.001$. **GRANDIN (2011)** in the 'Outline of cow welfare critical control points for dairies' asserted that less than 5% of lame cows represents an excellent level. Over 10%, should be not acceptable. There were on average 27.31% in 2010 and 35.29% of lame cows observed during the farm visits. That level of occurrence was found to be similar to **HASKELL et al. (2006)**, **HUXLEY et al. (2004)** and **RUTHERFORD et al. (2009)** with 19.3%, 24%, and 39% of cows found to be clinically lame, respectively.

4.2. Calves

Individual calving, in comparison to group calving pens, with or without sick cows has an advantage in cases of fewer respiratory problems, lower diarrhoea cases and a lower risk of *Salmonella* infections **(SVENSSON et al., 2003)**. Only on three farms among 25 (12%) calving occurred in group calving pens with contact with sick animals; it also takes place in Canada (52.8% of farms) and in the USA (32.4% of farms) **(VASSEUR et al., 2010)**. Group calving pens were present on sixteen farms (64%) which is between (57%) Canada and (70%) the USA **(VASSEUR et al., 2010)**.

GRANDIN (2011) highlights that calves should be dehorned before 4 months of age and older calves should require an anaesthetic for dehorning. On 25 farms all calves were dehorned using caustic paste before 4 months of age and only on ten farms calves were given a sedative agent to minimise the feeling of pain in the period of recovery.

RAMANZIN et al. (1994) and **KERTZ et al. (1984**) reported higher intakes and weight gains of those calves that had unlimited access to water. Milk or milk replacer alone could be not sufficient to cover the calf's need of water especially during hot days. In the study, calves up to 70 days had unlimited water access on 18 of the 25 farms in 2010 (19 in 2011). Older calves had access to water all the time on all the farms.

During the first months of life newborn calves are extremely susceptible to calf diarrhoea due to bacteria, viruses and parasites, which attacks the lining of the intestines. A decrease in the absorption of essential nutrients from milk occurs and leads to weight loss and dehydration. The calf may die if the disease level is severe. In the study, 4.50% in 2010 and 4.21% in 2011 of calves up to 70 days were noticed with diarrhoea. In comparison there were 2.81% in 2010 and 2.85% in 2011 calves older than 70 days to be sick and this change was very significant with χ^2 (1, N = 9870) = 6.795 and $p < 0.005$.

Calves isolated for the first eight to twelve weeks of life will be more resistant to the transfer of pathogens, diseases and even death in some cases. Calves up to about eight weeks can be reared in groups, but there is a greater risk for an invasion of infectious organisms which can be transmitted among young animals **(MCKNIGHT, 1978)**. Younger calves were weaned individually on 80% of the farms in 2010 and on 84% of farms in 2011. This result is similar to management in Canada (87.9%) and the USA (67.9%).

Mortality of calves is an important cause of economic losses on dairy farms **(WATHES et al., 2008)**. The most important diseases in calves are diarrhoea and respiratory infections with enteritis and pneumonia being the major causes of death. Mortality reported in the USA in 1999 was 11% at an average age of eight weeks. In most cases it was due to enteritic and respiratory infections. **SVENSSON et al. (2006)** estimated in Sweden an average mortality of 5% which on average occurred before 60 days of age and most of deaths were caused by gastrointestinal disorders. In a study from France 3.1% of the animals died before 80 days of age **(FOURICHON et al., 1997)** and in a Danish study 9% of calves died before 90 days of age **(TORSEINA et al., 2011)**. In the present study the mortality rate was 10.49% in 2010 and 11.18% in 2011. Most of the cases were related to diarrhoea and respiratory infections.

4.3. Heifers

Heifers are expected to grow, milk and bred successfully. The performance and ability of heifers to be conceived are highly affected by adjusting to new herd mates. Heifers fed separately and observed by **BRICKELL et al. (2008)** produced more milk and were culled less often than heifers fed with older cows. The issue is perceived as stressful for young animals, especially in modern farming with large herd sizes and a high ratio of animals per one stockman. In the present study, heifers were given an adaptation period before entering the milking herd on six of the 25 farms in both years.

4.4. Lactating Cows

On the 25 farms, lactating cows were kept on average for 2.42 in 2010 and 2.47 in 2011 lactations which give an average lifespan of about four and a half year for a cow entering a herd as a heifer at two years of age. This lifespan is rather short in comparison to the potential lifespan of dairy cows which can live ten years or more. In the UK cows were kept on average for 3.3 lactations in 1997 and 3.8 in 2009 **(FAWC, 2010)**. This is opposite to the belief that the number of lactations the cows spend in the herds has been becoming shorter. **HARE et al. (2006)** asserted that on average dairy cows in the United States are kept for 2.8 lactations. The authors observed an association between cows living for about five years and low fertility.

On average 22-23% cows of all milking cows were slaughtered on 25 farms. In the current study in 2010 and in 2011 cows were culled due to digestion disorders (20.83%), lameness (19.74%), reproductive disorders (17.23%), mastitis (17.23%), poor milk production (16.23%) and other outbreaks (8.61%) (data not shown). In the USA 25.9% of cows were slaughtered in 2009 **(USDA, 2012)** and the main reasons for that were: reproductive disorders (28%), mastitis and udder problems (23%), lameness or injuries (19%), poor milk production (16 %) and other reasons (14%). In comparison, according to **FAWC (2010)**, around 4.7% of British cows were culled because of lameness and 9% because of mastitis. **WHITAKER et al. (2000)** emphasised that a relatively low number of cows are slaughtered in the UK because of lameness even though the annual incidence is over 25%.

Dairy cow mortality indicates suboptimal herd health and welfare, causes financial loss and is increasing over time **(RABOISSON et al., 2011)**. The farm manager's husbandry methods highly influence mortality and various reasons are behind the percentages of lameness, respiratory disease, sick cows treated with antibiotics, feeding a total mixed ration, culling fewer cows in early lactation, longer calving interval **(THOMSEN et al., 2004)**. In the present study deaths were reported at 4.86% in 2010 and 4.80% in 2011. Those results are comparable with mortalities in other countries. In Denmark the mortality risk has increased from approximately 3.5% in 1999 to approximately 4.2% in 2008. In the USA the National Animal Health Monitoring System (NAHMS) evaluated increase in mortality from 3.8% in 1996, 4.8% in 2002 and 5.7% in 2007 **(USDA, 2007)**.

Stereotypic behaviours are seen when idling, like pushing the bars with the nose, grasping the bars with their mouths, moving the head from the left to the right or transferring weight from one leg to another. When the cow lies backward in the cubicle she is contaminating the bedding. Another negative behaviour is the dog-sitting position which might give an indication that the rail neck is wrongly positioned or there is not enough lounge space in front of the stall **(OVERTON et al., 2002)**. There was a highly significant increase in the number of lactating cows not engaged in any activities and expressing idling behaviours from 11.34% in 2010 to 13.72% in 2011 with χ^2 (1, N = 22844) = 37.777 and $p < 0.001$.

All farm animals, especially horses, pigs and cattle, perform grooming as part of their natural behaviour. Grooming brushes are a part of enrichment and help to satisfy this natural behaviour by reducing frustration or stress due to boredom when housed in free-stall barns. This is also a social activity for cattle. Cows denied grooming behaviour showed abnormal behaviour in study by **DE VRIES et al. (2007)**. In the study 9 out of 25 farms provided cows with grooming brushes what stands for 36%.

Sound stockmanship is crucial for managing high yielding cows for promoting and maintaining adequate good welfare. Some reports about dairy welfare pointed out a need for training which should be given to farm workers to ensure practical skills. **GRANDIN (2011**) in critical control points for dairies included beating animals as prohibited. The average stockman's attitude in the current assessment was observed to be professional with only some individuals rarely expressing negative behaviours like shouting, hitting and rushing the animals. On farms in the present study, stockmen were working in different shifts. Due to limitations of time and resources the performance of all workers was not estimated.

Welfare measures in the study covered almost completely the aims of the animal-based outcome standards published by **GRANDIN (2011**) and claimed by the author to be the same accepted in the European Union and the OIE (World Organization for Animal Welfare). Among practices to be prohibited, the following were not reported on 25 farms in Hungary: dragging downed non-ambulatory cows, unapproved euthanasia practices, depriving calves colostrum, prohibited surgical procedures. One of the behaviours was found very sporadically: beating animals. Additionally, there were no correlations found between animal based measures and environmental factors. The study aimed to check what kinds of welfare improvements are possible if farmers are only informed about cattle welfare. **CLARKSON et al. (1996) and WHAY (2002)** reported that in most of the welfare issues farmers underestimate problems on their farms. One of the major tasks for those seeking to improve farm animal welfare is to improve farmer perception of the problem **(WEBSTER, 2005a)**.

Table 4. Welfare measures taken for young calves (<70days) in 2010 and 2011 and the difference between the observations in the two years

Measure	2010		2011		Differ.	Sig.
	Mean or % of farms	Std. dev.	Mean or % of farms	Std. dev.		
Water – No./1m of trough	15.32	13.07	13.78	12.46	-1.54	NS
Obviously ill (%)	3.50	2.86	3.20	3.22	-0.30	NS
Dirty flanks (%)	10.86	11.95	9.30	8.71	-1.56	P<0.001
Dirty hindlimbs (%)	7.41	14.80	5.76	8.32	-1.65	P<0.001
Dirty belly (%)	6.93	19.11	4.44	6.08	-2.49	P<0.001
Hair loss (%)	2.65	2.67	2.51	2.17	-0.14	NS
Non-hock injuries (%)	1.94	1.86	1.97	2.84	+0.03	NS
Hock and knee lesions (%)	2.46	2.51	2.09	1.95	-0.37	NS
Neck rail injuries (%)	9.40	9.97	10.43	13.21	+1.03	NS
Flight distance (cm)	71.68	20.29	71.88	20.30	+0.20	NS
Thin (BCS 1+2) (%)	12.23	9.60	10.59	8.10	-1.64	P<0.001
Lameness (%)	2.81	3.87	2.85	2.97	+0.04	NS
Unlimited water (% farms)	72	-	80	-	+8	NS
Diarrhoea (%)	4.50	4.62	4.21	3.83	-0.29	NS
Reared together (% farms)	20	-	16	-	-4	NS
Mortality (%)	10.49	13.86	11.18	11.26	+0.28	NS

Table 5. Welfare measures taken for older calves (>70days) in 2010 and 2011 and the difference between the observations in the two years

Measure	2010		2011		Differ.	Sig.
	Mean or % of farms	Std. dev.	Mean or % of farms	Std. dev.		
Water – No./1m of trough	56.23	35.76	58.89	29.87	+2.66	NS
Obviously ill (%)	2.54	2.34	3.02	2.99	+0.48	NS
Dirty flanks (%)	22.48	29.04	21.94	26.61	-0.54	NS
Dirty hindlimbs (%)	35.70	37.45	36.03	35.23	+0.33	P<0.001
Dirty belly (%)	27.24	32.23	25.77	30.91	-1.46	P<0.001
Hair loss (%)	2.59	3.84	3.02	3.79	+0.43	NS
Non-hock injuries (%)	2.87	2.45	2.86	2.23	-0.01	NS
Hock and knee lesions (%)	7.06	13.94	8.19	14.78	+1.13	P<0.001
Neck rail injuries (%)	34.45	39.26	36.76	36.06	+2.30	P<0.001
Flight distance (cm)	96.16	56.22	92.76	59.78	-3.40	NS
Thin (BCS 1+2) (%)	6.21	4.17	6.43	5.28	+0.22	NS
Lameness (%)	5.48	5.68	6.74	4.32	+1.26	NS
Unlimited water (% farms)	100	-	100	-	0	NS
Diarrhoea (%)	2.18	1.79	2.78	2.47	+0.61	P<0.005
Reared together (% farms)	100	-	100	-	0	NS

Table 6. Welfare measures taken for heifers in 2010 and 2011 and the difference between the observations in the two years

Measure	2010		2011		Differ.	Sig.
	Mean or % of farms	Std. dev.	Mean or % of farms	Std. dev.		
Water – No./1m of trough	52.69	25.76	56.25	23.62	+3.56	NS
Obviously ill (%)	3.77	4.21	3.26	3.80	-0.51	P<0.05
Dirty flanks (%)	21.70	19.29	20.70	16.68	-1.00	NS
Dirty hindlimbs (%)	41.41	29.11	35.61	25.05	-5.80	P<0.001
Dirty udder (%)	42.06	37.17	36.34	33.23	-5.72	P<0.001
Hair loss (%)	5.11	3.55	4.13	2.96	-0.98	NS
Non-hock injuries (%)	5.57	4.48	7.60	6.17	+2.03	P<0.001
Hock and knee lesions (%)	8.38	10.49	9.75	8.91	+1.37	P<0.05
Neck rail injuries (%)	35.74	31.30	33.42	29.97	-2.32	P<0.005
Flight distance (cm)	88.88	23.52	84.52	25.71	-4.36	NS
Thin (BCS 1+2) (%)	5.16	5.17	7.20	5.96	+2.05	P<0.05
Fat (4+5) (%)	11.52	8.60	10.26	7.29	-1.26	P<0.05
Lameness (%)	7.46	4.91	7.65	3.81	+0.19	NS
Adaptation period (% farms)	24	-	24	-	0	NS

Table 7. Welfare measures taken for dry cows in 2010 and 2011 and the difference between the observations in the two years

Measure	2010		2011		Differ.	Sig.
	Mean or % of farms	Std. dev.	Mean or % of farms	Std. dev		
Water – No./1m of trough	36.32	22.85	34.45	19.23	-1.87	NS
Obviously ill (%)	3.51	3.45	4.91	3.62	+1.40	P<0.05
Dirty flanks (%)	21.85	24.06	16.90	18.02	-4.95	P<0.001
Dirty hindlimbs (%)	37.38	26.44	34.73	21.75	-2.66	NS
Dirty udder (%)	21.62	30.75	15.24	18.38	-6.38	P<0.001
Hair loss (%)	10.51	8.91	11.66	8.38	+1.15	NS
Non-hock injuries (%)	11.65	13.86	12.93	13.42	+1.28	P<0.05
Hock and knee lesions (%)	15.28	13.03	16.75	13.39	+1.47	P<0.05
Neck rail injuries (%)	43.56	23.53	38.79	22.20	-4.77	P<0.001
Flight distance (cm)	97.12	38.26	98.40	36.47	+1.28	NS
Thin (BCS 1+2) (%)	13.17	9.41	18.62	12.29	+5.45	NS
Fat (4+5) (%)	17.85	10.29	22.31	12.92	+4.46	NS
Lameness (%)	24.90	9.33	28.30	10.73	+3.40	NS

Table 8. Welfare measures taken for lactating cows in 2010 and 2011 and the difference between the observations in the two years

Measure	2010		2011		Differ.	Sig.
	Mean or % of farms	Std. dev.	Mean or % of farms	Std. dev.		
Water – No./1m of trough	44.83	23.47	42.56	22.69	-2.27	NS
Obviously ill (%)	4.13	2.97	5.58	4.38	+1.46	P<0.001
Dirty flanks (%)	26.85	27.22	20.19	18.08	-6.66	P<0.001
Dirty hindlimbs (%)	50.14	33.17	43.62	29.88	-6.52	P<0.001
Dirty udder (%)	24.73	26.69	20.97	23.56	-3.76	P<0.001
Hair loss (%)	13.19	11.05	14.09	11.11	+0.90	NS
Non-hock injuries (%)	14.17	16.30	14.35	13.33	+0.18	NS
Hock and knee lesions (%)	18.24	14.57	23.03	19.28	+4.79	P<0.001
Neck rail injuries (%)	49.30	35.68	45.63	35.11	-3.66	P<0.001
Flight distance (cm)	87.92	42.49	82.86	34.90	-5.06	NS
Thin (BCS 1+2) (%)	27.28	16.21	40.40	14.07	+13.13	P<0.001
Fat (4+5) (%)	15.65	11.36	5.89	3.42	-9.76	P<0.001
Lameness (%)	27.31	13.51	35.29	10.88	+7.98	P<0.001
Lifespan (No.)	2.42	0.26	2.47	0.24	+0.05	NS
Culling (%)	20.06	13.65	21.11	12.24	+1.05	NS
Mortality (%)	4.86	6.84	4.80	5.65	-0.06	NS
Idling (%)	11.34	7.04	13.72	8.69	+2.38	P<0.001
Grooming brushes (% farms)	36	-	36	-	0	NS

The success of this study is that the farmers' perception of animal welfare has improved, while not even forced by legislation, because of a higher number of positive achievements (18) over negative ones (14) (Table 9). This is questionable if that happened due to the project or if the farmers had already planned those improvements. Nevertheless it was proved that positive changes are possible.

Hypothesis 1: 'Hungarian Holstein-Friesian cattle have an acceptable standard of welfare.'

The 25 Holstein-Friesian herds observed do not necessarily represent the welfare conditions of cows throughout Hungary. However, the study probably constitutes the largest independently-observed assessment of the welfare of dairy cows to have been carried out in Hungary. This report considers whether the aims of the Five Freedoms and expectations of dairy welfare principles has been realised for Holstein-Friesian cattle on Hungarian dairy farms. No major problems were encountered in collecting the management and environment-based data. This is likely because questionnaires were thoroughly developed and tested before this study. Studies typically report that between 25% and 50% of farmers contacted will not participate in studies of animal health **(WELLS et al., 1996; FREI et al., 1997; WHAY et**

al., 2003). In the current study only 2 out of 27 farmers (7%) did not want to follow the project and rejected any cooperation after a few months.

Table 9. Summary of positive and negative welfare achievements estimated on 25 dairy farms

Welfare Categories	Positive welfare achievements (Significantly different)	Negative welfare achievements (Significantly different)
Cleanliness	Younger calves – Dirty flanks Younger calves – Dirty hindlimbs Young calves – Dirty belly Older calves – Dirty belly Heifers – Dirty hindlimbs Heifers – Dirty udder Dry cows – Dirty flanks Dry cows – Dirty udder Lactating cows – Dirty flanks Lactating cows – Dirty hindlimbs Lactating cows – Dirty udder	Older calves – Dirty hindlimbs
Condition	Younger calves – Thin (1+2) Heifers – Fat (4+5) Lactating cows – Fat (4+5)	Lactating cows – Thin (1+2) Heifers – Thin (1+2)
Illness	Heifers – Obviously ill /dull coat	Older calves – Diarrhoea Dry cows – Obviously ill Lactating cows – Obviously ill Lactating cows – Lameness Lactating cows – idling behaviour
Injuries	Heifers – Neck rail injuries Dry cows – Neck rail injuries Lactating cow – Neck rail injuries	Older calves – Hock and knee lesions Older calves – Neck rail injuries Heifers – Non-hock injuries Heifers – Hock and knee lesions Dry cows – Non-hock injuries Dry cows – Hock and knee lesions Lactating cows – Hock and knee lesions
The most influenced (Rank)	Total: 18 positive achievements Heifers – 5 Lactating cows – 5 Younger calves – 4 Dry cows – 3 Older calves – 1	Total: 14 negative achievements Lactating cows – 5 Older calves –4 Dry cows – 3 Heifers – 3 Younger calves – 0

Regarding the first hypothesis, the study confirmed that the welfare in Hungarian Holstein-Friesian herds was found to be comparable to those reported in other developed countries. There were no standards set for classification, results compare only welfare status in Hungarian herds with relevant publications. Unfortunately there are no available references regarding all kinds of measures taken in the study. In comparison to other studies estimating dairy welfare, the 25 Holstein-Friesian dairy farms were better in aspects like fewer cows with hair loss, non-hock injuries, hock and knee lesions and shorter flight distance **(RUTHERFORD et al., 2009; WHAY et al., 2003)**. Similar distributions with other authors **(WHAY et al., 2003; GRANDIN, 2011; HASKELL et al., 2006; HUXLEY et al., 2004;)** were found with dirty hindlimbs, dirty udders, bedding lameness, mortality and culling of lactating cows, lifespan and mortality of calves. There were also worst results with more cows observed with dirty flanks **(RUTHERFORD et al., 2008)**. The results of the present study suggest that the Hungarian dairy industry, even achieving more than a 30% increase in an average milk yield between 1998 and 2010 **(ATKFT, 2012)**, is still capable to provide adequate welfare for cattle.

Hypothesis 2: 'Advice voluntarily given about animal welfare will significantly improve specific, measurable, attainable, relevant and time-limited welfare measures of Hungarian Holstein-Friesian herds.'

After voluntary advice was given, welfare improvements were possible only with some measures. Farmers were able to decrease the number of dirty cattle and improve the conditions of younger calves, heifers and lactating cows. On the other hand more animals got injured and ill probably because of introducing cattle to new buildings and new facilities which were implemented between visits. The first reason that improvement was possible only with some measures was the money issue. Even some projects in the study were financed by EU funds and they mainly focused on making the dairy industry more efficient in production, but not always according to welfare standards. On many farms, managers had to choose between better and worse solutions. This is understandable because animal welfare is based on making compromises. This is also possible that farmers simply did not have an interest in improving the welfare of their cattle. Either because they were managers and all decisions are made by owners avoiding unnecessary expenditures or because they are overwhelmed with other issues on the farms which are prohibiting them from concentrating on improving welfare. From the point of view of the decision making process there were differences observed in the capabilities of particular businesses for investments and improving the welfare of cattle. In the case of the European Union subsidies, taking bank loans or making investments on their own, large private and state enterprises with diversity of production areas (animals, plants, agricultural services, retail, transport, etc.) found it easy to invest in improving efficiency and the well-being of cattle. Smaller private farms were next in order of making investments, afterwards, the smallest private farms and smaller state farms were the last because of a lack of funds and limitations of legal aspects of cooperative statuses. It is common to employ seasonal workers on dairy farms in Western Europe, in the USA and Australia. Employment takes usually place during harvesting, when engineering projects are carried on or when not enough labour is on the farm for some other reasons. On the other hand, experience shows that Hungarian farm managers are not very keen to employ extra farmhands **(personal communication and experience)**. This is usually explained by complicated employment procedures, lack of money for extra vacancy or simply becoming accustomed to old methods. Time pressure, cost-cutting policies or changing weather conditions during other activities leaves little room for workers to focus on everyday activities with animals.

This is very likely that if extra professional (social, ethical, herd management, HR, PR) help was given to farmers, then even better results could be obtained. **WEBSTER (2005b)** claims that welfare can only be improved by forcing animal keepers through law. This has, however, some disadvantages due to documents, signatures, confirmations, checks, possible corruption and other forms of bureaucracy which could do more (psychological) damage to farmers than any good to animals. The first step in a strategy to improve animal welfare at the farm level is to conduct a risk assessment that identifies the main risks to animal welfare within a particular population of farms **(WHAY, 2007)**.

Voluntarily given advice to farmers resulted in highly significant improvements in cleanliness of all cattle groups. The advice also resulted in significantly to highly significant improvements of body conditions of thin younger calves, fat heifers and fat lactating cows. There was significantly less evidence of obviously-ill heifers reported and from very to highly significantly less neck rail injuries among heifers, dry and lactating cows. A decrease in the welfare was observed in older calves with highly significantly dirtier hindlimbs, highly significant and significantly higher number of thin heifers and lactating cows, respectively. A higher number of older calves with diarrhoea and more dry and lactating cows being obviously ill were estimated. More lameness and idling behaviours were found in lactating cows. A higher number of hock and knee lesions was discovered among older calves, heifers, dry and lactating cows. Finally, more neck rail injuries among older calves with more non-hock injuries in heifers and dry cows were observed. A total of 18 positive and 14 negative measures were discovered after providing farmers with dairy welfare solutions.

In the results value of 0.51% and 1.4% counts for difference of 1-2 heifers among 220 and 1-2 dry cows among 88 observed in average on 25 farms. The measure was included due to standardised tables and chapter layouts. Practically, none of farm manager would probably bother about it, because this is a very small number. Those results were found to be statistically significant and one can consider if they are actually professionally relevant. On the other hand there are farm managers for whom every single animal on the farm counts. The question should not be how many animals are for example with sign of sickness or if it is economically acceptable, but if the animal had live worth living and how it could be avoided.

WEBSTER (2005b) highlighted a few steps for taking right action regarding animal welfare in a modern (industrial) farming:

- To acknowledge and understand sentience in animals. However: That depends on each individual how ones receives the well-being of farm animals (education, ethical values). The dairy farmers are responsible to ensure adequate welfare standards. They have legal obligations under the Act on the Protection and Humane Treatment of Animals 32/1999. (III. 31.) about keeping animals for farming purposes and their minimal requirements about well-being.
- To breed and manage farm animals that can sustain fitness and avoid suffering throughout their productive lives. However, industrial farming or component traits of breeding indices are still weighted by their relative financial contribution to overall profitability and less by their contribution to welfare and other non-production traits **(THE DAIRY SITE, 2009)**.
- To establish an effective system of welfare assurance for farm animals. However, there are a number of assurance schemes in Western Europe, but there is no standardisation which makes consumers unable to make informed, safe, healthy and sustainable choices **(EUROPEAN COMMISSION, 2009)**. Moreover, only a few of the voluntary schemes currently operating in Europe are making a significant contribution to added value for consumers, farmers or their animals **(WEBSTER, 2005a)**.
- To increase public demand for real improvements in farm animal welfare. The best example could be the campaign in the UK in 2008 for promoting the advantages of producing free-range eggs **(FAWC, 2010)**. However, so far there are no campaigns in Eastern Europe about any animal-friendly farming.

Undoubtedly, the modern dairy industry, whatever the country of origin, needs to face the new challenges. Some of the challenges being repeated in dairy welfare publications and which are found in the present study are: heifers should calve at two years of age and at 520 kg, minimise the non-productive period (two months), increase conception rate to first service (>70%) and lifespan, decrease replacement rate (<20%/year), decrease involuntary culling (<10%/year) and to minimise suffering. Until the late 1990s' cows were bred mainly for high milk yields, however nowadays breeding programs incorporate more traits related to health and welfare. There are available breeding values for dystocia, fertility, lameness, mastitis and lifespan, but possible progress for each trait is 1-2% per generation **(THE DAIRY SITE, 2009)**. Genetics cannot be expected anymore to be the only tool to provide an adequate well-fare to cattle.

No one exactly knows what kind of future is in store for the Eastern European dairy industry. So far dairy products are included in welfare labelling schemes which can be found in Western Europe (e.g. Freedom Food in the UK, Label Rouge in France, Neuland in Germany or Scan in Sweden) but there is still no harmonisation of labelling across the European Union **(EUROPEAN COMMISSION, 2009)**. For the last 10-15 years there is a consumer- and legislation-driven trend with an increase of sales of animal origin products under the rules of labelling regulations **(WEBSTER, 2005b)**. If those (or similar) rules are going to be implemented in Hungary, actions should be taken in advance to search for issues which could compromise cattle welfare and consumer health. Animal welfare in Eastern Europe does not seem to be such a crucial issue like it is in Western Europe. This is because of either lower incomes of consumers who are unable to pay for higher value products or a lack of effort is taken by governments to promote animal welfare. If not retailers, then effective government policies should ensure a high standard of welfare for dairy cattle.

5. Limitations of the study

Due to the fact that the research was run by one person, farm visits took place in different parts of the year which could influence the welfare measures (e.g. silage temperature, surface conditions).

Only averages of welfare measures were recorded on the farms which allows for a comparison between the years (2010 and 2011) but not between farms because of a lack of varying data sets. This however did not disrupt the main aims to check cattle welfare, inform farmers about possible solutions for increasing well-being standards and to check the responses of as many farmers as possible.

Dairy advisers or other persons with experience in social marketing or improving animal welfare were not involved in the study which could affect the low effectiveness of motivating farmers to improve welfare.

Slippery flooring was checked by its physical characteristic (e.g. slippery vs. not slippery, grooved vs. not grooved). There is another—probably more reliable—method for checking slipperiness by checking the number (e.g. 100) of animals walking through the holding area, milking parlour and/or passageways. **Grandin (2011)** claims that if 1% falls down, then the surface should be considered dangerous for animals.

6. Conclusions

Assessment of Hungarian Holstein-Friesian cattle proved welfare status on 25 farms observed being not drastically different to those found in the literature. There were better and worse farms, but there were no uniquely bad and uniquely good farms. 25 Holstein-Friesian dairy farms were better managed in aspects like fewer cows with hair loss, non-hock injuries, hock and knee lesions and shorter flight distance. Similar distributions with other authors were found with dirty hindlimbs, dirty udders, bedding lameness, mortality and culling of lactating cows, lifespan and mortality of calves. The worst results in comparison to already-presented studies were dirty flanks.

Voluntarily given advice to farmers affected in highly significant improve in cleanliness of all groups of cattle and from significantly to highly significantly improve of body conditions of thin younger calves, fat heifers and fat lactating cows. There were significantly less obviously-ill heifers reported and from very to highly significantly less neck rail injuries among heifers, dry and lactating cows. Decrease in welfare was observed in older calves with highly significantly dirtier hindlimbs, highly significant and significantly higher number of thin heifers and lactating cows, respectively. A higher number of older calves with diarrhoea and more dry and lactating cows being obviously ill were estimated. More lameness and idling behaviours were found in lactating cows. A higher number of hock and knee lesions was discovered among older calves, heifers, dry and lactating cows. Finally, more neck rail injuries among older calves with more non-hock injuries in heifers and dry cows were observed. A total of eighteen positive and fourteen negative measures were discovered after providing farmers with dairy welfare solutions. Estimates found in the study confirm that farmers made compromises between improved cleanliness with better body conditions and ill cattle with injuries.

7. Further research

There were new barns and new cubicles implemented on some farms. Further research could investigate the profitability of investments regarding changes in lameness, welfare and other performance data of the herd.

Research could be undertaken to find out what the perception of Hungarian consumers is and how much they would be able to pay for ‘added value’ animal origin products.

A study should be done to investigate further solutions to improve cattle welfare and the image of the dairy industry in Hungary by encouraging farmers, retailers, consumers, niche dairy producers (local products, ewe, sheep and/or dairy) and representatives from the government and local authorities into the project.

Part 2. Lameness

8. Introduction

Lameness is a very important factor in dairy cattle because of its huge impact affecting health and decreasing productivity **(ENTING et al., 1997)**. The disease is second only to mastitis in terms of its detrimental effect on herd productivity **(ESSLEMONT and KOSSAIBATI, 1996)**. **VERMUNT and GREENOUGH (1994)** recommend that in order to relieve their feet and help reduce the prevalence and incidence of lameness, cows being kept on hard surfaces for long periods of time should be given access to areas covered with a softer surface. With a number of negative implications to welfare and productivity the diseases was considered by farmers taking part in the study to be one of the most important outbreaks to be improved. For that reason lameness was chosen to be the second topic of this dissertation.

To run the study, precise records of measures related to lameness were taken on the same 25 farms involved in the cattle welfare project. Investigations included: status of farms regarding their lameness prevention measures, relations between the occurrence of lameness, welfare measures and environmental factors, relations between number of orthopaedic blocks used by claw trimmers, welfare measures and environmental factors, rank of farms regarding changes in the occurrence of lameness, effectiveness of professional and on-farm hoof trimming in different conditions, correlations between the occurrence of lameness and conformation traits, effect of lameness on milk production and heritability of lameness. Lameness distribution and preventive measures were assessed on all farms and results were presented to farmers with possible methods for decreasing the number of lame cows. A visit one year later was performed and the differences in dynamics of lameness were measured.

9. Literature review

9.1 Description of the disease

Lameness in cattle is a symptom of certain illnesses and disorders of the leg or the claw and occurs in several clinically recognizable forms **(GREENOUGH et al., 2007)**. Lameness is usually associated with tissue damage, discomfort and is manifested as an inability to walk **(O'CALLAGHAN, 2002)**. Some misconceptions due to the ability of cattle to experience pain and the paucity of licensed veterinary products might aggravate welfare. What is more, farmers often underestimate the scope of the lameness problem within their herds **(WHAY, 2002)**.

Lameness has been recognized as a multifaceted condition **(ESPEJO and ENDRES, 2007)**, severely-decreasing animal welfare **(WEBSTER, 2001)** and is an important constraint to the dairy industry **(KOSSAIBATI and ESSLEMONT, 1997)**. Lameness is a major welfare problem of dairy cows **(WHAY et al., 2003)** and because of its negative impact on milk production is one of the most important outbreak of dairy cattle **(COULON et al., 1996; WARNICK et al., 2001)**. If antibiotics are administered, milk may have to be discarded **(BLOWEY, 1993)**.

Lameness is an economically important production problem **(KANEENE and HURD, 1990; ENTING et al., 1997)** and losses include reduced milk yield and quality, weight loss and death **(WEBSTER, 2001)**. Lameness has an impact on decreasing reproductive performance **(SPRECHER et al., 1997)** and increasing treatment costs **(WEAVER et al., 2005)**. The cost of premature culling is also highlighted **(ENTING et al., 1997).** Cows with low milk yield and lameness and hoof lesions are more likely to be culled **(SOGSTAD et al., 2007)**. Lameness is the reason for culling 16% of the dairy cows sent to slaughter in the US **(NAHMS, 2002)** and has an impact on decreased carcass value of culled cows **(VAN ARENDONK et al., 1984)**. However some authors disagree with the common opinion about the condition and its impact on culling **(DOHOO and MARTIN, 1984; BARKEMA et al., 1994; MILIAN-SUAZO et al., 1988)**. Some of them found associations of lameness with increased milk production **(COBO-ABREU et al., 1979; MARTIN et al., 1982; DOHOO and MARTIN, 1984)**.

Nevertheless, lameness has a very high prevalence **(CLARKSON et al., 1996)** with studies showing up to 30-60% of the cattle affected on some farms **(WHAY et al., 2003)**. Lameness has an association with pain **(WHAY et al., 1997)** and distress in dairy cattle **(WEBSTER, 1986)**. Claw health and locomotion are also compromised when dairy cows spend less time lying down **(HASSALL et al., 1993; PHILLIPS and SCHOFIELD, 1994; GALINDO and BROOM, 2002)**. **GRANDIN (2010)** concluded that lameness and ticks, particularly with teat lesions aggravated by the milking procedure, can cause cows to kick or step during milking.

The lame cows usually spent more time lying out of cubicles, spend less time feeding and have longer total lying times **(GALINDO and BROOM, 2002)**. Lame cows lose the ability to defend themselves and are pushed farther down in the herd's hierarchy **(BLOWEY, 2000)**. **LOGUE and OFFER (2001)** claimed that it is hypothesized that the increased length of the housing period may have adverse effects on cow lameness and leg injury. A study conducted by **HASKELL et al. (2006)** found that locomotion scores were higher on free-stall farms compared with straw yard farms. Additionally, there were more lame cows on farms without access to pasture than on grazing farms. **TOUSSAINT RAVEN (1985)** claimed that reducing the time on grass gives a less chance for a natural recovery.

It is quite hard to cure lame cows partly due to the difficulties of monitoring individual animals in large herds **(RUSHEN et al., 2008)**. Veterinarians are inclined to avoid working on foot problems, and producers are inclined to avoid seeking their assistance, even when veterinary expertise may be necessary **(VAN AMSTEL et al., 2006)**. **COOK and NORDLUND (2007)** claim that the rate of new cases of lameness can be `reduced to very low levels by good leg hygiene, comfortable transition cows' facilities, stocking density control and limiting the time spent milking. Lameness can also be reduced by proper stall design. An uncomfortable stall can cause perching which is a position of the cow standing or laying in the stall with rear foot in the alley. Lameness is more likely to occur in herds in barns with features that encourage perching **(ANDERSON, 2008). GRANDIN (2010)** pointed out the saying 'bad becoming normal' as dairy producers have become so accustomed to seeing a high incidence of lameness that they have accepted it as a characteristic of a normal dairy operation. **LEACH et al. (2010)** highlight that 90% of farmers did not perceive lameness to be a major problem on their farms, although the average prevalence of lameness was 36%. For 62% of the sample, lameness was not the top priority for efforts made to improve herd health. There are management tools available worldwide for preventing lameness.

Locomotion scoring

Mobility scoring has been developed to help farmers improve the detection of lameness and to stimulate treatment and prevention as part of a herd health program. **SPRECHER et al. (1997)** asserted that checking the mobility scoring is the first step for taking action for decreasing lameness in the herd. Checking all lesions, sole ulcers and other hoof problems is too labour intensive and would require putting every cow in a crush which would cause unnecessary stress for the animals. Automatic methods of measuring floor and foot forces or weight are not sufficiently developed for regular use. Gait scoring requires that cows can be easily seen, walking on a flat concrete and clean surface. There are several accepted scoring systems available, but observing lame cows and scoring them is subjective. One of them is a four-point mobility score **(WHAY, 2002)** when evaluation involves observing the animal while walking and identifying foot placement and length of stride. Generally, a long, fluid stride where the rear foot falls into the position vacated by the front foot on the same side characterises a normal locomotion. Undesirable locomotion is thought to occur when the rear foot is placed outside the imprint of the front foot, when there is a reduction in the stride length, and decrease in step angle and walking speed.

The incidence of lameness is very different between farms and this is because of different sources of the survey materials **(BLOWEY, 1993)**. There are no standardized assessment criteria, so there is some degree of misclassification in the results **(WATSON, 2007)**. Observing lameness in cattle and scoring abnormalities in locomotion depends on the scoring system used, different observers and subjectivity **(AMORY et al., 2006)**. Examples of unclear descriptions are: "...obvious lameness, some difficulty turning..." **(MANSON and LEAVER, 1989)**, "...slightly lame...markedly lame..." and "abnormal locomotion/tender footed...lame...". The system developed by **SPRECHER et al. (1997)** has understandable, objective descriptions of posture and gait for scoring. This also includes subdivisions between sound and clinically lame cows. The system contains five categories of increasing severity. The first describes a normal locomotion and only considers the back position (flat while walking and standing). Another one describes a mild abnormality only visible when the animal walks when the back is arched. The last three scores classify a bovine as lame when the animals are arching the back while standing and walking. Using a locomotion scoring system seems to be a useful tool for lameness monitoring and its changes over the time.

There are studies checking how lameness is linked to management factors. If advising for Hungarian dairy farmers is going to take place, there should be a full understanding of any relationships between husbandry conditions and the prevalence of lameness. Dairy farming in every country differs and it is very likely that there are some areas of management on Hungarian dairy farms that are not related in the same way as other published management differences so far abroad. Knowledge about conditions that cows are kept in and their impact on bovine locomotion is increasing gradually. **AMORY et al. (2008)** reported that automatic scrapers were associated with elevated locomotion scores. Many modern Hungarian dairy enterprises consider scrapers as a useful tool for pulling the manure out from the barns. Are scrapers making cows lamer in Hungary? **SOMERS et al. (2005)** asserted that cows with restricted or no access to paddocks had an increased risk of digital dermatitis. Most of the Hungarian dairy farms are not capable to provide cows with paddocks where cows could walk freely on the soil or grass. Are farmers really compromising bovine locomotion?

Hoof trimming

The general aim of the trimming technique is to increase the hoof angle to induce a forward shift in weight bearing, particularly in hooves with overgrown toes **(TOUSSAINT RAVEN, 1985)**. This restores the balance of weight between the points of the foot and reduces the forces on the sole ulcer site. Proper trimming requires the right crush and herding the cows into it should not take more than a few seconds. When hoof trimming is to be performed on-farm, then specific training should be given. The alternative option is a trained and competent trimming service **(FAWC, 1993)**. Similar advice about trimming is given by **EFSA (2009)** that claw trimming should be carried out with care by professionally-trained and certified personnel. **WELLS et al. (1999)** reported a decreased risk of digital dermatitis when hoof trimming equipment was washed between trims and an increased risk when farmers used the same hoof trimmer which trimmed cattle on other farms without being washed. The same author concluded also that routine trimming of all cows only twice a year is not enough and cows should be treated between trimmings as well. Those cows which were trimmed twice a year only were lamer in comparison to cows trimmed two times a year with control treatments between general trimmings. This may be because lame and unsound cows were left untreated until the next visit by the professional claw trimmer. Another possibility is that inadequate hygiene of hoof trimming equipment or poor hoof trimming technique after led to lameness after trimming. There is no scientific knowledge what kind of trimming methods are performed on Hungarian farms and what kind of results are obtained. In the time of cost-cutting policies on dairy farms it is very likely that significant numbers of farmers are trying to change currently employed trimming services for farm workers. Employers should motivate workers to take part in training courses. In an ideal scenario, training should continue throughout the duration of the employment with refresher courses if necessary. The question is how many farm workers are really taking courses related to animal husbandry.

Use of orthopaedic blocks

Extremely affected hooves can be given relief by shifting the weight-bearing surface off affected lesions to promote healing and recovering. There are two ways of doing that, either by leaving the unaffected hoof untrimmed higher than the affected hoof or by applying a wooden, plastic or rubber orthopaedic block to the healthy claw. One of those methods should be applied every time the corium is exposed. If possible, the cow with the orthopaedic block is best kept on concrete after trimming so the affected claw does not sink into mud, manure or dung. **HIGGINSON et al. (2011)** asserted that orthopaedic blocks make no differences in lame cows with number of steps taken, in lying duration or bouts. However, the commonly used orthopaedic blocks lose the perpendicular placing, slope towards the axial cleft resulting in secondary hoof horn lesions when cows walk intensively not allowing enough time for lesion recovery. For that reason larger angle-adjusted blocks maintained their original shape and position longer resulting in fewer secondary hoof horn lesions **(BURGI, 2011)**. Blocks used are not direct indicators of overall prevalence of lameness in herds, but can give an idea how many cows are found with the most severe lesions. So far there was no publication found covering reasons for elevated use of orthopaedic blocks.

Foot bathing

Throughout a large portion of the year, infectious causes of lameness are commonly managed with routine cleaning of facilities as well as the use of well managed foot baths and spraying feet in the milking parlour. Although foot bathing and correct foot trimming can certainly improve locomotion, the presence of such equipment on a farm is not sufficient if not used or used improperly. There is need to check what kind of foot bathing is used and how it helps to decrease prevalence of lameness.

Facilities

The risk assessment published by **EFSA (2009)** showed that the most important management hazards causing leg and locomotion problems are those related to inadequate care and monitoring of foot health and hygiene. There is a number of management issues which might not be followed or implemented incorrectly. One of them is the number of stalls in free-stall barns which should be considered to provide an additional 5% (**WECHSLER et al., 2000)** to 10% **(FAULL et al., 1996)** of stalls, so all cows have a free access to the resting area. More cubicles provide more options for cows to take place, so their hooves are not affected by prolonged standing. This happens when a cow higher in the hierarchy is blocking the way or access to the cubicle to other subordinate animals.

GJESTANG et al. (1980) suggest that cows should be provided with surfaces which are not causing their hooves to wear out too fast and which are not too slippery. New, sharp and rough concrete is more likely to harm hooves. Dragging heavy blocks of concrete was found to be an effective way for making new concrete less sharp **(SOGSTAD et al., 2007)**. For slippery and old concrete, the solution is to use heavy-duty grinders which create grooves to prevent slipping.

Heifers

In herds where first lactation groups were managed separately, lameness prevalence was half than observed in mature cows **(COOK, 2003)**. Newly introduced animals to the herd are experiencing stress and have to find their position in the herd hierarchy. Interactions between animals might cause the new animals, when scared, to slip on the concrete. Furthermore the introduced animals might not immediately find a position in the cubicle which, when prolonged, could affect their locomotion. The impact on concrete in comparison to straw is very important. **Webster (2002)** observed that heifers housed in straw yards over the last four weeks of gestation and over the first eight weeks of lactation were less lame than those kept in free stalls on concrete. What is more, trimming the hooves was found to be helpful with decreasing occurrence of lameness in lactating cows **(MANSKE et al., 2002)**.

Production

Lameness was reported to be associated with a reduction in milk yield **(JUAREZ et al., 2003; ARCHER et al., 2010)**. **WARNICK et al. (2001)** discovered that interdigital phlegmon was associated with reduced yields before treatment. A reduction in mobility occurred four to eight weeks after cows had started to reduce milk yield and an increase in milk yield occurred approximately six weeks after a cow was cured from lameness according to the research of **READER et al. (2011)**. When cows become lame and a delay in treatment probably leads to a reduction of milk yields because of the increased metabolic demands from pain and reduced feed intake. Most dairy farmers underestimate the occurrence of lameness and do not have a logical way of detecting the illness. It is very likely that on Hungarian farms there is some relationship between production data, the stage of lactation and lameness which could be predicted and prevented.

The weather and changes over the months

WILLIAMS et al. (1986) noticed a relationship in patterns of lameness which were partly explained by differences in moisture caused by rainfall. **GÓMEZ et al. (2003)** also argued that high temperatures with high humidity are responsible for damaging factors which can lead to foot rot because of easier bacteria development. Conversely, **COOK and NORDLUND (2007)** claimed that January, February, March and September were the months where lameness was observed at the highest rate. Cold weather during the late winter may lead to manure handling problems in the alleys and reduced frequency of foot bathing, causing more lameness problems. There are very warm and dry summers with cold and wet winters in Hungary, so maybe there is some relation between lameness and the time of the year as well.

Genetics

GREENOUGH et al. (2007) state that a huge impact on lameness was caused by the genetic selection of dairy cows. Over twenty to thirty years the genetic potential for milk production in Holsteins has doubled. However, genetic selection was not focused on with non-production traits like locomotion, resistance to lameness and other factors that contribute to longevity and functional efficiency **(BOELLING and POLLOTT, 1998a)**. Heritability of hoof diseases is low, as for other diseases, ranging from 1% to 25% across traits **(NAESLUND et al., 2008; VAN DER WAAJ et al., 2005)**. However, conformation traits for feet and leg have considerably higher heritability **(BOELLING, et al., 2007; REINHARDT, et al., 2005)**. The heritability of lameness is thought to be low, but selection for high milk yields tends to increase lameness. On the other hand, it has been shown that daughters of some bulls were more likely to suffer claw lameness than those of other sires and it would be sensible to select bulls on the basis of clinical lameness **(MALMO, 2012).**

Variation in feet and leg disorders is associated with environmental effects like changes in housing and management. However, studies already have discovered a genetic impact of lameness on feet and legs **(O'CALLAGHAN, 2002)**. Therefore, selection could be used to decrease the incidence of leg problems. Traits used in dairy selection are relatively inexpensive to record. Conformation assessment is taking place usually in the first third of the first lactation. Type traits provide only an indication of susceptibility to lameness. How the particular trait will evolve was the aim of the research of **BOELLING and POLLOTT (1998b)**. The authors found that hoof traits and locomotion showed variation between years and were influenced by seasonal factors as well as the age of the animal, with the exception of foot angle. Additionally, the most noticeable relationship was found between locomotion and rear leg side view conformation trait.

Feeding

Nutrition has significant influences on hoof health in dairy cattle. So far studies related to feeding and laminitis are not giving promising conclusions **(WESTWOOD et al., 2003)**. Prolonged rumen acidosis (pH below 5.5) is considered to be the predominant predisposing cause of chronic laminitis **(LEACH et al., 2005)**.

9.2. Improvements with lameness

Investments

Staying in business, being able to cope with legislative, national and global market demands requires investments. In 2009-2012 many Hungarian dairy farms made the technological modernization on farms (manure treatment, barn and milking parlour reconstruction, etc.) which was co-financed by the European Agricultural Fund for Rural Development. The scientific opinion of **EFSA (2009)** states that since leg disorders are the major welfare problem for dairy cattle and leg disorders are a problem also in well-managed cubicle houses, alternatives to cubicles e.g. straw yards and improvements to cubicle house design should be considered. The authority's document provides information that foot and leg disorders are substantially more frequent in cattle when kept in cubicle houses than in straw yards. In the study of **SOMERS et al. (2003)** cows and heifers kept in a straw yard had less sole haemorrhages and other hoof disorders than those in cubicle houses. Another assessment of **EFSA (2009)** asserted that the risks with adverse effects are approximately twice as great in cubicle systems as in straw yards. If keeping cows in straw yards is responsible for more mastitis problems and cubicles for more lameness cases, then farmers are making a choice between two welfare measures. Is it better to have more cows with good locomotion and more mastitis cases or vice versa? In case of antibiotic treatment of mastitis (most commonly intrammary infusion, rarely systemic treatment of subcutaneous or intramuscular injection) milk does not only have to be discarded due to the withdrawal period but for deteriorated milk quality. Lameness is hard to cure and a drop in milking and fertility performance and dry matter intake are observed.

AMORY et al. (2006) and **BARKER et al. (2007)** reported that farmers underestimated the occurrence of lameness and this is very likely to be similar in Hungary. If farmers are shown statistics comparing particular husbandry parameters and the prevalence of lameness on farms, then the farmer recognises that there is a chance that the lameness issue will be understood better. The research will check how perceptions of researchers and farmers regarding changes in lameness differ. What is more, **ARCHER et al. (2010)** pointed out that looking to the future there is need for intervention studies on commercial farms that can be used to estimate the cost effectiveness of changes in farm buildings, floors and management of all cows and lame cows.

9.3. Using social marketing for decreasing the occurrence of lameness

In one of the projects **LEACH et al. (1997)** farmers were asked why new lameness management strategies have been not implemented. The answers were that because of lack of time, skilled labour or the task being repeatable and boring. The limitations of time and labour are likely to increase in the current economic climate, so the practical steps taken will need to be possible within these constraints **(LEACH et al., 2010)**. The other fact why the farmers are unable to make a significant difference is fear of spending money and possibility that new management might simply not work. In Hungarian conditions, decisions depend on the head of the enterprise or the owner who is not always the herd manager. In those cases the first questions arise – how much does it cost and how much money will we make (how much more milk will there be)? A solution for that would be free or very cheap actions, like cleaning the surfaces cows are walking on more often, maintaining floors which are slippery and contain holes, using rubber where the cows are walking the most. When the first improvements would be seen in locomotion, in milk production or in the average number of lactations, it is very likely that further actions would be more appreciated.

For successful improvements with lameness **KNUDSEN (1997)** is recommending facilitation. This is a method when a researcher (advisor) and a farmer are walking around the farm and any particular aspects of the farm that might be risk factors for lameness are discussed. There is an opportunity to share the experiences of other farmers by explaining the actions they have taken already. An action list might be left on the farm for the coming year with the changes that could be done by a particular individual on the farm. Additionally, farmers might be given verbal descriptions, photographs and comparisons of changes on other farms. These might be very promising motivation tools. If some procedures worked on other farms and has been proved, there is a higher chance they might be implemented again somewhere else. The fact that farmers know about other farmers, also working against lameness, helps to realize that the improvement is important for the industry and action needs to be taken. **GRANDIN (2010)** claims that showing what the financial cost of lameness is, does not make a significant difference in making changes in behaviour related to a welfare increase. On the other hand, in one of the projects farmers who received a small amount of money or a small gift as a contribution for taking part in the action, a higher level of behaviour change was observed. The idea of extra payment for keeping low level of leg problems was successful in Sweden, what was found by **ALGERS and BERG (2001)**. Chicken producers in this country were paid by number of foot-pad dermatitis in the birds at the time of slaughter. During the first two years, the prevalence of locomotion problems decreased from 11% to 6%.

9.4. Encouraging farmers to decrease lameness

The dairy cow industry in the UK is encouraging farmers to score their cows' mobility. So far lameness control is run by one of the retailers over there **(TESCO FARMING, 2011)**. The supermarket is not paying for lower level of lameness, but producers are reminded that as part of the contract they will be required to score their herd every two months and record the details to produce an improvement plan as part of their veterinary plan. It is also a requirement to arrange for an independent consultant to visit the farm and score the herd on an annual basis. From a commercial point of view mobility is important as it has the potential to influence the thoughts of consumers – if they see a lame cow; they may think the entire farming operation is bad. The retailer’s website says that as lameness is in the top three reasons for culling; dairy substitutes are expensive and dropping milk prices caused the retailer to find an idea for cutting costs by improving the cows’ locomotion. Unfortunately, the retailer did not agree to share the results about the effectiveness of that program **(MAIN – personal communication)**. A very similar attitude about lameness can be found in Germany, Holland, Belgium or Sweden. Governments are paying extra money when dairy cows are let to graze for a particular minimum period of time during a year. This is more a welfare issue by giving cattle chance to graze, but **TOUSSAINT RAVEN (1985)** claimed that increasing the time for grazing gives a greater chance for the legs to naturally recovery. A more radical approach is used in Holland where the dairy industry, based on the EU legislation (EC 853/2004) which requires milk to come from cows in a "good state of health", accepts milk only from healthy cows. It is the responsibility of the farmer to separate and destroy milk from sick cows including cows that are severely lame. The general animal health status is checked by veterinarians on a regular basis. There is no penalty for individual sick or lame animals, other than that the milk of these cows must be kept out of the milk tank. This is not a penalty but compliance to EU legislation **(Montessori, Programme manager at Dutch Dairy Organisation – personal communication)**.

There have been few improvements in the management of lameness in dairy cattle. **AMORY et al. (2008)** states that management plans to minimize lameness in dairy cattle have not yet been developed because the research evidence is not robust enough to provide such a plan. Whatever the scope of lameness is reported on the farm, it is important to be aware of the costs associated with lameness and to make sound management decisions to best minimize those costs and maximize profitability.

9.5. Objectives

This thesis focuses on the risks for an increased mean locomotion scores in Hungarian Holstein-Friesian herds; that is, a high prevalence of lameness from any cause. The following independent aims (studies) were included:

1. To evaluate the status of farms regarding their lameness prevention measures
2. To investigate relations between the occurrence of lameness, welfare measures and environmental factors
3. To observe relations between number of orthopaedic blocks used by hoof trimmers, welfare measures and environmental factors
4. To rank farms regarding changes in occurrence of lameness

5. To examine effectiveness of professional and on-farm hoof trimming in different conditions
6. To quantify correlations between the occurrence of lameness and conformation traits
7. To estimate effect of lameness on milk production
8. To assess heritability of lameness

Supporting aims were followed:

- To observe what kinds of changes are observed before the onset of lameness and if it can be predicted
- To investigate the most important reasons of occurrence of lameness in Hungary and what kind of advice to farmers can be proposed
- To examine how changes in husbandry systems affected the occurrence of lameness and how farmers perceive lameness status on their farms after investments

10. Materials and methods

Owners and managers of the same 25 farms recruited to the previous study about cattle welfare in Hungarian Holstein-Friesian herds agreed to take part in the project about lameness prevalence.

10.1. The status of farms regarding their lameness prevention measures

During visits for welfare purposes from May to December 2010 and from May to December 2011 the potential risk areas for increasing lameness, the changes between years and the comparison with international results were examined. The measures came from international literature information about prevention solutions against lameness. The aim was to estimate how Hungarian dairy farmers are prepared to cope with lameness. Each visit required a conversation with the farm manager and his or her help with examinations on the farm. After the first visit each farmer received a lameness report (Appendix 2) about his or her performance in comparison to the rest of the farms with possible solutions how to sort out a particular weak area.

10.1.1. Lameness measures taken for lactating cows

Foot bathing and solutions used

Definition: Number of foot baths per week with name of solution without measuring concentration of the fluid.

Reason: Foot bathing is a process of removing erosive materials from the foot, disinfecting the skin above the hooves, drawing moisture from the hoof and hardening it by regular use of antibiotics, formalin, copper sulphate, peracetic acid, hypochlorite or parlour wash. If used often or in high concentration, it can have burning effects on the skin.

Hoof trimming methods and its frequency

Definition: Restoration of appropriate weight bearing within and between the hoof of each foot and early identification of claw lesions. Categories: no trimming, trimmed by stockman, trimmed by professional hoof trimmer. Types of treatment (antibiotic spray, Hoof-fit, etc.), types of disorders (digital dermatitis, white line separation, etc) were not registered. Professional hoof trimmers were using Dutch Five Points Functional Claw Trimming method; on-farm claw trimmers were using their own methods. Frequency of (professional and on-farm) claw trimming refers to herd level and it did not included individual treatment of severely lame cows. There was no problem to differentiate between routine trimming and extra treatment of severely lame cows.

Reason: Trimming in general is considered to be one of the most effective ways of keeping hooves healthy.

Records of lameness cases

Definition: Any data including the date, cow number, foot affected, hoof affected, condition identified, treatment given and result.

Reason: Full and accurate records are useful in identifying and dealing with the leg problems in early stages. This is also a reliable tool for observing changes in lameness.

Housing type

Definition: Free stall – barn with cubicles (lying places divided with wooden, metal or plastic bars where cows take voluntarily places in parallel pattern). Straw yard – a barn with the entire area covered with straw.

Reason: Both types of housing are considered to be appropriate regarding lameness if adequate maintenance is performed. There is less straw needed in free stalls and cows are reported with lower number of Somatic Cell Counts. However, poorly designed stalls can motivate cows in extreme situations to stand or to lay half in a cubicle and half in a passageway in manure **(COOK, 2003)**. Straw yards are correlated with an increase of Somatic Cell Counts, but provide better resting comfort, if dry and soft bedding is provided **(BARBERG et al., 2007)**.

Bedding material

Definition: Straw, corn stover, straw and corn stover.

Reason: Given a choice, cows spent longer time lying and had lower incidence of lesions in cubicles deeply bedded with straw, sawdust or sand in comparison to cow on mattresses **(FAULL et al., 1996; TUCKER et al., 2003)**.

Scraping method

Definition: Automatic scraper or tractor-mounted scraper.

Reason: Passageways scraped by a tractor were linked with fewer lame cows. In contrast, automatic scrapers were correlated with increased incidences of the lame cows **(AMORY et al., 2006)**.

Passageway width and quality of surface next to cubicles and feeders, feed space

Definition: Width of passageways in front of cubicles and feeding troughs. Grooving: non-grooved solid concrete, grooved solid concrete. Surface quality: 1 – relatively dry, no holes not slippery; 2 – wet or some holes or slippery; 3 – wet, some holes and slippery. Number of cows per 1 metre of accessible feed trough.

Reason: In passageways wider than 300-350 cm slurry and dung is spread over a larger area, so the level of contamination is not influencing cows' legs as much as in passageways narrower than 3 metres. **(BARKER et al., 2007)**. In the case of feed space, competition for limited resources creates a threat in which cows push each other and can damage their hooves or simply slip. A non-grooved surface less traction for hooves and more slipping is observed which affects limbs, joints, muscles, tendons and hoof structures. Grooved concrete allows cows to take sharp corners without compromising stability **(BARKEMA et al., 1994)**.

Extra free stalls

Definition: Percentage of extra stalls in free stall barns available for cows.

Reason: New animals (especially heifers) introduced to a new herd can find empty cubicles with less effort and avoid prolonged standing **(BOWELL et al., 2003)**.

Lunge area

Definition: Lunge area – area in front of the cattle.

Reason: Needed for not disturbed weight shift forwards before standing.

Brisket board

Definition: Metal bar or wooden board in cubicle discouraging forward movement when a cow is resting.

Reason: Brisket boards preserve lunge space, minimize the change of striking the stall structure when rising and are thought to minimise soiling of bedding by properly positioning cows in cubicles.

Free stall width and length

Definition: Free stall width and length.

Reason: **TUCKER et al. (2004)** found that stall width increase from 110 to 130 cm decreased perching (standing or lying half in cubicles and half in alleys).

Neck rail position

Definition: The bar over the laying animal in a cubicle, positioning the cows to avoid soiling. Vertical – from rail to curb (cm); horizontal – from rail to surface (cm).

Reason: Thought to be useful in controlling perching behaviour, but kneeling and collisions are possible if the neck rail is mounted too low.

Rising

Definition: Starts when the animal lifts the hind quarter off the ground. The rising sequence ends when both front legs touch the ground and the animal stands with its whole body weight on all four legs. Ten animals per barn on the farm observed when rising. Then the average taken: 1 – unrestricted, 2 – mildly restricted when they modified their rising behaviour to stand up comfortably and take time, 3 – seriously restricted when they took time to stand up, dog-sitting position, when animals are sitting on their hind quarter with front legs fully stretched and when they rise on to their forelimbs before their hindlimbs and often hit fittings when rising.

Reason: Checking natural movements of rising for estimating quality of resting area.

Access to water

Definition: Easy access – level, open area with no obstacles, dry and firm surface and with easy access minimum from three directions. Limited – water trough higher or lower than normal level for the cow or step in front of trough located in a wall or between two construction elements or wet surface with holes and pools of manure.

Reason: Limited access to water troughs or feedstuffs increases risks that animals should have to walk unnecessary distances. Other aspects are higher-ranking cows scare other animals which can cause sudden movements affecting locomotion.

Ventilators

Definition: Presence of ventilators.

Reason: The percentage of cows standing increases as environmental temperatures increase **(SHULTZ 1984)**. A good air exchange will remove moisture from the building and help keep the stall and floor surfaces drier. Moisture is responsible for faster claw damage by softening the hoof and is a favourable environment for bacteria development.

Milking parlour

Definition: All areas in milking parlour considered to be compromising locomotion. Grooving: non-grooved solid concrete (smooth), grooved solid concrete (rough), rubber. Degree cows need to turn around in milking parlour – from 45° (fishbone milking parlour) to 135° (rotary milking parlour). Steps – any unpredicted and disrupting for cows steps higher than 5 cm. Smooth turns – any smooth turns (<90°) on the way out from the milking parlour and insemination parlour.

Reason: Cows in holding areas are crowded and push each other which significantly wears down the hooves. Proper grip, lack of contamination and holes are the most important characteristics of surfaces. It is best if cows do not have to turn sharply on concrete and there are no steps. If crowded and rushed, a significantly higher number of cows might be found slipping or injuring their legs.

Silage

Definition: Silage exposure – percentage of silage clamp wall exposed to changing atmospheric conditions. Dark layer at top of clamp – moulded and rotten part on the top of the silage clamp. Mould on clamp face – depth (cm) of a dark rotten layer at the top of the silage clamp. Clamp tidiness: clean – no water, no rotten mouldy silage, no strings, no soil in front of the silage clump, dirty – water or rotten mouldy silage or strings or soil in front of the silage clamp. Clamp temperature – mean of five temperature readings across clamp face checking the fermentation process. Big bale damage – percentage of big bale damage – the bales cows are eating directly from and the bales which are used for making TMR – brown to black, tobacco or ammonia smell, too dry, too wet, rotten.

Reason: Feeding corn silage was found to be related to an increase in the mean locomotion score what can be explained by cases of rumen acidosis disrupting horn production **(MULLING et al., 1999)**. **FAYE and LESCOURRET (1989)** demonstrated that any interruptions with feeding can influence dynamics of lameness.

Access to pastures or paddocks and track conditions

Definition: Housing system – zero grazing, access to pasture or paddock.

Shade – Access to the shade for all cattle throughout the entire day. Distance from building to pasture or paddock (m). Width of track to pasture or paddock – (m). Track camber – camber on the track for flowing down of the water. Stones on track – any stones creating a risk for hoof damage (e.g. small stones on concrete). Sharp turns – any corners compromising claw composition or disrupting the flow of cows. Gateway condition – good: wide, soft and clean surface, no sharp corners, obstacles and stones, bad: narrow, hard and dirty surface, sharp corners, obstacles and stones.

Reason: **BIELFEDLT et al. (2005)** reported that a supplement for zero grazing housing would be outdoor exercise to give a chance for the natural hoof recovery. Nevertheless, the quality of walking surfaces needs to be taken into account when allowing dairy cattle to have an access to pastures.

10.1.2. Lameness measures taken for dry cows

Housing

Definition: Kept in cubicles or straw yards.

Reason: Dry cows kept in stalls with access to straw yards during the dry period have more chance to recover by lying in softer and more comfortable positions than in cubicles **COOK (2003)**. However, **SINGH and WARD (1993)** believe that cows kept in straw yards around calving when come back to the milking groups kept in stalls experience shock when walking intensively on concrete again.

10.1.3. Lameness measures taken for heifers

Adaptation period

Definition: Period given to heifers in a separate barn or with dry cows before calving.

Reason: Heifers gradually introduced to the herd find it easier to take positions in cubicles. There is less time spent standing and the effect on their hooves is reduced.

Trimming heifers

Definition: Trimming heifers a few months before calving.

Reason: Trimming heifers sets them up for their entire lactation by shaping their hooves to sustain their feet in the following milking years.

10.2. Relations between the occurrence of lameness, welfare measures and environmental factors

The measures observed (11.1.) were then correlated with reported occurrences of lameness using the Spearman Rank Correlation test to determine the strength of that relationship, as long as both variables were quality variables and if the variable had more than three stages.

For estimating the differences between a group of two or more distributions an analysis of variance of these distributions was performed. Finally in the case of frequencies and lameness distributions, the Chi-square test was run. During the same visits, all cows leaving the milking parlour after the morning milking were observed for occurrence of lameness. Cows were checked when walking on flat, clean concrete which was free of mud, muck and other contaminations which could cause cows to walk abnormally. For that reason the locomotion scoring system developed by **SPRECHER et al. (1997)** was used (Chapter 3.3.1.). This method has understandable objective descriptions of posture and gait for scoring. This also includes subdivisions between sound with imperfect locomotion and clinically lame cows. The system contains five categories of increasing severity. The first describes a normal locomotion and only considers the back position (flat while walking and standing). Another one describes a mild abnormality visible only when the animal walks when the back is arched. The last three scores classify a bovine as lame when the animals are arch their back while standing and walking with more visible gait abnormalities. Researchers consider lame cows to be the ones with scores 3-5 **(CLARKSON et al., 1996; SPRECHER et al., 1997; COOK, 2003)**.

For measuring intra-observer variation a video camera was used and fifty cows were randomly recorded with notes about their score. The recorded video had been watched after the farm visit. The results from that observation and the one on the farm were compared for estimating repeatability of lameness judgement ($r = 0.83$, $P<0.05$). The following formula for calculating the repeatability coefficient with data obtained from Excel for Windows and SPSS 13.0 for Windows **(SPSS, 2004)** was used **(SOKAL AND ROHLF, 2012)**: $r = S^2A/(S^2 + S^2A)$; S^2A – variance between group; S^2 – variance within group.

10.3. Relations between number of orthopaedic blocks used by hoof trimmers, welfare measures and environmental factors

Cooperation with the leading professional trimming company helped to obtain the information about the number of orthopaedic blocks used during trimmings on 15 out of 25 farms in 2010 and 2011. The number of blocks was transformed to units of blocks/100 cows (lactating and dry). All cows leaving the milking parlour were observed for the occurrence of lameness following the method in chapter 11.2. Environmental factors considered were described in chapter 11.1. Then there was the possibility to run a Spearman Rank Correlation test, analysis of variance and Chi-square test to determine the strength of relationships between the number of orthopaedic blocks used on farms and environmental factors.

10.4. Rank of farms regarding changes in the occurrence of lameness

During and between visits, farmers were given suggestions on how to minimise the risk for lameness occurrence. The observations of the 25 farms in two years with explanation of lameness prevention solutions affected in creating a rank of farms with their successes in dealing with lameness. Average lameness occurrences were put together in a rank from the greatest decrease to the greatest increase in an average percentage of lame cows on each farm with significant differences between 2010 and 2011.

10.5. Effectiveness of professional and on-farm hoof trimming in different conditions

Farms and animals

Detailed investigations of trimming methods helped to rank farms according to their effectiveness in decreasing the number of lame cows in different circumstances. Similarly to previous parts of the current study, 25 Holstein-Friesian herds were observed. Two farms were found with no changes and cows were trimmed by on-farm trimmers as well as five farms with no changes with professional hoof trimmers employed. On four farms engineering projects were carried out (1 – milking parlour renewed, 1 – automatic scrapers and 2 – straw yards swapped for free stalls) and the on-farm trimming team was working. On three farms there were also engineering projects (1 – cubicles in one of the barns renewed and 2 – straw yards swapped for free stalls) but professional workers were employed. Two farms had exceeding levels of the following mycotoxins and these mycotoxins were observed: *Aspergillus flavus* toxin total > 0.005 mg/kg, T-2 > 1mg/kg, Zearlaenon > 0.15 mg/kg, DON > 2.5 mg/kg and an exceeded level of *Clostridium perfringens* > $1x10^2$ cfu/kg (Appendix 3). On one farm a relatively high level of urea in milk was reported (43 mg/dl). Finally, on one farm, a probable TMR imbalance was observed. On three farms there were changes of trimming services. On the last four farms there were no changes (2), cubicles were renewed (1) and there was change in trimming (1), but on those farms the differences were reported to be not significantly different. Eleven on-farm trimming teams and four professional teams (companies) were judged.

Measurements

All cows leaving the milking parlour were observed for the occurrence of lameness following the method already described in chapter 11.2.

Statistical analysis

Lameness estimations were put together into Excel for Windows. The results from 2010 and 2011 were compared using SPSS 13.0 for Windows by running a Chi^2 test using the number of cows in particular scales form 1 to 5 **(SPSS, 2004)**. For checking the significance between changes on farms with on-farm trimmers and professional services, univariate analysis of variance was used.

10.6. Correlations between the occurrence of lameness and conformation traits

Out of 25 farms, 5 farms were selected for precise observations to measure correlations between the occurrence of lameness scores, body condition scores and conformation traits. Judge from the Hungarian Holstein-Friesian Association observed heifers at 15-18 months of age. Conformation recording recommendation integrated with the World Holstein-Friesian Federation guidelines on the international harmonisation of linear type was used. Linear classification is based on measurements of individual type traits instead of options. It describes the degree of trait not the desirability. Depending on age of cows locomotion scores were observed from one up to several years after the traits were observed. Every month from May 2010 to November 2011, five cows from the first lactation and five cows from second lactation were selected which gave a total of 826 cows. In some months there were less than five cows calving. During the visits the cows on the farm were judged for their locomotion score and body condition score. A 5-point scale locomotion score of dairy cattle was used which was described earlier (Chapter 3.3.1.). The cows were observed in the barns and were provided with relatively dry, unobstructed concrete surfaces. Cows which were found in the cubicles were given a few minutes to recover after standing up, so the impact of muscle cramps would not affect the cows' locomotion. For evaluating the body condition score, a 5-point scale condition score of dairy cattle published by **(EDMONSON et al., 1989)** was used. For measuring intraobserver variation notes were made at the beginning of the observation. Half of the cows were observed for the second time at the end of each visit and the results were compared with the first observation. The number of cows observed twice ranged from five (during the first visit) up to sixty (during the last visit, if no cow left the farm).

Repeatability coefficient **(SOKAL AND ROHLF, 2012)** (chapter 11.2) for locomotion scores was r=0.87, P<0.05 and for body condition scores r = 0.92, P < 0.05. The cows were observed for one and a half years, which means the animals were observed in different production groups (barns), stages of lactation and during dry period as well. Culled and slaughtered cows were included in records. All lactating cows entering the milking herds were judged at 15-18 months of age by the judge from Hungarian Holstein-Friesian Association. Production data and type traits reported were retrieved from the RISKA farm herd management software. Data was collected and transformed in Microsoft Office Excel application. A table was prepared and put into SPSS 13.0 for Windows **(SPSS, 2004)**. For calculations, the Pearson correlation coefficient between type traits and lameness score, and its associated significance value (p) was used to interpret the correlation between measures.

10.7. Effect of lameness on milk production

The material and methods from chapter 11.6 were used to find associations between lameness scores, body condition scores and monthly calculated milk yields of 826 dairy cows on five farms. Production data was also retrieved from the RISKA farm herd management software and contained: milk yield, percentage of fat, protein and somatic cell count. The dataset contained a farm ID (1-5), cow ID, parity (1-3), months of lactation, body condition score (1-5), lameness score (1-5), clinically lame and not lame (1=lame=lameness score 3-5; 0=not lame=lameness score 1-2), never lame (1=lame at least once; 0=never lame during the observational period), lame for the first time (1=lame for the first time; 0= already lame or not lame in time of checking), and monthly calculated milk yield. BCS, LS and milk yields were also coded with observations up to five months before and up to five months after observed lameness for each three parameters. The Kolmogorov-Smirnov test of normality for a sample size of more than hundred was used to measure milk yield data which was found to be normally distributed (P>0.05). The occurrence of first lameness by month in milk was plotted, and the mean lactation curve for cows that were never lame and cows that were clinically lame during a lactation (ever lame) was compared visually in Excel for Microsoft. Data was collected and transformed in the Microsoft Office Excel application. Different linear models were used to evaluate the traits. For the analysis of milk production data, two linear models were used. Model I included five locomotion scores effects from the two months before and up to two months after the milk production data: (Milk = Cow[a)] + Farm[b)] + Lactation[b)] + Month of lactation[b)] + Ever Lame[b)] + Locomotion score (-2)[b)] + Locomotion score (-1)[b)] +

Locomotion score (0)[b] + Locomotion score (+1)[b] + Locomotion score (+2)[b]). Model II included body condition scores as further fixed effects from the period two months before and up to two months after the milk production data: (Milk = Cow[a] + Farm[b] + Lactation[b] + Month of lactation[b] + Ever Lame[b] + BCS (-2)[b] + BCS (-1)[b] + BCS (0)[b] + BCS (+1)[b] + BCS (+2)[b]). Model III was used to test the effect of locomotion scores on body condition scores (BCS): (BCS = Cow[a] + Farm[b] + Lactation[b] + Month of lactation[b] + Ever Lame[b] + Locomotion score (-2)[b] + Locomotion score (-1)[b] + Locomotion score (0)[b] + Locomotion score (+1)[b] + Locomotion score (+2)[b]). Model IV included the effects of body condition scores on locomotion scores: (Lameness = Cow[a] + Farm[b] + Lactation[b] + Month of lactation[b] + Ever Lame[b] + BCS (-2)[b] + BCS (-1)[b] + BCS (0)[b] + BCS (+1)[b] + BCS (+2)[b]). Additional fixed effects were lameness information from the period of two months before and up to two months after the measuring BCS measuring time. The fixed effects for each model were analysed by least-square analysis using the GLM-procedure in SAS 8.2 statistical software **(SAS, 1999)**. For pairwise comparison the Dunnett test was used as the default.

[a] random effect

[b] fixed effects

10.8. Heritability of lameness

Similarly to chapter 11.6 and 11.7 the same 826 milking cows from the five herds were chosen for estimating heritability and repeatability of lameness scores, body condition scores and milk yields. The significances of effects included in the four models presented were also calculated. The cows' 10-digit individual numbers (ENAR – Egységes Nyilvántartási és Azonosítási Rendszer) retrieved from the RISKA farm herd management software were converted with help of Hungarian Holstein-Friesian Association into pedigree data. The variance components were estimated with the GLM-procedure in SAS 8.2 statistical software **(SAS, 1999)**. The heritability was calculated as a ratio:

$$\sigma^2_a/(\sigma^2_a + \sigma^2_e),$$

while repeatability as:

$$(\sigma^2_p + \sigma^2_a)/(\sigma^2_p + \sigma^2_a + \sigma^2_e),$$

where: σ^2_a – the additive component;

σ^2_p – the permanent environment component;

σ^2_e – the error variance.

11. Results and discussion

11.1. The status of farms regarding their lameness prevention measures

The results obtained are usually expressed in average values, so this way it will help to observe tendencies regarding lameness control in Hungarian dairy herds (Table 10). None of the changes were found to be significantly different, probably because of a lack of power. Subsequent discussion will explore the issues observed and how they can influence the prevalence of lameness.

This study was aimed to describe how Hungarian dairy farmers are coping with preventive activities against lameness in their herds. Among the 25 farms observed there was a wide variation in frequency of foot bathing from not being used at all, to being used every day; the average was 1.38 per week in 2010 to 1.56 in 2011. Commercially-available solutions were used containing formalin, glutaraldehyde and copper sulphate. Trimming frequency ranged from not being performed at all to two trimmings per year in 2010 with an average of 1.72 and 1-2 trimmings per year in 2011 with an average of 1.95.

Table 10. Lameness measures taken for lactating cows – Part 1

Measure		2010		2011		Difference (Not sign.)
		Mean	Std. dev.	Mean	Std. dev.	
Foot bathing (No./week)		1.38	1.45	1.56	1.42	+0.18
Trimming (No./year)		1.72	0.61	1.95	0.28	+0.23
Passageways (cm)		356.10	85.09	348.80	86.71	-7.30
Extra free stalls (No.)		8.28	3.84	8.99	3.79	+0.71
Free stall length (cm)		221.77	17.22	223.80	16.92	+2.03
width (cm)		114.08	5.94	115.87	5.57	+1.79
Neck rail horizontal (cm)		164.46	18.47	167.20	16.20	+2.74
vertical (cm)		116.54	10.28	117.37	9.57	+0.83
Degree – turning (°)		82.80	42.45	80.00	43.08	-2.80
Silage	Dark layer – top (cm)	16.80	10.30	12.80	12.51	-4.00
	Mould on clamp (%)	14.72	24.63	11.70	15.05	-3.02
	Mean temperature (°C)	29.43	6.07	26.86	6.26	-2.57
	Big bale damage (%)	3.20	10.09	1.20	4.15	-2.00
Building-paddock (m)		175.7	257.5	188.4	263.4	+12.7
Width of track (m)		4.91	2.51	4.70	2.62	-0.21

The width of passageways close to cubicles was found to decrease 7.3 cm from an average of 356.10 cm to 348.80 cm; the width of passageways in front of feeders decreased 5.6 cm from 393.24 cm to 387.64 cm. An increase in percentage of extra free stalls was discovered at

0.71%. Cubicles got longer and wider in 2011 in comparison to 2010- 2.03 cm and 1.79 cm respectively. Due to reconstructions, neck rails were positioned 2.74 cm higher and 0.83 cm farther from the cubicle's curb. On average the cows needed to turn 2.8º around less in milking parlours. The distance from the barns to the paddocks had decreased on average from 12.7 m; however the width of tracks to the paddocks decreased 21 cm.

There was a slight improvement noticed regarding the dark layer on the top and mould on the clamp with on average 4 cm less and 3.02%, respectively. There were also a slightly lower average temperature of silage and there were less damaged bales of hay (-2%).

In the study 52%, 40% and 8% in 2010 and 60%, 40% and 0% in 2011 of farms were reported with professional, on-farm and no trimming, respectively (Table 11). On the 25 farms, the records about lameness were done on 52% of the farms in 2010 and on 56% of the farms in 2011. This includes cows needing immediate treatment, history of hoof trimming and all other information useful in effective curing of lame cows. During one and a half years 12% of the farms changed straw yards to free stalls which is found to be a common tendency in modern dairy housing. In 2010 only one among 25 farms used corn stover for bedding, but its use increased to six farms with two using corn stover with straw. On some farms the number of investments was run for improving milk production. During observations on two farms, automatic scrapers were introduced. On 4% more farms, grooved and better quality concrete flooring was found next to cubicles and next to the feeders. There was an increase in the number of farms providing relatively dry and not slippery surfaces with no holes. 14% more farms offered lunge space to cows housed in cubicles and 12% more farms equipped cubicles with brisket boards. Rising opportunities have decreased from 44% to 36% of farms providing unrestricted area. Unfortunately, there was no improvement in the access to water troughs. More farms provided barns with ventilators (+4%). All ventilators found on the farms worked. On 4% more of farms, steps higher than 5 cm were reported in milking parlours in 2011 with 12% more farms where grooved concrete was provided in holding areas. Milking parlours with smooth corners stayed at the same level of 32%, however the surface quality has improved with slightly less holes, wet and slippery areas. In both years the whole silage face clamps were exposed to the sun. 8% more clean silage clamps were found in 2011 with slightly better silage fermentation firmness. Fewer farms provided their cattle with access to paddocks in 2011 than in 2010. Paddock alleys and surface quality on average has improved, but 3% less farms provided shade to the cattle on paddocks. Only one farm was able to improve track camber, remove stones from the track, make smoother corners and improve gateway conditions.

Table 11. Lameness measures taken for lactating cows – Part 2

Measure		% of farms		Difference (Not sign.)
		2010	2011	
Methods of trimming				
Professional trimming		52	60	+8
On-farm trimming		40	40	0
No trimming		8	0	-8
Records of lameness cases		52	56	+4
Housing type Free stall		48	60	+12
Straw yard		52	40	-12
Bedding mat. Corn stover		4	24	+20
Straw		96	76	-20
Scraping method Tractor		84	76	-8
Scraper		16	24	+8
Grooved concrete		28	32	+4
Surface quality	1 – relatively dry, no holes not slippery	4	16	+12
	2 – wet or some holes or slippery	60	52	-8
	3 – wet, some holes and slippery	36	32	-4
Lunge area		46	60	+14
Brisket board		62	73	+11
Rising 1 - Unrestricted		44	36	-8
2 - Mildly restricted		40	44	+4
3 - Seriously restricted		16	20	+4
Easy water access		64	64	0
Ventilators		68	72	+4
Steps in milking parlour		24	28	+4
Grooved concrete		60	72	+12
Smooth turns		32	32	0
Silage exposure (%)		100	100	0
Clamp tidiness		44	52	+8
Access to paddocks		44	40	-4
Shade		64	62	-2
Track camber		7.7	15.4	+7.7
Stones on track		38.47	30.77	-7.7
Sharp turns		23.07	30.77	+7.7
Good gateway condition		23.07	30.77	+7.7
Dry cows in straw yards		84	84	0
Heifers adaptation period		24	24	0
Heifers – trimming		28	28	0

On 21 farms (84%) dry cows were kept in straw yards and there were no differences between years. On six farms (24%) heifers were given an adaptation period before entering the milking herd. On the same six farms plus one (28%) trimming for heifers was provided few months before calving. There were no significant differences between the two observations.

It was intended that the information on the prevalence of lameness among dairy cattle derived from this study should provide a basis for a study of the epidemiology of lameness in Hungary. There are a wide range of studies done on dairy cattle lameness, but none of them covered prevention measures on Hungarian Holstein-Friesian herds with comparison to results of others. Among 27 farms, where cooperation was established, only two did not allow for further visits. On the other 25 farms the whole project was received with great enthusiasm. So far no one had called the farmers, offered them free discussion and shared the experience of other farmers about the welfare and lameness issues in dairy farming. Lameness was found to be more accepted, understood and questioned than cattle welfare itself. This probably comes from the fact that lameness is more measurable and visible than cattle welfare measures which are harder to realize if there had been a compromise or not.

Farmers have their own methods for using foot baths. Monitoring the levels of infectious lameness in the herd gives an idea of how frequently foot bathing should be done. As a rough guideline, if more than 10% of the cows are affected, then foot bathing should be done at least two or three times a week. At levels below this, once a week may be sufficient **(SUMNER and DAVIES, 1998)**. In the study, the solutions were observed to be used not regarding to the current state of the cows' feet, but rather as a standard, e.g. ‘one bag per one foot bath’. Using a low concentration of solution is a major reason for farmers experiencing poor results and thus giving up on foot bathing, often with disastrous results. If solutions are in high concentration, they may do more harm than good (especially formalin which can cause chemical burns to the skin at concentrations greater than 5%). An average number of foot baths per week has slightly increased with two farms reporting effective foot bathing together with checking severely lame cows between visits to be successful in decreasing lameness (Farm 2 and 3 in Table 18).

In two years the quality of hoof trimming has increased by employing qualified claw trimmers or by training workers. Although more expensive, professional trimming was observed to be a more-and-more attractive lameness preventive tool for dairy farmers. The comparison of trimming methods shows that the on-farm trimming method stayed the same in both years (10 farms). Two farms, where there was no trimming before, chose professional trimming services. One farm swapped professional trimmer for on-farm trimmer and vice versa. In the current study trimmings were performed on average 1.72-1.95 annually. There are conflicting results regarding frequencies of hoof trimming. **MANSON and LEAVER (1989)** suggested that claw trimming should be performed at least once a year, and **MANSKE et al. (2002)** recommended performing hoof trimming at least twice a year. On the other hand, **FAYE and LESCOURRET (1989)** stated that the total frequency of foot diseases increased when claw trimming was performed more than once a year. **MANSKE et al. (2002)** concluded that the optimal frequency of hoof trimming should be determined by specific factors on each farm and each cow. **ESPEJO and ENDRES (2007)** discovered that the prevalence of lameness was greater when farms performed claw trimming only when the manager decided cows needed it because of hoof overgrowth or lameness (33.7%) compared with farms on which the feet of all cows were trimmed on a maintenance schedule once (22.9%) or twice (21.3%) annually.

Next to lameness scoring and effective trimming, keeping reliable records about lame cows is thought to be the most crucial action to be taken to monitor dynamics of lameness in herds. Slightly more farmers were found to keep records of lame cows. Such records can be used to identify problem areas such as any chronic cases.

EFSA (2009) estimated that free stall housing is affecting dairy cows by increasing the number of locomotion problems and collisions with facilities in comparison to straw yard housing with more incidents of mastitis and compromised cleanliness of cattle. Among seven farms, either rebuilding old cubicles or building new stalls, only two were half successful. On one there was a decreased number of lame cows by 1.7%, but this difference was not significant and on the other, lameness increased significantly at 1.7% (Table 18). In advent of investments run on Hungarian dairy farms, that example gives a clue how complex and challenging it is to prepare well-planned and well-built free stall barns. The barns should provide a comfortable and productive living environment for the cow. In addition they should contribute to the continual production of quality milk and should protect the area surrounding the farm. Farmers who took part in the study stated that for a long time economical calculation was in favour for straw. However, in bad weather conditions and with lack of straw for bedding, corn started to be an attractive bedding solution. Other straw equivalents found on farms were gypsum bedding and dry manure solids.

Automatic scrapers are thought to be related to increased cases of lameness because cows are forced to walk over the moving parts while the manure is being scraped **(BARKER et al., 2007)**. The conclusion can be made from the observation of two farms which introduced scrapers. The cows with very poor locomotion had difficulty walking over the newly-introduced equipment. Moreover, if cows are unable to step over and the machine does not stop automatically but rather feels the resistance of a standing, the cow scraper wares hooves and harms the joints and skin.

Narrower passageways in the study will probably not be significant issues. However narrow passageways make reaching and clearing slurry more difficult which can cause hooves to become softer and more susceptible to damage because of the acids in the manure. Narrower passageways were correlated with elevated mean locomotion scores in the study of **COOK and NORDLUND (2009)**.

A slight decrease of the number of cows on some farms was probably related to more extra free stalls offered to cows in 2011 in comparison to 2010. Modern barn equipment is better meeting the needs of the cows which can be observed in an increased percentage of farms offering cows lunge space and brisket boards – helpful in rising and position taking in cubicles. Farmers are also observing their cows and how they rest in the stalls. Over the last decades Holstein-Friesian cows got bigger and new scientific outcomes provide more information about comfort in barns. The most popular opinion in husbandry publications suggests providing cows with adequate length and width of cubicles so that the largest and smallest cows in the herd can easily position themselves in the stall. An average cubicle has increased in length and width which seems to be observable and an important issue in investments on dairy farms.

The neck rail often prevents cows from fully standing inside the stall to keep the bedding clean. Rails were found not affecting laying time but they were restricting cows from standing on all four feet inside the stall, increasing the time cows spent standing with only two feet inside the stall **(BERNARDI et al., 2009; FREGONESI et al., 2002)**. **HERNANDEZ-**

MENDO et al. (2007) reported that lame cows recovered in a few weeks after the neck rail was removed from free stalls.

Access to and surface quality around water troughs has not been found to be an issue for farmers. This area seems to be influential for epidemiology of lameness caused by *Treponema* bacteria. Any wet conditions with muck where a lot of cows are passing through every day might be a potential risk for spreading digital dermatitis. Infection was reported by **JURKOVICH et al. (2007)** to be the most prevalent (45.9% of all locomotion disorders affecting 33.5% of all cows) on randomly chosen Hungarian dairy farms. Many times the areas around water troughs are neglected during scraping because of no access.

There is no strong confirmation in science that ventilators can influence the prevalence of lameness. So far only **LOBECK et al. (2009)** have found that older cows in cross-ventilated barns tended to have lower lameness prevalence than cows in naturally ventilated barns (15% vs. 23 %). Nevertheless, heat stress makes cows stand rather than lay; an effective ventilation system can help increase lying time during the summer and consequently tends to reduce lameness.

In milking parlours, an improvement in more grooved holding areas was found which might reduce future slipping. Another risk area is turning on concrete which cows are supposed to do relatively quick (2-3 times daily). The fewer times cows turn, the less chance of wearing down the hooves. The issue that was not measured, but is worth to mention, is the daily time away from the pen for milking. **ESPEJO and ENDRES (2007)** found a positive association between prevalence of lameness and time cows were away from the pen for milking. In the current study, on some farms, milkers took a break in milking when cows were waiting in the holding area. This is thought to be unnecessary time when cows are standing on concrete.

Certain types of lameness are caused or aggravated by nutrition which is often due to the influence on the corium of the hoof. The corium is the area of soft tissue containing nerves and blood vessels, providing oxygen, amino acids, minerals and other nutrients to sustain horn growth. Rumen acidosis, which lowers rumen pH, is caused by too much acid in the rumen; usually after overfeeding with concentrates. Forage and fibre are important in ruminant diet and a lack of adequate forage can cause the development of acidosis. Disrupted intakes of forage can be due to wet, high-in-ammonia, poorly-fermented, acidic silage, mycotoxins of toxinogenic *Aspergillus* moulds and toxinogenic *Penicillium* moulds **(MOSTROM and JACOBSEN, 2011)**. Considering silage and hay a slight improvement was observed. Covered silage clamps seem to provide basic protection against weather conditions and provide fresh feed to cows; however this habit was not practised on all farms.

Modern dairy farming relies on a zero-grazing housing system. Cows live in buildings and are provided with all the resources; locomotion, however, of the cattle is compromised due to the proximity of the resources. Pasture access can be used to help the lame cattle recover from claw and leg injuries because the pasture provides a more comfortable surface upon which cows can stand. On the other hand cows in pasture are losing more weight and produce less milk likely caused from reduced nutrient intake relative to cows in zero-grazing housing systems. None of the studied farms provided cows with access to pasture, but cows on half of them were able to walk in paddocks. It is understandable that in Hungary, with extensive grassland, cows are more likely to be kept in zero-grazing housing systems. An open and free area is attractive for animals due to fresh air and greater possibility to express natural behaviour. The most common risk areas include little stones on concrete and ponds of mud and manure. A lack of shade makes cows more likely to stand rather than lie in hot days. Access to hoof-friendly paddocks seems to be underestimated on the 25 dairy farms.

It is essential that cows around calving time are provided with a comfortable environment in which to lie down. On four farms, dry cows were kept in cubicles which might have affected the comfort of lying because dry cows are slightly bigger during that time than cows in lactation. On some of farms the stalls were found to too short or too narrow and cows were putting their legs between the bars to get more space. **COOK and NORDLUND (2007)** share the same opinion and significant improvements in sole haemorrhages have been shown in first lactation heifers after calving when provided with a straw yard at pre- and post-partum compared to a poorly-designed free stall barn. On the other hand, **SINGH and WARD (1993)** noticed that herds with dry cows housed in straw yards were associated with impaired locomotion when compared with herds in which dry cows were housed in free stalls. The cattle experience the change from soft to hard floors as they enter the free stalls at calving and consequently may be more prone to sole lesions. Additionally, lactating cows have less time to lie down compared with dry cows, and this may cause further wear of the distal horn **(SINGH et al., 1994)**.

BARKER et al. (2007) reported that keeping heifers with lactating cows elevated the occurrence of lameness in comparison to heifers kept with dry cows. This might be considered by a greater number of managers in the 25 farms. On none of the farms heifers were kept with dry cows (data not shown).

Trimming heifers increases the foot angle, keeps the claw upright and the bulb out of manure which decreases the incidence of digital dermatitis. Trimmed heifers are thought to be better prepared for being introduced to milking herds and they experience less locomotion disorders **(MEYER et al., 2007)**. This method is also slightly underestimated which might be explained by extra costs and a hardly-measurable outcome decreased by other management and environmental factors.

11.2. Relations between the occurrence of lameness, welfare measures and environmental factors

Among a long list of measures of potential risks for lameness only some of them were found to be correlated with an increased prevalence of locomotion disorders on 25 Hungarian dairy farms (Table 12). Although, in three years of the project on some farms different conditions were observed and some farms were put in contrasting categories the objective of the analysis was not compromised. The objective was to focus on different environmental conditions and their impact on prevalence of lameness. There was a correlation between the higher number of foot baths per week and increased number of lame cows. Less extra cubicles in barns were discovered to be correlated with more lameness.

Table 12. Correlations between occurrence of lameness, welfare measures and environmental factors observed on 25 dairy farms in Hungary

Measures	No. of farms	Correlation coefficient (lameness)	Significance
Foot bathing (No./week)	50	+0.29	0.045
Extra free stalls (%)	50	-0.41	0.034
Milking cows – Obviously ill (%)	50	+0.29	0.040
Milking cows – BCS*1 (%)	50	+0.36	0.010
Milking cows – BCS*2 (%)	50	+0.40	0.004
Milking cows – BCS*3 (%)	50	-0.52	0.001
Thin dry cows (%)	50	+0.43	0.002
Dry cows bedding cleanliness	50	-0.31	0.03

*) Body Condition Score

More dull, thin and obviously sick cows (definitions described in chapter 3.3.) were found with compromised locomotion. Regarding performance data lower average milk yield, higher protein content, SCC and urea level were correlated to growth in prevalence of lameness. Finally, similarly to lactating cows, thin dry cows with soiled or wet bedding were found lamer.

The analysis of variance proved that more lame cows can be found on farms with limited access to water troughs compared to easy access to water, concrete square feeding troughs compared to feeder on flat surface and with steps higher than 5 cm in milking parlours compared to farms with no steps higher than 5 cm in milking parlours (Table 13).

Table 13. Analysis of variance between means of lameness in different environmental conditions

Measures	No. of farms	Mean of lameness	Std. dev.	Significance
Limited access to water	19	36.31	12.76	0.029
Easy access to water	31	28.23	11.99	
Feeder (flat surface)	25	27.08	12.88	0.018
Feeder (concrete trough)	25	35.52	11.44	
Feed yard non-grooved	31	35.97	12.03	0.001
Feed yard grooved	19	23.68	10.25	
Milking parlour with no steps	32	28.42	12.82	0.032
Milking parlour steps >5cm	18	36.42	11.32	

The investigation of resting areas for lactating cows shows that there is a very significant impact of a lack of lunge area and brisket boards on rising behaviour of cows (Table 14).

Table 14. Rising opportunities with different cubicle setups

		Measures			
		No lunge area	Lunge area present	No brisket board	Brisket board present
Rising scores	1 - Unrestricted	0	12	0	12
	2 - Mildly restricted	9	3	6	6
	3 – Very restricted	4	0	3	1
No. of farms		28		23	
Df		2		2	
Chi-Square Tests - Value		18.96		10.87	
Asymp. Sig. (2-sided)		0.001		0.005	

Finally, a lower number of hock and knee lesions was found in straw yards in comparison to free stall barns (Table 15).

Table 15. Analysis of variance between mean occurrence of hock and knee lesions in straw yard and free stall barns

Measures	No. of farms	Mean of hock and knee lesions	Std. dev.	Significance
Straw yard	24	13.88	11.88	0.006
Free stall	26	26.85	18.92	

There is no agreement in literature with some of the measures how they affect lameness distributions; misinterpretation can have a place if advice are going to be given to Hungarian dairy farmers. There are different bedding materials used in free stalls and it is unclear which, if any, of the available surfaces are best for the health of legs and hooves **(COOK, 2003; ESPEJO et al., 2006; FAULL et al., 1996; WECHSLER et al., 2000)**. There is no agreement which housing is better regarding lameness development **(BARKER et al., 2007; PHILIPOT et al., 1993)** and if overcrowding is really elevating the number of lame cows **(ESPEJO et al., 2007; WIERENGA and HOPSTER, 1990)**. For clarifying those and other issues this study in the condition in Hungary gives the best confirmation how scientific outcomes (similar or different) are found to affect lameness on Hungarian dairy farms. The estimated measures can give an idea what are potential risk areas which should be considered in applying lameness preventive solutions in Hungary. Locomotion scores provide an estimate of the prevalence of lameness in a herd. Scoring many cattle on many farms and correlating the scores with management practices can assist in understanding impaired locomotion and provide the opportunity to generate hypotheses for improved locomotion.

FAYE and LESCOURRET (1989) reported that the use of foot baths is beneficial in controlling digital dermatitis. However, benefits of foot bathing were not detectable on commercial farms in this study with more lame cows and more orthopaedic blocks used by hoof trimmers on farms using more often foot baths. The same relations were found by **AMORY et al. (2008)** in dairy cattle and by **WASSINK et al. (2003)** in sheep. Foot bathing was probably positively correlated to an elevated prevalence of lameness because farmers used the baths incorrectly. This could include the chemical solution being too concentrated, too diluted, contaminated or not changed frequently enough. It is very likely that the reservoir with the solution became filled with faeces and cows had to walk through the slurry when leaving the milking parlour, possibly increasing the chance for the spreading of digital dermatitis. The other explanation is that on farms with poor housing and management, foot bathing, alongside trimming, is thought to be the only possible effective routine solution, whatever the quality of action is taken. **SUMNER and DAVIES (1998)** concluded that these are not the foot baths which make cows lamer, but farmers, seeing more lame cows, use foot baths more often. Increased occurrence of lameness should motivate to look for solutions not being only higher frequency of foot bathing, because in theory it is preventive measure only. Management or housing changes should be investigated in parallel to higher frequency of foot bathing (if applied). There are already commercially innovative approaches to foot bathing. Some foot baths separate the legs of the cows for proper cleaning, with special brushes or jets cleaning hooves from five sides. Additionally, pressurised water is sprayed when the cows vacate the bath; the equipment is sprayed down and the solution is changed with programmable repetitions. In other words what was until now a simple hole in the concrete became a thing of technology. Whichever method is used it should be used effectively.

A minimum 5-10% of extra stalls are recommended by different authors to be in the barn to provide enough space for all the cows **(ESCE, 2012; TUCKER et al. (2003); WAGNER-STORCH (2003)**. That solution gives every cow free access to a resting area. Animals will rest longer if there is enough place to lie. **BOWELL et al. (2003)** and **LEONARD et al. (1996)** had shown that the ratio of cubicles to cows in his research was negatively correlated with the locomotion score and the same correlation was found in the present study. Moreover, the number of orthopaedic blocks used by hoof trimmers was also correlated with less extra stalls available for cattle.

In chapter 11.6. (Table 20) the body condition scores were found to be negatively correlated to elevated lameness cases among 826 cows and the same relation was found on the 25 farms. **ÓZSVÁRI et al. (2007)** reported that the body weight of lame cows decreased by 6.6% (41.7 kg) compared to the indices of healthy cows. **WELLS et al. (1993)** also found a strong correlation between poor body condition and clinical lameness. For a long time researchers believed that lameness was the result of sub-clinical rumen acidosis and body condition thought to be not a cause, but a consequence of lameness. A study at **BICALHO et al. (2009)** found that a thinner digital cushion was correlated to lower body conditions of cows. A weaker cushion has a lower capacity to protect the corium tissue from compression by the third phalanx which causes more incidences of impaired locomotion. The relation is likely to be true because a great part of the digital cushion is built up of adipose of fatty tissue. **HASSALL et al. (1993)** and **JUAREZ et al. (2003)** claim that a lower body condition could be a consequence of reduced feeding times. **JUAREZ et al. (2003)** go further with conclusions that restriction of movement and not being able to arrive to the feeder as fast as healthy cows make lame cows unable to acquire larger portions of feed.

In the study, the farms where dry cows had compromised resting area cleanliness, there were more lame cows. **BORDERAS et al. (2004), GREGORY (2004)** and **SOMERS et al. (2005)** associated contaminated surfaces and housing conditions with softer claw horns, increased hoof horn lesions and digital dermatitis. This relation is likely to be a reason for increased use of orthopaedic blocks by hoof trimmers on farms where an elevated percentage of heifers were found with dirty hindlimbs. When dry cows and heifers are moved from wet and dirty straw yard barns to milking groups they are experiencing a shock of contact with abrasive concrete passageways.

On farms with limited access to water more cows were reported with lameness and more blocks were used by claw trimmers. This is possible that on those farms the water troughs were positioned slightly higher and cows needed to walk on a concrete steps which increases the risk for slipping especially in winter. On some farms the water stations were placed at the end of passageways where the scraper arms were present when not in use. If the cows wanted to access the water trough, they needed to walk over the metal parts of the scraper. As a result safe and stable hoof position was compromised. In another situation, the cows drinking water were disturbed by the scraper when it started its movement. On some farms the water troughs were positioned along passageways on the way of the tractor scraping the manure. The area around the water troughs was not properly scraped and cows were walking in manure.

The cows kept in barns with flat feeding surfaces were observed with less locomotion problems. Modern feeders (flat surfaces) are build slightly higher than the level of the cows stand and feed is pushed few times a day closer to the cattle. In old fashioned troughs, which are usually relatively wide, food is most of the time spread to the farther end of the feeder. The cows that are trying to reach the farthest pieces of TMR are placing more weight on the front legs and placing more pressure on the hooves.

In the study the cows kept in barns with grooved feed yard passageways were less likely to be lame and more orthopaedic blocks were used by hoof trimmers in comparison to non-grooved yards. **DEMBELE et al. (2006), FAULL et al. (1996)** and **FLOWER et al. (2007)** correlated slippery flooring with a higher prevalence of lameness and **TELEZHENKO and BERGSTEN (2005)** with alterations in gait. Abnormal gait on slippery surfaces causes altered weight bearing on the sole and white line disease. In comparison, **BARKER et al. (2007)** claimed that the risk of white line disease increased with solid grooved concrete floors in housing and yards, compared with other floor surfaces.

Cows walking in the milking parlour are most of the time herded by stockmen. The cattle are in proximity to each other and if rushed, are not able to carefully observe where it steps. Cows which collide with an extra step must change their gait and either put more pressure on the hooves or lose equilibrium.

The stalls should have adequate lunge space in front to allow the cows to easily stand up and lie down. The comfort of cubicles was studied by **DIPPEL et al. (2009)** who concluded that cows were more often choosing stalls with a lunge area in comparison to stalls without that area. In the present study the same relations were found in addition to fewer blocks used by claw trimmers on farms providing their cows with lunge areas. It is possible, that in the barns with lunge areas, cows have longer lying times and do not affect their hooves so much.

The purpose of the brisket locator is to discourage forward movement when a cow is resting to preserve lunge space and minimize the change of hitting the stall structure when rising. It should allow the largest cow in the group to comfortably rest on the stall surface. It should also allow cows to extend their front leg(s) forward when resting, and step forward when rising. However, **TUCKER et al. (2006)** and **ANDERSON (2008)** agreed that if given a choice, cows prefer stalls without brisket boards because they do not contribute to restlessness and brisket boards reduce the amount of time cows spend lying. A brisket board higher than 15 cm was estimated by **ESPEJO and ENDRES (2007)** to be associated with greater prevalence of lameness. In the present study there was no observation to estimate the preference for cubicles with and without boards, lying times and the height of brisket boards. However, considering rising easiness significantly more cows had unrestricted rising in cubicles with a brisket board present in comparison to stalls lacking that device.

SINGH et al. (1994) estimated improved laying times in straw yards when compared with free stalls and **SINGH and WARD (1993)** observed a relation between elevated sole lesion scores, growth in locomotion disorders and increased standing times. In the current study free stalls were confirmed to be more hazardous for dairy welfare than straw yards with a more average percentage of cows found with hock and knee lesions. There were also more orthopaedic blocks used by hoof trimmers on farms where cows were kept in free stalls. Unlike those studies, **BARKER et al. (2007)** did not report any significant differences in mean herd locomotion scores between herds housed in straw yards and herds housed in free stalls.

11.3. Relations between the number of orthopaedic blocks used by hoof trimmers, welfare measures and environmental factors

On average 8.54 orthopaedic blocks were used by hoof trimmers per 100 cows with standard deviation of 5.73. The number of blocks used during trimming was reported to have a rather strong and positive correlation with an increased number of foot baths per week and a higher number of trimmings per year (Table 16).

Table 16. Correlations between the number of orthopaedic blocks used by hoof trimmers, welfare measures and environmental factors observed on 25 dairy farms in Hungary

Measures	No. of farms	Correlation coefficient (blocks)	Significance
Foot bathing (No./week)	24	+0.59	0.003
Hoof trimming per year	24	+0.41	0.049
Extra free stalls (%)	24	-0.85	0.002
Passageways – feeder (m)	24	-0.42	0.042
Building – paddock (m)	10	+0.82	0.007
Passageways – cubicles (m)	20	-0.60	0.005
Neck rail – vertical position	10	-0.73	0.016
Lactating cows perching (%)	20	+0.51	0.02
Heifers dirty hindlimbs (%)	20	+0.45	0.02

Similar to lameness, more orthopaedic blocks were used on farms with lower number of extra free stalls provided for milking cows. Narrower passageways in front of cubicles and feeders with longer distances to paddocks were strongly correlated to more lame cases. The neck rail positioned lower was negatively correlated to more lameness. Finally, more perching cows with dirty hindlimbs in heifers were positively correlated to increased occurrence of lameness.

The number of orthopaedic blocks was evaluated to differ significantly regarding the method of trimming with on-farm trimmers using 5-6 blocks per 100 cows and professional trimmers using 9-11 blocks per 100 cows (Table 17). In straw yards fewer orthopaedic blocks were used than in free stalls.

Table 17. Analysis of variance between mean the number of orthopaedic blocks used by hoof trimmers in different environmental conditions

Measures	No. of farms	Mean blocks	Std. dev.	Significance
On-farm hoof trimming Professional hoof trimming	10 14	5.63 10.65	3.85 5.64	0.044
Straw yards Free stalls	14 10	6.72 11.86	4.20 5.72	0.019
Scraping – scraper Scraping – tractor	19 5	7.29 14.83	3.99 6.45	0.003
Lunge area present Lunge area not present	5 5	7.42 16.31	3.76 3.16	0.004
Water surface quality – good Water surface quality – bad	16 8	7.36 11.87	4.35 6.38	0.039
Feed yard surface grooved Feed yard surface not grooved	13 11	6.39 11.79	3.41 6.03	0.012
Parlour – smooth flooring Parlour – rough flooring Parlour – rubber flooring	12 8 4	7.98 12.34 4.59	5.47 4.82 1.48	0.04
No access to paddocks Access to paddocks	10 14	12.75 6.09	4.40 4.34	0.001
Track – no stones Track – stones present	6 4	3.84 7.51	1.59 3.68	0.047

In comparison, in barns where tractors were used for scraping manure a higher number of orthopaedic blocks was used. Interestingly, there were less cows with blocks in barns with grooved flooring in front of feeders in comparison to not grooved, however, there were more orthopaedic blocks used on farms where milking parlours were provided with grooved surfaces. Fewer numbers of blocks was found in milking parlours with non-grooved flooring and the least number of blocks was observed when cows walked on rubber. Increased provision of orthopaedic blocks was on farms without access to paddocks and stones on tracks.

The number of orthopaedic blocks used by hoof trimmers was not correlated to the prevalence of lameness. That means that a high prevalence of lameness does not require a high number of blocks (for example, if digital dermatitis or only slightly-impaired locomotion takes place on a high scale in the herd). On the other hand, a high number of blocks used by claw trimmers does not mean that the level of lameness is very high if some cows need blocks to be used and the rest of cows have hooves in relatively good condition. Nevertheless, cows that need orthopaedic blocks are definitely the most affected by lameness.

The number of trimmings per year and its correlation with increased number of blocks can be explained by more care taken with lame cows. Herds which are more often trimmed are also more often monitored and the most severe cases can be treated which gives a greater chance for those cows to recover. The higher number of blocks used by professional trimming services in comparison to on-farm workers probably means that skilled hoof trimmers are more likely to find and estimate severe cases treatable with the use of orthopaedic blocks.

In a study by **BARKER et al. (2007)** narrower passageways were correlated with a growth in the number of lame cows. In the present study, narrower aisles in front of feeders and cubicles were also correlated with a higher number of blocks used by claw trimmers. This is driven either by a higher level of slurry or more traffic and more wear of hooves in narrower passageways compared to wider areas.

The distance between barn and paddocks and between barn and milking parlour was found only to be investigated by **ESPEJO and ENDRES (2007)**, but the relation in that study was found to be insignificant. In the current project, the cows on the farms with paddocks located farther from the barn were found with an increased number of orthopaedic blocks. The same relation was found in New Zealand and described to be a reason of excess exercise on hard surfaces causing mechanical stress on the hooves **(VERMUNT, 1992)**. It is not completely in agreement with **HARRIS et al. (1988)** who concluded that interdigital cracking and pain were more common when the distance to paddocks was shorter. An explanation for this was that in shorter tracks there is an increased crowding with more cows trying to pass the same place in the same time and with limited foot placement. On 25 Hungarian dairy farms, farmers and hoof trimmers confirmed that more problems with white line disease and stones in the hooves were reported when cows were walking on concrete where small stones penetrated the horn. Those situations happen when wheels of vehicles crossing routes of cattle bring small stones on a concrete during everyday activities or engineering works carried. As a confirmation in the present study more blocks were used on farms with stones found on tracks where cows were walking to milking parlours and to paddocks than on farms with tracks free of stones.

Neck rail position and its presence was found by scientists to have advantages and disadvantages. The neck rail often prevents cows from standing fully inside the stall in order to keep the bedding clean, but cows showed no clear preference for the position of the neck rail **(TUCKER et al., 2005)**. In the current study with the neck rail positioned lower was correlated with a higher number of orthopaedic blocks used. This finding agrees with **FREGONESI et al. (2009)** who observed that an aggressive neck rail placement contributes to the occurrence of lameness and when removed helps lame cows recover. Lower positioned neck rails did not affect lying times, but forced cows to perch, with only the two front feet inside the dry stall and hindlimbs usually in passageway in manure. **BERNARDI et al. (2009)** found and described that as the stall-design paradox because neck rails improve udder and stall hygiene, but increase lameness. In the present study there was a link existing between a higher number of blocks, lower position of the neck rail and increased number of cows perching.

BARKER et al. (2007) demonstrated that the use of automatic scrapers was associated with an increased risk of lameness. Although automatic scrapers can improve hygiene in the free-stall barn because of frequent scraping; they are thought to be associated with an increased percentage of lame cows because cows have dirtier hooves as the wave of slurry passes. Moreover, the movement of automatic scrapers is believed to result in the cows moving rapidly to avoid its path. **STEFANOWSKA et al. (2001)** measured that 91% of locomotion incidents observed in barns with automatic scrapers occurred as a result of contact with the scrapers. During feeding, automatic scrapers can cause further disruption because cows lower in social rank may be displaced from their position at the feed barrier. Automatic scrapers in the present study were associated with fewer numbers of orthopaedic blocks used by hoof trimmers in comparison to tractor scraping. Number of blocks used by trimmers and mean occurrences of lameness were not correlated in this study but both measures are expressing compromised locomotion of dairy cows. The reason for more blocks being used on farms with tractor scrapers could be that scrapers are used on flat, regular concrete surfaces. Tractors, however, are mostly used on poor-quality passageways where manure and dung is cumulating in holes and damaged areas. It is possible that the poor hygiene of feet and legs in dairy cows provides more favourable conditions for digital dermatitis.

Rough flooring in milking parlour alleys was associated with more blocks being used by hoof trimmers in comparison with smooth flooring which was associated with more blocks being used than on farms with rubber flooring. The surface where cows are milked is rarely maintained because is hard to reach with other machines. The concrete floors in the milking parlours are covered with manure and cleaned with chemicals and water many times a day which, with heavy traffic, makes it rougher because small particles are washed out, leaving sharper, bigger lumps. The destructive effect of rough, sharp, or eroded concrete is that these surfaces have higher frictional properties and results in an increased wear of the claw horn. As a result the white line more is prone to separation and the thin horn of the sole is at increased risk of penetration by foreign bodies. Smooth flooring is less abrasive and does not wear down hooves like rough concrete surfaces. It is documented, that the majority of cows prefer to stand and walk on soft rubber flooring, rather than on concrete floors **(TELEZHENKO et al., 2004)** because of its optimal softness **(IRPS, 1983)** and friction **(WATSON, 2007)**. The present study confirms that softer flooring is related with fewer numbers of orthopaedic blocks used by hoof trimmers because rubber is not affecting hooves as concrete does.

HERNANDEZ-MENDO et al. (2007) asserted that cows, when given access to pasture even for a few weeks, are able to improve locomotion and some attributions of gait (head bob, back arch, tracking up, and reluctance to bear weight evenly on all four hooves). Improved gait for cows in pasture was not because of increased lying times, but softer surfaces. This is probably the reason why in the current study fewer numbers of blocks used by hoof trimmers were on farms which provide cows with access to paddocks compared to those farms which did not have that opportunity. Paddocks are different to pastures mentioned earlier because there is no grass; yet, paddocks are considered to be friendlier to hooves than concrete.

11.4. Rank of farms regarding changes in the occurrence of lameness

There was a highly significant increase in the occurrence of lameness between 2010 and 2011 considering an average percentage of lame cows observed on 25 farms (27.31% and 13.51 vs. 35.29% and 10.88, mean and S.D. of lameness in 2010 vs. mean and S.D. of lameness in 2011, respectively, $p<0.001$). Among the 25 farms taking part in a project, four were able to significantly decrease the number of lame cows between 6.5 and 13.6%. Another seventeen farms were found with significant to highly-significant greater proportion of cows with locomotion disorders ranging from 1.7% to up to 30.6%. Four farms did not show any significant changes in lameness distributions between two years (Table 18).

Table 18. Rank of farms regarding their success with treating lameness

Farm/Rank	Lameness in 2011 in comparison to 2010 (%)	Chi-square tests - value	N of valid Cases	df	Asymp. sig. (2-sided)
1.	-13.6	25.521	1115	4	0.001
2.	-13.2	28.865	740	4	0.001
3.	-12.3	27.660	1005	4	0.001
4.	-6.5	36.495	1627	4	0.001
5.	+1.7	27.272	675	4	0.001
6.	+6.0	26.633	908	4	0.001
7.	+7.0	9.593	1218	4	0.048
8.	+7.7	24.292	1599	4	0.001
9.	+8.6	38.466	1563	4	0.001
10.	+9.4	16.149	990	4	0.003
11.	+9.7	20.338	355	4	0.001
12.	+11.5	16.287	354	4	0.003
13.	+12.4	25.766	947	4	0.001
14.	+14.4	113.398	1882	4	0.001
15.	+17.9	44.060	863	4	0.001
16.	+17.9	34.259	740	4	0.001
17.	+21.6	124.013	1058	4	0.001
18.	+24.4	90.231	688	4	0.001
19.	+27.4	81.260	560	4	0.001
20.	+29.7	132.305	633	4	0.001
21.	+30.6	24.930	106	3	0.001
22.	-10.8	7.493	215	4	NS
23.	-1.7	6.754	664	4	NS
24.	-0.2	4.530	242	4	NS
25.	-0.1	7.823	467	4	NS

The average occurrence of lameness in the present study (27.31% in 2010 and 35.29% in 2011) was found to be similar to **Huxley et al. (2004), Haskell et al. (2006)** and **Rutherford et al. (2009)** with 19.3%, 24%, and 39% of cows found clinically lame, respectively. Out of 45 single measures, 30 were improved, 9 got worst and 6 did not change. There were changes for the worst with: more farms with steps > 5cm in milking parlours, narrower passageways in front of cubicles and feeders, longer distances form buildings to paddocks, narrower tracks, sharper turns in milking parlours, gateway conditions, access to paddocks and access to shade. In some measures, the changes were not observable: dry cows housed in cubicles or straw yards, heifer adaptation period, heifer trimming, silage exposure, water access, quality and smooth turns. Farmers did not apply other measures on the farms, like keeping surface clean in the milking parlour, applying rubber mats on the way out from the milking parlour, arrangements improving cow flow and removing obstacles on routes used by cows. It is hard to estimate if positive changes were driven by given advice or done independently and why negative measures occurred. The four farms from the top of the table (Table 18) made radical changes and their main aim was to decrease lameness in the herds. The fifth and twenty third farm from the table can be described as half successful in controlling lameness. Among seven farms, where engineering projects took place, those two were the only farms where lameness increased significantly by 1.7% on the first farm and decreased not significantly by 1.7% on the second. Surely some efforts were taken on those farms to control lameness and the example shows that not many farmers were successful with implementing new equipment and controlling the level of lameness. Positive and negative changes observed on the 25 dairy farms were caused by all kinds of investments. In this study 23% of all investments (9 out of 39 all changes), considered by scientists **(MANSKE, 2002; AMORY et al., 2006; BARKER et al., 2007)** to be possible risk areas for the increased occurrence of lameness, were actually introduced on farms. This in combination with changing the housing systems, feeding disorders and cost-cutting policies could be the possible reasons for poor improvements of reducing lameness.

The most popular opinion among farmers about the high percentage of lame cows is thought to be bad quality feed given to animals. This is presumed to be happening because of the extreme changes in the weather, influencing quality of forage and maize silage which caused an imbalanced TMR or feeding higher amount of concentrates and effects with cows being lamer. The importance of housing technology and farm hygiene are equally important. The second reason is the heritage of the old buildings from the time of socialist. In most of the cases, those buildings were originally used for tethered cows. After swapping to the free stall or straw yard housing systems no significant improvements were made. Finally, the lack of time, a properly-sized workforce and cost-cutting policies are important factors influencing the opinions of the farmers and farm managers that not enough attention and time can be spent decreasing lameness.

FAWC (2009) asserts that one reason for the slow progress in dealing with lameness is the farmer's perception of the problem. **LEACH et al. (2010)** observed on 222 farms that 90% of farmers did not perceive lameness to be a major problem on their farms and for 62% lameness was not the top priority, although the average occurrence of lameness was 36%. In the present study 17 out of 25 farmers underestimated the occurrence of lameness on their farms. That means farmers have not enough skills for monitoring and judging which cow is normal, mildly lame, moderately lame, lame or severely lame **(SPRECHER et al., 1997)**. That ability helps to estimate when immediate actions should be taken for preventing cows not to become lamer. It also helps in estimating which actions are more effective in decreasing lameness.

There was evidence that training farmers to recognise early cases of lameness and to request veterinary treatment resulted in a marked reduction in the duration of cases of lameness **(Clarkson et al., 1996)**. This statement is not completely in agreement with **FAWC (2009)**. The report states that work at the University of Bristol has shown that informing farmers about the prevalence of lameness within their herds and providing external advice often fails to stimulate the farmers to take preventive actions.

11.5. Effectiveness of professional and on-farm hoof trimming in different conditions

On two farms where farm workers were performing hoof trimming and on five farms, where professional service was provided for unknown reasons, there were increases on an average occurrence of lameness observed of 8.8% and 5.6%, respectively (Table 19). When engineering projects were carried out, cows showed more locomotion problems. On four farms, where farm workers were working, there were on average 18.9% more cases and on farms where a professional company was working there were in average only 2.1% more lame cows.

On one farm with a presence of mycotoxins (*Aspergillus flavus* toxin total = 0.00727 mg/kg, Zearlaenon = 0.296 mg/kg, DON = 5.14 mg/kg and exceeded level of *Clostridium perfringens* > 5.5×10^3 cfu/kg) and extreme drop in milk yield in all groups of cows (on average from 9456 to 5493 l/lactation checked between 2011.02.14 and 2011.03.26) and on one farm with a relatively high level of urea in milk (43 mg/dl) with an on-farm claw trimming team there was a growth in lameness of 17.6%. In comparison, on one farm with, probably, energy imbalance caused by low-quality forage and on one farm with mycotoxins present in silage mycotoxins (*Aspergillus flavus* toxin total = 0.00639 mg/kg, Zearlaenon = 0.175 mg/kg, DON = 4.84 mg/kg) with professional claw trimming service there was an average increase of occurrence of lame cows of 15.2%.

Table 19. Changes in occurrence of lameness after on-farm and professional hoof trimming

<table>
<tr><th rowspan="2">Sig.</th><th colspan="2">Claw trimming</th><th rowspan="2">Lameness in 2011 in comparison to 2010 (%)</th><th rowspan="2">No. of farms and changes observed</th></tr>
<tr><th>2010</th><th>2011</th></tr>
<tr><td rowspan="9">Yes</td><td colspan="2">On-farm</td><td>+8.8</td><td>2 – no change</td></tr>
<tr><td colspan="2">Professional</td><td>+5.6</td><td>5 – no change</td></tr>
<tr><td colspan="2">On-farm</td><td>+18.9</td><td>1 – milking parlour renewed
1 – automatic scrapers
2 – straw yards swapped for free stalls</td></tr>
<tr><td colspan="2">Professional</td><td>+2.1</td><td>1 – cubicles in one of the barns renewed
2 – straw yards swapped for free stalls</td></tr>
<tr><td colspan="2">On-farm</td><td>+17.6</td><td>1 – high level of urea
1 – mycotoxins</td></tr>
<tr><td colspan="2">Professional</td><td>+15.2</td><td>1 – mycotoxins
1 – TMR imbalance</td></tr>
<tr><td>On-farm</td><td>Professional</td><td>-13.6</td><td rowspan="3">3 – change in claw trimming</td></tr>
<tr><td>Professional</td><td>On-farm</td><td>+21.6</td></tr>
<tr><td>No</td><td>Professional</td><td>-12.3</td></tr>
<tr><td rowspan="4">No</td><td colspan="2">On-farm</td><td>-0.2</td><td>1 – no change</td></tr>
<tr><td colspan="2" rowspan="2">Professional</td><td>-10.8</td><td>1 – no change</td></tr>
<tr><td>-1.7</td><td>1 – cubicles renewed</td></tr>
<tr><td>No</td><td>Professional</td><td>-0.1</td><td>1 – claw trimming</td></tr>
</table>

Change from on-farm to professional trimming team resulted in 13.6% decrease in occurrence of lameness. On the other hand, when farm employers were working in place of a professional claw trimming service, a 21.6% increase in prevalence of lameness was observed. Professional hoof trimmers employed on the farm where there was no hoof trimming for the last two years resulted in a 12.3% decrease in lameness between 2010 and 2011.

Although on four farms there were no significant differences between 2010 and 2011 one can observe that on-farm trimming method shows lower effectiveness than professional trimming. On farms where claw trimming was performed by farm workers there was on average, significantly more lame cows than on farms where professional trimming service was employed (16.4% vs. 5.4% ± S.D. 9.44, $p<0.001$). There were no significant differences between professional and on-farm hoof treatments in groups of engineering projects, feeding disorders and changes in trimming. This is probably because of a lack of power due to very low number of variables.

Although lameness had been already reported 20-30 years ago, as an outbreak that significantly decreased the performance of dairy cows, relatively small progress has been done in creating feasible management practices since that time. There are many reasons why there are a lot of lame cows present in the modern dairy industry. Hoof trimming is not the only way to prevent lameness, but, when properly done, definitely has a positive impact on mobility. If routine trimming was found to be a preventive way for treating claw disorders, this procedure should be done properly on every farm. Lameness is painful for cows which was proved by **CHAPINAL et al. (2011)**. Researchers reported that before hoof trimming, lame cows spent more time lying down each day than non-lame cows. Bad locomotion is disturbing for lame cows and this is why they are looking for relief. Trimming by itself is also causing a kind of trauma for the cows. The same authors found that both lame and non-lame cows increased the time spent each day lying down after claw trimming for up to five weeks after having their hooves trimmed. In the study, all farms were visited approximately 5-10 weeks after hoof trimming to avoid noticing the negative change in gait immediately following claw trimming **CHAPINAL et al. (2011)**.

In the study, unpredictable factors should be taken under consideration because the factors might influence the results interpreted without clear explanations; those would be feeding, the weather, human resources and others. The nine farms can be an example where, in theory, there were no differences in husbandry over one year, however, there was an increase in lameness on seven farms and not a significant decrease on two of them.

There is a specific time on a dairy farm when building projects are carried out because everyday activities are changing. Cows might be walking around working zones, avoiding the paths of moving vehicles which increases the risk for longer distances, worse surface quality, more holes or presence of stones. Observations confirm that farm workers were less confident with cleaning hooves of stones than the employees of professional trimming services. The study proved that professional hoof care is more efficient than the skills of farm workers during the time of trauma which could be caused by engineering projects and adaptation to new husbandry systems. What is more, the scientific opinion of **EFSA (2009)** about the welfare of dairy cows in relation to leg and locomotion problems states that animals kept in free-stall barns are at higher risk of being lame in comparison with straw yards. **HASKELL et al. (2006)** also found that lameness scores were higher on free-stalls farms compared with straw yard farms. When cows are introduced to new facilities, it is extremely important to provide them with professional trimming: the best lameness preventive solution.

The dairy industry, like other businesses, is at risk of cost-cutting policies and faces challenges to have the ability to produce a final product in a sustainable way at the lowest price possible. Sometimes farmers do not see the outcomes of professional trimming and have tendencies to substitute that activity by employing farm workers. In the research, on the farms, where trimming was done by farm employees instead of a company, there were extremely more lame cows (21.6%). Unfortunately, from the author's experience, in most of the cases those people were not trained properly for maintaining such an important task. The labour force is usually preoccupied with other farm activities; there is lack of repeated training and there is no monitoring of trimming quality and curing progress. On the other hand, when smart farm managers can see no improvement in lameness, the decision is made to employ a professional company. This solution is more effective in comparison to farm workers. A half-effective solution is when a professional team is called either only to trim cows when they are very ill or to run a workshop for farm workers trimming cows. Nevertheless, training should be renewed routinely to keep skills on a professional level **(VAN DER TOL, 2005)**.

In the present study professional trimming was found to be more effective than trimming performed by farm workers. The same conclusions were reported by **FAWC (2009)** that professionally-working trimmers are very effective in controlling sole ulcers and foul-in-the-foot. However, **BARKER et al. (2007)** asserted that routine hoof trimming done by a professional hoof trimmer or by the farmer was related with an increased mean herd locomotion score in comparison to those herds in which no routine trimming took place. **WELLS et al. (1999)** claimed that routine hoof trimming is better than no trimming, but works better if the most severe lame cows are checked between visits. This suggests that routine trimming of all cows 1-2 times per year was an effective method of controlling the prevalence of lameness because lame and unsound cows were left untreated until the next visit by the professional claw trimmer. Another possibility is that inadequate hygiene of hoof trimming equipment or poor foot-trimming technique led to lameness after trimming **(WELLS et al., 1999)**. Once a cow has chronic lameness, then the natural wear associated with normal mobility and locomotion are lost and imbalances between the claw horn growth and wear becomes a permanent problem. This situation occurs when, except professional trimming, e.g. twice a year, cows with the worst locomotion disorders are not treated and are waiting for the next trimming which might be in the next 4-6 months. In the current study, on most of the farms preventive checks between visits were run on almost every farm where a professional team worked and very rarely on farms where farm workers performed the trimming. On farms where there are no checks between trimmings, awareness of the lameness could possibly be very low, or financial matters are the issue, or farm workers do other jobs instead. Studies more closely investigating trimming between professional hoof trimmer visits, found that cows were lamer when farmers trimmed them in crushers with foot-lifting apparatus than without such apparatus **AMORY et al. (2008)**. It is possible that claw trimming by farmers between visits of professional hoof trimmers was detrimental to the locomotion of the cows because of low-quality trimming and ownership of professional tools, alone, is not sufficient enough to treat lameness when improperly used **(KOFLER, 1999)**.

WHAY (2002) calculated that in the UK the average case of lameness costs £178 per year and the average herd is losing about £10 000 per 100 cows every year. The money lost with a single lame cow equals the treatment of eighteen cows using a professional hoof trimmer. In Hungary where prices of ill cows are comparable and where labour is much cheaper, the ratio could even be as much as thirty cows. This seems to be a very cost-effective way of preventing lameness disorders for most herds in Hungary, if done properly and may reduce, for example infertility. It is interesting why so many farmers are still incapable of employing professional claw trimmers and why they are putting cows at risk when the task is given to workers employed on the farm.

There are golden rules for preventing lameness in dairy herds **(TOUSSAINT RAVEN, 1985)**. Trimming should be avoided when cows are turned out on very long or abrasive tracks (e.g. tarmac or concrete). This happens often when cows are trimmed and need to walk a few hundred meters between barns and milking parlours a few times a day on concrete. None of the farms monitored provided rubber mats between the barns and the milking parlours. Rubber mats in the milking parlour were found on four farms. On three farms there was straw on alleys between barns and milking parlours. Special attention should be paid with trimming freshly-calved cows (the first four weeks of lactation), as they are under strain and horn growth is less than wear and this raises the risk of a thin sole after trimming **(WHAY, 2002)**. Regarding trimming, none of the farms take into account special treatment of freshly-calved cows. All the herds are different and probably the best way for trimming would be a system designed for the individual cow, which would be created as a result from reliable records. However, only half of the dairy farms kept clear lameness case records.

The most occurring reasons for higher prevalence of lameness where on-farm teams worked and less common in professional groups would be:

– not properly cleaning the area between the inner and outer claw
– using a spray on not clean area between the inner and outer claw
– not dishing out the sole ulcer
– not making the dishing out on the outer claw larger to relieve weight off the sole ulcer site
– bruising or under-running the horn
– dull tools and the lack of proper grinders for sharpening
– letting cows walk in the manure after serious bleeding or spray treatments of haemorrhages
– using bandages and letting cows walk in the mud and dung
– improper crushes where cows are unstable, making them stressed and making trimming affected.
– improper crushes without barriers helping to herd cows into the crushes
– a lack of training and routine repetition for performing trimming

Cheaper and quicker solutions, like various hoof trimming methods, have a great chance for significantly decreasing the level of lameness. The best combination is found when the professional team is running the service with an occasional treatment of cows with the worst cases between regular visits. Regular visits with locomotion scoring in advance of the trimming makes sure the correct cows are treated and the performance of trimming can be monitored. This hoof management strategy was already described in the literature **(TOUSSAINT RAVEN, 1985; VAN DER TOL et al., 2004; WILLSHIRE and BELL, 2009)**, but unfortunately farmers not always find this method useful. One of the reasons is time and money and the other reason is that farmers get used to bad conditions and do not realize when bad becomes worse. Alternatively, the farm workers can carry out this work, but essential courses and routine trainings should be provided.

11.6. Correlations between the occurrence of lameness and conformation traits

Rear leg side view

The estimates of correlations between lameness and the linear traits are in Table 20. Not surprisingly, the greatest correlations between conformation and lameness were for traits that describe the structure of the leg, rump and dairy form. The greatest correlation was between lameness and rear leg side view. The estimate was 0.30 indicating that decreased leg angle was associated with an increase occurrence of lameness. This finding can be placed between the results of **BOELLING and POLLOTT (1998b)** where the correlation (0.22) was found and with **BOELLING and POLLOTT (1998a)** (0.44). **BOETTCHER et al. (1998)** found a similar relationship between rear leg side view and lameness on the phenotypic scale. They reported, however, a correlation only at level of 0.13.

Front and back teat placement

The front (0.19) and back (0.18) placement of the teat was slightly more correlated than udder depth (0.13) and udder cleft (0.14). This pattern demonstrates that cows with front and back teats slightly positioned inward are more disposed to lameness. In contrast, the research of **BOETTCHER et al. (1998)** found lame cows moderately and negatively correlated (-0.33) with front teats being positioned rather outward. Literature is not providing information being robust enough to explain this correlation.

Rump angle

A correlation between rump angle and lameness was low (0.18). In the other studies this was reported with a correlation of -0.03 **(BOETTCHER et al., 1998)** or 0.03 **(BOELLING and POLLOTT, 1998b).**

Rear leg rear view

There was no correlation found between rear leg rear view and lame cows (p=0.542). Unlike this study, **BOETTCHER et al. (1998)** had measured a correlation at -0.68. That result indicates that cows that tend to stand or walk with their toes pointing outward and hocks pointing inward and genetically predisposed to being lamer.

Table 20. Correlations between lameness and traits observed on 5 dairy farms

Trait	Present study	**BOETTCHER et al. (1998)**	**BOELLING and POLLOTT (1998a)**	**BOELLING and POLLOTT (1998b)**
Rear Leg Side View	+0.30**	+0.13**	+0.44**	+0.22*
Front Teat Placement	+0.19**	-0.33**	-	-
Rump Angle	+0.18**	-0.03**	-	+0.03**
Back Teat Placement	+0.18**	-	-	-
Dairy Form	+0.18**	+0.60**	-	-
Udder	+0.15**	-	+0.07*	-
Udder Cleft	+0.14**	-0.46**	-	-
Body Depth	+0.14**	+0.42**	-	-
Udder Depth	+0.13**	-0.44**	-	-0.15 to 0.15*
Stature	+0.13**	-	-	-
Strength	+0.12**	+0.22**	-	-
Rear Udder Height	+0.12**	+0.26**	-	-
Rump Width	+0.12**	+0.63**	-	-
Milk yield/1 lact.	+0.12**	-	+0.09*	-
Feet and legs	+0.11*	+0.11*	-	-
Teat Length	+0.10*	+0.30**	-	-
Fore Udder Attachment	+0.09**	-0.06*	-	-
BCS	-0.40**	-	-	-
Rear Leg Rear View	-	-0.68*	-	-
Foot Angle	-	-0.76*	-0.08*	-0.21*

* – $P < 0.05$; ** – $P < 0.01$

Rump width

A correlation between rump width and lameness was found to be low (0.12). In the research of **BOETTCHER et al. (1998)** that a correlation was greater than 0.60. That correlation shows that heifers of bulls that transfer genes for wider rumps are more disposed to locomotion problems. Rump width could predispose to lameness because its influence on the free forward movement of the rear legs.

Dairy form

Correlation between the dairy form and lame cows was 0.18. In the study of **BOETTCHER et al. (1998b)** that correlation was 0.60 which shows that increased sharpness and decreased body condition were associated with increased lameness.

Udder

At the time of judgement heifers were not expressing characteristics of mature animals. That is why udder scores were weakly correlated to lameness. In the future, more bulgy udders of mature cows form an obstacle for the rear legs and force them to make a circle **(GREENOUGH et al., 2007).** Bigger udders make cows walk with legs spread apart, uneven foot wear can occur which can lead to lameness **(BLOWEY, 1985)**. Similar, weak correlation was discovered by **BOELLING and POLLOTT (1998a)**. Fore-udder attachment had very low correlation, similar to **BOETTCHER et al. (1998)**.

Udder cleft and udder depth

Correlations between lameness, udder cleft and udder depth were moderately low (0.13 and 0.14 respectively). This means that cows with two halves of udders orientated towards the inside and udders positioned higher than the hocks are more prone to lameness. The same unexpected results were noticed by **BOELLING and POLLOTT (1998b)** ranging from -0.12 to 0.15. The differences were caused because of a use of alternative statistical methods - the sire component and the distinction between young and proven bulls. Some other research has found, however, some different relation, -0.46 for udder cleft and -0.44 for udder depth respectively. In the work of **BOETTCHER et al. (1998)** cows with halves of udders orientating towards the outside and udders positioned lower than the hocks are more disposed to being lame. Phenotypically, cows may have to alter their gaits if the udders are deep and pendulous, what can be understandable in the work of **BOETTCHER et al. (1998)**. There is however no clear explanation why well-attached udders in this study and the study of **BOELLING and POLLOTT (1998b)** are associated with an increase of lameness. Possibly, different statistical methods are giving alternative results.

Stature

The correlation between stature and lameness was only 0.13, however, suggesting that, genetically, increased body weight relative to frame size may be a more important risk factor for lameness than absolute body weight. **WELLS et al. (1993)** reported that the lame cows in their study were significantly heavier than the cows that were not lame. The weight was estimated by measuring the heart girth of each cow, and lame cows probably had more body depth and strength (width of chest) than did cows that were not lame. **ROWLANDS et al. (1985)** previously reported a positive phenotypic relationship between heart girth and lameness.

Strength and body depth

The correlation between strength and body depth and lameness were also low 0 (0.12 and 0.14 respectively with $P<0.05$). In the research of **BOETTCHER et al. (1998)** genetic correlations between those traits were moderately high and positive (0.22 and 0.42 respectively). These correlations and the high correlation of lameness with rump width, indicated that sires with larger, wider, and possibly heavier daughters tended to be predisposed to lameness.

Milk production

The average 305-d production across the herds was 9098.3 kg (SEM = 173.5 kg) of milk, with a range of 6728 to 10860 kg. There was a weak correlation found between milk production during one lactation (10946.34 ± 7440.08) and lameness (0.12). A weak association between milk production and the results of locomotion scores was also found by **REURINK and VAN ARENDONK (1987)** and **BOELLING and POLLOTT (1998a)**.

Feet and legs score

Similarly to **BOETTCHER et al. (1998)** the correlation between feet and legs scores and lameness was not high (0.11).

Foot angle

There was no significant correlation between lameness and foot angle found. However, some studies found significant negative correlation close to 0 **(BOELLING and POLLOTT, 1998a, 1998b)**. **WELLS et al. (1993)** and **BOETTCHER et al. (1998)** found some strong negative relationships between those measures (-0.76). Following this, a decreased foot angle was genetically associated with increased lameness occurrences. What is more, **WELLS et al. (1993)** reported an odd ratio of 2.4 for a decrease of 10 degrees in the angle of the rear lateral claw. Not directly a foot angle, but the angle of the dorsal wall was investigated by **DISTL et al. (1990)** and the same conclusions were found. On the other hand a decreased foot angle is a consequence of not only genetic factors. Inadequate claw trimming or no claw trimming (overgrown horn) could also lead to the condition.

Body condition score

In the current study, the body condition score was negatively correlated to lameness (-0.40). This finding is similar to **WELLS et al. (1993)** who reported the same phenotypic relationship. In the study, the average condition score was 2.5 for healthy cows and 2.32 for clinically-lame cows. Moreover, **MANSON and LEAVER (1989)** also reported a decreased body condition score related to increases in the occurrence of lameness. The reasons and effects of this association are not clear, but an explanation may be reduction in the adipose tissue of the digital cushion. Both body condition scores and lameness may be indicators of susceptibility to metabolic diseases such as rumen acidosis. Cows in severe negative energy balance are usually in poorer condition than healthy cows and are more prone to laminitis.

Other traits

Rump angle, dairy character, final score, capacity, total score, and locomotion had very low correlation with lameness with no significance.

Estimates of correlations between several type traits were low to moderate. The correlations were highest for lameness with rear leg side view, rump angle and dairy form. Astonishingly, there was no reported foot angle and rear leg rear view as being correlated to lameness. However, those traits are thought to be the most related to lameness **(WELLS et al., 1993; BOETTCHER et al., 1998)**. However, this might be misleading, because overgrown horn or inadequate hoof trimming might cause the feet to rotate outwards, resulting in hocked-in rear legs. Only in case of an otherwise healthy foot might be genetic predisposition an influential factor. The correlation between lameness and feet and leg scores was close to 0. A weak correlation between milk production and lameness probably means that all cow groups are affected by lameness in a similar way. What is more, the locomotion trait used by the judge in this study was not correlated significantly to lameness. This suggests that lameness is hard to distinguish in the time of judging cows of first lactation. The correlation between lame cows and rear leg side view was the highest among all traits. That combination demonstrates that decreased leg angle is strongly associated with cows being lame. The magnitude of these correlations indicate that a selection index with rear leg side view (0.30), rump angle (0.19) and dairy form (0.18) could be used to directly select for more lameness resistance.

Lameness is a problem in a modern dairy industry. Most of the correlations between lameness and conformation traits are low. Heritability of locomotion was also found to be very low. Potential of high yielding dairy cows was already put to a maximum and passed the point when sustainable adequate welfare can be provided. Low values presented confirm that other routes should be considered to decrease lameness (e.g. improvements in feeding, management or housing). Rear leg rear view and foot angle were found to be not in relation with the occurrence of lameness probably, because those animals were after bulls with very good locomotion traits or due to adequate treatment of hooves in heifers.

11.7. Effect of lameness on milk production

Among all the cows, 48.2% of them on five farms became lame at least once during the study. The incidence of first episode of lameness peaked at 1 and 3 months after calving (Figure 4).

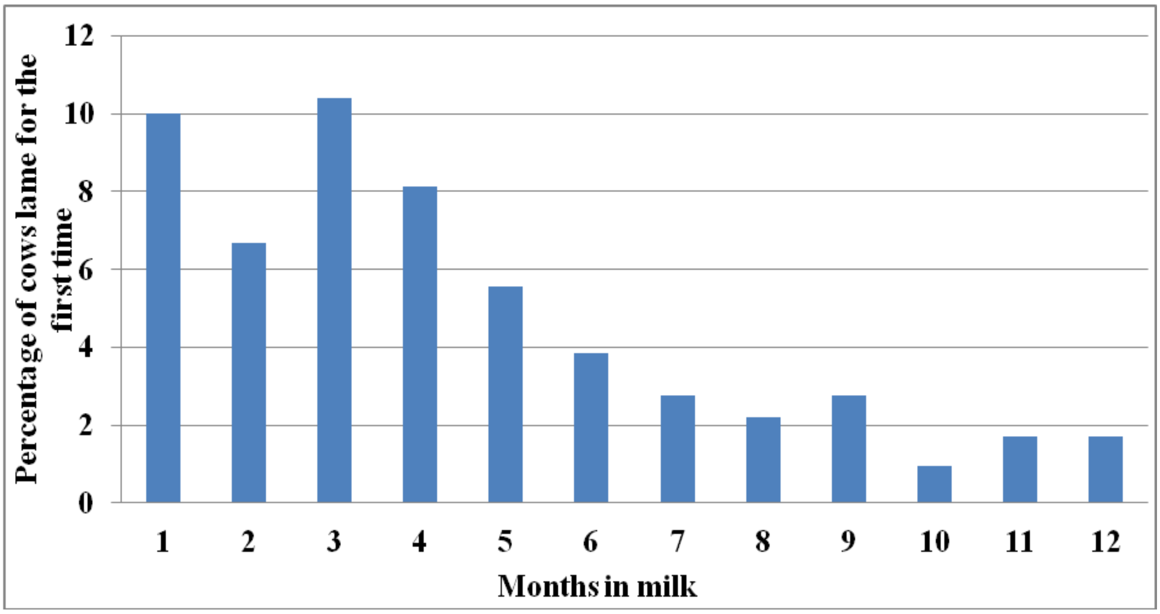

Figure 4. Percentage of cows lame for the first time by month in milk observed on five farms

A very clear pattern with significant differences between not lame and clinically lame cows was observed in the study regarding average test day milk yields and average BCS (Table 21). This information might be useful in explaining and helping to realize how lameness is affecting milk production and the condition of cows for those farmers who underestimate the impact of lameness on the welfare of cattle.

Table 21. Differences in milk yields and BCS of particular lameness scores observed on five dairy farms

Lameness score	Test day milk yield (mean)	Std. dev.	BCS (mean)	Std. dev.
1	32.96 [a]	8.75	2.75 [a]	0.58
2	32.07 [a]	9.43	2.64 [b]	0.54
3	30.86 [b]	9.87	2.48 [c]	0.53
4	29.84 [b]	8.45	2.41 [c]	0.58
5	28.56 [b]	8.61	2.31 [c]	0.98

a, b: Means in the same column with different letters differ at $P<0.05$

Never lame cows produced significantly more milk through lactation than cows that were at least lame once (32.12/day, std. dev. 8.81 vs. 30.90/day, std. dev. 9.45, respectively, P < 0.001) (Figure 5).

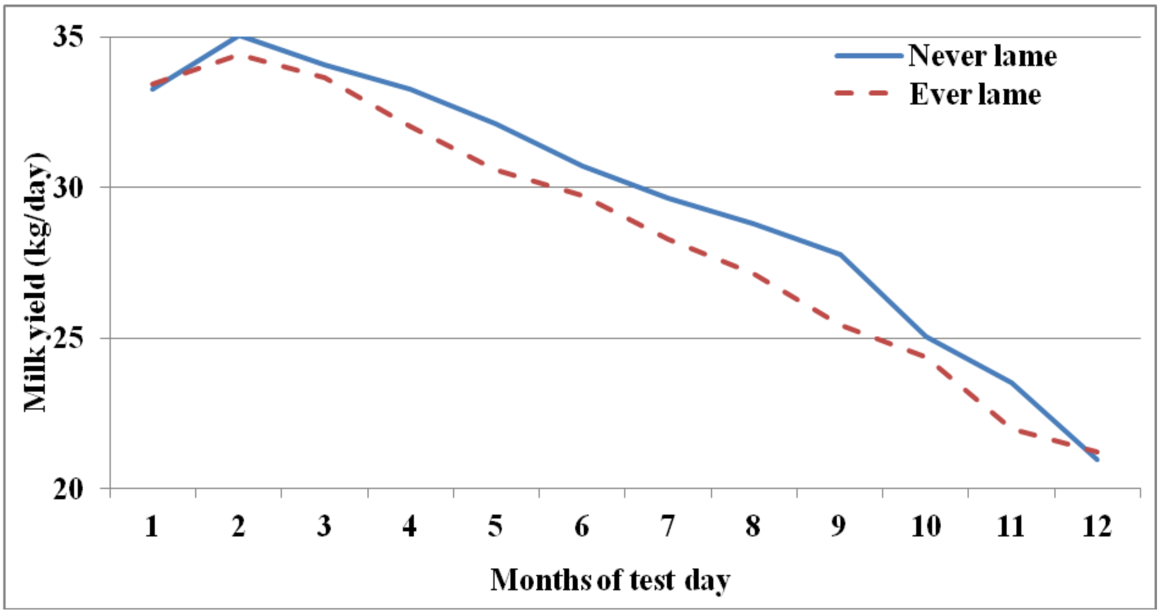

Figure 5. Mean lactation curves for cows that were ever lame versus those that were never lame. X axis = repeated measures of test day yield, Y axis = kg of milk per day

In the study, cows that were lame at least once during the study had a higher fat content in the milk (mean 3.57% and standard deviation 0.82) in comparison to never lame cows during the study (mean 3.41% and standard deviation 0.89) (Table 22).

Table 22. Comparison of never lame and at-least-once lame cows during the study

Parameter	Never Lame / Ever Lame	Mean	Standard Deviation
BCS (1-5)	Never	2.51[a]	0.61
	Ever	2.56[b]	0.73
SCC no.(*100)/ml	Never	415[a]	924
	Ever	530[b]	1215
Fat (%)	Never	3.41[a]	0.82
	Ever	3.57[b]	0.89
Protein (%)	Never	3.19[a]	0.44
	Ever	3.28[b]	0.51

a, b: Means of the given value in the same column with different letters differ at P<0.05

In the present study significantly more lame cows were observed in winter than in the summer (Table 23).

Table 23. Mean locomotion scores observed in 4 seasons on 5 dairy farms

Season	Mean lameness score	Std. dev.
Summer	1.74 [a]	0.86
Autumn	1.87 [b]	0.92
Spring	1.99 [c]	0.97
Winter	2.28 [d]	1.08

a, b, c, d: Means in the same column with different letters differ at P<0.05

In the current study the BCS was significantly higher in non-lame cows (scores 1-2) in comparison to lame cows (scores 3-5) two months before milk yield test day and lameness were observed (Table 24). Regarding milk yields, the highest milk yields were observed in those cows that had the lowest lameness score observed two months earlier (Table 25). The relationship between lameness score (two months earlier) and current milk yields shows that if the cows' locomotion score changes from 1-2 to 3-5 there will be a significant drop in milk production observed in the preceding two months.

Table 24. Associations between current LS and BCS observed 2 months earlier

Lameness score (of current TDY)	Mean BCS (2 months earlier)	Std. dev.
1	2.68 [a]	0.54
2	2.59 [b]	0.61
3	2.56 [b c]	0.53
4	2.50 [b c]	0.57
5	2.33 [b c]	0.85

a, b,c: Means in the same column with different letters differ at P<0.05

Table 25. Highly significant associations between lameness scores and test day milk yield observed 2 months earlier

Lameness score (2 months earlier)	Mean of milk yield (of current TDY)	Std. dev.
1	32.39 [a]	9.86
2	32.07 [a]	8.21
3	30.85 [b]	8.55
4	29.83 [b]	7.23
5	28.60 [b]	11.06

a, b: Means in the same column with different letters differ at P<0.05

Factors affecting milk yields included: the farm, parity, the animal ID and whether a cow ever became lame or not during the study. Those factors were found to be similar to **GREEN et al. (2002)** and **BLOWEY (1993)**. On five farms cows were lame for the first time mostly in the first 4-5 months of lactation. The high incidence of lameness cases after calving illustrates the need to focus on the transition period to prevent both infectious and metabolic diseases directly after calving, as well as lameness cases months after calving. Never lame cows produced 1.22 kg more milk/d than cows that were lame at least once. This is a mean of 372.1 kg extra kilograms of milk over 305 days of lactation. Multiplying this with the current average milk price in Hungary (€0.3005, assessed 12 February 2012) **(DAIRYCO, 2012)** it gives a €111.82 loss per one lactation due to the difference in milk yields only. Analysis has identified a higher mean lactation yield in cows that were never lame during lactation versus those that were at least once lame during a lactation as postulated by **HERNANDEZ et al. (2005)** and **(LUCEY et al., 1986)**. **ÓZSVÁRI et al. (2007)** also estimated in Hungary the average decrease owing to lameness for lactation of 579 kg, however **LEHOCZKY et al. (2007)** found no significant difference between the milk yield and milk composition of lame and not lame animals in Hungarian dairy herds. The drop in milk yield and an increase in lameness score in the current study are also not in agreement with **ARCHER et al. (2010)** and **GREEN et al. (2002)** where cows with higher lameness scores produced more milk. Higher milking cows were thought to be at greater risk of ketosis and other health disorders because their nutritional demands were not met.

SPRECHER et al. (1997) has provided a lameness scoring system, nowadays widely-recognised, that uses posture and gait to predict dairy cattle reproductive performance. A 5-point score system was considered by a few author to describe clinically lame cows with scores from 3 to 5 **(COOK and NORDLUND, 2007; CLARKSON et al., 1996; BARKER, 2010)**. Interestingly, lameness scores (from 1 to 5) were negatively related to the mean BCS but ever lame cows in comparison to never lame cows were observed with a greater mean BCS. This might mean that exactly when lameness occurred, a drop in BCS was so great that cows with lower lameness scores (or not lame at all) were in that time in better conditions in comparison to ever lame cows. It is also very likely that ever lame cows were experiencing more extreme BCS scores in comparison to never lame cows. The relationship between mastitis and lameness is unclear. Based on ten dairy herds, **PEELER et al. (1994)** associated the clinical lameness before the first service with a 1.4-fold increase in the odds of clinical mastitis. However, cows with sole ulcers in 102 dairy herds did not have higher odds of mastitis or high SCC than did unaffected cows **(HULTGREN et al., 2004)**. In the current study ever lame cows were observed with a significantly higher number of SCC. The most elevated SCC was found with LS5 reaching an average 1 086 000 SCC/ml (data not shown).

Lower milk fat content is known to be related to subacute ruminal acidosis (SARA) **(OETZEL, 2007)**, however SARA is considered as one of the reasons of lameness causing decreased blood flow between the tissue and the corium **(NORDLUND et al., 2004)**. That means that SARA was probably not the main reason for a higher prevalence of lameness on five farms. The digital cushion consisting of fat and loose connective tissue is an important support structure in the claw **(SHEARER, 2010)**. Recent studies suggest that body condition score mirrors the size (i.e. fat content) of the digital cushion and may be very important to the integrity and the health of hooves. In a study by **BICALHO et al. (2008)**, body condition scores were positively associated with digital cushion thickness. These results give support to the concept that sole ulcers and white line abscesses are related to contusions within the hoof horn capsule and such contusions are a consequence of the lower capacity of the digital cushion to dampen the pressure exerted by the third phalanx on the soft tissue beneath. The highest prevalence of cows lame for the first time in the current study was observed to be in the first 4-5 months of lactation. Maintenance of good body condition throughout the first 100-150 days of lactation may prove to be a very important feeding objective. In contrast to milk fat content ever lame cows were in better condition.

The literature is not providing many associations with lameness and milk protein content. **DIPPEL et al. (2009)** found that cows with suboptimal milk protein content (<3.2% or >3.8%) were more likely to be lame. However, **TRANTER and MORRIS (1991)** reported that lame cows had lower milk protein content. In the current study ever lame cows had higher milk protein content.

MOHAMADNI et al. (2008) found in Iran the average lameness to be higher in the spring than in the autumn (2.73 vs. 2.47, respectively). Relations between seasons and average lameness were thought to be linked with moisture, humidity and temperature in particular parts of the year in the UK **(WILLIAMS et al., 1986)**. **GÓMEZ et al. (2003)** argued that high temperatures with high humidity are responsible for damaging factors which can lead to foot rot by means of easier bacteria development. In the USA, **COOK and NORDLUND (2007)** claimed that there were more lame cows in the summer than in winter which was thought also to be partly related to heat stress-associated ruminal acidosis responsible for an elevated prevalence of lameness. Cold weather during winter may lead to handling problems of manure in the alleys and a reduced frequency of foot bathing, causing more lameness problems. It is also possible that warm and dry summers in Hungary are less harmful for cows than much colder and wetter winters, springs and autumns with which more lame cows observed. There were significant differences in the means of lame cows in different seasons. There were several studies aiming to predict the prevalence of lameness using a logistic regression model **(BICALHO et al., 2007)**, the Fuzzy Set Theory **(CRUZ et al., 2001)** or observation of cows' movement **(SONG et al., 2008)**, but none of them are developed on such a level to satisfactorily provide prediction reliability.

11.8. Heritability of lameness

Heritability, repeatability and effects of factors were evaluated for four general linear models described already in chapter 11.7. Heritability was found to be very low in four models and the lowest in the model including the effect of body condition scores on locomotion scores (0.029) (Table 26). Effects significantly influencing milk yield in the first model including the effect of locomotion scores on milk yield were cow, farm, lactation number and locomotion scores observed two months earlier. In the second model with the effect of body condition scores on milk yield cow, farm, lactation number and cow being ever lame, affected significantly milk yield the most. The third model consisting of the effect of locomotion scores on body condition scores was influenced significantly by cow, farm, lactation, cows being ever lame, current locomotion score and locomotion score observed two months later. The fourth model with the effect of body conditions scores on lameness scores was significantly affected by all factors except lactation number and month of lactation.

The heritability is an analysis of the relative contributions of the differences in genetic and non-genetic factors to the total phenotypic variance in a population. In the current study the proportion of observable differences due to genetic differences was very low. The lowest heritability (0.029) was observed in the model measuring factors affecting locomotion scores. This result is in agreement with **HUANG and SHANKS (1995)** who observed heritabilities of 0.05, 0.12, 0.06, 0.14, 0.02 and 0.08 for corkscrew claw, heel erosion, interdigital dermatitis, laminitis, sole ulcers and white line separation, respectively; and repeatabilities were 0.17, 0.19, 0.15, 0.19, 0.14 and 0.14, respectively. Low heritability of foot angles, heel depth, rear leg side view and rear leg rear view was reported by **BOETTCHER et al. (2001)** with h^2 = 0.13, 0.10, 0.26, 0.11, respectively and by **DECHOW et al. (2002)** with h^2 = 0.16, 0.12, 0.21, 0.14, respectively. Unfortunately, in the present study heritability of traits and influence of bulls were not estimated due to limited number of cows in dataset (n = 826).

Table 26. Heritability and repeatability of four general linear models with significant effects of factors observed in 25 Holstein-Friesian herds

Model	Heritability (Standard error) h^2 (s.e.)	Repeatability	Effect	Significance
I	0.163 (0.056)	0.567	Cow [a]	P < 0.0001
			Farm [b]	P < 0.0001
			Lactation [b]	P < 0.0001
			Month of lactation [b]	NS
			Ever lame [b]	NS
			Locomotion score (-2) [b]	P < 0.0011
			Locomotion score (-1) [b]	NS
			Locomotion score (-0) [b]	NS
			Locomotion score (+1) [b]	NS
			Locomotion score (+2) [b]	NS
II	0.189 (0.061)	0.569	Cow [a]	P < 0.0001
			Farm [b]	P < 0.0001
			Lactation [b]	P < 0.0001
			Month of lactation [b]	NS
			Ever lame [b]	P < 0.0005
			BCS (-2) [b]	NS
			BCS (-1) [b]	NS
			BCS (-0) [b]	NS
			BCS (+1) [b]	NS
			BCS (+2) [b]	NS
III	0.216 (0.074)	0.451	Cow [a]	P < 0.031
			Farm [b]	P < 0.0001
			Lactation [b]	P < 0.018
			Month of lactation [b]	NS
			Ever lame [b]	P < 0.048
			Locomotion score (-2) [b]	NS
			Locomotion score (-1) [b]	NS
			Locomotion score (-0) [b]	P < 0.001
			Locomotion score (+1) [b]	NS
			Locomotion score (+2) [b]	P < 0.002
IV	0.029 (0.033)	0.268	Cow [a]	P < 0.013
			Farm [b]	P < 0.001
			Lactation [b]	NS
			Month of lactation [b]	NS
			Ever lame [b]	P < 0.012
			BCS (-2) [b]	P < 0.008
			BCS (-1) [b]	P < 0.044
			BCS (-0) [b]	P < 0.001
			BCS (+1) [b]	P < 0.001
			BCS (+2) [b]	P < 0.001

[a] random effect

[b] fixed effects

12. Limitations of the study

The study did not focus on feeding. There was no in-depth analysis of TMR given to the animals which could have a significant impact on explaining a correlation between lameness and feeding regimes.

Slippery flooring was checked by its physical characteristic (e.g. slippery vs. not slippery, grooved vs. not grooved). There are other—probably more reliable—methods for checking slipperiness; for example, checking the number of animals walking through the holding area, milking parlour and/or passageways. **GRANDIN (2011)** claims that if 1% fall down, the surface should be considered as dangerous for animals.

13. Conclusions

13.1. The status of farms regarding their lameness prevention measures

25 Hungarian Holstein-Friesian herds in the study were relatively well-prepared for preventing lameness outbreaks in comparison to suggestions in publications. None of the measures were observed to be drastically different in comparison to already published data. The only reported aspects needing immediate actions to be taken were: ineffective foot baths, no training for on-farm trimmers, cattle colliding with new equipment, damaged concrete in passageways and on cow routes, slippery passageways, poor scraping with tractors, lacks of lunge areas, limited access to water, acidosis, extreme losses in BCS, compromised accesses to paddocks, farm managers and farm workers not fully aware of lameness implications and no adaptation periods for heifers. Rubber flooring was found on only one farm in areas where cows walked the most, except in some rotary milking parlours.

13.2. Relations between the occurrence of lameness, welfare measures and environmental factors

The majority of relations between the occurrence of lameness, welfare measures and environmental factors on 25 farms were similar to those already reported in publications where elevated locomotion disorders were related to: increased number of foot baths per week, decreased number of extra free stalls, decreased BCS, dirtier bedding and non-grooved feed yards. Unrestricted rising was related to the presence of lunge areas and brisket boards. There were fewer hock and knee lesions in straw yards than in free stalls and rising was unrestricted on farms where stalls were provided with lunge areas and brisket boards. Associated with increased number of lame cows and not reported before were: limited access to water, old-fashioned, square feeders and milking parlours with steps > 5 cm. There were no contradictory findings to those already known related to the growth of locomotion disorders.

13.3. Relations between the number of orthopaedic blocks used by hoof trimmers, welfare measures and environmental factors

Orthopaedic blocks used by hoof trimmers on hooves with the most severe lesions were not studied before. In the present study, an elevated number of blocks was associated and related to an increased number of foot baths per week, more frequent trimmings per year, decreased number of extra free stalls, narrower passageways, longer distances between barns and paddocks, lower placement of neck rails, increased percentage of cows perching and heifers with dirty hindlimbs, no access to paddocks, presence of free stalls, lack of lunge areas, poor quality surfaces in front of water troughs, non-grooved feed yards and stones on tracks. Those measures were already reported by scientists to be related to an increase occurrence of lameness. The increased percentage of obviously ill cows, scraping passageways using tractors and the presence of grooved alleys in milking parlours were three measures related to an increase in the average number of blocks. These three measures were not previously reported to be related to lameness.

13.4. Rank of farms regarding changes in the occurrence of lameness

Among the 25 farms the prevalence of lameness was decreased on 16% of the farms and controlled (did not change statistically) on 20% of the farms; that means that those farmers recognised the locomotion problems and took effective actions. The most common effective changes were employing professional hoof trimmers, checking cows between trimmings and provisions of effective foot baths. One needs to consider that on the majority of farms engineering projects, silage contamination with mycotoxins and probable energy-imbalanced diets were reported between 2009 and 2011. Those factors are very likely to be thought to have a significant impact on the increased number of lame cows. It is also possible that an elevated occurrence of lameness between 2010 and 2011 will drop after some time on farms where negative factors were observed. The results give promising information that decreasing the prevalence of lameness is possible on Hungarian dairy farms. On the other hand, there was proof that old and unreviewed routine programs for preventing lameness need to be altered and implemented according to changing conditions on the farms.

13.5. Effectiveness of professional and on-farm hoof trimming in different conditions

Professional trimming was found to be more effective than on-farm trimming on farms with engineering projects, with feeding disorders and when trimming was changed from on-farm to professional and vice versa. There should be monitoring of lameness and comparison of hoof trimming teams. There is a huge variation between farms and cows regarding proper trimming, but general information about the performance of the particular hoof trimmer (or a team) should be used for successful lameness treatment. Sadly, many farm managers are not interested in checking different trimming methods or services. The human nature of becoming used to everyday activities and routines creates a risk which self-confidence in performing trimming overwhelms the curiosity for checking and comparing the quality of trimming.

13.6. Correlations between the occurrence of lameness and conformation traits

The study did not show high values of correlations between lameness and type traits, which might be because of the environment which modifies the correlations. Low leg angle, low rump angle, back and front teats orientated towards the inside were associated with increased clinical lameness. This knowledge can be used in the future to give more attention cows in need of additional care with legs and which kind of bulls should be used for selection. For the conformation traits, it is important not only to breed an ideal-looking heifer, but an animal which shows equilibrium between milk production, rear leg side view, and lameness resistance.

13.7. Effect of lameness on milk production

Lameness accounted for 19.7% of the reasons for culling on five dairy farms in the present study. So there is a need for taking immediate actions for decreasing the prevalence of the problem. The findings about the impact of lameness on milk production on five Hungarian dairy farms can be used for providing farmers with more accurate information on the impact of lameness on production and the welfare of cattle. There was a higher fat content observed in cows which were lame at least once during the study in comparison to those which were never lame. This shows that there are limited fat resources available for undisturbed functioning of the hoof. Ever lame cows experienced more extreme changes of BCS which could have a possible impact on the thickness of the digital cushion in the hooves and could make them lame. This study proves that more care should be taken in the first 4-5 months of lactation to protect cows against elevated prevalence of lameness. Winter seems to be more harmful for dairy locomotion in Hungary than summer.

13.8. Heritability of lameness

The individual characteristics of cows, management on the farms and the number of lactations were the most common factors affecting milk yields, locomotion scores and body condition scores. The low heritability estimates of approximately 0.20 from the models indicate that a direct selection for a lower locomotion score could be hard to achieve. Also, the results from the analysis of milk yields and locomotion scores show an unfavourable correlation. Thus, the selection for a decreased locomotion score should not compromise the genetic progress for production. Over 90% of the observed differences between animals are controlled by non-genetic factors. However the potential economic impact of lameness is high enough to make the genetic variation between animals useful. Lameness data can be collected to develop a mobility breeding value which could be used to identify bulls whose daughters are more resistant to lameness.

The acceptance of independent advice

Experience from the project shows that farmers, with enthusiasm, appreciated the help of an independent person sharing the same values for improving the well-being of their cattle. This creates an opportunity for the development of an independent governmental or non-profit institution to gather and share knowledge about animal-friendly, sustainable and effective farming. Such projects are run in Canada (University of British Columbia – Animal Welfare Program), in the USA (University of Minnesota – Extension) as well as in the UK (Agriculture and Horticulture Development Board – DairyCo). Before the transformation of the political system in the early 1990s', the staff employed in state organisations was responsible for propagating and advising new solutions in agriculture. Nowadays, advice is only offered by sales representatives of companies offering products to the dairy industry, however, they cannot be considered to be independent.

14. Further research

There were new barns and new cubicles implemented on some farms. Further research could investigate the profitability of the investments regarding changes in lameness, welfare, production and performance data.

This study only covered some measures taken and some which could be taken to decrease prevalence of lameness. Monitoring could be done on dairy farms regarding changes related to lameness only. Precise data of implementing new solutions, their costs and rank could be built with profits expressed in terms of money, lameness scores, welfare status and performance data.

Precise monitoring of 1-5 farms with the lowest lameness prevalence could be carried out. Effort should be taken to observe control and preventive solutions, reproduction strategies and feeding regimes.

Observation could be taken to explore and to investigate some other methods which could help identify, prevent and use early treatment of sub-clinical lameness.

15. New scientific results

Dairy welfare

1. Even the great shift of milk yields in the last 12 years the average welfare measures were not different to those found in the literature.
2. In total, eighteen positive and fourteen negative measures were discovered after providing farmers with dairy welfare solutions.

Lameness

1. The effectiveness of professional over on-farm hoof trimming was proved on Hungarian dairy farms.

2. The relationship between the lameness score (2 months earlier) and current milk yield shows that if the cows' locomotion score changes from 1-2 to 3-5 there will be significant drop in milk production observed in the succeeding two months.

3. BCS was significantly higher in non-lame cows (scores 1-2) in comparison to lame cows (scores 3-5) two months before milk yields and locomotion were observed.

16. Summary

Economic constrains on the dairy farmers over the last years have drove the European dairy industry to look for greater efficiencies. Some believe that those significant changes in dairying have disturbed the welfare of cows. Very likely, the low profitability of dairy enterprises has compromised investments and maintenance on many farms which in turn may neglect the reduction of the occurrence of lameness, mastitis and metabolic diseases. The need for creating such a review is especially pertinent in the light of the increasing intensification of dairy farming, the obligations of legislation, and increasing retail and consumer demands. Lameness in cattle s a symptom of certain illnesses and disorders of the leg or the claw and occurs in several clinically recognizable forms. This is a major welfare problem of dairy cows and because of its negative impact on milk production is one of the most important dairy cattle diseases. What is more, farmers often underestimate the scope of the lameness problem within their herds. With a number of negative implications to welfare and productivity, the outbreak was considered by participating farmers to be one of the most important outbreaks to be improved. For that reason lameness was chosen to be the second topic of this doctoral dissertation.

The welfare was checked in 2010 and the welfare report was given to farmers with suggestions for improving cattle welfare. In 2011 the same assessment was performed. Lameness measures were checked in 2010 and a lameness report was given to the farmers with suggestions for decreasing prevalence of lameness. Another visit in 2011 was performed for checking if any changes occurred.

In comparison to the literature, the 25 Holstein-Friesian dairy farms were better run in aspects like fewer cows with hair loss, non-hock injuries, hock and knee lesions and shorter flight distance. Similar distributions, among other authors, were found with dirty hindlimbs, dirty udders, bedding, lameness, mortality and culling of lactating cows, lifespan and mortality of calves. In comparison to already-presented studies, dirty flanks was the worst result. Estimates found in the study confirm that farmers made compromises choosing between improved cleanliness with better body conditions or ill cattle with injuries. The weakest areas are old facilities which make some of the preventions ineffective. The numbers of associations specific for Hungarian dairy farms were found between elevated occurrence of lameness, number of orthopaedic blocks used by hoof trimmers, prevention measures and

environmental factors. The most effective practices for decreasing the prevalence of lameness were employing professional claw trimmers, checking cows between trimmings and provision of effective foot baths. The effectiveness of professionals over on-farm hoof trimming was proved. Low leg angle, low rump angle, back and front teats pointing inside were found to be associated with increased lameness. Cows lame at least once produced 372 kg per lactation less than not lame cows. A drop in locomotion score from 1-2 to 3-5 was related to a drop in milk production in the next two months. BCS was significantly higher in non-lame cows in comparison to lame cows two months before milk yield and locomotion were observed. Low heritability (0.03) and low repeatability (0.27) of locomotion scores were found. The characteristics of the individual cow, management on the farms and number of lactations were the most common factors significantly affecting locomotion scores, milk yields and body condition scores.

The 25 Holstein-Friesian herds observed do not necessarily represent the welfare conditions of cows throughout the Hungary. However, the study probably constitutes the largest independently observed assessment of the welfare of dairy cattle to have been carried out in Hungary. Farmers were able to decrease the number of dirty cattle and improve the condition of younger calves, heifers and lactating cows. On the other hand more animals got injured and ill probably because of introducing cattle to new buildings and new facilities implemented between visits. Possible reasons that voluntarily given advice did not result in greater improvement of cattle welfare could be because of a lack of funding, low profitability, a lack of labour, no interest in improving welfare, a lack of consciousness or education of farmers or a lack of professional cattle welfare advisors.

Farmers are more aware of the negative impact of lameness in dairy cattle what was observed by changes in applying more effective prevention measures. Care, however, should be taken with providing adequate width of passageways, distance the cows walk, new facilities cattle are introduced to, effective use of foot baths and tractor scrapers on uneven surfaces. So far there was no publication found covering the reasons for elevated use of orthopaedic blocks. Farmers resist applying cheap solutions on their farms which could improve cows' locomotion, like providing rubber mats (or conveyor belts as a cheaper substitute), maintaining or cleaning surfaces when needed.

17. References

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18. Appendices

Appendix 1. Example of results of welfare assessment presented to farmers

Animal welfare report

Name of the farm	
Location	
Date of visit	
Person in charge	
E-mail address	
Phone no.	

The following report was created as a part of a PhD thesis ‘Study of animal welfare status in dairy cow herds in Hungary’ run by PhD student Ryszard Gudaj with supervision of Prof. Dr. István Komlósi[1)] and Prof. Endre Brydl[2)]. This document was created in cooperation with contact person on the farm <u>for educational purposes only.</u> No information will be shared with the third party without permission of contact person or farm manager. The assessment was created to be as objective as possible to show estimations and measures based on experience, literature and dairy husbandry recommendations in the European Union. Further discussion and investigation will be appreciated, if current welfare status on the farm is expressed improperly.

With many thanks for professional assistance,

PhD Student
Ryszard Gudaj

1) – Department of Animal Breeding, Faculty of Agricultural and Food Sciences and Environmental Management, Centre of Agricultural and Applied Economic Sciences, University of Debrecen.
2) – Head of Department of Animal Hygiene, Faculty of Veterinary Science, Szent István University in Budapest.

Lactating cows:

1. Lame cows – 55%
2. No records of lame cows
3. On average 25% of cows are staying half in the cubicles and half in the passage way, standing or laying in the passage way or idling.
4. All groups of animals (except young calves) are dirty (>25%)
5. Cows have problem with rising
6. Cows with hock and knee lesions – 23%

Dry cows:

7. Almost 100% with dirty udders
8. 17.2 % with hock and knee lesions

Younger calves:

9. Some of them with no water during the hot months
10. Relatively a lot of animals with diarrhoea – 15%
11. More than 75% of animals are dirty
12. 6% of animals with neck rail injuries
13. 28% of animals are relatively thin BCS<3

Older calves:

14. 10-45% of animals are dirty in different parts of their bodies
15. 11% of calves with neck rail injuries

Heifers:

16. 45% of heifers are with dirty hindlimbs
17. 12.2% of heifers with neck rail injuries
18. 12.5% in BCS <3

Nutrition:

19. Mouldy food in troughs
20. Silage clump is exposed to the sun with large dark layer at the top
21. Big bales are damaged – the ones dry cows are eating

Building:

22. Passageway dimensions lower than recommended (3.5m) – 3.0m
23. Slippery floors in the buildings
24. Holes in the concrete in front of the troughs
25. Poor bedding in the cubicles
26. Poorly designed barns and stalls
27. No lunge areas in the cubicles
28. No brisket boards in the cubicles
29. Steep entrances to the barns (dry cows)
30. Water troughs - dirty water and surface with limited access – slippery
31. A lot of sharp turns in the insemination area
32. Outside paddocks are muddy and without shade
33. Slippery surface in the milking parlour with holes
34. Muddy and wet areas around the buildings where the cows are suppose to spend time at the clean paddocks
35. Slippery alleys with dangerous wooden bars
36. No shade for animals (if they are suppose to stay only in the paddocks)

Appendix 2. Example of results of lameness assessment presented to farmers

Lameness report

Name of the farm	
Location	
Date of visit	
Person in charge	
E-mail address	
Phone no.	

The following report was created as a part of a PhD thesis ‘Study of animal welfare status in dairy cow herds in Hungary’ run by PhD student Ryszard Gudaj with supervision of Prof. Dr. István Komlósi[1)] and Prof. Endre Brydl[2)]. This document was created in cooperation with contact person on the farm for educational purposes only. No information will be shared with the third party without permission of contact person or farm manager. The assessment was created to be as objective as possible to show estimations and measures based on experience, literature and dairy husbandry recommendations in the European Union. Further discussion and investigation will be appreciated, if current lameness status on the farm is expressed improperly.

With many thanks for professional assistance,

PhD Student
Ryszard Gudaj

1) – Department of Animal Breeding, Faculty of Agricultural and Food Sciences and Environmental Management, Centre of Agricultural and Applied Economic Sciences, University of Debrecen.
2) – Head of Department of Animal Hygiene, Faculty of Veterinary Science, Szent István University in Budapest.

Animal welfare and lameness assessment was taken on ... farm on 3rd of December 2010. 1137 lactating cows were checked after milking regarding their locomotion scores. This is a comprehensive tool used worldwide in farming and by researches for estimating lameness in herds. Special attention was taken to find all possible measures on the farm which might be reasons for predicted high level of lame cows. Lameness was found in 42.2% of cows to be affected in different levels. The following table describes precisely the percentage and the way how of animals’ were observed (Table 1).

Table 1. Percentage of lame cows found on the farm with descriptions

%	Score - level	Definition
42.2	Lameness	Lameness score 3+4+5
31.6	Lameness score 1 Normal	Stands and walks normally with a level back. Makes long confident strides.
26.2	Lameness score 2 Mildly lame	Stands with flat back, but arches when walks. Gait is slightly abnormal.
22.1	Lameness score 3 Moderately lame	Stands and walks with an arched back and short strides with one or more legs. Slight sinking of dew-claw in limb opposite to the affected limb may be evident.
11.8	Lameness score 4 Lame	Arched back standing and walking. Favouring one or more limbs, but can still bear some weight on them. Sinking of the dew-claws is evident in the limb opposite to the affected limb.
8.3	Lameness score 5 Severely lame	Pronounced arching of back. Reluctant to move, with almost complete weight transfer off the affected limb.

Poor locomotion was proved by hooves check with claw trimmers working in the same day when the assessment was taken.

The most severe (with the quickest possibility for improvement) factors influencing poor hooves and locomotion status of cows:

1. Cows are not provided with professional trimming and the lack of knowledge of hard cases was found among hoof trimmers. The assessment did not include professional claw trimmers working on the farm and is limited only to workers dealing with the most severe cases. Hoof trimmers were found asking managers what to do with some of the special cases. The manager was not able to provide any constructive answer. That special treatment must not include people who hesitate with which method they should use. Mistakes might be too risky for the cow and for her further presence and production on the farm.

Observation of the trimming team doing the most severe cases found:

1.1 No professional model trimming (5 point Dutch functional trimming).
1.2 Wall separation not cleaned.
1.3 Short toe.
1.4 Toe not fixed properly.
1.5 In some cases orthopaedic blocks not provided.
1.6 Claws not cut enough in some cases.
1.7 Cows are experiencing unnecessary bleeding when trimmed.
1.8 No cutting of inner wall.
1.9 Cows leaving the crush are not found to be cured properly.
1.10 No sharp knives which are making the job harder for people and more irritating for animals.

2. Some cows are found walking 2600 m a day on concrete flooring. This is creating massive harm to cows' hooves. Cows should be given as comfortable surfaces for walking as possible. On this particular farm cows walking comfort should be at the highest priority due to the long distance between the milking parlour and barns.

2.1 Holes on the way in to the milking parlour.
2.2 Slippery ways in the middle of the new buildings when cows need to walk up and down before and after milking.
2.3 A lot of high steps (22cm) where cows need to walk up and down through 4 alleys 3 times a day which gives 2,6m up and 2,6m down.
2.4 When temperature drops significantly almost 50% of cows are found slipping with minimum 1 leg when walking on the steps.
2.5 Slippery surface (ice) in front of water troughs when temperature drops significantly.

Other areas on the farm with strong influence on creating lameness:

Building:

3. Less than 10% of extra cubicles in the new barns.
4. Relatively a lot of older calves found lame due to slippery flooring.
5. Not enough feeding space in front of the feeders. Animals found competing for space in front of the feeder and slipping.
6. Young calves found with too much straw/muck in the individual cubicles. Some of them found with bloody injuries on their backs.
7. A lot of water in the barns. Manure flushing system is not providing a sufficient flow for cleaning all alleys in the buildings with dry cows and heifers. 5-10cm of dung and manure in the last 20-40 m of the alley from the flushing valve was found.
8. Alleys in the barns also with dung and manure accumulated at the end of the barns.
9. Cows too big for small cubicles.
10. Uncomfortable boxes.
11. Holding area in the milking parlour not cleaned during milking, but after milking.

Suggestions for decreasing lameness on the farm.

1. *Suggestion*: Give professional training to claw trimmers.
   For example: Ask the leading professional claw trimmer(s) to give a lecture, presentation and training with a strong focus on the worst cases.
   Benefit: Workers will be more self-confident with severe cases. They will understand why some procedures need to be done, and why some of them must be avoided. This will minimise so called 'man made diseases'.

2. *Suggestion*: Provide cows with non slippery, soft and comfortable surface on the way to the milking parlour.
   For example: Use rubber belts from old conveyors. 2x50 cm will be enough in one row when cows are walking.
   Old straw, e.g. from freshly calved cows.
   Poor quality straw, lucerne or hay.
   Wood shavings
   Old, shredded paper
   Benefit: Cows' hooves will not be affected so much by abrasive, hard and sharp concrete. Softer flooring will minimise distance and hardness factors.

3. *Suggestion*: Periodical lameness scoring.
   For example: At least 25% of each production group. Assessment needs to be done by one person with animals walking on a hard, level and sound surface.

Cows need to be able to walk 5-10 steps freely, so the correct assessment can be done.

Benefit: This is the first step for monitoring lameness and the impact of improvements done for its decreasing.

The most severe cases observed:

Dung in alleys after scraping.

No professional care of hooves.

Compromised walking comfort. Long distance, hard concrete, holes, steps, angles, highly slippery flooring in winter.

Too small cubicles for dry cows.

Appendix 3. An example of silage examination from one of the farms

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EREDMÉNYKÖZLÉS

Naplószám: **TA432/2010**

Megrendelő adatai	
Cég neve:	**Hajdúböszörményi MgZrt.**
Megrendelő személy neve:	**Molnár József**
Levelezési címe:	**4220 Hajdúböszörmény, 35.sz. főút, Polgári útfél**
Költségviselő:	**Hajdúböszörményi MgZrt.**
Számlázási cím és számlázás módja:	**4220 Hajdúböszörmény, 35.sz. főút, Polgári útfél**
ALKALMAZOTT VIZSGÁLATI MÓDSZEREK:	

	Minta	***1. minta***	Depresszív	Toxikus		
Minta adatai	**Naplószám**	TA432				
	Megnevezése/Azonosító	TMR (nagytejű)				
	Származása	Hajdúböszörmény				
	Szárazanyag tartalma	301g/kg				
Mikotoxin vizsgálatok *Sz.a.-ra vonatkoztatva*	Aflatoxin M1					
	Aflatoxin Total 0,00727	7,27μg/kg	0,005 mg/kg			
	T-2 0,114 mgr	114μg/kg	1 mg	2 mg.		
	Zearalenon F2 0,296 mgr	296μg/kg	0,15 mgr	0,3 mgr		
	DON 2,662 mg	2662μg/kg	5 mgr.			
	Ochratoxin A					
	Fumonisin					
Mikrobiológiai vizsgálatok	Összcsíraszám	$1{,}3 \times 10^{7}$ cfu/g				
	Penészszám	$3{,}0 \times 10^{5}$ cfu/g élesztőgomba				
	Penészek Törzsidentifikációja					
	Enterobaktérium					
	Szalmonella fajok					
	B-glükuronidáz-pozitív E. coli					
	Clostridium perfringens	$5{,}5 \times 10^{3}$ cfu/g	1×10^{2} cfu/g			

Megjegyzés: A vizsgálati eredmények a beérkezett mintára vonatkoznak. Az eredmények megengedett eltéréseire a 43/2003 (IV.26.)FVM rendelet 15.sz. mellékletben megadott eltérések érvényesek. A dokumentumot a laboratórium írásbeli engedélye nélkül csak teljes terjedelmében szabad lemásolni.

Eredményközlés dátuma: 2010-12-03

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DECLARATION

I hereby declare that I prepared this dissertation in order to attain the doctoral degree (PhD) at the Doctoral School of Animal Sciences, Centre for Agricultural and Applied Economics Sciences, Faculty of Agricultural and Food Sciences and Environmental Management of the University of Debrecen.

Debrecen, …………………….

…………………………..
Signature of PhD candidate

DECLARATION

We hereby declare that Ryszard Tadeusz Gudaj doctoral candidate performed his work under our supervision at the Doctoral School of Animal Sciences of the University of Debrecen. The findings of the dissertation represent the candidate's own ideas and the dissertation is the candidate's own work. We recommend to accept the dissertation.

Debrecen, …………………………..

……………………………..

Prof. Dr. Komlósi István
professor

……………………………..

Prof. Dr. Brydl Endre
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