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Distribution of Hoof Lesions and Hoof Health Strategies on a Robotic Milking Farm

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Abstract

In Turkey, the use of robotic milking technology is still very new. The scientific data showing the effects on animal health are important as well as the studies related to the economic performance of milking robots. The aim of this study was to evaluate the hoof diseases encountered on dairy cattle farms working with robotic milking system and to determine the causes and to provide the necessary precautions to prevent and control hoof health problems. In the study, 93 Holstein dairy cattle aged between 35-54 months were evaluated in a dairy farm with two robotic milking system (system capacity of 120 cows/day). The locomotion scores were recorded and the cows' feet were examined in hoof trimming chute and claws of all cows were trimmed according to biomechanical characteristics of foot. The treatment method was determined according to the condition of the lesion in cases of hoof disease and the results of recovery were followed. In the herd, cases of claw deformation (6.4%; n=6), sole ulcer (4.3%; n=4), white line disease (3.2%; n=3), digital dermatitis (8.6%; n=8), heel lesion (6.4%; n=6), foot rot (1.0%; n=1), limax (2.1%; n=2), hoof crack (2.1%; n=2) and coroner inflammation (1.0%; n=1) were recorded. Evaluated etiologically, it has been found that mistakes in the application of bath solutions used in the single footbath at the exit of the robotic milking unit in the formation of infectious foot diseases, feeding mistakes made without regard to cow traffic in the case of non infectious foot diseases and exposure of the foot to traumas due to not paying attention to comfort in the feeding areas are effective. As a result, to prevent management malfunctions causing metabolic problems, stress and traumas in animal, the use of senseless technology should be avoided in order to ensure sustainable hoof health on robotic milking farms.

Keywords: Cattle, hoof disease, robotic milking

Introduction

Robotic milking is a milking system based on the principle that whole milking is carried out all by machines without the need of human power during milking and cows visit the system voluntarily (de Koning and Rodenburg, 2004). Following the establishment of the first milking robot in the Netherlands in 1992, more than 35,000 milking robots are used all over the world today, most of them in Europe, US and Canada (de Koning and Rodenburg, 2004, Garcia et al., 2014, Salfer et al., 2017). In 2014 more than 8% robotic milkin units were sold in 2013 around the world (Klimpel, 2016). In Turkey, the existence of these technologies is new and it is known that a total of 170 robotic milking systems were installed up to now since 2011. There are farms working with single twin, quadruple, and even 20 robotic operators in these systems and it is probably that number of farms with robotic milking will be higher in the next years in Turkey (Anonymus, 2017, İlhan and Orman, 2017).

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It is known that many factors such as physical conditions, environmental factors, relationships with each other, care, nutrition and herd management directly affect the efficiency and health of animals in dairy cows. Milking system in a dairy cattle farm affects cow health as well as factors such as labor, milk yield and quality (Alıç and Yener, 2006). Researchers reported that the robotic milking system gave cows more freedom to choose daily activities and movements compared to traditional systems, which in turn affected animal welfare positively (Wiktorsson and Sorensen, 2004). It was noted that the milking frequency and milk yield increased as the cows voluntarily came to the milking unit (Armstrong and Daugherty, 1997). In addition, during milking process of robotic milking systems, health and quality parameters (milk flow rate, milking time, number of somatic cells, progesterone and beta-hydroxybutyric acid levels, body condition score, locomotion score and number of cows) related to milk and cow could be evaluated, diseases could be diagnosed earlier (de Koning et al., 2004, Anonymus, 2017, İlhan and Orman, 2017).

Economical performance of milking robots; expenditures like production, labor, feed consumption, electricity, water, etc and as repair and insurance, capital and financial impact were compared with conventional milking systems in 7 titles. It was reported that milk production was increased by 2-5% in the farms with robotic milking (Wade et al., 2004, Rodenburg, 2011) and total labor was 29% lower for robotic milking farms (Salfer et al., 2017). It was found that labor force was significantly saved in farms using robotic milking system and an economical increase was noticed related with time and adaptation (Engel and Hyde, 2003, Bijl et al., 2007, Heikkila et al., 2010). It was reported that conventional milking systems were less costly in expenditures, repairs, insurance and capital matters (Bijl et al., 2007, Rodenburg, 2008).

As well as studies on the economic performance of milking robots, scientific data showing the impact of them on animal health are important. In literature, there are studies on subjects like evaluations of lameness by performing body condition, locomotion scoring and estimations of somatic cell numbers in milk and herd fertility at robotic milking systems (Hillerton et al., 2004). In our country, there is no scientific evidence related with animal health except the studies on robotic milking systems and economical evaluations of them (Alıç and Yener, 2006, Mundan et al., 2014, Ünal et al., 2015; Örs and Oğuz, 2016; Ünal and Kuraloğlu, 2016).

More than half of the labor required for dairy enterprises is used in milking sheds. In parallel with developed countries, it is highly possible that robotic milking systems will become more widespread in time installation cost of them drops in our country where labor cost develops to be expensive increasingly. On robotic milking systems, giving a significant portion of concentrated food during milking in order to get animals forward to robot increases the likelihood of animals to have rumen acidosis. The most important problem that may be caused by this condition is the increased frequency of foot diseases. It is certain that the profitability of the farms that are not well managed or having insufficient information on this subject will decrease.

It is well known that lameness is one of the most important animal welfare concern in the dairy cattle today and lameness prevalence is considered a reliable animal-based indicator of welfare (Whay et al., 2003). In addition, lameness leading to financial waste of money for the dairy enterprise (Weaver, 2000).

In this study, foot health problems encountered in a farm with robotic milking systems and necessary precautions to prevent and control them are presented as suggestions.

Materials and Methods

In the study, the data of a private farm [Robot I (RI) n=48; Robot II (RII) n=45] having 93 cows in the province of Kütahya (Sobran village/center) with 2 robotic milking systems (120 cows /day capacity) and requesting professional support about hoof health were evaluated in 2016.

Treatment and examinations of animals taking a medical history and inspecting records in the farm were performed including a program in June and December in 2016. The first animals in the farm which was founded in 2014 were 120 Holstein heifers imported from Germany with 3-6 month gestation in February, 2015. The transport of animals was provided by a 4-day highway and during the travel the animals were only taken out of the vehicles once and rested. No routine claw trimming in the farm were performed until November 2015.

The population we surveyed for foot diseases was Holstein female cattle aged 35-54 months (mean 41.7 ± 6.6 months). Before taking animals to research, their locomotion scores were evaluated in standing and moving on a flat concrete floor. This assessment was made according to the scoring system described by Sprecher et al. (1997). Subsequently, a detailed foot examination of the animal taken into research and just after that all the claws were cut regarding foot function and biomechanics. In cases of foot disease, the treatment method was determined according to the condition of the lesion. After curing or excising necrotic tissues in digital and interdigital dermatitis lesions, feet were kept with dressing applying a special preparation of composition containing a broad spectrum antibiotic (Azithromycin) on the lesion. In cases of superficial sole ulcer, localized 10% poviodine-iodine after removal of the lesioned area and in cases of complicated sole ulcer, following applications of intramammary preparations containing broad-spectrum antibiotic (Neomycin sulphate, Procaine penicilin G, Streptomycin sulphate) on the well-opened lesion after removal of the granulation tissue, feet were taken into dressing. Local anesthesia (Intravenous Regional Anesthesia (IVRA); 2% Prilocain HCl) was applied for painful interventions during treatment. Other claw lesions detected were treated according to their methods. Regional antibiotics (Intravenous Regional Antibiosis (IVRAB); 1 g Ceftriaxone sodium) was administered systemically with parenteral antibiotherapy and non-steroids applications in the required cases. As described earlier by Çeçen (2016), during treatment cows were kept on dry and clean rubber beds. For footbath, a program to be applied primarily for treatment purpose was determined. For this purpose, during the development of the study, the entire herd was allowed to pass through the footbath containing 2% formalin (Cook, 2017). New footbath solution was prepared and used every day for 1 month. In the following period, the animals were treated one day with 1.5% formalin solution and the other day through the only water footbath. This practice continued as prophylactic.

In the period after the treatments, the protective measures initiated to protect the foot health of the animals in the farm were maintained.

Proportional data were analysed by Chi-square Test. Differences were considered significant at a probability level of P<0.05 in all analyses. All statistical analysis was performed with SPSS software (version 20.0, SPSS Inc, USA).

Results

Six months after the animals were brought into the farm, lameness was observed. In this period, the animals were fed with roughage and concentrated food separately and 95% of the concentrated food was given from the robot at milking point and food machines. Clover and corn silage used as roughage food were kept in food boxes in front of the free stops, but it was noted that the animals did not consume enough. In the period lameness was noticed in the farm, there was acidosis in 50% of the herd. The mean milk yield of cows in this period was measured as 22 lt/day. In the examined records of this period, the foot diseases rate had high and found were cases of sole ulcer (20%, n = 24) and digital dermatitis (40%; n = 48).

As for the farm buildings, the areas where animals stand at food points were concrete floors. It was observed that a plastic footbath of 80 x 200 x 15 cm placed at the exit of each robot unit was used. Until professional support was provided, it was informed that 2% of the prepared copper sulfate solution changed once in two days was used in the footbath.

During the study period, locomotion scores of the herd were recorded between 1-4 points (mean 1.32 ± 0.8 points). Limping in 3.2% (n=3), mild lameness in 8.6% (n=8) mild and moderate lameness in 4.3% (n=4) of the current population were observed. When it was examined how lameness was located according to hooves it was found out that it was 73.3% in rear hooves (right rear 60%, left rear 13.3%) and 26.6 % in front hooves (right front 20%, left front 6.6%) (Table 1). This result was anticipated because previous study (Van Amstel & Shearer, 2006) indicated similar results for lameness distribution according to limb in farms with conventional milking systems. There is no research yet on lameness distribution on robotic milking farms, therefore objective comparison was not possible.

Table 1- Severity and localization of lameness (%).

SYMPTOM		% (n)	LOCALIZATION (%)			
			Rear Hooves		Front Hooves	
			Left	Right	Left	Right
Limping		3.2^c (3)	13.3^c	60^a	6.6^d	20^b
Lameness	Mild	8.6^a (8)				
	Moderate	4.3^b (4)				

$^{a,\ d}$: Different superscripts indicates statistical significance (p<0.05). (Symptoms and Localization of lessions were evaluated own between)

In the herd, cases of claw deformation (6.4%; n=6), sole ulcer (4.3%; n=4), white line disease (3.2%; n=3), digital dermatitis (8.6%; n=8), heel lesion (6.4%; n=6), foot rot (1.0%;

n=1), limax (2.1%; n=2), hoof crack (2.1%; n=2) and coronary inflammation (1.0%; n=1) were recorded (Table 2). It is well known that digital dermatitis is the most common disorder (Van Amstel and Shearer, 2006) and our results were similar with this statement. We concluded that robotic milking did not change incidence of claw disorders.

Table 2- Distribution of hoof diseases % (n).

DISEASE	Claw Deformation	Sole Ulcer	White Line Disease	Digital Dermatitis	Heel Lesion	Foot Rot	Limax	Hoof Crack	Coroner Inflammation
%	6.4^{b}	4.3^{c}	3.2^{d}	8.6^{a}	6.4^{b}	1.0^{f}	2.1^{e}	2.1^{e}	1.0^{f}
(n)	(6)	(4)	(3)	(8)	(6)	(1)	(2)	(2)	(1)

$^{a,\ f}$: Different superscripts indicates statistical significance ($p<0.05$).

In the study, the treatment protocol determined according to the condition of the lesion was maintained by the farm veterinarian and health technician. Some positive results were taken in cases of digital dermatitis, heel lesions in 7-14 days, sole ulcer in 14-28 days, limax and foot rot in 14 days. It was reported that there was a decrease in problems of claw and hoof, the mean milk yield per cow increased to the levels of 30-33 lt/day in farm controls after the treatment period.

Discussion

As acknowledged throughout the world, lameness is one of the most common causes of economic loss in dairy cattle and one of the prevalent problems in cattle farms. It is known that breeding and maintenance conditions of cattle play an important role in the formation of hoof and claw diseases (Gitau et al., 1996, Greenoug, 2007, Çeçen, 2016). The prevalence of hoof diseases is high in farms where hoof and claw care is not taken seriously, footbaths are not used regularly and the claw triming technique is not used. It has been reported that wet floor conditions create a high bacterial surface, leading to hoof diseases (Vermunt and Greenough, 1994, Gitau et al., 1996, Sağlıyan and Ünsaldı, 2002, Çeçen and Görgül, 2007). First of all, it is important for a farm with robotic milking to have a useful project of milking unit in order to be successful. The system should be built well-planned in advance. Matters of feeding, ways and gates, bedding design, waiting area, comfort of cow, water, air, lighting factors and hoof care should be considered very well (Anonymus, 2017, İlhan and Orman, 2017). Inadequate hoof care is extremely detrimental to robotic milking systems (Lee, 2013).

The deformed claw structure, which was determined as 6.4% in this study, was reported as 17.3% by Çeçen and Görgül (2007) and 20.3% by İstek and Durgun (2004) in previous studies. It cannot be denied that many factors like breed, farm, milk yield affect findings of other researchers to be in very high levels, however, it can be said that robotic milking systems cause lower deformation claw structure than conventional ones. Because, on robotic milking systems, although there are differences in the operating principle of the system according to the manufacturers, there are basically different cow traffic arrangements to lead cows to the robot (Anonymus, 2017). This provides adequate mobility and helps the regular wearing of the horny claw and regulation of the blood circulation in claws.

Cases of sole ulcer were the fourth of hoof diseases mostly encountered in the farm (4.3%). As a matter of fact, Çeçen and Görgül (2007) reported that the third most common hoof disease was similarly sole ulcer, and they stated that the incidence was 4.4%, the same as this study. Atasoy (2003), informing sole ulcer as the most common fourth hoof disease, stated it as 1.5%. It is thought that the study material is the difference with our study. Because, 40% of Atasoy's (2003) study material consisted of native breed and crossbred cattle, but the whole material of ours comprised of high yielding dairy cows. On the other hand, in the first 6 months, emerging acidosis because of misfeeding strategy in the herd was also considered to be responsible of those recorded high–leveled sole ulcer cases in the farm.

White line disease is the most common hoof disease with a rate of 3.2% after cases of sole ulcer. İstek and Durgun (2004) reported that white line disease was the most common fourth hoof disease with 1.2% in their study comprising of materials of which 60% is native breed and crossbred cattle. The absence of identical study materials does not make it possible to objectively compare the cases.

The most common hoof disease in this study was digital dermatitis with 8.6%. The same disease was reported by Çeçen and Görgül (2007) as 5.7%. The higher incidence of digital dermatitis in our study is thought to be due to the problems related with the footbaths when the animals first arrived in the farm. A significant reduction in the incidence of digital dermatitis has been recorded by taking some measures like choosing footbath solutions over time, preparing rates and paying attention in determining the frequency of application and increasing work frequency of the strippers in order to reduce the wetness of the walking paths to the barn.

Çeçen and Görgül (2007) reported that heel lesion was the most common (11.5%) hoof disease. Despite the low incidence (6.4%) in our study, it was found to be the second most frequently encountered hoof disease, similar to previous investigators. It is known that heel lesions are an inevitable problem for milking cows raised especially in concrete floors. On robotic milking systems, cows have to go to the identification station for milking or feding (Alıç and Yener, 2006). For animals adapted to the system, this provides free and sufficient mobility throughout the day. Therefore, if the cow traffic is well regulated on robotic milking systems, it can be said that less heel lesions can be seen compared to conventional systems.

The locomotion score is a qualitative index of normal walking ability of a cow and if the evaluation is carried out on a regular basis (eg monthly), it can specifically be used to discriminate cows at risk for lameness in the herd (Çeçen, 2016). According to the results of evaluating the lameness of the robotic milking system in the Netherlands and the United Kingdom, it was noted that locomotion scores did not change 1 month after the system was installed and a slight increase was observed after 3 months but this increase was not statistically significant. An apparent increase in lameness scores was reported at 12 months follow-up. It was reported that this condition could be connected with increased walking distances unfamiliar to cows, concrete floor factor and standing for a longer time of poor adapted animals to the system due to insufficient training (Hillerton et al, 2004). Although this informational literature coincides with anamnesis data obtained in our study, it has been thought that importation of pregnant young cows after a long and tiring transport to the farm may also have an effect in etiology.

On robotic milking systems, cows have different traffic arrangements, both free and compulsory, for robotic access. According to these regulations, feeding strategies also change (Ünal et al, 2015, İlhan and Orman, 2017). In the farm where the presented study has been carried out, the system called 'first milk preselected' is used according to the regulation of obligatory type cow traffic. In these systems, the main motivation source is total mixed feed (TMR). Apart from the first familiarization period, there is no need for qualified and delicious food in the robot. Animals find out they are required to be milked at robot to reach TMR. The amount of concentrated feed to be given to animals in the robot is calculated by subtracting the average daily feed concentration to be added into the TMR from the amount to be given to each animal daily. This value is assigned collectively according to the efficiency groups in the program. Only 20% of the daily consumption per cow in the milk preselection system should firstly be given in the robot (Latvietis and Priekulis, 2011, Ünal et al., 2015). In the farm where the study was carried out, it was considered that the metabolic problem (acidosis) caused by the strategic mistake (feeding animals with rough and concentrated food separately and not consuming enough coarse food by animals due to delivering 95% of concentrated food in robots and food machines) in feeding the animals during the first period of the farm played a role in etiology of sole ulcer (Peterse et al., 1984, Çeçen, 2016). On robotic farms, it is crucial that nutritional strategies should be determined correctly because high and low yielding cows are in the same population. Firstly, the TMR mixture to be consumed by the animals must be balanced. Concentrated food that animals need is served in robots, food machines and foodboxes in front of free points. Serving the total concentrated food that animals need only in robots or food machines even in multiple use will reduce rough food consuming and lead to metabolic problems. Our experiences show that minimizing metabolic problems on robotic milking systems and consequently regarding prophylaxis of foot health, a nutritional strategy except traditional ones is appropriate. In this approach which aims to increase rough food consumption, it would be useful to prepare a decreased amount of concentrated food that animals are considered to consume in robots and food machines, but to intensify the nutrient content.

The comfort in the feeding section is very important on robotic milking systems. Except the food served in the robot is a kind of reward used in processing animal traffic it is a source of motivation for the animal to visit the robot. Animals must feel safe and comfortable in the robot. For this purpose, the areas where the animals stand on the side of the food line can be covered with rubber. It will be like a pillow for legs and feet and help them to stand for a longer time in comfort (Graves, 2002, Ünal et al., 2015). Footbaths and systems should be installed paying regard to cow traffic design on robotic milking farms (Lee, 2013).

Evaluated all the data of the farm we presented in the study, it is considered that the capacity of the existing footbath is sufficient for a system with 120 cows and 2 robotic milking. However, it was noticed that there were some mistakes in selection, preparation and usage of footbath solutions. With a professional management, a maximum level of benefit has been taken from footbaths.

The use of robotic milking technologies in our country is still very new. Therefore, advantages and disadvantages of the robots compared to the automatic milking systems by farmers are not completely known. This situation naturally leads to the slow adoption of these technologies in our country (Örs and Oğuz, 2016), and also restricts the robotic milking farms from producing quick solutions to the problems. Whether imported or obtained within the country, heifers will likely have problems in milking for the first time when they are trained on robotic milking. The study we presented will contribute to the literature in this area, and there is a need for scientific studies in our country regarding robotic milking systems.

As a result, robotic milking farms do not show an increase in hoof diseases compared to conventional systems but for sustainable hoof health; paying regard to comfor in feeding sections in the planning period of farm buildings, providing efficient usage of footbath, determining nutrition strategies considering cow traffic and not to cause management mistakes leading animals to stress, insensible usage of technology should be avoided.

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