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Examination of the presence and effect of udder edema in Holstein-Friesian cattle

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SUMMARY

Mastitis is the most common disease of dairy cows and the most expensive in terms of treatment. For this reason, great emphasis must be placed on its prevention. Based on literature sources, it can be said that there is a positive correlation between the prevalence of udder edema and the occurrence of mastitis. Our studies were carried out in a dairy farm in Csongrád-Csanád county. So far we have collected data from 64 cows with udder edema. The severity of udder edema was evaluated on a scale of 0–3 points one week before calving and for 3 weeks after calving. We observed that udder edema occurred in 78% of the studied cows at the time of the first calving. After calving, the length and diameter of the four udder teats were examined. Both anterior and posterior teats were shortened in severely edematous cows. When examining the diameter of the teat, we found that, depending on the severity of the edema, the anterior and posterior udder teats were 2.5 and 1.6 and 1.6 and 1.5 mm thicker respectively than those of cows without edema.

Keywords: *udder edema; udder teats; dairy cattle; culling*

INTRODUCTION

Edema means fluid retention in the body's tissue and refers to swelling and puffin in different areas of the body. The disease with symptoms of edema has been described in several animal species. For example, pig-edema disease is known to cause important losses, mainly observed in recently weaned piglets, also appear in the growing and finishing phases. Symptoms are: periocular edema and extensive edema of the stomach and mesocolon. The pigs have breathing difficulties, they stop eating, can't vomit and don't urinate, in severe cases it leads to death (Novotni-Dankó and Dankó, 2021).

Udder edema is a specific form of edema. In addition to dairy cows, the presence and effects of udder edema have also been demonstrated in dairy goats (Roger, 2009; Radosits et al., 2010), sows (Björkman et al., 2017), and buffaloes (Shahzad et al., 2011), among others. In dairy cows' udder edema is an accumulation of lymphatic fluid in the interstitial space between the udder and the surrounding tissues (Kojouri et al., 2015). Edema typically occurs 2–4 days before calving, peaks in severity at calving, and normally subsides within 1–2 weeks after calving (Schmidt and Schultz, 1959; Lamb et al., 1979; Dentine and McDaniel, 1983; Malven et al., 1983).

Dentine and McDaniel (1983) and Erb and Gröhn (1988) observed some degree of udder edema around calving in 97% of cows. It was also observed that the severity of edema increased linearly with age in the first and second lactations. Some older studies have found that udder oedema is generally more severe in the first lactation around calving and in the first week after calving than in later lactations (Mitchell et al., 1976; Vinson et al., 1976; Conway et al., 1977). In a study in Bavaria, the udder health situation of local farms with Simnetal and Brown Swiss breeds was assessed. The results showed that only 79 out of 1906 cows had udder edema. Udder oedema was associated with litter thickness and lactation stage. On farms with thick bedding material (>5 cm), the chance of udder oedema is reduced compared to farms that only thinly bedded cows. Cows in early lactation (0–60 d) were 4.9 times more likely to have udder edema than cows in later lactation. It should be mentioned that the milk yield of the Bavarian herd at the time of the study was below the national average (Groh et al., 2022).

Results from various studies show that udder depth and udder attachment are factors that show a statistically significant correlation with useful lifespan (DeGroot et al., 2002; Caraviello et al., 2004; Němcová et al., 2007). This is why it is important to note that udder edema has a detrimental effect on useful lifespan, as edema can cause damage to the ligaments that attach the udder (Okkema and Grandin, 2021). Coban et al. (2009) found that the incidence of mastitis increased as the diameter of the teats increased. Hussain et al. (2012) found in their study that the incidence of mastitis was higher in udder quarters with short teats and teat ducts, as well as thicker teat diameters. These results are of particular importance because several researcher have noted that as a result of udder edema, the teats can shorten and thicken, and the teat canal can even narrow, which makes the milking more difficult (Medrano-Galarza et al., 2012; Okkema and Grandin, 2021).

Several literature sources describe that extensive udder edema can affect milk production and udder health (Kojouri et al., 2015; Morrison et al., 2018). Shanks et al. (1978) discovered that the prevalence of oedema was 11% higher in high producing cows compared to low producing cows. Waage et al. (2001) found that udder edema and the edematous condition of the teats are related to clinical mastitis developing in the period around calving. Melendez et al. (2006) observed that milk yield decreased by 3.6 kg during the

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first test milking for cows with udder edema. Regarding udder morphological characteristics, it was found that, for example, a strong anterior udder attachment and a strong, pronounced udder central ligament were associated with a lower incidence of clinical mastitis and a lower somatic cell count (Seykora and McDaniel, 1986; Rogers et al., 1991; Schutz et al., 1993; Rogers et al., 1998; Nash et al., 2000). Morrow and Schmidt (1964) described that cows with severe or recurrent oedema are more likely to have drooping udder and side facing udder teats. Based on these findings, reducing the presence of udder edema can help to preserve udder quality and positively influence the economics of milk production.

Some possible methods for the prevention and treatment of udder edema: in order to control the anionic salt intake, the development of a special feed recipe for heifers in the last stage of pregnancy (Al-Ani and Vestweber, 1986), selection for moderate milk production in order to reduce the phenotypic appearance of udder edema (Al-Ani, 1984), providing adequate amounts of exogenous antioxidants such as vitamin E, vitamin C, carotenoids and flavonoids in the ration to alleviate oxidative stress (Mueller et al., 1989; Alhadrami and Faye, 2016; Reddy et al., 2016; Mueller et al., 2019). Randall et al. (1974) found in their feeding experiment that increasing the sodium or potassium content of the feed increased the development of udder edema, therefore it is advisable to limit the salt content of the feed ration. Ghodasara et al. (2012) recommend regular massaging of the edematous udder, as well as hot and cold water compresses, as this stimulates blood circulation.

MATERIALS AND METHODS

We investigated the main causes of culling in a Holstein-Friesian dairy herd in the Southern Great Plain, the presence of udder oedema and its effects. The number of milking cows in this dairy farm is 615. There is milking three times a day. The milking equipment has a parallel arrangement with 2X20 positions.

During our investigation, we determined the most important causes of culling occurring on the farm, and monitored the changes in the edematous condition of the animals before calving. Animals with udder edema were selected from the group of individuals before calving. We examined a total of 7 parameters on the edematous animals, which were the following: body condition, severity of udder edema, teat length, teat diameter, udder skin temperature, udder skin elasticity, udder suspension. One week before calving, we scored the body condition, the severity of udder edema and the udder suspension. The other parameters were recorded once a week 1, 2 and 3 weeks after calving. The size of the teats was measured with a measuring tape and a digital caliper. The temperature of the udder was measured with a non-contact digital thermometer. The elasticity of the udder skin was determined using the so-called "fingerprint test", which involves pressing a finger into the oedematous area and measuring the time it takes for the udder skin to return to its original condition using a stopwatch. A scoring system ranging from 1 to 5 we used to evaluate the body condition (Wildman et al., 1982; Edmonson et al., 1989; DEFRA, 2001). The udder suspension was scored from 1 to 9 according to the WHFF (2005) recommendation. The severity of udder edema was determined on a 0–3 point scale developed by Morrison et al. (2018). We collected the data of a total of 62 individuals.

We examined the prevalence of the main causes of culling in each lactation. We examined whether the severity of the edema has an effect on the average length and diameter of the teats. Data were prepared, organised and analysed using Microsoft Office Excel 2016. Production and breeding data were analysed using data collected from the RISKA farm management system.

RESULTS AND DISCUSSION

Figure 1 shows the distribution of reasons for culling in the first three lactations and in subsequent lactations. It can be observed that, regardless of lactation, the main causes of culling on the farms studied are reproductive biology disorders and udder problems. Almost 50% of first lactation culling of young cows is caused by reproductive biology problems. Udder problems cause 22% of first lactation cows to leave production. From the second lactation, the rate of culling due to reproductive disorders decreases, while the rate of culling due to mastitis and udder problems increases. In the third lactation, when the cow's milk production is expected to peak, the rate of culling due to udder problems and mastitis reaches 34%.

Figure 2 shows the prevalence of udder edema in terms of number of calving. In the case of the examined group, the prevalence of oedema was highest in the first calving. This result is in agreement with Emery et al. (1969) and Dentine and McDaniel (1983), who found that edema was more common in cows with first calving. However, it cannot be said that this condition is unique to first calving cows. Admittedly, to a lesser extent, however, udder edema can also be observed during later calving.

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Figure 1: **Distribution of the reasons for the culling of the investigated dairy farm by lactation (2015–2020)**

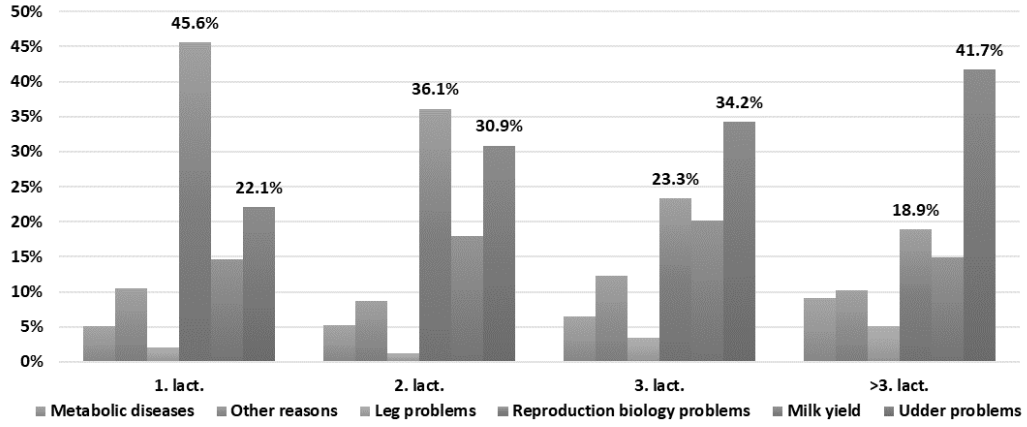

Figure 2: **The prevalence of edema in terms of the number of calving**

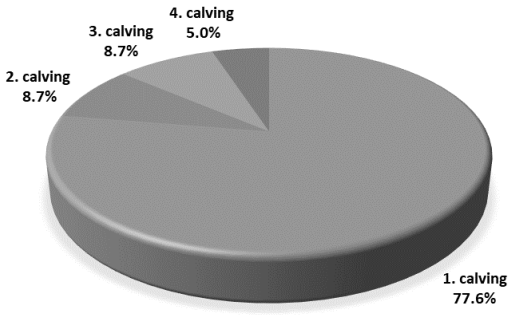

Figure 3 shows the average development of the length of the nipples, taking into account the severity of the udder edema. The results show that the severity of udder edema affects the length of the udder teats. In the case of healthy individuals, the average length of the anterior udder teats was 48.6 and 49.8 mm, and the average length of the posterior teats was 41.2 and 41.8 mm. Weiss et al. (2004) found the following average teat lengths in their flock: anterior teat length 66–67 mm, posterior teat length 56–57 mm. Tilki et al. (2005) in their study of Brown Swiss cows obtained the following results: anterior udder teat length 59.45 mm, posterior udder teat length 49.72 mm. As the edematous condition worsened, teat shortening was observed in all four teats. In the case of very severe edema, the length of the anterior teats was on average 47.9 and 48.6 mm, which means a shortening of 0.7 and 1.2 mm compared to the healthy condition. A 1.7 and 1.1 mm shortening of the posterior udder teats was observed in severely edematous cows compared to non-edematous animals. In relation to udder morphology, Thomas et al. (1984) found that a deep posterior udder, wide udder teats or short, broad udder teats may predispose to mastitis.

Figure 3: **Examination of udder teats length as a function of edema severity**

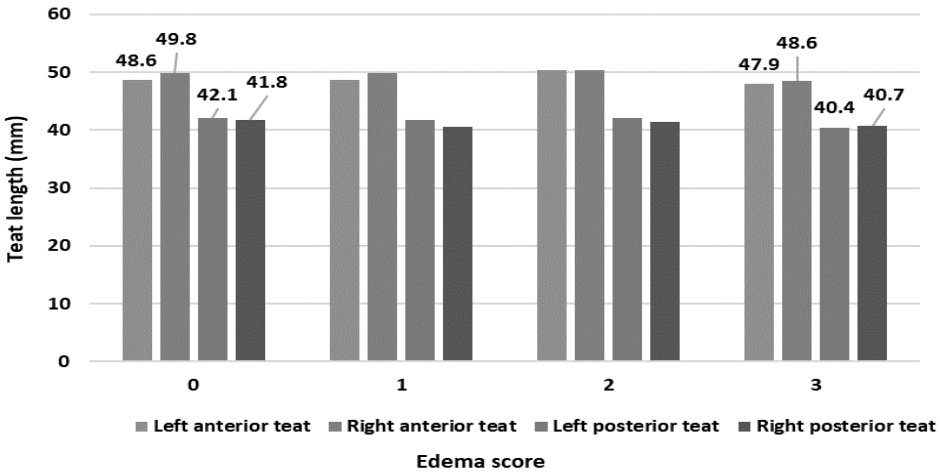

Figure 4 illustrates the average change in diameter of the udder teats as a function of edema severity. Based on the collected data, it can be said that all four teats gradually thickened with the worsening of the edematous condition. The average teat thickness of healthy individuals was 19.2 mm for anterior teats and

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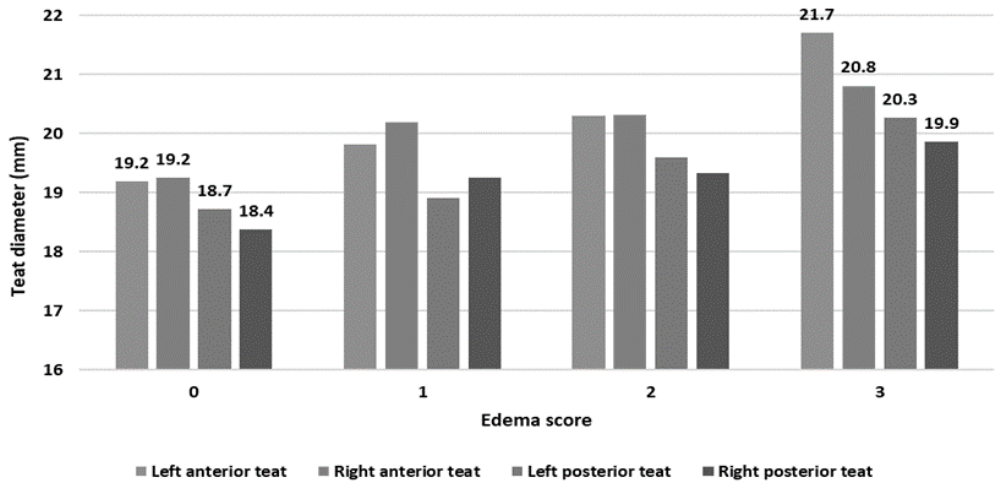
18.4 and 18.7 mm for posterior teats. Weiss et al. (2004) obtained the following values for the diameter of the teats in their own study: the average diameter of the anterior teats was 27 mm, while the diameter of the posterior teats was 28 mm. Tilki et al. (2005) obtained the following results when examining Brown Swiss cows: the diameter of the anterior teats was 22.14, the diameter of the posterior teats was 21.53 mm. Another author has estimated the average diameter of healthy udder teats to be 22.3 mm (Coban et al., 2009). Regarding the anterior teats, the teats of severely edematous cows were 2.5 and 1.6 mm thicker compared to healthy cows. A thickening of 1.6 and 1.5 mm was observed in the posterior teats.

Figure 4: **Examination of the evolution of the udder teat diameter as a function of edema severity**



CONCLUSIONS

Nowadays, the primary causes of leave the herd are reproductive disorders, mastitis, inadequate milk production and foot-end disease (Bascom and Young, 1998; Nash et al., 2002; Chiumia et al., 2013). It is well known that the economics of milk production are greatly affected by mastitis of various origins. Mastitis also has a negative impact on animal health and productivity (Müller and Sauerwein, 2010). As mastitis is one of the primary causes of culling, its prevention is very important to improve animal health and reduce the cost of milk production (Sánchez et al., 2013). In their studies, Bar et al. (2008) found that 5–20% of cows were quit from production due to mastitis. In the herd studied by Tóth et al. (2019), mastitis and udder problems led to culling in 30% of the herd. Several studies have described that an edematous udder is more prone to injury, thus udder edema has been identified as a risk factor for the occurrence of clinical mastitis (Slettbakk, 1995; Ivemeyer et al., 2011). Some studies described that higher culling rates were observed in cows with severe mastitis (Hayes and Albright, 1976; Gussmann et al., 2019). Udder edema is more of a management problem than a life-threatening disease.

In our study the main reasons for leave from production in the examined dairy farm were reproductive biology problems, mastitis and udder problems, as well as low milk yield. The culling rate due to udder problems, mastitis started to increase in the 3rd lactation, while the culling rate due to reproductive biology problems decreased. We found that udder edema occurred most often in first-calving cows. In accordance with the literature results, we found a possible correlation between the severity of udder edema and the length of the teats. Based on our results so far, the teats of cows suffering from very severe edema were shorter than the teats of healthy cows. Furthermore, we found that in our case, the severity of the edema resulted in thickening of the udder teats.

Considering the literature, it can be stated that udder edema can be a predisposing factor for the development of mastitis, which is one of the main reasons for culling. It can be said that udder edema occurs mainly in heifers and in severe cases negatively affects the morphological characteristics of the udder, increasing the likelihood of mastitis and thus the risk of early culling. In practice, it would be very important to keep high-performance individuals in production as long as possible, in order to achieve the maximum milk yield possible genetically, thus making milk production more economical. Several literature has identified the appearance of udder edema as a possible risk of clinical mastitis. As is already known, mastitis is one of the most common diseases of dairy cows and one of the most expensive to treat. That is why the goal is to prevent mastitis, and this can be helped by reducing the severity of mastitis and possibly preventing it.

It is not yet possible to draw concrete, far-reaching conclusions from the test results described above, since data collection is ongoing, and the data collected so far is still small, so further research and data collection is needed in relation to udder edema. In our opinion, the examination of udder edema can be a possible solution to reduce the occurrence of mastitis.

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