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Mastitis Prevention is the Key for Maintaining Good Udder Health

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ABSTRACT: Milk production safety in Slovakia is under constant veterinary supervision from its acquisition on the farm, throughout processing, up to its retail. Maintaining the good health of dairy cows is a daily challenge for everyone involved in primary milk production. Preserving the good health of dairy cows is a daily challenge for all involved in primary milk production. Despite the increasing level of technological support and veterinary measures, inflammation of the mammary gland - mastitis, is still one of the main health problems and reasons for economic losses faced by cow farmers. The mammary gland of high-yielding dairy cows requires making the right decisions and enforcing the proper measures aimed at minimizing external and internal factors that increase the risk of intramammary infection. An overview analyzes antimastitis measures aimed at damping and prevention of mastitis include somatic cells count control, proper nutrition, housing and management, milking and drying as practiced in dairy farming conditions to improve the health status of mammary gland and quality of milk produced.

KEYWORDS: Dairy cows, Milking, Mastitis, SCC, Humic acids.

I. INTRODUCTION

Within the primary production milk is the main economic resource. Most important are, however, the health benefits of milk and dairy products to their consumers due to their unique composition. The World Health Organization recommends to consume at least 220 kg of milk and dairy products per person annually. The EU provisions emphasize that such products must come from milk from healthy animals, which significantly limits its production [1].

Regardless of the increasing level of rearing of dairy cattle and safety of milk production, mastitis is still one of the main problems the dairy farmers have to face. The cows affected by this disease produce milk with increased somatic cell counts (SCCs) and increased levels of microorganisms and their mammary glands undergo changes of various degrees. Inflammation of the mammary gland may result in clinical mastitis involving visible changes in the udder and milk, but also in subclinical mastitis with absence of clinical signs [2].

The negative economic consequences of clinical or subclinical mastitis include a decrease in milk production and lower price for milk with high SCC, increased rate of culling, and higher cost of veterinary treatment, which can climb from 130 to 200 US (Table 1) [3].

Table 1: Cost of an average case of clinical mastitis in a dairy cow producing 7000 kg milk per lactation

Factor	Cost (£)
Labour, 2 h at £6	12
Treatment, drugs and vet	3 - 11
Discarded milk	26
Production loss (10%)	135
Reduced food intake	56 - 25
Fatality (1%)	3
Total	**131**

Source: Hillerton and Berry [3].

The causes of development of mastitis can be principally divided into two groups. The first group of mammary gland inflammations involves the action of microbial agents including bacteria, viruses, mycoplasma, yeasts and algae [4]. However, most of the mastitis cases are caused by one of the bacterial pathogens presented in Table 2 [5].

In the second group, incorrect technological procedures during milking and various stress factors are involved in the development of non-infectious mastitis. Due to the large number of causes of mastitis in dairy cows and their potential combinations, this disease cannot be completely

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eliminated from the herd but only kept as low as possible [6].

As mastitis is a multifactorial disease, it is necessary to take into account all aspects resulting from daily breeding practice that may affect the health of dairy cows and safety of produced milk [7].

Table 2: Bacterial pathogens in a dairy cow producing 7000 kg milk per lactation

Bacterial pathogens	**Positive identifications (%) from 100 clinical cases of IMI**
Coliforms	43
Streptococcus spp.	33 - 36
Str. uberis	30 - 33
Str. dysgalactiae	1 - 3
Staphylococcus spp.	16 - 18
S. aureus	10 - 14
CNS*	2 - 4
T. pyogenes	1 - 2

Note: CNS* - coagulase negative staphylococci, IMI – intramammary infection
Source: Zigo et al. [5].

Among the most important measures aimed at controlling mastitis include: SCC control, proper nutrition, housing, milking and drying [4,8].

SCC control

Producing milk with a low somatic cell count is an aim important for good dairy farming economy. The fastest way is the culling of cows with increased "somatics". This is a short-term and rapid solution for reducing the number of somatic cells (SCC) in a milk cooling tank [9]. The second way consists in prevention, i.e. establishment of a control programme and treatment of affected animals. This is a long-term method, but also more economical and efficient. It is important to mention that reduction of somatic cells from 600,000 to 300,000 in a herd of 100 dairy cows and at a price of € 35 per 100 kg of milk, can bring to the farmer up to € 6,240 per year due to reduced loss of milk production by the same herd, under the same housing conditions and the same feeding [10].

In this method, based on the rapid detection of mastitis, milkmen play a key role in detecting suspicious dairy cows during udder toilet and milking and reporting such cases (Figure 1). One of the main advantages of early detection of cow mastitis is the immediate initiation of treatment that increases its effectiveness and the chance of complete cure of affected animals. For cows with long-term elevated SCC (> $1000x10^3$) that do not respond to antibiotic therapy or cows with chronic mastitis and atrophied quarters, culling is the best solution as they pose a risk to healthy cows in the herd as a permanent source of infection [11].

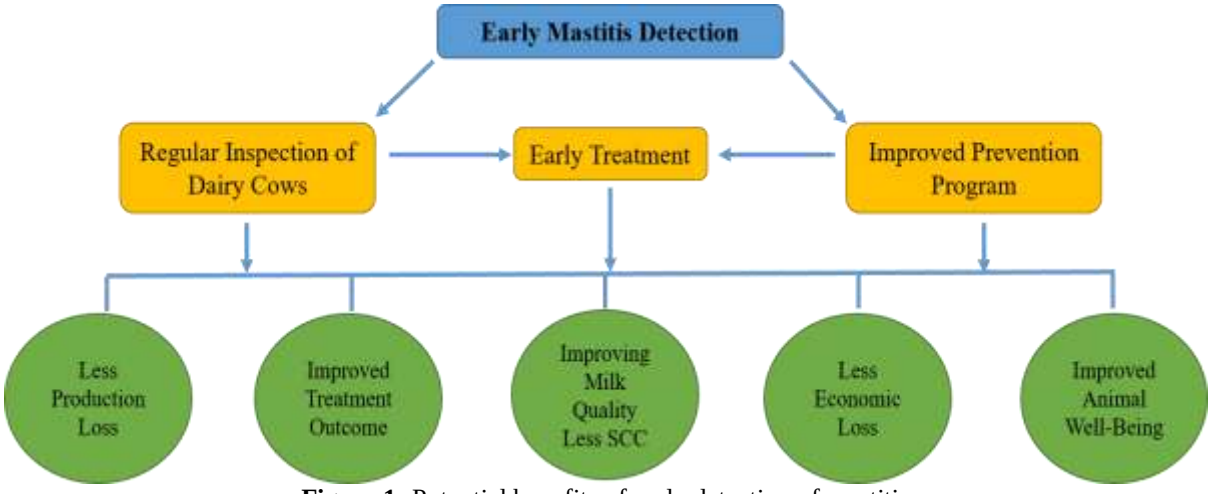

Figure 1: Potential benefits of early detection of mastitis

Proper nutrition

Increased resistance of dairy cows to mastitis causing pathogens can also be achieved by a properly balanced feed rations. The most important is to provide non-hazardous feed free of fungi and mycotoxins. Contaminated feed affects adversely the immune system of animals that are then unable to ward off successfully the pathogens entering the udder [12].

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A similar effect on the immunity have also the rations deficient in energy, nitrogenous substances and other essential nutrients necessary for the proper functioning of the body, which means that rations with appropriate amounts of vitamins and minerals will improve the cow's ability to reverse attacks by pathogenic microorganisms [13,14].

Recently, when compiling feed rations, breeders use various feed supplements in the form of mineral-vitamin supplements (vitamins E, C, A and essential trace elements; zinc - Zn, copper - Cu, and selenium - Se) with significant antioxidant and immunostimulatory effects [13-16] or organic additives as humic acids (uptake of mycotoxins, optimization of rumen pH, stabilization of symbiotic microflora and increased utilization of nutrients) to reduce the risk of mastitis in the postpartum period [17,18].

The results from practice showed that especially Se, together with vitamin E have a very positive effect on the regeneration and health of the udder. For a dairy cow the minimum daily intake of vitamin E through feed is 500 IU/head and of Se 0.1 - 0.3 mg / kg dry matter to maintain optimum health. For the dry cows and those in the initial phase of lactation, the daily supplementation of vitamin E equal to 1000 - 1500 IU/head and Se in the range of 0.3 - 0.4 mg. Se /kg dry matter of the ration is recommended to achieve a positive effect on the mammary gland health and reproduction [14,19].

In addition to the supplementation of minerals and vitamins, humic acids have been added to the feed rations in the recent years in order to increase the body defences and eliminate adverse conditions leading to the occurrence of various diseases and ailments [18].

The increased use of humic acids in animal nutrition is further exacerbated by the fact that from 28th January 2022, the legislation will be applied in all Member States of the European Community prohibiting the preventive and mass administration of antibiotics for all groups of farmed animals. In practice, this means continued administration of antibiotics to sick animals, however, only individually, with a clinical examination performed before their administration, respecting the withdrawal period for animal products after their administration. Oral administration of humic acids is one of the approved real alternatives to antimicrobials and zinc oxide [20].

Housing of cows

The cleanliness of the environment in which the animals are housed is important to the health of the udder and elimination of mastitis. It is mainly a regular replacement of bedding (straw) and removal of manure. The bed must always be dry and clean to prevent the creation of a breeding ground for bacteria (E. coli) that act as agents of environmental mastitis [21].

Proper bedding selection and application of appropriate components to achieve disinfectant effect is one of the key factors in maintaining cow health. Disinfection effectiveness affects the resistance of microorganisms, the selection and use of disinfectant components and the external environment in which the disinfection process takes place [22].

Due to lack of straw, recycled manure solids (RMS) have been used as a substitute bedding material in recent years to create sufficient comfort for dairy cows. RMS consists of dry matter and a nutrient-rich fraction obtained by mechanical or gravitational separation of slurry manure removed from dairy cow housing systems. To ensure its hygienic quality and optimum pH, RMS is often combined with straw and other components such as limestone or zeolite [23].

To increase the hygienic quality of RMS is better to mix with ground limestone in a ratio of 3:1 before applying it, however it may be used occasionally without mixing with limestone. In our previous study we used RMS which was left standing for two weeks for the production of bedding. The RMS was mixed with limestone at a ratio of 1:4 to increase the proportion of limestone and the accompanying disinfectant effect of the bedding formed. The increased disinfection effect in the bedding we produced was confirmed from the taken samples. Comparing classical straw bedding with improved bedding, we found that the total viable count (TVC) and coliform bacteria (CB) were reduced in freshly-laid bedding as well as for the next two months after laying. In addition to TVC and CB, decreased numbers of faecal coliform bacteria (FCB) and faecal streptococci (FS) were also observed in freshly-laid bedding as well as in the first, second and third months after laying (Table. 3) [24].

More so, regular cleaning and disinfection of the milking parlour and waiting room should be observed. Usually, the cleanliness of the housing of heifers and dried cows is neglected, making room for pathogens to enter the mammary gland. In herd management, it is important to separate mastitis or otherwise sick dairy cows from healthy animals until they are completely cured or eliminated. Additionally, it is likewise ideal to create a group for primipary cows to prevent the transmission of

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infection from cows [25].

Table 3: Effect of bedding on the level of indicator bacteria (log CFU.ml^{-1})

Bedding	TVC[1]	CB[2]	FCB[3]	FS[4]
Control - straw	8.6^{a}	6.6^{a}	6.5^{a}	9.2^{a}
IB 1month	6.9^{b}	5.6^{b}	4.9^{b}	6.2^{b}
IB 2 months	7.3^{b}	6.0^{b}	5.3^{b}	6.5^{b}
IB 3 months	8.4^{a}	6.5^{a}	5.7^{b}	7.1^{b}

Note: TVC - total viable count; CB - coliform bacteria; FCB - fecal coliform bacteria; FS - fecal streptococci; IB 1month - one month after use of improved bedding; IB 2 months - two months after use of improved bedding; IB 3 months - three months after use of improved bedding; ^{a,b}values in column with different superscript letters differ significantly at $p < 0.05$.

Lactation and milking

After calving in early lactation, milk production begins at a high rate which continues to increase for three to six weeks. During this period, the dairy cows are inspected based on a once a month performance check, giving us a detailed picture of SCC, while highlighting the level of California mastitis test (CMT) needed on the farm. At the end of the colostrum period on the 4th - 6th day, it is necessary to examine each dairy cow by CMT, that is, upon which only healthy animals are moved to the production group [26].

In case of a positive CMT result, it is necessary to proceed with a possible treatment. An important outcome is also the early culture of positive samples from cows with subclinical mastitis based on the positive CMT [27].

To maintain good udder health significantly affects the correct procedure for milking, which should have the following steps (Figure 2):

- washing the teats;
- pre-milking teat dipping (disinfection of teats with the product before milking);
- cleaning teat ends;
- fore stripping and perform a sensory assessment of milk quality;
- drying teats;
- aplying machines with 60 – 120 seconds pep-lag-time, no milking on dry;
- preparation after milking, post-milking teat dipping;
- rinsing and regular technical maintenance of milking equipment;
- after milking, feed the cows to keep them upright until the teat close (approx. 20-30 min. [28].

It is also necessary to keep in mind the service life of the individual components of the milking equipment as well as the service and setting the functional parameters of the milking equipment. Any underestimation or delay in regular inspections of the milking equipment to „save money“ later draws much more money out of the cash register [29].

Drying cows

Dry period is the ideal time (between the last milking of one lactation and calving at the start of the next), when the mammary gland undergoes a series of changes that influence the cow's resistance to bacterial infection. The risk of mastitis is the greatest at the beginning and end of the dry period and therefore extreme care should be taken of dairy cows in this stage of production. [30,31].

It has been reported that the rate of closure of teat canals after drying-off varies greatly from cow to cow, with 50% of teats still 'open' 10 days after drying-off. This delay may lead to an increase in new infections, as 97% of clinical dry period IMIs occur in open quarters [32].

The cows ready for drying must be examined by CMT. If they are positive, they need to be treated and then dried. After the last udder swelling, one should use intramammary antiobiotic injections for drying (eg. Orbenin - DC) and injections that form a keratin plug (e. g. Orbeseal) in the teat duct. After these operations, teats should be soaked in a post-dip. If the cow is prepared in this way, the onset of a new infection while standing dry is eliminated (Figure 3) [33,34].

Before calving, the cow is at risk of developing a new infection when it is no longer under antibiotic protection. At this point, colostrum, which is an ideal breeding ground for bacteria, is beginning to form. During this period, the cleanliness of the environment in which the cows are kept is most important [35].

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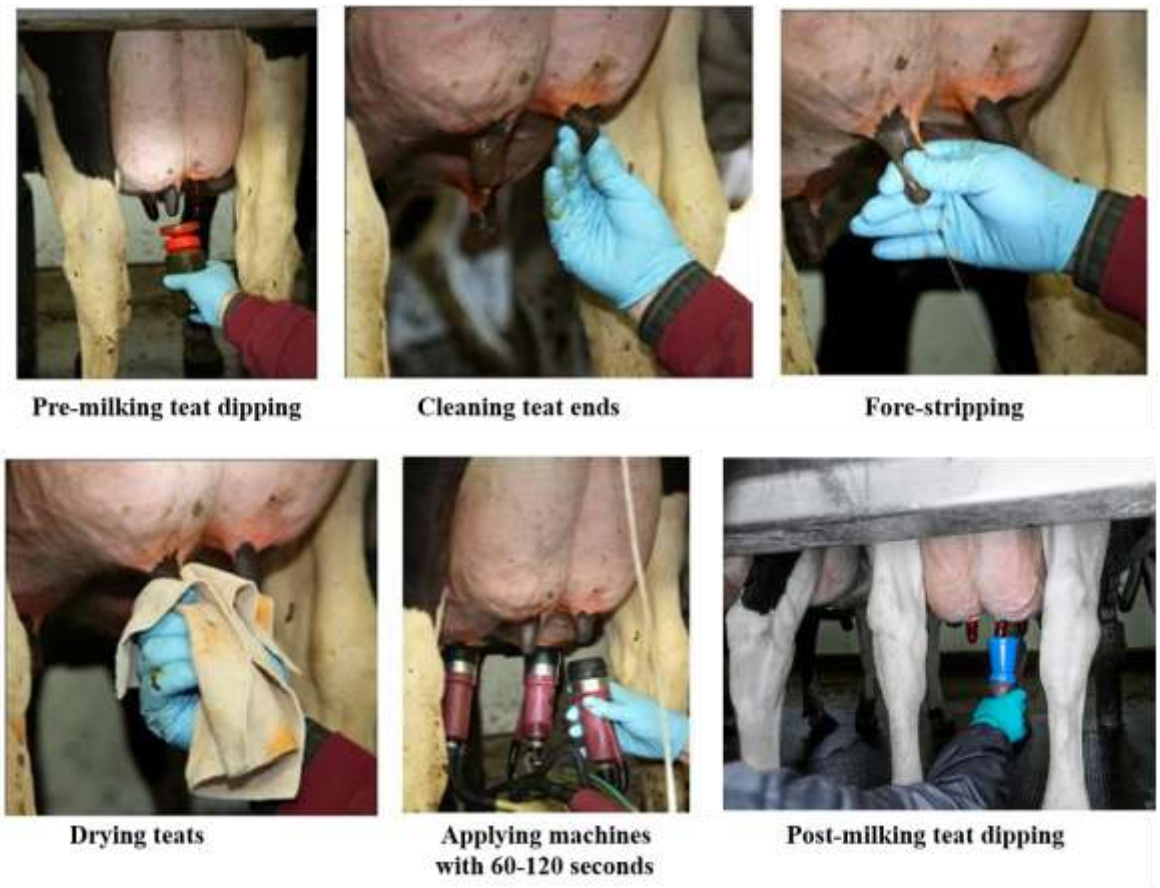

Figure 2: Summary milking procedure steps

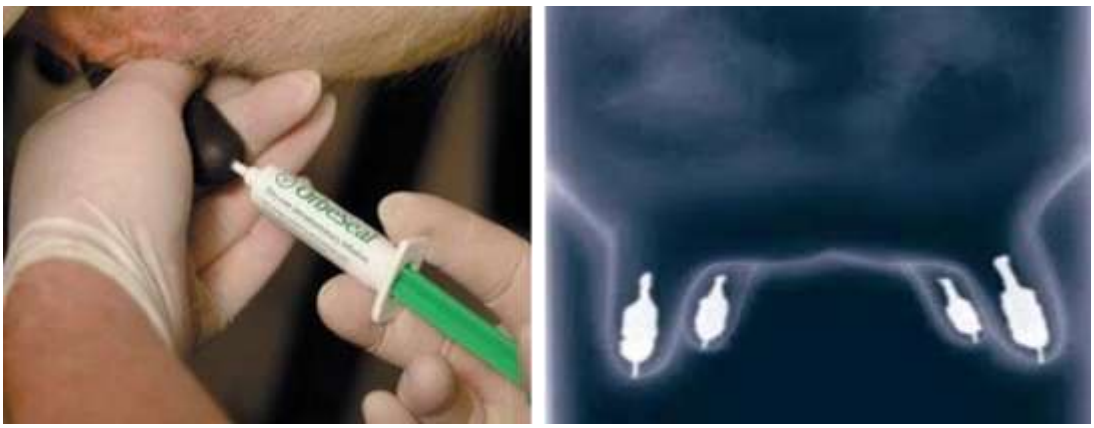

Figure 3: Use of teat sealant in each quarter of an udder
Source: Booth et al. [34].

II. CONCLUSION

The discussed issues indicate the need for constant monitoring and updating the anti-mastitis measures. Only respecting the current scientific knowledge in a logical context and complexity when applying the proven preventive and suppressive anti-mastitis procedures in dairy farming, can positively affect the overall health, production and quality of milk with a positive impact on consumer's health.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or

financial relationships that could be construed as a potential conflict of interest.

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