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Management of *Staphylococcus aureus* Mastitis at herd level

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1. Introduction

A mong dairy herd production disorders, mastitis is responsible for the largest disease-related economic losses due to it being so wide-spread (Volling et al. 2005; Halasa et al. 2009). In addition, the largest share of antibiotic usage on a farm is due to this infection. As with any other infection, mastitis occurs when cows with an impaired homeostasis (state of physiological equilibrium) come into contact with pathogens. Routinely, the pathogens enter the udder by the teat canal and colonise different portions of the parenchyma. Since there are many different pathogens capable of producing an infection and many ways of acquiring impaired homeostasis, the incidence of mastitis varies greatly from farm to farm. Dairy farmers perceive increasing mastitis problems differently and, therefore, frequently class them into different sets of problems, which may occur either alone or in combination with others. In many countries, udder infections with *Staphylococcus* (*S. aureus*) are still mainly responsible for mastitis problems, especially for excessively high bulk milk somatic cell counts over a long period and low milk yields due to

many chronic cases and/or too much milk withdrawal.

In order to mitigate a mastitis problem, a herd as well as an individual approach is required. While it is common to try to control mastitis by treating subclinical or clinically diseased animals (or by providing the necessary preparations) and suggesting measures to reduce the new infection rate “on the hoof”, a more holistic consulting approach helps to start a real change to the health situation of udders on the farm, especially in view of the economic situation in which many dairy farmers find themselves. Because of the difficulty in eradicating *S. aureus* on farms and remaining uninfected with that germ for a longer time, the target is to reduce the prevalence of *S. aureus* infections to a rate of less than 5 %. This target value was set according to data collected in dairy enterprises, which represent the top 5% of Northern Germany's herds in terms of lowest bulk milk somatic cell counts (Volling, 2011).

Usually, udder health is defined via the presence or absence of pathogenic bacteria and an increased somatic cell count,

although the threshold varies according to different authors and milk fractions (German Veterinary Medical Society, 2002; Bradley and Green, 2006).

The somatic cell count per ml of milk may be indicative of dramatic changes. At 100,000 cells/ml milk, the usual cellular immune defence has already begun to pass into an inflammatory reaction (DVG, 2002). Individual cell counts and pathogens are analysed by quarters. The following variables are used to describe the health of udders in groups of cows or herds, mainly based on a threshold of 100,000 somatic cells/ml from a composite sample from a cow defined as a “healthy animal”. For herds with problems induced by *S. aureus*, the number of healthy animals and the percentage of incurable animals are particularly important. The ratio of lactating healthy animals indicates the ratio of cows with presumably healthy udders. The term, incurable animals, refers to cows with cell counts repeatedly ranging at least three times above 700,000 cells/ml per cow composite sample. The number of cows with this status should be controlled and not exceed 2% (Østerås, 2006).

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2. Sampling

When *S. aureus* is identified either in quarters or the bulk tank, then the entire herd should be sampled (including sampling of cows that have calved after their dry period). When standard hygiene measures are undertaken (such as post-dipping, use of milking gloves, use of individual wipes for udder cleaning, cluster disinfection, etc.), then infection may happen at a later time since this pathogen spreads at a slower rate. *S. aureus* infected animals should be marked in the herd software system or by foot tapes so that everyone on the farm is able to identify infected animals at all times. Due to the problem that infected animals do not continuously shed *S. aureus*, a negative sample gives no guarantee of a cure after a therapy. In large herds with more than 200 animals, establishing a monitoring programme regarding *S. aureus* in bulk milk samples has proven useful. The target value is a maximum of 10 cfu *S. aureus*/ml (Zinke et al. 2010).

3. *S. aureus* is an Infectious Agent

The major reservoir for *S. aureus* as a cow-associated pathogen is the infected udder, and

infections are spread among cows or between quarters during the milking process by contaminated milking equipment, milkers' hands, or cloths used to wash, clean or dry more than one cow. Other typical reservoirs are wounds at the teat or near to the teat (e.g. necrotic dermatitis). *S. aureus* possesses several virulence factors that enable the pathogen to survive intracellularly or to spread in the udder tissue or to produce biofilms. This results in long-lasting infections that can persist through the lactation and into subsequent lactations.

4. *S. aureus* mastitis control

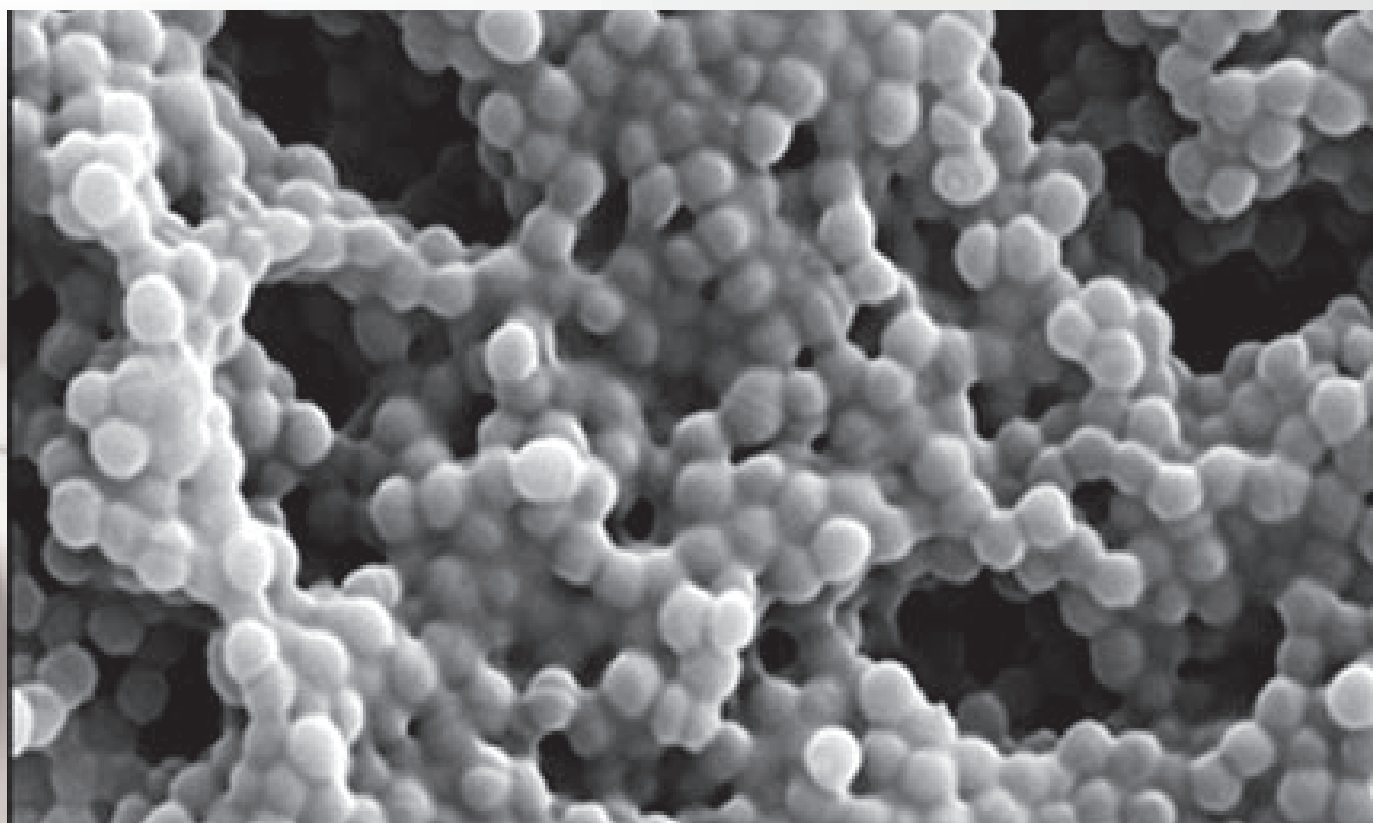
When mastitis is seen as a problem and production parameters are affected efforts to improve udder health should start. Dodd (1981) showed that the prevalence of mastitis (P) is the product of duration of inflammation (D) multiplied by the new incidence rate (NIR) ($P = D \times NIR$), expressed as a percentage of time (duration) or of cows (NIR). From this equation, we can see that there are two possible approaches to decrease the prevalence of the disease. One is to decrease duration (D) by culling or therapy or to decrease the incidence rate (NIR) by improving the environment thereby

removing or reducing the negative effect of risk factors. So the risk factors associated with *S. aureus* in the given herd have to be identified, minimised and monitored by the implementation of standard operating procedures.

To prevent *S. aureus* intramammary infections, it is necessary to limit the spread of this organism from cow to cow and to reduce to a minimum the number of infected cows in a herd. To avoid the spread of *S. aureus*, a strict hygiene programme is necessary including good milking hygiene (e.g. use of milking gloves, a replacement protocol for liners and other rubber parts, milking machine checks, post-dipping with a licensed disinfectant, skin care preparation, cluster disinfection, etc.), the prevention of teat and adjacent tissue injuries, and the abatement of flies in the summer months. Infected cows should be kept separated from the healthy herd and milked last (in order to avoid contamination via milking). Cows with damaged teat and tissues that do not respond to therapy have to be separated from the others and culled in the mid-term.

5. Teat immune defence

There is a connection between *S. aureus* infections and teat condition problems. All signs



which suggest reduced blood supply to the teat are unwanted and indicate an increased risk for the absorption of pathogens onto the teat thereby aiding their entry to it. When teat condition problems are detected, the preparation of the cows before milking (such as adequate stimulation, dry teat skin, etc.), the milking equipment pulsation characteristics and the milking duration have to be reviewed and evaluated critically. As a general rule, after removing the milking equipment, teats should look like they did, just before milking began (i.e. pink, even, dry etc.). The documentation of different visible changes of the teat condition (acute and chronic) immediately after removing the milking equipment helps to identify risks in this area. If more than 20% of the herd show these changes (in the case of haemorrhages), a teat condition problem exists, which is a huge negative on the efficiency of the milking equipment and substantially increases the risk for mastitis infections. The target is to have less than 10% of teats affected.

6. General immune defence

From an immunological point of view, the failure to eliminate a potential pathogen may be attributed either to low local defence systems or to a low general immune status of the cow (e.g. activation and release of phagocytes) or to both. Achieving constant homeostasis translates into improved health and sustainable high yields but deficiencies in husbandry, cow nutrition and overall herd management are known to affect this equilibrium; they also affect the general immune status and as a result the mastitis situation at both individual cow and herd levels. As seen with other risk factors, issues pertaining to the general immune status may vary strongly with regard to intensity and period; the animals' ability to adapt to these impairments also plays an important role. In addition to husbandry and feeding of cows, a better general immune defence against *S. aureus*

can be reached by using a specific vaccine. Common results of the different mastitis vaccines developed in recent years are the reduction in clinical episodes and an increase in spontaneous cure rates. STARTVAC®, a new mastitis vaccine from HIPRA has shown both a positive influence on somatic cell counts and improved cure rates of *S. aureus* infected animals and is proving to be a new tool for *S. aureus* control in dairy herds.

7. Therapy or culling

The duration of infections can be reduced by self-cure, therapeutic cure and culling. The decision to cull is supported by: somatic cell counts in cow composite samples > 700,000 cells/ml for several months, more than two *S. aureus* infected quarters, more than two treatments in the previous lactation against the same pathogen, clearly palpable tissue changes



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of the mammary gland or an extensive mastitis anamnesis.

Subclinical infections due to *S. aureus* are treated with typical antibiotic dry cow treatments, because the highest cure rates (>80% in quarters; self-cure and cure by treatment) occurred during the dry period when the therapy selected uses molecules that relate to specific mastitis pathogens' susceptibility. If heifers are infected with *S. aureus*, they should be identified by bacteriological examination of milk samples within the first month after lactation begins. Positive animals can be treated resulting in a high cure rate during the first

month of lactation (Zecconi, 1999). Clinical cases of *S. aureus* mastitis are regularly treated with antibiotics because routine treatment (antibiosis) is recommended for medium to severe clinical cases of mastitis. Practically after treatment, the success of a therapeutic activity won't be assessed because of diagnostic problems with *S. aureus*.

8. Conclusion

S. aureus mastitis control should be based on preventive measures to reduce the risk of

uninfected animals becoming infected and on therapeutic programmes (cull chronic *S. aureus* cows, antibiotic dry cow treatments, etc.) to stop the duration of infection. The most important preventive measures are identification of infected animals, separation of infected from uninfected animals, routine milking hygiene including post-milking teat dipping, cluster disinfection and successful vaccination against *S. aureus*. Our goal is not the eradication of *S. aureus* on a farm, but the reduction of the spread of *S. aureus* and new infections to a very low level.



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STARTVAC® Inactivated vaccine, Bovine mastitis, in injectable emulsion. COMPOSITION PER DOSE (2 ML): Inactivated *Escherichia coli* (J5) 50 REDg; Inactivated *Staphylococcus aureus* (CP8) SP 140 strain expressing SAAC** 50 REDg; Adjuvant. * REDg: Rabbit effective dose in 60% of the animals (serology). ** SAAC: Slime Associated Antigenic Complex. *** REDg: Rabbit effective dose in 80% of the animals (serology). **PROPERTIES:** Mastitis is one of the main problems in dairy cows, not only from an economic point of view due to losses in the quantity and quality of the milk, but also from a sanitary point of view, because the milk produced has low bacteriological quality and a high level of antibiotics, as a consequence of antimastitis treatments. The vaccine STARTVAC, which combines specific antigens and a special adjuvant, prevents and minimizes the effects of mastitis caused by *Staphylococcus aureus* (the main responsible for chronic mastitis) and *Escherichia coli* (causative agent of acute clinical mastitis). **INDICATIONS: Cows and Heifers:** To prevent Mastitis. For herd immunisation of healthy cows and heifers, in dairy cattle herds with recurring mastitis problems, to reduce the incidence of sub-clinical mastitis and the incidence and the severity of the clinical signs of clinical mastitis caused by *Staphylococcus aureus*, coliforms and coagulase negative staphylococci. The full immunisation scheme induces immunity from approximately day 13 after the first injection until approximately day 78 after the third injection (equivalent to 120 days post-parturition). **SIDE EFFECTS:** Slight to moderate transient local reactions may occur after the administration of one dose of vaccine, which disappears within 1 or 2 weeks at most. **ADMINISTRATION ROUTE:** Intramuscular, into the neck muscles. The injections should be preferably administered on the alternate sides of the neck. It is advisable to administer the vaccine at a temperature between +15 and +25 °C. Shake before use. **DOSAGE: Cows and Heifers:** 2 ml/animal. Generally, the following vaccination programme is recommended: **First injection:** at 45 days before the expected parturition date, **Second injection:** 35 days thereafter (corresponding to 10 days before the expected parturition date), **Third injection:** 62 days after the second injection (equivalent to 52 days post-parturition). The full immunisation programme should be repeated with each gestation. The whole herd should be immunised. Immunisation has to be considered as one component in a complex mastitis control program that addresses all important udder health factors (e.g. milking technique, dry-off and breeding management, hygiene, nutrition, bedding, cow comfort, air and water quality, health monitoring) and other management practices. Can be used during pregnancy and lactation. **WITHDRAWAL PERIOD: 0 days. SPECIAL PRECAUTIONS:** Store at +2 to +8 °C, avoiding freezing. Protect from light. **PACKAGING:** Pack of 20 vials of 1 ds, 5 ds vial, 25 ds bottle. Under veterinary prescription. Marketing authorisation holder: Laboratorios Hipra, S.A, la Selva, 135, 17170-AMER (Girona) SPAIN. Legal category: UK [COM]. ROM [COM]. Marketing authorisation numbers: 1 dose: EU/2/08/032/003; 5 doses: EU/2/08/032/004; 25 doses: 2/08/032/006. Use medicines responsibly.

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