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Efficient milk production under heat stress conditions

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Heat stress is now considered to be the cause of the largest economical loss to the world's dairy sector. The reasons for this are global warming, the increase in milk output per cow and the "immigration" of dairy sectors from temperate to tropical and sub-tropical regions, where the demand for milk in most cases is increasing.

Heat stress negatively affects the global dairy sector along the production, processing and commercialization chain.

At dairy farm level, heat stress negatively affects the cows in all stages of lactation (including dry cows):

- Milk production efficiency is reduced due to the negative effect heat stress has on the cow's annual production, the reduction in milk fat and protein content and an increased milk SCC.
- Reproduction efficiency: the cow's conception rate is negatively affected, which leads to seasonality in calving rate and in the milk supply to the market. It also leads to an increase in calving interval, above the optimal level.
- Animal health: heat stress leads to an increase in health disorders.
- Feed efficiency is affected when the cow's energy demand for maintenance increases (more feed required to produce determined amount of milk).

A lot of research has been done in the last decades, mostly in intensive dairy sectors located in warm regions, in order to develop effective systems to mitigate heat stress in dairy cows, trying to adapt them to different climate zones and dairy farm types.

In the dry regions of the world, and where farms require closed buildings (due to very cold winter conditions), “indirect” cooling systems (cooling the air around the cows) have been developed. These systems are based on the evaporation of water inside the building, created by high pressure misters or evaporative pads. Lowering the air temperature allows cows to loose more heat through convection means.

In humid regions (where most cows in warm regions are located) where cows are housed in open shelters, a “direct” cooling system was developed, based on a combination of forced ventilation of the cows combined with sequences of short wetting periods of the cow’s surface. In this treatment, cows loose heat through convective and evaporative means. Cows can be directly cooled in the holding pen (before, and sometimes between milking time) and in the feed line. In addition, cows can be provided forced ventilation in the resting area. According to the studies mentioned above, 6-8 cumulative hours of cooling per day, during all summer days, can increase the cow’s annual milk production and feed efficiency by 5-10% in the summer months.

Research and surveys carried out in different warm countries and published recently, compare cow’s performance with and without cooling in the summer. Intensive cooling allows the cows to maintain normal body temperature (< 39.0 C). As compared to non cooled cows, cooled dry and lactating cows increased their milk production by 10% annually, mainly by increasing cows in early lactation “peak” production and mid and late lactation cows persistency. Milk fat and protein content of cooled cows in the summer was 0.4% and 0.2% percentage units higher respectively and their milk SCC was reduced by 100,000/per ml of milk. Intensively cooled cows reached a summer milk production and content almost equal to that obtained in winter months. Cooling dry cows during summer increased their subsequent lactation, mainly by increasing their “peak” lactation by 5 kg/d.

Intensively cooled cows almost doubled their summer conception rates compared to the non-cooled cows, but it was still 10 -15 percentage units lower that those obtained in the winter.

Cooled cows required less feed energy for their maintenance, a fact that leads to a 10% improvement in their summer feed efficiency (kg feed required to produce 1 kg of milk).

Based on these results, economical studies were recently carried out to evaluate the cost-effectiveness of the implementation of cooling means in different farm conditions. These studies took into account on one hand the cost of cooling (installation and operational cost, as well as additional feed required for the extra milk produced) and on the other hand, the economical benefits due to cooling the cows (additional milk produced, improved milk fat and protein content, doubled regular summer heat detection and conception rates and improved feed efficiency).

Under all examined conditions (farms in different climates, different farm types and different prices for feed, energy and milk), most of the cooling expenses were covered almost completely by the improvement in feed efficiency. When all the economical benefits were taken in account, per cow net annual profit was increased by more than 20% above that obtained in farms that did not cool their cows in the summer.

In addition to its economical value, heat abatement by cooling the cows also has other beneficial aspects, which have become increasingly important in the last decades, namely the improvement in animal welfare and environmental sustainability.

Heat stressed cows tend to spend more hours standing and crowded, which reduces rumination time (as consequence of reduce activity and feed consumption). Cooled cows, although “being obliged” to spend more time per day standing (when being cooled), tend to spend more hours per day laying down and ruminating, two main symptoms related to improvement in cow welfare.

Increased production per cow allows the production of the same amount of milk with less cows and replacement heifers, saving maintenance costs and reducing Green House Gases (GHG) mainly methane, emission to the atmosphere. Therefore, cooling the cows in the summer, in spite of its use of electricity for fan operation, can also be considered “environmentally friendly”, as it reduces total GHG emission in the milk production process.

In conclusion, heat stress abatement, through cooling the cow, in any convenient system improves cow’s performance and farm profitability, improves animal welfare and at the same time, helps lessening the impact on the environment by reducing GHG emission to the atmosphere per unit of milk produced.