Dairy production can be negatively impacted by heat stress. A recent re-evaluation of heat stress threshold indicates that dairy cows are affected earlier than previously acknowledged. Microbial natural solutions can limit the impact of heat stress on cows’ health and productivity, thus creating benefits for the dairy producer. One specific live yeast is elaborated in this article, how it affects the dairy performance, maintains rumen function, improves rumen pH and feed efficiency under stressful climate conditions. Furthermore, positive impacts of selenium yeast on milk hygiene, cow fertility and immunity are discussed.

Appropriate nutritional programmes are important to reduce the impact of heat stress. One of the goals is to improve feed efficiency to compensate for the reduced feed intake, while protecting the rumen environment from acidosis risks. Since cows eat less dry matter as the temperature rises, increasing the energy density of the diet can compensate in part for the decreased dry matter intake. High quality, highly digestible, cool and palatable forage should be available to the animal if possible. More starch or added fat can be useful too. Balancing the mineral electrolytes in cow diets is another important aspect, because excessive sudation (sweating) leads to loss of sodium and potassium. It is also recommended to increase antioxidant intake such as organic selenium and Vitamin E, as the increased respiration induces a higher production of reactive oxygen substances.

The rumen pH balance is challenged in heat stressed cows and they are at a higher risk of acidosis. Therefore extra care is necessary to manage the rumen. Feeding of a high quality fibre source in the diet helps a rumen in a stable condition, however it is even better to fuel energy at the same time, especially for high-producing herds receiving high starch diets. The use of rumen modifiers is also considered to be effective, which improves and protect the rumen environment, such as ruminant specific live yeast. In the next section, a trial conducted under severe heat stress condition is summarised, which confirms the benefits of live yeast *Saccharomyces cerevisiae* I-1077 to limit loss of milk production.
**Effect of live yeast fed cows under moderate heat stress**

*Saccharomyces cerevisiae* I-1077, is a ruminant specific yeast strain selected with INRA for its effects on the rumen function and environment. A 2010 meta-analysis by De Ondarza and Sniffen that encompassed 14 trials and 1,615 dairy cows in total, indicates that under non-stressful conditions, daily supplementation with this specific yeast strain significantly enhances both milk yield and feed efficiency (+ 3% feed efficiency on average).

Two previous trials indicated that *Saccharomyces cerevisiae* I-1077 is also effective in reducing the impact of heat stress on dairy performance. A trial conducted in Shanghai in 2003 showed that under heat stress, supplementation of dairy cows diet with *S. cerevisiae* I-1077 improved income over feed cost by 9%, translated into a ROI of 10:1 for the dairy producer. Another trial performed in New York in 2004, showed that under heat stress, *S. cerevisiae* I-1077 improved income over feed cost by 9%, equivalent to a ROI of 14:1. Based on these results and the abundant literature about the positive effect of this live yeast on rumen function, the Department of Animal Sciences of the University of Florida, USA, conducted a trial in 2009 to evaluate the impact of the live yeast on feed efficiency and rumen condition of high producing dairy cows under moderate to severe heat stress conditions (temperature humidity index 80 on average).

Cows were randomly allocated to two treatment groups:

- **Control**: basal diet only (20 cows)
- **Live yeast**: basal diet plus 20 billion CFU/cow/day (equivalent to 1.0g/cow/day); stress-condition recommended dose (20 cows).

The basal diet comprised of: corn silage (41%), alfalfa hay (10%), wet brewer’s grains (5%), and a grain mixture (43%), on dry matter basis. The three-month study provided very interesting conclusions. The live yeast increased feed efficiency by 7%, equivalent to an extra 120g of milk per kg dry matter intake (Figure 1). The return on investment is calculated as 6:1 for the producer on higher milk production alone.

The live yeast significantly decreased the risk of acidosis: 45% of cows had a pH lower than 5.8 in the control group versus 10.5% of the cows treated with 1.0g/cow/day of live yeast (Figure 2).

The return on investment was calculated as 6:1 for the producer on higher milk production alone.

**Mechanisms**

The live yeast strain *Saccharomyces cerevisiae* I-1077 has been selected and extensively studied by international research institutes and universities and summarised in over 60 scientific publications, for its modes of action in the rumen and benefits on rumen health and function.

Three main mechanisms have been identified to explain its positive effect on ruminants performance:

- Improved rumen pH: reduced acidosis risk.
- Improved fibre digestion and nitrogen utilisation: increased feed efficiency.
- Rumen microflora stabilisation. All these actions will help counteract the detrimental effects of heat stress, and also of any stressful event for the rumen balance, such as feed transition and transportation. Heat stress is a risk factor for rumen acidosis: the live yeast stabilises rumen pH. This effect has been demonstrated under various conditions and with different diets. Dry matter intake and feed efficiency are typically decreased in heat stress. However, in the Florida University trial, feed efficacy was improved during heat stress with the addition of the live yeast, with more milk yield for no significant change in dry matter intake.

Research conducted by Bach in 2007 demonstrated an effect of this yeast strain on feeding behaviour in dairy cows: the average meal interval is reduced from four hours in control cows to three hours and 20 minutes. The cows fed with the live yeast had smaller and more frequent meals, meaning less slug feeding. In the same study, rumen pH was also increased with the live yeast and time spent under pH 5.6 was reduced.

**Antioxidants: the key role of organic selenium**

Under heat stress, extra care should be taken to maintain the cow’s antioxidative status by increasing dietary antioxidants intake, among them selenium. This trace element has long been recognised for its antioxidant properties. In particular, the glutathione peroxidases family of antioxidative enzymes, containing selenium incorporated with an organic amino acid, plays a major role in maintaining the antioxidative balance and protect the cells.

It is evident that the level of antioxidative activity of these enzymes are intimately linked to the organism selenium status and dietary intake, hence the necessity of supplementing the ration with selenium. This is even more crucial during heat stress periods, when the oxidative balance is challenged.

Selenium supplementation exists under various forms, either of mineral origin...
(selenate or selenite), or organic (incorporated within amino acids, the natural form found in plants and yeast). It was demonstrated that organic selenium, such as that found in selenium enriched yeast, is more bioavailable than mineral selenium. Trials have shown that dairy cows supplementation with selenium enriched yeast increased selenium status in the cows blood, milk and colostrum, to higher levels than equivalent doses of mineral selenium. Based on selenium antioxidative activity, the selenium enriched yeast has a potential to improve immune and reproductive functions, playing a role in preventing retained placenta. Moreover, it was shown that dairy cow supplementation with selenium yeast can help reduce somatic cell counts in milk more efficiently than mineral selenite, as shown in Figure 4. Scientists have linked the protective effect of selenium to the influence of the antioxidant status on neutrophil functions, the circulating immune cells implicated in the early response against pathogens. When antioxidant capacity is limited under stressful conditions, the lifespan of those immune cells is reduced and the risk of infection is increased. AAF

References are available on request via www.lallemandanimalnutrition.com

Figure 3 - Effect of dairy cows diet with live yeast on rumen lactate concentration.

Figure 4 - Effect of dairy cows diet with selenium yeast on somatic cells count in milk.