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Rumen efficiency during challenging conditions

Improving rumen health is necessary during difficult conditions for high productive cows

Since high productive cows are depending strongly on the rumen efficiency, every challenge has to be compensated by (nutritional) management. When challenges like heat stress and sorting behavior impact the rumen health, cows will produce less efficient with a direct impact on economic results. Especially during summer period cows are highly impacted by heat stress, with both in short and longer terms tremendous effects on cows health and productivity. Nuscience really acknowledges this big challenge and offers solutions to deliver relevant and sustainable value on farm.

'Rumen stress'

Different factors can bring a healthy rumen in a stressful condition. Most impactful is of course a too low drop in rumen pH, causing rumen acidosis. Rumen acidosis is a metabolic disease appearing as acute rumen acidosis but more often as the sub-acute form. In case of acute rumen acidosis, the pH will drop drastically below 4.8 for an extended period of more than 24 hours. Fortunately acute rumen acidosis occurs rarely on professionally managed dairy farms. Subacute ruminal acidosis (SARA) occurs however much more frequent and is caused by accumulation of volatile fatty acids (VFA) in the rumen. If the production of VFA exceeds the capacity of the rumen absorption, the rumen pH will drop. SARA is characterized by repeating periods of a rumen pH below 5.5, occurring for several minutes to several hours. Several studies agree that 19-26% of all dairy cows deals with SARA. During this period of SARA the rumen efficiency decreases to a large extent. Less digestion, lower absorption of volatile fatty acids (VFA's), higher production of endotoxins and even damage to the rumen wall will be the result. To prevent these negative effects an excellent buffering strategy is needed.

Heat stress

Heat stress is a very broad term, but what does it exactly means? Normally temperature should be the first indicator, but to estimate the real effect on dairy cows also humidity has to be taken into account. Naturally, cows are losing heath by nonevaporated cooling (radiation, conduction, convection). When temperature rises cows start using the evaporative cooling mechanisms (sweating, panting). These evaporation strategies are effective but when humidity rises cows are not able to lose enough body heat to prevent the rise of body temperature. In order to make a good estimation of the risk of heat stress the Temperature Humidity Index (THI) gives a good indication (Table 1). Above a THI index of 72, cows start to suffer from heat stress.

THI	
Light	(68-71)
Moderate	(72-79
Severe	(80-89)
Very severe	(>90)
Deadly (>100)	

Temperature (°C) \ Humidity (%)	20	30	40	50	60	70	80	90	100
22	66	66	67	68	69	69	70	71	72
24	68	69	70	70	71	72	73	74	75
26	70	71	72	73	74	75	77	78	79
28	72	73	74	76	77	78	80	81	82
30	74	75	77	78	80	81	83	84	86
32	76	77	79	81	83	84	86	88	90
34	78	80	82	84	85	87	89	91	93
36	80	82	84	86	88	90	93	95	97
38	82	84	86	89	91	93	96	98	100
40	84	86	89	91	94	96	99	101	104

Table 1: Temperature Humidity Index

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Impact of heat stress

A lower dry matter intake is one of the first reactions of a dairy cow during heat stress directly affecting the energy balance in a negative way. Another important risk is an altered ratio of concentrates to roughage, especially when cows are able to select the concentrates. Together with a lower number of meals, resulting in bigger meal sizes during heat stress, the risk for rumen acidosis will strongly increase. Knowing that on average about 21% of the cows are suffering from sub-acute rumen acidosis (SARA), this number will without any doubt increase to a large extent during heat stress. In periods of low rumen pH, the feed digestion will be impacted strongly . Beside this the level of endotoxins will increase, up to 10-20 times the amount in a healthy rumen (Li et al, 2012). Absorption of these endotoxins in the blood, along the digestive tract, will result in a high amount of endotoxins in the blood. This activates the immune system and causes more inflammation which makes cows less healthy and uses a lot of energy! Also the rumen itself is negatively impacted by the endotoxins and will be less capable to absorb Volatile Fatty Acids (VFA) resulting in a lower nutrient intake and lower acid absorption stimulating even more rumen acidosis. Besides the risk for SARA cows suffering from heat stress start to produce stress hormones like cortisol and prolactin both affecting the immune system (Collier et al., 2008).

Milk production drops much more…

If we look at the lower DMI during heat stress, this only explains about 35-50% of the reduction in milk production. What are the additional causes for producing less milk? Like cows in heat stress, early lactating cows also experiencing a negative energy balance. Early lactating cows have however a compensating mechanism in place. Thanks to a low insulin level and insulin resistance during early lactation they can compensate a significant part of the ‘missing’ energy by using body fat. Cows in heat stress have a quite normal insulin concentration in the blood which prevents the use of body fat as alternative energy. In this case cows become very dependent on glucose as energy source. More glucose needed for energy results in lower glucose available for the production of lactose which is directly related to a lower milk production.

The big increase in endotoxin production causes an additional drop in milk production. Oxidative stress causes an impairment of the natural barrier function of the GIT. Similarly, hypoxia, a lower oxygen content in epithelial cells due to heat stress, damages the natural barrier function of the GIT. The higher permeability of the gastro intestinal wall results in a higher absorption of endotoxins. Moreover, these endotoxins are present at an increased level in situations of heat stress. Once entered in the body they activate the immune system using a lot of energy in the form of glucose. This higher use of glucose again results in less available glucose for milk production.

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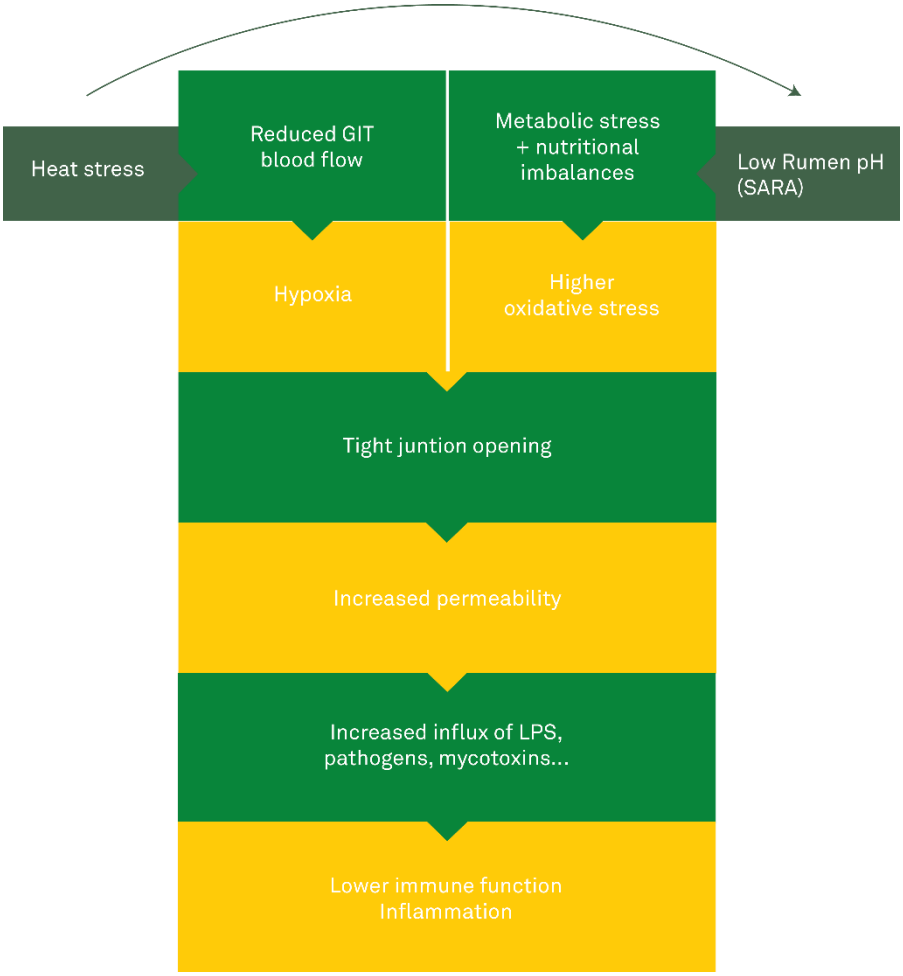

Figure 1: Consequences of heat stress in cattle

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Excellent protection needed to minimize the effects of heat stress

To protect the cows from the negative effects of heat stress Nuscience developed an extensive buffering concept effectively supporting cows in different ways. Mervit® Buffer is characterized by a carefully selected combination of buffering ingredients and products that support the (rumen) health. An excellent buffering profile over a longer period is required to guarantee an optimal result. In practice, single sodium bicarbonate is often used, having a large buffering capacity but only during a short period of time directly after consumption. To obtain a good buffering profile over the complete rumen tract it is necessary to have a good combination of fast, moderate and slow buffering products. This way the rumen will be buffered when needed and the capacity in time is tuned with the needs of the rumen in time. Next to buffering ruminal acids, Mervit® Buffer also steers the bacterial population in the good direction. Supporting cellulolytic bacteria will result in a lower production of lactic acid. Additionally, a stimulation of lactic acid consuming bacteria will minimize the decrease of the rumen pH. Finally the use of natural antioxidants will reduce the effect of stress in the animal. Different natural components effectively reduce the negative effects of stress by protecting the barrier function of the intestinal wall. This minimizes the amount of endotoxins absorbed in the body and results in a lower waste of glucose and a more healthy and productive animal.