EFFECT OF SUPPLEMENTATION WITH SODIUM BICARBONATE IN LACTATING DAIRY COWS DURING HEAT STRESS

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BACKGROUND:

Heat stress in dairy cattle is a common problem in many areas of the world at least in some months of the year. The main consequences of heat stress are a **reduction in dry matter intake, milk production and reproductive performance** (Rejeb et al., 2002). Furthermore results in the loss of some electrolytes and bicarbonate. It has been suggested that cows under heat stress may find a benefit of being supplemented with additional sodium bicarbonate, resulting in an improved productive performance (Beede et al., 1986; Scheneider et al., 1986).

The objective of this study was to evaluate the effectiveness of sodium bicarbonate (Bicar-z®)[1] on milk production during heat stress.

MATERIAL AND METHODS

This study was conducted in a farm located in La Garrotxa area (Girona, Spain). A total of **197 lactating Holstein cows** were used. Animals were distributed in three lots, two for the treatment and one for the control. Control cows (n=87) were fed a TMR diet once daily and treatment cows (n=111) received the same diet but with the addition of **250 g/cow/day** (Bicarb-Z®. The diet was design to meet or exceed dietary recommendations for cows in the farm following NRC (2001). The study was conducted in two periods: period 1 (days 1 to 31 of july) and period 2 (1 to 31 of August) because these are the two hottest months of the year. Temperature, humidity and rainfall were collected daily (Meteorological Service of Catalunya -Vall d'en Bas) Station; Meteocat) and the Temperature-Humidity-Index (THI) was calculated using the following formula: THI= (1.8xT+32) - ((0.55-0.0055xRH) x (1.8xT-26)) T=Temperature; RH=Relative Humidity. Daily milk production and dry matter intake by group were determined daily. At the end of each period, respiration rate, rectal temperature and urine samples from a subset of cows (n=14 per treatment) were collected. Respiration rate and body temperature were determine between 10:00 and 12:00 h of sampling days, which represent a time of high temperature during the day. Urine samples were analyzed for urine pH, and potassium and bicarbonate ion concentrations.

Urine samples were collected by spontaneous urination, and pH was determined immediately with a portable pH-meter. The remaining of the sample was frozen at -20ºC for further analysis of bicarbonate and potassium ion concentrations. Bicarbonate was analyzed by volumetric techniques and potassium by potentiometry at Laboratorios Echevarne (Barcelona, Spain).

[1] Bicar-z® : marca registrada por Solvay Chemicals

RESULTS

Results indicate that the overall average, the THI index was just under the threshold of heat stress. However, at the hottest times of the day, the THI was at 86 and 88 for period 1 and 2, respectively (table 1). This THI are moderate to severe, and may result in an increase in breading rate and body temperature, and result in reduced milk production ranging from 3 to 7 kg of milk daily. These results suggest that cows were at least during part of the day under heat stress conditions, which justifies the use of prevention measures and provide an adequate set-up for the test of feeding Bicarb-Z® in heat-stressed cows.

Table 1: Summarizes weather conditions in the last 15 days of each period and any index in La Garrotxa in July (Period 1) and August (Period 2).

	Period 1	Period 2
Temperature, ºC		
Average	20.6	20.5
Maximum	33.3	34.7
Minimum	13.9	12.7
Relative Humidity, %	73	75
Rainfall, mm	142.4	129.2
Average Maximum Temperature-Humidity-Index		
Average	67	67
Maximum	86	88

Respiration rate was high in both control and treatment cows, compared with normal breathing rates, but the addition of Bicarb-Z did not affect this frequency. Rectal temperature was below normal ranges (generally suggested between 38.0 and 39.3 for lactating dairy cows), which may be associated with methodological processes. However, rectal temperature was consistently reduced in cows fed Bicarb-Z an average of 0.52 ºC (table 2). This reduction is relevant for dairy cows and has been associated with a reduction of milk production (Zimbelman et al., 2009). Urine pH were within normal ranges for lactating dairy cows, but tended to decrease in the Bicarb-Z treatment. Bicarbonate ion concentration in the urine was also reduced with the group Bicarb-Z treatment, but potassium concentration was not affected. Overall, data suggest that animals had some degree of heat stress, and that the addition of Bicarb-Z appear to reduce some of them.

Table 2: Respiratory frequency (breaths per minute), rectal temperature and urine profile of cows fed a TMR with and without Bicarb-Z.

	Control	Bicarb-Z	SEM	P<
Respiratory Frequency, (/min)	62.6	59.6	3.00	0.49
Rectal Temperature ºC	37.76	37.24	0.082	<0.001
Urine				
pH	7.97	7.80	0.056	0.10
Bicarbonate	262.1	229.5	12.6	0.05
Potassium	186.8	178.8	7.76	0.47

Table 3: Milk production and dry matter intake of cows fed a control diet with and without Bicarb-Z

Variable	Treatment		SEM	P <
	CTR	TRT		TRAT
Milk production (MP), Kg/d	26.2	30.5	0.199	<.0001
Dry Matter Intake (DMI), Kg/d	18.6	20.2	0.173	<.0001
DIM, d	204	205	0.341	0.640
Ratio MP/DMI L/kg MS	1.41	1.51		

Milk production increased 4.3 kg of milk (table 3), likely due to a increased dry matter intake (reduction of 2.2 kg of dry matter daily). This difference of milk production could not be attributed to differences in days in milk (very similar between groups). It should be noted, however, that the control and treatment groups were about 2 kg of milk difference before the trial started, and that the major differences were observed in August. However, even if the initial difference is subtracted from the overall difference, the effect in milk production is highly relevant. The reason of the sharp change at the beginning of August and the persistent different along that month has no obvious reason. The above average response is difficult to explain because heat stress only occur during the day, and it is well documented that when night temperature are below heat stress, this relieves part of the heat stress suffered during the day.

CONCLUSIONS

The experiment was conducted under heat stress conditions justified by weather measurement and animal measurements. The addition of Bicarb-Z **reduced some of the indicators of heat stress** (rectal temperature, urine bicarbonate and pH), and **improved dry matter intake and milk production** compared with control animals not fed Bicarb-Z®.

REFERENCES

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