Effect of a constant high ambient temperature on the intake and excretion of water in dry and lactating Holstein cows

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Introduction At a world scale, the concomitant increase of livestock production and risks of global warming reinforce the issue of the use of water for livestock. In this context, it will be important to predict accurately the water requirement of the herds, particularly dairy herds. An issue for theses predictions is to include climatic parameters in predictive equations in such a way that they could be used across geographic contexts. Even though mechanistic models of the impact of the climate on animal water evaporation have been developed, their use assumes to quantify the compensations between evaporation and water consumption by cows when ambient temperature increases. The aim of the present study was to determine the effect of two ambient temperatures (under or above upper critical temperature for cow) on all water flows on dairy cows either dry or lactating. An increase of Na and K supplementation is recommended when ambient temperature is high. Given that supplementation could also affect the partition between flows, the interaction of temperature with sodium supplementation was also tested.

Materiel and methods The effects of two constant ambient temperature thermoneutrality TN (15°C) and High Temperature HT(28°C) in interaction with two mineral complementation Na^-(0.15%DM) and Na^+(0.55% DM) were compared according to 2 Latin square design, on 4 dry and 4 middle lactation Holstein cows (98.5±3.32 day in milk, 42 kg/d milk yield). Cows were housed in two climate chambers (2 dry and 2 lactating cows) during 4 periods of 2 weeks each. Feed intake, milk yield, water drunk and vaginal temperature were daily recorded. Urine and faeces were collected during the last 3 days of each period. The volume of evaporated water was calculated as the difference between water drunk, ingested with feed, urine, faeces and milk, retained or produced by metabolic reactions. Cow diets consisted on 76% maize silage, 10% dehydrated alfalfa and 13.8% soybean meal. Dry cows were restricted to their protein and energy requirement. Animal's data were analyzed using PROC MIXED of SAS Institute (1990).

Results The daily average of temperature-humidity index (THI) was 59 for TN and 73 for HT (Mader *et al*.2006). Daily average vaginal temperature increased from TN to HT by 0.12°C for dry cows and 0.91°C for lactating cows. Dry matter intake (DMI) of lactating cows decreased significantly from 21.1kg/d at TN to 18.8 kg/d at HT (P<0.01) and remained constant at 13.9 kg/d for dry cows. Both dry and lactating cows increased significantly the volume of water evaporated at HT compared to TN (P<0,001), with no significant interaction with the physiological stage. For dry cows, the increase of water drunk between HT and TN was very similar to the increase of evaporation and most of the other flows of water were not affected by the temperature. For lactating cows, the increase of water drunk was lower to that of evaporation, likely because of a decrease of the amount of water excreted in faeces. When all water flows were expressed as a proportion of DMI, the decrease of faecal water and increase of urine water remained significant in lactating cows but the range of variation were low compared to those of evaporated and drunk water. Mineral complementation only increased urine and water drunk with no interaction with physiologic stage.

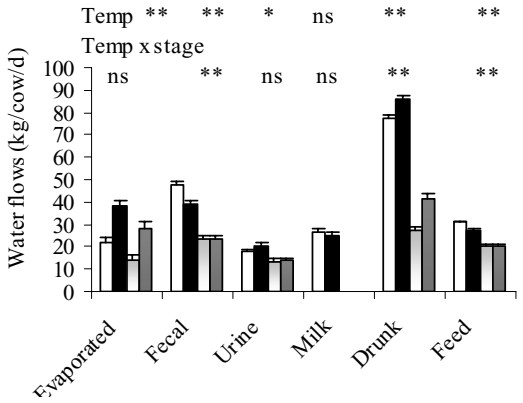

Figure 1 Water flows of dry and lactating cows (kg/cow/d)
** :P<.01,*:P<.05,NS: Not significant

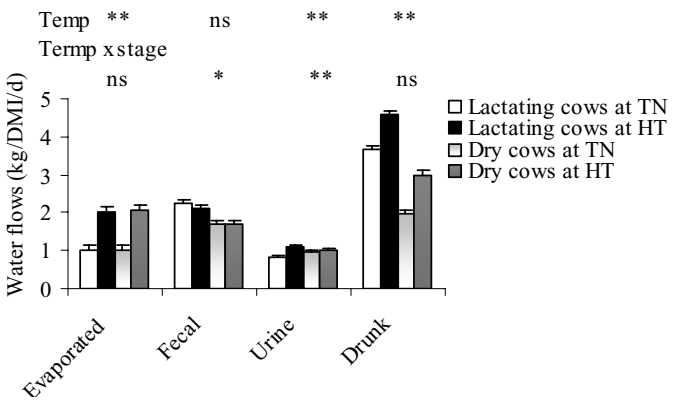

Figure 2 Water flows of dry and lactating cows (kg/DMI/d)

Conclusion These results shows that when expressed as a proportion of intake, the increase of evaporation with increased temperature in dairy cows is mainly compensated by increasing volumes of water drunk whatever the physiological stage of the cows, at least in conditions of moderate heat stress. This means that the development of predictive models of water intake including climatic parameters could be based on mechanistic models of evaporation.

References

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