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Heated drink water for dairy cows?

During recent years dairy farmers and manufacturers have recommended heating drink water for high performance dairy cows in order to improve yield and animal health. Trials indicate that there is not much sense in this because no significant positive change in performance could be determined compared with where animals were offered 3 C water. On the contrary, milking performance (FECM) and milkfat content were both tendencially higher when cool water was offered. Additionally, one has to calculate an energy consumption for heating to 24 C of around 2.4kWh/cow/day.

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Many trials have been involved in the effects of drink water temperature on the performance of ruminants [1,2,3,4,5,6,7,8,9]. According to farmers and drinker manufacturers, warming should have a positive effect on high yielding cows. This point of view was tested over four trial cycles at the Research Station for Livestock Biology and Ecological Agriculture, University of Hohenheim, in cooperation with the Institute for Animal Nutrition in that University. Here the influence of heated drink water compared to a constant supply of cold drink water was investigated under the parameters feed and water consumption, milk yield and drinking behaviour.

Trial animals and methods

In three trial periods (V1, V2, V3) the trial groups were offered warmed water (24 C, 17 C, 24 C) and the data compared with the control group which always had 3 C cold water on offer. The tests in the alternative trials in each case lasted two times four weeks. The fourth trial was carried out as a three-week choice-test (3 C and 24 C).

Involved were a maximum of 20 dairy cows (German Holstein) each with an average daily yield of 25 kg. The animals were housed in a naturally ventilated cubicle building with built-up cubicles and slats. They were milked twice daily in a 2x3 auto-tandem parlour and fed a modified TMR plus additional concentrates per transponder from two self-feeding boxes. TMR components were maize and grass silage, hay (first and second cut), supplemental feed and soya pulp. Ration dry matter and energy content was 47.1% and 5.7 MJ NEL in the first trial, 46.2 and 5.6 MJ NEL in the second, 41.6% and 5.6 MJ NEL in the third and 42.7% and 5.5 MJ NEL in the choice trial. The concentrate feed contained 8.3 MJ NEL/kg DM; this was fed according to yield (9 kg milk from ground rations). The individual troughs with compu-

Fig. 1: Integration of the heated storage drinker into weighing technique and data aquisition of the experimental unit for registration of roughage intake (Experimental station for livestock biology and ecological farming „Meiereihof")

ter-controlled lids were fitted onto precise scales (+/- 10g) and fitted with transmitter-receiver units for the cattle neck transponders *(fig. 1)*.

In this way data on individual animal feed intake could be recorded. In the same way the recording of individual water consumption was carried out. Through computer controlled access for individual animals to a particular drinker, no separation was necessary between trial and control groups. The water in the reservoir drinkers (capacity 130 l) was heated by an immersion rod (3 kW) or cooled by a milk cooler. In addition to feed and water intake, liveweight and milk yield were recorded daily automatically. Milk components were analysed once per week. Additionally, the electricity consumption for the warm water drinkers was recorded. Weather data was available from the University of Hohenheim.

Results

In none of the three trials could significant differences be found in the consumption of ground ration feed and/or concentrate feed (error probability (= 0.05). On average in 46 feeding periods per day 11.40 to 12.35 kg DM in ground ration feed per cow was consumed, which required from 2.98 to 3.55

Table 1: Milk yield and fat content, depending on drinking water temperature

Trial (Drink - water temperature)	Cold drink water		Warm drink water	
	FECM (kg)	Fat content (%)	FECM (kg)	Fat content (%)
V1 (3°/24°C)	25,92	3,81	25,99	3,75
V2 (3°/17°C)	24,53	3,87	24,07	3,83
V3 (3°/24°C)	28,23	3,82	27,95	3,78

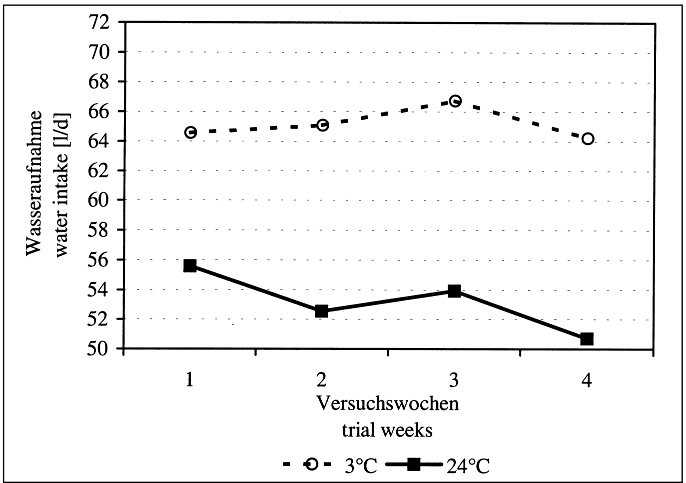

Fig. 2: Water intake per cow and day with 3 °C und 24 °C water temperature (whole herd, V3)

hours. In a single feeding period 0.27 to 0.32 kg DM/cow was eaten. Rationed according to milk yield, individual concentrate consumption was from 6.3 to 7.6 kg DM/day and cow.

Water intake was only in part significantly influenced. In trials 1 and 2 there was a tendency for more cold water to be consumed than warm water (67.04 l against 66.43 l and 69.66 l against 66.70 l). In trial 3 (*fig. 2*), the difference was, however, significant: 65.2 l against 53.2 with warm water.

The number of drink periods per cow and day ranged from 7.50 to 9.14. The time each day taken for drinking was significantly higher in the case of cold water: 20.38 against 13.92 minutes (trial 1), 24.14 against 15.70 min. (trial 2) and 23.64 against 13.19 min. (trial 3). With the exception of trial 3 the amount of water consumed per drinking period was not significantly different, although with cold water more was consumed (8.57 against 8.36 l in trial 1, 9.21 against 8.84 in trial 2 and 10.01 against 8.16 l in trial 3). In the same way the drinking speed with cold water (3.53 to 4.0 l/min.) was significantly slower than with warm water (4.53 to 5.35 l/min).

No significant differences were able to be discovered in terms of milk yield. However, the production with cold water tended to be higher than that where heated water was offered. The fat content of milk also showed a rising tendency where cold water was offered (*table 1*). The milk protein content remained uninfluenced. Also uninfluenced by the drink water temperature was animal liveweight.

The average minimum/maximum temperature of outside air was 3.7 C/12.2 C in trial cycle 1, 10.5 C/20.4 C in trial 2, and in trial cycle 3 – 0.9 C/5.0 C.

The choice trial showed conclusively that the cows preferred the warmed drink water. They covered 94.4% of their water requirements with 24 C water. From an average 68.34 l/d only 3.85 l were taken from the cold water drinkers. As to drinking behaviour, two main drinking times were established, each after morning and evening milking. At those times, 41.6% of total daily water was consumed.

Discussion

The amount of daily feed consumption was uninfluenced by the drink water temperature in all three trials (*table 2*).

Furthermore, the difference could be explained through the different milk production figures. The ground ration feed consumption showed relatively constant values. The concentrate feed was rationed according to yield and as a result the consumed amounts differentiated between the three trials. Trial 3 is an example for ground feed intake suppression.

It is known that the thermo-neutral area with dairy cows is pushed downwards in line with rising performance. Because of the high metabolic activity, much surplus heat is produced and this has to be released [10]. This represents a stress on the animal at the expense of the energy household. Water has a high heat capacity and therefore is very suitable for cooling a body.

Taking the example of trial 1, the heat set-free was calculated. The animals weighed 620 kg on average. This represented a metabolistic W0.75 of 124 kg. The milk production lay by around 26 kg FECM. This indicates a daily heat production of H = 114.9 MJ/cow.

However, for the maintenance of body temperature in the thermo-neutral area only 0.293 MJ/kg W0.75 is required, in this case about 36 MJ/d. The difference is 79 MJ/d of surplus heat. With the absorbed heat amount of 10.1 MJ/d in trial 1, the 3 C water temperature meant that around 12.8% of the surplus heat could be dealt with without animals having to utilise their thermo-regulation mechanisms. Where the water is 24 C this figure would only be 5.3%. Thus cold drink water can reduce metabolic stress for the dairy cow. It appears that this does not register with the animals. At least it appears that they are aware of the comfortable feeling from drinking warm water in that they definitely prefer this to a measure of 94%.

The individual animals showed substantial differences in drinking water consumption.

The differences in the daily milk production (as in [11]) were not significant in all three trials. On the other hand, [2] represented significantly higher performance with warm drink water (3 C: 25.39 kg FECM/d, 17 C: 26.33 kg FECM/d and 24 C: 26.09 kg FECM/d). This was explained through more energy being required for the warming of the cold water up to body temperature. Own calculations indicate, however, that substantially more surplus heat is present in the animal than is required for the warming of the cold drink water.

Milk yield and milk fat content are influenced through the fermentation relationships in the rumen. Cold drink water could make the conditions more suitable for the fibrolytes. It was additionally observed that milk fat content rose when cold water was consumed (*fig. 3*), whilst levels dropped a little with heated water. This indicates a shifting of the microflora and multiplication of fibrolytes.

Table 2: Influence of water temperature on roughage and concentrate intake with different milk yield for all of the three trials

Water temperature	Trial 1 3°C	24°C	Trial 2 3°C	17°C	Trial 3 3°C	24°C
Milk yield (kg/d)	26,72	27,05	24,87	24,57	29,21	29,04
Basic feed (kg dm/d	12,09	12,35	12,01	11,85	11,40	11,44
Concentrate feed kg dm/d)	6,76	6,87	6,42	6,34	7,64	7,64
Grundf. + Kraftf.(kg dm/d)	18,85	19,22	18,43	18,19	19,04	19,08