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Conference paper

EFFECTS OF HIGH TEMPERATURE ON DAIRY PERFORMANCE AND BEHAVIOUR OF DAIRY COWS

J. Dolejš, O. Toufar J. Knížek, P. Kunc, R. Loučka

Abstract

The object of the dairy cow experiment was a quantitative determination of the negative influences of high temperatures in a stable environment on the performance and behaviour of animals. It was limited with an adequate device. It was attempted to this purpose an evaporation cooling method. This experiment was done in model provisions of an air-conditionet barn. Eight dairy cows were used. The duration of compare and experimental isotermic periods was 6-9 days with temperatures cca 21°C, resp. 30°C. The evaporation coling of animals was used in the second experimental period.

The quantitative determination of a waste in milk production of influence hight temperatures was 3.77 kg. head^{-1}. day^{-1} (i.e. 16.5%). In the period with using evaporation cooling was difference nearly zero. The effect of using evaporation cooling was 13.8%. High temperatures environmend had influence on behaviour of animals. The feed intake was decreased 50%, on the other hand the drinking duration was increased 2.5 times.

Introduction

High temperature causes a stress of dairy cows. It comes into question in a summer time in conditions of Czech republic. This time has a different duration in course of years. It can be from 1 to 3 month. In a mamory has held a time of high temperature in June and July 1994, when temperature values in the afternoon reached 35°C. Similar situations can fall too often in view of the fact the hypothesis of an atmosphere earth warming up by consequence of "green house effect".

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J. Dolejš, O. Toufar J. Knížek, P. Kunc, R. Loučka, Research Institute of Animal Production, 10400 Praha 10-Uhřínevěs, Czech Republic

Method and contribution

The objective was a research of a quantitative determination of negative influence of heat stress on dairy performance in cows and nextly heat stress elimination by the evaporation cooling method. 2 experiments were realised within years 1993-1994. The basic animal activity (behaviour) was evaluated by the descriptive ethologie method. The conditions of this experiments were as follows.

Table 1. - THE CONDITIONS OF EXPERIMENTS

	Experiment 1	Experiment 2
1. The experiment place	Barn-conditions control (temperature)	Natural climatic conditions-outdoor boxes
2. The type of housing	Bound housed	Loose housed
3. Dairy cows:		
- number n	8	8
- age after calving (m)	2-4	2-4
- lactation (years)	2-4	2-4
- breed	black pied catle	blac pied catle
- milk performance (kg per lactation)	up 5000	4500
4. Feed ration	Maize silage Green fodder Alfalfa hay Concentrate food	Maize silage Green fodder Alfalfa hay Concentrate food
water drinking	Individual	Group trough
5. Milking	In barn	Milking parlour
6. Water spraying equipment - placement - work regime	Nozzles over cows spraying interval was 20 min spray duration: 20-25s	Nozzles over manure corridor (jet of water affect box space as well + next equipment 1 nozzle in food corridor with active access of cows (controlled by photocell) dtto In food corridor was duration 30 s afteractivation by photocell
7. Microclima in a housing space	Model durations of periods = 6 (5) days Periods - temperature: - experiment per. 30°C - compare 21.5°C see fig. 1 and table 2	Given by the topical weather (VII-IX 1993) characteristic periods see fig. 2. and table 3

Table 2. - CONDITIONS OF EXPERIMENT 1

	Unit	Part 1 without evaporation spraying		Part 2 with evaporation spraying	
		x (C1, C2)	E1	x (C2, C3)	E2
Periods duration	day	5+5	6	6+5	5
Average daily air temperature	°C	21.4.	30.8.	21.6.	29.6.
Average daily air relative humidity	%	69.8	53.0	70.6	55.8
Diference between E, and C	K	-	9.4	-	8.0

Table 3. - CONDITIONS OF EXPERIMENT 2

Period	Date - number of days	Average day temperature $\bar{x}$ °C	Average day rel. humidity $\bar{x}$ %	Rainfall total in period mm	Temperature over 24°C duration (h) % of time period %
1	15.7.-28.7	17.3	73.4	8	18
	14				(5.4)
2	29.7.-6.8.	21.4	66.1	18	56
	9				25.9
3	7.8.-11.8.	18.7	64.9	6	0
	5				0
4	12.8.-24.8	19.6	60.3	2	70.0
	13				22.4
5	24.8.-8.9.	13.8	77.8	34	1.0
	15				0.2
6	9.9.-11.9.	19.5	70.3	4	8.5
	3				11.8
7	12.9-20.9	14.3	67.5	16	0
	9				0
8	21.9-26.9.	18.1	81.5	13	26.5
	6				18.4
Total -	-	17.2	68.3	101	162.0
Average	74				9.1

Results

1. Dairy performance
Experiment No 1.

Table 4. - DAIRY PERFORMANCE - EXPERIMENT No 1.

	Unit	Part 1 without evaporation cooling		Part 2 with evaporation cooling	
		x (C1, C2)	E1	x (C2, C3)	E2
Average day milk production	kg.head^{-1} . day^{-1}	22.90	19.13	21.75	21.77
Absolute differente between E_1 and C_1	kg. head^{-1} .day =-1	-	3.77	-	+0.02
Index E_1/C_1	-	1.000	0.835	1.000	1.001
Absolute difference betweeen E2 and E1	kg.head^{-1} .day				+2.64 (+2.26)
Index E2/E1					1.138 (1.115)

Influence of the high temperature stress on performance of dairy cows is quite evident. The milk production decrease was about 3.77 kg.head^{-1}.day^{-1}, it is 16.5% lower in comparasion with the compare periods C1 and C2. At nearly the same temperature of environment, but with the evaporation cooling aplication, milk production decrease doesn't occurred (a comparasion of experiment parts 2 and 1). In view of the fact that temperature difference between parts 1 and 2 reached 1.3 K, after correction by regress analysis method the milk production decrease is different.

Experiment No. 2

Table 5. - DAIRY PERFORMANCE - EXPERIMENT No 2.

Periods - concentrate	Duration of periods d	Average day temperat. °C	Average day milk production kg.head^{-1}.day^{-1}	Index
Period No 1	14	17.3	18.05	1.000
Periods with evapor. cooling aplication No 2, 4, 6, 8	31	19.8	18.91	1.048
Periods without evapor. cooling = lower day temperature No 3, 5, 7	29	14.5	19.66	1.089

Fig 1.

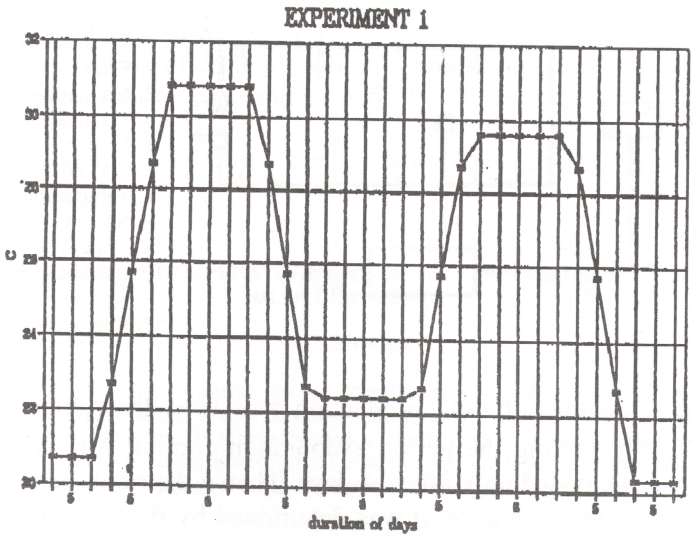
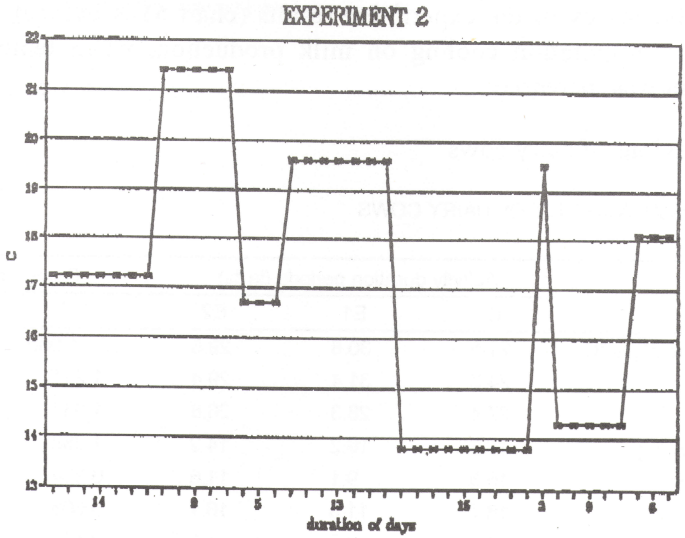
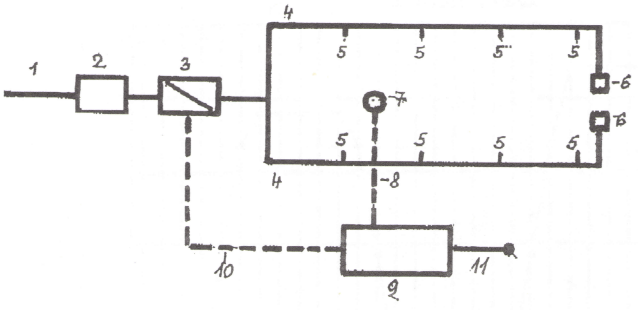


Fig 2.



From the surrvey of experiment conditions results, that time of utilization of the evaporation cooling equipment was during experiment No 2. 162 h only (=9.1% of it's total time). The time of utilization was dependent on the weather and activity boundary of equipment (over 24°C).

FUNCTION CHART OF EVAPORATION COOLING EQUIPMENT



1. Water supply
2. Filter
3. Magnetic valve
4. PE-tubing
5. Nozzle
6. Drip-off valve
7. Temperature senzor
8. Senzor connection
9. Control box
10. Connection cable to magnetic valve (24 V)
11. Power connection (220 V)

For the evaluating of milk production was used the period No 1 as a control (17.2°C). During the period evaporation cooling was not used. This equipment was activated only after 14 days. Then a distribution of experiment time was not given in advance. It was determined by the topical weather. For this reason periods have different duration. For the comparison was fused periods with and without the equipment utilization.

From the survey of the experiment results (chart 5) is evident favourable influence of evaporation cooling on milk production, when temperature of environment was increased.

2. Behaviour of dairy cows

Table 6. - ANIMAL ACITIVITY OF DAIRY COWS

Animal activity	Activity duration periods (in %)			Comparasion	
	C	E1	E2	C:E1	E1:E2
Average temperature °C	21.5	30.8	29.6	C = 1.000	E1 = 1.000
Staying	24.3	31.4	29.4	1.291	0.959
Lying	27.4	28.3	26.8	1.033	0.945
Staying + chewing	11.6	16.2	14.2	1.388	0.882
Lying + chewing	16.5	9.1	11.6	0.554	1.277
Eating	18.7	11.3	16.1	0.605	1.423
Drinking	1.5	3.7	1.9	2.457	0.511
Together	100.0	100.0	100.0		
From this: chewing only	28.1	25.3	25.8	0.899	1.024
Consumption drinking water 1. head^{-1}.day^{-1}	76.2	114.1	100.9	1.497	0.884

Results come from experiment No 1 only. The evaporation cooling method good influence upon a feed incoming duration. It is longer about 42.3%. It was decreasing the activity "drinking" on 51.1% against period E1. By that way it was reached a decrease of drinking water consumption on 88.4%. A comfort of animals shows an improve of animal activity "lying + chewing". It is longer about 27.7%.

A comparasion C:E1 express a dairy cows stress during high temperature of environment.

DJELOVANJE VISOKE TEMPERATURE NA DNEVNU PERFORMANCU I PONAŠANJE MLIJEČNIH KRAVA

Sažetak

Cilj pokusa s mliječnim kravama bio je kvantitativno odrediti negativne utjecaje vioskih temperatura u stajama na performancu i ponašanje životinja. Upotrebljena je odgovarajuća naprava, te metoda hlađenja isparivanjem. Pokus je izveden u uzornim uvjetima klimatizirane staje. Uključeno je osam mliječnih krava. Trajanje uspoređivanja i pokusnog izotermičnog razdoblja bilo je 6-9 dana s temperaturama od oko 21°C, odnosno 30°C. Hlađenje životinja isparivanjem primijenjeno je u drugom pokusnom razdoblju.

Kvantitativno određivanje gubitka u proizvodnji mlijeka zbog visokih temperatura bilo je 3.77 kg po glavi^{-1} na dan^{-1} (tj. 16.5%). U razdoblju primjene hlađenja razlika je bila gotovo nikakva. Djelovanje hlađenja bilo jd 13.8%. Visoke temperature okoline djelovale su na ponašanje životinja. Uzimanje hrane smanjeno je za 50% ali je pijenje povećano 25 puta.

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