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Developing an early warning system for heat stress in cattle

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Abstract Purpose of this study was to develop an early warning system for heat stress in cattle. For this purpose, total of 8 lactating cattle (4 Holstein of which 2 high and 2 low producing, 4 Brown Swiss of which 2 high and 2 low producing) which were raised at Dalaman branch of Agricultural Enterprises Directorate of Turkey were used. Before starting the experiment, adjustment time was given to the cattle to get used to human presence. After animals were accustomed to the human presence, researcher positioned herself in a shaded area where cattle came for shade seeking and skin temperature of cattle was read by infrared thermometer and also rectal temperature was read by using rectal probe. Temperature readings were taken at 10:00, 13:00 and 16:00. Study started on July 16 and lasted until August 16 when most of the heat stress is observed. Panting score of the animals were also recorded. Results showed that panting score increased as skin surface temperature increased. Rectal temperature also increased with panting score. Holstein cattle tended to have higher panting score than Brown Swiss cattle. Results showed that measuring skin surface temperature of cattle by infrared thermometer and observing panting scores could be used to early warn heat stress in cattle.

Keywords: infrared thermometer, heat stress, panting score, cattle

Introduction

Temperature is one of the most important factor affecting animal performance. (Koknaroglu et al 2008). Heat stress causes decreases in performance and in some cases it even causes death depending upon its severity. When geographical regions of Turkey are considered, it could be observed that dairy cattle production is concentrated in Western region of Turkey where incidence of heat stress is high (TUIK 2016). Heat stress displays its primary effect on feed intake and thus it causes decrease in performance of animal. Heat stress, which its effect is not measured in Turkey caused over one billion dollars loss in California in 2006 due to decrease in performance and death (Collier and Zimbelman 2007). It is thought that heat stress is going to affect performance of cattle in Turkey and some early warnings and precautions should be developed. Seasonal effect of heat stress is generally displayed in hot and humid regions during hot summer months. However heat stress may also be displayed at low temperatures as well. Since high temperature causes more problems, when heat stress is mentioned it is generally linked to the problems occurring at high temperatures. Effect of heat stress in dairy cattle could be observed from their performance and behavior. Research showed that cattle instinctively are in search of cooler places when temperature rises (Hoffman and Self 1973). Since display of heat stress in cattle takes some time, this causes economical losses. Thus developing and early warning system for heat stress becomes important.

Hand-held infrared thermometers are becoming more popular in measuring temperature due to their easy-use, quick response and accuracy. They have been used in animal science studies as well (Schütz et al 2011; Hillman et al 2001).

Purpose of this study was to develop an early warning system for heat stress in cattle by observing panting score and measuring the skin surface temperature by infrared laser thermometer that could also be easily applied by farmers.

Materials and Methods

In the study Holstein and Brown Swiss lactating dairy cows raised at Dalaman branch of Agricultural Enterprises Directorate of Turkey were used. The farm had 1000 heads of cattle during which study was conducted and of these 1000 cows, 8 lactating cows (4 Holstein of which 2 high and 2 low producing, 4 Brown Swiss of which 2 high and 2 low producing) were chosen for the study. Cows were housed in free-stall barns. Before starting the experiment, adjustment time was given to the cattle to get used to human presence. After animals were accustomed to the human presence, researcher positioned herself in a shaded area where cattle came for shade seeking and skin temperature of cattle was

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read by infrared thermometer and also rectal temperature was read by using rectal probe. Temperature readings were taken at 10:00, 13:00 and 16:00. Study started on July 16 and lasted until August 16 when most of the heat stress is observed. Hand-held infrared thermometer (FLUKE 568) was capable of reading the temperature at half second, thus skin surface temperature of cow were measured and noted immediately for each cow. Panting scores of cows were determined by using the guidelines reported by Meat & Livestock Australia (2006). Accordingly, panting scores were determined as:

0 No panting – normal, difficult to see chest movement,
1 Slight panting, mouth closed, no drool or foam easy to see chest movement,
2 Fast panting, drool or foam present, no open mouth panting,
2.5 As for 2 but with occasional open mouth, tongue not extended,
3 Open mouth + some drooling neck extended and head usually up,
3.5 As for 3 but with tongue out slightly, occasionally fully extended for short periods + excessive drooling,
4 Open mouth with tongue fully extended for prolonged periods + excessive drooling, neck extended and head up,
4.5 As for 4 but head held down cattle 'breath' from flank, drooling may cease.

After gathering the data, they were entered and analyzed by SPSS program by looking at the relationship between panting score, skin surface temperature and rectal temperature. In addition, since we had ear tag numbers of the cows we were able to investigate the effect of heat stress on milk production as well.

Results and Discussion

Since the nature of the data was repeated measures, results are given for every day. Panting score, mean skin surface temperature and mean rectal temperature (measured at 10:00, 13:00 and 16:00) are provided in Table 1. Since there were 4 cows in each breed and total of 8 cows, number of observations were not enough for evaluating panting score. Thus panting score below 2.5 was assigned as 1 and those above 2.5 was assigned as 2. As it can be observed in Table 1, panting score increased as skin temperature increased. This result was expected and was the theory that we wanted to prove. Panting score of animals is related to thermal environment they are subjected to and when surrounding environment is hot due to thermal gradient, heat load of the animal increases and causes animal have heat stress. Thus stressed animal develops alleviation (protection) measures. One of these measures is seeking shelter. If provided shelter does not alleviate the heat stress then animal decreases its feed intake. If these measures do not alleviate the heat stress then panting comes into action and tries to cool off animal by evaporation. Since during panting number of breath increases, this decreases carbon dioxide concentration in the blood and this causes increase in pH and is called respiratory alkalosis (West et al 1991). Throughout the study mean skin temperature for panting score 1 and 2 were 36.05 and 37.09 C, respectively. Results showed that skin temperature had relationship with the panting score that is indicator of heat stress. Rectal temperature by panting score varied among days but in general it was higher for panting score of 2. Throughout the study rectal temperature for panting score 1 and 2 were 38.87 and 38.97 C, respectively.

Panting score, mean skin surface temperature and mean rectal temperatures of Holstein and Brown Swiss cows are given in Table 2. As it could be observed in Table 2, Holstein cows tended to have higher panting score than Brown Swiss cows. This showed that Holstein cattle were more prone to heat stress. Results supporting this finding was reported by Ragsdale et al (1953). When Ragsdale et al (1953) compared milk yield of Holstein and Brown Swiss cows reared at 34 °C and 46 % humidity to those reared at 24 °C and 38 % humidity, they found that at 34 °C and 46 % humidity Holstein and Brown Swiss cows retained 63 and 84 % of their milk yield at 24 °C and 38 % humidity. This shows that Brown Swiss cows are more resistant to heat stress than Holstein cows. As it can be observed in Table 2, Holstein cows had lower milk yield than Brown Swiss cows. In general Holstein cows have higher milk yield than Brown Swiss cows (Gergovska et al 2012). This shows that environmental factors such as temperature and humidity are the reasons behind Holstein cows having lower milk yield than Brown Swiss cows.

Table 1 Panting score, mean skin surface temperature, mean rectal temperature, mean ambient temperature and mean humidity by days of observation.

Days of observation	Panting score*	Mean skin surface temperature (°C)	Mean rectal temperature (°C)	Mean ambient temperature (°C)	Mean humidity (%)
1	1	36.76[a]	38.97	34.27	50.00
	2	37.94[b]	.		
2	1	36.61[a]	38.82	36.66	36.33
	2	37.32[b]	40.15		
3	1	36.65	39.66	31.66	57.00
	2	36.73	38.70		
4	1	36.03[a]	39.20	30.93	63.66
	2	37.11[b]	39.05		
5	1	35.89	38.91	30.66	62.33
	2	36.43	38.80		
6	1	36.16	.	30.43	66.00
	2	36.73	.		
7	1	35.84	.	30.96	65.33
	2	36.82	.		
8	1	36.73	39.32	32.13	60.00
	2	37.217	39.75		
9	1	35.93	.	30.26	67.66
	2	36.55	.		
10	1	35.98	38.51	29.66	69.33
	2	36.50	38.50		
11	1	35.54	.	29.70	68.00
	2	.	.		
12	1	35.67	38.91	29.86	67.33
	2	.	.		
13	1	35.62	39.32	28.73	68.33
	2	36.63	39.20		
14	1	36.15	38.90	28.76	63.00
	2	37.86	38.70		
15	1	35.91	37.86	28.03	52.33
	2	.	.		
16	1	.	.	34.60	23.33
	2	37.59	39.10		
17	1	35.83[a]	38.60	32.13	32.00
	2	37.34[b]	38.56		
18	1	35.94	38.66	31.73	26.66
	2	37.56	38.45		
19	1	36.10[a]	38.85	32.43	33.33
	2	37.08[b]	38.83		
20	1	35.96[a]	38.92	30.40	43.33
	2	37.53[b]	38.81		
21	1	35.85	38.62	26.53	41.66
	2	.	.		
22	1	36.25	38.54	28.63	28.00
	2	.	.		
23	1	35.58[a]	38.83	28.58	32.33
	2	37.18[b]	39.13		
24	1	36.07	38.81	28.90	31.66
	2	.	.		

[ab]Means with different superscript within the same observation day differ (P<0.05).
*Panting score below 2.5 was assigned as 1 and those above 2.5 was assigned as 2.

Table 2 Panting score, mean skin surface temperature, mean rectal temperature and milk yield.

Breed	Panting score*	Mean skin temperature (°C)	Mean rectal temperature (°C)	Milk yield (kg/d)
Holstein	1.85	36.43	38.98	16.45
Brown Swiss	1.60	36.26	38.76	17.04

* Panting score below 2.5 was assigned as 1 and those above 2.5 was assigned as 2

Conclusions

Results showed that infrared thermometer can be used as early warning system along with panting score observation. For future studies number of cows should be increased to get better readings.

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