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Full Length Research Paper

Effects of selenium and vitamin E and night or day feeding on performance of Holstein dairy cows during hot weather

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An experiment was carried out to evaluate the selenium-vitamin E and night time or day time feeding on performance of Holstein dairy cows in heat stress. A total of 20 Holstein dairy cows (86±10 days postpartum and 600±20 kg BW) were randomly assigned to 4 treatments in a 2×2 factorial design and received a ration according to National Research Council (NRC) 2001 formulation. All dairy cows were divided into four groups, two groups were fed day time (5 cows for each group) and two groups were fed night time. One group from each day time and night time feeding groups was injected intramuscularly with 10 ml from a solution of selenium-vitamin E (each ml contains 0.5 mg selenium as sodium selenite and 50 mg vitamin E as dl-α-tocopheryl acetate) every 2 week. Night time feeding with selenium-vitamin E group was observed to have higher feed intake (kg DM/day), milk yield and milk persistency than other treatments ($p>0.05$). Night time feeding group had a higher dry matter intake (DMI) (kg/weight metabolic) than day time feeding group ($p<0.05$). The rectal temperature and respiration rate between treatments was not significant, but the selenium-vitamin E group was observed to be higher rectal temperature and less respiratory rate than non selenium-vitamin E group ($p>0.05$). The respiration rate for day time feeding group was observed to be higher than night time feeding group ($p>0.05$). Also blood plasma parameters, NH_3-N and pH of rumen fluid were not affected by the treatments. Although night time feeding with selenium-vitamin E group in comparison of other treatments had no significant effect on milk production, DMI, blood plasma parameters, rumen fluid and physiologic condition, but it seems the performance of dairy cow for night time feeding with selenium-vitamin E can alleviate the effects of heat stress.

Key words: Dairy cows, heat stress, day time feeding, night time feeding, selenium-vitamin E.

INTRODUCTION

Heat stress

One of the greatest challenges of production facing dairy farmers in Iran is heat stress and it causes, the lactating dairy cows were suppressed. Climatic conditions in the northeast (especially in razavi and khorasan province) are such that the warm season is relatively long (4 to 5 month); there is intense radiant energy for an extended period of time. Lactating dairy cows create a large quantity of metabolic heat and accumulate additional heat from radiant energy. Heat production and accumulation, coupled with compromised cooling capability because of environmental conditions, causes heat load in the cow to increase to the point that body temperature rises, intake declines and ultimately the cow's productivity (such as milk production) declines (West, 2003). Cooling systems have been developed to relieve the heat load on high-yielding dairy cows in hot climates (Her et al., 1988; Ryan et al., 1992), but, although some of these systems were found quite efficient, the heat load in hot summer weather was not completely relieved. Milk production, as well as milk fat content, was found to be reduced by heat load,

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even in herds in which dairy cows were cooled by such systems (Aharoni et al., 1999). Brosh et al. (1998) suggested that, in hot weather, feeding cattle at night might reduce the heat load imposed upon them by their increased heat production during the hours following a meal because this increased production is complemented by decreased heat output at other times of the day.

Hence, animals would produce less metabolic heat during daytime and more during the cooler night hours. Ominski et al. (2002) tested the response of morning-fed and evening-fed cows to short-term heat stress and found that evening feeding did not alleviate production losses associated with heat stress. Beede and Collier (1986) identified three management strategies to minimize the effects of heat stress: (1) physical modification of the environment (shading, cooling), (2) genetic development of heat-tolerant breeds and (3) improved nutritional management practices. Based on current knowledge, it appears that a combination of these practices may be necessary to optimize production of dairy cows in warm climates. Much of the decrease in milk production observed during heat stress can be attributed to the decreased DMI and cows decrease DMI in an attempt to reduce heat production from the digestion and metabolism of nutrients (West, 2003). Increasing air temperature, temperature-humidity index and rising rectal temperature above critical thresholds are related to decreased DMI and milk yield and to reduced efficiency of milk yield (Weat, 2003).

Oxidative stress

Oxidative stress occurs when the production of reactive oxygen metabolites (ROM) exceeds the capacity of the antioxidant system of the cell, tissue, or body. Heat stress has been proposed to increase production of oxygen-derived free radicals, which can have various deleterious effects (Mitchell and Russo, 1983). Certain nutrients act as antioxidants or are components of antioxidant enzymes and have a direct effect on oxidative stress. The major ROM found in biological systems is superoxide, hydrogen peroxide, hydroxyl radical and fatty acid radicals. These compounds can react with enzymes, cell membranes and deoxyribonucleic acid (DNA) causing cell damage or cell death, hence several trace minerals (as part of enzymes such as se in structure of glutathione peroxidases) and some vitamins (such as E and C) are integral components of the antioxidant system (Miller et al., 1997; Weiss et al., 1997). Several researchers have studied the effects of heat stress on oxidative status in lactating cows. Harmon et al. (1997) reported that heat stress decreased the antioxidant-activity of plasma in lactating cows.

Selenium as an essential component of selenocysteine-containing protein is involved in most aspects of cell biochemistry and function (Arthur et al., 2003).

Mean milk yield and milk composition determined from monthly samples for cows receiving supplemental inorganic selenium (as sodium selenite) and organic selenium (as selenium yeast) were greater for cows receiving organic selenium (Silvestre et al., 2007). Vitamin E is the term for a group of tocopherols and tocotrienols, of which α-tocopherol has the highest biological activity. Due to the potent antioxidant properties of tocopherols, the impact of α-tocopherol in the prevention of chronic diseases believed to be associated with oxidative stress has often been studied and beneficial effects have been demonstrated (Brigelius and Traber, 1999). Little is known about vitamin nutrition of heat stressed cows. One recent experiment evaluated injection of vitamin E (3000 IU) or placebo at the time of AI during summer breeding. Vitamin E had no effect on pregnancy rate during heat stress (pregnancy rate: 22.3% - vitamin E; 21.7% - placebo) (Ealy, 1994).

Goals of investigation

The present study was conducted to determine the effects of selenium-vitamin E, as well as the day time and night time feeding, on performance and health of Holstein dairy cows exposed to heat stress.

MATERIALS AND METHODS

Animal and treatments

The study was conducted from 5 June to 10 September, 2010 in Ferdowsi (Mashhad-Iran) University Dairy Cattle Research Unit about 999.2 m above sea level with rainfall mean of 262 mm per year in northeast of Iran. The average ranges of ambient temperature and relative humidity in stressful experimental period was 19°C (sd., 2.5) to 36.5°C (sd., 3.5) and 18.5% (sd.,6.5) to 36.5% (sd.,7.5) for minimum and maximum, respectively. The temperature-humidity index (THI) in stressful experimental period was 62.5 (sd., 0.5) to 83.90 (sd., 0.5). Twenty Holstein dairy cows (10 primiparous and 10 multiparous (86±10 days of lactation, 600±20 kg BW) were assigned randomly to 4 groups of five cows in a 2×2 factorial design.

The experimental period was 98 days; two weeks were assigned as an adaptation period. The four treatment groups, 5 cows in each, were housed in identical open sheds, with concrete strips under a roof along the feeding trough, open yards and roofs over straw bedding in the resting area. Sampling was repeated in three weeks interval. Treatments consist of 4 groups (each group consist of 5 cows) prepared by this instruction: (A) Day time feeding with intramuscular injection of selenium-vitamin E solution (DF+SevitE). B) Day time feeding with intramuscular injection of distilled water (DF-SevitE). (C) Night time feeding with intramuscular injection of selenium-vitamin E solution (NF+Se vitE). (D) Night time feeding with intramuscular injection of distilled water (NF-SevitE).

Every two weeks once, injection of selenium-vitamin E (10 ml per each cow) was performed. Selenium-vitamin E solution with selenoferol commercial name was prepared by Erfan Company in Iran and each ml from it contains 0.5 mg selenium (as sodium selenite) and 50 mg vitamin E (as dl-α-tocopheryl acetate). Day time feeding group were fed total mixed ration between 6.00 am to 6.00 pm and night time feeding group were fed between 6.00 pm to

6.00 am. Experimental diet contained, 40% forage (50:50, corn silage: alfalfa hay) and 60% concentrate. Cows were fed 5 to 10% more than their anticipated intake on an as-fed basis. Access to water was provided at all times. Ingredient and nutrient of experimental diet is shown in Table 1. All dairy cows received a ration. Diet was formulated to meet the nutrient requirements of cows producing 30 kg of 3.5% milk fat and 3% milk protein per day according to NRC (2001) recommendations.

Sampling, analysis and calculation

Feed offered and feed refused were monitored daily for each cow and averaged per week. Samples of total mixed rations (TMR) ration and orts from individual cows were collected daily. The samples of diet and ort were stored in the freezer (−20°C) until required for analyze. Weekly, composite samples of TMR and orts were analyzed for dry-matter (DM). Samples of forage and other dietary ingredients were collected once weekly and analyzed for DM. Diet ingredients and orts were dried in a 60°C forced air oven for 48 h and analyzed for DM content. Body weight was recorded triweekly on 2 consecutive days. Dietary formulations were adjusted weekly, if necessary, to account for small changes in ingredient DM content. Samples of dried feed were ground through a Wiley Mill using a 1-mm screen (Arthur H. Thomas, Philadelphia, PA). Samples were analyzed for Ash, neutral detergent fibre (NDF), acid detergent fibre (ADF) and crude protein (CP). Ash content was determined after 5 h of oxidation at 500°C.

NDF and ADF contents were determined according to Van Soest et al. (1991). Daily feed intake for individual cows was calculated by subtracting the weekly mean of orts from the weekly mean of feed offered during that week. Milk production was recorded daily. Milk samples were collected triweekly from nine consecutive milking. Milk samples were analyzed for fat, protein, lactose, solids non-fat (SNF), total solids (TS) and urea, with milk analyzer (Foss Electric, conveyor 4000). Blood samples were collected (approximately 3 h post feeding) from a jugular vein into heparinized tubes (containing sodium heparin) biweekly. Blood was centrifuged at 3000 × g for 15 min immediately after sample collection and plasma was harvested and frozen at -20°C until required for assay.

Ruminal samples were taken through mouth using a vacuum pump (3 h after the feeding) to determine pH and NH_3- N concentrations (in 2 days consecutive). Samples were filtered through four layers of cheesecloth and pH was measured immediately by glass electrode (Metrohm, 691 models). For determination of NH_3-N, 10 ml of filtered rumen fluid were added to 10 ml of 0.2N hydrochloride (HCl) (vol/vol) and were frozen immediately at -20°C. Plasma sample were analyzed to determine glucose and albumin. Blood urea nitrogen (BUN) and cholesterol with autoanalyser apparatus (biosystem, A15, Spain). Vaginal temperatures were recorded at 3.00 pm by a thermometer digital (GLA, M700) for 4 days consecutive. Respiration rate was measured visually at 3.00 pm and was recorded as number of breaths per 30 s for 4 days consecutive.

Statistical analysis

Statistical analysis was performed using 2×2 factorial (2 levels of day time and night time feeding and 2 levels of selenium-vitamin E and no selenium-vitamin E) analysis of variance by Minitab software, version 16 (Minitab Inc., State College Pennsylvania, USA) according to General Linear Model. Mathematical model used was:

$$y_{ijk} = \mu + A_i + B_j + (AB)ij + \varepsilon_{ijk}$$

Where, y_{ijk} = observation; μ, the overall mean; A_i, the effect of night time or day time feeding; B_j, the effect of selenium-vitamin E injection or no selenium-vitamin E injection; $(AB)_{ij}$ = the effect of the interaction of night time or day time feeding with the effect of selenium-vitamin E injection or no selenium-vitamin E injection.

ε_{ijk} = random error with mean 0 and variance σ^2

The least squares means was used to calculate means and differences between least-squares means was calculated by a Duncan's test. Significance was declared at $P<0.05$. Data were analyzed for total experiment period. Effect of each treatment (such as selenium-vitamin E) alone or with other treatments (interaction effects) was analyzed. The THI was calculated according to: THI = tdb - 0.55 (1 - rH) (tdb - 58), where tdb = dry bulb temperature (°F) and rH = relative humidity expressed as a decimal value.

RESULTS

Dry matter intake

Effect of selenium-vitamin E injection, night time and day time feeding on DMI was shown in Table 2. DMI in dairy cows was affected by day time or night time feeding, as in night time feeding group the DMI (kg/weight metabolic) was significantly ($p<0.05$) higher (0.015 kg) than day time feeding group but DMI according to kg/day and kg/100 kg body weight not affected by treatments. Also DMI not affected by selenium-vitamin E injection however DMI in night time feeding with selenium-vitamin E injection was observed to be higher value than other treatments ($P>0.05$).

Milk production

Effect of selenium-vitamin E injection, night time and day time feeding on milk performance was shown in Table 3. Effect of night time or day time feeding with or without selenium-vitamin E on milk performance was insignificant, however the night time feeding with selenium-vitamin E was observed to be higher value for milk performance (except lactose) than other treatments ($P>0.05$), also the night time feeding group was observed to be higher milk yield, milk composition (except lactose) and milk persistency than day time feeding group ($P>0.05$). Selenium-vitamin E injection group was observed to be higher milk yield, milk composition (except protein) and milk persistency than no selenium-vitamin E injection group ($P>0.05$).

Blood plasma

Effect of selenium-vitamin E injection, night time and day time feeding on blood plasma was shown in Table 4. Blood plasma such as glucose, BUN, cholesterol and albumin not affected significantly by the treatments, however some parameter such as glucose and cholesterol for night

Table 1. Ingredient and nutrient of experimental diet.

Composition ingredient	Diet[1] (DM %)
Alfalfa hay[2]	20.00
corn silage[3]	20.00
Barley Grain and rolled	20.00
Corn Grain, ground and dry	18.00
Soybean, meal, solV,44%CP	8.00
Cottonseed meal, solV	7.00
Wheat bran	2.00
Beet sugar pulp and dried	3.50
Calcium carbonate	0.50
Vitamin and mineral mix[4]	0.50
Salt	0.50
Nutrients	
DM	49.85
NDF	31.50
ADF	18.90
CP	15.70
ME (Mcal/kgDM)	2.51
NEl (Mcal/kgDM)	1.58
NEg (Mcal/kgDM)	1.12

[1]All cows were fed diet according NRC2001 formulation. [2,3]Alfalfa hay and corn silage contained 89.00, 16.00, 45.00, 33.40, and 18.00, 7.00, 54.10, 34.10% DM, CP, NDF, and ADF, respectively. [3]contained 19.6% Ca, 9.6% P, 7.1% Na, 0.0% K,1.9% Mg, 0.0% S, Mn(0.20mg/kg), Zn(0.30 mg/kg), Fe(0.30 mg/kg), Se(0. 0 mg/kg), Cu(0. 03 mg/kg), I(0. 02 mg/kg),Co(0.01 mg /kg), Vit-A (500000 IU/kg), Vit-D (100000 IU/kg), Vit-E (1000 IU/kg).

Table 2. Effect of selenium-vitamin E injection, nightly and daily feeding on DMI[1].

Treatment	DMI (kg/day)	DMI (Kg/100 kg body weight)	DMI (kg/weight metabolic)
NF[2]	19.68	3.25	0.160
DF[3]	17.58	2.95	0.145
SEM	0.61	0.17	0.007
P value	0.02	0.22	0.14
SeVitE[4]	18.79	3.17	0.156
No SeVitE [5]	18.47	3.03	0.150
SEM	0.61	0.17	0.007
P value	0.70	0.56	0.59
NF+SevitE[6]	19.73	3.27	0.161
NF-SevitE[7]	19.63	3.23	0.160
DF+SevitE[8]	17.95	3.06	0.150
DF-SevitE[9]	17.20	2.83	0.140
SEM	0.81	0.24	0.01
P value	0.61	0.69	0.65

[1]All data were averaged for 4 period of sampling.[2] Nightly feeding; [3]Daily feeding; [4]Selenium-vitamin E injection;[5] No selenium-vitamin E injection; [6]Nightly feeding with selenium-vitamin E injection; [7]Nightly feeding without selenium-vitamin E injection; [8]Daily feeding with selenium-vitamin E injection; [9]Daily feeding without selenium-vitamin E injection.

time feeding group was observed to be higher than day time feeding group (P>0.05) and also the glucose and albumin for selenium-vitamin E group was observed to be higher than no selenium-vitamin E group (P>0.05). Among the treatments, BUN and cholesterol concentration for day time feeding without selenium-vitamin E, the

Table 3. Effect of selenium-vitamin E injection, nightly and daily feeding on milk performance[1].

Treatment	Milk (kg/day)	Milk persistency (%)	Fat (%)	Protein (%)	Lactose (%)	TS (%)	SNF (%)
NF[2]	21.31	82.06	3.52	3.24	4.12	11.46	7.71
DF[3]	21.17	79.88	3.42	3.15	4.19	11.28	7.65
SEM	0.79	3.55	0.12	0.05	0.07	0.19	0.07
P value	0.80	0.67	0.59	0.21	0.11	0.52	0.58
SeVitE[4]	21.83	82.46	3.55	3.18	4.35	11.51	7.72
No SeVitE[5]	20.65	76.48	3.39	3.21	4.05	11.22	7.65
SEM	0.80	3.55	0.12	0.05	0.07	0.19	0.07
P value	0.32	0.10	0.38	0.67	0.01	0.31	0.50
NF+SevitE[6]	21.64	86.37	3.61	3.24	4.36	11.65	7.80
NF-SevitE[7]	20.98	73.38	3.44	3.24	4.88	11.27	7.62
DF+SevitE[8]	21.02	84.54	3.51	3.12	4.35	11.37	7.64
DF-SevitE[9]	20.33	79.58	3.34	3.18	4.23	11.18	7.67
SEM	1.13	5.03	0.18	0.07	0.10	0.26	0.09
P value	0.66	0.45	0.99	0.60	0.09	0.72	0.33

[1]All data were averaged for 4 period of sampling. [2]Nightly feeding; [3]Daily feeding; [4]Selenium-vitamin E injection;[5] No selenium-vitamin E injection; [6]Nightly feeding with selenium-vitamin E injection; [7]Nightly feeding without selenium-vitamin E injection; [8]Daily feeding with selenium-vitamin E injection; [9]Daily feeding without selenium-vitamin E injection. Milk persistency was calculated according to: (milk yield after treatment application /milk yield before treatment application) ×100.

Table 4. Effect of selenium-vitamin E injection, nightly and daily feeding on blood plasma[1].

Treatment	BUN (mg/dl)	Glucose mg/dl)	Cholesterol (mg/dl)	Albumin (mg/dl)
NF	20.77	52.32	129.4	3.85
DF	20.77	50.80	127.3	3.86
SEM	0.55	2.08	3.47	0.09
P value	0.53	0.61	0.67	0.91
SeVitE	20.41	52.92	126.00	3.87
No SeVitE	20.62	50.21	130.7	3.84
SEM	0.55	2.09	3.47	0.09
P value	0.79	0.37	0.35	0.86
NF+SevitE	20.21	51.25	127.4	3.89
NF-SevitE	20.33	50.36	127.2	3.84
DF+SevitE	20.62	54.58	124.7	3.85
DF-SevitE	20.92	50.07	134.1	3.85
SEM	0.78	2.95	4.91	0.13
P value	0.91	0.54	0.34	0.85

[1]All data were averaged for 4 period of sampling. [2]Nightly feeding; [3]Daily feeding; [4]Selenium-vitamin E injection;[5] No selenium-vitamin E injection; [6]Nightly feeding with selenium-vitamin E injection; [7]Nightly feeding without selenium-vitamin E injection; [8]Daily feeding with selenium-vitamin E injection; [9]Daily feeding without selenium-vitamin E injection.

glucose concentration for day time feeding with selenium-vitamin E and albumin concentration for night time feeding with selenium-vitamin E was observed to be highest, respectively (P>0.05).

Rumen flood

Effect of selenium-vitamin E injection, night time and day time feeding on rumen fluids was shown in Table 5. NH3-N and pH not affected significantly by the treatments. The night time feeding group was higher in NH3-N and lesser in pH than day time feeding group (P>0.05). Also the selenium-vitamin E group had a higher pH and lesser NH3-N than no selenium-vitamin E group. The NH3-N concentration and pH for night time feeding without selenium-vitamin E and night time feeding with selenium-vitamin E was observed to be highest than other treatments,

Table 5. Effect of selenium-vitamin E injection, nightly and daily feeding on rumen fluids[1].

Treatment	NH_3-N (mg/l00 ml)	pH
NF[2]	22.52	6.51
DF[3]	22.11	6.55
SEM	0.62	0.06
P value	0.51	0.64
SeVitE[4]	21.96	6.59
No SeVitE[5]	23.67	6.47
SEM	0.62	0.06
P value	0.07	0.23
NF+SevitE[6]	22.33	6.65
NF-SevitE[7]	23.89	6.45
DF+SevitE[8]	21.59	6.52
DF-SevitE[9]	23.46	6.50
SEM	0.88	0.09
P value	0.86	0.34

[1]All data were averaged for 4 period of sampling.[2]Nightly feeding; [3]Daily feeding; [4]Selenium-vitamin E injection;[5] No selenium-vitamin E injection; [6]Nightly feeding with selenium-vitamin E injection; [7]Nightly feeding without selenium-vitamin E injection; [8]Daily feeding with selenium-vitamin E injection; [9]Daily feeding without selenium-vitamin E injection.

respectively (P>0.05).

Physiological activity

Effect of selenium-vitamin E injection, night time and day time feeding on rectal temperature and respiration rate was shown in Table 6. The respiratory rate for day time feeding group was observed to be higher than night time feeding group but unlike respiratory rate, the rectal temperature was observed to be higher for night time feeding group (P>0.05). The respiratory rate and rectal temperature was observed to be higher for day time feeding with selenium-vitamin E and day time feeding without selenium-vitamin E groups (P>0.05). Also the selenium-vitamin E group was observed to be higher rectal temperature and less respiratory rate than no selenium-vitamin E group (P>0.05).

DISCUSSION

There have been several extensive reviews of nutritional management for the lactating dairy cow in hot climates (Beede and Collier, 1986; Sanchez et al., 1994; West, 1998). There are several key areas of nutritional management which should be considered during hot weather. These include reformulation to account for reduced DMI, greater nutrient requirements during hot weather, dietary heat increment and avoiding nutrient excesses. Though the NRC (2001) did not consider the effects of heat stress on the nutritional requirements of dairy cattle there is extensive literature that demonstrates that nutrient requirements for cattle should be modified during hot weather. Voluntary DMI can decrease by 50% in heat stress (West, 2003). Milk production, milk composition and milk persistency not effected by treatment but the values for night time feeding with selenium-vitamin E was observed to be higher (except of lactose) than other treatments and much of the decrease in milk production observed during heat stress can be attributed to the decreased DMI. Igono et al. (1992) reported that despite high ambient temperatures during the day a cool period of less than 21°C for 3 to 6 h will minimize the decline in milk yield.

At the same time DMI or nutrient intake is decreasing, nutrient requirements for active cooling processes like panting are increasing. Also, blood flow to internal organs like the mammary gland is reduced delivering fewer nutrients to these organs for metabolism. Thus, fewer nutrients are available and used for milk production during heat stress. No significant differences in milk fat and protein concentrations were observed from day time feeding and night time feeding cows. Aharoni et al. (2002) and Barash et al. (2001) were able to detect heat-load depression effects on milk fat and protein concentrations by analyzing large-scale databases obtained from test days of many cows in many herds over a period of several years. The transfer of part of the intake of high-yielding dairy cows in summer conditions from day to night hours resulted in a decline of energy expenditure by these cows during the hot daytime hours, with no compensation for this decline during night hours (Aharoni et al., 2004). In this experiment amount of milk production and DMI was higher for night time feeding and it seems that cows had been in better physiologic condition. Also it shown that selenium-vitamin E has an antioxidant characteristics for preventing of free radicals

Table 6. Effect of selenium-vitamin E injection, nightly and daily feeding on rectal Temperature and respiration rate[1].

Treatment	Respiration rate (breaths/30 s)	Rectal temperature (°C)
NF[2]	31.23	38.91
DF[3]	41.63	38.83
SEM	0.52	0.04
P value	0.75	0.25
SeVitE[4]	23.12	38.88
No SeVitE [5]	23.95	38.85
SEM	0.52	0.04
P value	0.29	0.65
NF+SevitE[6]	23.88	38.87
NF-Sevit[7]	22.94	38.79
DF+SevitE[8]	24.01	38.90
DF-SevitE[9]	23.30	38.92
SEM	0.74	0.06
P value	0.87	0.41

[1]All data were averaged for 4 period of sampling. [2]Nightly feeding; [3]Daily feeding; [4]Selenium-vitamin E injection;[5] No selenium-vitamin E injection; [6]Nightly feeding with selenium-vitamin E injection; [7]Nightly feeding without selenium-vitamin E injection; [8]Daily feeding with selenium-vitamin E injection; [9]Daily feeding without selenium-vitamin E injection.

action in tissue (Hogan et al., 1990; Miller et al., 1997) so these antioxidants are good function in reducing of heat stress. Estimated milk yield reduction was 0.32 kg per unit increase in THI (Ingraham, 1979), and milk yield and total digestible nutrients (TDN) intake declined by 1.8 and 1.4 kg for each 0.55°C increase in rectal temperature (Johnson et al., 1963). Rectal temperature and respiratory rate in this experiment was not affected by treatment that agreed with Her et al. (1988) results. Cows in a shaded versus no shade environment had lower rectal temperatures (38.9 and 39.4°C) and reduced respiratory rate (54 and 82 breaths/min), and yielded 10% more milk when shaded (Roman-Ponce et al., 1977). In order to avoid confounding effects, psychological stress must be minimized when studying the effects of high temperatures simulated in climatic chambers on the animal physiology. Blood plasma parameters (such as glucose, albumin, cholesterol and BUN) in the animals subjected to the experiments can give information about their psychological state, which can affect the interpretation of experimental results. Psychological stress can alter blood plasma parameter (for example increase or decrease as abnormal) when psychological stress is kept at minimum, physiological reactions and endocrine changes are mostly related to the intensity of the thermal stress and the heat tolerance of the animals.

Numerous physiologic changes occur in the digestive system, acid-base chemistry and blood parameter during hot weather, in this experiment the differences between treatments for blood plasma parameter was insignificant, however Cabello and Wrutniak (1989) was shown that some parameter (such as T3) have been affected by heat stress. In the other hand all estimated blood plasma parameters in this experiment had a normal range. During hot weather, declining DMI and high lactation demand requires increased dietary mineral concentration. However, alterations in mineral metabolism also affect the electrolyte status of the cow during hot weather. Feeding diets that have a sufficient dietary minerals (such as calcium, sodium, selenium and etcetera) improved DMI and milk yield.

Conclusion

Extended periods of high ambient temperature compromise the ability of the lactating dairy cow to dissipate excess body heat. Cows with elevated body temperature exhibit lower DMI and milk yield and produce milk with lower efficiency, reducing profitability for dairy farms in hot climates. The occurrence of heat stress can be determined by the monitoring of weather conditions and by measuring some parameters in dairy cows, especially rectal temperature and respiration rate. The heat stress increases maintenance energy requirements and lowers dry matter intake, making it difficult to meet energy needs. Therefore, feeding management and composition of feed become important. Also developing nutritional strategies which support yield but which also address metabolic and physiologic disturbances induced by heat strain will help the cow to maintain a more normal metabolism which should enhance performance. The most effective feeding management strategy to minimize production losses during heat stress periods is to provide a cool, comfortable environment by shading, sprinkling and/or forced air flow. Feed rations should be changed gradually, and sufficient space for feeding should be provided.

Maybe night time feeding and application of vitamin-mineral such as selenium-vitamin E and appropriate housing facilities for dairy cows are of significant importance for production maintenance. Results obtained in this study suggested that application of night time feeding with selenium-vitamin E can help to improve dairy cow productivity under heat tress condition.

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