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Effect of Heat Stress on Production and Chemical Composition of Milk in Kundhi Buffaloes

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ABSTRACT

The present study determined the effect of severe and lesser severe periods of heat stress on production and chemical composition of milk in Kundhi buffalos in the environment of Tandojam. For this total ten (10) buffaloes of third mid lactation period were selected and divided into two groups A and B, with five buffaloes in each group. Group A was studied in the severe period of heat stress whereas Group B was observed for a lesser severe period of heat stress in the Department of Livestock Management, Sindh Agriculture University, Tandojam. The data indicates that significantly higher milk production (7.56±0.30 liters) was recorded for group B in comparison to group A (5.35±0.20 liters). Higher moisture content in milk (83.84±0.21%) was recorded for group A in comparison to group B (83.26±0.18%). Slightly higher total solid content (16.74±0.18%) was recorded for group B in comparison to group A (16.15±0.21%). Higher ash content (0.76±0.06%) was recorded for group A in comparison to group B (0.50±0.10%). Higher fat content (4.88±0.14%) was recorded for group B in comparison to group A (6.40±0.13%). Higher protein content (4.65±0.10%) was recorded for group B in comparison of group A (4.34±1.16%). Higher lactose content (5.19±0.18%) was recorded for group B in comparison to group A (4.48±0.16%). The results for physiological parameters showed that significantly higher results were found for respiration rate, body temperature, and pulse rate breaths/minute in group A having severe heat stress as compared to group B with lesser heat stress of Kundhi buffalos The results. concluded that Kundhi buffalo produce more milk production during cold or lesser heat periods, while during severe heat periods the production of milk is considerably reduced.

Keywords: Buffaloes; Chemical compositions; Heat stress; Kundhi; Milk production

INTRODUCTION

In the economy of Pakistan, Livestock plays a crucial role, it contributes 58.92% in agriculture and 11.11% to GDP, recording a growth of 3.76 percent compared to 2.99 percent during the corresponding period last year (Pakistan, 2017).

Kundi and Nili-Ravi are main breeds with 10.4 and 6.7 million population, respectively in Pakistan. Non-descript population of buffaloes (cannot be any ascribed breed) is 10.13 million (37%) in Pakistan (Khan et al., 2007). Buffaloes are well appropriate to humid and hot weather with muddy terrain, but the solar radiation are fall on the buffalo, and working sunlight during hot season may produce exhibit signs.

This is because the body of buffalo absorbs excessive solar radiation due to their dark sparce, hairs, coat and skin, and they also have a less effective cooling evaporative system due to their less poor sweating ability. Mainly, revelation of dairy buffaloes to the latter conditions an extreme series of changes in the biological systems which include feed intake, water intake, depression, efficiency and utilization, are disturbances in metabolism of proteins, energy, water, hormonal secretions, blood metabolism, enzymatic ractions and mineral balances. Therefore such types of changes may affect growth and development, reproduction performance and milk production Heat stress may produce severe adverse effects on the production performance of reproductive dairy buffalos and cattle. The dairy sector is a more susceptible to climate and global warming (Marai & Haeeb 2010).

The physciological function is also disturbed by heat stress, especially during extreme summer seasons which lead to increased temperature and the maintenance energy of buffalos. Temperature - wetness in Temperature humidity index (THI) is the common and accurate measurement unit of stress of Thermal regularization and to determine the influence of heat stress on the production of milchy animals (Pawar et al., 2013).

It has been reported that the effect of heat stress produced a negative effect on animal reproductive efficiency. The dairy sector is mainly influenced by global warming as well changes in climate such as temperature, humidity index is mainly applied to observe the level of heat stress in dairy animals. The main objective was to assess the decline in performances of reproductive traits such as service period, pregnancy rate and conception rate of dairy buffalos and cattle for an increase in Temperature Humidity Index (THI). The service period in cattle is also affected by season of calving by which cows calved, in summer season had the longest service period (Dash et al., 2016).

Mostly, during the extreme summer seasons there a many of changes in the biological functions of the animals, which include cellular changes, stress, depression, dullness, efficiency and utilization, are disturbances in metabolism of carbohydrates and proteins, energy intake, water intake, vitamins and mineral balances, hormonal secretions, enzymatic reactions in the cell, and blood metabolites. Such types of changes may produce effects on growth development, reproduction performance and milk production (Marai & Haeeb, 2010).

In recent years, climate change has been a big problem. Many factors are associated with climate changes which may lead to effects on production, reproduction, work capacity and adaptability of the animals. The animal husbandry sector depends upon the climatic conditions mainly by the temperature and humidity. The effects of environmental heat stress decrease the production of livestock resulting in consistent losses in economics. Heat stress influenced the production and performance of dairy animals in all phases of production. Therefore present study was designed to evaluate the effects of environment on the animal's ability to dissipate heat and the effect of heat stress on the production and chemical composition of Kundhi buffaloes milk.

MATERIALS AND METHODS

Experimental animals and their diets

The present study was conducted at the Department of Livestock Management and Department of Animal Products Technology, Sindh Agriculture University, Tandojam. A total of ten (10) buffaloes of third lactation of mid lactation period were selected and divided into two groups A & B each group contained five numbers of buffaloes. Group A was observed for a severe period of heat stress during the highest temperature, whereas Group-B was observed for lesser severe period during a lower heat stress period.

The buffaloes of both groups were kept under the Livestock Experimental Farm environment for the above-mentioned period and provided with Feed ad labitum three times in a day.

Milk Productivity

Milk (liters) was collected twice a day through hand milking and measured with weight balance.

Chemical analysis of milk

Moisture, TS and Ash contents of milk samples were analyzed according to the method described by Association of Official Analytical Chemists (AOAC, 2000).

The fat content (%) of buffalo milk was examined through Gerber method (James 1995).

The protein content was determined from milk samples through the method of British Standard institute (BSI, 1990).

The lactose content of the milk was observed by difference using following formula,

Lactose % = TS %-(Fat %+Protein %+Ash %)

Physiological Parameters

Respiration Rate

The respiration rate was observed twice a day by counting the movement of flank region of buffalo before milking (Mohammed et al., 2015).

Body Temperature
Body temperature was recorded twice a day through digital thermometer inserted in rectum before milking.

Pulse Rate
The pulse rate was observed twice a day by counting the movement of the pulse by pressing the tail nerve of the buffalo before milking.

Statistical Analysis
Data was evaluated through a computerized statistical package (ie) student addition of statistics (SXW) version 8.1 (copy right 2005, analytical software USA).

RESULTS
Milk production during severe and lesser heat periods
The data indicates in (Table -1) that significantly higher milk production (7.56±0.30 liters) was recorded for group B in comparison to group A (5.35±0.20 liters). The statistical analysis of the result shows a significant ($p<0.05$) difference in milk production of Kundhi buffalo among both groups.

Table-1. **Milk Production (liters) during severe and lesser heat periods (mean±SE)**

Animals	Group A (severe periods of heat stress)	Group B (lesser severe periods of heat stress)
1	5.30	7.30
2	4.95	8.10
3	6.10	8.44
4	5.44	7.10
5	5.00	6.88
Average	**5.35±0.20**	**7.56±0.30**

Moisture content (%) of milk during the severe and lesser heat periods
The data indicates in (Table-2) that higher moisture content (83.84±0.21) was recorded for group A in comparison to group B (83.26±0.18%). The statistical analysis of the result shows a non-significant ($p>0.05$) difference in moisture content of Kundhi buffalo milk among the group A and B.

Total solid content (%) in milk during the severe and lesser heat periods
The data shows in (Table -3) that slightly higher total solid content (16.74±0.18) was recorded for group B in comparison to group A (16.15±0.21). The statistical analysis of the result shows a non-significant ($p>0.05$) difference in total solid content % of Kundhi buffalo milk among groups A and B.

Table-2. **Moisture (%) during the severe and lesser heat periods (mean±SE)**

Animals	Group A (severe periods of heat stress)	Group B (lesser severe periods of heat stress)
1	84.50	83.65
2	84.10	83.34
3	83.80	83.58
4	83.52	83.07
5	83.30	82.66
Average	**83.84±0.21**	**83.26±0.18**

Table-3. **Total solid content during the severe and lesser heat periods (mean±SE).**

Animals	Group A (severe periods of heat stress)	Group B (lesser severe periods of heat stress)
1	15.5	16.35
2	15.9	16.66
3	16.2	16.42
4	16.48	16.93
5	16.7	17.34
Average	**16.15±0.21**	**16.74±0.18**

Ash content (%) in milk during the severe and lesser heat periods

The data presented in (Table-4) indicates that higher ash content (0.76±0.06) was recorded for group A in comparison to group B (0.50±0.10). The statistical analysis of the result shows non-significant ($p>0.05$) difference in ash content % of Kundhi buffalo milk among both groups.

Table-4. Ash content during the severe and lesser heat periods (mean±SE)

Animals	Group A (severe periods of heat stress)	Group B (lesser severe periods of heat stress)
1	0.81	0.51
2	0.82	0.28
3	0.79	0.36
4	0.9	0.44
5	0.51	0.91
Average	**0.76±0.06**	**0.50±0.10**

Fat content (%) during the severe and lesser heat periods

The data indicates in (Table -5) that a higher fat content (4.88±0.14%) was recorded for group B in comparison to group A (6.40±0.13%). The statistical analysis of the result shows non-significant ($p>0.05$)

difference in fat content % of Kundhi buffalo milk among both groups.

Table-5. Fat content during the severe and lesser heat periods (mean±SE)

Animals	**Group A (severe periods of heat stress)**	**Group B (lesser severe periods of heat stress)**
1	6.40	6.80
2	6.30	6.60
3	6.90	6.10
4	6.40	6.20
5	6.80	6.30
Average	**6.56±0.12**	**6.40±0.13**

Protein content (%) during the severe and lesser heat periods

The data shows in (Table-6) that higher protein content (4.65±0.10%) was recorded for group B in comparison to group A (4.34±1.16%). The statistical analysis of the result shows non-significant ($p>0.05$) difference in protein content of Kundhi buffalo milk among t groups A and B.

Table-6. Protein content during the severe and lesser heat periods (mean±SE)

Animals	**Group A (severe periods of heat stress)**	**Group B (lesser severe periods of heat stress)**
1	4.10	4.50
2	4.00	4.44
3	4.41	4.92
4	4.25	4.88
5	4.96	4.51
Average	**4.34±1.16**	**4.65±0.10**

Lactose content (%) during the severe and lesser heat periods

The data indicates in (Table-7) that significantly higher lactose content (5.19±0.18%) was recorded for group B in comparison to group A (4.48±0.16%). The statistical analysis of the result shows a significant ($p<0.05$) difference in lactose content % of Kundhi buffalo milk among both groups.

Table-7. Lactose content during the severe and lesser heat periods (mean±SE)

Animals	**Group A (severe periods of heat stress)**	**Group B (lesser severe periods of heat stress)**
1	4.19	4.54
2	4.78	5.34
3	4.10	5.04
4	4.93	5.41
5	4.43	5.62
Average	**4.48±0.16**	**5.19±0.18**

Respiration rate (breaths/minute), Body temperature (0F), and Pulse rate during the severe and lesser heat periods

The recorded data shown in (Table- 8) indicates that a significantly higher respiration rate (49.64±1.01 breaths/minute) was recorded for group A in comparison to group B (43.76±0.86 breaths/minute). The significantly higher body temperature (102.42±0.29 ^{0}C) was recorded for pulse rate of Kundhi buffalo among groups A and B.

DISCUSSIONS

The present study was conducted to observe influence of environmental variation on the milk production of Kundhi buffalo reared under severe and lesser severe periods of heat stress. The findings of our study showed that milk was observed to lower during severe heat periods, while the production of milk was observed higher during lesser heat periods or cold. The production of animals can be influenced by environment on productive traits has been mainly reported. The findings of our study were similar to those (Reyes et al., 2000) who reported that in water buffalo milk production winter seasons were increased in that seasons as compared to summer season. In the due purpose breed milk yield and reproductive traits are key traits in livestock animals, because they have direct effect on productivity and profitability. The present study is also in agreement with (Lateef et al., 2008). Subtropical areas of regions affect the production of dairy animals, because there is no awareness program for animal healths, which may lead to an effect on reproductive performance including breeding programs and vaccinations. It can be improved by giving artificial environments that may lead to an increase in the production of milk as well as reproductive performance.

In the present study results for milk production and its composition including proteins content, lactose content, moisture content, and total solid ash content, were recorded higher in animals that were kept at low temperature levels as compared to hot temperature, similar statements have been reported by various authors. Heat stress also reduces the productive efficiency of the dairy. (Ahmad et al., 2013) it was also recorded that low-medium temperature were also effective on the dairy animals for constant milk production, slight elevation of temperature may lead to decreases in the production efficiency in dairy animals (Ahmad et al., 2013) was reported that other factors including water intake. feed intake, body weight, metabolism in the body, reproductive performance and milk production are the factors that influence the body temperature of lactating cows. argued that lactation curve is directly related to heat

stress length, the milk production increases as the temperature increases and milk production simultaneously drops when the temperature (De la Cruz-Cruz, et al., 2014) stated that temperature-humidity index is significantly correlated with milk production. It was noticed that milk yield dropped when THI elevated up to 69. On the other hand, our findings were also agreed with (Lateef et al., 2008). That temperature fluctuation may decrease the productivity efficacy of dairy animals. The rainy season in the summer may produce a positive effect on the milk and reproduction of the animals and also changes in the behavior of the animals.

Medhammar et al., 2012 reported that heat stress diminished the physio-chemical properties of milk, particularly somatic cell counts and mastitis frequencies. (Aharoni et al., 2002), argued that 38.4-39.10C body temperature was beneficial for effective milk production. De la Cruz-Cruz et al., (2014) argued that ambient temperature greater than 250C influenced the metabolic rate, feed intake and ultimately milk production. Similar findings are reported by (Younas et al., 2018).

In our present study, different physiological parameters such as respiratory rate, temperature, and pulse rate were influenced by temperature variation as the researcher reported physiological parameters. These results are consistent with (Chakravarty, 2013), who reported that skin and rectal temperature are increased due to heat stress. The main reason for the difference between our present results and theirs as a possible response of skin and rectal temperature against the heat stress might be due to using different experimental conditions like breed and age of the animals. The present results were also in line with (Medhammar et al., 2012), who reported that due to the summer season, heat stress respiration rate can be elevated. the respiration level is higher as compared to winter seasons when a high load effect of temperature and relative humidity, the rate of respiration is further increased. This was also related to an increase in the perception of warmth (Younas et al., 2018). The pulse rate reflects primarily the homeostasis of circulation along with the general metabolic status. High environmental temperature increased the rate of exposure (Ahmad et al., 2013). The pulse rate was also significantly higher in the winter seasons.

CONCLUSIONS

It was concluded from present study that Kundhi buffalo produce higher milk yield during lesser heat periods while during severe heat stress periods the quantity of milk is considerably declined. The moisture, total solid, ash, fat, protein and lactose content significantly improved in lesser severe periods of heat stress, whereas, respiration rate, body temperature, and Pulse rate also maintain in in lesser severe periods of heat stress, during the severe and lesser heat periods.

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