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Effect of Seasons x Meteorological Variables on Normal Milk Constituents in Marathwadi Buffaloes

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A B S T R A C T

The aim of the study was to evaluate the effect of environmental variables and different seasons onnormal milk constituents in Marathwadi buffalo. The milk samples were collected from Marathwadi buffaloes(*n*=6) fortnightly while, environmental variables i.e., dry bulb temperature (DbT), wet bulb temperature (WbT), wind speed (WS) and solar intensity (LUX) were recorded at a weekly interval (at 14:00 hrs). Non-significant (P>0.05) variation was observed in milk constituents (fat, protein, SNF, lactose and salt) in summer, winter & monsoon seasons. Similarly, different environmental variables had no effect on milk constituents during different seasons. Whereas, significantly (P<0.01) positive correlation was observed between protein and SNF (*r*=.986), lactose and SNF (*r*=.993), salt and SNF (*r*=.898), lactose and protein (*r*=.984), salt and protein (*r*=.901) and salt and lactose (*r*=.901), respectively during the study.Therefore, it can be concluded that native breeds have better adaptability to environmental conditions, which is reflected by optimum production and lack of variation in milk constituents in marathwadi buffaloes during different seasons.

Introduction

Climate change, defined as the long-term misbalance of weather conditions such as temperature, wind and rainfall characteristics of a specific region, is likely to be one of the main challenges that mankind faces during the present century and coming times. Milk protein contains more essential amino acids of high bioavailability, than any other natural food. Solid not fat (SNF) includes non-fatty constituents of milk like protein, minerals and other minor milk constituents. Total solids in milk are the function of different milk constituents. The sum of all the milk constituents measured in percentage result in total solids percentage in milk (Bahiram *et al.*, 2020). When nutritive value of milk protein and other non-fatty constituents especially calcium and vitamins are concerned, SNF content has its own importance.

Indigenous animals are comparatively less affected by heat stress, due to their natural genetic selection. But prolonged high temperatures and humidity constantly challenge the thermoregulation and homeostasis, increasing the energy demands. Thus, less energy is available for productive purposes, leading to decrease in milk production and variation in constituents (Wankar *et al.*, 2020). However, the effects of heat stress have proven to be a great hindrance to their production and optimum productivity in buffaloes and hence require special housing, nutritional or managemental adoptions. The buffalo housing

should be well ventilated, protected from cold and hot weather (Garkal *et al.,* 2014). Keeping this in view, the present study was panned to evaluate the effect of meteorological variables during different seasons on normal milk constituents in marathwadi buffalo.

Materials and Methods

The study was carried on six Marathwadi buffaloes (Age > 4 yrs; Body weight >390 kg) at livestock farm complex (LFC), College of Veterinary & Animal Sciences (MAFSU), Parbhani. All the animals were allowed to graze daily (two hours) after which they were stall fed, milked twice and kept under identical managemental and feeding conditions, with ad libitum water throughout the experiment. The experimental design and procedures were approved by institutional animal ethics committee and were followed stringently throughout the experiment. The data was collected in three seasons (summer, winter and monsoon). According to Kekan *et al*., (2016) the climate of Marathwada region in wet monsoon (weeks 23 - 44, 4th June - 4th Nov) period alternates with long rain free cold winter (weeks 45 - 9, 5th Nov - 4th March). While in summers maximum temperature ranges between 40–45°C (weeks 10–22, 5th March - 3rd June).

Milk samples (50 ml) were collected in sterile sample vials at fortnight's interval from all the animals in morning and analyzed within two hours on automatic milk analyzer (Lactosure, Eco model). While, meteorological variables *viz*. dry bulb temperature (DbT), wet bulb temperature (WbT), wind speed(WS) and solar radiations (LUX)were recorded near the animal shed, every week at 14.00 hrs throughout the experiment.

Dry bulb (^{o}C), wet bulb temperature (^{o}C) and wind speed (M/sec) were recorded by using fully automatic anemometer (Testo India Pvt Ltd) till maximum readings were reached within one minute. Similarly, solar intensity (LUX) was recorded by using luxmeter (Testo India Pvt Ltd) till maximum reading was achieved. The temperature humidity index (THI) was calculated by using the formula of McDowell (1972).

$$THI = 0.72 (DbT + WbT) + 40.6$$

Where,

THI=Temperature humidity index
DbT=Dry bulb temperature
WbT=Wet bulb temperature

Statistical analysis

Data for milk constituents were analyzed by the by one-way analysis of variance (ANOVA) model using SPSS 20.00 software and reported standard error of means (SEM). Correlation between temperature, THI, wind speed, solar radiations and milk constituents were estimated by *Pearson's correlation* and indicated by *r* value. Significance was declared at *P<0.05.

Results and Discussion

The mean values of milk constituent's% (fat, solid not fat, protein, lactose and salt) during different seasons are presented in Table 1.It is observed that, fat % was non significantly higher in monsoon, whereas, SNF %, protein %, lactose % and salt % were non-significantly higher in winter season as compared to summer and monsoon. Fat % was higher in monsoon and lower in winter but the difference was non-significant. According to Haque *et al.,* (2017) and Cinar *et al.,* (2015), seasons can alter buffalo milk fat % as there is alteration in nutrient utilization and assimilation during summer season. Fat value variations are expected, as it is the most sensitive milk component to a variety of factors, such as food management, genotype, nutrition, lactation, calving phase and parity (Macedo *et al.,* 2001). Although, the variation for milk fat % was not significant, it still reflects the seasonal influence in buffaloes in accordance with the past research.

SNF % were non-significantly (P>0.05) higher in winter and lower in monsoon as compared to summer season. The mean values obtained in the present study in all the seasons are in close agreement with Sodi *et al.,* (2008) and Balusami (2015), reported in Murrah buffaloes. Cheruiyot *et al.,* (2018) stated that the month of sampling had a significant effect on the content of milk SNF %

and Haque *et al.*, (2017) reported milk SNF to be significantly higher during winter season as compared to hot dry and hot humid seasons which supports the present findings. Harris and Bachman (2002) and Mushtaq (2009) opined that milk SNF content also varies with the quality and quantity of the feed. In their study, reducing the concentrate ration below requirements or increasing the roughage and concentrate resulted in decrease and increase, respectively in SNF % in high yielding cows. Further, the changes that occur in SNF may be primarily attributed to changes in the protein and occasionally to the lactose content of milk.

Table.1 Normal milk constituents in Marathwadi Buffalo during different seasons i.e. winter, summer and monsoon

Season	Fat %	SNF %	Protein %	Lactose %	Salt %
Winter	5.86	9.25	3.34	5.05	0.70
Summer	6.43	9.17	3.32	5.00	0.70
Monsoon	6.54	9.04	3.27	4.93	0.69
SEM	0.15	0.83	0.30	0.04	0.06
P	0.14	0.59	0.63	0.54	0.00

*****SNF=solid not fat; **Superscripts $^{a, b, c}$ indicates significant difference at P < 0.05 level within column

Table 2. Correlation between milk constituents and environmental variables in Marathwadi Buffaloes

	DbT	WbT	WS	LUX	THI	Fat	SNF	Protein	Lactose	Salt
DbT	1									
WbT	.207	1								
WS	.088	-.261	1							
LUX	.501**	-.003	.218	1						
THI	.814**	.737**	-.094	.345*	1					
Fat	-.055	.205	-.290	.014	.083	1				
SNF	-.014	.072	-.191	.023	.033	.262*	1			
Protein	-.015	.077	-.201	.023	.036	.253*	.986**	1		
Lactose	-.001	.078	-.192	.039	.045	.267**	.993**	.984**	1	
Salt	-.032	.088	-.130	.026	.030	.215*	.898**	.901**	.901**	1

* Correlation is significant at P<0.05 level, ** Correlation is significant at P<0.01 level

Table.3 Environmental variables during three seasons

Season	DbT (^{o}C)	WbT (^{o}C)	WS(M/sec)	SI (LUX)	THI
Winter	31.87^{a}	21.93^{a}	1.86^{b}	56218.66	79.33^{a}
Summer	36.18^{b}	25.47^{b}	1.29^{ab}	60450.00	84.98^{b}
Monsoon	31.11^{a}	25.85^{b}	0.80^{a}	47728.50	81.61^{a}
SEM	0.54	0.47	0.13	3103.61	0.57
P	0.00	0.00	0.00	0.23	0.00

*Superscripts $^{a, b, c}$ indicates significant difference at P < 0.05 level within column

DbT=dry bulb temperature, WbT=wet bulb temperature, WS=wind speed, SI=solar intensity, THI=temperature humidity index

The mean values of protein % did not differed (P>0.05) in all the seasons. Our values for milk protein are similar to those reported by Pawar *et al.*, (2013) and Cinar *et al.*, (2019). The milk protein concentration shows comparatively high heritability and its quantity in milk is virtually almost constant (Meena *et al.*, 2007). The protein content in buffalo milk is normally around 2.7 –

5.2% (Claeys *et al.*, 2014; Patbandha *et al.*, 2015) which correlates well with the average value for the milk samples analyzed in the present study.

The mean values of lactose % were non-significantly higher in winter and summer as compared to monsoon season. The values observed for lactose % in the present study are in accordance with findings reported by Sales et al (2018) and Zhou et al (2018) in buffaloes. There is close relationship between lactose synthesis and the amount of water drawn into milk, making lactose a stable milk component and which probably maintains secretion rates of lactose and water nearly constant throughout lactation (Pollott 2004).

The salt % remained stable in summer, winter and monsoon during the study. Similar observation were reported by Wankar *et al.*, (2020) in marathwadi buffaloes and red kandhari cows. They further stated that the process of acclimation and acclimatization to heat stress utilizes both short term and long-term metabolic alterations to maintain electrolyte balance. Animals affected by thermal stress have negative mineral balance as these minerals are lost in sweat and other body fluids.

Correlation between milk constituents and environmental variables are presented in Table 2. Among the environmental variables (THI, wind speed, solar intensity) and milk constituents no notable correlation were recorded in the present study. But highly significant ($P<0.01$) positive correlation was observed between protein and SNF (r=.986), lactose and SNF (r=.993), salt and SNF (r=.898) lactose and protein (r=.984), salt and protein (r=.901) and salt and lactose (r=.901). Bharucha (2019) reported non-significant positive correlation for milk fat and SNF. Whereas, milk proteins and lactose concentrations were also non significantly but negatively correlated with each other, which is contradictory to the findings of the present study.

The environmental variables (DbT, WbT, wind speed, solar intensity and THI) during three seasons are presented in Table 3. It is observed that, the mean WbT and wind speed were significantly ($P<0.05$) higher in monsoon and winter, respectively. Whereas, DbT temperature, solar intensity and THI were significantly ($P<0.05$) higher in summer season as compared to other seasons. Although the DbT temperature and THI during summer was highest (84.98) as compare to winter (79.33) and monsoon (81.61) but it was still moderate. This might be the reason for non significant variation in milk constituents during our study. Also the native animals are very well adapted to local conditions and spend minimum comparatively lesser energy for thermoregulation. Although, there were variation in DbT, WS and THI amongst different seasons, it failed to evoke any measurable stress, which resulted into lack of difference for various milk constituents in Marathwadi buffaloes.

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