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Body Condition Scoring and Serum Metabolic Profiles *vis-a-vis* Parity in Postpartum Surti Buffaloes

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ABSTRACT

Background: Lactating animals tend to lose body tissue reserves in support of lactation and move into a negative energy balance that leads to a higher incidence of metabolic disorders and compromised productive performance. Despite several efforts to assess the influence of parity on BCS and metabolic profiles in postpartum buffaloes, systematic information is less. The current study was conducted to evaluate the effect of parity on metabolic profile and changes in BCS in postpartum Surti buffaloes.

Methods: In the present study conducted from September-2017 to May-2018, fourteen postpartum Surti buffaloes were selected and grouped based on parity as primiparous and multiparous (2nd to 5th lactation). The blood sample was collected from all the selected animals on the day of calving, 15th, 30th and 60th day post calving. Serum biochemical parameters *viz*., glucose, total protein, blood urea nitrogen (BUN), cholesterol and Non-esterified fatty acids (NEFA) were analysed. The body condition score (BCS) was assessed from the day of calving up to 60th day of the study at 15-day interval.

Result: The study revealed that the BCS was significantly higher in multiparous buffaloes as compared to primiparous group. Among biochemical parameters, glucose was significantly higher in primiparous group as compared to their multiparous counterparts. Parity did not have a significant influence on serum total protein, BUN, cholesterol and NEFA. However, NEFA was slightly higher in multiparous group of Surti buffaloes. High NEFA and low serum glucose indicated a greater degree of negative energy balance in multiparous buffaloes due to higher milk output.

Key words: BCS, Metabolic profile, Parity, Surti buffaloes.

INTRODUCTION

Metabolic profile testing is an important tool to assess the nutritional and physiological status of dairy animals and it is the prerequisite for diagnosing many pathophysiological and metabolic disorders. Blood profiles have been used to find any dietary imbalances even before the productivity is impaired (Farouk, 2012). Constant monitoring of metabolic profile may help in managing and preventing deficiencies in dairy animals there by improving their welfare and productivity.

Monitoring body condition score (BCS) is a management technique used routinely to estimate the body fat reserves and energy status of the animals (Edmondson *et al*., 1989) and can be used effectively to prevent the reproductive disorders in high producing dairy herds (Bouhroum *et al*., 2013). Milk yield and reproductive disorders have a direct correlation with BCS in buffaloes (Ishaq *et al*., 2011). The BCS at calving is correlated positively with the fat corrected milk yield and milk fat, whereas the mammary health is negatively correlated (Singh *et al*., 2015).

Limited reports are available regarding blood biochemical profiles with respect to primiparous and multiparous animals. Although few attempts have been made to assess the influence of parity on BCS, the complete and systematic information is meagre. In view of the need to address the aforesaid issues in holistic manner, the present study was undertaken to critically examine the change in BCS and blood metabolites in postpartum period especially for primiparous and multiparous Surti buffaloes.

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MATERIALS AND METHODS

Experimental animals

The present study was conducted on 14 postpartum Surti buffaloes at Livestock Research Station (LRS), Navsari Agricultural University, Navsari, Gujarat from September-2017 to May-2018. The grouping of animals was done based on parity *i.e*., primiparous and multiparous (from 2nd to 5th

lactation) animals as separate group. All animals were kept under similar management practices. All the animals were regularly dewormed before and after monsoon, vaccinated against infectious diseases like Foot and Mouth Disease and Haemorrhagic Septicemia and they are annually screened for the prevalence of Tuberculosis, Johne's disease and Brucellosis.

Blood collection and metabolic profiling

Approximately 5 ml blood sample was collected from the selected animals on the day of calving, 15th, 30th and 60th day post calving. The VACUTE® containing blood samples were kept in slant position at room temperature for 1-2 hours. Finally, serum was separated by centrifugation at 1500 rpm for 15 minutes and stored in properly labelled sterilized 4.5 ml plastic cryo vials at -20$^{238}_{92}$C in deep freezer until analysis. Serum metabolites such as glucose, total protein, blood urea nitrogen (BUN), cholesterol were analysed using Diatek diagnostic kits as per the instruction provided along with kits. Non-esterified fatty acids (NEFA) concentration was analysed using Sigma-Aldrich free fatty acid quantification kit. A standard Enzyme Linked Immuno Sorbent Assay (ELISA) technique based on the principle of coupled enzyme assay was employed to measure NEFA concentration.

Body condition scoring (BCS)

The body condition score of animals in the present study was recorded as per the score card given by Edmondson *et al.* (1989) up to 60 days postpartum starting from the day of calving, at fortnight interval.

Statistical analysis

Statistical analysis of the data obtained during the course of experiment was carried out using t-test for investigating the effect of parity on different traits in the present study. The means were compared using DMRT as per standard statistical procedures (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

Body condition score (BCS)

Excessive body tissue mobilisation and negative energy balance (NEB) to support lactation are associated with increased incidence of metabolic disorders and poor reproductive performance. The results of BCS have been presented in the Fig 1. The mean BCS did not varied significantly (P>0.05) between primiparous and multiparous group on different test days though BCS was slightly higher in multiparous as compared to primiparous group. However, overall mean BCS in primiparous animals (3.31±0.04) was lower (P<0.01) as compared to multiparous animals (3.49±0.03). Similarly, Hossein-Zadeh and Akbarian (2015) reported that BCS was low in first parity, increases up to third lactation and decreases thereafter. Chacha *et al.* (2018) also reported significantly (P<0.05) higher BCS in multiparous cows as compared to their primiparous counterparts. In contrary, Gallo *et al.* (1996) reported a slight decrease in mean BCS from first to third and later parities. Yehia *et al.* (2020) reported that parity does not have significant effect on BCS during periparturient period.

Maximum BCS was observed on the day of calving and thereafter BCS showed a declining trend up to 30th day and 60th day in primiparous and multiparous animals, respectively. Multiparous animals showed tendency more to lose BCS which might be attributed to the higher milk yield in multiparous animals and less suffering from peri-parturient stress due to previous calving experiences. Similarly, Gallo *et al.* (1996) observed a decreasing trend in BCS during early lactation. Contrarily, Meikle *et al.* (2004) reported a steeper decline in BCS in primiparous animals as compared to multiparous animals. Physiological differences in growth, production and energy utilization pattern may influence the BCS.

In primiparous group, significant correlation was not observed between BCS and metabolic profile (Supplementary Table 1). Whereas, in multiparous group of animals negative

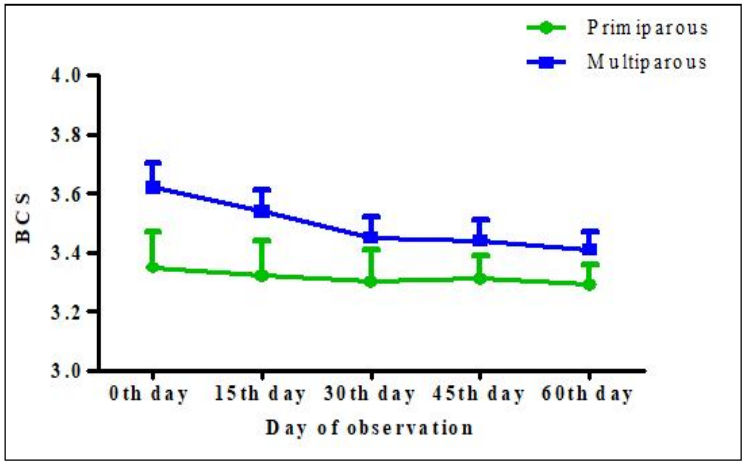

Fig 1: Body condition score (BCS) in postpartum Surti buffaloes.

correlation of BCS was observed with serum cholesterol (P<0.05) and BUN (P<0.05) (Supplementary Table 2).

Serum metabolites

Glucose (mg/dl)

Glucose is considered as an indicator of energy status in ruminants. In the present study, serum glucose concentration did not differ significantly (P>0.05) between primiparous and multiparous group on different test days (Table 1). However, overall mean glucose concentration was higher (P<0.05) in primiparous animals as compared to multiparous animals. Similarly, Kume *et al.* (2003) reported higher plasma glucose concentration in primiparous Holstein Friesian cows as compared to their multiparous counterparts. This might be attributed to large amount of blood glucose withdrawal by mammary gland for the synthesis of milk lactose as the milk production is higher in multiparous animals (White, 2015). In contrary, Chacha *et al.* (2018) and Yehia *et al.* (2020) reported that parity does not have significant (P>0.05) effect on glucose concentration, although it was higher in primiparous animals as compared to multiparous animals. Furthermore, Wu *et al.* (2019) reported non-significant difference in hormone concentration such as glucagon and insulin like growth factor-1 among lactating cows of different parities which might be the reason for parity not having significant effect on serum glucose concentration.

In the present study, serum glucose concentration did not differ significantly (P>0.05) on different test days within primiparous and multiparous group. Similarly, Khan *et al.* (2011); Abdulkareem (2013) and Fiore *et al.* (2018) reported a steady pattern of serum glucose in postpartum buffaloes. This might be due to lack of changes in the absolute rate of gluconeogenesis and glycogenolysis; and indicates an efficient glucose homeostasis during lactation. The correlation analysis revealed no significant association between glucose level and other serum metabolites and also with BCS (Supplementary Table 1, 2).

Total protein (g/dl)

The results of serum total protein have been presented in the Table 1. Serum total protein did not differ significantly (P>0.05) between primiparous and multiparous group on different test days. Overall mean total protein was slightly higher in primiparous animals as compared to multiparous animals, although it was not significant.

Supplementary Table 1: Overall BCS and serum metabolites correlation table of primiparous buffaloes.

	BCS	Glucose	Total protein	Cholesterol	BUN	NEFA
BCS	1					
Glucose	0.326	1				
Total protein	-0.031	-0.149	1			
Cholesterol	0.111	-0.279	-0.035	1		
BUN	0.100	0.068	-0.124	0.264	1	
NEFA	-0.100	-0.210	-0.083	0.095	-0.202	1

* and ** indicates significance at P<0.05 and P<0.01, respectively.

Supplementary Table 2: Overall BCS and serum metabolites correlation table of multiparous buffaloes.

	BCS	Glucose	Total protein	Cholesterol	BUN	NEFA
BCS	1					
Glucose	-0.155	1				
Total protein	0.201	0.026	1			
Cholesterol	-0.442*	0.155	-0.268	1		
BUN	-0.410*	0.049	-0.050	0.542**	1	
NEFA	0.101	0.069	0.332	-0.401*	-0.063	1

* and ** indicates significance at P<0.05 and P<0.01, respectivel

Supplementary Table 3: BCS and Serum metabolites correlation table of primiparous buffaloes on 0th day.

	BCS	Glucose	Total protein	Cholesterol	BUN	NEFA
BCS	1					
Glucose	0.505	1				
Total protein	-0.264	0.076	1			
Cholesterol	0.049	-0.348	0.264	1		
BUN	0.143	-0.444	-0.071	0.896**	1	
NEFA	0.493	0.422	-0.720	-0.360	-0.065	1

* and ** indicates significance at P<0.05 and P<0.01, respectively.

Mean total protein was almost stable throughout the experimental period in both primiparous and multiparous animals. Similarly, Abdulkareem (2013) reported a steady pattern of serum total protein up to 60 days of calving in buffaloes. Besides, Vallejo-Timarán *et al*. (2020) reported a non-significant difference in serum protein between animals of different parity. Higher serum total protein concentration in primiparous animals might have been associated with infectious processes or have had improved because of dietary intake of concentrates. Serum total protein did not show significant association with BCS and other serum metabolites in both primiparous and multiparous group of buffaloes (Supplementary Table 1, 2).

Blood urea nitrogen (BUN) (mg/dl)

Serum BUN concentration did not differ significantly between primiparous and multiparous group on different test days (Table 1). Overall mean BUN concentration was higher in primiparous animals as compared to multiparous animals, although it was not significant. Serum BUN concentration varied (P<0.01) on different test days and it showed an increasing trend till the end of experiment in both primiparous and multiparous group. Similarly, Serdaru *et al.* (2011) reported that serum urea was influenced by days in milk and the diet. This might be due to higher protein intake associated with practice of more concentrate feeding in lactating animals. Lower value of BUN in multiparous buffaloes indicates efficient renal status as compared to primiparous buffaloes.

In primiparous animals, the level of serum BUN did not show significant association with BCS and other serum metabolites (Supplementary Table 1) except on the day of calving in which serum BUN displayed higher (P<0.01) positive correlation with cholesterol (Supplementary Table 3). Similarly in multiparous counterparts, BUN concentration showed positive association (P<0.01) with serum cholesterol and inverse relation (P<0.05) with BCS (Supplementary Table 2). Increase in mobilisation of fat reserves for milk production might be attributed to positive association of BUN with serum cholesterol and negative relation with body condition.

Cholesterol (mg/dl)

Serum cholesterol did not differ significantly between primiparous and multiparous animals on different test days (Table 1). Overall mean cholesterol was lower in primiparous animals as compared to multiparous animals; however, it was not significant. Similarly, Folnozic *et al.* (2016) reported that parity does not have significant effect on total cholesterol in dairy cows. In contrary, Chacha *et al.* (2018) reported a higher cholesterol concentration in primiparous animals as compared to multiparous animals; however, it was not significant.

On different test days of observation serum cholesterol did not differ significantly within primiparous group. Similar result was also reported by Abdulkareem (2013). However, in multiparous group serum cholesterol exhibited an increasing trend up to the end of experiment. Lower cholesterol concentration in initial days of lactation might be due to increase in energy requirement for milk production and increasing trend with advancement of lactation might be a physiological adaptation to meet the lactation requirements. Increasing trend in blood cholesterol also well associated with decreasing trend in BCS *i.e*., reserve fat of body dissolved to increase serum cholesterol.

Non-esterified fatty acids (NEFA) (µmol/l)

In the present study, serum NEFA concentration did not differ significantly between primiparous and multiparous animals (Table 1). Overall serum NEFA concentration was lower in primiparous animals as compared to their multiparous counterparts, although it was not significant. The values obtained in current study were lower as compared to values reported by Khan *et al.* (2011) in Murrah buffaloes. This might be due to lesser degree of negative energy balance in Surti buffaloes related to their low milk production as compared to Murrah buffaloes. The higher NEFA concentration in multiparous animals might be linked to their greater degree of negative energy balance due to high milk production as compared to primiparous animals. Similarly, Folnozic *et al.* (2016) reported that parity does not have significant (P>0.05) effect on serum NEFA concentration in dairy cows. In contrary, Verdurico *et al*. (2015) reported higher concentration of NEFA in both pre-partum and postpartum period in multiparous buffaloes as compared to primiparous buffaloes; whereas, Yehia *et al.* (2020) reported higher NEFA concentration in primiparous cows attributed to notable negative energy balance in primiparous animals due to their higher requirement for growth, fetal development and milk production.

Test day of observation did not have significant effect on serum NEFA concentration within primiparous group. However, in multiparous group serum NEFA concentration on the day of calving was higher (P<0.05) as compared to NEFA concentration on 15th and 60th day postpartum owing to more NEB during initial days of lactation. The serum NEFA concentration showed inverse relation with cholesterol

Table 1: Effect of parity and test day on metabolic profile of postpartum Surti buffaloes.

Biochemical parameter	Primiparous (n=7)	Multiparous (n=7)	Overall (n=14)	't' value
Serum glucose (mg/dl)	35.70±2.05	30.48±1.36	33.09±1.26	2.128*
Total protein (g/dl)	8.03±0.55	7.85±0.40	7.94±0.34	0.261
BUN (mg/dl)	18.29±0.69	17.51±0.68	17.90±0.48	0.805
Cholesterol (mg/dl)	83.95±4.33	97.34±5.23	90.65±3.48	-1.974
NEFA (µmol/l)	161.63±7.99	176.13±7.45	168.88±5.50	-1.327

Table 2: Milk yield (kg) in primiparous and multiparous Surti buffaloes.

Group	Total milk yield (kg)	Average milk yield (kg/day)
Primiparous	204.8±15.14	2.56±0.19
Multiparous	294.23±17.77	3.68±0.22
Overall	249.51±16.72	3.12±0.21
't' value	-3.831**	-3.848**

* and ** indicates significance at P<0.05 and P<0.01, respectively.

concentration in multiparous animals highlighting the catabolism of body fat reserve to produce energy during initial lactation (Supplementary Table 2).

Milk yield (kg)

The total milk yield up to 80 days postpartum and average daily milk yield calculated for 80 days postpartum was found to be higher (P<0.01) in multiparous buffaloes as compared to their primiparous counterparts (Table 2). Similarly, Yadav *et al.* (2013) also reported significantly (P<0.05) lower daily milk yield in first parity as compared to other parities. Besides, 305 days milk yield was lower (P<0.05) in primiparous Murrah buffaloes as compared to other parities (Sundaram and Harharan, 2013).

CONCLUSION

From the present findings it can be concluded that the BCS was significantly affected by the parity as the overall BCS was lower in primiparous Surti buffaloes as compared to their multiparous counterparts. In both primiparous and multiparous group of buffaloes BCS showed a steady declining trend during initial days of postpartum period. Serum biochemical parameters like total protein, BUN, cholesterol and NEFA were not affected by the parity in postpartum Surti buffaloes; however, overall serum glucose concentration was significantly higher in primiparous group as compared to multiparous group of buffaloes. Though serum NEFA concentration was significantly not affected by the parity, it was higher in multiparous group during initial days and showed a declining trend which might be attributed to their productive performances. The results obtained in the present investigation can be utilized for proper nutritional management of primiparous and multiparous animals to have optimum BCS during postpartum period to avoid metabolic disorders and to optimise their production.

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Conflict of interest

The authors declare no conflict of interest.

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