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Effects of shortened dry period on the physical indicators of energy reserves mobilization in high yielding Murrah buffaloes

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ABSTRACT

The aim of the study was to investigate the physical indicators of energy reserves mobilization (ERM) *viz.*, Body weight (BW), Body Condition Score (BCS), altered BW percentage (ABWP) and altered BCS percentage (ABCSP) levels in forty eight dairy buffaloes allotted to three dry period lengths (60 or > 60d; 46 to 60 d; and 30 to 45 d). Hybrid Napier and paddy straw, used as roughage, were supplied together with concentrate mixture; and the buffaloes were fed individually according to their requirements. The mean body weights of the group I, II and III buffaloes were 549.41 ± 4.36, 597.97 ± 6.20, and 584.54 ± 3.84, respectively. The BW, BCS, ABWP, and ABCSP levels were influenced by length of dry period, as well as pre and postpartum periods of the entire experimental study. The BW (kg) and BCS showed an increasing ($P<0.01$) trend from the day of drying to calving with highest ($P<0.05$) ABWP and ABCSP in traditional dry period group compared to shortened dry periods. Subsequently, the BW and BCS showed a decreasing trend ($P<0.01$) from calving to 90 days postpartum with highest ($P<0.05$) decrease of ABWP and ABCSP in group I. Further, 6% Fat corrected milk (FCM) production had a negative significant ($P<0.01$) correlation with BCS at 30d postpartum, followed by positive ($P<0.05$) correlation with BCS and BW at 60 or 90 d postpartum.

Key words: Body condition score, Body weight, Energy reserves mobilization, Shortened dry period.

INTRODUCTION

Transition period in dairy animals is the most critical period in dairy animal's life cycle, with highest incidence of metabolic diseases and infections. The dramatic increase of energy requirement after calving for milk production in high-yielding dairy animals and insufficient dry matter intake (DMI) at the same time lead to a well-described negative energy balance, especially in early lactation (Drackley *et al*., 2001). As BW, BCS, ABWP, and ABCSP factors are more readily affected by body energy reserves, and because of their easily calculated complexion, they can be considered as direct indicators of ERM. Gerloff (2000) reported that the loss of Body weight or BCS during early lactation in healthy dairy animals is inevitable, although the ingested nutrients and mobilized endogenous energy meets the energy demands of lactation. The weekly milk yield and fat percent are positively correlated to either BW (Yilmaz *et al*., 2016) or BCS (Mashalji *et al*., 2016). The BCS is a more reliable parameter than BW to know the energy reserves, as it reflects the subcutaneous fat in dairy animals. Further, BCS can be considered as an important management tool for maximizing milk production and reproductive efficiency accompanied by the reduced incidence of metabolic and other pre-partum diseases.

Several researchers noticed improved BCS, BW and mean negative energy balance in cows with either short (Pezeshki *et al.*, 2008; Watters *et al*., 2008) or completely omitted dry periods (Andersen *et al*., 2005; Rastani *et al*., 2005) in dairy cows. On the contrary, decreased dry period length to less than 40 d often show negative effects on the energy balance leading to decreased milk yield during the subsequent lactation (Watters *et al*., 2008), thus counteracting the potential benefits of a short dry period. Moreover, almost all of the works conducted on physical indicators of ERM are primarily geared towards high yielding cattle. A total 57% of the world's Buffalo population resides in India, and it was hypothesized that Indian coastal region is dominated by buffaloes over other livestock species, as they are more able to tolerate high humid climatic condition characterizing the region (Raju *et al*., 2017). Considering the fact that buffalo production holds a predominant role in Indian rural economy, a work has been carried out in high yielding Murrah buffaloes with an objective to investigate the consequences of either a traditional or a shortened dry period length on

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the physical indicators of ERM during the early lactation period.

MATERIALS AND METHODS

Forty eight multi-parous Murrah buffaloes in dry periods were selected from organized private buffalo farms located at Veeravalli village, Krishna District, Andhra Pradesh state and assigned to a completely randomized design with three dry period lengths viz., pre-partum period of 60 or more than 60 d (n=16); 46 to 60 d (n=16); and 30 to 45 d (n=16). They were blocked by parity, previous 305 days milk yield, and the expected dates of calving. The buffaloes were fed individually with concentrate mixture (1 kg for maintenance, 1 kg for 2 kg milk production, and 1.5 kg in last 30 days pregnancy to meet the fetus requirements) along with *adlibitum* Hybrid Napier, and 4 kg paddy straw. The ingredients and nutrient composition of the diet fed are presented in Table 1 and 2, respectively.

Proximate analysis was done as per the AOAC (2007), and forage fibre fractions according to Vansoest *et al*. (1991). The 6% FCM was calculated using the formula (Rice *et al*., 1970);

6% FCM = 0.308 x Total Milk Yield +11.54 x Total Fat Yield (kg).

BW and BCS of Murrah buffaloes were determined at the time of dry off, 30 d before the expected calving, at the time of calving and 30, 60 and 90 d postpartum as per Sastry *et al.* (1983) and Anitha *et al.* (2010), respectively.

Table1: Ingredient composition of the Concentrate mixture prepared.

Ingredient	Percentage
Maize	33.25
Deoiled Rice Bran	34.00
Soybean meal	18.75
Sunflower cake	10.00
Urea	1.00
Mineral mixture	2.00
Salt	1.00
Sub Total	**100.00**

Table 2: Nutrient composition of the diets fed throughout the experimental period.

Nutrient*	Hybrid Napier	Paddy straw	Concentrate mixture
DM	25.30	90.85	90.2
CP	6.23	3.54	21.3
EE	1.84	1.65	9.14
CF	23.11	42.58	5.98
NDF	69.09	69.80	14.88
ADF	39.60	46.30	6.47
TA	13.54	19.45	5.03
AIA	3.28	2.54	0.65

*DM – Dry matter, CP – Crude Protein, EE – Ether extract, CF – Crude fiber, NDF – Neutral detergent fiber, ADF – Acid detergent fiber, TA – Total Ash, AIA – Acid insoluble ash.

Statistical analysis: The estimated data of BW, BCS, ABWP, and ABCSP levels was subjected to ANOVA (Snedecor and Cochran, 1994) using software package SPSS version 17.0, and differences in mean were assessed by using Duncan's multiple range test (Duncan, 1955). Data was analyzed for statistical correlation (two tailed test of significant) of BW, BCS and 6% FCM at 30, 60 and 90 d postpartum using Pearson coefficient.

RESULTS AND DISCUSSION

Effects of shortened dry period on body weight: The values of mean BW and ABWP of examined dairy Buffaloes are presented in Table 3 and 4, respectively. The mean body weights at the time of drying were significantly ($P<0.05$) lower in traditional dry period group compared to shortened dry period groups. The increased fetal growth due to advanced pregnancy in second and third groups at the time of drying might be responsible for the increased body weights. The body weights (kg) have shown an increasing ($P<0.01$) trend from the day of drying to calving, regardless of the groups. However, the gain in body weight (kg) was significantly ($P<0.05$) higher in group I compared to group II and III. Similarly, Weber *et al*. (2015) also reported significantly higher ($p<0.05$) body weights in cows with 90 days DP than 28 and 56 day DP. However, Gulay *et al*. (2005) did not observe any differences in body weights at parturition in cows having DP of either 70 or 30 days.

The body weights (kg) have shown a decreasing trend in all the groups of buffaloes from the time of calving to 90 days postpartum with highest ($P<0.05$) loss percentage in group 1. Likewise, Anderson *et al*. (2005) and Gulay *et al*. (2005) reported a highest loss percentage in traditional dry period lengths in 50 d Vs omitted; and 70 d Vs 30 d dry periods, respectively. In shortened dry period cases, the animals pre-partum were fed high energy concentrate diets to meet the milk production demand, there by maintaining a continuous adaptability for rumen microbes to the concentrate feed (Reddy *et al*., 2016); and so, they can successfully utilize the high energy diets fed immediately after calving, thereby decreasing body weight loss. Further, shortened dry period improves the energy balance in early lactation due to the decreased nutritional stress of diet change, easing of transition to lactation, and reduced risk of metabolic disorders (Pezeshki *et al*., 2008) as evident from the less altered body weight changes in group II and III.

Effects of shortened dry period on body condition scoring: The values of mean BCS and ABCSP of the dairy Buffaloes are shown in Table 5 and 6, respectively. The evaluated physiological range of BCS throughout the course of study was from 3.31 to 4.00, and 3.32 to 4.73 in pre and postpartum periods, respectively. The higher ($P<0.05$) BCS was observed in group II and III compared to the first group at the time of drying. On the contrary, Weber *et al*. (2015) reported a higher BCS in 90 d DP compared to 28 and 56 d

Table 3: Effect of Pre-partum dry period (DP) on Body weights (Kg) in Murrah buffaloes.

Days Pre/Postpartum	Body Weights*			SEM
	GROUP-1 (> 60)	GROUP-2 (46 - 60)	GROUP-3 (30 - 45)	
At the time of drying	$549.42^{a B}$	597.97^{bB}	584.55^{bB}	4.85
At calving	$603.96^{a C}$	645.33^{cC}	628.03^{bC}	4.72
30 days Post partum	$537.70^{a AB}$	$584.66^{c AB}$	570.00^{bA}	4.55
60 days Post partum	$527.83^{a A}$	$579.09^{c AB}$	$564.84^{b A}$	4.68
90 days Post partum	$521.60^{a A}$	$573.40^{c A}$	$559.67^{b A}$	4.72

^{abc}Values bearing different superscripts in a row differ significantly (P<0.05).

^{ABCDEF} Values bearing different superscripts in a column differ significantly (P<0.01).

*Each value is a mean of 16 observations (n=16).

Table 4: Effect of Pre-partum dry period (DP) on Altered Body weights percentage (ABWP) levels in Murrah buffaloes.

Days Pre/Postpartum	Altered Body Weight percentage (ABWP) *			SEM
	Group-1 (> 60)	Group-2 (46 - 60)	Group-3 (30 - 45)	
Dry period to calving	9.93 $(+)^{b D}$	7.94 $(+)^{a C}$	7.46 $(+)^{a C}$	0.25
Calivng to 30 days Post partum	10.97 $(-)^{a A}$	9.41 $(-)^{b A}$	9.24 $(-)^{b A}$	0.23
30 to 60 days Post partum	1.84 $(-)^{a B}$	0.96 $(-)^{b B}$	0.91 $(-)^{b B}$	0.10
60 to 90 days Post partum	1.18 $(-)^{C}$	0.98 $(-)^{B}$	0.92 $(-)^{B}$	0.10

^{abc}Values bearing different superscripts in a row differ significantly (P<0.05).

^{ABCDEF} Values bearing different superscripts in a column differ significantly (P<0.01).

*Each value is a mean of 16 observations (n=16). '+' Increased BW Percentage '-' Decreased BW Percentage.

Table 5: Effect of Prepartum dry period (DP) on BCS in Murrah buffaloes.

Days Pre/Postpartum	Body Condition Score*			SEM
	GROUP-1 (> 60)	GROUP-2 (46 - 60)	GROUP-3 (30 - 45)	
At the time of drying	3.60^{aB}	3.79^{bA}	3.89^{bA}	0.03
At calving	4.23^{aD}	4.33^{bD}	4.43^{bD}	0.03
30 days Post partum	3.76^{aC}	4.07^{bC}	4.17^{bC}	0.02
60 days Post partum	3.53^{aB}	3.94^{bB}	4.03^{bB}	0.02
90 days Post partum	3.41^{aA}	3.86^{bAB}	3.96^{bAB}	0.02

^{abc}Values bearing different superscripts in a row differ significantly (P<0.05).

^{ABCDEF} Values bearing different superscripts in a column differ significantly (P<0.01).

*Each value is a mean of 16 observations (n=16).

Table 6: Effect of Pre-partum dry period (DP) on Altered Body Condition Score percentage (ABCSP) levels in Murrah buffaloes.

Days Pre/Postpartum	Altered BCS percentage (ABCSP) *			SEM
	Group-1 (> 60)	Group-2 (46 - 60)	Group-3 (30 - 45)	
Dry period to calving	17.49 $(+)^{b D}$	14.32 $(+)^{a C}$	13.97 $(+)^{a C}$	0.77
Calivng to 30 days Post partum	11.07 $(-)^{aA}$	5.88 $(-)^{b A}$	5.78 $(-)^{b A}$	0.36
30 to 60 days Post partum	6.09 $(-)^{a B}$	3.27 $(-)^{bB}$	3.37 $(-)^{bB}$	0.23
60 to 90 days Post partum	3.35 $(-)^{a C}$	1.94 $(-)^{b B}$	1.85 $(-)^{b B}$	0.18

^{abc}Values bearing different superscripts in a row differ significantly (P<0.05).

^{ABCDEF} Values bearing different superscripts in a column differ significantly (P<0.01).

*Each value is a mean of 16 observations (n=16). '+' Increased BCS Percentage '-' Decreased BCS Percentage.

DP cows during pre-partum period. However, the higher pre-partum BCS is not a favorable factor, as it often leads to enhanced lipolysis around calving that results in enhanced metabolic load and fat storage in liver (Weber *et al*., 2013), often leading to fatty cow syndrome (Morrow, 1976). The observed phenomenon in the present study might be due to higher fetal growth in buffaloes checked for BCS at 45 and 30 days pre-partum, compared to those at 60 days pre-partum. The absolute amount of BCS loss is a good indicator of nutritive status and correlates well with the high incidence of reproductive and metabolic diseases (Kalaitzakis *et al*., 2007). The BCS loss from drying to calving (0.62 points) is in the range of the physiologically acceptable loss (0.6 to 0.7 points), as indicated by Samanc *et al*. (2010).

Increased BCS from drying to calving might be due to a linear increase in body weights. Even though the difference in BCS gain from drying to calving among the groups was not significantly different, higher gain (P>0.05) was observed in buffaloes of group I. Similarly, Anderson *et al*. (2005) and Gulay *et al*. (2005) reported a higher BCS gain at calving in traditional DP lengths in cows allotted to 50 d Vs omitted; and 70 d Vs 30 d dry periods, respectively. Later, a decreased BCS trend (P<0.01) was observed from calving to 90 days postpartum, irrespective of the group,

Table 7: Correlation coefficients of BW, BCS and 6%FCM for high yielding Murrah Buffaloes at 30, 60, and 90 d post partum.

Parameter	30 d Post Partum			60 d Post Partum			90 d Post Partum		
	BW	BCS	6%FCM	BW	BCS	6%FCM	BW	BCS	6%FCM
BW	1	.659**	-.049	1	.705**	.510**	1	.711**	.692**
BCS	.659**	1	-.297*	.705**	1	.735**	.711**	1	.836
6%FCM	-.049	-.297*	1	.510**	.735**	1	.692**	.836**	1

*P<0.05, **P<0.01

and it reflects the increased negative energy balance in the buffaloes after calving (Wathes *et al*., 2009). Although the DMI increases along with the increased milk production during postpartum period, the intake cannot meet the required energy for lactation (NE_L), leading to the fastened mobilization of body reserves and decreased BCS as the postpartum days advances (Reddy *et al*., 2016). Later, traditional dry period group buffaloes tend to lose (P<0.05) more BCS compared to the other shortened dry period groups, as mentioned by Rastani *et al*. (2005) and Gulay *et al*. (2005). The higher losses of BCS in traditional dry period might be a factor of decreased Body weights, in-turn regulated by lower energy balance and nutritional stress. Both ABWP and ABCSP levels during 60 and 90 days postpartum were lower (P<0.01) compared to the same at below 60 days postpartum period. The physiological changes occurred after 60 days postpartum due to the increased DMI and a downfall in peak milk production (Obtained at 60 days postpartum), might have decreased the stress, thereby increasing the stability of BCS and BW losses.

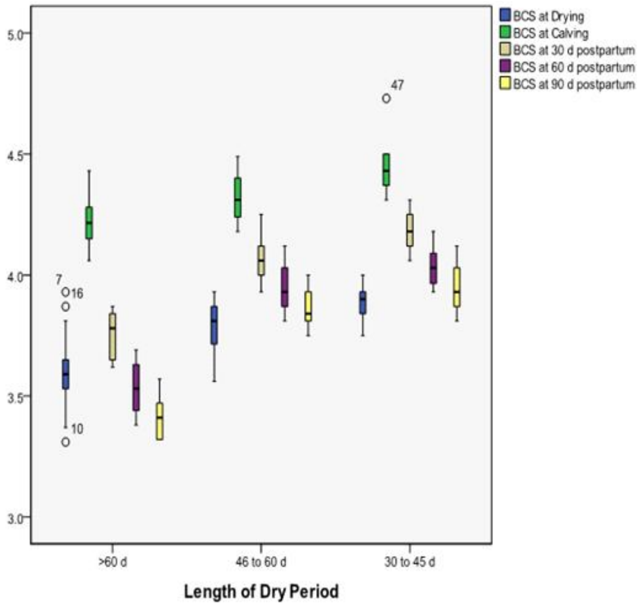

Fig 1: The box and whisker plot of Body Condition Scores of Murrah Buffaloes allotted to three dry period lengths.

Correlation coefficients of BW and BCS with 6 % FCM: 6% FCM production had a negative significant (P<0.05) correlation with BCS at 30d postpartum, followed by positive (P<0.01) correlation with BCS and BW at 60 or 90 d postpartum (Table7). During the very first period of early lactation phase (30 d period), excessive mobilization of body reserves occurs due to the increased milk production and low DMI, thus causing an excessive loss of BCS which harmonizes with higher milk yield. The positive correlation after 60 d postpartum is more of an intake factor which tremendously increases around 60 days after calving, thereby increasing the BCS, BW and milk yield in parallel.

Box plot analysis: The box and whisker plot of Body Condition Scores of Murrah buffaloes allotted to three dry period lengths was presented in fig 1. The respective median values for group I, II, and III were 3.78, 4.06 and 4.18 (at 30 days postpartum); 3.53, 3.93 and 4.03 (at 60 days postpartum); and 3.41, 3.84 and 3.93 (at 90 days postpartum). As anticipated, higher BCS median values were noticed in shortened dry period animals compared to the traditional (>60 d) DP group. Within the inter quartile ranges, the higher quartiles indicate higher BCS and so, the higher amounts of 6% FCM, at 60 and 90 d postpartum (Table 7). Moreover, the dissimilarities among higher quartiles were more when compared to those among the lower quartiles, demonstrating the greater effect of shortened dry periods in high yielding buffaloes compared to lower yielders within the study.

CONCLUSION

Not all the dry periods are able to guarantee the mobilization of energy reserves at optimum levels, thus maintaining the BW, BCS and milk production, and this is particularly relevant in high yielding animals. With the present study it is evident that the shortened dry periods (either 45 to 30 d or 46 to 60 d) are more beneficial in maintaining the BW, BCS, ABWP, and ABCSP, consequently maintaining the negative energy balance in threshold levels for metabolic disorders prevention. Besides, the correlation studies revealed an excessive BCS loss during first phase of early lactation (30 d), which has to be taken into consideration to prevent higher negative energy balance that predisposes the high yielding dairy animals to various metabolic disorders.

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