BODY CONDITION SCORING BY VISUAL AND DIGITAL METHODS AND ITS CORRELATION WITH ULTRASONOGRAPHIC BACK FAT THICKNESS IN TRANSITION BUFFALOES

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ABSTRACT

The effect of transition on body condition score (BCS) and ultrasonographic back fat thickness (USG BFT) was examined in 101 multiparous buffaloes grouped according to transition stage i.e., Far off dry (FOD), Close up dry (CUD) and Fresh (F). With BCS 2 to 2.5, the BFT of F period was significantly lower than FOD period. With BCS 3 to 3.5 and 4 to 4.5, the mean BFT at F period was significantly reduced as compared to FOD and CUD periods. Buffaloes with BCS 5, showed a significant reduction in BFT from FOD to CUD and from CUD to F period. BCS 5 at FOD period was characterized by accumulation of 'fat Pads' around the buttock. Majority of buffaloes with BCS of 4 to 5 showed reduction in BCS at F period. The overall correlation coefficient between BCS and USG BFT was 82, 83 and 78% for FOD, CUD and F period respectively. The overall correlation coefficient between visual BCS and BCS assessed from digital images for FOD, CUD and F period was 99, 98 and 95% respectively. It was concluded that digital images can be readily used to estimate BCS in buffaloes and USG BFT gives an accurate measure of fat reserves in buffaloes.

Keywords: body condition score, transition period, ultrasonographic back fat thickness

INTRODUCTION

Body condition scoring (BCS) is a subjective technique for assessing the condition of livestock at regular intervals. It is particularly helpful in assessing the body fat reserves of farm animals by visual and manual inspection of the thickness of fat cover and prominence of the bone at the tail head and loin region. The BCS system being non invasive, quick and inexpensive is universally accepted to estimate the degree of fatness (Bittante *et al*., 2004; Drame *et al*., 1999) and is also used to assess the post parturient reproductive health (Kadivar *et al*., 2014). Body condition scoring is particularly useful as an aid to dry cow and pre calving management with the main objective that the cows calve down uneventfully and enter the lactation stage safely. As the dairy cows use body energy reserves in the early lactation to cope up with negative energy balance (NEB) body condition scoring along with a less common method to assess fat reserves in body tissues i.e., measurement of back fat thickness by using real time ultrasound are more promising approaches to ensure an uneventful transition of dairy cows. Various studies on the precision of BCS system including the ultrasonographic assessment of subcutaneous back fat indicated that BCS values were closely related to the actual measurement of

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subcutaneous fat (Zulu *et al*., 2001).

Few studies are available on buffaloes relating BCS to USG BFT (Anitha *et al*., 2010), but critical information regarding effect of transition period on BCS and USG BFT is lacking. Therefore, the objective of this study was to examine the relationship between BCS and USG BFT in transition buffaloes.

MATERIALS AND METHODS

Animals

101 multiparous buffaloes in advanced pregnancy from organised buffalo farm were used for this study, conducted during August 2013 to July 2014. The buffaloes were grouped according to transition stage i.e.

Far off dry (FOD): >10 days following dry off and not <30 days expected to calving.

Close up dry (CUD): expected calving within 3 to 21 days.

Fresh (F): 3 to 30 days in milk.

Body composition

Body condition score (BCS) was estimated by the same individual using the five point visual BCS technique (Table 1) with 0.5 increment (Wildman *et al*., 1982). Some modifications were included in BCS system for buffaloes having BCS above 4.5, keeping in view the consistent and unusual site for fat deposition (Figure 1) and its mobilisation thereafter for meeting energy demands of early lactation after parturition.

Digital BCS

The digital photographic images were taken on the day of assessment of visual BCS. Images were taken from behind the buffalo at 0 to 20 degree angle to the tail head and from the bird's eye view with the help of Sony cyber shot digital camera having 12.1 Megapixels and 4x optical zoom (Figure 2 to 4). The images were evaluated by the same individual who assessed visual BCS but while assigning BCS to digital photographs the visual BCS was not referred.

Ultrasonographic back fat thickness (USG BFT)

Subcutaneous back fat thickness was measured by real time ultrasound using a portable Sonosite instrument at 7.5 MHz frequency. Back fat thickness in the rump or thurl area was measured as the thickness of the layer of sub cutaneous fat between skin and the fascia trunci profunda located above the gluteus medius muscle (Figure 5). The transducer was placed vertically to an imaginary line between the pins (tuber Ischia) and hooks (tuber coaxe) at the sacral examination site (9 to 11 cm cranial to the pins) (Nanda and Herdt, 2009) after shaving of site and application of coupling gel.

Image measurement and interpretation

Images were measured at depth of 4.7. Buffaloes having BCS above 4 were having fat layer deep enough that their interpretation was better done at depth of 9. Captured back fat images were freezed and measured using inbuilt measurement calliper protocol in the instrument.

Both BCS and USG BFT were estimated on the same day at each stage of transition. Visual BCS and USG BFT were measured at all the three periods i.e., FOD, CUD and 'F' period in order to observe and calculate any significant change in BCS and USG BFT. The body condition scoring was done as per the characteristics described in Table 1.

Feeding and management

Animals were fed in head to head housing system in mangers. Feeding involved 50 kg green fodder (Maize, Pearl millet and Sorghum during summer; Egyptian clover and Oats during winter), 6 kg of wheat straw and 2 kg of concentrates per day during last 90 days of gestation. During lactation the feeding involved 55 kg green fodder, 8 kg wheat straw and 3 kg of concentrates per day. The proximate analysis from feed and fodder samples was carried out by the methods of AOAC, 1970 (Table 2).

Statistical analysis

The statistical analysis was carried out using SPSS (16.0). ANOVA followed by Duncan's multiple range test (DMRT) was used to estimate significant difference between BFT at different transition stages at $P<0.05$. The correlation between BCS and BFT was estimated by Microsoft excel.

RESULTS

The results of proximate feed analysis revealed low levels of crude protein (CP) and ether extract (EE). The mean USG BFT of buffaloes with different body condition scores for different time periods (FOD, CUD, F) is presented in Table 3. In buffaloes with BCS 2 to 2.5, the USG BFT of F period was significantly lower than FOD period. The mean USG BFT at F period was significantly reduced as compared to FOD and CUD period in BCS group 3 to 3.5 and 4 to 4.5. In buffaloes with BCS 5, there was a significant reduction in BFT from FOD to CUD and from CUD to F period.

Out of 11 buffaloes with BCS 2 to 2.5 at FOD period, two buffaloes at CUD and F periods had a BCS of <2. Sixty buffaloes had BCS 3-3.5 at FOD period (Table 4). Out of these, two and seven buffaloes had BCS <2 and 2 to 2.5, respectively at CUD period. Further at F period, 32 out of 60 buffaloes showed reduction in BCS from 3 to 3.5, to 2 to 2.5 (25/60) or <2 (7/60). The majority of buffaloes with BCS 4 to 4.5 showed a reduction in BCS at F period. Twenty two out of 27 buffaloes lost BCS from 4 to 4.5, to 3 to 3.5 at fresh period. All three animals with BCS 5 were characterized by presence of fat pads (Figure 1, 2) at FOD period and had BCS 4 to 4.5 at F period with disappearance of fat pads. Figure 6 represents the USG BFT for different BCS scores of buffaloes.

The overall correlation coefficient between BCS and USG BFT was 82, 83 and 78% for FOD, CUD and F period, respectively. The overall correlation between visual and digital BCS for FOD, CUD and F period was 99%, 98% and 95%, respectively.

DISCUSSION

To our best knowledge this is the first study to evaluate the effect of transition period on BCS and USG BFT in buffaloes. In the present study the BCS was evaluated at three predefined transition stages in buffaloes on 1 to 5 scale with 0.5 increments, as a single BCS does not give any indication of whether a buffalo is gaining or losing body reserves over a period of time. Furthermore, USG BFT was concurrently used in this study to validate the BCS, as during transition it is difficult to judge accurately the real condition of animal due to weight gain associated with fetal growth. In our study the buffaloes with BCS >3.5 were more severely affected with further change in BCS and USG BFT in subsequent stages. Similar to our findings Bernabucii *et al.* (2005) reported higher

Table 1. Body condition score (BCS) along with corresponding illustration of buffalo and principal descriptors involved for visual assessment.

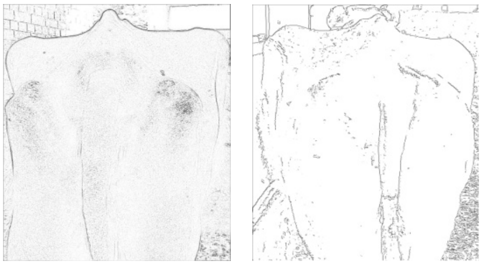
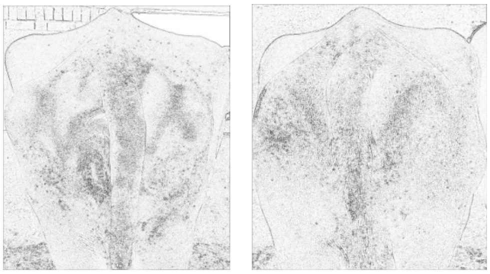
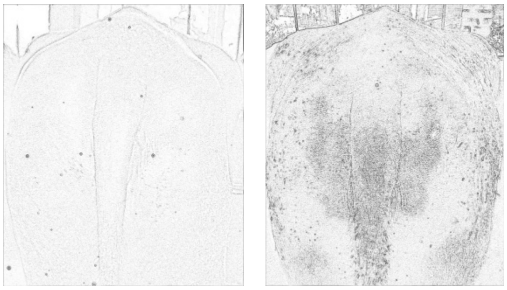
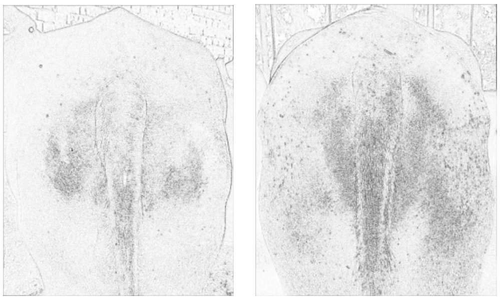
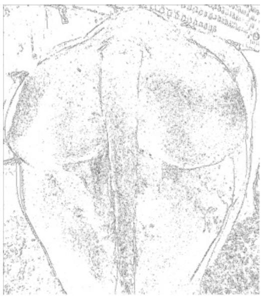
BCS	Animal	Descriptors
1.0-1.5 Emaciated / poor		**Tail head**: deep cavity with no fatty tissue under skin. **Loin**: prominent spine with sharp horizontal processes.
2.0-2.5 Thin / moderate		**Tail head**: shallow cavity with prominent pin bones. Traces of fat under skin. **Loin**: horizontal processes can be identified individually with round ends.
3.0-3.5 Average / good		**Tail head**: fat cover over entire area but pelvis can be felt. **Loin**: end of horizontal process can only be felt with pressure with slight.
4.0-4.5 Fat		**Tail head**: entirely filled, evidence of folds and patches of fat. **Loin**: processes not felt, completely rounded.
5.0 Obese / grossly fat		**Tail head**: buried in fatty tissue or "fat pads". Pelvis not palpable even with firm pressure.

Table 2. Proximate analysis of feed, fodder and wheat straw (% DM basis).

	BIS	Feed	Fodder	Wheat straw
DM	89	91	30	93
CP	20	16	8.4	2.7
EE	4.5	2.7	1.5	2.2
Ash	-	11.1	11.5	10.6
ADF	21	20.7	42	47.2
NDF	28	40.5	61.4	70.2
OM	-	90	89.1	90.2

*As per Bureau of Indian specifications (BIS), 2009 for high yielding cows.

Table 3. USG BFT at different transition stages in buffaloes for different BCS (Mean ± S.E.).

BCS (n)	Ultrasonographic Back fat thickness (USG BFT) (in cm)		
	FOD	**CUD**	**F**
1-1.5 (00)	-	-	-
2-2.5 (11)	1.391±0.10^{a}	1.156±0.089^{ab}	1.075±0.104^{b}
3-3.5 (60)	1.750±0.052^{a}	1.657±0.055^{a}	1.384±0.043^{b}
4-4.5 (27)	2.704±0.10^{a}	2.565±0.094^{a}	2.220±0.10^{b}
5 (03)	3.567±0.073^{a}	3.397±0.014^{b}	3.083±0.018^{c}

*The values with different superscripts in a row differ significantly at P≤0.05.

Table 4. Effect of transition period on BCS in buffaloes.

BCS	FOD					CUD					F				
	< 2	**2-2.5**	**3-3.5**	**4-4.5**	**5**	**< 2**	**2-2.5**	**3-3.5**	**4-4.5**	**5**	**< 2**	**2-2.5**	**3-3.5**	**4-4.5**	**5**
Number of buffaloes	-	11	-	-	-	**2**	9	-	-	-	**2**	9	-	-	-
	-	-	60	-	-	**2**	**7**	51	-	-	**7**	**25**	28	-	-
	-	-	-	27	-	-	-	**6**	21	-	-	-	**22**	5	-
	-	-	-	-	3	-	-	-	**1**	2	-	-	-	**3**	-

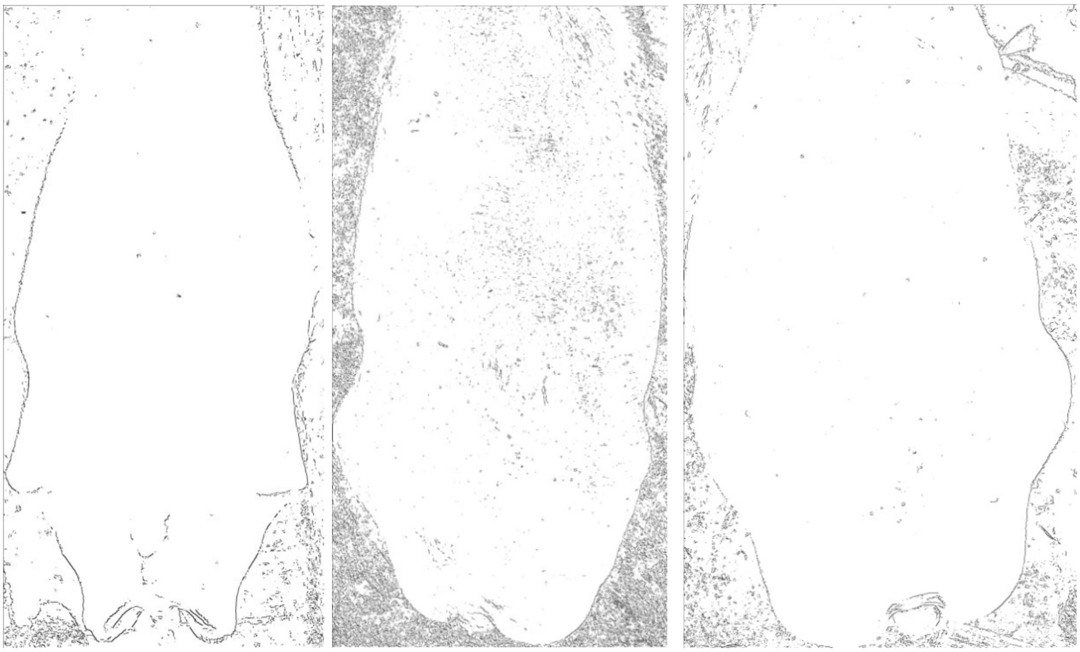
*The bold numerical represent the number of buffaloes with reduced BCS from FOD to CUD and or 'F'.

Figure 1. Buffalo with BCS 5 having ‘Fat Pads’.

Figure 2. BCS assessment by digital photographs taken from rear of buffaloes.

Emaciated Good Obese

Figure 3. BCS assessment by digital photographs taken from bird's eye view.



Emaciated Good Obese

Figure 4. Contour of buffaloes with different body conditions as seen from bird's eye view.

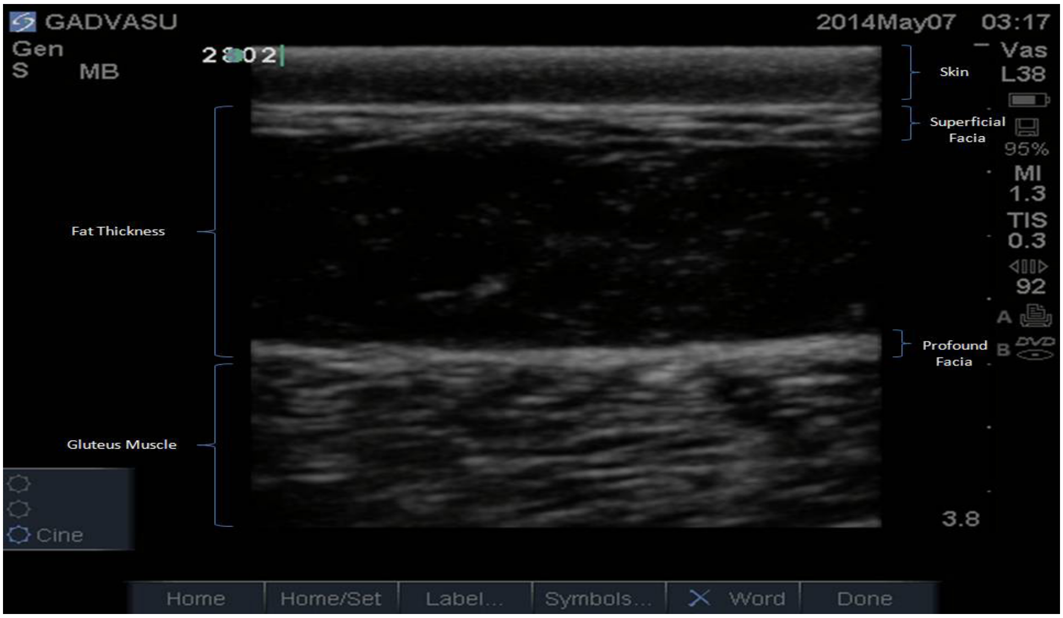


Figure 5. USG dipicting various layers of facia, fat and muscle.

BCS/ Remarks

Ultrasonographic Back fat thickness (USG BFT)

in cm (0.1 cm = 1 mm)

BCS/ Remarks
1.0-1.5 Emaciated - Poor
2.0 – 2.5 Thin – Moderate (Depth 4.7)

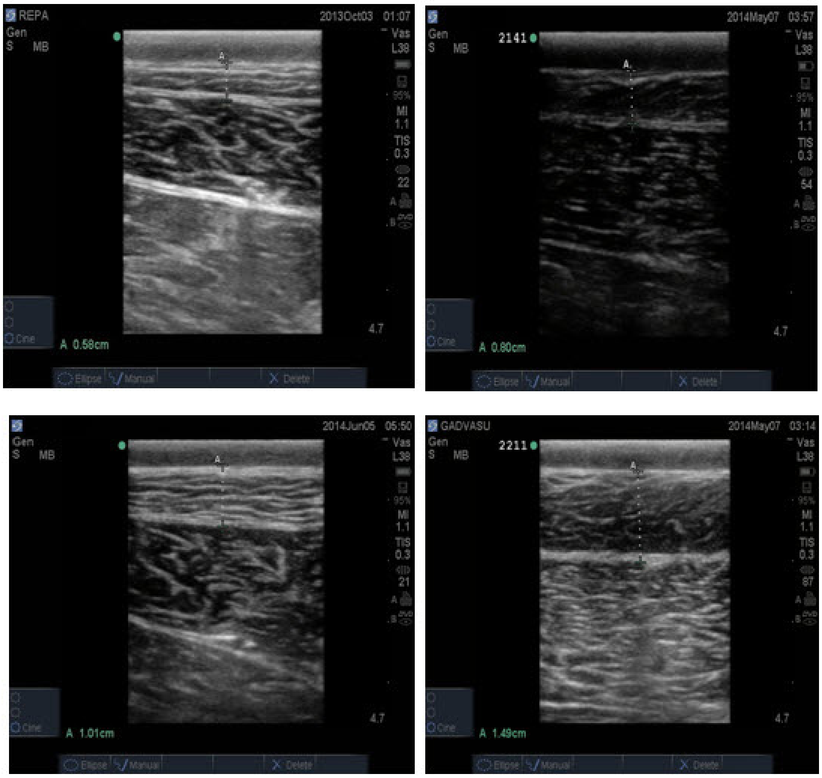


Figure 6. USG Back fat thickness (BFT) of buffaloes with different BCS.

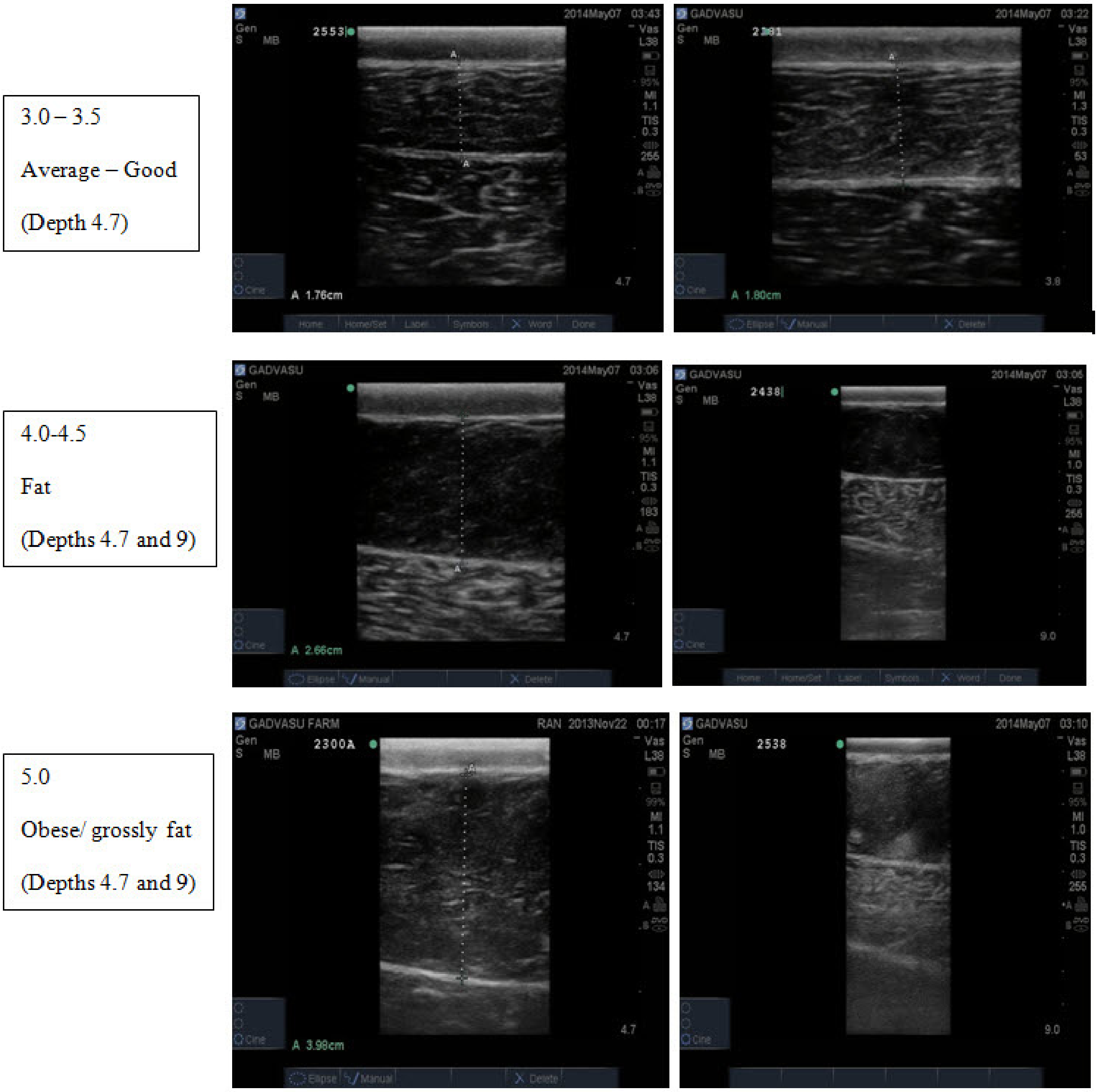


Figure 6. USG Back fat thickness (BFT) of buffaloes with different BCS. (Cont.)

reduction in high BCS cows from late pregnancy to first 30 days in milk, than the cows with average and good BCS. This may be attributed to increased resistance of adipose tissue to insulin which predisposes the dairy animal to mobilize non esterified fatty acid (NEFA), thus potentially creating a vicious cycle of NEFA mobilization and dry matter intake (DMI) reduction during late prepartum period. This is why high BCS animal have lower DMI and more rapid decrease in BCS during prepartum period than animal of average or good BCS (Grummer *et al*., 2004).

Our results show there is strong correlation between BCS and USG BFT for all three transition stages. Similar findings were reported by Anitha *et al*. (2010) with correlation coefficient of 87% between BCS and USG BFT in Murrah buffaloes. Wittek and Furll (2002) and Lubi and Fletcher (1985), also reported a significant correlation coefficient of 91% and 87%, respectively between BCS and USG BFT.

It was observed that 83.33% (25/30) buffaloes having BCS above 4 reduced significantly to a lower BCS over the passage of time during transition, where as only 53.33% (32/60) and 18.18% (2/11) buffaloes having BCS 3 to 3.5 and 2 to 2.5, respectively reduced to lower BCS at F stage (Table 4) over a period of time. Chebel, 2010 reported that only 24.7% of cows entering the dry period with BCS under 3.5 lost BCS during the dry period, whereas 76.6% of cows over 3.75 lost BCS during the dry period. This difference may be due to the feeding management, environmental and species differences. This further indicated that cows with BCS above 3.75 lost almost 45 pounds of body weight. With mobilization of 50 to 60 kg of fat during transition period with majority being in early lactation, adipose tissue quantitatively represents the most critical energy storage and seems suitable to assess energy balance of dairy cow because the amount of mobilized body fat approximates the energy demand that is lacking for milk output and maintenance (Waltner *et al*., 1993). This is further justified by our study in which there was significant loss of USG BFT and BCS between FOD and 'F' period in buffaloes with BCS > 3.5 and no buffalo remained in BCS group of 5 as compared to initial three buffaloes during the FOD period.

Three buffaloes which were having BCS 5 at FOD period were characterized by accumulation of 'fat pads' around the tail and pins (buttock region). At the first instance it was assumed that it may be some sort of edema but ultrasonographic examination revealed it as a fat layer. This layer of 'fat pads' subsequently disappeared in later transition stages due to fat mobilization. The assessment of BCS by digital photographs revealed that photographs taken from rear and bird's eye view can also be used for estimating accurate BCS in buffaloes. This was the first attempt to estimate BCS by digital means in buffaloes and the results depicted a strong correlation coefficient between visual BCS and digital BCS. Previously, Ferguson *et al*. (2006) correlated visual and digital BCS in cows using four observers and found a strong correlation of 82 to 90 percent among different observers. In our study the correlation was strong which may be due to the fact that in buffaloes there is very little body hair which exposes the full outline of animal's body in photographs as compared to cows where body has thick layer of hair which could probably mask the body outlines and angles and deter in exact assessment of BCS. Also, in the present study, the assessment of BCS by both the methods was done by the same observer which may have resulted in high correlation even when the assessment was done independently, without referring to the scores assigned by other method (visual BCS) in same animal.

CONCLUSION

Ultrasonographic BFT should be concurrently used as an aid to BCS for assessment of body fat reserves in transition buffaloes. BCS assessment by digital means in transition buffaloes can be used with reliable results and buffaloes having BCS 5 tend to accumulate fat around tail and pins which is prominent major descriptor for characterization of buffaloes with BCS 5. Further, disappearance of 'fat pads' was the most prominent descriptor when a buffalo with BCS 5 reduced its body condition.

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