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Study of body condition score and its impact on dam body weight and calf growth rate during the transition period in Mithun (*Bos frontalis*) cows

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Abstract
The present study aimed to assess the influence of BCS on the dam body weight and its impact on calf birth weight and growth rate. This is the first study on the impact of body condition score of Mithun which was conducted at ICAR – National Research Centre on Mithun, Nagaland, with 25 Mithun (*Bos frontalis*) cows in the advanced pregnant stage. The cows were grouped based on their BCS; Group 1: BCS ≤ 3.0, Group 2: BCS > 3.0 to ≤ 4.0, and Group 3: BCS > 4.0. The animals were examined to record BCS and body weight at fortnightly intervals from days 14 (Stage I) and 7 days (Stage II) prepartum, and on days 3 (Stage III), 14 (Stage IV), 28 (Stage V), 42 (Stage VI), and 56 days (Stage VII) postpartum. The birth weight of all the calves was recorded before feeding the colostrum, and their monthly body weight was recorded up to six months of age. The mean BCS at stage I(before calving) were 3.04±0.05, 3.76±0.06 and 4.73±0.12 for 1, 2 and 3 BCS groups showing a significant difference (p<0.05). There was a general trend of decline in body weight from stage III until stage VI, followed by an increase at stage VII. Group 3 animals had significantly (p<0.05) higher body weight than groups 1 and 2. The cows with high BCS at calving lost more body weight than the other two groups of cows. The mean calf birth weight at calving was 20.44±1.18, 19.64±0.45 and 21.50±0.84 for groups 1, 2 and 3 respectively. Group 3 had marginally higher calf birth weight than groups 1 and 2, and their growth rate was higher throughout the six months. However, there was a non-significant difference in calf growth rate among all the BCS groups from the third to the sixth month. In conclusion, cows with higher BCS at calving had a higher body weight but lost more weight than those with lower BCS. Calf birth weight was significantly influenced by the BCS of the dam at calving.

Keywords: Body condition score, transition period, body weight, calf birth weight

Introduction
The success of a dairy largely depends on the performance of fresh cows, making the transition or peripartum period a crucial aspect for their health, production, and profitability. This phase extends from the start of the dry period to peak yield in the following lactation and is characterized by negative energy balance, fat mobilization, and an increase in circulating non-esterified fatty acids and ketone bodies. Despite the peak incidence of production diseases during the 3 weeks pre-calving to 3 weeks post-calving, their effects on dairy cow health and productivity can extend throughout the following lactation (Seifi *et al.*, 2007) [32]. Indicators, which characterize dairy cows metabolic processes are body condition score (BCS) and live weight (LW). It is very important to evaluate the changes of these indicators. Body condition scoring has been widely recommended as a method of evaluating nutritional management of the dairy cows and is one such managemental tool which can be suitably utilized to overwhelm these problems and improve profitability of dairy farm (Gillund *et al.*, 2001; Manzoor *et al.*, 2017) [11, 17]. It is also an evaluation of the nutritional status of an animal. Body condition scoring allows you to coordinate feed resources required by the animal, that need supplemental feed or restrict intake in those animals that need less feed (Pfeiffer and Seefeldt, 2015) [26].
The birth weight of calves is a crucial factor in dairy cattle farming as a significant portion of the farm's food resources is devoted to rearing herd replacements and dry cows' maintenance. If the mother is underfed during the last three months of pregnancy, it may affect the young ones, leading to death in utero or reduced viability at birth (Mc Donald *et al.*, 1985) [18]. The nutrition of the dam during pregnancy also affects the young ones after birth since it may affect the milk yield. Sometimes, the death of fetuses may lead to abortion or stillbirth.

On the other hand, high levels of nutrition during pregnancy may reduce calf birth weight, and the cow's appetite after calving may be poor, resulting in poor milk yield (Russel *et al.*, 1969) [31].

The Mithun (*Bos frontalis*) is a unique ruminant, free-range bovine species primarily used as a meat animal and is the pride of North Eastern Hilly states of India (Arunachal Pradesh, Manipur, Mizoram and Nagaland). As mithun inhabits remote forests with undulating topography and adverse climatic conditions, it remains as one of the neglected and least studied bovines (Mondal *et al.*, 2004; Mondal *et al.*, 2006) [20, 21]. At present no studies on BCS has been completed in mithun. In this manner, information on BCS of mithun would incredibly help the mithun farmers just as the farm manager, to get ideal benefit. Therefore, the present study has been carried out to study body condition score and its effect on dam body weight, calf birth weight and calf growth rate during the transition period in Mithun (*Bos frontalis*) cows.

Materials and Methods

This current study was conducted at ICAR – National Research Centre on Mithun, Medziphema Dimapur district, of Nagaland is situated between 25.75° N latitude and 93.86° E longitude and at an altitude range of 360 m above the mean sea level (MSL). 25 Mithun (*Bos frontalis*) cows in the advanced pregnant stage. The cows were grouped based on their BCS; Group 1: BCS ≤ 3.0, Group 2: BCS > 3.0 to ≤ 4.0, and Group 3: BCS > 4.0. The animals were examined to record BCS and body weight at fortnightly intervals from days 14 (Stage I) and 7 days (Stage II) prepartum, and on days 3 (Stage III), 14 (Stage IV), 28 (Stage V), 42 (Stage VI), and 56 days (Stage VII) postpartum. The body condition score of the cattle was recorded through palpation and visual as per the body condition scoring chart formulated by Prasad (1994) [28]. The birth weight of all the calves was recorded before feeding the colostrum, and their monthly body weight was recorded up to six months of age.

Statistical analysis

To see the periodical variations of BCS during transition period, one way analysis of variance was applied as per the procedure of Snedecor and Cochran (1994) [34] followed by Duncan's multiple range test. Data were expressed as Mean ± S.E. Statistical analysis was performed using the SPSS 21.0 programme.

Results and Discussions

Body condition score

The fortnightly mean BCS of cows of the three groups are presented in Table 1, and statistical analysis revealed that differences in BCS at all seven stages were significant (p<0.05) among the groups. The mean BCS at stage I(before calving) were 3.04±0.05, 3.76±0.06 and 4.73±0.12 for 1, 2 and 3 BCS groups respectively and saw a decline at stage III, which is after calving. There was a continuous decrease in BCS for all the groups from calving till it reached to 2.60±0.05, 3.15±0.06 and 3.99±0.09 at stage VII.

The results obtained regarding BCS in the present study are in close agreement to those reported by Singh *et al.*, (2009) [33], Patel *et al.*, (2018) [24], Godara *et al.*, (2016) [13], Manzoor *et al.*, (2017) [17], Ruegg and Milton (1995) [30], Yamazaki *et al.*, (2011) [37] and Gergovska *et al.*, (2011) [10] observed that body condition score (BCS) decreases gradually after calving until the early lactation stage. The highest loss in BCS is observed in animals with higher BCS. The decrease in BCS is significant in all different BCS groups, and it starts from calving to early lactation. The highest BCS is observed before calving, and it begins to decline until 45-60 days after calving, where it remains constant for a certain period. The loss in BCS is common in cows of moderate BCS (3.0). The reduction in BCS is linear in the first month after parturition, reaches a lowest point at about 2-3 months, and then gradually recovers.

In the present study, the unit loss in BCS was higher in BCS Group 3 although it was significantly higher than group 1 and 2 throughout the study period. The present study found that changes in BCS pattern were consistent with previous research. Cows with a high genetic merit have a higher predisposition for mobilization of body fat reserves to cover milk production demands, resulting in a higher loss of BCS after calving. This loss in BCS is usually associated with negative energy balance, which normally occurs after parturition. The decrease in BCS during early lactation has been attributed to the fact that energy from body reserves gets mobilized to support milk production (Banuvalli *et al.*, 2014; Pryce *et al.*, 2000; Bauman and Currie, 1980; Bewley and Schutz 2008; Kim and Suh, 2003; Lacetera *et al.*, 2005 and Alapati *et al.*, 2020) [3, 29, 5, 7, 15, 16, 1].

Body weight

Mean body weight of dam across different BCS groups are presented in Table 2. The result revealed that differences in body weight at all seven stages were significant (p<0.05) among the different BCS groups. BCS group 3 had a higher body weight than group 1 and 2. The mean body weight at stage 1 (before calving) were 326.67±7.97, 387.09±8.12, 444.60±25.80 kg for BCS group of 1, 2 and 3 respectively. At stage 3 (after calving) the body weight declined to 312.11±8.97, 367.82±7.58 and 425.00±23.58 kg for BCS Group 1, 2 and 3 respectively. There was a general decline in body weight till stage VI, subsequently their body weight showed increasing trend at stage VII even though there was a decrease in BCS in all the groups.

The present study's findings are in agreement with previous studies that reported higher body weight in buffaloes with a high body condition score (BCS) at calving (Delfino *et al.*, 2018) [8]. The body weight was found to be highest 15 days before calving and lowest at 45 days after calving, but it increased from 60 days after calving onwards (Godara *et al.*, 2016) [13]. The body weight was highest 60 days pre-calving and declined at calving in Irish Holstein Friesan animals. Body reserves decreased during early lactation until about 100 days in milk and were restored during mid and late lactation (Berry *et al.*, 2011 and Mishra *et al.*, 2016) [6, 19]. The BCS decreased after calving and continued up to 90th day postpartum in Murrah buffaloes. Loss of body weight occurred only during the first 3-4 weeks of lactation, and body weight increased for the remainder of lactation despite a decline in BCS (Patel *et al.*, 2018) [24]. The level of body fat at calving has a negative feedback effect on feed intake, and cows that calved in higher condition score could not increase feed intake sufficiently to meet energy requirements for milk production until they had lost a certain amount of body fat (Edmomson *et al.*, 1989 and Pedron *et al.*, 1993) [9, 25]. The mobilization of adipose tissue is associated with decreasing body weight (BW), and cows in transition with higher BCS lose more (Barletta *et al*. 2017 and Treacher *et al.*, 1968) [4, 36].

Table 1: Mean BCS across different stages of lactation in different BCS groups

BCS Group	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Stage VII
1 (11)	3.04±0.05^{c}	3.00±0.05^{c}	2.89±0.05^{c}	2.82±0.05^{c}	2.76±0.05^{c}	2.68±0.05^{c}	2.60±0.05^{c}
2 (10)	3.76±0.06^{b}	3.72±0.06^{b}	3.65±0.07^{b}	3.53±0.07^{b}	3.41±0.06^{b}	3.30±0.07^{b}	3.15±0.06^{b}
3 (4)	4.73±0.12^{a}	4.70±0.12^{a}	4.63±0.13^{a}	4.51±0.14^{a}	4.42±0.14^{a}	4.24±0.12^{a}	3.99±0.09^{a}
Total (25)	3.69±0.12	3.70±0.12	3.64±0.12	3.52±0.12	3.42±0.12	3.30±0.12	3.17±0.11

^{abc} Mean showing different superscripts in a column differ significantly (p<0.05)
Figure in parentheses indicate number of experimental animals.

Table 2: Mean Body Weight (Kg) of dam across different stages of lactation in different BCS groups

BCS Group	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Stage VII
1 (11)	326.67±7.97^{c}	329.00±7.91^{c}	312.11±8.97^{c}	302.00±9.47^{c}	295.56±10.00^{c}	291.89±9.85^{c}	293.11±9.37^{c}
2 (10)	387.09±8.12^{b}	390.09±8.16^{b}	367.82±7.58^{b}	360.27±7.62^{b}	349.55±7.37^{b}	339.18±7.18^{b}	341.64±7.24^{b}
3 (4)	444.60±25.80^{a}	448.40±25.94^{a}	425.00±23.58^{a}	405.60±19.23^{a}	397.60±18.06^{a}	391.20±18.30^{a}	393.20±18.54^{a}
Total (25)	376.84±10.95	379.76±11.05	359.20±10.46	348.36±9.79	339.72±9.58	332.56±9.30	334.48±9.32

^{abc} Mean showing different superscripts in a column differ significantly (p<0.05)
Figure in parentheses show sample number

Calf birth weight and subsequent growth rate

The mean calf birth weight and subsequent growth rate in different BCS groups are presented in Table 3. The mean calf birth weight at calving was 20.44±1.18, 19.64±0.45 and 21.50±0.84 for groups 1, 2 and 3 respectively. The result of the present study revealed that the calf birth weight in BCS Group 3 was significantly (p<0.05) different from group 1 & 2 till the 2nd month of growth rate.

The findings of Spitzer *et al.*, (1995) [35] and Godara *et al.*, (2017) [12] both observed a significant difference in calf birth weight in different body condition score (BCS) groups of cows with BCS of 3.5 to 4.0 seems to be better for fetal growth. Mukasa-Mugerwa *et al.*, (1994) [23] found that calf birth weight and subsequent weight gain were better for cows calving in better condition, with calf birth weight increasing with dam body condition and body weight at calving. Poczynek *et al*., (2023) [27], observed that BCS class had an impact (p<0.01) on calf birth weights where cows with BCS < 3.0 gave birth to lighter calves than the calves from cows with BCS > 4.25. Meanwhile contrary to the present findings, Alharthi *et al*., (2021) [2], found that a high maternal BCS (≥3.75) during late-gestation gave birth to calves with lower weights, which could be due to lower maternal intakes and a state of inflammation and metabolic stress. In the present study, the mean calf weight at 6th month were 79.56±6.37, 77.00±8.02 and 93.60±11.62 for Group 1, 2 and 3 respectively. Group 3 had a marginally higher calf birth weight than group 1 and 2, however, the statistical analysis revealed that the growth rate from 3 to 6 month was non-significant among all the groups. Khan *et al.* 2002 [14] observed a dietary energy effect on calf birth weight. The findings revealed that cows given low energy diet during pre-calving period produced lighter calves at birth. However, there was no significant effect of pre-calving energy on growth rate of calves. Calf growth rate calculated from birth to one month of age showed that growth rate was little higher in high-energy group than that of the calves of low energy group.

Table 3: Mean calf birth weight and subsequent growth up-to 6 months in different BCS groups

BCS Group	Birth Weight	1 Month	2 Month	3 Month	4 Month	5 Month	6 Month
1 (11)	20.44±1.18^{b}	30.00±1.44^{b}	39.89±2.47^{b}	48.83±3.09^{NS}	58.67±3.51^{NS}	67.33±4.97^{NS}	79.56±6.37^{NS}
2 (10)	19.64±0.45^{b}	29.68±1.72^{b}	38.64±2.86^{ab}	47.14±4.35^{NS}	56.50±5.58^{NS}	65.86±7.12^{NS}	77.00±8.02^{NS}
3 (4)	21.50±0.84^{a}	37.00±3.30^{a}	51.10±6.08^{a}	62.90±7.54^{NS}	74.90±9.51^{NS}	83.70±10.78^{NS}	93.60±11.62^{NS}
Total (25)	20.30±0.50	31.26±1.22	41.58±2.10	50.90±2.83	60.96±3.50	69.96±4.26	81.24±4.78

^{abc} Mean showing different superscripts in a column differ significantly (p<0.05)
Figure in parentheses show sample number

Conclusion

In conclusion, the present study found that in Mithun cows body condition score (BCS) decreases gradually after calving until the early lactation stage in cows of all BCS groups. The highest loss in BCS was observed in animals with higher BCS, and the decrease in BCS was significant in all different BCS groups. The study also revealed that cows with a high genetic merit have a higher predisposition for mobilization of body fat reserves to cover milk production demands, resulting in a higher loss of BCS after calving. Additionally, the study found that calf birth weight and subsequent growth rate were better for cows calving in better condition, with calf birth weight increasing with dam body condition and body weight at calving. Understanding the relationship between BCS, body weight, and calf growth can help farmers in making informed management decisions to enhance the productivity and health of their Mithun herd.

Conflict of interest statement

Authors declare that there is no conflict of interest involved in the present work.

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