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BODY CONDITION SCORE AS A MARKER OF MILK YIELD AND COMPOSITION IN DAIRY ANIMALS

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ABSTRACT

Under tropical condition the BCS may influence the feed intake and metabolism leading to variation in economic parameters. This study investigated the BCS as a regulator of milk yield (MY) and composition (MC) in dairy animals. A total of 154 animals, comprising Azakheli (AZ) and Nili-Ravi (NR) buffaloes, Holstein Friesian (HF), Jersey (JC), Sahiwal (SW), Achai (AC) and crossbreds (XB) cattle and Beetal (BT) goats were selected from various public and private farms in NWF Province of Pakistan. MY and BCS were recorded weekly and milk samples were collected for analysis. The experiment continued for 6 months postpartum in buffaloes and cattle and three months in goats during the year 2008. Higher BCS was maintained by AZ, XB and HF, medium by NR and lowest by AC, SW, JC and BT. Highest yield was recorded with moderate BCS in buffaloes. BCS correlated positively with fat and protein and negatively with lactose contents. MY decreased while BCS increased with advancing lactation. MY and BCS correlated inversely. The negative relationship may be due to mobilization of body reserves, indicating their better genetic potential as dairy breeds. We suggest that dairy buffaloes perform well under the tropical conditions and BCS can be used as a marker for MY and quality.

Key words: Dairy breeds, Buffalo, Sahiwal, Achai, Crossbred, Beetal, BCS, milk composition and yield

INTRODUCTION

Body condition scores (BCS) are subjective, visual or physical assessment of the amount of metabolizable energy stored in fat and muscle on a live animal. It has been considered an effective tool in monitoring the energy intake of cows and herds (Jeffrey and James, 1989). Until 1970s, there was no simple measure of a cow's energy reserves or condition. Body weight alone is a poor marker because energy stores can vary by as much as 40 % in cows with similar body weight (Andrew et al., 1994). In addition, tissues are mobilized in early lactation even though feed intake is generally increasing, the extent of body tissue loss can be masked by gastrointestinal fill, such that body weight changes may not reflect changes in bio-energetically important tissues (National Research Council, 2001). Most research reports currently available on the impact of BCS on milk production are from technologically advanced countries with temperate environment, predominantly on Friesian cows (Garnsworthy and Jones, 1987). In local dairy animals BCS with reproduction and fertility, has been extensively studied by our group (Qureshi et al., 2002a) in local buffaloes. BCS was significantly affected by the period of calving and season of the year.

Research work on the effect of BCS on milk production and composition in the subtropical environment of Pakistan under the prevailing management practices is needed. Therefore, the present study was undertaken to evaluate the role of BCS as a regulator of milk yield and composition in dairy buffaloes under tropical conditions.

MATERIALS AND METHODS

Selection and management of animals: The present study was conducted at Peshawar, situated in the central valley of the North-West Frontier Province (NWFP) of Pakistan, located at 31-37° north and 65-74° east. The temperature ranged from 25 to 48 °C during summer and 4 to 18 °C during winter. Annual precipitation was recorded as 400 millimeters. The experiment continued for 6 months postpartum for the buffaloes and cows while three months for the goats during the year 2008. A total of 154 animals, comprising of buffaloes (47 Nili-Ravi, 3 Azakheli), cows (58 crossbred; 16 Holstein Friesian; 4 Sahiwal; 6 Jersey and 10 Achai) and 10 Beetal goats were selected from various public and private farms. The cattle and buffaloes were in 60 to 90 days (initial to mid lactation stage) postpartum while goats in 30 days (initial lactation stage) postpartum. Nili-Ravi buffaloes are kept at private dairy farms, located close to big cities to meet the demand of urban population. These buffaloes are reared under intensive farming system with higher input cost but little development, scientific and marketing support. Nili-Ravi buffaloes are also kept at public sector farms along with Azakheli dairy buffaloes. All the

experimental animals were offered green fodders ad libitum and concentrates at the rate of 1 kg per 2 liters of milk produced. The animals were milked twice a day at 12 hours interval. A total of 3572 raw milk samples were collected from buffaloes (n = 1200), cows (n = 2252) and goats (n = 120) for laboratory analysis.

Body condition, milk yield, sampling and analysis: Body condition score (BCS) of all the cows was recorded weekly, using the method described by Peters and Ball (1987). Daily milk yield (kg) was recorded once a week for six months in buffaloes and cows and for three months in goats. Both morning and evening milk samples (200 ml) were collected in bottles, and transported in an icebox to the dairy technology laboratory for further analysis. Milk samples were analyzed for fat, protein and lactose using ultrasonic milk analyzer (Ekomilk Total Ultrasonic Milk Analyzer, Bullteh 2000, Stara Zarqora, Bulgharia) according to manufacturer's instructions. Milk progesterone was determined through ELISA as described by Qureshi et al., (1992).

Data analysis: The data obtained were subjected to analysis of variance for means comparison. The general linear model and correlation analysis were applied, using SPSS-10 (1999). Means were subsequently ranked using Duncan's Multiple Range Test (DMRT) as described by Steel and Torrie (1980).

RESULTS

Breed effect on milk yield, composition and BCS: The fat, protein and lactose contents were significantly affected by breed (Figure 1, P< 0.05). Fat was highest in Jersey, protein in Sahiwal and lactose contents in crossbred cattle. The BCS was significantly affected by the breed. Azakheli, crossbred and Friesian maintained the higher BCS while medium BCS by Nili-Ravi and lowest by Achai, Sahiwal and Jersey. Beetal goats exhibited minimum BCS among the experimental animals.

BCS effect on milk yield and composition: BCS significantly affected the milk yield and fat, protein and lactose contents in buffaloes (Table 1). Highest yield (9.92± 2.26 kg/day) was recorded with poor BCS (1.5) followed by moderate (2.5) and higher (3.5 and 3.0). Protein contents increased with increasing BCS up to 3.0 and declined with 3.5 while lactose showed an opposite trend (Figure 2). Correlation analysis of the data showed that BCS was significantly and positively correlated with fat and protein contents while negatively with milk yield (Table 2). The milk yield consistently decreased beyond four months postpartum. While, BCS showed an initial decrease followed by a slight increase (Figure 3).

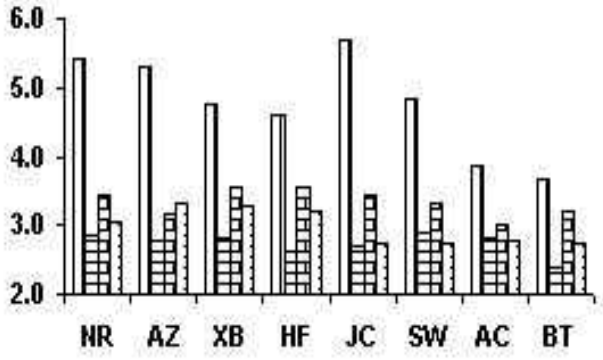

Figure 1: Milk fat (%, vertical lines), protein (%, horizontal lines), lactose (%, bricks) and BCS (at a scale of 1 to 5, dots) across Nili-Ravi (NR) and Azakheli (AZ) buffaloes; Crossbred (XB), Holstein Friesian (HF), Jersey (JC), Sahiwal (SW) and Achai (AC) cows; and Beetal (BT) goats. All the milk components and BCS were significantly effected by the breeds (P< 0.05).

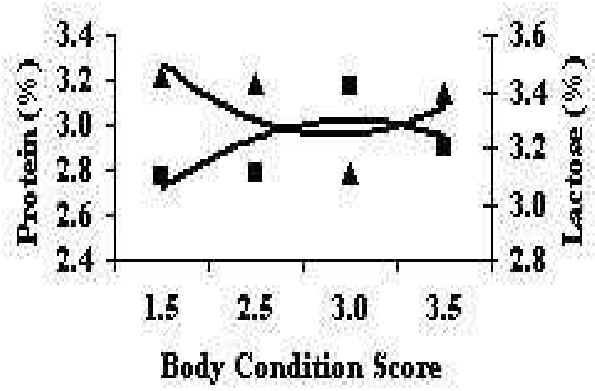

Fig. 2: Changes in milk protein (■) and lactose (▲) with changes in body condition score (BCS) in buffaloes (R^2 = 0.50, 0.47).

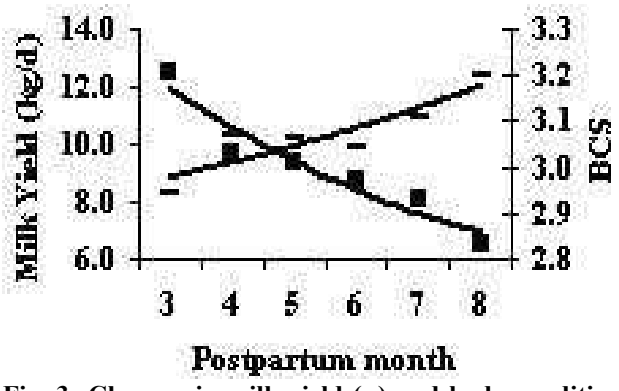

Fig. 3: Changes in milk yield (■) and body condition score (BCS, □) with advancing lactation in buffaloes (R^2 = 0.92, 0.77).

Table 1: Mean and standard deviation for milk composition and yield as influenced by BCS in dairy buffaloes (Figures in parenthesis indicate the number of observations).

BCS	Fat (%)	Protein (%)	Lactose (%)	MY (kg/d)
1.5	$5.16^{a} \pm 0.99$ (96)	$2.77^{b} \pm 0.49$ (96)	$3.46^{a} \pm 0.72$ (96)	$9.92^{a} \pm 2.26$ (96)
2.5	$5.34^{a} \pm 1.21$ (312)	$2.79^{b} \pm 0.55$ (312)	$3.43^{a} \pm 0.66$ (312)	$9.59^{a} \pm 3.13$ (312)
3.0	$4.56^{b} \pm 1.12$ (24)	$3.17^{a} \pm 0.32$ (24)	$3.11^{b} \pm 0.48$ (24)	$4.29^{b} \pm 0.02$ (24)
3.5	$5.49^{a} \pm 1.21$ (768)	$2.90^{b} \pm 0.53$ (768)	$3.39^{a} \pm 0.63$ (768)	$9.13^{a} \pm 3.50$ (768)
P- value	P < 0.05	P < 0.05	P < 0.05	P < 0.05

^{a,b} *Mean in the same column having different superscripts are significantly different;* MY, Milk Yield

Table 2: Relationship of body condition score with milk yield and composition in buffaloes (Pearson's correlation coefficient, Figures in parenthesis indicate number of observations).

Parameters	BCS	Fat (%)	Protein (%)	Lactose (%)	MY (kg/d)
Fat (%)	0.085^{**} (1200)				
Protein (%)	0.091^{**} (1200)	0.189^{**} (1200)			
Lactose (%)	-0.032^{ns} (1200)	0.106^{**} (1200)	0.061^{*} (1200)		
Milk Yield (kg/d)	-0.076^{**} (1200)	0.025^{ns} (1200)	-0.030^{ns} (1200)	0.033^{ns} (1200)	
Progesterone(ng/ml)	-0.009^{ns} (350)	0.012^{ns} (350)	-0.015^{ns} (350)	-0.004^{ns} (350)	0.096^{ns}(350)

*** P< 0.01; * P< 0.05; ns Non-Significant difference;* MY, Milk Yield.

DISCUSSION

Breed effect on composition and BCS: The results of this study revealed that crossbred animals showed satisfactory levels of protein and lactose and lowest fat contents. Buffaloes showed highest milk fat, protein and lactose contents. Holstein Friesian and Jersey could not perform well. Same was true for the two local cattle breeds, Sahiwal and Achai, which are well adapted to the environment but their dairy characteristics could not get improved due to lack of any research and development support. Although, the milk yield of beetal goats was the lowest among the dairy breeds of this study, still the level was satisfactory for the species.

The higher BCS was maintained by Azakheli, crossbred and Holstein-Friesian and medium by Nili-Ravi. As buffalo milk is preferred over cow's milk in this part of the world therefore, more inputs are diverted towards buffaloes rather than cattle. In addition, crossbred and Holstein-Friesian cattle were kept by the large state farms under proper housing and management conditions. Therefore, all these breeds maintained higher BCS, while poor BCS was showed by Achai, Sahiwal, Jersey and Beetal goats. Jersey is an exotic temperate area breed not compatible with the local environment. While Sahiwal, Achai and goats are maintained on low input cost. Moreover, there is no selective breeding for genetic improvement of these breeds. In the present study breed type significantly affected milk composition. Generally, there is an inverse relationship between milk fat and yield (Banerjee, 1980). Those breeds producing milk with high fat generally produce less milk (Eckles et al., 1973). Bovine milk yield is related to genetic, nutritional and environmental factors. Buffaloes and crossbred cattle are kept by the local farmers for higher milk yield, fat contents and good disease resistance status. According to Preston and Leng (1987) and Roman-Ponce (1987) these two breeds are well adapted to tropical conditions, producing in some cases 1000–3000 liters of high-fat milk per lactation. Our group Qureshi et al. (2000) evaluated records of 300 crossbred cows, produced through use of Holstein Friesian semen in native, nondescript cows between 1981 and 1995 under semiarid farming. Subsequent study (Qureshi et al., 2002b) revealed the dry period in local and Holstein Friesian crossbred cattle was 152.6 and 89.3 days, respectively (P<0.01) while the average milk recorded in local cows was 4.76 liters/day and in crossbred cows 7.13 liters/day (P< 0.01). The wide variation makes a good base for productivity enhancement through selective breeding. It was suggested that productive and reproductive performance was satisfactory in crossbred cattle under field conditions showing their adaptability to the local environment. Through genetic and management intervention development of Sunandini cattle breed was reported in Kerala state of India, which improved the dairy economy of the state (Chacko 2005).

Effect of BCS on milk yield and composition: Moderate BCS supported higher milk yield in buffaloes (Azakheli and Nili-Ravi). The milk yield was negatively correlated with BCS probably due to mobilization of body reserves, showing their better genetic potential to be used as dairy breeds under tropical conditions. This study confirms the previous report (Jílek et al., 2008) that cows with moderate BCS in the first month of lactation showed the highest milk yield during the first 5 months of lactation. Roche et al. (2007) reported that optimum calving BCS for milk production was approximately 3.5 in the 5-point scale. However, there was little increase in milk yield beyond a BCS of 3.0.

The high genetic merit dairy cattle have a higher predisposition for mobilization of body fat reserves to cover milk production demands (Pryce et al., 2002). This was demonstrated in cows selected for higher milk yield (Berry et al., 2003). These cows had lower BCS during lactation and their BCS changes after calving were higher than in cows with lower genetic merit (Horan et al., 2005). Thus, mobilization of body fat reserves and milk production are closely related (Pryce et al., 2002). Therefore, BCS and milk yield are in a negative correlation (Veerkamp and Brotherstone, 1997) and high-yielding dairy cows generally have a lower BCS (Pryce et al., 2001). Cows that are genetically inclined to lose more BCS in early lactation tend to have higher yields of milk, fat and protein (Dechow et al., 2002). Our findings of the negative correlation of BCS with milk yield are in conformity with these reports.

Conclusion: Higher milk yield was supported by moderate BCS in buffaloes. BCS correlated positively with fat and protein and negatively with lactose contents. These findings suggest that BCS may be used as a marker of milk yield and composition in dairy animals.

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