The present investigation was conducted to assess the nutritional status and biochemical profile of buffaloes under field conditions at the farmers’ level. The farmers were divided into four categories viz. landless, marginal, small, and large, depending on their land holdings. Measurement of body weight (BW) and body condition scores (BCS) along with blood biochemical profiling for glucose, total protein, albumin, albumin/ globulin (A/G) ratio, cholesterol, serum calcium and phosphorus were utilized for nutritional status assessment. The BW and BCS in the pooled population were 428.16±0.884 and 4.18±0.078, respectively. The BW of buffaloes differed significantly among all groups; whereas, the BCS of buffaloes did not differ significantly (P<0.05). The values of blood glucose, serum total protein, albumin, A/G ratio, cholesterol, Ca and P in the pooled population were 57.66±0.949 mg/dl, 6.85±0.058 g/dl, 3.08±0.039 g/dl, 0.83±0.019, 95.27±1.075 mg/dl, 9.42±0.102 mg/dl and 5.15±0.068 mg/dl, respectively. The values for blood glucose, total protein, albumin, A/G ratio and cholesterol were within the normal range, whereas, serum Ca and P were below normal. Based on the present observation, it was concluded that the buffaloes of this area are deficient in calcium and phosphorus, whereas their energy requirements are being met under field conditions at the smallholder farmers’ level.

Keywords: nutritional status, buffalo, blood biochemical profile

INTRODUCTION

Assessment of nutritional and health status of animals is invaluable in present-day animal husbandry. Body weights and body condition scoring are the commonly used methods of assessing nutritional status of animals. But as these methods have drawbacks, the use of blood metabolites in assessing the nutritional status of animals is becoming popular (Ndlovu et al., 2007). Blood metabolite levels indicate the extent of metabolism of energy, protein and other nutrients in animals. Blood metabolites can be used objectively, reliably and routinely to assess the nutritional status of buffaloes. In India, the use of these blood metabolites is rare due to lack of equipment for blood analysis and the high cost of analyzing the blood parameters. Several factors, such as physiological status of an animal, breed, nutrition, season and age affect levels of blood metabolites.

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Combining body weights, body condition scores and blood metabolites increases the accuracy of assessing the nutritional state and welfare of a buffalo population. Thus the present investigation was done to assess the nutritional status of buffaloes of farmers in different landholding categories under field conditions.

**MATERIALS AND METHODS**

The study was conducted in Sultanpur district of Uttar Pradesh. Farmers were selected on the basis of a stratified random design for the present investigation from the 30 villages of 10 blocks in 5 *tehsils*. The livestock owners were categorized in to four categories depending on their land holdings viz. a.) Landless labourers / Farmers (Livestock owners who had no land and whose mode of survival was labour); b.) Marginal farmers (Livestock owners who had up to 1.0 ha of land); c.) Small farmers (Livestock owners who had between 1.0 to 2.0 ha of land) and d.) Large farmers (Livestock owners who had above 2.0 ha of land).

The animals of the above farmers comprised the subject for the study. A total of 533 lactating buffalo were used for recording of body weight and body condition scores (BCS). The body weights of the individual animals were calculated by using the Minnesota formula (Verma, 1992). Body condition of the study animals was scored based on the criteria set by Richards *et al*. (1986) and ranged from 1 to 9.

For the analysis of blood metabolites, 30 animals from each category were selected randomly. Five to ten ml of blood was collected from the jugular vein of each animal. The blood was transported to the laboratory in ice, where serum was collected and stored at -20°C till further analysis. From the serum samples, glucose, total protein, cholesterol, albumin, calcium and phosphorus were measured using commercial kits (Span Diagnostics) as per manufacturer’s protocol.

Data thus generated were analyzed statistically using Graph Pad Prism version 5.00 software.

**RESULTS AND DISCUSSION**

The body weight, body condition scores (BCS) and blood metabolite data of the buffaloes of different categories of farmers are presented in Table 1.

The mean and SEM of body weight of buffaloes (kg) in the Landless, Marginal, Small and Large categories of farmers were 415.97±1.906, 423.20±1.250, 431.87±1.307 and 446.31±2.454, respectively. The overall body weight of the buffaloes was 428.16±0.884. There was a significant difference (P<0.05) in body weights of among the buffaloes of all categories of farmers.

The mean and SEM of BCS of the buffaloes of the Landless, Marginal, Small and Large categories of farmers were 3.83±0.051, 4.07±0.032, 4.37±0.216 and 4.46±0.061, respectively. The overall BCS of the buffaloes was 4.18±0.078. The BCS of buffaloes did not differ significantly (P<0.05) among the different categories of farmers.

Similar findings have also been reported by Chantalakhana *et al*. (1984) who studied the effect of seasonal fluctuations and parturition on body weight of swamp buffaloes. They found the body weight of the buffaloes to be within a range of 424.6±54.8 to 473.6±43.5.

However, higher body weights were
reported by Jogi and Lakhani (1996); they reported a mean body weight of 563.87±14.21 and 519.39±13.29 in adult male and female buffaloes on a livestock farm at Jabalpur. This difference could be attributed to the fact that Jogi and Lakhani observed the body weight on an organized farm and in Murrah buffaloes, which have higher body weights.

Even lower body weights were reported by Singh and Tulachan (2001). They reported adult body weights of 209 kg and 398 kg in the smallholder cattle and buffaloes of Uttaranchal. This may be due to the poor genetic conformation and nutritional status of animals in the hills.

The present findings concur with the study of Lanyasunya et al. (2006) who reported that dairy cows in zero grazing systems recorded higher body weights (480±75 kg) compared to those in free (338±39 kg) and semi-zero (397±59 kg) grazing systems, respectively. They also concluded that animals that are reared mainly on grazing land have in general lower body weight.

The mean and SEM of blood glucose (mg/dl) in the buffaloes of Landless, Marginal, Small and Large categories of farmers were 54.99±1.154, 55.87±1.302, 58.79±2.066 and 60.98±2.405, respectively. The blood glucose level in the overall population of buffaloes was 57.66±0.949. There was no significant difference (P<0.05) in blood glucose levels among buffaloes of different categories of farmers.

The mean and SEM of serum total protein (g/dl) in the buffaloes of Landless, Marginal, Small and Large categories of farmers were 6.51±0.089, 6.89±0.122, 6.91±0.086 and 7.07±0.098, respectively. The serum total protein (g/dl) level in the overall population of buffaloes was 6.85±0.058. There was a significant difference (P<0.05) in

Table 1. Body weight, BCS and blood biochemical parameters of buffaloes of different groups of farmers.

<table>
<thead>
<tr>
<th>Parameter/Animal</th>
<th>Landless</th>
<th>Marginal</th>
<th>Small</th>
<th>Large</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>415.97±1.906a</td>
<td>423.20±1.250b</td>
<td>431.87±1.307c</td>
<td>446.31±2.454d</td>
<td>428.16±0.884</td>
</tr>
<tr>
<td>BCS</td>
<td>3.83±0.051</td>
<td>4.07±0.032</td>
<td>4.37±0.216</td>
<td>4.46±0.061</td>
<td>4.18±0.078</td>
</tr>
<tr>
<td>Blood Glucose (mg/dl)</td>
<td>54.99±1.154</td>
<td>55.87±1.302</td>
<td>58.79±2.066</td>
<td>60.98±2.405</td>
<td>57.66±0.949</td>
</tr>
<tr>
<td>Total Protein (g/dl)</td>
<td>6.51±0.089a</td>
<td>6.89±0.122</td>
<td>6.91±0.086</td>
<td>7.07±0.098b</td>
<td>6.85±0.058</td>
</tr>
<tr>
<td>Albumin (g/dl)</td>
<td>2.88±0.094a</td>
<td>3.04±0.053</td>
<td>3.15±0.053</td>
<td>3.27±0.049b</td>
<td>3.08±0.039</td>
</tr>
<tr>
<td>Albumin/Globulin Ratio</td>
<td>0.81±0.050</td>
<td>0.79±0.034</td>
<td>0.84±0.036</td>
<td>0.87±0.037</td>
<td>0.83±0.019</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>88.83±1.557a</td>
<td>95.28±2.111ab</td>
<td>97.10±2.214b</td>
<td>99.86±0.957b</td>
<td>95.27±1.075</td>
</tr>
<tr>
<td>Calcium (mg/dl)</td>
<td>9.25±0.228</td>
<td>9.40±0.297</td>
<td>9.48±0.168</td>
<td>9.56±0.077</td>
<td>9.42±0.102</td>
</tr>
<tr>
<td>Phosphorus (mg/dl)</td>
<td>5.01±0.120</td>
<td>5.08±0.088</td>
<td>5.15±0.139</td>
<td>5.35±0.178</td>
<td>5.15±0.068</td>
</tr>
</tbody>
</table>

Values with different superscripts in a row differ significantly: (P<0.05).
serum total protein levels of buffaloes between the Landless and Large categories of farmers. Buffaloes of the other categories of farmers had no significant difference (P<0.05) in serum total protein levels.

The mean and SEM of serum albumin levels (g/dl) in the buffaloes of Landless, Marginal, Small and Large categories of farmers were 2.88±0.094, 3.04±0.053, 3.15±0.053 and 3.27±0.049 respectively. The serum albumin (g/dl) level in the overall population of buffaloes was 3.08±0.039. There was a significant difference (P<0.05) in serum albumin levels of buffaloes between Landless and Large categories of farmers. Buffaloes of the other categories of farmers had no significant difference (P<0.05) in serum albumin levels.

The mean and SEM of A/G ratio in the buffaloes of Landless, Marginal, Small and Large categories of farmers were 0.81±0.050, 0.79±0.034, 0.84±0.036 and 0.87±0.037, respectively. The A/G ratio in the overall population of buffaloes was 0.83±0.019. There was no significant difference (P<0.05) in albumin/ globulin ratio among the buffaloes of different categories of farmers.

The mean and SEM of serum cholesterol levels (mg/dl) in the buffaloes of Landless, Marginal, Small and Large categories of farmers were 88.83±1.557, 95.28±2.111, 97.10±2.214 and 99.86±0.957 respectively. The serum cholesterol level in the overall population of buffaloes was 95.27±1.075. There was a significant difference (P<0.05) in serum cholesterol levels of buffaloes between Landless and Small and Landless and Large categories of farmers. Serum cholesterol levels of buffaloes among the other categories of farmers did not differ significantly (P<0.05).

The mean values of glucose, protein and cholesterol were within the normal physiological range, whereas the levels of serum calcium and phosphorus were lower than the normal physiological range (Kaneko et al., 1997).

Typically, growth is measured as an increase in body weight, and it includes not only cell multiplication (hyperplasia) but also cell enlargement (hypertrophy) and incorporation of specific components from the environment (for example, apatite deposition) (Flier and Maratos-Flier, 2000). Growth can be monitored by using body weights. Body weights are commonly used because measurement is easier and quicker to perform and does not require much expertise. Body weights are commonly used for monitoring nutritional status and growth of animals (Chimonyo et al., 2000). However, the body weight of an animal per se does not reflect its nutritional status (Oulun, 2005).

Body condition scoring describes the systematic process of assessing the degree of fatness of an animal (Nicholson and Sayers, 1987). The score reflects the plane of nutrition on which an animal has been exposed over a reasonable length
of time (Stuth et al., 1998). The loin, ribs, tail head, brisket, flank, vulva and/or rectum and udder are the important parts of the body used in determining the score. Physiologically, the proportions of protein and water of the animal’s bodyweight decrease as it gains body condition (NRC, 1996). Several authors have documented association between body condition scoring and fertility (Buckley et al., 2003) and health (Roche and Berry, 2006).

The metabolic profile test in dairy animals is used to assess the nutritional status, to predict occurrence of metabolic diseases and to diagnose the diseases, and to assess the fertility status of animals (Ingraham and Kappus, 1988). But the success of the metabolic profile test is limited because several non-dietary factors like herd origin, stage of lactation, milk yield and season of the year affect the concentration of blood metabolites (Lee et al., 1978).

Blood metabolite concentrations represent an integrated index of the adequacy of nutrient supply in relation to nutrient utilization of buffaloes (Chester-Jones et al., 1990). They give an immediate indication of an animal’s nutritional status at that point in time (Pambu-Gollah et al., 2000). In the dairy industry, the use of metabolic profiles for assessing the nutritional and health status of cows is widespread (Doornenbal et al., 1988; Grunwaldt et al., 2005). Use of such metabolites in the management of field buffalo is still uncommon.

Blood glucose has a moderate diagnostic value in the assessment of nutritional status of buffaloes as it varies moderately in blood. Insufficient nutrient intake can reduce circulatory glucose and cholesterol levels. In conditions of undernutrition, the blood levels of propionate and other precursors derived from the diet decrease thus causing a reduction in the rate of glucose synthesis (Reynolds et al., 2003).

Total protein levels are lower in young animals and higher in mature animals whilst albumin levels are lower at birth and then increase (Doornenbal et al., 1988; Otto et al., 2000). Malnutrition decreases albumin levels. Total protein and albumin reflect availability of protein, and their concentration decline in the face of protein deficiency.

On the basis of above observations, it can be concluded that buffalo of unorganized smallholder farmers of Sultanpur district of Uttar Pradesh are deficit in the minerals calcium and phosphate whereas their energy requirements are being met with their diet. It is also concluded that blood biochemical profiles must be combined with traditional methods for assessment of nutritional status.

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