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Effect of cross species (buffalo) colostrum feeding on serum biochemical parameters in Vrindavani calves

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Abstract

Colostrum is essential for newborn calves as it provides essential nutrients and passive immunity required for survival, early growth and disease resistance. However, in field conditions cow colostrum may sometimes be unavailable or insufficient, making the search for a suitable alternative necessary. Since buffalo colostrum is known to contain higher levels of nutrients and immunoglobulins than cow colostrum, the present study was undertaken to evaluate its suitability as a cross-species colostrum source for Vrindavani calves. A total of twelve neonatal Vrindavani calves were divided equally into control (n = 6) and treatment (n = 6) groups. During the first three days after birth, calves in the control group received dam's colostrum whereas calves in the treatment group were fed buffalo colostrum at one-tenth of their body weight. Serum samples were collected for biochemical analysis and parameters such as total serum protein, albumin and urea were assessed. The results showed that the mean total serum protein concentration on day 3 was slightly higher in the treatment group (6.58 ± 0.13 g/dl) compared to the control group (6.46 ± 0.22 g/dl), although the difference was not statistically significant. Similarly, serum albumin and urea concentrations did not differ significantly between the two groups. Overall, the biochemical parameters observed in calves fed buffalo colostrum were comparable to those of calves fed dam's colostrum. These findings indicate that buffalo colostrum can serve as an effective alternative in situations where cow colostrum is unavailable or insufficient while dam's colostrum continues to remain the gold standard for neonatal calf feeding.

Keywords: Colostrum, total solid protein, globulin, urea, passive immunity

Introduction

Colostrum is the first mammary secretion produced immediately after parturition and is essential for the survival, immunity, and early growth of neonatal calves. The bioactive components in colostrum may act as mediators in the passive transfer of immunity, protect against pathogens, and contribute to cellular differentiation and growth (Paskaš *et al.*, 2025)^[5]. It is a rich source of nutrients and bioactive compounds, including proteins, fats, vitamins, minerals, growth factors, hormones, and immunoglobulins such as IgG, IgA, and IgM. Since calves are born with limited immune protection, timely intake of colostrum is critical for the passive transfer of immunity and for reducing the risk of neonatal morbidity and mortality. Buffalo colostrum contains higher levels of total solids, fat, lactose, ash, insulin-like growth factor-1 (IGF-1), and immunoglobulins, particularly IgA and IgM compared to cow colostrum. This richer nutritional and immunological profile suggests its potential use as an alternative colostrum source for calves, especially when maternal cow colostrum is unavailable or insufficient. Such situations are common in dairy management practices and may adversely affect calf health and growth if an effective substitute is not provided. Despite the significant contribution of buffaloes to dairy production, studies on the use of buffalo colostrum in feeding crossbred cattle calves are limited. In particular, there is insufficient information regarding its effects on growth performance, health status, and physiological responses in neonatal calves. Therefore, the present study was undertaken to evaluate the effect of feeding buffalo colostrum to Vrindavani (crossbred cattle) calves to assess its impact on serum biochemical thereby determining its suitability as an alternative colostrum source for neonatal calf rearing.

Materials and Methods

Experimental location and details

The experiment was conducted at the Cattle and Buffalo Farm of ICAR-Indian Veterinary Research Institute (ICAR-IVRI), Izatnagar, situated at 28°22' N latitude and 79°24' E longitude with an altitude of 169.2 m above mean sea level in the upper Gangetic plains of India. A total of 12 Vrindavani calves, possessing 50-75% exotic inheritance from Holstein Friesian, Brown Swiss, Jersey cattle, and Haryana cattle, were selected from the farm, and the study was carried out over a period of four months starting in April, 2022. The calves were equally divided into control (n = 6) and treatment (n = 6) groups. During the first three days after birth, calves in the control group were fed dam's colostrum, whereas those in the treatment group received buffalo colostrum at the rate of one-tenth of their body weight. From the 4th day to the 60th day, both groups were provided cow milk according to the standard feeding schedule followed at the farm, i.e., one-tenth of body weight up to 56 days and one-twentieth up to 60 days. From the second week onwards, green fodder and calf starter were offered to both groups as per the standard farm practices.

Housing and general management of calves in the control and treatment group

Throughout the experimental period, all calves were housed individually in clean, dry, and well-ventilated pucca floor pens. They were allowed outside the pens for about four hours each morning for exercise and to facilitate cleaning of the pens. Proper hygiene was maintained in the housing area, feeding utensils, and water containers throughout the study. Routine deworming was carried out from the second week of life, and all general health and management practices were followed according to the standard procedures of the Cattle and Buffalo Farm, ICAR-IVRI.

Collection and preservation of colostrum for characterisation and feeding

For feeding the treatment group, buffalo colostrum was collected from healthy Murrah buffalo immediately after calving, starting from the first milking up to the sixth milking over a period of three days during both morning and evening sessions milking. The collected colostrum was stored and preserved at -20 °C until use for feeding.

Collection of blood and storage of serum for analysis

Blood samples were collected from all experimental calves on 3rd day post-birth by jugular venipuncture for serum biochemical analyses and collected aseptically in 5 ml centrifuge tubes and allowed to clot at room temperature. Following clot formation, the samples were centrifuged for serum separation, and the harvested serum was carefully aliquoted into sterile storage tubes. The serum samples were then preserved at -20 °C in a deep freezer until further biochemical analysis. Further, biochemical parameters including total protein, albumin and urea were analysed to assess the physiological and metabolic status of the experimental calves.

Total Serum Protein (TSP)

Total serum protein was estimated by the Biuret method using a commercial kit (Erba Total Protein Kit). Total serum protein concentration was expressed as g/dL and calculated using the following formula:

$$\text{Total protein} = \frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times \text{Concentration of standard}$$

Serum Albumin

Serum albumin concentration was estimated by the Bromocresol Green (BCG) method using an Erba Albumin Kit and expressed as g/L.

Determination of urea concentration

The urea in serum was determined using the modified Berthelot method using the kit (Coral Urea kit).

Statistical analysis

The experimental data generated during the study were subjected to statistical analysis using Student's *t*-test in JMP software (version 9.0) to evaluate differences between the control and treatment groups. All data were expressed as mean ± standard error of the mean (SEM).

Results

Total Serum Protein

The total serum protein concentration in the serum of calves belonging to the control and treatment groups was determined by the Biuret method. Serum TSP concentration was measured in both groups to assess the increase following colostrum intake, which is associated with immunoglobulin absorption. The estimation carried out on the 3rd day of life indicated that the mean serum protein concentration was slightly higher in the treatment group (6.58 ± 0.13 g/dl) as compared to the control group (6.46 ± 0.22 g/dl); however, the difference between the two groups was not statistically significant.

Albumin

The albumin concentration in the serum of calves belonging to the control and treatment groups was determined by the Bromocresol Green method. Serum albumin concentration was estimated on the 3rd day of life. The results indicated that there was no significant difference between the two groups; however, the mean albumin concentration was higher in the control group (3.43 ± 0.19 g/dl) as compared to the treatment group (3.21 ± 0.17 g/dl).

Urea

The urea concentration in the serum of calves belonging to the control and treatment groups was determined by the modified Berthelot method. The estimation carried out on the 3rd day of life revealed no significant difference in serum urea concentration between the two groups. The mean serum urea levels were 10.71 ± 0.92 mg/dl and 11.57 ± 0.86 mg/dl in the control and treatment groups, respectively.

Discussion

Buffalo colostrum is reported to possess a richer nutritional composition than cow colostrum, with higher concentrations of total solids, fat, lactose, vitamin E, phosphorus, insulin-like growth factor-1 (IGF-1), and ash (El-Fattah *et al.*, 2012). In addition, the levels of immunoglobulins and IGF-1 in buffalo colostrum have been found to be comparatively higher than those present in bovine colostrum. The presence of higher antibody concentrations in colostrum contributes to adequate gamma globulin levels in the bloodstream of neonates, thereby enhancing passive immunity and improving disease resistance during early life. Although dam's colostrum is considered the most suitable source of

nutrition and immune protection for newborns, early access may not always be possible due to factors such as maternal death, multiple births, severe mastitis, poor maternal behaviour, or agalactia (Wereme *et al.*, 2001) ^[10]. Likewise, while cow colostrum is optimal for calves, its unavailability necessitates the exploration of suitable alternatives. Since buffalo colostrum is richer in various major constituents than cow colostrum, this study evaluated its effects on serum biochemical parameters of Vrindavani calves.

Total Serum Protein (TSP)

The TSP concentration carried out on the 3rd day of life indicated that the mean serum protein concentration was slightly higher in the treatment group (6.58±0.13 g/dl) as compared to the control group (6.46±0.22 g/dl); however, the difference between the two groups was not statistically significant. Rauprich *et al.* (2000) ^[8] similarly reported an increase in total protein and IgG concentrations after the first colostrum meal, which was attributed to the absorption of colostral IgG. Comparable observations were also made by Muri *et al.* (2005) ^[4], who reported an increase in TSP concentration to 5.45 g/dl after colostrum intake, which was lower than the values observed in the present study. Peckan *et al.* (2013) ^[7] suggested that the rise in total protein concentration may be due to an increase in the serum gamma globulin fraction resulting from intestinal absorption of immunoglobulins. In addition to immunoglobulin absorption, colostral proteins are also utilized by the neonate for protein synthesis. Kurz and Willett (1991) ^[3] observed that calves generally have lower TSP concentrations (5-7 g/dl) than adult cattle (6-8 g/dl). Several studies have also established a positive correlation between TSP and serum immunoglobulin concentration in calves. Tyler *et al.* (1998) ^[9] used TSP concentration during the first week of life as an indirect indicator of colostrum intake and passive transfer status. The increase in serum globulin and total protein concentrations following colostrum intake indicates that serum protein levels are influenced by colostrum feeding.

Albumin

The serum albumin concentration was determined on the 3rd day of life, and no significant difference was observed between the two groups. However, the mean albumin concentration was higher in the control group (3.43±0.19 g/dl) than in the treatment group (3.21±0.17 g/dl). Similar findings were reported by Peetsalu *et al.* (2022) ^[6], who observed a negative association between colostrum IgG concentration and serum albumin during the first week of life and suggested an inhibitory effect of colostral globulins on neonatal albumin synthesis. Kurz and Willett (1991) ^[3] also reported that albumin concentration decreased to 2.75 g/dl following colostrum intake, which was close to the lower reference limit for adult cattle. Furthermore, Peetsalu *et al.* (2022) ^[6] reported that although albumin is the predominant protein fraction at birth, its relative concentration decreases significantly after colostrum intake and then gradually increases during the first month of life.

Urea

The mean serum urea concentrations on day 3 were 10.71±0.92 and 11.57±0.86 U/ml in the control and treatment groups, respectively. There was no significant difference in the serum urea levels between the two groups, although the mean concentration was slightly higher in the

treatment group. Rauprich *et al.* (2000) ^[8] reported that higher urea levels partly reflected increased protein and fat intake and additionally indicated higher protein synthesis and lipid turnover. Elevated urea levels at 24 h after colostrum feeding were reported to result from protein breakdown. They also observed that BUN values peaked at 16.6 mg/dl at 12 h of age and subsequently decreased to 9.5 mg/dl at 72 h of age. The mean urea concentrations in both the control and treatment groups in the present study were almost similar to the values observed at 72 hours. Urea is synthesized by the liver and finally excreted by the kidneys, and its concentration is directly influenced by the total protein level. Bull *et al.* (1991) ^[2] also observed a similar trend in total serum proteins after colostrum feeding and found that urea followed a comparable pattern of change over time. It was further reported that serum urea concentration was influenced by the total protein level. Peckan *et al.* (2013) ^[7] suggested that an increase in BUN levels is generally associated with kidney diseases and, when observed concurrently with increased creatinine levels, may be interpreted as an indication of renal dysfunction. In the present study, however, creatinine levels were not found to be increased.

The independent increase in urea levels observed in both groups may be attributed to nutritional factors associated with a high-protein diet. Since colostrum is known to have a high protein content, mainly composed of immunoglobulins, the increased urea levels in both the control and treatment groups were attributed to nutrition, and the values remained within the normal reference intervals.

Conclusion

The significance of buffaloes in dairy production in our country is remarkable, and in many cases, buffaloes are reared alongside cattle. For successful and profitable dairy farming, the calf is considered the future of the herd. Its survival and development are critically dependent on early colostrum feeding; therefore, the present investigation on feeding buffalo colostrum as a cross-species source to cow calves was undertaken. Among the biochemical parameters, serum total protein, albumin, globulin, and urea were determined on day 3 of age in calves. The biochemical parameters observed in calves fed buffalo colostrum were comparable to those of calves fed dam's colostrum, suggesting that buffalo colostrum was nearly as effective as the dam's colostrum. Undoubtedly, the dam's colostrum remains the gold standard for feeding calves; however, in situations of unavailability or deficiency of cow colostrum, buffalo colostrum may serve as a suitable alternative for the survival, growth, and health performance of cattle calves.

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