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Effect of Fortified Soymilk as Partial Milk Replacer on Performance and Feeding Economics of Murrah Buffalo Calves

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ABSTRACT

The present study was conducted to study the effect of fortified soymilk as milk replacer on growth performance and feeding economics of Murrah buffalo calves. Twenty four Murrah buffalo calves of (5 days age) were randomly distributed to four dietary treatment groups (T_1, T_2, T_3 and T_4). T_1 was control group in which calves were reared on buffalo milk only. In T_2 and T_3 groups calves were fed with buffalo milk and soymilk fortified with vitamins and minerals in the ratio 40:60 and 20:80 respectively. Group T_4 was same as T_3 except that in this group fortified soymilk was again supplemented with enzymes (proteinase + xylanase + pectinase). Fortnightly body weight (kg) and average daily weight gain (g/d) of the calves were found statistically similar among different dietary treatments groups. Overall dry matter intake (g/d) was significantly ($P<0.05$) higher in calves of control group as compared to other groups. Minimum feed cost per kg weight gain was observed in T_4 group. The present study revealed that up to 80% buffalo milk can be replaced by soymilk fortified with vitamins, minerals and enzymes as economical substitute in buffalo calf feeding without any adverse effect on their performance.

Keywords: Body weight, buffalo calves, economics, fortified soymilk

In India, buffalo contributes 51 per cent of the total milk production (132.4 million tonnes), despite the fact that buffalo population is nearly half to that of cattle (BAHFS, 2014). Calves are the future of herd. The first three or four months of calf's life are very critical and their feeding programme at this period plays very important role in their growth and development. In the early age of development, calf only sustain on milk. Milk is known to facilitate early development of reticulorumen which subsequently lower weaning age and improve calf health (NRC, 2001).

The milk production of our indigenous animals is low and due to shortage of dam milk, many times calves do not get sufficient nutrients as per their requirements, which lead to stunted growth, delayed maturity and poor productive future life. Calves require a high quality protein to grow properly (Huber and Slade, 1967). However, since casein is not essential in the diet of young calf, alternative and more affordable protein sources may be used in milk replacers and calf starters (Leibholz, 1967).

Soymilk is a white emulsion which resembles buffalo milk in both appearance and consistency (Williams and Akiko, 2000). It is prepared from soybean (Glycine max) seeds. Soymilk as milk replacer has been used for artificial rearing of young animals in many countries (Ghorbani *et al*., 2007). Soymilk contains as much as 3.50 per cent protein, 2.00 per cent fat, 0.50 per cent ash and 2.90 per cent carbohydrate (Riaz, 2006). It is an inexpensive source of protein and calories which compares favorably with dairy milk and can be used as a vital and cheaper substitute for buffalo milk. Feed related weaning cost of calves is reduced after feeding soymilk instead of whole milk as whole milk is more expensive than soymilk (Ghorbani *et al*., 2007). Soymilk is having a composition very close to that of buffalo's milk and if soymilk is fortified

with certain vitamins and minerals its composition will resemble buffalo milk. Due to different amino acid compositions of alternative proteins, calves often do not have the proper digestive enzymes to breakdown non-milk proteins before their rumen is functioning (Zieliniski *et al.,* 1978). Fortification with enzymes can help to make non-milk protein sources more digestible and utilizable for the young calf.

Keeping in view this brief background, the present study was planned to evaluate the effect of fortified soymilk as milk replacer on growth performance and feeding economics of Murrah buffalo calves.

MATERIALS AND METHODS

The study was carried out at the Livestock Farm, Adhartal, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India.

Experimental design and dietary treatments

Twenty four Murrah buffalo calves (5 days age) were randomly distributed to four different dietary treatment groups (T_1, T_2, T_3 and T_4). T_1 was control group in which calves were reared on buffalo milk only. In T_2 and T_3 groups, calves were fed buffalo milk and soymilk fortified with vitamins (Vit.A+D_3+E+B_{12} @ 0.05 g/L) and minerals (Calcium @ 0.62 g/L + Phosphorous @ 2.80 g/L + Sodium @ 0.589 g/L + Zinc @ 8.18 mg/L + Iodine @ 0.026 mg/L) in the ratio 40:60 and 20:80 respectively. Group T_4 was same as T_3 except that in this group fortified soymilk was again supplemented with enzymes (proteinase @ 61154.8 IU/L + xylanase @ 16412.4 IU/L + pectinase @ 7535.75 IU/L).

During the experimental period of three months buffalo calves were offered weighed quantity of feed (Milk, calf starter and green fodder) to meet their nutrient requirement for growth (Kearl, 1982).

The chemical composition of different feeds offered to calves i.e. calf starter and green fodders (berseem and maize) are presented in Table 1. Mainly, the berseem and maize green fodders were available during the experiment in different periods.

Table 1: Chemical composition (%) of different feeds offered to calves (DM basis)

Attributes	Calf starter	Berseem green fodder	Maize green fodder
Dry matter	91.00	15.98	20.03
Crude protein	20.12	16.34	10.86
Ether extract	3.98	6.02	1.79
Crude fibre	7.86	25.01	26.42
Nitrogen free extract	59.72	41.32	51.83
Total ash	**8.32**	**11.31**	**9.11**

Preparation of soymilk

Soymilk was prepared from the large size and not more than one year old, yellowish varieties of soybean. For preparation of one litre of soymilk, 125 g ground soy flour was dissolved with 1000 ml of water and boiled at 100°C for 10-15 minutes with constant stirring. After cooling, it was strained with fine muslin cloth (Masum *et al.,* 2011). Thereafter, this soy-milk was used for feeding buffalo calves. The chemical composition of buffalo milk and soymilk is presented in Table 2.

Table 2: Chemical composition (%) of buffalo milk and soymilk (As such basis)

Attributes	Buffalo milk	Soymilk
Fat	6.69	2.91
Protein	3.52	3.65
Lactose/ Carbohydrate	4.84	3.81
Total ash	0.81	0.69
Total solid	16.43	11.19
Solid not fat	9.74	8.28

Parameters studied

Body weights of all the experimental calves were recorded at fortnightly interval. Overall average daily gain (ADG) was calculated based on the initial and final weight of the calves. Amount of feed offered and residue from all the experimental calves in different groups were weighed daily and sampled at weekly intervals for subsequent analysis of dry matter (DM) to assess daily dry matter intake. At the end of experiment, economics of feeding

buffalo calve was calculated by considering expenditure on various feeds.

Statistical analysis

The statistical analysis was performed using SPSS computer package (SPSS version 20.0, SPSS Inc., Chicago, USA) adopting standard statistical procedures (Snedecor and Cochran, 2004).

RESULTS AND DISCUSSION

Body weight and average daily gain (ADG)

Fortnightly body weight and overall average daily gain (ADG) of calves in different groups is presented in Table 3. Fortnightly body weights of experimental calves were statistically similar in different treatment groups during different fortnights fed various levels of soymilk as replacement to buffalo milk. When we compared the average daily gain (g/d) of the calves, overall average daily gain (g/d) was higher in calves under control group (T_1) than other treatment groups (T_2, T_3, and T_4) however, among the groups differences were not significant.

Table 3: Fortnightly body weight (kg) and overall average daily gain (g/d) in Murrah buffalo calves

Fortnights	T_1	T_2	T_3	T_4
Initial	29.72 ± 0.38	29.94 ± 0.06	29.80 ± 0.66	30.08 ± 0.63
1	33.98 ± 0.84	34.12 ± 0.29	33.52 ± 0.65	33.88 ± 0.89
2	38.44 ± 1.66	38.54 ± 0.33	37.66 ± 0.69	38.18 ± 0.92
3	43.52 ± 1.68	43.46 ± 0.44	42.40 ± 0.68	43.14 ± 0.88
4	49.26 ± 2.07	48.90 ± 0.67	47.66 ± 0.76	48.72 ± 0.87
5	55.82 ± 2.18	55.06 ± 0.61	53.58 ± 0.90	54.96 ± 0.87
6	62.80 ± 2.28	61.80 ± 0.40	60.22 ± 0.89	61.64 ± 0.82
Overall ADG	367.56 ± 21.94	354.00 ± 3.91	338.00 ± 5.06	350.67 ± 3.92

Recently, Shakya (2015) also did not observe any significant change in average daily gain of buffalo calves when whole milk was replaced by soymilk up to 40% level; however it was numerically reduced in soymilk fed dietary treatments, which is in agreement with our results. The results of the present study are supported by findings of Nitsan *et al.* (1972) and Wadud and Rahman (1978), who reported non-significantly higher weight gain in whole milk fed group than those fed milk replacer which might be due to low protein digestibility and reduced fat and ash absorption. Similarly, Campos and Huber (1983) has reported 20 per cent lower weight gain in Holstein calves when 50 per cent milk protein was replaced by soy protein. Kamble *et al.* (2003) has reported significantly lower weight gain in calves with increase in replacement level of soymilk, which is in partial agreement with the findings of the present study.

Total dry matter intake (DMI) and feed conversion ratio (FCR)

The fortnightly DMI (g/d) and overall FCR of calves among different groups during different fortnights are furnished in Table 4.

Table 4: Total dry matter intake (g/d) and FCR in Murrah buffalo calves

Fortnights	T_1	T_2	T_3	T_4
1	441.74^a ± 10.93	402.62^b ± 3.45	382.08^b ± 7.40	386.23^b ± 10.12
2	499.72^a ± 21.54	454.77^b ± 3.92	429.32^b ± 7.82	435.25^b ± 10.50
3	561.10^a ± 15.25	527.06^b ± 2.32	507.28^b ± 9.30	510.39^b ± 7.50
4	674.85^a ± 16.55	633.25^b ± 6.44	609.74^b ± 5.06	617.06^b ± 7.21
5	579.71^a ± 14.31	551.10^b ± 2.22	535.64^b ± 6.74	540.42^b ± 7.65
6	679.22^a ± 13.73	640.19^b ± 4.20	618.04^b ± 3.94	625.24^b ± 3.41
Overall Total DMI (g/d)	572.72^a ± 15.01	534.83^b ± 3.64	513.68^b ± 5.67	519.10^b ± 6.61
Overall Total DMI (g/kg $W^{0.75}$)	33.10 ± 1.49	31.02 ± 1.25	30.31 ± 0.71	30.20 ± 0.76
FCR	1.57 ± 0.06	1.51 ± 0.01	1.52 ± 0.02	1.48 ± 0.02

Means with different superscripts in a row differ significantly ($P<0.05$)

Fortnightly and overall DMI (g/d) was significantly ($P<0.05$) higher in calves of T_1 group followed by other groups. Overall DMI per kg metabolic body weight and FCR in calves were comparable in all the four groups (T_1, T_2, T_3 and T_4). The trend observed regarding total DMI of calves was because of our feeding pattern as per the design of the study. Our findings partly corroborate with the findings of Shakya (2015) who reported that overall DMI of soymilk fed calves was non-significantly lower than that of control group.

In present study, overall DMI per kg metabolic body weight of calves was comparable in all the four groups (T_1, T_2, T_3 and T_4). Supplementation of enzymes in calves of T_4 group did not influence their DMI significantly which is supported by Hooper *et al.* (1981) who observed that DMI was not affected by the enzyme level or addition of cofactor. The cumulative FCR indicated non-significant improvement in different dietary treatments as compared to control. FCR is the reflection of feed consumption and body weight hence accordingly values were observed. Results of present study regarding comparable feed efficiency in fortified soymilk fed calves are in agreement with Campos and Huber (1983) who reported no change in feed efficiency of calves in which 50 per cent milk protein was replaced by soy protein. Shakya (2015) also reported non-significant change in feed efficiency of calves fed soymilk up to 40 per cent level in replacement to whole milk.

Economics

Economics of feeding Murrah buffalo calves is presented in Table 5. Expenditure on the whole milk feeding was highest in the calves of T_1 group followed by T_2, T_3 and T_4 groups. Expenditure on fortified soymilk feeding was increased in T_2, T_3 and T_4, because only in these dietary treatments fortified soymilk was fed. The total feeding cost was highest in the calves of T_1 group while it was lowest in those under T_3 group.

The total feeding cost in group T_4 was slightly higher in comparison to T_3 due to supplementation of enzymes in their diet. However, maximum feeding cost per kg weight gain was observed in the calves of T_1 group and was reduced in T_2, T_3 as well as T_4 groups. The per cent saving over feed cost when compared to control group (T_1) was maximum in group T_4 (63.93) followed by T_3 (63.61) and T_2 (47.47) dietary treatments. The reduction in the cost of feeding in T_2, T_3 and T_4 dietary treatments is attributed to replacement of buffalo milk with fortified soymilk which was economically much cheaper than whole milk.

Table 5: Economics of feeding Murrah buffalo calves

Attributes	T_1	T_2	T_3	T_4
Cost of whole milk/calf/day (₹)	133.26	53.09	25.92	26.39
Cost of fortified soymilk/calf/day (₹)	0.00	12.69	16.52	17.30
Cost of calf starter/calf/day (₹)	2.67	2.66	2.64	2.64
Cost of green fodder/calf/day (₹)	0.67	0.67	0.66	0.67
Feeding cost/calf/day (₹)	136.60	69.11	45.74	47.00
Total feeding cost for 90 days/calf (₹)	12294	6219.9	4116.6	4230
Total weight gain/calf (kg)	33.08	31.86	30.42	31.56
Total feeding cost (₹)/kg weight gain	371.64	195.22	135.32	134.03
Total saving over feed cost in 90 days/calf (₹)	—	176.42	236.32	237.61
Percent saving over feed cost in 90 days	—	47.47	63.61	63.93

*Ingredients rates (₹): Whole milk, 44.0/kg; Fortified soymilk without enzymes, 7.01/kg; Fortified soymilk with enzymes, 7.21/kg; Green fodder, 2.0/kg, Calf starter, 21.64/kg.

In support to present results Kamble *et al.* (2003) and Ghorbani *et al.* (2007) reported that soymilk can act as an economic substitute for whole milk in calf-raising. Masum *et al.* (2009) inferred that soymilk as milk replacer can be used successfully for raising dairy calves. Similarly, Shakya (2015) also concluded that soymilk can replace whole buffalo milk up to 40 percent level to reduce the cost of rearing buffalo calves.

CONCLUSION

From the results of present study it was concluded that up to 80% buffalo milk can be replaced by soymilk fortified with vitamins, minerals and enzymes as economical substitute in buffalo calf feeding without any adverse effect on their performance.

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