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ORIGINAL ARTICLE

Effects of Partial Replacement of Milk with Whey on Growth Performance of Murrah Buffalo Calves

Nirbhay Kumar,[1] Manmohan Singh Rajput,[2] Birendra Singh[3] and Atul Kumar Rajput[4]
1* M.V.Sc. Scholar, Nana ji Deshmukh Veterinary Science University Jabalpur – 482001
2* Assistant Professor ND College Shikohabad Uttar Pradesh- 283135
3* PhD Scholar, Livestock Production Management, NDRI, Karnal Haryana
4* PhD Scholar, Livestock Production Management, IVRI, Izatnagar, Bareilly, UP

ABSTRACT

The present study was conducted at the Livestock Farm, Adhartal, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.), located at 85° longitude and 411 meters above mean sea level. The region experiences a light tropical, sub-humid climate with seasonal temperature variations ranging from 6.6°C to 41.9°C and an average annual rainfall of 1,415 mm. During the experimental period, ambient room temperatures ranged from 10°C to 25°C. Eighteen Murrah buffalo calves were randomly allocated into three groups (C, G1, and G2), with six calves in each group. Over a three-month milk-feeding period, the calves received diets with varying proportions of buffalo whole milk and paneer whey. Group C was fed 100% whole milk, Group G1 received 85% whole milk and 15% whey, while Group G2 was provided 75% whole milk and 25% whey. Initial average body weights (kg/calf) were 35.08±2.11, 34.82±1.51, and 37.20±1.13 for groups C, G1, and G2, respectively. Final average body weights were recorded as 59.13±3.42, 58.43±1.92, and 60.13±1.31 kg, respectively. Statistical analysis revealed significant differences among the groups. The results indicate that up to 25% of buffalo milk can be replaced with paneer whey without adverse effects on growth performance, feed intake, or economic viability. Therefore, the partial replacement of whole milk with whey is a cost-effective strategy for buffalo calf rearing."

Key words: *Murrah buffalo calves, partial milk replacer, Whey*

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INTRODUCTION

In India, buffalo plays a foremost role in the economy of poor land owner and landless people of rural India who owns in excess of 67% dairy animals. Buffalo provides 49.2% of the absolute milk yielding in India, in spite of the fact that population of buffalo is nearly half to that of cattle [1]. Besides this, they are also valued for meat and draught purposes. In the midst of various breeds, Murrah buffalo is the most competent milk producer and it has better adaptability in all over India. They are chiefly used for up-gradation of non-descript buffalo's breed in all over India and many other parts of the world. Colostrum and subsequently milk provide a complete diet for the neonatal calves during the initial phase of life [2]. Whole milk would be the most natural feed for young calves, but due to its high cost, milk replacers are commonly used [3]. Liquid feed used as a substitute for whole milk is known as milk replacers and the solid feed used to supplement or replace milk replacers is known as starter feed. The farmers feel burden to raise buffalo calves as it is considered as uneconomical, largely due to economic compulsion to sell milk for human consumption [4] Whey is a highly nutritious by product of cheese industry which can be utilized well when fed to animals in a variety of forms such as liquid whey, dried whey or dried whey products [5]. Whey protein is one of the highest qualities naturally-occurring proteins having a higher Protein Efficiency Ratio i.e., 3.0 to 3.2 as compared to casein i.e., 2.5 [6, 7]. Whey is the source of energy primarily because of its high lactose content. Whey is cheaper and is easily available and large amounts of milk products in the form of whey presently are wasted. Whey can be fed to calves to replace the whole milk and thus reduce the cost of rearing of calves. Whole milk provides good growth of calves and excellent health condition therefore we need a milk replacer which give similar nutrient as whole milk. Many countries have already developed milk replacer by using by-products of milk which is cheaper than whole milk. When high quality milk replacers are compared with full milk diets, performance is similar [8].

MATERIAL AND METHODS

Present experimental work was conducted at Livestock farm, Adhartal, College of Veterinary Science & Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.). The farm is situated on the tropics of cancer on 85° longitude and an elevation of 411 meters above the mean sea level. The climate of the region is light tropical, sub humid with a seasonal variation in temperature ranging from 6.6 to 41.9°C and an average annual rainfall of 1,415 mm. Room temperature ranged from 10-25°C during the experimental period. Experimental animals were conducted on fifteen days old eighteen healthy buffalo calves reared as per the guidelines of Institutional Animal Ethics Committee. All the selected animals were maintained under semi-intensive farming system and reared in individual calf pen (7ft X 5ft). Each pen fitted with feeder and waterer. Half of the total required quantity of milk and whey was offered daily in the morning at 6.30 a.m and rest of amount offered in the afternoon at 5.00 p.m. The water was kept available to animals round the clock. The calves were distributed into three different groups, namely C, G1 and G2 with six animals in each group. During three months milk feeding period, the buffalo calves were offered buffalo whole milk along with paneer whey in various proportions. In the C group feed was offered whole milk, In the G1 group feed was offered 85:15 (85% Whole milk + 15% Whey) and in the G2 group feed was offered 75:25 (75% Whole milk + 25% Whey). Other than milk feeding, rest of the managemental conditions was same for all the calves. Calf starter were formulated as per the guidelines given by ICAR, [10] feeding standards consisting of 23-24% CP and 70% TDN. Calf starter and good quality green fodder (berseem and maize) were offered in morning and evening from 15th days and onwards. Whey was prepared by heating buffalo milk to 82°C and citric acid was added at the rate of 2 g per kg of milk. Complete coagulation was effected within one minute and coagulum was collected by filtering through muslin cloth and left waste part is whey, which was used for feeding of calves as milk replacer during experimental period [9]. After cooling, whey was mixed with the buffalo milk with suitable proportions before feeding as per requirement of the experiment. Parameters recorded as Body weight, Average daily gain

$$\text{Weight gain} = \frac{W_2 - W_1}{t_2 - t_1}$$

$W_2 - W_1$ = Initial and final body weights of calf for a particular period $t_2 - t_1$ = Corresponding time units, feed intake and Cell-mediated immune response Cell-mediated immune response was measured in vivo by phyto heamagglutinin (PHA) skin test. On day 90, calves were injected by 150 µg of PHA in 0.1 ml of PBS with the help of tuberculin syringes. The site of injection was intradermal of posterior to the scapula. The skin fold thickness was measured before injection and 2, 4, 6, 8, 16, 24 and 48 hours after injection using vernier caliper. [11] After the experiment, the economic aspects of rearing buffalo calves up to three months were assessed. Costs included feed (calf starter and whey), milk, labor, and other expenses at market rates. Total spending and body weight gain were recorded, and the cost per kilogram of weight gain was calculated and compared between groups.

Statistical analysis

Data were analyzed by using one way ANOVA. Following mathematical model was used for one way ANOVA.

Mathematical model:

$$Y_{ij} = \mu + G_i + e_{ij}$$

Where;

- Y_{ij} represents the observation, under ith group (i=1, 2 and 3).
- μ is the general mean effect.
- G_i is the effect of ith group (i= 1, 2 and 3)
- The errors e_{ij} are assumed to be normally and independently (NID) distributed with mean zero and variance σ_e^2.

RESULTS AND DISCUSSION

In India, buffalo play a major role to improve the economy of poorer families. The population of buffaloes and production of buffalo milk is nearly half to that of cattle. For better production of buffalo milk, good calves are used to replace the older and less productive animals. That's why, good growth performance of calves are very important aspect. Due to high cost of milk and high demand for human consumption, whole milk is not provided to the calves thus the good growth performance of calves and survivability of calf will hamper.

Body weight changes

Good growth of calves is occurring in skeleton system. The skeletal system is the framework upon which the body is built. It consists of the bones and the muscles in the body. Whole milk provides essential nutrient which helps into growth of young calves. Rates of growth are expressed as the percentage increase of body size/weight (either as mass or height) [12].

Body weight changes on weekly basis were presented in table 01 and figure 01. Average body weight (kg/calf) of the Murrah buffalo calves at initiation of the experiment was 35.08±2.11, 34.82±1.51 and 37.20±1.13, respectively for C, G1 and G2 groups. Final average body weight (kg/calf) of the calves was 59.13±3.42, 58.43±1.92 and 60.13±1.31 respectively for the C, G1 and G2 groups. Statistical values show no significant difference was observed among the groups. Pinchasov *et al*. [19] found that there is no significant difference when fed liquid whey to high-yielding cows from 1 to 147 days of postpartum on body weight. Quigley *et al.* [20] found that body weight and body weight gain were improved when fed with milk replacer plus whey processed with β-galactosidase. Soberon *et al*. [24] reported that when only milk replacer was fed, higher proportions of whey protein concentrate improved calf performance (body weight gain), but, when starter was also provided, no effect of milk replacer was found. Bharti *et al.* [3] reported that the total body weight gains in whole milk based feeding group showed significantly higher weight gain than control and whey based commercial milk replacer feeding.

Table 1: Effect of whey as partial milk replacer on weekly body weight changes (kg) of Murrah buffalo calves

Week	C	G1	G2
2nd	35.08±2.11	34.82±1.51	37.20±1.13
3rd	36.35±2.28	36.65±1.64	38.52±1.37
4th	38.18±2.36	38.50±1.84	40.37±1.58
5th	39.98±2.37	40.48±1.89	42.17±1.73
6th	41.85±2.43	42.73±1.92	44.37±1.79
7th	43.98±2.55	44.88±2.00	46.43±1.82
8th	46.32±2.62	47.22±2.04	48.80±1.78
9th	48.42±2.67	49.45±2.03	51.00±1.70
10th	50.92±2.83	51.68±2.02	53.37±1.64
11th	53.45±3.03	53.92±2.00	55.75±1.54
12th	56.18±3.23	56.10±1.94	57.82±1.42
13th	59.13±3.42	58.43±1.92	60.13±1.31
Overall	**45.82±2.66**	**46.24±1.90**	**47.99±1.57**

Feed intake and dry matter intake

Young calves are allowed to suckle whole milk from dam which nourish calves at their earlier life because whole milk are the excellent source of energy, proteins and various important minerals for young ones. Thus quantity of whole milk and calf starter is important for better growth and health status of calves. Feeding whole milk is very costly in today's calf rearing practices and due to that involvement of a cheap and having rich nutritive value of milk replacer is used. According to NRC [18] calves fed with milk or milk replacer at the rate of 10 per cent of the body weight. The overall average total whole milk intake (l/calf) was 2.76±0.162, 2.37±0.100 and 2.18±0.074 in group C, G1 and G2, respectively. Average total whey intake was 0.418±0.018 and 0.726±0.025 in group G1 and G2, respectively The Initial average total daily dry matter intake (g/calf) were 683±41.58, 604.8±21.45 and 615±17.96 and final average total dry matter intake (g/calf) were 1155±28.61, 1114.0±18.85 and 1088±14.49 in C, G1 and G2 groups, respectively. The overall average total daily dry matter intake (g/calf) were 865±36.55, 849±27.20 and 840±22.41 in C, G1 and G2 groups, respectively. Statistically there was no significant difference, among the groups

Table 2: Effect of whey as partial milk replacer on average daily total dry matter intake (g/calf) in Murrah buffalo calves

Week	C	G1	G2
2nd	683±41.58	604.8±21.45	615±17.96
3rd	755±48.62	686.0±29.43	696±25.32
4th	824±46.25	775.2±38.09	795±30.90
5th	685±31.89	658.1±36.23	672±21.19
6th	766±32.97	755.6±35.67	753±26.39
7th	847±36.74	865.6±30.05	838±24.90
8th	934±39.05	955.4±26.25	922±30.30
9th	805±33.22	836.3±24.27	818±13.26
10th	886±34.90	907.9±22.79	886±26.17
11th	978±31.35	974.9±23.59	969±21.98
12th	1059±33.48	1049.4±19.69	1026±16.04
13th	1155±28.61	1114.0±18.85	1088±14.49
Overall	**865±36.55**	**849±27.20**	**840±22.41**

Restricted milk replacer or milk feeding to calves generally depressed their growth [13, 26], because of poor nutrient supply [14]. Whereas, *ad libitum* milk replacer or milk feeding to calves delayed the initiation of ruminal fermentation and development [15] due to depressed solid feed intake [16-19]. In the present study calf starter intake was very low during first few week. Similar findings were observed by Jesper and Weary [12], they observed consumption of calf starter was very low during first few week of age. Dry matter intake was lower in group G2 than G1 and C due to decreased dry matter consumption from milk. Similar finding were reported by Morrill and Dayton [17]. Quigley *et al*. [13] reported that addition of whey or galactosyl-lactose did not affect consumption of milk replacer. Yavuz *et al*. [26] reported that calves receiving starter with dry whey tended to start eating about two days earlier compared to calves receiving starter in the same physical form, but without milk products (dried whey). Huuskonen [8, 9] reported that there was no difference in feed conversion among treatments and the result indicated that both skim milk powder and whey-based products were suitable energy sources in milk replacers.

Economics of whey as partial milk replacer in Murrah buffalo calves

There are two main reasons to calculate economics of calves rearing, high feeding cost of calves rearing and high demand of milk for human consumption. To reduce the cost of rearing of calves milk replacers are used and whey is the cheapest by-product of milk industry which can be fed to animals in various proportions. Whey can be fed to calves as milk replacer to replace the whole milk thus reducing the cost of calves rearing. The average total whole milk (kg) of Murrah buffaloes, consumed per animal during the 3 month of experimental period were 244.30, 211.40 and 184.29, respectively in C, G1 and G2 groups. The average whey (kg) consumed per animal during the experimental period were 37.31 and 61.43, respectively, in G1 and G2 groups. The calf starter consumption during the whole experimental period was 21.42, 21.56 and 20.68 in group C, G1 and G2, respectively. Green fodder (kg/calf) intake was 56.59, 63.50 and 60.79 in C, G1 and G2 groups, respectively.

Conclusions

On the basis of findings of the present experiment, it can be concluded that whey can be used as partial milk replacer to the Murrah buffalo calves without affecting the growth, feed intake Partial replacement of whole milk with whey can be significantly decrease the recurring expenditure of buffalo calf rearing. Upto 25 per cent buffalo milk can be replaced by whey without much affecting the performance of the calves. On the basis of findings of the present experiment, it can be concluded that whey can be used as partial milk replacer to the Murrah buffalo calves without affecting the growth, feed intake

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