EFFECT OF SOYMILK AS PARTIAL MILK REPLACER ON FEED INTAKE AND GROWTH PERFORMANCE ON MURRAH BUFFALO CALVES

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ABSTRACT

This study investigated the effect of soymilk as a partial milk replacer on growth performance and feed intake on Murrah buffalo calves. The results of the experiment conducted on Murrah buffalo calves revealed that the body weight changes, daily feed intake, protein intake, dry matter intake, average daily dry matter intake from calf starter and green fodder (% body weight) were non-significantly ($P<0.05$) varied between the groups. The effect of feeding different proportions of whole milk and soymilk on growth and feed efficiency parameters like average daily body weight gain, feed conversion ratio were also found non-significant ($P<0.05$) between the groups. Body measurements like wither height was also non-significantly difference ($P>0.05$) between the groups. Body length was no significant difference ($P>0.05$) between M and SM20 groups. Body measurements were not significant different ($P>0.05$) between the groups. Blood parameters (PCV and Hb) and faecal score were also found non-significant between the different groups.

Keywords: growth performance, feed intake, faecal score, blood parameters, feed conversion ratio

INTRODUCTION

Calves are the future of the dairy farming. Calves at their pre-ruminant stage, solely depend on milk or such similar liquid feed which is indispensable for nourishment and gradually adapt to solid feed. Liquid feed used as a substitute for whole milk is known as milk replacers (NRC, 1989). 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 (Ranjhan, 1992). Many countries have already been developed alternatives of whole milk by using by-product of milk processing industries and successfully adopted to raise calves by reducing the amount of whole milk. Soybean meal is the most popular protein source in the animal feed industry, because of its high protein content and wide availability (Easter and Kim, 1999; Baker, 2000).

Soymilk as milk replacer has also been used for artificial rearing of young animals in many countries (Ghorbani *et al.*, 2007). Due to the lower nutrient content of soymilk than whole milk, its partial substitution for whole milk is possible. Substitution of milk with soymilk drives calf appetite toward dry starter feed. It stimulates butyrate and propionate production, and thereby hastens reticulo-rumen development (Baldwin *et*

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al., 2004). The faster reticulo-rumen development enables early weaning and reduces calf-raising costs (Davis and Drackley, 1998). Keeping in view of the above facts the study was designed to evaluate the effect of soymilk as partial milk replacer on feed intake and growth performance on Murrah buffalo calves.

MATERIALS AND METHODS

The study was conducted at Livestock farm, Adhartal, College of Veterinary Science and Animal Husbandry, N.D.V.S.U., Jabalpur (M.P.) for period of six months. Twelve Murrah buffalo calves with similar body weight of either sex at the age of 5 days were selected and randomly distributed in two different groups (M and SM20) with six calves in each group. Calves of the M group were reared on buffalo whole milk, whereas, SM20 groups were reared in combination of buffalo whole milk and soymilk in the proportion of 80:20. Calves were maintained under uniform managemental condition except milk feeding.

Milk was offered two times daily 1/10th of the body weight once in the morning and again in the afternoon. Green grasses and concentrate mixture were also supplied in the morning (6.30 am) and afternoon (5.00 pm) at the age of 10 days.

Detail feeding schedule of buffalo calves followed at livestock farm, is presented in Table 1.

The calves were weighed and their height, length, and heart-girth were measured initially at starting of the experiment and subsequently once a week in the morning before offering their feed throughout the experimental period. The stalls were cleaned and washed daily in the morning, when the leftover of the feeds were weighed. Proper sanitary measures were taken to protect the calves against parasitic infestation and the other contagious diseases. The water troughs filled with clean and fresh water were accessible to the calves while in the paddock.

Preparation of soymilk

Soymilk was prepared from the large size, thin hull and not more than one year old, straw yellow or yellowish varieties of soybean free from immature, field damage and black soybean. One kilogram of whole soybean was grounded in a soy flour mill. An amount of 125 g of powder was dissolved with 1,000 ml of water. It was then strained with fine muslin cloth. Thereafter, soymilk was boiled at 100°C for 10 to 15 minutes with constant stirring (Masum *et al.*, 2011). After cooling, soymilk was mixed with the buffalo milk with suitable proportions before feeding as per requirement of the experiment.

Calf starter was formulated as per formula depicted by Mishra and Singh (1993) with maize

Table 1. Feeding schedule of buffalo calves followed at livestock farm.

Age (days)	Colostrum and transition milk	Milk and soymilk	Calf starter (g)	Green fodder
0-5	1/10th of body weight	-	-	-
6-30	-	1/10th of body weight	125	Adlib
31-60	-	1/15th of body weight	250	Adlib
61-90	-	1/25th of body weight	250	Adlib

(50 kg), ground nut cake (30 kg), wheat bran (10 kg), fish meal (7 kg), mineral mixture (2 kg), common salt (1 kg), antibiotic (100 g), vitamins A, B2 and D3 (15 g) with 20% crude protein.

Daily feed consumption was recorded on the basis of fed offered and left over.

Analysis of feed, fodder and milk

Green grass and concentrate mixture were analyzed to know the dry matter, crude protein, ether extract, crude fibre, nitrogen free extract and total ash content as per the methods described in the manual of Association of Official Analytical Chemist (AOAC, 2003). Milk sample were analysed in the laboratory within 15 minutes after collection of sample by Lactoscan (Ultrasonic milk analyser, Netco Private Limited).

Haematological examination

For haematological examination (PCV and Hb), five ml blood was collected from each experimental animal at monthly interval in dried clean test tubes added with 0.1 ml anticoagulant (heparin) from jugular vein by taking all aseptic precautions from each animal in the morning just before feeding. All the observations were done with the help of auto analyzer, which works on the principle of electrical impedance. Due care was taken to maintain all aseptic condition with proper restraining of animals at the time of collection of blood samples.

Data was analysed, using ANOVA described by Snedecor and Cochran (1994).

RESULTS

Composition of calf starter and fodder

During the experimental period, it was observed that buffalo calves started consuming calf starter from 2nd week onwards and green fodder from 3rd week onwards. Berseem and maize fodder were available during the study period. Proximate compositions of calf starter, green fodders (berseem and maize) were analysed. Dry matter (%) content of calf starter, berseem and maize were 92.52, 16.81 and 24.51, respectively. Crude protein (%) content of calf starter, berseem and maize were 19.73, 18.45 and 13.55, respectively. Ether extract (%) content of calf starter, berseem and maize were 3.97, 6.04 and 4.85, respectively. Crude fibre (%) content of calf starter, berseem and maize were 8.06, 24.56 and 25.64, respectively. Nitrogen free extract (%) content of calf starter, berseem and maize were 60.00, 39.71 and 46.71, respectively. Total ash (%) content of calf starter, berseem and maize were 8.24, 11.24 and 9.25, respectively.

Body weight (BW) changes and average daily body weight gain

The body weight of all the calves were recorded at birth weight the initiation of experiment at the age of 5 days the calves were offered buffalo whole milk along with soymilk in desired combination. Average body weight (kg/calf) of the calves at the start of the experiment was 35.58±1.07 and 34.27±1.25, respectively for the M and SM20 groups. Final average body weight (kg/calf) of the calves were 62.75±1.10 and 61.05±2.20, respectively for the M and SM20 groups. No significant difference ($P>0.05$) between the groups was observed. Average daily gain (kg/calf) over the entire experimental period was 0.315±0.010 and 0.309±0.009, respectively for the M and SM20 groups. Statistical analysis of the parameter revealed that they were non-significantly ($P<0.05$) different. In the 2nd week of age initial average daily whole milk intake was 3.558±0.125 in M

group and soymilk was not offered in this group. Initial average daily whole milk and soymilk was 2.748±0.115 and 0.687±0.029 in SM20.

Feed intake and dry matter intake

The calf starter has direct influence on the feed intake of the calf which ultimately enhances the micro flora content of the premature developed rumen. Calf starter intake is directly correlated with the dry matter intake of the calves. Initial average daily calf starter intake (kg) was 0.035±0.003 and 0.036±0.002 and the final average daily calf starter intake were 0.324±0.006 and 0.355±0.005 in M and SM20 groups respectively. Statistically there was no significant difference, between the groups. At the 3rd week of age the Initial average daily green fodder intake (kg/calf) were 0.145±0.010 and 0.176±0.012 and the final average daily green fodder intake were 1.407±0.041 and 1.495±0.071 in M and SM20 groups, respectively. Statistically there was no significant difference, between the groups.

Initial average daily dry matter intake (kg/calf) from calf starter was 0.033±0.002, and 0.033±0.008 and the final average dry matter intake (kg) from calf starter were 0.298±0.004 and 0.327±0.015 in M and SM20 groups respectively. Statistically there was significant difference (P>0.05) in calf starter intake, between the groups. At the 3rd week of age the Initial average dry matter intake (kg) from green fodder were 0.029±0.002 and 0.029±0.006 and the final average dry matter intake (kg) from green fodder were 0.281±0.007 and 0.299±0.012 in M and SM20 groups, respectively. Statistically there was no significant difference, between the groups.

The overall average daily total dry matter intake (kg/calf) of Murrah buffalo calves were 0.790±0.011 and 0.736±0.011 in M and SM20 groups, respectively. Whereas, initial average daily total dry matter intake were 0.616±0.018 and 0.523±0.033 and the final average daily total dry matter intake were 0.972±0.005 and 0.958±0.029 in M and SM20 groups respectively. Statistically there was no significant difference between the groups. Initial average daily total dry matter intake (% body weight) were 1.66±0.018, and 1.47±0.033 and the final average total dry matter intake (% body weight) were 1.55±0.005 and 1.57±0.029 in M and SM20 groups, respectively. Statistically there was no significant difference between the groups. The overall average daily crude protein intake (kg/calf) in Murrah buffalo calves were 0.171±0.011 and 0.164±0.011 in M and SM20 groups respectively. Whereas, initial average daily crude protein intake (kg/calf) were 0.143±0.004 and 0.126±0.004 and the final average daily crude protein intake (kg/calf) were 0.204±0.001 and 0.203±0.004 in M and SM20 groups respectively. Statistically there was no significant difference between the groups.

Efficiency of feed utilization

The result of the feed untilisation efficiency is presented in Table 2. The overall weight gain (kg) was 27.175±1.241 and 26.777±1.762 in M and SM20 groups. The overall dry matter intake (kg/day) was 0.790±0.011 and 0.736±0.011 in M and SM20 groups. There was no significant difference between the groups. Feed conversion ratio was 2.503±0.008 and 2.382±0.014 in M and SM20 groups. There was no significant difference between the groups. Crude protein intake was (kg/day) 0.171±0.011 and 0.164±0.011 in M and SM20 groups. There was no significant difference (P<0.05) between the groups. Crude protein intake (kg/kg body weight gain) was 0.541±0.002 and 0.529±0.009 in M and SM20 groups. There was no significant difference (P<0.05) between the groups.

Table 2. Effect of soymilk as partial milk replacer on growth rate and feed conversion efficiency of Murrah buffalo calves.

Parameters	M	SM20
Initial weight of calf (kg)	35.580±1.071	34.271±1.251
Final weight of calf (kg)	62.750±1.101	61.050±2.202
Weight gain of calf (kg)	27.175±1.241	26.777±1.762
Average daily gain (kg)	0.315±0.010	0.309±0.009
Dry matter intake (kg/day)	0.790±0.011	0.736±0.011
Feed conversion ratio	2.503±0.008	2.382±0.014
Crude protein intake (kg/day)	0.171±0.011	0.164±0.011
Crude protein intake (kg/kg body weight gain)	0.541±0.002	0.529±0.009
Gain/dry matter intake	0.399±0.002	0.419±0.004

Gain/dry matter intake were 0.399±0.002 and 0.419±0.004 in M and SM20 groups. There was no significant difference (P<0.05) between the groups. Body measurements.

The detail body measurements of both the groups are presented below.

Withers height

At the start of experiment initial withers height (cm) of Murrah buffalo calves were 72.167±1.869 and 72.667±0.615 in M and SM20 groups respectively. However, at last fortnight withers height (cm) were 94.333±1.994 and 91.667±3.612 in M and SM20 groups respectively. Statistically, there was no significant difference (P>0.05) between the groups.

Body length

At the start of experiment initial body length (cm) of Murrah buffalo calves were 87.667±2.789 and 93.500±1.384 in M and SM20 group respectively. However at last fortnight body length (cm) were 117.500±1.708 and 118.500±1.979 in M and SM20 group respectively. Statistically, there was no significant difference (P>0.05) between M and SM20 group.

Heart girth

At the start of experiment initial heart girth (cm) of Murrah buffalo calves were 73.000±2.620 and 74.167±0.703 in M and SM20 groups respectively. However at last fortnight hearth girth (cm) were 105.000±1.807 and 105.333±4.890 in M and SM20 groups respectively. Statistically, there was no significant difference (P>0.05) among the groups.

Haematological parameters

The detail blood parameters are presented in Table 3. The initial value of PCV (%) was 31.23±2.62 and 29.31±02.33 and the initial value of Hb (g/dl) was 11.22±0.92 and 12.21±1.03, respectively for the M and SM20 groups. The final value of PCV (%) was 32.11±1.92 and 29.20±2.94 and final value of Hb (g/dl) was 13.12±1.12 and 10.58±1.33, respectively for the M and SM20 groups, statistical analysis reveals that there was no significant difference between the experimental groups.

DISCUSSION

Composition of buffalo whole milk and soymilk

In the present study, composition of buffalo milk, offered to the buffalo calves was evaluated regularly and found within the normal range (Banerjee, 1998). Soymilk, the water extract of soybeans, is typically produced by grinding the soaked soybeans with water. As an inexpensive and convenient source of high quality proteins, soy milk is one of the most important traditional beverages that are consumed widely in many countries. Soymilk possesses a balanced nutrient combination, which is similar to cow's milk. However, the presence of natural anti-nutrients, such as trypsin inhibitors (TI), lectins, phytic acids and indigestible oligosaccharides, has limited its consumption. The heating process during conventional soy milk making considerably destroys most of the anti-nutritional factors in soy milk and improves the digestibility of soy protein, as well (Jiang *et al.*, 2013). In the present study, detail composition (%) of soymilk was evaluated and fat, protein, carbohydrate, total solid and solid not fat content (%) were 2.82, 3.95, 3.52, 0.62, 10.91 and 8.09, respectively. Similar soymilk composition was reported by Masum *et al.* (2009) and Masum *et al.* (2011).

Body weight (BW) changes and average daily body weight gain

Growth in young calves before weaning mainly occurs in the skeleton and muscle systems. Tissue growth is largely a function of protein deposition in bone and muscle, with corresponding mineralization of the protein matrix in bone. Rates of growth expressed as the percentage increase of body size/weight (either as mass or height) (Kertz *et al.*, 1998). Body weight at early age also has an important bearing on the life time performance including growth, production and reproduction. Body weight is commonly used for monitoring nutritional status and growth of animals (Chimonyo *et al.*, 2000; Ndlovu *et al.*, 2007). In the present study, body weight changes were slow at the initial phase in the both groups. Average daily gain was higher in the whole milk fed group in comparison to the soymilk fed groups, although values were non-significant. The result of the present study agrees with the findings of Wadud and Rahman (1978); Rahman *et al.* (1988) who found that weight gain of whole milk feeding group was little higher than that of different milk replacer groups but the weight gain was not significant (P>0.05).

Feed intake and dry matter intake

In conventional system, buffalo calves are allowed to suckle milk from dam. Whole milk is an

Table 3. Effect of soymilk as partial milk replacer on blood parameter in Murrah buffalo calves.

Month	Parameters	M	SM20
1st	PCV (%)	31.23±2.62	29.31±2.33
	Hb (g/dl)	11.22±0.92	12.21±1.03
2nd	PCV (%)	33.33±3.12	30.25±2.54
	Hb (g/dl)	12.22±0.92	10.11±1.13
3rd	PCV (%)	32.11±1.92	29.20±2.94
	Hb (g/dl)	13.12±1.12	10.58±1.33

excellent source of energy, proteins and important minerals for the young one. Newly born calves have limited energy reserves; therefore, provision of adequate quantities of milk and milk replacers is vital for growth and health status. Liquid feeding is an important and a costly component in modern calf rearing practices, involving the use of milk or milk replacers as liquid feeds. According to NRC (2001) calves should be fed either on milk or milk replacer at 10% of their body weight. In the present study, buffalo calves are separated from the dam and they are artificially raised without suckling. Calves were offered milk or milk with soymilk 10% of their body weight initially, later the requirements were modified as the age increases. Besides milk, the calves were offered calf starter and green fodders from 2nd week. Calf starter was prepared in the farm according the formula described in the materials and method section. Farm grown good quality green fodders were offered to the calves from 2nd week onwards.Unlike liquid feeds, solid feeds are directed to rumen for digestion instead of abomasum. During the first few weeks, calf starter intake is low, due to ample liquid feeds intake which depresses starter intake. Consumption of solid feed is of paramount importance in successful transition from simple stomach to a ruminant. New born calves have adequate amount of bacterial population even at early days of their life but the development has been found to be affected by the dry feed consumption (Anderson *et al.*, 1987). Therefore, access to calf starter feed as early as possible encourages starter intake and consequently early rumen development.

Generally, amount and feeding method of milk replacer rather than its composition effect the solid feed consumptions in calves during pre-weaning and early post-weaning periods (Quigley *et al.*, 2006). Restricted milk replacer or milk feeding to calves generally depressed their growth (Jasper and Weary, 2002), health and behaviour (Huzzey *et al.*, 2006) because of poor nutrients supply (Khan *et al.*, 2007a). Whereas, adlib milk replacer or milk feeding to calves delayed the initiation of ruminal fermentation and development (Baldwin *et al.*, 2004) due to depressed solid feed intake (Hammon *et al.*, 2002; Jensen, 2006; Quigley *et al.*, 2006). In the present study, total solid contents were low in the soymilk supplemented group (SM20) in comparison to the whole milk fed group (M). This may favour the consumption calf starter at early age in the soymilk supplemented group (SM20). The calves started taking calf starter at 9th day of age in the SM20 group. Gradual increased of calf starter intake upto weaning age indicates the appetite towards the calf starter. It was also observed that calf starter intake was higher in the soymilk fed group (SM20), although the value was non-significant. In agreement of the present study, Jasper and Weary (2002) reported similar results. They found that the consumption of calf starter was very low during first few week of age.

The reduction in supply of nutrients from milk or milk promotes higher starter intakes to fulfill higher growth demands. Calves fed limited amount of milk consumed double amount of starter as compared to those fed adlib milk during the pre-weaning period. Adding calf starter to the diet of the young calf provides the opportunity for rumen development and growth. The grain is fermented in the tiny rumen which produces volatile fatty acids, which leads to rumen growth, which leads to a need for water and starter grain, which leads to more rumen development.

In the present study, non-significantly lower dry matter intake was reported in the SM20 group in comparison to the M group. This may have contributed to reduced growth rate in the

SM20 group during the study. However, it should be noted that the reduced nutrient intake in the SM20 group was not due to palatability but was attributed to the experimental design. Whole milk was replaced with 20% soymilk in the SM20 group on a wet basis regardless of its nutrient content. This enabled the study to examine the proposal that partial replacement of whole milk with soymilk (possessing fewer nutrients than whole milk per unit of liquid) drives calf appetite toward dry feed and stimulates higher starter intake. This theory was proved later by the fact that soymilk-fed calves achieved the weaning criterion earlier than calves on whole milk. The present study also demonstrates that soymilk can partially replace whole milk.

Efficiency of feed utilization

Efficiency of feed utilisation determines how efficiently feed is utilised for the growth of the calves. McDonald *et al.* (1995) stated that an important factor which was essential to consider was the amount of feed consumed by an animal in a certain period of time. The optimum amount of feed consumed each day, the greater will be the opportunity for increasing daily growth. An increase in growth obtained by higher feed intake is usually associated with an increase in overall efficiency of the production. Since, maintenance costs are decreased proportionately as growth rises in a certain period. In the present study, feed conversion ratio was 2.503±0.008 and 2.382±0.014 in M and SM20 groups. There was no significant difference ($P<0.05$) between the groups. The result of the present study is in agreement with the findings of Masum *et al.* (2009 and 2011).

Body measurements

In the present study various body measurements (body length, heart girth and withers height) were taken in all the buffalo calves. Statistical analysis revealed that there were no significant differences of body measurements among the groups. Body measurements provides the overall gross picture of skeletal and tissue growth of the animals. A clear increment of the body measurements were found as the age progresses in all the groups of the present study. Similar findings were reported by Wadud and Rahman (1978); Rahman *et al.* (1988); Mete *et al.* (2000) when calves were fed milk and milk replacer.

On the basis of the findings of the present experiment, it can be concluded that soymilk up to 20% can be used as partial milk replacer to the Murrah buffalo calves without affecting the growth, feed intake, feed conversion efficiency, body measurements and blood parameters.

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