EVALUATION OF THE PONDERAL DEVELOPMENT OF MURRAH BUFFALO CALVES SUBMITTED TO DIFFERENT FORMS OF BREASTFEEDING

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ABSTRACT

Buffaloes are versatile animals, since they allow the economic exploitation of their milk, meat and work production, besides adapting to tropical edaphoclimatic conditions. In the Southwest region of São Paulo, there is a predominance of milk production of buffaloes destined for dairy products specializing in the production of derivatives, especially mozzarella cheese. The present study was developed in a property located in the city of Alambari - SP, specialized in the production of milk of buffalo Murrah, with 21 animals born between March and May 2017. Buffalo calves were separated from mothers with 24 to 48 h of life and kept in an Argentine-type calf, so that they had free access to shade, water and ration during all the hours of the day, until the 90 days of age. The buffalo calves were divided into three treatments: 1) milk of buffaloes, succedaneum, water, and feed; 2) succedaneum, water and feed; and 3) milk of buffaloes *in natura*, water and feed (control). Exclusive breastfeeding with buffalo milk (control) resulted in weight gain of 640±43.1 g/day, treatment with milk + succedaneum gained 451±43.1 g/day, whereas the treatment that received succedaneum alone gained 381±39.0 g/day. The results obtained demonstrated that the weight gain of the control treatment has a statistically significant difference in relation to the other treatments. The use of commercial bovine substitutes as an integral substitute for buffalo milk for the buffalo calves Murrah demonstrated considerable weight gain.

Keywords: *Bubalus bubalis*, buffaloes, early weaning, succedaneum, weight gain

INTRODUCTION

In the southwestern region of the State of São Paulo, there has been an expressive expansion in buffalo production since the 1980s, making the region one of the most important buffalo milk production basins in the State of São Paulo (Rodrigues *et al*., 2008).

The predominant race in the southwestern region of São Paulo is Murrah. Murrah buffaloes are robust and have a well-developed udder, with well-marked veins and well-framed quarters. The ceilings are easy to manipulate and traction and the descent of the milk is fast. All this makes them excellent milk-producing animals. With good nutrition they produce more milk, between 1,500 and 4,000 liters, in an average of 300 days

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1,500 and 4,000 liters, in an average of 300 days of lactation, with fat content higher than the other races. The production can increase until the fourth lactation and then it declines very slowly (Verdurico, 2010).

Research efforts are needed to establish pre-weaning and post-weaning nutritional regimes and feeding management systems for buffalo calves bred for both distinct purposes, milk and meat production (Sarwar *et al*., 2009). The present work had the objective of evaluating different feeding strategies in a system of intensive management of buffalo calves of the Murrah breed, aiming at the early weaning of the animals with satisfactory weight development.

MATERIALS AND METHODS

The research was developed in the field after analysis and approval of the Committee of Ethics in Animal Experimentation of the Biological Institute of São Paulo under registration number 151/17, book 01, leaf 51, dated 01/26/2017.

The experiment was carried out in a dairy farm located in the municipality of Alambari, Latitude 23º 33 '08 "S and Longitude 47º 55' 56" W, in the southwest region of the state of São Paulo. The cattle establishment had buffalo milking twice a day, with no calves on foot but with exogenous oxytocin. The herd of the estate was predominantly composed of Murrah animals. Twenty-one animals were monitored, 12 males and 9 females newborn animals. The calves remained with the mother until 48 h of life for colostrum suckling and then they were separated, being housed individually in an Argentine-type calf. The animals were contained by a 1.5 m rope tied around the animal's neck, the other end being attached to a rotating tab, which

ran through an 8-meter-long steel wire stuck to the ground by buried wooden stumps in the east - west direction and perpendicular to the shade orientation, so that they had free access to shade during all hours of the day. The space explored by each animal was approximately 33 m².

The buffalo calves received buffalo milk until the 9th day of life when they were then separated into 8 homogeneous blocks according to the sex, weight and dates of birth and casually distributed in treatments according to the diet:

Control: fed with 4 liters of whole buffalo milk from 10th to 90th day.

Milk replacer: suckling with 2 liters of whole buffalo milk and 2 liters of milk replacer succedaneum mixed in the bucket from the 10th to the 30th day of life. After this period they had 4 liters of substitute supplied in the bucket from the 31st to the 90th day of life.

Milk replacer succedaneum: fed with 4 liters of milk replacer succedaneum in the bucket from the 10th to the 90th day of life.

Each treatment had 7 animals, 3 females and 4 males, which were evaluated until complete weaning, which occurred when the animals reached the 91th day of life.

From the 9th day of life the animals started to receive initial concentrate *ad libitum* (Table 1). Feed consumption (concentrate and liquid diet) was monitored daily by weighing leftovers.

The commercial milk replacer (Sprayfo Blue) was used as a partial and total substitute for buffalo milk, which was diluted in the ratio of 140 grams of milk powder to 1 liter of water, resulting in a liquid diet of 14% solids. The preparation of the buffalo milk substitute was carried out by adding water at a temperature of 38 to 40ºC, measured with thermometer, on the previously weighed substitute with frequent agitation until

the complete homogenization of the mixture and subsequent placement in the plastic bottles and buckets for the supply to animals with a temperature of approximately 35°C.

The animals received the *in natura* milk or the milk replacer succedaneum in two daily meals (morning and trade), initially in bottles and later were trained to drink in the individual plastic buckets. The training was performed at the moment of suckling by placing the suckling spout on the bottom of the bucket with milk or milk replacer succedaneum until the animal acquired the habit of sucking the milk without intervention of the handler.

The navel disinfection of the newborn buffalo calves was done 24 to 48 h after birth, when the newborns were separated from their mothers with the umbicura product. The prevention of endo and ectoparasites of the animals was performed with the active principles of Levamisole Sulfate 18.8% and Ivermectin 4% in applications in the first and third month of life of the animals. The prevention of eimeriosis was performed in animals between 7 and 15 days of age with application of 12 ml of toltrazuril 5%.

The calves were weighed at birth, fortnightly and at the weaning for the monitoring of weight gain in scales of the Açôres brand, measured with an object of known weight, and the thoracic perimeters of the animals were measured using a tape measure of the Paranaense Association of Holstein Cattle Breeders of the Dutch Race, on the same weighing dates.

Samples of whole buffalo milk, the substitute and the feed used in this research were collected for the purpose of conducting a bromatological analysis and the accurate verification of the nutritional content of each feed given to buffalo calves every 15 days. The samples were analyzed in the laboratories of the Department of Animal Science of ESALQ / USP.

The data were analyzed with the STATISTICAL ANALYSIS SYSTEM package (SAS Inst. Inc., Cary, NC). Before the analyzes, the data were analyzed in relation to the presence of discrepant information (outliers) and normality of the residues (Shapiro-Wilk). When the normality premise was not met, logarithmic or square root transformation was required. The performance data were analyzed according to the Mixed Proc. For mixed models, with the collection days being repeated measures. For the analysis, 15 different covariance structures tested were evaluated, being the best fit to the chosen statistical model based on the lowest value of the corrected Akaike information criterion (AICC) (Wang; Goonewardene, 2004).

The model included fixed effects of treatment, time and interaction time, as well as the covariant initial weight. Block effect, formed as a function of birth weight and calf sex, was included in the model as a random effect. For all variables, the comparison between the treatments was performed according to the adjusted Tukey test, in the same manner as for all the tests performed, with a significance level of 5% being adopted.

RESULTS AND DISCUSSION

The three treatments tested presented different levels of daily intake of dry matter, crude protein and ether extract verified with the bromatological analysis of all the foods used in the research.

The daily intake of dry matter, crude protein and ether extract were higher in the treatment that received only the milk of buffaloes, intermediate in the treatment that received milk

of buffaloes + succedaneum and inferior in the treatment that only received the succedaneum, according to Table 2.

Weaning should not occur due to age, but independently of this, it can be done conveniently when buffalo calves reach about 75 kg live weight (Vecchio, 2010).

In the present study, it was not observed the difficulty of buffalo calves in adapting to artificial feeding with the use of bottles and buckets. The results obtained by Snel-oliveira *et al.* (2004) demonstrate that artificial liquid diet feeding is a viable alternative for buffaloes.

The milk replacer used in this research proved to be a viable and adequate alternative to the creation of newborn buffalo calves. In the study by Snel-oliveira *et al.* (2004) did not observe statistical difference between the weights of the animals nor between the average daily gain during the natural and artificial breastfeeding period nor between the sexes, indicating that the artificial feeding system does not compromise the performance of buffalo calves, provided that the milk supplied is of adequate quantity and quality.

Buffalo calves benefit from early weaning systems through improvements in rumen digestion efficiency. The general observations on the performance of animals with early weaning presented little variation in relation to that of late weaning. However, it is considered necessary to evaluate the effect of early weaning on the performance of adult buffaloes in planned experiments (Ahmed; El-Shazly, 1975).

The animals of this research were fed twice a day, with 2 liters of liquid feed during the morning and 2 liters during the afternoon. Vecchio *et al.* (2013) comment in their study that although water buffalo in Italy is created by modern techniques similar to those applied to dairy cattle,

the management of calves from birth to weaning still has room for improvement.

Two animals that did not adapt to T1 treatment were removed from the study. In the study by Abbas *et al.* (2017) two buffalo calves did not accept feeding into the bottle until the end of the experiment and were removed from the study.

The average daily intake of concentrate was similar in the three evaluated treatments, but the control treatment presented animals that were weaned with greater daily consumption of ration, when compared to the other evaluated treatments. The daily intake of liquid diet was almost the same in the three treatments studied, Table 3. In the study by Ahmad *et al.* (2004) treatment A received specific initial feed for buffalo calves while treatment B received a conventional feed. Treatment A animals gained 470 g/day, while treatment B animals gained 340 g/day. The values obtained in the daily weight gain of treatments A and B demonstrated a statistically significant difference. The cost per kilogram of weight gain and the total cost of feeding for buffalo calves fed the initial ration were higher than the calves fed the conventional ration, but the net gain was similar in both groups. As the buffalo calves fed with initial feed presented greater weight gain, they grew faster and reached maturity sooner than the buffalo calves fed the conventional feed.

The feed consumption of buffalo calves in the first four weeks of life is low and shows a marked increase from the fifth to the fourteenth week of life. The reduced consumption in the first month does not mean that the concentrate should not be supplied during this period, but that it should be offered in small quantities so that the buffalo calves are adapted and attracted to consume in larger quantities in subsequent periods, as shown in Figure 1.

Regarding the average weight gain of the study period, the control treatment presented a statistically significant difference in relation to T1 and T2 treatments. The final weight of the control treatment was higher and showed a statistically significant difference in relation to T1 and T2 treatment, among which there was no statistical difference observed.

The daily weight gain and the thoracic perimeter of the control treatment were superior when compared to T1 and T2 treatments, as shown in Table 4. Arbabi *et al.* (2011) studying male Nali-Ravi buffalo calves found daily weight gains ranging from 420 to 520 g/day.

Cruz and Cabrera (1994) in their research with Murrah buffalo calves separated from their mothers shortly after birth and with feeding levels of 10, 12 and 14% of live weight for 12 weeks observed weight gains of 620 g/day, 820 g/day and 880 g/day, respectively. The authors concluded that the increase in weight gain is directly proportional to the amount of buffalo milk intended for calves. Kumar *et al.* (2017) studying Murrah calves divided into two treatments, one in which the animal remained with the mother and the other that was completely separated from the mother after birth, found weight gains of 510 and 450 g/day, respectively.

The average weight of buffalo calves found at birth was 37.2±5 kg. Males tended to be born heavier than females (Jorge *et al.*, 2005). In the study developed by Bianchini (2008) the average birth weight of buffalo calves was 38.58 kg. Andrade (2011) in his study carried out with Murrah buffaloes and their calves on *Brachiaria brizantha* manuring marandu pasture found mean weight at birth of 37.87±4.94 kg and weight at 120 days of 99.98±15.64 kg.

The mean weight of the male calves at birth was higher than the average weight of the females. Usually, as in cattle and other species, buffalo males are heavier than females, both at birth and throughout their life (Lopes, 2006).

The consumption of the liquid diet, milk of buffalo *in natura*, milk replacer succedaneum or the mixture of the two, was very similar between the treatments and did not present significant statistical difference, which explains the non-rejection of consumption of the three net diets evaluated in this research from the 10th to the 90th day of life of the studied buffalo calves. These results are shown in Figure 2.

Control animals fed fresh and concentrated buffalo milk gained more weight (632±31.5 g/d) than T1 (436±30.0 g/d) and T2 (352±28.0 g/d), which received partly and integrally, respectively, more concentrated substituent. The treatments T1 and T2 did not differ among themselves, as explained in Figure 3.

Vecchio *et al.* (2013) in their study of water buffalo calves used amounts of liters of succedaneum per meal ranging from 4 to 7 L/day and with concentrations ranging from 18 to 29% over the 90 days of the study. The animals in Group 1 received daily breastfeeding while those in Group 2 received two daily breastfeeds. The two groups received the same concentrations of dry matter in the different established stages. The authors observed daily weights of 635 g/day for Group 1 and 681 g/day for Group 2.

In the Vecchio (2010) study with buffalo calves the animals that received whole buffalo milk showed a weight gain of 1103 g/day. While buffalo calves treated with succedaneum gained 973 g/day.

The curve of increase of the thoracic perimeter was very similar to the one observed in the body weight gain, being similar for treatments T1 (87.9±1.05 cm) and T2 (86.5±1.05 cm) and

statistically different from these in relation to the control treatment (91.7±1.13 cm). The weight gain and the increase of the thoracic perimeter of the buffalo calves showed a constant growth of the birth until the twelfth week of life with subsequent deceleration. The data are available in Figure 3 and 4.

Live weight estimates of growing Mediterranean buffaloes maintained on pasture can be made according to age, thoracic perimeter, height at the withers and body length with high correlations, as well as other correlations between these variables (Alves, 2010).

The three treatments studied demonstrated an increase in daily weight gain from the fourth to the twelfth week of life, with a subsequent decrease. The daily weight gain of the control treatment was higher and with a statistically significant difference in relation to the other treatments, T1 and T2, according to Figure 5.

The pronounced decrease in the daily gain of buffalo calves between the twelfth and the fourteenth week of life of the animals is due to a prolonged period of intense rains, in which the animals did not receive concentrate in the troughs, which did not have impermeable cover. This fact demonstrates the importance of supplying enough quality concentrate and quantity to maintain a high daily weight gain, especially after the first month of life of buffalo calves.

With the gain of body weight from the first month of life only the liquid feed is not enough to establish a pronounced weight gain of the animals, which has energy costs for the corporal maintenance increasing, being determinant the use of specific concentrate.

Male buffalo calves consumed more feed than females, but they had the same intake of liquid diet, milk of buffalo *in natura* and / or succedaneum. The mean weight in kg between genders was similar, but the average daily gain presented a statistically significant difference, being higher for male buffalo calves, as shown in Table 5.

In the study of Andrade (2011) with Murrah buffalo calves in relation to the weight gain of animals in grams per day, the males presented a superior weight gain (563 g/day), to the females (464 g/day).

CONCLUSIONS

The weaning of 90-day-old Murrah buffalo calves has proved to be an adequate alternative to the good development of the animals and the greater availability of buffalo milk to the consumer markets.

The bovine milk replacer showed to be an adequate alternative in the feeding of Murrah buffalo calves. New researches with higher levels of total solids of the bovine succedaneum or the use of specific succedaneum for buffaloes are necessary in order to achieve similar weight gains with that obtained with the exclusive use of buffalo milk, once the fat and protein contents of these species are different.

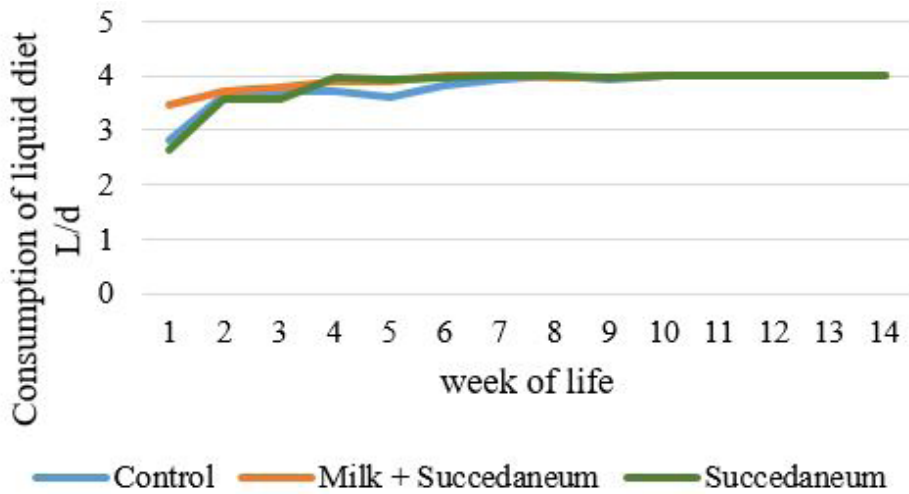Figure 1. Average concentrate intake of calves buffaloes studied.

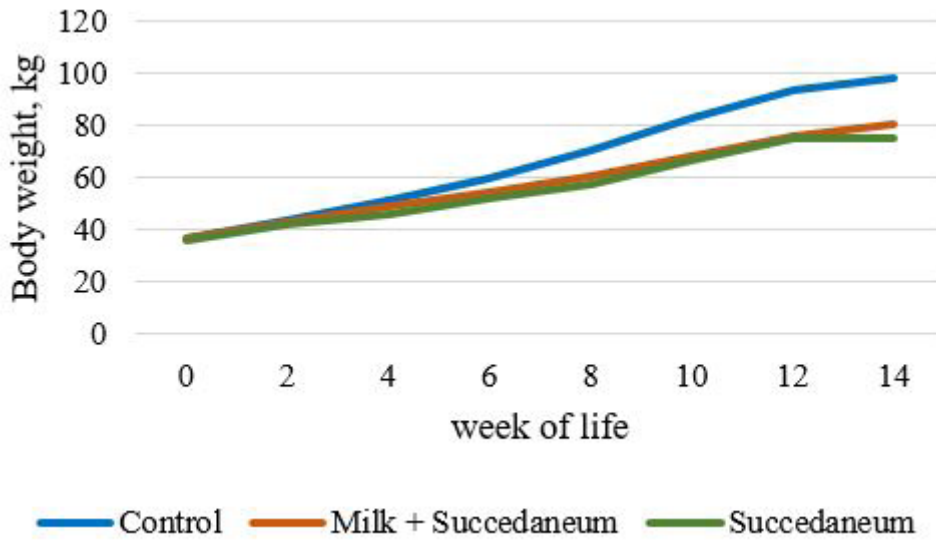Figure 2. Net diet intake of buffalo calves.
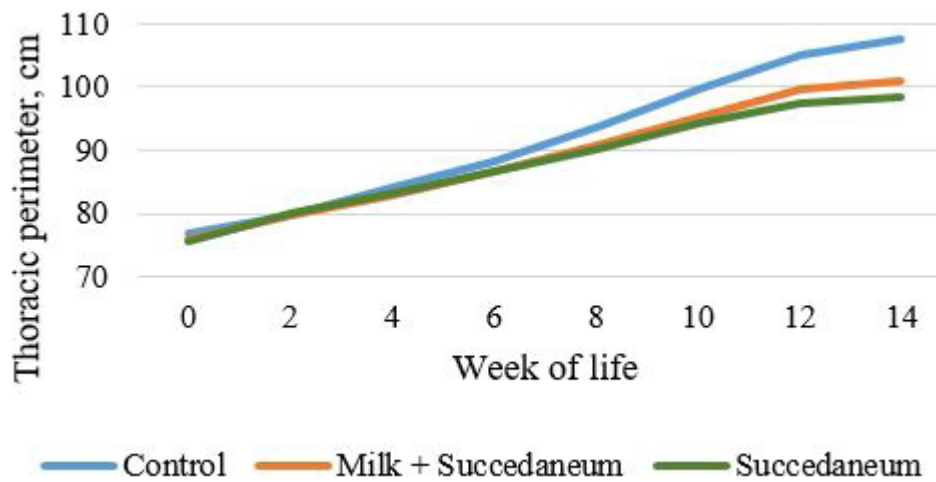
Figure 3. Body weight of buffalo calves.
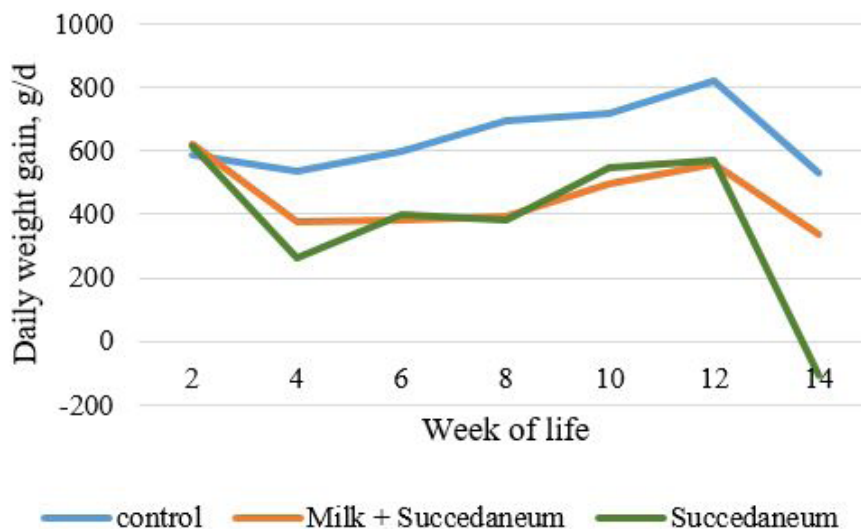

Figure 4. Thoracic perimeter of buffalo calves.

Figure 5. Daily weight gain of buffalo calves.

Table 1. Bromatological analysis of meal.

SAMPLE	MS %	PB %	NDF %	EE%	MM%	CNF%
1850	88.9	25.8	10.9	5.25	6.5	51.5
1851	90.3	26.7	11.1	6.43	6.5	49.1
1852	90.2	26.7	11.5	6.2	6.57	48.9
1853	90.3	25.9	11.6	6.8	6.88	48.7
1854	89.6	25.8	11.5	6.4	6.8	49.4
AVERAGE	89.86	26.18	11.32	6.216	6.65	49.52

Notes: MS% = dry matter in percentage; PB% = crude protein in percentage;
NDF% = neutral detergent fiber in percentage; EE% = ether extract in percentage;
MM% = mineral matter in percentage; CNF% = non-carbohydrate fibrous in percentage.

Table 2. Daily intake of dry matter, crude protein and ethereal extract by buffalo calve of the three treatments tested.

Treatments	Daily ingestion		
	Dry matter (g/dia)	Crude protein (g/dia)	Ether extract (g/dia)
Control	890.76	228.34	258.12
Milk + milk replacer succedaneum	836.30	214.24	188.21
Milk replacer succedaneum	764.17	196.29	110.84

Table 3. Concentrate intake and net diet of Murrah buffalo calves fed according to the three treatments studied until weaning.

Concentrate consumption	Treatment			P-value		
	Control	Milk + milk replacer succedaneum	Milk replacer succedaneum	Trat	Week	Trat*week
Average period, g/d	313.4±56.87	299.89±49.0	294.7±52.65	0.97	<0.0001	0.1633
Of meaning at weaning, g/d	858.9±77.19	876.5±73.45	755.9±71.46	0.97	--	--
Net liquid diet intake, L/d	3.80±0.065	3.90±0.056	3.83±0.060	0.4668	<0.0001	0.1186

Notes: trat = treatment; treatment*week = treatment per week; g/d = grams/day; L/d = liters/day.

Table 4. Weight gain and thoracic measurements of Murrah buffalo calves fed according to the three treatments studied until calving.

Weight, kg	Treatment			P-value		
	Control	Milk + milk replacer succedaneum	Milk replacer succedaneum	trat	week	Trat*week
Average period	67.1±2.36[a]	58.4±2.37[b]	56.3±2.36[b]	0.0106	<0.0001	<0.0001
Starting weight	37.1±2.66	36.5±2.66	36.1±2.66	0.999	--	--
Final weight	98.0±3.21[a]	80.2±3.21[b]	74.9±3.11[b]	0.036	--	--
Daily weight wain, g/d	640±43.1	451±43.1	381±39.0	0.0018	0.0001	0.3923
Thoracic perimeter, cm	91.8±1.21[a]	88.2±1.21[ab]	86.9±1.21[b]	0.0286	<0.0001	0.0001

Notes: trat = treatment; treatment*week = treatment per week; g/d = grams/day; L/d = liters/day.

Different letters on the same line represent a significant statistical difference between treatments. Equal letters on the same line do not represent a significant statistical difference between the treatments.

Table 5. Effect of the sex of buffalo calves on food consumption and gain weight.

Food consumption	Sex		P-value
	Male	Female	
Performance concentrate, g/d	343.4±41.1	255.4±44.2	0.1621
Liquid diet, L/d	3.84±0.050	3.86±0.053	0.7944
Average weight, kg	62.6±1.85	57.7±2.12	0.096
Average weight gain, g/d	512±26.2	463±29,6	0.2266

Notes: g/d = grams/day; L/d = liters/day, kg = kg.

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