PRODUCTION OF BUFFALO MILK (*BUBALUS BUBALIS*) IN BRAZIL

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ABSTRACT

The objective of this work was to estimate the influence of environmental factors on milk production traits in buffalo from the herds participating in the Programa de Melhoramento Genético de Búfalos do Brasil (Brazilian Buffalo Breeding Program - PROMEBULL). The data file consisted of 80,408 dairy control data, 9,286 delivery records from 1969 to 2016, with information on total milk production corrected for 305 days (TMP), lactation length (LL) and percentage of fat (% F). Analysis of variance was performed using the SAS PROC MIXED, using fixed effects of farm, calving season (PS), farm * calving season interaction and buffalo age class at calving (CABC), and the animal as random effect. Means were differentiated using the Tukey test. The average production was 1,963.42±713.94 kg TMP, 281.71±53.89 days for LL and 7.07±0.86 % for % F, with influence of farm, farm * PS interaction and CABC; farm, PS and farm interaction * PS; and CABC for TMP, LL and % F, respectively. The phenotypic correlations were 0.32, 0.03 and 0.26 for TMP and LL, TMP and % F, and LL and % F, respectively. From the results, it was concluded that the studied characteristics show reasonable phenotypic variability, making buffalo farming a promising activity in the national scenario.

Keywords: *Bubalus bubalis*, buffaloes, buffalo farming, phenotypic, milk, promebull

INTRODUCTION

Since their arrival in Brazil at the end of the 19th century, buffaloes have been playing a prominent role in alternative livestock production, yet their productive efficiency still needs to be improved to reach their true potential, this being the first step towards recognizing productive potential. There is also a need to study environmental factors that influence the production characteristics nationwide (Bezerra Júnior *et al.*, 2014).

These animals produce between 1500

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and 4500 liters of milk per lactation and can produce milk up to 20 years of age (Garcia and Planas, 2003; Moreira *et al*., 1994). Studies with buffaloes show that it is possible to increase total milk production, carrying out breeding programs associated with improvements in management, increasing total milk production per cow up to 32.86 kg/year. Therefore, the importance of the control of the environmental factors can reduce the interference of diverse stressors on the productive characteristics, improving genetic management in regional herds, taking into account the phenotypic information (Ramos *et al*., 2006).

However, there is a lack of work in Brazil involving buffalo production data from commercial herd information. There is usually information from isolated regions, with little or no connection between animals, sires or dams, increasing the importance of knowing the environmental factors that influence the production of this species.

The objective of this work is to estimate the influence of environmental factors on the phenotypic characteristics of milk production of buffaloes reared in different regions of Brazil, to be used as a basis for the genetic management strategy of this species.

MATERIALS AND METHODS

The database used had 80,408 records on milk control of buffaloes predominantly of the Murrah breed and its crosses, from 22 properties located in the North, Northeast, Southeast and South regions of Brazil participating in the Programa de Melhoramento Genético de Búfalos do Brasil (Brazilian Buffalo Breeding Program - PROMEBULL). Cows were born between 1957 and 2012 and calvings were recorded from 1969 to 2016.

Total milk production up to 305 days (TMP) was corrected according to Biachini Sobrinho (1986). After TMP calculation, the file contained a total of 9,286 calving records, 6,940 TMP yields from 17 properties, 5,458 lactation lengths (LL) from three properties and 842 fat percentage (% F) from a single property, with a total of 144 bulls that had offspring in the database.

The properties, almost all of them, used a semi-intensive system of management, characterized by feeding at pasture of high support capacity and forage supplementation in the season of low pasture growth, as well as concentrate to high production animals, using commercial concentrates or ingredients such as corn, cotton seed and / or wheat bran being most common. A few properties adopted a more intensive system, with animals being fed exclusively in the trough, based generally on corn silage or high quality grasses.

Four calving seasons (PS) were considered: 1 (January to March), 2 (April to June), 3 (July to September) and 4 (October to December). Comparison of the number of calvings between the first and second semester was performed using the G-test in the SAS program (Statistical Analisys System, v. 9.2). The age of the buffalo cow at calving was grouped into seven classes (CABC), 1 = animals with calving age from 24 to 38 months, 2 = 38.1 to 42 months, 3 = 42.1 to 56 months, 4 = 56 , 1 to 70 months, 5 = 70.1 to 84 months, 6 = 84.1 to 96 months and 7 = greater than 96.1 months.

Univariate distributions were evaluated using a model with density based on the normal parametric distribution, with the mean and standard deviation obtained from the sample. The analysis of variance was performed using the SAS program through PROC MIXED, and the comparison of

means was obtained by the Tukey test (0.01).

For TMP and LL, the model had as fixed effects: farm, calving season, farm * calving season interaction and the age class of buffalo cow at calving and the animal as a random effect. The same model was used to analyze % F, with the exception farm and farm * calving season interaction, since only one property contained this data. The correlation analysis between the characteristics was performed through the PROC CORR of the same program.

RESULTS AND DISCUSSION

All traits presented a normal distribution and descriptive are reported in Table 1.

Malhado *et al.* (2007) found similar values, with a mean of 1,863.50±682.40 kg for milk production, when analyzing more than 3,500 lactations of Murrah buffaloes belonging to the buffalo breeding program. Lower means were found by Tonhati (1994, 2002) with 1.019.20±225.30 and 1,495.00±617.10 kg, studying data from buffaloes from the State of São Paulo and Rodrigues *et al.* (2010) found 1,663.84±383.60 kg.

Higher yields to those described were obtained in Brazilian farms, where production was controlled and management was modernized, as described by Bezerra Júnior *et al.* (2014) in the state of Alagoas, with an average of 2,218.03±408.18 kg of milk from crossbred buffaloes. Sampaio *et al.* (2001) analyzing a herd of Murrah buffaloes in the state of Ceará, recorded an average of 2,130.80±535.60 kg for total milk production.

The distribution of births according to the time of year shows that more than two-thirds of calvings occurred in the first semester of the year (P<0.01), findings consistent with those of Sampaio Neto *et al.* (2001) who observed that almost 80% of buffalo calves born in the Northeast of Brazil were born in the first half of the year. This period coincides with the rainy season in most of the studied sites, which, consequently, generates more pasture availability.

Environmental factors can influence milk production, such as management, region and climatic factors, among others. In this study, TMP was significantly influenced (P<0.01) by farm and farm * calving season interaction, as well as by buffalo cow age at calving (Table 2).

The farms that had the highest milk production were those that have higher levels of technical advice, whose importance was highlighted by Gonçalves *et al.* (2014), whose study concluded that properties that had a good technical orientation and monitoring obtained an increase in dairy production, gross margin of activity and quality of the raw milk produced taking into account its composition and microbiological quality.

The highest milk production averages were found in older females, between four and eight years of age. The same was alluded to by Bezerra Júnior *et al.* (2014); Tonhati *et al.* (2000) whose studies found higher milk yields in older buffaloes compared to younger ones, concluding that buffalo age exerts influence on milk production, tending to increase until the female reaches physiological maturity, decreasing afterwards.

The mean lactation length obtained in this study was 281.71±53.89 days, with a coefficient of variation of 19.13%. The characteristic was influenced (P<0.01) by the farm, calving season and by the interaction farm * calving season (Table 3). Similar results were found by Bezerra Júnior *et al.* (2014) of 282.59±39.48 days, being influenced by the year of the beginning of lactation, and the

linear effect of lactation length was important for the addition of up to 8.45 kg of milk for each additional day in lactation.

Studies carried out in other Brazilian herds tend to show lower averages. Rodrigues *et al.* (2010) found an average of 269.89±56.36 days and Malhado *et al*. (2013) reported an average lactation length of 265.64±33.25 days.

Sampaio Neto *et al.* (2001) found a mean lactation length of 301.41±49.30 days in the State of Ceará, a result influenced by the year of calving. There was a substantial increase in lactation length over the years. The longest lactations were observed for calvings from October to December and January to February, coinciding with a lower incidence of rainfall in the region. Therefore it is important to understand the influence of calving season on the traits of interest to be able to guide the feeding and management of the herd, minimizing its effects.

In this study, farms 8 and 17 located in the north and southeast regions, respectively, had the highest lactation lengths when the calving occurred between July and December (PS = 3 and 4). On farm 16, located in the Northeast region, the most durable lactations correspond to the calvings that occurred in the months of September to December and from January to March (PS = 4 and 1), coinciding with the driest period, when the animals were supplemented to meet nutritional needs, due to the lack of good pastures, justifying the best performances.

Mean fat percentage was 7.07±0.86%, with a coefficient of variation of 12.16% and was influenced by the age class of buffalo at calving (P<0.05) (Table 4). The highest percentage of fat was observed for buffaloes of class 1, that is, when they were at the beginning of productive life, less than 3 years of age. F % found in the Brazilian literature varied from 6.11 to 8.16% (Verruma and Salgado, 1994; Tonhati *et al*., 2000; Faria *et al*., 2002).

A milk fat content above 5.5% is a characteristic of the buffalo species, regardless of the conditions studied, with the percentage of fat being closely related to the animal´s habits, the quality of the management of milking and the season of the year, since the reduction of pasture availability may favor the concentration of solids in milk (Costa *et al.*, 2014).

The phenotypic correlations were 0.32, 0.03 and 0.26 between TMP and LL, TMP and % F, and LL and % F, respectively, with significant results (P<0.01) between TMP and LL, and between LL and % F. These last values have medium to high correlation, both positive, indicating that when selecting a characteristic, there is an indirect and simultaneous progress in the other.

Malhado *et al.* (2009, 2013) reported similar correlations between milk yield and lactation length of 0.57 and 0.47, respectively, when studying crossbred buffalo females in Brazil. Rodrigues *et al.* (2010) reported a higher correlation of 0.76, studying Murrah buffaloes and their crosses in the northern region of Brazil. Barros *et al.* (2016) reported correlation values of 0.66, -0.29, and 0.08 between milk yield and lactation length, milk and fat yield, and lactation length and fat content, respectively, from buffalo five farms located in the States of São Paulo and Rio Grande do Norte.

However, the correlation between milk yield and fat percentage in most studies is negative (Tonhati *et al*., 2000; Campos *et al*., 2007; Barros *et al*., 2016). However, this is not a serious problem in buffalo due to the high percentage of milk fat found in buffalo milk, which, even if negative, fat rates will not be low even at high yields (Marques,

Table 1. Descriptive statistics of total milk production (TMP), lactation length (LL) and fat percentage (% F) of buffaloes participating in PROMEBULL.

Index	TMP (kg/lactation)	LL (days)	% F
N	6.940	5.458	842
Average	1,963.42	281.71	7.07
Standard deviation	±713.94	±53.89	±0.86
Minimun	291.40	67.00	3.46
Maximun	5,982.50	819.00	10.30
CV (%)	36.36	19.13	12.16

N = Number of observations; CV = Coefficient of variation.

Table 2. Results of variance analysis of the total milk production (TMP) of buffaloes participating in PROMEBULL.

Effect	DF	F-value	Probability
Farm	16	48.72	<0.0001
Calving season	3	0.17	0.9192
Farm * calving season	36	2.91	<0.0001
CABC	6	76.64	<0.0001

CABC = Age class of buffalo at calving; DF = Degree of freedom.

Table 3. Results of variance analysis of the lactation length (LL) of buffaloes participating in PROMEBULL.

Effect	DF	F-value	Probability
Farm	2	12.84	<0.0001
Calving season	3	7.65	<0.0001
Farm * calving season	6	3.91	0.0007
CABC	6	0.78	0.5821

CABC = Age class of buffalo at calving; DF = Degree of freedom.

Table 4. Results of variance analysis of the fat percentage (% F) of buffaloes participating in PROMEBULL.

Effect	DF	F-value	Probability
Calving season	3	0.51	0.6732
CABC	6	3.86	0.0009

CABC = Age class of buffalo at calving; DF = Degree of freedom.

2015).

CONCLUSIONS

The traits evaluated were at levels compatible with other studies in in the species, being superior in some cases;

Buffalo farming is viable in several environments;

Environmental factors are of paramount importance in the evaluation of the animals, especially in terms of farm management;

The use of good management practices, associated to the good genetic standard of the herds should be adopted in the rearing of buffaloes.

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