Voluntary intake and productive performance of female buffaloes with a new pre-mixture adjusted to their nutritional requirements

Odilia Gutiérrez[1], J.Cairo[1], B.Ramírez[2], Natacha Dorta[1], G. Vasallo[1] and M. Valera[1]
[1]*Instituto de Ciencia Animal, Apartado Postal 24, San José de las Lajas, Mayabeque, Cuba*
[2]*Universidad de Granma, Bayamo, Granma, Cuba*
Email: ogutirrez@ica.co.cu

In order to determine the productive behavior of water female buffaloes, supplemented with a mineral pre-mixture, two studies were carried out at the cattle enterprise "La Bayamesa", from Bayamo, Granma province. In the first study, 30 female buffaloes from unit 1 were used, through a completely randomized design, and were divided into two groups: one of control that received 400 g of Norgold and an experimental group, which was offered 400 g of Norgold, plus 100 g of a mineral pre-mixture. In the second study, four units with 30 female buffaloes each were used, and the procedure was similar to the first one. Milk production was measured in the 100 % milking animals. There were no differences among treatments for the intake of dry matter. The values ranged between 16 and 19 kg/animal/d, and the mean digestibility was 48 %. There was an increase in the digestibility of crude protein and milk production was favorable for animals that received the mineral supplementation. The results demonstrated that mineral supplementation increases nutrient digestibility and milk production in female water buffaloes under the conditions of this study

Key words: *female buffaloes, minerals, milk production*

The potential of buffaloes, talking about the advantages they posses, specially their ability to make a good use of low quality grass and their high reproductive rate, besides the low death incidence in their calves, are some elements to be taken into account for considering this specie as a current alternative for milk and meat production.

Studies carried out with this specie in Cuba are mainly related to management and feeding to achieve better productive yields. At global level, punctual studies on digestive physiology and microbiology of the rumen have been carried out, in comparison to these indicators in cattle (Fundora *et al* 2005 and Méndez and de Lima 2011). One of the advantages attributed to grazing buffaloes is their skills for grasping natural grasses of low cut, apart from the nutritional quality of this feed (Gutiérrez *et al* 2012). Few studies refer to the subject of supplementing water buffaloes with mineral pre-mixtures under grazing conditions (Paul and Lad 2010).

The objective of this study was to determine the productive behavior of female water buffaloes, supplemented with a mineral pre-mixture, adjusted to grazing needs.

Materials and Methods

A first study was carried out in unit 1 from the Empresa Agropecuaria from Bayamo. The efficiency of mineral supplementation in milk production of female buffaloes was demonstrated in this study. For that purpose, 30 female buffaloes were used, in a completely randomized design, divided into two groups: one of control that received 400 g of Norgold and another experimental group, which was offered 400 g of Norgold, plus 100g of a mineral pre-mixture, prepared according to these nutrient deficiencies in grasses (table 1). In the second study, the mineral pre-mixture was extended to the four production units, and the procedure was similar to the first study, were the animals were distributed into two groups, according to a completely randomized design.

Table 1. Proposed mineral mixture

Components	%
Dicalcium phosphate	50.0
Sodium chloride	44.6
Zinc carbonate	0.7
Manganese sulphate	1.3
Copper sulphate	1.7
Cobalt sulphate	0.01
Sodium selenite	0.0022
Maize meal	1.6878

Localization. The experiments were carried out in the cattle enterprise "La Bayamesa", belonging to the Empresa Agropecuaria "Bayamo"

Feeding and management regime. Female buffaloes remained in the grazing areas with naturalized grasses, mainly jiribilla (*Dichantium caricosum*), without irrigation and fertilization. The stocking rate was close to 1.5 LAU/ha. The study was carried out in a consecutive way during the two seasons of the year. The animals alternated in eight paddocks, during nine hour daily, as average, for five days.

Animals. Female buffaloes with weights between 590 and 650 kg were used, which genotype comes from a crossbreeding with a predominance of Murrah blood, known in Latin America as Buffalypso.

Four animals were selected from each group in

each unit, in which the dry matter intake (DMI) was determined, and the milk production was controlled to 100% of the milking animals during the period.

The yield of the pasture was determined through the visual estimation method of Haydock and Shaw (1975), at five samples per each occupied paddock, and the availability per animal in the moment of experiment was calculated according to the formula:

$$\text{Availability (kg DM/animal/day)} = \frac{\text{Yield kg/DM}}{\text{Number of female buffaloes x days of stay}}$$

Determination of the intake through the external marker chromic oxide. An amount of 20 g of the external marker Cr_2O_3 (two daily doses) was offered to each animal, administered in small paper capsules. The period of adaptation of the animals to the marker was of 10 d, and the collection of fecal samples was carried out during the five subsequent days. They were extracted directly from the rectum of each animal, at 8:00 a.m. and at 3:00 p.m. The daily samples of feces were dried under the sundried.

For calculating the intake, the double marker method was used, with chromic oxide and acid insoluble ash (AIA) (Geerken *et al*. 1987).

Chemical analysis. A total of 20 samples of natural grass was taken, distributed in different grazing areas. The determination of dry matter, ash and organic matter was performed according to AOAC (1995). Calcium, sodium and potassium, and micro-elements were determined by an atomic absorption spectrophotometry (AAS) and phosphorus by the method of Amaral (1972).

Statistical analysis. An analysis of descriptive statistics was carried out, where the mean (x), standard deviation (SD), standard error (SE) and coefficient of variation (CV) were determined, as well as an analysis of variance for the necessary cases. The program Statistic, Version 6.0 for Windows was used for that purpose.

Results and Discussion.

Table 2 shows the pasture chemical composition. The content of crude protein was of 7.62 %, which can be qualified as a low quality pasture, according to Ramírez (2009). This low quality is closely related to a grass specie that has a predominance over the experimental area, which is the *Dichantium caricosum*. Another aspect is the high content of total ash and of the acid insoluble ash, which is a characteristic of the green mass that grows in soils of the area. These soils are, generally, of Fluvisol type, with a slightly acid pH, and with low content of organic matter (Ramírez 2009). In previous studies, Gutiérrez (2011) found a high relation ($R^2 = 0.98$) between the total content of ash and the percentage of acid insoluble ash, in grasses from unit 1 of this same enterprise. The low content of organic matter also confirms the poor quality of the grass as a feeding basis for this herd. The values of chemical composition of the grass were similar to those pointed out by Ramírez (2009) in studies carried out in the same unit during the first days of the rainy season.

Table 2. Chemical composition of pastures

Indicators	Mean	SD	CV (%)
MS, %	33.52	2.28	6.8
PB, %	7.62	1.03	13.5
Ash, %	15.44	2.25	14.6
Ca, %	0.26	0.04	15.4
P, %	0.12	0.02	16.7
Na, %	0.05	0.02	20.0
K, %	1.22	0.17	13.93
Fe, ppm	311.8	42.1	13.5
Mn, ppm	47.54	3.64	7.65
Cu, ppm	8.25	2.82	34.18
Zn, ppm	44.71	9.94	17.76

Grass availability was low. The value of 30 kg of DM/animal/d was not reached, which is considered as acceptable for bovine cattle (tabla 3).

Table 3. Yield and availability of pastures

Indicators	Value
Yield, t DM/ha	1.94
Availability, kg DM/animal/d	17.36

It is highlighted that this study was carried during the dry period, between March and April, moment in which the lowest values of grass yield does occur. However, the relation availability/intake is regulated by the stocking rate/ha, which was higher than 1.3 LAU/ha. It has been stated that, under grazing conditions, without supplementation, the stocking rate should not exceed 1 LAU/ha (García and Planas 2002).

A study previous to the mineral supplementation showed the results of intake, fecal excretions and apparent digestibility of dry matter (average per animal) (table 4).

The linear regression analysis of the intakes (x) and the fecal excretion of dry matter (y) showed that data were fitted in a straight line, where the increase of the intake was proportional to the excretion of dry matter in an $R^2 = 0.97$ SE (b) = ± 0.75. The relation between both variables at $P < 0.001$ was significantly strong.

The intakes of dry matter varied among the animals and reached figures up to 16.83 kg in animal 1. This coincides with a higher fecal excretion of dry matter. In this case, the dry matter intake represented values close to 2.6 % of live weight, similar to those informed by Gutiérrez *et al*. (2011). These authors found intakes for lactating female buffaloes of around 2.8 % of liveweight,

Table 4. Intake and apparent digestibility of dry matter in female buffaloes without supplementation

Indicators	Animal 1	Animal 2	Animal 3	Animal 4
Intake DM. Kg	16.83[b]	15.55[ab]	12.47[a]	16.08[ab]
Fecal Exc. DM. Kg	9.10[b]	8.33[ab]	6.61[b]	8.71[ab]
ADDM. %	45.90	47.99	46.68	45.66

[ab] Figures with uncommon letters per line differ significantly (P < 0.05)

when a diet based on forages without supplementation was offered.

A mineral pre-mixture was prepared (table 1) and was offered to production female buffaloes, apart from the productive state. In unit 1 (table 5), a study was carried out with animals of lower size than the animals used in the previous study, which showed the performance of intake and apparent digestibility of dry matter (ADDM), as well as the fecal excretion per groups. In these groups, differences for the fecal excretion (P < 0.01) and digestibility (P<0.01) were found. However, the intake did not differ from the supplemented group and represented between 1.27 and 1.50 % of the liveweight. These results were slightly inferior to those informed by Méndez and de Lima (2011), who point dry matter intakes close to 2 % of the liveweight.

Table 6 presents the effects of mineral supplementation on milk in unit 1. The analysis of variance showed differences in favor of the treated group and the favorable effect of mineral supplementation on milk production. This is confirmed by Fader and Marro (2001), who reduced in 1.6 months the period between parturitions, extended the lactation between 40 and 60 d and increased milk production in 10%, by giving injected Cu and Se to deficient milking bovine herds of the central region from Cordoba, Argentina,

The study carried out about the evolution of milk production for 22 weeks is shown in figure 1

Milk production, in both groups, was superior to 5L/female buffalo/d. Authors like Méndez and Fraga (2012) found that the highest values of production were reached during the second month of lactation, and that it was decreasing until drying. In this study, the supplemented group showed the highest production between the seventh and ninth lactation week. In fact, the control treatment showed inferior values. A recovery in the production was evidenced during the ninth and

Table 5. Intake (IDM) and apparent digestibility (ADDM) of dry matter in buffaloes

Indicators	Group I (suplemmented)	Group II (control)	Sig.SE
IDM, kg DM/day	8.27	9.74	0.63
Fecal excretion, kg	3.34	4.75	0.33**
ADDM, %	59.55	52.46	1.42**

** (P < 0.01)

Table 6. Milk production during the evaluated period

Group	Milk production (L/B/d) (bimonthly)	Sig SE
Treated	5.87	0.065***
Control	5.29	

*** P < 0.001

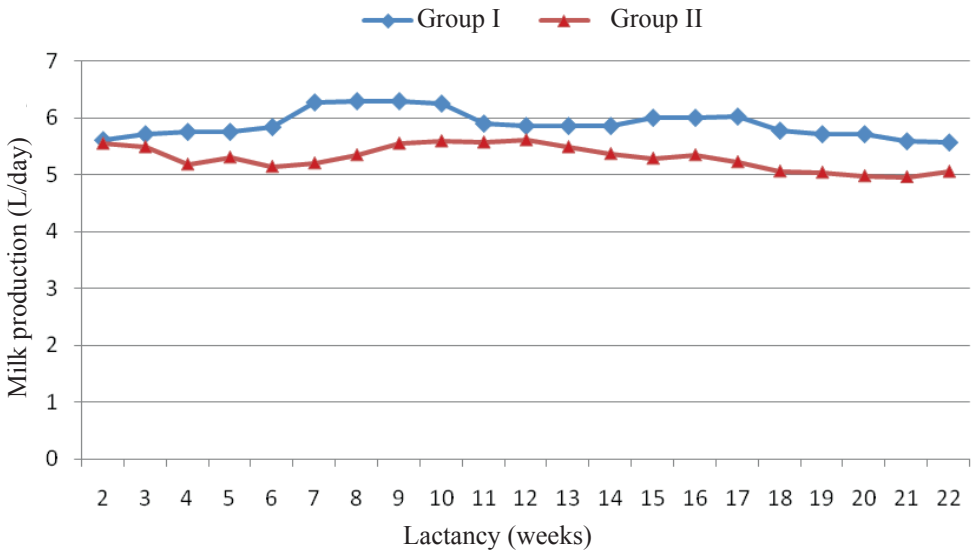

Figure 1. Curve of milk production from female buffaloes during the first 22 weeks of lactation.

the eleventh week. In all cases, mineral supplementation favored the productive performance of the herd.

In the second experimental study, mineral supplementation was generalized in the four units of the enterprise. Table 7 shows the results of intake and mean nutrient digestibility.

Table 7. Intake and apparent digestibility of OM, CP and ash per groups

Indicators	Suplemmented	Control	Sig.SE
Dry matter Intake, kg	19.31	15.11	1.18
Digestibility, %	53.95	53.85	0.95
Crude protein Intake, g/kg	9.76	9.40	1.23
Digestibility, %	59.97	53.24	2.29**
Ssh Intake, kg	3.56	2.86	0.66
Digestibility, %	8.72	8.20	0.45

** (P < 0.01)

Average milk production of four units is presented in table 8. There was a discreet and favorable increase in the indicator referred to animals that received the mineral premixture. This coincides with the previous results, where it was only supplemented in unit 1 of the enterprise.

Table 8. Mean milk production from dairy farmss

Groups	Production(L/B/d)	SE	Sig
Suplemmented	5.52	0.17	*
Control	4.95	0.63	

*P < 0.05

It can be concluded that, under the conditions of the study, female buffaloes carry out a high intake of natural grasses and mineral supplementation, adjusted to the deficiencies of these nutrients in grasses. With this, the feed digestibility improves and milk production increases.

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