

Performance and feeding behavior of Mediterranean river buffaloes fed different proportions of maize and sugar cane silage rations

O. Fundora¹, R. Franzolin², Paola C. Castañeda³, Irma S. Bautista³ and Yuli A. Peña³

¹*Instituto de Ciencia Animal, Apartado Postal 24, San José de las Lajas, Mayabeque, Cuba*

²*Facultad de Zootecnia e Ingeniería de los Alimentos, Universidad de Sao Paulo, Brasil*

³*Universidad de Cundinamarca, Colombia*

Email: ofundora@ica.co.cu

Four Mediterranean river buffaloes with an average live weight of 824 kg were used. Animals were individually housed in corrals with front feeding trough and automatic drinking dishes for characterizing the consumption and feeding behavior of river buffaloes fed isoenergetic and isoproteic rations. The experimental diets were formed by maize (*Zea mays*) silages and sugar cane (*Saccharum officinarum*) in four proportions in dry basis (100/0, 67/33, 33/67 and 0/100) and 3 kg daily of a concentrate mixed with the silages. A Latin square design with four periods of 21 d each, with 14 d for adaptation and 7 of collection was used. Daily consumption in DB of the silages (4.43 to 6.27 kg), of the total ration (7.15 to 8.99 kg) and of total dry matter regarding live weight (0.85 to 1.08 %) decreased ($P < 0.001$) as the sugar cane silage level increased in the ration. The consumption speed (1.60 to 1.32 kg h⁻¹), the time proportions devoted to the activities of feed ingestion (16.44 to 20.37 %), rumination (32.41 to 38.66 %), water intake (1.50 to 2.08 %) and movement (1.39 to 2.55 %) did not differ between treatments, while the rest time (37.33 to 47.80 %) was lower ($P < 0.01$) in animals fed sugar cane silage. It is concluded that the substitution of maize silage by sugar cane silage decreased the voluntary intake while maintaining circadian patterns of silage ingestion and rumination similar to those registered in other forages.

Key words: *feed ingestion, rumination, rest, movement*

The use of sugar cane for ruminant feeding is an interesting alternative for livestock producers of tropical climate zones, due to their great biomass production per surface unit and to the higher yields in the dry period that coincides with the decrease of pasture yield.

Few studies have been developed to evaluate the use of sugar cane in the feeding of water buffaloes in the tropical zone. The performance of grazing buffaloes, was assessed by Fundora *et al.* (2001) and stated that animals devoted the greatest part of daytime to pasture intake, while under stabling conditions, in a feeding system based on guinea grass (*Panicum maximum*) forage, the time devoted to rumination was greater (Fundora *et al.* 2007a). This indicates that this change of the consumption pattern can be associated to the energy expense of the animals in both feeding systems.

In many zones of Brazil, the maize silage is a common way of preserving this forage for cattle feeding in the dry season. However, since this country is the greatest sugar cane producer there is also great interest in knowing the possibilities of this feed to cover the pasture deficit during this critical period. Also in Cuba has been widely evaluated the sugar cane for bovine feeding with satisfactory results. In this context, buffalo producers need to know the possibilities of this feed for the species.

This study is part of the experiments developed in the Faculty of Zootechnics and Foodstuffs Engineering, campus Pirassununga of the University of Sao Paulo. The objective of this experiment was to characterize the consumption and feeding behavior of river buffaloes in isoenergetic and isoproteic rations, with

different proportions of maize/sugar cane silage and concentrates.

Materials and Methods

Four Mediterranean river buffaloes with an average live weight of 824 kg, with cannulae at the dorsal sac of the rumen were used for assessing the consumption and feeding behavior from rations based on different proportions of maize silage and sugar cane silage. Animals were individually housed in corrals with front feeding trough and automatic drinking dishes.

The experimental diets were isoproteic and isoenergetic and supplied *ad libitum*. There were four proportions (DB) of maize silage/sugar cane silage (100/0, 67/33, 33/67 and 0/100), mixed with 3 kg daily of concentrates and supplied *ad libitum*. Table 1 shows the percentage and chemical composition of the rations. Feed were supplied twice daily at 7 a.m. and 4 p.m.

The contents of total digestible nutrients (TDN) of the rations were estimated according to NRC (2001) on the basis of the mean CP and NDF contents of the ingredients determined in the bromatology analyses in the laboratory of the Department of Zootechnics of the FZFE/USP (Campus Pirassununga).

A Latin square design with four periods of 21 d each, with 14 d for adaptation to the rations and seven for data collection was used. Daily feed consumption and feeding behavior of the animals were measured in the collection period every 10 min for 12 h in daytime hours and in alternate days. The consumption speed was controlled in the days in which behavior was not measured.

Table 1. Composition of the experimental rations in DB

Ingredients	Maize silage/sugar cane silage, %			
	100/0	67/33	33/67	0/100
Maize silage	70.0	46.5	23.5	0.0
Sugar cane silage	0.0	23.5	46.5	70.0
Maize meal	22.9	19.9	19.8	19.8
Soybean meal	7.0	10.0	10.0	10.0
Urea	0.0	0.0	0.1	0.1
Mineral salts	0.1	0.1	0.1	0.1
Chemical composition				
Crude protein	11.1	11.1	11.2	11.1
NDF	43.5	43.7	43.7	43.8
TND	68.6	68.2	68.2	66.6

Silage consumption was determined through the difference between supply and refusal. Consumption speed was registered in the same way every two hours. Feeding behavior was controlled every 10 min through the registration of the number of animals devoted to the activities of feed intake, water, rumination, movement and rest and according to Petit (1972) the proportion of time in each activity was calculated. Also, the density of the silages was determined by weighing a given volume of these feeds. Once known this indicator in both feeds, the volume consumed of silages was estimated from the proportion ingested in each ration.

An analysis of variance, according to a Latin square design through the statistical package InfoStat (2002), version 1.1 was used for the analysis of results. Duncan (1955) multiple range test was applied in the necessary cases.

Results and Discussion

Feed consumption, intake speed and feeding behavior are set out in table 2. Dry matter consumed relative to

buffalo live weights was low and resulted inferior to that registered with other forages (Fundora *et al.* 2000) and with sugar cane forage (Delgado *et al.* 2005). However, it was similar to that reported with buffaloes fed *Cynodon* hay (Costa *et al.* 2009). Also, there was significant decrease in silage consumption and of the total ration regarding the live weight of the animals as the silage level of sugar cane was increased in the ration.

In growing cattle, stabled and fed sugar cane forage and concentrates (Fundora *et al.* 2007b), and also in dairy cows, Rodrigues *et al.* (2006) compared maize silage and sugar cane forage consumptions. These authors found greater consumptions of sugar cane relative to the live weight of the animals. The fact that buffaloes concluded their growing stage and, consequently, their requirements were lower could account for this result. Also to this could contribute their energy requirements due to low minimum movement expenses.

The consumption decrease of the rations with greater proportion of sugar cane silage could be due to the

Table 2. Effect of treatment on consumption and the different circadian activities

Indicators	Proportions of maize/sugar cane silages				SE± Sig.
	100/0	67/33	33/67	0/100	
Daily intake in DB					
Silages, kg	6.27 ^a	5.97 ^b	5.30 ^c	4.43 ^d	0.08 ***
Total ration, kg	8.99 ^a	8.69 ^b	8.02 ^c	7.15 ^d	0.08 ***
Total ration, kg 100 kg LW ⁻¹	1.08 ^a	1.03 ^b	0.95 ^c	0.85 ^d	0.01 ***
Volume of silages consumed in HB, m ³ .day ⁻¹	0.05	0.06	0.06	0.06	-
Speed of consumption in HB, kg.h ⁻¹	1.60	1.63	1.47	1.32	0.53
Circadian activity, % of time					
Feed intake	16.44	17.82	17.25	20.37	1.85
Total rumination	32.41	37.50	38.66	37.50	2.17
Lying down	19.68	22.34	24.42	20.95	1.84
Standing	12.73	15.16	14.24	16.55	1.51
Water intake	1.50	1.50	2.08	1.85	0.55
Movement	1.85	1.39	1.50	2.55	0.56
Total rest	47.80 ^a	41.78 ^b	40.51 ^b	37.33 ^b	2.14 **
Lying down	21.88 ^a	15.28 ^b	15.74 ^b	11.46 ^b	1.63 ***
Standing	25.93	26.50	24.77	26.27	1.92

^{a, b, c, d} Different letters indicate significant differences at $P < 0.05$ (Duncan 1955)

** $P < 0.01$ *** $P < 0.001$

difference in the fiber levels in both silages and to the type of fiber per se, according to González (1995). This author characterized a group of factors affecting consumption including the specific gravity and the degradability of this feed. The density, varying from 364 kg per m³ in the maize silage to 253 kg per m³ in that of sugar cane, did not affect the volume consumed of these feeds.

The speed of consumption, the proportion of time devoted to the activities of feed and water intake, rumination and movement, did not differ in the different treatments. Total rest time and lying down was significantly higher in animals not consuming sugar cane silage. This result is related to the lower time, in absolute value, devoted to the activities of feed intake and rumination in this treatment, suggesting a change in the behavior pattern of the animals, probably associated to the peculiar type of the sugar cane fiber.

A consumption pattern of the average of all the buffaloes in the four experimental periods was similar in all the treatments. Therefore, it was similar to that indicated by Fundora *et al.* (2007a) with guinea grass (*Panicum maximum*) forage is presented in figure 1. A large meal was made in the first two hours after feed supply. Later there was a drastic decrease of consumption due to the need of alternating this activity with rumination for allowing rumen emptying in the following hours. According to studies carried out in India by Vaidya *et al.* (2010) and in Brazil,

by Silva *et al.* (2010), this result could be associated to the increase of the environmental temperature at midday. Later, from the schedule when the second part of the daily ration was supplied, the consumption speed was increased again.

Fundora *et al.* (2001) reported similar results in grazing buffaloes indicating that this behavior responds more to the consumption pattern of the animals than to the number of times included in the supply.

In figure 2 is presented the time devoted to consumption and rumination, 12 h after feed supply of the average of the buffaloes in the four experimental periods. Animals devoted 42 min to ration ingestion in the first hour, while from the second hour, after the first supply, invested periods lower than 9 min. until the second feed supply in the afternoon. At this moment, another great ingestion period was carried out.

Rumination alternated with the consumption and rest activities. From the second hour, after food supply, increased with values between 18 and 28 min. per hour until the second supply of the afternoon. In this moment rumination decreased drastically, since animals devoted an important proportion of time to the consumption of the second supply.

It is concluded that voluntary intake of buffaloes in sugar cane silage decreases proportionally with the increase of the levels of this feed, while it maintains a circadian pattern of intake and rumination similar to that registered in guinea grass forage.

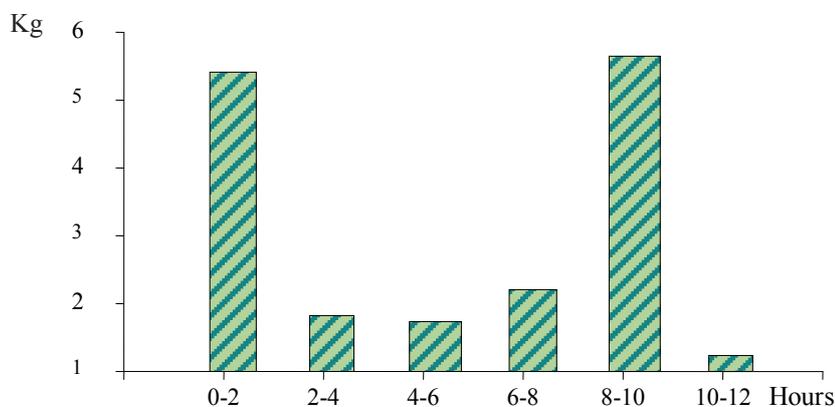


Figure 1. Effect of the postprandial time on the silage consumption speed

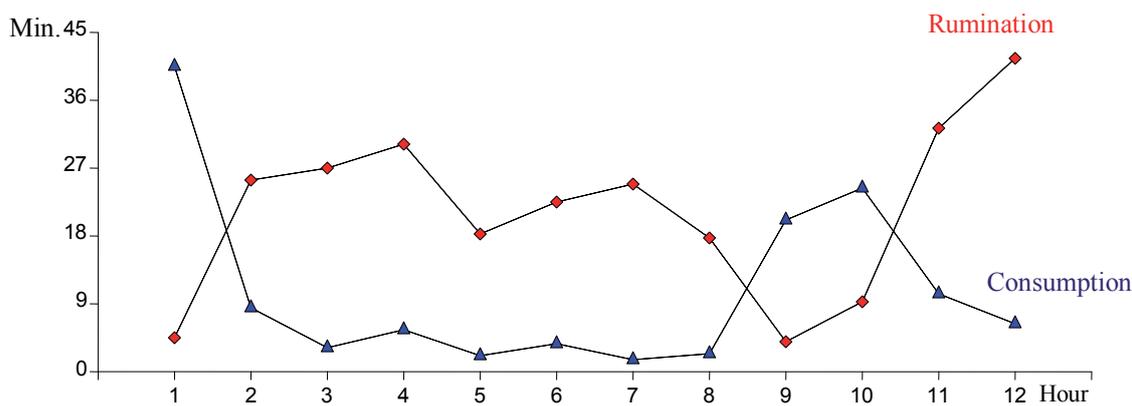


Figure 2. Effect of the postprandial schedule on the time devoted to consumption and rumination

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