

Feeding performance of stabulated dairy cows consuming integral diets of tropical forages

J. J. Reyes¹, M. Gálvez², Aida Noda¹ and Carmen Redilla²

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

² Empresa Pecuaria Bacuranao, Carretera Campo Florido, km 7 ½. Minas. La Habana, Cuba

Email: jreyes@ica.co.cu

In order to characterize the performance of dairy cows under stabulation conditions, fed integral diets of tropical forages, a study was conducted for three years. The observations were conducted for 72 h consecutively in each season to calculate the times spent in each activity (feed intake, rumination, water ingestion, resting and walking). A linear model of fixed effect was used for the statistical analysis, controlling group, season, year and possible interactions. The times dedicated to consumption were longer ($P < 0.01$) during the day and in the dry season (369.47, 83.67, 415.55 and 120.40 min, rainy/daytime, rainy/night time, dry season/daytime and dry season/night time, respectively). In rumia, the times increased ($P < 0.001$) in the dry season and at night (67.35, 271.79, 61.23 and 329.07 min for rainy/daytime, rainy/night time, dry season/daytime and dry season/night time, respectively). The intake rate of the milking cows in both seasons diminished ($P < 0.01$) in 24.2 and 25.5 % in the rainy and dry season, respectively, compared with those that were not lactating. The distribution of the animals' percentage in the intake activity was maintained, approximately, in 90.0 % in the rainy season, three hours after the feed supply, and in the dry season during the first five hours. Meanwhile, the animals' percentage in rumination was concentrated between 10.00 p.m. and 3.00 a.m., and was superior to 40 %. The study demonstrated that, apart from the management under stabulation conditions, the animals maintained a behavior in accordance with the availability and quality of forages. Besides, it was proved that the feed supply time influences markedly on the intake distribution.

Key words: *intake, rumination, forages, stabulation, schedule.*

It is known that the farther the management of the normal conditions, the higher the animal's stress, which will not express their whole potential (Eliás 2012). The voluntary intake of food is the most important factor to show the production capacity of all species (Jensen 2004 y Eliás 2012). This is the main limitation of tropical production, as depending on multiple factors related among them, all of them in function of satisfy the needs of animal nutrition (Kouba 2001 and Quincosa 2006).

In the tropics, the systems of milk production are based on the use of pastures and forages. They, due to seasonal variations such as the decrease of availability and quality, may vary the feeding performance of the animal (Mejías *et al.* 2003 and Pérez *et al.* 2008). However, bovine production under stabulation conditions and low incomes has increased at present. There is scarce information about the dairy animals' behavior under these conditions, in which the success will be on achieving the correct balance between the nutritive needs of the dairy animals, the plant, the soil and the high productions to obtain by surface (Reyes *et al.* 2006 and Senra 2011). The objective of this study was to characterize the feeding behavior of dairy cows, fed integral diets under stabulation conditions.

Materials and Methods

The studies were conducted for three years in a unit from the Cattle Rearing Enterprise "Bacuranao". Twenty dairy animals, total crossbred (milking and dried) were used under stabulation conditions. They were supplied a basic integral diet, composed of tropical

forages, sugarcane (*Saccharum officinarum*), king grass (*Penisetum purpureum* cv. Cuba CT-169), leucaena (*Leucaena leucocephala*) and a low-concentrate supplementation, in each milking.

Two milkings were conducted to the productive cows (6:00 am and 4:00 pm). After the morning milking, in order to clean up the pen and allow a staying of three hours in land due to the low pasture availability, the animals went out to a grazing area of 0.25 ha, near the shade pen. There were water *ad libitum* and mineral salts in the pen.

The roughage feeds were prepared in an integral mixture (sugarcane, pennisetum and leucaena). The proportion of each forage varied according to the physiological stage of the animals (from 28.00 to 50.00 and 37.00 to 50.00 %, for the sugarcane and king grass forages in the milking and dried groups, respectively). The diet was given twice a day (9.00 a.m. and 4.00 p.m.).

For studying the animals behavior, under the conditions of the experiment, observations were taken every 15 min (Mitlohner *et al.* 2001), during 72 consecutive hours. The times dedicated to feed intake, rumination, resting, water intake and walking were calculated by the formula of Petit (1972). The observations were conducted twice in each period during the three years (in March, for the dry season and September for the rainy season).

The statistical analysis used was the linear model of fixed effect, controlling group, season, year and their possible interactions. Duncan's test (1955) was used to establish differences between means.

Results and Discussion

The study of time distribution used by the animals during their staying in the pen (table 1) showed interaction ($P < 0.01$) between the day time and the season. The animals dedicated more time ($P < 0.01$) to ingesting during the day and the rainy season ($P < 0.01$). Those dedicated to rumination were longer ($P < 0.001$) in both seasons during night time and increased in the rainy season.

The dairy animal's behavior, under stabulation conditions, is closely related with the availability and quality of the roughage feed offered (Pinheiro 1998, Reyes *et al.* 2006 and Pérez *et al.* 2008). The highest intake times during the days and rumination during the nights respond to the feed offering time (Reyes *et al.* 2006 and Rodríguez 2008). Likewise, the rumination increase during the dry season could be due to the increase of sugarcane forage intake and due to the quality of total diet. However, the 400.30 min dedicated to rumination in the day during the dry season are below the 519 min reported by Schmidt *et al.* (2007b). This reaffirms that this mixture of forages has beneficial effects on the rumination (Álvarez 2005 and Zebeli *et al.* 2007).

Pérez Infante *et al.* (1998) stated that among the factors included in the performance of milk production systems, the ration quality explains more than 55.0 % of the system variability.

Similarly, the animals dedicated more time ($P < 0.001$) to drink water and walk during the day, and rested more ($P < 0.001$) at nights. This activity is equally higher in the rainy season (table 1).

Table 2 presents the times dedicated to consuming 1 kg of DM of the integral diet (minutes⁻¹ kg DM). There was interaction ($P < 0.01$) between the seasons and the physiological groups. The milking cows in both seasons dedicated 24.2 and 25.5 % less time ($P < 0.01$) consuming 1 kg of DM, compared with those that were

not milking, for the rainy and dry seasons, respectively. In respect to the behavior, the time increased ($P < 0.05$) in 6.6 % regarding the second and first years, that did not differ among them.

In this study, the times dedicated by the animals to consume 1 kg of DM were superior to those reported by Krause *et al.* (2002) and Yang and Beauchemin (2006), who recorded values between 14 and 23 min. These authors used forages of better quality than those of this experiment. However, Rodríguez (2008) informed values from 31 to 33 min, with diets based on sugarcane forages.

The minutes dedicated to rumination 1 kg⁻¹DM are in correspondance with the quality of the feed consumed. An increase ($P < 0.01$) of the minutes dedicated to this activity in the last year (12.03 %) compared with the second and of this (4.5 %) compared with the first year was proved. In the dry season, the animals dedicated 33.2 % more time ($P < 0.001$) to ruminate 1 kg⁻¹ DM consumed than in the rainy season. Equally, the milking animals dedicated 24.96 % less ($P < 0.001$) time that those not lactating.

These results about the time dedicated to rumination are inferior to those of Schmidt *et al.* (2007a), although these authors used 68.0 % of the diet as sugarcane silage, and in this study did not surpass 50.0 %. The difference between groups could be due to the integral diet and the supplementation level, which was better in the milking animals compared with those not-lactating, more specific in the rainy season. This makes possible the degradation of the roughage material in the rumen (Zebeli *et al.* 2007). Likewise, Biricik *et al.* (2007) reported a decrease in the rumination time as the particle size of the feeds decrease, because the proportion of the physically effective fiber decreases with the higher intake of supplement conducted by the milking animals.

The distribution of animals percentage in the intake activity (figure 1) indicated that at about 90 % conduct

Table 1. Time distribution in the activities related with the intake of the animals under stabulation during the day and night times.

Activity (minutes)	Effects	Day time	Night time	SE ±
Eating	Treatment/season			
	Rainy	369.47 ^c	83.67 ^a	5.54**
	Dry	415.55 ^d	120.40 ^b	
Walking	Treatments	33.80	20.56	1.15***
Ruminating	Tratamiento/época			
	Rainy	67.35 ^a	271.79 ^b	3.27***
	Dry	61.23 ^a	329.07 ^c	
Resting	Treatment/season			
	Rainy	128.07 ^b	238.25 ^d	5.42***
	Dry	100.62 ^a	203.87 ^c	
Drinking	Treatments	33.74	12.67	0.94***

^{a,b,c,d} Different means per activity differ at $P < 0.05$

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

Table 2. Time of DM intake and rumination in stabulated animals fed integral diets of tropical forages.

	Effects	1	2	3	SE ±
Intake minutes kg ⁻¹ of total DM	Years	48.29 ^b	47.48 ^b	50.63 ^a	0.31*
	Group/season				
	Rainy	38.30 ^d	47.57 ^c		0.36**
	Dry	50.05 ^b	62.81 ^a		
Rumination minutes kg ⁻¹ total DM	Years	35.00 ^a	36.67 ^b	41.08 ^c	0.49***
	Season				
		32.24	42.93	-	0.41***
		33.43	41.74	-	0.41***

Effects 1, 2, 3: for seasons 1-rainy, 2 dry; for group 1-milking, 2- dry, for year 1- first year, 2- second year and 3- third year.

^{a,b,c}Different means per row differ at P < 0.05

* P < 0.05 ** P < 0.01 *** P < 0.001

this activity in the rainy season during the first three hours after the feeds supply (9.00 am y 4.00 pm). However, in the dry season, these high percentages of animals consuming reach up to five hours after the feed supply.

The percentage of animals in the rumination activity, in both seasons, is concentrated within the fresh night hours (10.00 p.m. to 4.00 a.m.). In both periods, it surpasses the 40 % of the animals, although this proportion, in the rainy season, surpasses, as average, in 10.57 % the rainy season (figure 1).

The results described, related with the increase of the highest proportion of animals in rumination, and with extension of the time spent consuming in the dry season respond to the quality of the diet offered. This is explained because, in the rainy season, the sugarcane forage was included, as average, in 29.4 %, while in the dry season contributed in 48.5 %. This diminished the intake rate (table 2).

Álvarez and Ruiz (2002) informed that adding forage to animals fed sugarcane forage influence positively on the ruminal environment conditions, due to the improvement on the nutritive quality of the mixture,

compared with the forage of sugarcane only. The results coincide with those of Rotger *et al.* (2006) and Rodríguez (2008), in respect to the animals' preference for the night rumination.

Figure 2 shows the animals' percentage in other activities. Renting is highlighted, showing a higher proportion of animals in the three hours after offering the feed, and that during night time it is combined with the rumination activity. However, an increase of 13.52 % is proved in the rainy season, as a mean of this activity in respect to the dry season.

This performance could be given by the fact that the animals diminish their intake activity to reduce the heat production generated in the organism due to the digestive processes (feed ingestion, rumination), and minimize the heat stress with resting (Mitlohner *et al.* 2001 and Álvarez 2005).

The other studied activity (drinking water) kept low animals' percentage during the whole day and in both seasons. It did not surpass 10 %, but with certain stability, at about up to 10.00 p.m., when was almost zero (figure 2).

This research demonstrated that, apart from the

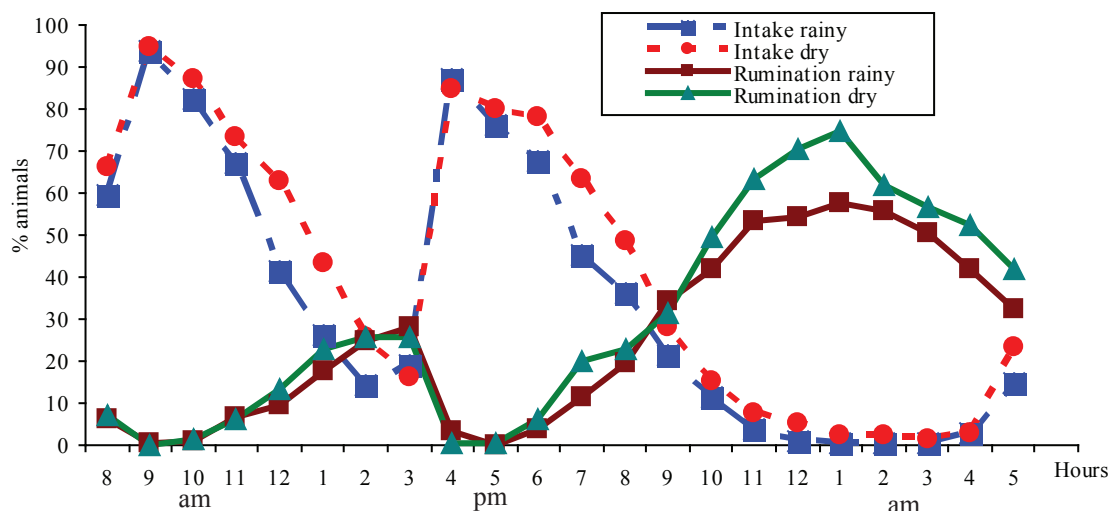


Figure 1. Distribution of animals' percentage per chewing activity (intake and rumination) per seasons.

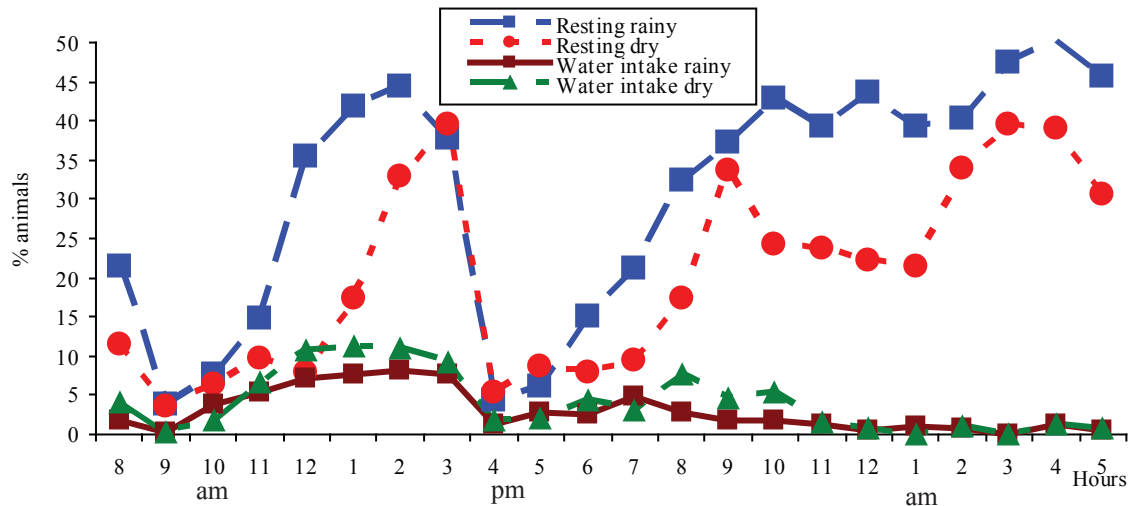


Figure 2. Distribution of animals' percentage in other activities (resting and water intake) per seasons.

system management, stabulation conditions and use of integral diets, the animals keep a behavior in accordance with the availability and quality of feeds. Besides, it corroborated that the offer time influences markedly on the distribution of the intake activity.

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