Effect of the microbial additive VITAFERT on the intake of dry matter and neutral detergent fiber in Saanen goats fed *Brachiaria brizantha* hay

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A microbial additive, VITAFERT (a product biologically active, rich in yeasts and lactobacilli and their metabolites) was included in a basic ration of *Brachiaria brizantha* hay of low nutritive quality to assess its effect on the voluntary intake of dry matter (DM) and neutral detergent fiber (NDF) in goats from the Saanen breed. In a Latin square design and for 45 d, three Saanen goats of three years of age were used, with average live weight of 43 kg (17.0±0.82 kg LW0.75), out of lactation and canulated in the rumen. The treatments were: T1) basic diet of *B. brizantha* hay + caprine commercial supplement; T2 and T3) *B. brizantha* hay + caprine commercial supplement and two levels VITAFERT (6.0 and 12.0 ml kg LW^{-1}). Different from the hay that was offered twice (08:30 and 16:30 h) at a rate of 1.2 kg $animal^{-1}$ (DB), the levels were added to the supplement at the supply time (09:30 h) according to the treatments. The intake of DM, NDF and their expressions were higher ($P < 0.001$) in the level of 6.0 ml kg LW^{-1} of VITAFERT in the ration, with great ratio NDF-TN^{-1} and higher use of nutrients (ME vs. CP $P < 0.001$) in the ration, compared to the rest of the treatments. It is concluded that the addition of this microbial additive at a rate of 6.0 ml kg LW^{-1}, in a basic diet of *Brachiaria brizantha* hay of low quality, together with a minimum of energy-protein supplement, had an associative effect between both of them, increasing the intake of DM and NDF.

Key words: *Sannen, rumen, associative.*

In tropical areas, forages are the most economic source of animal feed. However, a great part of those used are native or naturlized pastures, of low productivity and quality (Peters *et al*. 2010). For these reasons, the use of technologies to improve quality and efficiency of nutrients in ruminants is imposed in cattle production (Elías 1983 y Galina *et al*. 2008). In the last years, the use of additives from cultures of alive microorganisms as activators of ruminal fermentation has gained great scientific and productive interest (Elías and Herrera 2008, Castillo 2009 and Galina *et al*. 2010). The addition of these microorganisms to the ruminants' diet may increase the intake of the feeds in the ration (Marrero 2005).

Worldwide, generally, goats feed is based, mainly, on free grazing with grass species of the area. In most of the cases, this is inefficient in biomass and nutrients, especially during the dry season when the quality and availability of pastures diminish.

This situation delays the body development of the animals, provokes weight losses, low fertility, abortions, mortality and decrease of milk and meat production (Sánchez 2001).

The microbial additive VITAFERT, as a product of biological activity, rich in lactobacilli, yeasts, carbonated short-chain organic acids and low pH (Elías and Herrera 2008), stabilizes the microbial flora of the ruminal ecosystem, at the time that increases the DM digestibility and that of the cell wall (Elías *et al*. 2010).

The objective of this study was to assess the effect of including in the diet three levels of the microbial additive VITAFERT on the DM and NDF intake of goats fed *Brachiaria brizantha* hay of low nutritive quality.

Materials and Methods

Localization. The experiment was conducted during February-March 2010 in the area of caprine metabolism of the Department of Ruminants Management and Feeding, from the Institute of Animal Science (ICA), located in San Jose de las Lajas municipality, Mayabeque province, Cuba. This facility is between 22º 58 NL and 82º 02 WL and at 80 m a.s.l.

Animals and design. Three goats (*Capra hircus*) from the Saanen breed, clinically healthy, canulated permanently in the dorsal part of the rumen were used. Thay were distributed in a 3 x 3 Latin square design. The animals, allocated in individual metabolism cages (60 x120 cm), were three years old and had a mean liveweigth of 43 kg (17.0 ± 0.82 kg LW0.75). The experiment lasted 45 d, distributed into three experimental periods, with nine days of adaptation to the diet and five for data collecting.

Procedure for elaborating the feed. The microbial additive VITAFERT was obtained by a fermentation mixture of the final molasses of sugar cane, soybean, maize, urea, magnesium sulfate and mineral formula. Yogurt was used as microbial inoculant (Elías and Herrera 2008). A fermentor with 250 L capacity was used, made of stainless steel, with a central shovel to homogenize the mixture and an automatic regulator to control the agitation and resting time (2 h of resting and 20 min. of agitation). The microbiological and chemical composition of the product includes concentrations of yeasts and lactobacilli, ranging between 10^7-10^8 cfu and 10^9-10^{10} cfu, respectively, and of 450-600 mmol L^{-1} of lactic acid and 225-230 mmol L^{-1} of acetic acid.

Brachiaria brizantha is a grass species, established in the forage areas of ICA, on a typical red ferralic soil, easily dried out and uniform profile (Hernández *et al*. 1999). *Brachiaria brizantha* hay is a fibrous material, of 85 d of age, prepared according to the methodology of Michelena and Delgado (2008).

Chemical indicators of feeds. The analysis of the chemical composition of feeds was conducted in the Laboratory of Analytical Chemistry of the Institute of Animal Science (LASAICA). Thay were determined DM, CP and ash, according to AOAC (1995). The fiber fractioning was carried out according to Goering and van Soest (1970). The ME of hay and supplement were determined following the prediction equations proposed by García-Trujillo and Pedroso (1989) (table 1).

Feed and distribution. During the experiment, the animals had free access to water and mineral salts. The basal diet was *B. brizantha* hay, of low nutritive value (Pérez- Infante 2010), offered at about in a dry basis ratio of 80:20 in respect to the supplement. This last was used for offering the VITAFERT. The treatments were: T1) basic diet of *B. brizantha* hay + caprine commercial supplement; T2 and T3) *B. brizantha* hay + caprine commercial supplement and two levels VITAFERT (6.0 and 12.0 ml kg LW^{-1}, respectively) added to the supplement with the ration (09:30 h), different from the hay that was offered at 8:30 and 16:30 h, at a rate of 1.2 kg $animal^{-1}$ (DB). The intake was determined after weighing the feed offered and rejected, according to that left on the feeder during four continuous days and in each experimental period, once the adaptation to the diet ended (10 d).

Statistical analysis. Duncan's test (1955) was used to establish the difference between means. The data processing was conducted with the statistical software INFOSTAT (Balzarini *et al*. 2001).

Results

Table 2 presents the voluntary intake of DM, CP and ME and their correlation. In the treatment with 6.0 ml kg LW^{-1} of VITAFERT in the ration, the intake increased ($P < 0.001$) compared to the rest. In respect to the specific analysis of DM intake, the results show that when adding 12.0 ml kg LW^{-1} of VITAFERT to the ration, the total intake decreases 230 g d^{-1}, equivalent to 14 g of DM per kg of metabolic weight and 0.6 % less of live weight, in respect to the treatment with 6 ml kg LW^{-1} of VITAFERT in the ration. Similar performance had the fiber intake, with 0.64 and 0.47 percent units compared to the control treatment and 12.0 ml kg LW^{-1}, respectively. The hay

Table 1. Bromatological composition of the feeds used in the ration

Feed	DM %	CP %	TP %	ME MJ	NDF %	Ash %	Ca %	P %
Supplement	88.17	16.45	-	11.80	-	6.25	2.11	0.29
Hay	86.26	5.99	-	7.70	85.18	6.15	0.45	0.24
1VITAFERT	9.70	4.80	2.88	-	-	5.19	1.20	0.17

Table 2. Effect of three levels of VITAFERT on the voluntary intake of total DM, forage DM, NDF, energy and CP consumption and their relationship

Indicators	Treatments			±SE Sig.
	Control	6.0 ml $kgPV^{-1}$	12 ml $kgPV^{-1}$	
DM intake, kg $anim^{-1}$	0.725^a	1.050^b	0.820^a	0.03***
DM intake, g kg LW0.75	43.89^a	63.22^c	49.13^b	1.67***
DM intake, g kg LW	17.27^a	24.83^c	19.30^b	0.64***
DM intake, % LW	1.72^a	2.48^c	1.93^b	0.06***
NDF intake, % LW	1.47^a	2.11^c	1.64^b	0.05***
NDF intake, % LW	1.00^a	1.65^c	1.18^b	0.05***
NDF intake, g NDF LW 0.75	26.04^a	42.50^c	30.50^b	1.42***
Total ME intake, MJ $anim.^{-1}$	6.51^a	9.01^b	7.21^a	0.22***
Total CP intake, g $anim.^{-1}$	66.90^a	86.57^b	72.41^a	1.80***
Forage DM intake, kg $anim.^{-1}$	0.49^a	0.82^b	0.58^a	0.03***
Forage ME intake, MJ $anim.^{-1}$	3.75^a	6.25^b	3.45^a	0.22***
Forage CP intake, g $anim.^{-1}$	29.48^a	49.13^b	34.97^a	1.80***
Concentrated ME intake/Forage ME, MJ $anim.^{-1}$ ratio	0.85^b	0.44^a	0.64^a	0.06**
Concentrated CP intake/Forage CP, g $anim.^{-1}$ ratio	1.47^b	0.77^a	1.10^a	0.10**
F-C intake ratio (DS)	66.34^a	$78:22^b$	$71:29^b$	1.58***
NDF-TN-1 ratio	38.92^a	51.10^c	43.50^b	1.42***

$^{**}P < 0.01$, $^{***}P < 0.001$ different letters within the same row differ at $P < 0.05$

contributed with 79 % of the total NDF consumed, at the same time of a wide ratio NDF-TN^{-1} ($P < 0.001$) with 6.0 ml kg LW^{-1} of the product compared to the rest of the treatments.

The nutrients intake (ME vs. CP) had a similar performance to that of the DM. The treatment with 6.0 ml kg LW-1 of VITAFERT in the ration showed the highest intake values and higher use of the total nutrients, as well as those from the basic feed (hay). More than 50 % of the total energy and protein consumed came from the forage (69 % for energy and 57 % for proteins). The use of the concentrate energy meant 44 %, while that of protein 77 %. It was lower ($P < 0.01$) in respect to the treatments, once hay intake increased notably. AQUÍ TABLA 2

Discussion

In spite the treatment with 6.0 ml kg LW^{-1} of VITAFER^{-1} in the ration showed superior values of DM intake and its relation with the live weight, the value reached is within the range (2.0-2.8 % LW) reported by Meneses (2010) for goats out of lactation, as those used in this experiment.

The difference of DM intake on the treatment with 6 ml kg LW^{-1} of VITAFERT in respect to the rest could be related with the high NDF percentage of the hay supplied, limiting seriously the voluntary intake, where the ruminal rechange rate and that of the material degradation assume the main roles (Mc Leod and Minson 1987). In this respect, Mertens (1983) stated that a diet with 35 % of NDF stimulates the DM intake, with values over 60-65 % NDF and limits markedly the intake due to the physical filling of the organ (Santini 1989). Therefore, the affection of the DM intake could be also due to the hay used coming from a plant with 80 d of fenalogical age and 85 % of NDF.

Unsolved limitations on the intake were found in this study, even when the intake levels of the energy-protein supplement was of 6.25 ±0.39 g kg LW^{-1} in all treatments, similar values to those reported by Elías (1983), García Trujillo and García López (1990), Ramos (2005) and Rotger *et al*. (2006). These authors refer 6 g kg PV^{-1} as optimum intake level of the supplement for a ruminal environment where the cellulolysis does not decreases.

In this treatment, the result could only be due to the increase of the fiber degradation, process conducted by the ruminal microorganisms, from a positive associative effect, together with the protein and energy contribution of the supplement and the VITAFERT used as substrate. It could also be understood from growth factors of the biological product (root and short-chain fatty acids) and for its microbial stock. According to Huhtanen (1991), these mechanisms guarantee the nutrients needed for improving the ruminal environment and increase the growth efficiency of cellulolytic microorganisms, the cellulose digestibility and with that, the voluntary intake.

In respect to the apparent intake of NDF and is relation with live weight in goats, recent studies of Carvalho (2002) showed that the voluntary intake of NDF varied linearly between 1.06 and 1.94 % PV, with mean values of 1.53 %. These NDF levels were assessed from a basic diet with Tifton-85 (*Cynodon sp.*) hay. The values of these studies were higher than those reported by Carvalho (2002).

These results justify those described by Mertens (1994), when pointing out that the variation on the fiber consumption is determined by the goat capacity of adjusting growing amounts of fiber in the rumen, when facing low-quality feeds. This phenomenon is of great importance for the forage voluntary intake. This greater intake capacity in goats, particularly its increase in the fiber stock, could be associated to the capacity of this species of exceeding the physical distension of the reticulum-rumen (Borges 1999) and to factors associated with mastication, which is more prolonged and efficient (Hadjigeorgiou *et al*. 2003), as well as to the higher recycling of blood urea towards the rumen (Tisserand *et al*. 1986). These beneficent effects occur in this species in diets with less than 10 % of protein and increase the number of cellulolytic microorganisms (Tolkamp and Brouwer 1993).

The intake limitation, when using 12 ml kg LW^{-1} of VITAFERT, could be conditioned by the increase of the contractions of organic acids and other metabolites of the product VITAFERT in the ruminal environment. This could inhibit the microorganisms' activity at that level; even provoke the cell death (Nisbet and Martin 1990). It could influence on the intake, the water contribution of VITAFERT to the ration. Although humidity in the ration was at an acceptable rate (45 %) for goats (Castillo 2011), it duplicates the value reached with the middle level.

Assuming that all treatments were submitted to the same diet and that the responses were different, it proves that not only the proper supply of peptides and amino acids from the supplement and the substrate of VITAFERT and its balance with the available energy, stimulated the growth of cellulolytic bacteria in the rumen but also the microbial additive, in the concentrations of 6 ml kg LW^{-1}, as a biologically active product, rich in yeasts and lactobacilli, nitrogen (CP and TP), organic acids and their metabolites (Elías and Herrera 2008), could determine on these results and influence on the development of fibrollytic microorganisms as deslignificant agents (Galina *et al*. 2010), from the improvement and stabilization of the ruminal ecosystem. This indicates that ruminal fermentation could be not only a direct function of the substrate in the rumen, its composition and balance, but could be an effect, synchronized and synergic of the substrate use by the microorganisms and ration management (Elías *et al*. 2010). This depends on the dosage of the microbial additive.

It is concluded that when using *Brachiaria brizantha* hay of low nutritional quality as basic diet in goats, adding the microbial additive VITAFERT, at a rate of 6 ml kg LW^{-1} to the ration, provides the ruminal environment of growth factors and microbial stock. Likewise, the addition of 6 g kg LW^{-1} of an energy-protein supplement has an associative effect between both of them, increasing the intake of DM and NDF.

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