

# PERFORMANCE OF HOLSTEINS COWS IN PASTURE OF *Cynodon dactylon* cv. Coast-cross SUPPLEMENTED WITH CONCENTRATE<sup>1</sup>

## Desempenho de vacas da raça Holandesa em pastagem de *Cynodon dactylon* cv. Coast-cross suplementada com concentrado

Rodrigo Carvalho Cardoso<sup>2</sup>, Paulo César de Aguiar Paiva<sup>3</sup>, Duarte Vilela<sup>4</sup>

### ABSTRACT

The work was developed in the experimental station of Embrapa Gado de Leite (Dairy Cattle Embrapa), in Coronel Pacheco, in Zona da Mata Region of Minas Gerais, with the purpose of evaluating the productive performance of Holstein cows kept on 'Coast-cross' (*Cynodon dactylon* (L.) Pears) pasture, fertilized, strategically irrigated and where the cows were daily supplemented with 3 or 6 kg of concentrate/cow/day. The data were collected during three years (October/2000 to October/2003), involving 108 lactations. An experimental randomized block design with two replicate areas per treatment was adopted, with nine animals per area and eighteen animals per treatment being utilized, with fixed stocking rate of five cows/ha. The system of grazing, under rotated stocking, with one day occupation of the enclosures (piquetes) and 25 and 35 days rest in the rainy and dry seasons, respectively was used. The pasture was irrigated in the months of lowest rainfall and fertilized with NPK broadcast at six applications/year. The availability of dry matter of the pasture was 7,280 kg/ha and 6,167 kg/ha in early grazing, with the post-grazing waste stubble of 4,885 kg/ha and 3,994 kg/ha, in the rainy (Spring/Summer) and dry (Fall/Winter) seasons, respectively. During part of the experimental period, a few morphogenic characteristics of the pasture were evaluated, recording availability of 83.9; 125.6 and 89.5 kg of DM of leaf blades/ha/day, on spring, summer and fall, respectively. The daily averages of milk production per cow were 15.57 and 18.80 kg/day with 3.5% of fat and per area 77.80 and 94.00 kg/ha, when 3 or 6 kg of concentrate/cow/day were fed, respectively. It was concluded that supplemented and managed 'Coast-cross' pasture adequately enables high milk production per animal and per area, as quantitatively and qualitatively adequate for milk production.

**Index terms:** Nutrition, intake, grazing, milk production, milk quality, reproductive performance.

### RESUMO

O trabalho foi desenvolvido na base física da Embrapa Gado de Leite, em Coronel Pacheco, na Zona da Mata de Minas Gerais. Objetivou-se avaliar o desempenho produtivo de vacas da raça Holandesa mantidas em pastagem de 'Coast-cross' (*Cynodon dactylon* (L.) Pears) fertilizada, irrigada e suplementada com 3 ou 6 kg de concentrado/vaca/dia. Os dados foram coletados durante 3 anos consecutivos (outubro/2000 a outubro/2003), num total de 108 lactações. Adotou-se o delineamento experimental em blocos, ao acaso, com duas repetições de área por tratamento, sendo utilizados 9 animais por área e 18 por tratamento, com lotação fixa de 5 vacas/ha. Foi utilizado o sistema de pastejo rotacionado, com um dia de ocupação e 25 e 35 dias de descanso dos piquetes, nas épocas de chuvas e seca, respectivamente. O pasto foi irrigado nos meses de menor precipitação e fertilizado com adubo formulado (NPK) distribuído a lanço, em 6 aplicações anuais. A disponibilidade de matéria seca foi de 7.280 e 6.167 kg/ha no início do pastejo, com resíduo pós-pastejo de 4.885 e 3.994 kg/ha, nas épocas de chuvas (primavera/verão) e seca (outono/inverno), respectivamente. Durante parte do período experimental, algumas características morfológicas do pasto foram avaliadas, registrando-se disponibilidade de 83,9, 125,6 e 89,5 kg de MS de lâminas foliares/ha, nas estações de primavera, verão e outono, respectivamente. As produções médias diárias de leite (corrigidas para 3,5% de gordura) foram de 15,6 e 18,8 kg/vaca e de 77,8 e 94,0 kg/ha, quando se forneceu para cada vaca 3 ou 6 kg de concentrado, respectivamente. Concluiu-se que com a pastagem de 'Coast-cross', quando suplementada, fertilizada e manejada adequadamente, obtém-se elevada produtividade de leite por animal e por área, podendo-se considerar ser essa uma das forrageiras mais promissoras para produção de leite, em pasto, com vacas de elevado potencial produtivo.

**Termos para indexação:** Nutrição, consumo, pastejo, produção de leite, qualidade do leite, desempenho reprodutivo.

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### INTRODUCTION

The intensive production of milk on a pasture has been the effective way to reduce costs and maintain competitiveness of dairy farm in the current scenario. In Brazil, increasing the milk production in a sustainable and

competitive way has been a major challenge for researches in which, among other investigation segments, aim continually at seeking tropical forage species that, when managed correctly and intensively present a good potential to implement profit and competitiveness in this activity.

<sup>1</sup>Work extracted from part of the Doctor's degree thesis presented at UFLA by the first author

<sup>2</sup>Graduated in Animal Science – D.Sc. in Ruminant Nutrition

<sup>3</sup>Full Professor, PhD, of the Departamento de Zootecnia/DZO – Universidade Federal de Lavras/UFLA – pcapaiva@ufla.br

<sup>4</sup>Dsc. in Animal Science, Researcher – Empresa Brasileira de Pesquisa Agropecuária, Centro Nacional de Pesquisa de Gado de Leite – Rua Eugênio do Nascimento, 610 – Dom Bosco – 36038-330 – Juiz de Fora, MG – vilela@cnpgl.embrapa.br

Grass species of *Cynodon*, because of their nutritional benefits, productive potential, response to fertilization, adaptation to different environment and use flexibility have been intensively researched in Brazil since the last decade. Embrapa Dairy Cattle has been developing researches (Alvim et al., 1997, 1999; Mota et al., 2004; Vilela et al., 1996, 2002, 2003a, b, 2004) in which was sought to define the best management for this grass species considering the intensive production of milk in pasture with high productive potential animals. The results have been promising, achieving stocking rate from 5 to 7 cows / ha, with daily production of milk up to 104 kg / ha. With these results, it is verified that, producing milk on pasture, in a intensive and rational way, is more profitable than the fully confined production models, according to observations from Resende & Vilela (2004a, b), Vilela et al. (1996) and Vilela & Resende (2001).

One of the main advantages of forage from *Cynodon* genre is the response to use of technology. In the production models with these grass species, it has been observed a high capacity to reduce costs and increase the profits in this activity (Fontanelli et al., 2000; Vilela et al., 1996; Vilela & Rezende, 2001). Therefore, the cost reduction in the milk production, associated with increase

in the production scale, might be the path to obtain higher profits and remain on the activity. In this context, Alvim et al. (1999) evaluated three nitrogen levels (100, 250 and 300 kg/ha/year) applied on 'Coast-cross' pastures, and found, during two years, individual milk productions similar to the studied levels. However, the allocation rate was inferior on the smaller doses with positive reflex on milk production per area on the two biggest nitrogen doses, however not differing from each other.

The present study aimed to evaluate the performance of Holstein cows in 'Coast-cross' pastures, seeking to identify concentrate supplementation strategies with which it is possible to obtain the most efficient milk production per animal and per area.

## MATERIAL AND METHODS

The work was implemented in the Embrapa Dairy Cattle facilities, in Coronel Pacheco, in the Zona da Mata region of Minas Gerais (21 ° 33 '22" South Latitude and 43 ° 6'15" West Longitude). The local climate is Cwa type (mesothermal), with rainy summer, dry winter and average annual rainfall of 1,500 mm, distributed unevenly. The climatological information of the last 40 years (1961 to 1999) and those of the experimental period (October 2000 to October 2003) are shown in Figure 1.

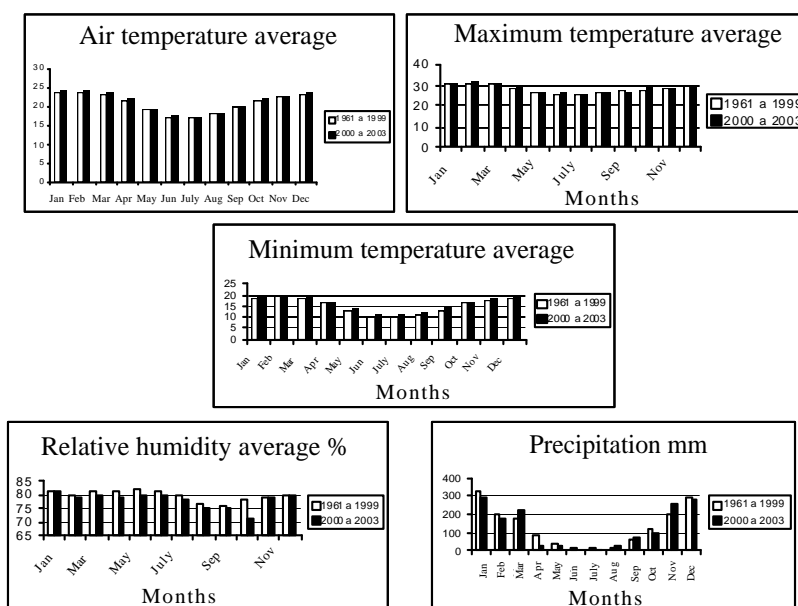


Figure 1 – Average climatologic data in the experimental period (200 to 2003) compared with the historical series of the region in the period from 1961 and 1999.

The experiment was conducted in an area with seven hectares with pasture formed with *Cynodon dactylon* cv. "Coast – cross", handled in rotation pasture with 5 cows/ha.

36 cows from the Holstein breed were used, with average live weight of 550 kg and production potential of 6,000 to 6,500 kg/lactation. These animals were divided in four equal groups, with two area repetition per treatment. 9 animals were used per area and 18 per treatment. Each group of cows had at their disposal 40 "piquetes" with 470m<sup>2</sup> each, divided with electric fences. The occupation period of the "piquete" was of one day and a resting period of 25 to 35 days, according to the time of the year, dry (fall/winter) and rainy (spring/summer), respectively. The data were collected during three consecutive years (October 2000 to October 2003), and covered a total of 108 lactations (3 years with 36 animals per year).

The pasture was fertilized with 1,000 kg/ha/year of the formula 20-05-20, distributed by throwing in 6 annual applications, always after the animals left the "piquetes". In the dry months, the pasture were irrigated by aspersion, using a conventional irrigation set with a discharge of 60m<sup>3</sup>/hour. The system counted with a motor bomb set, a main metallic tabulation line with 4 inches and two secondary lines with 3 inches, with one of them as wait. In each line 15 spray heads were installed, with individual discharge of 4.0m<sup>3</sup>/hour. The respected a space of 24 x 18 meters, with 1 meter high ascension tube, suspended by metallic tripods. The "piquetes" were irrigated after the forage fertilization, made after the animals left. The interval between irrigations was evaluated by porous capsules tensiometer. It was sought to maintain available water between 60 and 65%. The water quantity in each irrigation was established by the formula:

$$BB = (fc - \phi) Ed.ad.10 / Ef$$

Where: BB = Brute blade of water to be applied (mm); fc = field capacity (g water/g soil); f = Soil moisture rate at the tension of - 6a - 7atm. (g water/g soil); Ed = effective depth of the radicular system (cm); ad = apparent density of the soil (g soil/cm<sup>3</sup>); Ef = irrigation system effectiveness.

Before and immediately after the pasture, available and residual forage quantities of the pasture were estimated. The quantities had as reference the forage cut before (available) and after the pasture (residual). The cuts were 8 cm above the ground level. The location of this cut was determined by the use of a square with 1 meter in the sides, which were thrown randomly, three times in each "piquete". All the existing vegetation under the under the mattress of 8 cm was disregarded. Part of the collected material in this

process was used to estimate the forage quality (crude protein, fiber in neutral detergent and dry matter digestibility *in vitro*) that is found on table 1. The animals had free access to water and artificial shade, when in the "piquetes".

The daily consumption of dry matter of the pasture was estimated by the difference between available quantities (accumulated through the month) and residual (after one day pasture), and the stocking rate (5 cows/ha).

It was supplied daily, per cow, 3.0 and 6.0 kg of a concentrate formulated with whole corn crushed (62%), whole soy toasted (35%), mineral mixture (2%) and calcitic limestone (1%), with the following dry matter composition: crude protein 19.5%; protein degradable in rumen, 9.3%; and total digestible nutrients, 86%. The concentrate was supplied during the milking, realized twice a day (7:00 a.m. and 3:00 p.m.). Concluding the milking, the cows were always conducted back to the "piquetes". In the dry period (between May and September), when the forage availability was lower than 4000 kg of DM/ha, the pasture was supplemented with corn silage (33% of DM), in the daily quantity of 17 kg per cow. This supplementation was needed only in the last evaluation year (2002/2003). Every 15 days, throughout the production cycle, the cows were weighted. To estimate the bodily score was taken into account visual and touch evaluations. Grades were attributed that vary from 1 to 5, being 1 = very thin; 2 = thin; 3 = regular; 4 = fat; 5 = very fat. The milk production was registered daily. The criterion to dry the cows was the following: 60 days before delivery or when the daily production was lower than 4 kg per cow. The milk production was corrected to 3.5% of fat (CMP) by the equation quoted by Sklan et al. (1992).

$$CMP = (0.432 + 0.1625 \times F) \times \text{quantity (kg) of milk.}$$

Where: F is the milk's fat percentage.

The production was analyzed according to delineation in random blocks, with two area repetitions and two concentrate levels (3.0 and 6.0 kg/cow/day). The criterion to form the blocks was the delivery season. Variance analyses were made using the statistic package SAS (SAS INSTITUTE, 1996).

## RESULTS AND DISCUSSION

In the periods from October to November 2000 (Spring), February to March 2001 (Summer) and May to June 2001 (Fall), some pasture's morphogenic characteristics were evaluated, observing the daily accumulation of dry matter rates (DM) and leaf blades of

83.9, 125.6 and 89.5 kg/ha, respectively. Even when considering the smaller availability of DM, registered during the spring (83.9 kg of DM/ha/day), it was possible to achieve the availability of 16.78 kg/cow/day (83.9 kg of DM/ha per 5 cows/ha/day). This value is referring only to leaf blades, because during the pasture, besides leaves, the animals also ingest green and tender stems.

On Table 2, are presented: estimate of available and residual dry matter; consumption of dry matter from the pasture; and estimate consumption of dry matter, when provided 3 or 6 kg of concentrate to the cows.

The small difference observed in the DM availability (1,113 kg) may be explained by fertilization and irrigation, which allowed a DM availability in the dry season of 84.7% of the one reached on the rainy season. This fact caused the post pasture residues to remain with similar values between the two evaluated seasons.

However, the difference in the consumption of DM from pasture between the two evaluated seasons (1.46 kg of DM/cow) was, certainly, due to fertilization and irrigation that stimulates the constant re-sprout in the plants, maintaining forage quality through the dry season into the rainy season (Table 1). Also the temperature, that did not reach excessively low values in the dry season (Figure 1), did

not make the pasture consumption alter excessively between the two seasons of the year.

In the dry season, the availability and quality of the DM did not reduce significantly. It made the MS consumption to also continue with no big change. The correct handling of pasture, with frequent fertilization, strategic irrigation and rational pasture and rest periods, is fundamental to an adequate productivity. In the post pasture residues, the smaller average value observed in the dry season (3,994 kg of DM/ha) and, during this season, the smaller value occurred in august (2,524 kg of DM/ha). Considering that it is recommendable a residue of, at least 2,000 kg of DM/ha, to avoid pasture degradation and ensure good re-sprout strength, is recommended *Cynodon* pastures to be utilized up to a minimum height of 20-25 cm (2,00 to 1,500 kg of DM/ha).

The total DM consumption (pasture, concentrate a corn silage) maintained its percentage of 3.3 and 3.8% in the live weight of the animals, respectively, for 3 and 6 kg of concentrate. Therefore, it was concluded that there was no food restriction for the animals and that the total DM consumption was adequate. According to NRC (1987), it is expected a total DM consumption of 15.5 and 19.7% kg/head, in cows of the Holstein breed, with average live

Table 1 – Average contents of dry matter (DM), crude protein (CP) fiber in neutral detergent (FND) dry matter digestibility *in vitro* (DMDIV) of “Coast-cross” pasture (average of 3 years of evaluation).

Season	DM (%)	CP	FND	DMDIV
		(% MS)		
Fall/Winter (dry period)	25.5	16.0	63.3	65.4
Spring/Summer (rainy period)	24.0	18.0	65.8	65.8

Table 2 – Dry matter estimates (DM), available and residual (kg of DM/ha), daily consumption of dry matter (kg/cow) from the pasture and total daily consumption of dry matter (kg/cow), using cows from the Holstein breed kept in “Coast-cross” pastures, for three consecutive years.

	Pasture <sup>1</sup>			
	Rainy season		Dry season	
Available DM (kg/ha)	7,280		6,167	
Residual DM (kg/ha)	4,885		3,994	
DM consumption of pasture(kg/cow/day)	15.96		14.50	
	kg of concentrate/cow/day <sup>2</sup>			
	3	6	3	6
Total DM consumption (pasture + concentrate)	18.72	21.48	17.26	20.00
Total DM consumption (% PC)	3.4	3.9	3.1	3.6

<sup>1</sup>Average levels of sampling conducted every month, in each season.

<sup>2</sup>Concentrate with 92% of dry matter.

weight of 550 kg and daily milk production between 15 and 20 kg. It is evident, therefore, that the milk production obtained in this study was not limited by the DM consumption, or by the forage quality (Table 1).

The milk production, per animal, in the different evaluation periods and the averages referring to the total period are presented on Table 3.

There was no difference ( $P>0.05$ ) in the fat content in the milk between the two levels of concentrate (3.61 and 3.54%). The general average (0 to 330 days) of production corrected to 3.5% of fat in the milk was  $16.09 \pm 0.44$  and  $19.50 \pm 0.50$  kg/cow/day, respectively, to the supply of 3 or 6 kg/cow/day.

The average production (both with no correction as well with corrected to 3.5% of fat) were higher ( $P<0.01$ ) when supplied 6 kg of concentrate, independently of the evaluated period. The cows that received 6 kg of concentrate produced, averagely, 3.61 kg of milk/day more than the ones that received 3 kg/cow/day. Between the two evaluated levels, every additional kg of concentrate stimulated the production of, approximately, 1.2 kg of milk. Probably with higher consumption of concentrate, it is permitted a partial substitution of the dry matter from pasture consumption. In this case, the higher production of the cows when receiving 6 kg of concentrate was a reflex of the diet's quality, independently of the evaluated period in which, in the first 100 days, registered milk production of 22.2 and 19.0 kg/cow/day. According to Holmes & Wilson (1990), in each unit of ingested DM via concentrate, is estimated a reduction in the consumption of DM from the voluminous of 0.5 to 0.8 units, verifying, therefore, substitutive effect. In other hand, the lactation persistence was higher with animals receiving six than receiving three kilos of concentrate per cow, per day (-0.27 and -0.35 kg of milk/cow/day). Alvim et al. (1997) also reported a higher lactation persistence of cows that received bigger quantities of concentrate, during the initial third part of lactation.

In the evaluation made during two successive lactations of Holstein cows, kept in a "Coast-cross" pastures, Vilela et al. (2004) concluded that the concentrate supply resulted in an average increase of 1.0 kg of milk per extra kilo of supplied concentrate. For the relative costs, according to the authors, this substitution only would be economically viable if the milk price was equal or higher than the concentrate price, taking into account the reproductive efficiency of the animals had not been affected in a meaningful way. Davidson (1990) outlines that the decision about using or not using concentrate is related to the price, and the liquid margin of the activity increases according with the price reduction of the concentrate and increase of the milk production.

The part of the concentrate, in the diet of lactating cows, assumes a higher or lower importance also according to the individual production potential. Cowan (1995) affirms that, in systems with productivity higher than 4,500 kg/cow/lactation, it is fundamental to resort to supplementation with concentrate, however the level and kind of protein in the concentrate also affects directly the production cost.

The pasture must be the main source of nutrients for the animal, but it is necessary to be well handled and formed by species with elevated nutritional and productive potentials. In a general view, in the chemical composition of fertilized pastures, it is observed an imbalance in the relation energy/protein, maybe causing a excessive concentration of fermented protein in the rumen. In this case, it is necessary to neutralize the excess of ammoniacal nitrogen present in the rumen, which can be done through a strategic supplementation with specific concentrates. In this study, the fact of being utilized concentrates with higher energy concentrations and lower protein degradation in the rumen, resorting to toasted whole soy, this problem possibly did not occur.

Table 3 – Milk production in the 3 evaluation periods and total of cows from the Holstein breed, kept in "Coast-cross" pastures and receiving 3 or 6 kg of concentrate per head daily (average of 3 consecutive years).

Concentrate level (kg/cow/day)	Milk production (kg/cow/day)			
	0-100 (Days)	101-200 (Days)	201-330 (Days)	330 (Days)
3	$19.07 \text{ B} \pm 0.60$	$15.50 \text{ B} \pm 0.49$	$11.99 \text{ B} \pm 0.53$	$15.54 \text{ B} \pm 0.38$
6	$22.27 \text{ A} \pm 0.85$	$19.20 \text{ A} \pm 0.64$	$16.25 \text{ A} \pm 0.63$	$19.15 \text{ A} \pm 0.45$
Average	$20.62 \pm 0.54$	$17.36 \pm 0.44$	$14.16 \pm 0.46$	$17.07 \pm 0.23$
CV				22.89

<sup>1</sup>Averages followed by different letters differ, in the column, by the SNK test ( $P<0.01$ ).

Usually, the energy ingestion is a limiting factor in milk production in tropical pastures, especially in the initial third part of lactation, because of the inability of cows to consume energy in sufficient quantity to sustain high levels of milk production. Occurs in this situation, a bodily reserves mobilization (NRC, 2001), which induces weight loss in the animals, with the case not being discussed in the present study.

The milk production per are were of 77.85 and 94.99 kg/ha/day for the levels of 3 and 6kg of concentrate/cow/day, respectively, projecting yearly production potential over 31 thousand kg of milk/ha. Alvim et al. (1997) registered and average yearly production approximated to 37 thousand kg/ha, with stocking rate of 5.1 cows/ha. The difference was that it was used 380 kg/ha of nitrogen and 304 kg/ha of potassium, fractioned in 10 coverage application. With fertilization and irrigation, a higher pasture and forage production in better quality was achieved, securing high milk production per area, as well as per animal, with the possibility of optimizing the production by supplementation with concentrate. On Table 2.3, it is verified that, with 6kg of concentrate, it was possible an average daily production per cow of 19.4kg of milk and with 3kg, 15.4 kg/cow/day, maintaining stocking rate at 5.0 cows per ha. Vilela et al.(1996), comparing the performance of Holstein cows, confined and in "Coast-cross" pasture supplemented with 3kg of concentrate achieved a daily individual production of 10.6 (confined) and 16.6kg (pasture). In the pasture, the average stocking was 5.8 cows/ha/day. The authors concluded that, although the income from commercialized milk in the pasture system had been lower than in the confined system, the brute margin was 32% higher, demonstrating the viability and economic superiority of pasture production when compared to confined production.

The *Cynodon* pasture potential in milk production of Holstein cows was also evaluated in other experiments by Alvim et al. (1997, 1999) and Vilela et al. (1996, 2002, 2003, 2004), and in the records it was verified production of up to 104kg of milk per ha, with stocking rate of 7.3 cows/ha, and individual production of 17 to 20 kg/day. In the present study, the average daily production (15.5 and 19.1 kg/cow and 77.8 and 94.0 kg/ha) with constant stocking of 5 cows/ha, are suitable with productions reported on the studies quoted above. The small variances in the production per area and in stocking rate may be explained by the fact that the used nitrogen quantity (200 kg/ha) is smaller than in the reported in the studies quoted before (360 kg/ha/year). As for the animal production, it is due to the fact that the same experimental animals were used in

during three successive lactations, while in the previous studies, there was animals reposition after each experiment.

In pasture production systems, with animals of higher productive potential, it is important the concentrate supplementation for the manifestation of its potential. Alvim et al. (1997, 1999) and Mota et AL. (2004), studying concentrate supply strategies, showed that, when doubling the concentrate quantity, it was possible to increase the pasture stocking up to 50% and reducing in 11% the pasture related operational cost.

There was no difference ( $P>0.05$ ) in the milk production between years (2000 to 2003), as between season of the year ( $P>0.05$ ). Even the pasture's quality stability between yeas and through the evaluated year interfered positively in this results, possibly influenced by the used handling, or, with regular fertilizations throughout the year, distributed in six applications and facilitated by the use of irrigation.

There was no difference observed ( $P>0.05$ ) for bodily score in the animals between the two tested concentrate levels. According to Lago et al. (2201), the bodily score varies according to the adopted method, and in the higher value, always animals with more bodily reserves are verified. However, according to Ferguson et al. (1994), both the excess and the low weight in cows at labor cause adversities, as well as metabolic problems, reduction in the production, lower conception rates and difficulties in the delivery. Edmonson et al. (1989) observed that very fat cows have propensity to ketosis because they consume less food right after labor, and mobilize bodily reserves. Ferguson et al. (1994) suggest different values to bodily scores. For theses authors, the values must vary according to the production stage, according to this scale: beginning of lactation, 2.50 to 3.25, middle of lactation 2.75 to 3.25; and end of lactation 3.00 to 3.50. In the present study, the observed scores fit in the interval suggested for the beginning of lactation, although, are lower than the values suggest for the middle and end of lactation. Although the fact that cows mobilize bodily reserves and loose weight to supply the negative energetic balance, possibly this did not occur in this study, allowing inferring that the nutrient consumption was sufficient to meet the necessary demands for maintenance, production and reproduction.

## CONCLUSIONS

The "Coast-cross" pastures, when adequately handled, fertilized, irrigated and supplemented, show good forage availability. In this situation, the pasture is capable of supplying the quantitative and nutritional demands of

Holstein cows to stand 5 cows/ha and average milk production of up to 19.1 kg/cow/day.

With 6kg of concentrate per day, more milk was produced ( $P<0.01$ ) than with 3kg, independently of the evaluation period. However, even with 3kg of concentrate, a daily milk production of up to 19.1 kg/cow/day was possible.

It was verified that "Coast-cross", when well handled, is an adequate and promising forager for intensive pasture milk.

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