



Productive response of crossbred cows grazing *Brachiaria decumbens* pasture to supplementation of *Saccharomyces cerevisiae*

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ABSTRACT

The objective of study was to evaluate the productive response of crossbred cows grazing on *Brachiaria decumbens* pasture to supplementation with an experimental concentrates (CEXP) with or without addition of *Saccharomyces cerevisiae* (SC). Four milking Brown Swiss × Zebu cows were utilized 4×4 Latin square design. Treatments were T₁= 3 kg of CEXP; T₂= 2 kg of CEXP; T₃= 2 kg of CEXP + 10 g of SC; and T₄= 3 kg of commercial concentrate as control treatment. CEXP was 63% ground maize, 25% canola meal, 10% molasses and 2% urea. All cows received 3 kg of maize silage plus free access to grazing *Brachiaria decumbens*. Experimental periods consisted of 21 days each. Chemical analysis was performed on *Brachiaria decumbens* grass, maize silage and the concentrate supplements. Variables evaluated were milk yield, protein and fat content in milk, live weight and body condition score (BCS). Mean milk yield was 6.6 kg/cow/day, with no differences among treatments, nor there were differences in live weight or BCS. However, significant differences were found in protein and fat in milk, with lower values for these components in T₂ and T₃ than in T₁ and T₄. The addition of different levels of inclusion had no effect on milk yield, live weight and body condition, as well as fat and protein in milk.

Key words: Body condition score, *Brachiaria decumbens*, Milk production, *Saccharomyces cerevisiae*

Milk production in tropical regions in Mexico is based on the use of large amount of commercial concentrates, up to 6 kg/cow/day (Pedraza-Beltran *et al.* 2011). However, this form of production is expensive and leaves farmers with a small profit margin. Maize silage is one of the most common forages offered as a supplement to dairy cows (Bargo *et al.* 2003). The response from dairy cows varies, however, Hernández-Mendo and Leaver (2004) reported only beneficial effects when animal grazed at a lower sward height, when the availability of forage was low and the animals did not receive any other supplement. *Saccharomyces cerevisiae* has been used for improving ruminal fermentation, since it reduces pH fluctuations, improves the production of volatile fatty acids, increases the use of ammonia, modifies the proportion of protozoa in the rumen and reduces the oxygen content in the rumen (Dolezal *et al.* 2005). For these reasons the response from animals improves, dry matter intake increases, there is more energy available, milk production increases, less animal weight loss and body condition score is maintained

(Erasmus *et al.* 2005). Holtshausen and Beauchemin (2010) reported a 0.90 kg increase in milk/day, when 5 g/day of SC was included. However, Santos *et al.* (2006) and Dann *et al.* (2000) did not find increase in milk production when they added 5 and 6 g/cow/day of SC. This study evaluated the productive response of crossbred cows grazing *Brachiaria decumbens* pasture to supplementation with an experimental concentrates (CEXP) with or without addition of *Saccharomyces cerevisiae* (SC) in a subtropical region of central Mexico.

MATERIALS AND METHODS

Experimental site: The experiment was conducted in a representative smallholder dairy farm in the municipality of Zacazonapan, located in the southern region of the State of Mexico.

Experiment plan: The experiment lasted for 84 days, divided into four experimental periods of 21 days each. The first 14 days of each experimental period were used for diet adaptation and to eliminate any carry-over effects. The last week was used for recording milk yield, live weight, BCS, and collecting samples. Four cross-bred Brown Swiss X Zebu cows were utilized, with an average live weight at the beginning of the experiment of 400±22 kg. The cows were in the first third of lactation, and mean milk production was 6.0±0.60 kg of milk cow/day. The cows were grazing

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in an established sward with *Brachiaria decumbens* grass. Cows were manually milked once a day (08:00), when treatments were supplied and milk was weighed with a spring scale. Milk samples were taken to determine protein and fat contents, with an ultrasound wave milk analyzer (EKOMILK KAM98-2A). The cows were weighed at the beginning of each experimental period with a portable digital weigh bar indicator (Gallagher Weigh Scale W210). The body condition score (BCS) was assessed by applying the methodology proposed by Rodenburg (2000) at the beginning and end of each experimental period.

Experimental design: A 4 × 4 Latin square experimental design was used, with four cows in the rows and the four evaluation periods in the columns. Four were evaluated: T₁ consisted of 3 kg/cow/day of CEXP; T₂ consisted of 2 kg/cow/day of CEXP; in T₃, 2 kg of CEXP plus 10 g of *Saccharomyces cerevisiae* were administered to each cow; and T₄ was the control treatment, consisting of 3 kg of CC. All cows received 3 kg DM/cow/day of maize silage, remaining 24 h in a pastures own to *Brachiaria decumbens*, and they had access to water *ad libitum*. The experimental concentrate (CEXP) was composed of 60% maize grain (*Z. mays* L.), 28% canola meal (*Brassica napus*), 10% molasses and 2% urea, compared to a commercial concentrate (CC) typically used by farmers. The commercial concentrate contained milled grains, byproducts of grains, molasses, urea and minerals. The concentrates used in this experiment were given on dry matter basis.

Pasture measurement: In order to measure the net herbage accumulation, 6 exclusion cages were placed at random, according to the method proposed by Hodgson (1994). The cages were fitted to the size and growth of the grass, so the cages were larger than those utilized by the aforementioned author. The dimensions were 1 m high, 1.20 m long and 0.60 m wide; every 28 days a cut was made inside and outside the cage, for which a 0.25 m² quadrant was used to cut forage. On measurement day 0, the cage was placed at random on the pasture; then, five height measurements were made beside the cage, being careful that the characteristics of the area to be measured were similar to those of the area excluded by the cage. Later on, the 0.25 m² metal quadrant was placed in an adjacent place to the exclusion cage and all the forage inside the quadrant was cut.

The NFA was calculated with the following formula:

$$\text{NFA (kg DM/ha)} = \text{DMi} - \text{DMf}$$

where NFA, net forage accumulation (kg DM/ha); DMi, initial average weight outside the cage on Day 0 (kg DM/ha); DMf, final average weight inside the cage on Day 28 (kg DM/ha).

Chemical analysis of forages and concentrates: Samples of the pasture were obtained by the simulated grazing technique for each of the experimental periods. In addition samples of the maize silage and the concentrates were taken for each experimental period. Samples were dried at 60°C until constant weight, was ground and subjected to chemical analysis and *in vitro* digestibility of organic matter (OMD)

was determined by using the Daisy method (Ankom technology). The nitrogen content was obtained using the Kjeldahl method (AOAC 1990), with CP expressed as nitrogen × 6.25 (AFRC, 1993). The content of neutral detergent fiber (NDF) and acid detergent fiber (ADF) was determined using a fiber analyzer (ANKOM²⁰⁰ Technology Corporation, Fairport, NY, USA). The metabolizable energy (ME) of the concentrate and grass was calculated with the equation proposed by AFRC (1993), which estimates ME from OMD.

$$\text{ME (MJ/kgDM)} = (\text{OMD}) (0.0157)$$

Voluntary intake: Voluntary intake was indirectly determined using the equation described by Davies *et al.* (1993).

$$C = M - M_f - gM_i$$

where C, voluntary intake (kg); M, herb mass at the beginning of grazing (kg/ha); M_f, residual herb mass at the end of the grazing period (kg/ha); g, correction factor for the accumulation of intact herb mass (0.05); M_i, intact herb mass in the exclusion area during the grazing period (kg/ha).

Analyses of results: Results for milk yield, fat and protein content of milk, changes in body weight and BCS were analyzed using analysis of variance for the 4 × 4 Latin square design and Tukey's test applied when differences among the treatments were detected. The Minitab general linear model command (2003) v14 was used.

RESULTS AND DISCUSSION

The chemical composition of concentrates and maize silage is shown in Table 1. The nutritional quality of the experimental concentrate had an adequate concentration of CP (180 g/kg DM), which was higher than the commercial concentrate used in the experiment. In addition, the NDF and ADF were higher in the CC than in the experimental concentrate, resulting in lower digestibility and ME in comparison to the CEXP.

Chemical composition by period is shown in Table 2. The nutritional characteristics of *B. decumbens* decreased

Table 1. Chemical composition of the concentrates and maize silage used in the experiment in the municipality of Zacazonapan in the semitropical region of central Mexico

Feed	CP (g/kgDM)	NDF (g/kg DM)	ADF (g/kg DM)	OMD (g/kg DM)	ME (MJ/kg DM)
CC	163.47	328.67	175.69	901.92	14.16
CEXP	180.08	228.87	100.66	948.61	14.89
Maize silage	74.00	549.01	289.22	747.92	11.74
Mean	139.84	368.18	188.52	866.15	13.59
SD	57.05	163.80	94.93	105.01	1.65

CP, Crude protein; NDF, Neutral detergent fibre; ADF, Acid detergent fibre; OMD, Organic matter digestibility; ME, Metabolizable energy; SD, standard deviation; CC, commercial concentrate.

Table 2. Average chemical composition, by period, of the experimental *B. decumbens* pasture grazed by the cows in the municipality of Zacazonapan in the semitropical region of central Mexico

Period	CP (g/kg DM)	NDF (g/kg DM)	ADF (g/kg DM)	OMD (g/kg DM)	ME (MJ/kg DM)
1	92.36	699.08	474.21	528.64	8.30
2	85.33	699.80	449.06	508.18	7.98
3	83.56	710.23	444.57	490.12	7.69
4	83.94	714.06	436.64	484.26	7.60
Mean	86.29	705.79	451.37	502.80	7.89
SD	3.25	5.90	4.42	3.67	2.27

CP, Crude protein; NDF, Neutral detergent fiber; ADF, Acid detergent fibre; OMD, Organic matter digestibility; ME, Metabolizable energy; SD, standard deviation.

as the evaluation periods advanced, with implications in the OMD and ME that also decreased with time. It is important to mention that CP decreased from 92.36 g/kg DM in Period 1 to 83.99 g/kg DM in Period 4.

The nutritive quality of the grass was low, with low CP content during the experiment. However, they were within the value mentioned as critical limit (7%) by Van Soest *et al.* (1991), necessary to provide the nitrogen requirements of microorganisms in the rumen, prevent appetite loss and therefore reduce the tropical grass intake. Juárez *et al.* (2004) found CP values of 7.86% for *Brachiaria decumbens*, similar to the values reported in this study. In addition, structural carbohydrates (NDF and ADF) were relatively higher, since the amount of green leaves decreased and the amount of stem increased during the dry season. Ramírez *et al.* (2009) reported similar results with *Panicum maximum*.

Milk protein and milk fat content were significantly different ($p < 0.05$) among treatments (Table 3). Results indicated that there were no differences ($p > 0.05$) in milk

Table 3. Effect of supplementation with concentrates, on daily milk yield, milk composition, body weight and body condition score for the experimental cows grazing on a *B. decumbens* pasture

Treatments	Milk yield (kg)	Milk Protein (g/kg)	Milk fat (g/kg)	Body weight (kg)	BCS (1–5)
T1	6.56	31.51 ^a	30.02 ^a	412	1.6
T2	6.17	29.03 ^b	35.05 ^b	404	1.2
T3	7.61	29.94 ^b	36.66 ^b	407	1.4
T4	6.02	31.01 ^a	31.21 ^a	411	1.5
SEM	0.40	1.56	1.89	21.57	0.07
P(>0.05)	ns	*	*	ns	ns

Different literals between columns show significant differences ($P < 0.05$). SEM, standard error of the means; BCS, body condition score (1, emaciated; 2, thin; 3, average body condition; 4, heavy condition; 5, fat). T1, 3 kg of CEXP + 3 kg DM of maize silage; T2, 2 kg of CEXP + 3 kg DM of maize silage; T3, 2 kg of CEXP + 10 g of SC + 3 kg DM of maize silage; T4, 3 kg of the commercial concentrate of the producer + 3 kg DM of maize silage.

yields. However, there was more than one-kilo increase in milk production with T₃ in comparison to the other treatments. The cows' live weight was constant throughout the experiment, and no significant differences were observed among treatments ($p > 0.05$), with live weight remaining around 400 kg. BCS was maintained between 1.2 and 1.6, this is due to the supplementation and the silage. The milk fat is a factor that determined their quality, in this work significant differences among treatments were observed ($p < 0.05$), where treatments 2 and 3 had the higher fat content in comparison with 1 and 4 treatments. Significant differences ($p < 0.05$) were observed in milk protein content, the higher content were observed in treatments 1 and 4.

The low milk production, is due to the animal genetics, because of the crossbred of zebu with Brown Swiss, typically are animals with low milk production, in comparison to crossbred of zebu with Holstein. According to Hernández-Reyes *et al.* (2000), the genotype in a significant way affected milk production and the genotype in which brown Swiss is used, the milk production is lower in comparison with Holstein. Rios-Utrera *et al.* (2015), reported milk productions of 6.27 kg/day in brown Swiss dairy cattle, which are similar to this work.

Other reason is due to the forage with low nutritional quality evaluated in this experiment. The low milk production observed is due to the low nutritional quality of the grass, particularly the high content of NDF and the low content of CP. Costa *et al.* (2005) and Pedraza-Beltrán *et al.* (2011) reported low milk production attributable to these factors; with milk yields of 6.3 and 6.7 kg/cow/day respectively, in cows grazing on *Brachiaria mutica* and *Paspalum notatum*, being an issue of tropical grasses used for feeding dairy cows.

No significant differences were detected among treatments; it means that the treatments cover the animal requirements for the milk production. Also the addition of SC didn't have significant effect on milk production, which depends on several factors as diet composition, quality of forage, the ration of concentrate with forage and the dairy lactation period (Robinson and Garret 1999; Dann *et al.* 2000). Although no differences were observed in milk production ($P < 0.05$), an increase of 1 kg also were reported by Rivas *et al.* (2008). Other authors as Schingoethe *et al.* (2004) and Bagheri *et al.* (2009) reported that no significant difference was observed in milk production when SC was added, which is in agreement with present findings.

The numerical increase in milk production in Treatment 3 could be attributed to the addition of SC, since SC is considered to optimize ruminal metabolism, thereby improving digestion of the grass and the maize silage fiber. Lascano *et al.* (2009) mentioned that the addition of SC increased the apparent digestibility of the NDF, providing soluble growth factors that stimulated the growth of cellulolytic bacteria and cellulose digestion (Yalcin *et al.* 2011). Rivas *et al.* (2008) reported a 1 kg increase in milk production in Holstein cows, when SC was added, in

congruence with results of present study.

Low CP content in milk from T_2 and T_3 is due to the lower level of supplementation, which resulted in a lower content of ME in the diet and supposed higher forage intake by cows. According to Hernández and Ponce (2005), the intake and the insufficient content of CP in the ration is a main factor that has an effect on the concentration of milk protein, suggesting that the intake levels can maintain milk production, but the protein levels decrease. Beever *et al.* (2001) mentioned that supplementation with concentrates led to an increase in yields and milk protein content.

The milk fat content was different ($P < 0.05$) in T_2 and T_3 . Dhiman and Satter (1997), found an increase in milk fat content when the forage increased in dairy cattle diets.

Live weight and the BCS were stable throughout the experiment, suggesting that the amount of supplied concentrate and forage intake covered requirements for ME and CP for the observed production level, even at the lowest supplementation level. Pedraza-Beltrán *et al.* (2011) reported BCS values from 2.5 to 3 in cross-bred Brown Swiss $\times$ Zebu cows supplemented with 6 kg of a concentrate and grazing on *Paspalum notatum*.

Figure 1 shows that voluntary intake is influenced by forage availability in the pasture; with increased intake when net forage accumulation is higher. The highest NFA took place during period 4 (700 Kg DM/ha), which influenced the productive response of the cows in the experiment, since NRC (1987) indicated that for an adequate intake to exist, a forage availability of 2,250 kg/ha had to be secured. Mayne *et al.* (2000) mentioned that the quantity and quality of available forage were the main factors that influenced the intake by grazing livestock.

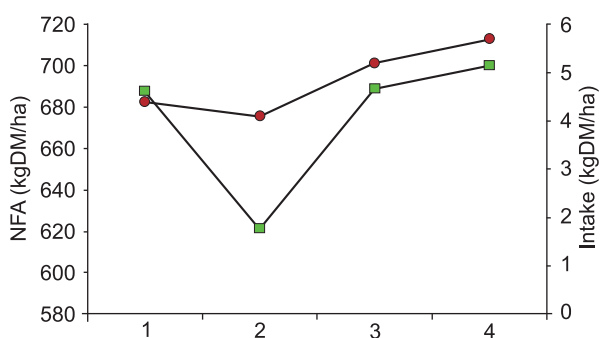


Fig. 1. Influence of net forage accumulation (squares) on average daily grass dry matter intake (empty circles) per cow for every experimental period.

From the present study, it may be concluded that the inclusion of different supplementation concentrate levels didn't have significant effect on animal performance especially on milk production, body weight and body condition score of crossbred cows grazing *Brachiaria decumbens* pasture.

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