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EFFECT OF *SACCHAROMYCES CEREVISIAE* SUPPLEMENTATION ON MILK PRODUCTION, BODY CONDITION, AND ANIMAL WELFARE IN DUAL-PURPOSE COWS GRAZING ON HIGH-BIOMASS TROPICAL GRASSES

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Abstract: The objective of this study was to analyze the impact of including *Saccharomyces cerevisiae* (SC) in the diet of dual-purpose cows during lactation, evaluating milk production and body condition (BC). The trial was conducted at a production unit located north of the municipality of Pánuco, Veracruz, Mexico. The cows were evaluated in two treatments (N=8 each), T1= (control group) received a feed supplement without SC, and T2= was supplied with 1% SC in the supplement, both treatments for 28 days (d). The trial was conducted under grazing conditions with high-yielding tropical cultivars, *Panicum maximum, Megathyrsus maximus* cv. Miyagui and *Panicum maximum Jacq.* cv. Mombasa, and concentrated feed with 20% crude protein (CP) at a rate of 2 kg/cow/d. Milk production was recorded daily, determining the average cow/d. production each week (period) for 4 weeks. CC was recorded at the beginning and end of the test in both study groups. A cross-over experimental design was used, and a comparison of means was performed using Tukey's test. Forage biomass production was higher (P>0.05) for Miyagui grass with 32 tons/ha at harvest. No statistical difference (P<0.05) was observed between the varieties evaluated in terms of NDF, CP, and ash. The values obtained are within the ranges reported in other studies. In terms of milk production, a difference was found (P>0.01), with the highest value (2,973 liters) for the S. *Cereviseae* supplement. On a scale of 1 to 9, there was no difference in CC between cows supplemented with and without S. *cerevisiae.* The average CC observed in this study for each treatment (3.9 to 4.3 on a scale of 1 to 9) was considered moderate and functional for lactating, dual-purpose cows of different breeds under production systems in tropical regions.

Keywords: Dual-purpose system, Saccharomyces cerevisiae, milk, Miyagui, Mombasa.

INTRODUCTION

Dual-purpose cattle farming is a key production strategy in tropical regions, combining milk and meat production in generally extensive systems. However, these systems face structural limitations such as seasonality in forage production, low nutritional quality of pastures during the dry season (Martínez and Sánchez, 2019), and limited adoption of nutritional technologies, which have an impact on herd production and reproductive rates, affecting the cattle production system in the tropics.

Tropical cultivars such as *Panicum maximum*, species: Megathyrsus maximus Cultivar: Miyagui and *Panicum maximum* Jacq. Cultivar: Mombaza offer advantages in terms of adaptation and biomass production, but their high fiber content can limit digestibility and energy intake, especially in animals with high metabolic demands. One of the accessible alternatives for improving the utilization of cell wall components by ruminants is probiotics, among which *Saccharomyces cerevisiae* yeast stands out. Studies conducted on tropical grazing cattle have shown an increase in NDF digestibility and an association with a higher population of cellulolytic bacteria (Sousa *et al.,* 2018). It has also been reported that fermented S. *cerevisiae* products increase total VFA, stimulate fibrolitic fungi and bacteria, and improve microbial efficiency (Zhu, W. *et al.,* 2017). Furthermore, a study on calves also showed effects on pH, digestibility, and weight gain, demonstrating how yeast can improve fermentation and

efficiency even in young animals and under fiber-rich dietary conditions (Maamouri O. and Ben Salem M., 2021).

In the current context, the incorporation of functional additives such as *Saccharomyces cerevisiae* has become increasingly important as a nutritional strategy aimed at optimizing ruminal efficiency, strengthening the immune response, and promoting animal welfare in cattle production systems. Its inclusion in dual-purpose cow diets has shown positive effects on milk production, body condition, and resilience to environmental and nutritional stress factors. This species has demonstrated positive effects on both animal welfare and productive performance, in addition to contributing significantly to fiber digestibility (Narváez *et al.,* 2021).

S. cerevisiae yeast provides bioactive compounds such as β-glucans, B vitamins, antioxidant peptides, and organic acids, which can modulate the ruminal microbiota, improve nutrient absorption, and reduce the incidence of digestive and metabolic disorders (Borgues-Duran *et al*., 2025). *Saccharomyces cerevisiae* is distinguished by its high protein content, which can reach between 40% and 45% (Suarez *et al.,* 2017) of its dry weight, making it a potentially valuable source for nutritional and biotechnological applications. Its inclusion in the diet not only provides quality protein, but also contributes to the reduction of oxygen in the rumen, favoring anaerobic conditions that stimulate the growth of cellulolytic bacteria (Suarez and Guevara, 2018). This optimizes nutrient digestion and can improve feed conversion efficiency, promoting better utilization of fiber and other dietary components. In addition, the use of S. *cerevisiae* has been linked to improved ruminal pH stability, a reduction in harmful microorganisms, and an increase in the production of volatile fatty acids (Dawson K.A., 1993; cited by Rivas, *et al.*, 2008). An increase in milk production was also observed. Dawson and Girard (1997) and Wholt *et al.* (1998) have demonstrated positive results with the addition of 10 g/cow/day of S. *cerevisiae* to the diet of dairy cows. In addition, its contribution of bioactive compounds such as β-glucans, B vitamins, and antioxidant peptides can strengthen the immune response and reduce the incidence of metabolic disorders (Borges-Durán *et al.*, 2025). These advantages make its use as an additive in ruminant feed a promising strategy for enhancing livestock health and productivity.

International reviews have shown that yeast supplementation can lead to moderate but consistent increases in milk production and improvements in ruminal fermentation (Desnoyers *et al.,* 2009; Amin *et al., 2020)*. Studies conducted in Europe, North America, South America, and Africa have documented positive results on milk yield and composition, as well as on the metabolic health of cows, especially under diets with a high proportion of forage or under conditions of thermal and nutritional stress (Shi *et al.*, 2019). In tropical grass-based diets, the addition of SC or products derived from its fermentation has shown increases in fiber digestibility, pH stability, and nutrient utilization (Narváez *et al., 2021).*

In dual-purpose tropical systems in Latin America, research is still scarce but shows encouraging results. Several regional studies have shown improvements in milk production and quality, as well as in ruminal fermentation efficiency, when CS is incorporated into supplementation (Wohlt *et al*., 1998; Narváez, 2021). However, the effects

depend on factors such as the yeast strain used, the dose, the type of supplement, the forage base, and the animal genotype, which explains the variability of the results observed. There are still gaps in knowledge regarding the efficacy of SC in dual-purpose cows grazing high-biomass tropical grasses under real farm conditions (Galindo *et al.,* 2018).

From a physiological perspective, the bioactive compounds in *S. cerevisiae*, such as β-glucans, mannans, and B vitamins, can modulate the ruminal microbiota and strengthen the immune response, improving animal resilience t e stress factors (Chaucheyras-Durand *et al., 2010; Sun et al., 2021).* These characteristics make SC a strategic, accessible, and low-cost supplement for optimizing production efficiency and animal welfare in tropical dual-purpose systems.

Considering the background and the limited evidence generated in the Mexican tropics, the present study aimed to evaluate the effect of supplementing the diet of dual-purpose lactating cows with 1% *Saccharomyces cerevisiae*, managed under grazing of high-biomass tropical grasses (*Panicum maximu cv. Miyagui and Panicum maximum cv. Mombasa)*, determining its impact on daily milk production, body condition, and animal welfare indicators under real field conditions. The hypothesis was that the inclusion of SC in the feed supplement may have an effect on milk production and nutrient utilization without affecting body condition.

MATERIALS AND METHODS

The project was carried out at the Tres Potrillos Livestock Production Unit (UPP) belonging to the Las Potrancas Rural Production Society of R. L. located in the municipality of Panuco, Veracruz, which has a hot and extreme climate with an average temperature of 24°C and average annual rainfall of 1,079.3 mm (INEGI, 1997). The project was carried out at the facilities of the Altamira Technological Institute (ITA) located on the Tampico-Mante highway at km 24.5 in the city and port of Altamira, Tamaulipas, Mexico.

In order to determine the production of forage biomass in tons per hectare (t/ha) and the nutrients in the forage where the animals were grazing, four sites were randomly located in each plot, a 1x1 m wooden quadrant was used, and the total forage was cut. Four random forage samples were collected from in the summer, 70 days after regrowth, cutting at a residual height of 15 cm. This season is characterized by reduced rainfall and the onset of the dry season. To estimate forage biomass production, the square method (1 m^2) was used, which has been widely validated in tropical pasture studies (Romero & Pichardo, 2006), allowing the data to be extrapolated to tons per hectare.

The forage material collected was dried in a forced-air oven at 65°C until it reached a constant weight, with the aim of eliminating residual moisture. Subsequently, the samples were passed through a blade mill using a 1 mm diameter mesh, in order to obtain a uniform particle size for the bromatological analyses.

A Weende proximal analysis of the grass was performed to determine the crude protein (CP) and ash content (AOAC, 1989), and the Van Soest method (1994) was used to obtain neutral detergent fiber (NDF).

Feeding was based on grazing in areas where Mombasa grass (*Panicum maximum cv. Mombasa*) and Miyagui grass *(Panicum maximum cv. Miyagui)* prevailed. At milking time, concentrated feed was provided at a ratio of 2 kg of concentrate per cow/day, with a single milking in the morning. The feed supplement was formulated at 20% CP, using ground sorghum, soybean meal, molasses, yeast (*Saccharomyces cereviceae),* ground sorghum forage bales, common salt, dehydrated orange peel, and a vitamin and mineral premix.

To evaluate the effect of including *S. cerevisiae* on milk production, eight dual-purpose cows (N=8) of different breeds were used, which were included in two treatments: T1: (control group) = supplementation without *Saccharomyces cerevisiae*, and T2: (experimental group) = supplementation with 1% *S. cerevisiae*. Milk production was recorded individually during milking, which was performed once a day in the morning (6:00 a.m.). Both groups were evaluated for 28 days, recording milk production daily. Body condition score (BCS) was recorded using a scale of 1 to 9, where a score of one (1) represents a very low BCS (skeletal) and nine (9) represents an extremely fat (obese) cow (Herd and Sprott, 1987). A crossover experimental design was used, and a comparison of means was performed using Tukey's test. The data were analyzed using one-way ANOVA with IBM SPSS Statistics software (2021).

RESULTS AND DISCUSSION

In determining the forage biomass content, significant differences ($P<0.05$) were observed between the two forages evaluated. Miyagui showed a higher yield, reaching up to 32 t/ha, which is very similar to that reported by Galindo *et al.* (2019), who documented yields of 31.3 t DM/ha. In contrast, the yield of the Mombasa cultivar was 11.5 t/ha in this study, which is higher than that reported by Santistevan-Veliz (2023), which was 8.13 t/ha under irrigation and fertilization conditions with cuts every 75 days.

On the other hand, Núñez-Arroyo *et al*. (2022) report a biomass production in Mombasa grass of 11.507 t DM ha^{-1} at 56 days. This shows that this grass has high biomass production potential, with the response depending on cutting dates, physiological stage, nutrition conditions, and climate. Patiño *et al.* (2018, cited by Santistevan-Veliz, 2023) argue that dry matter content varies depending on the cutting stages, being lower during the first cutting stage.

No significant differences ($P>0.05$) were found in neutral detergent fiber (NDF) content among the tropical cultivars evaluated (Graph 1). The highest NDF value was 57.4% for Miyagui, which coincides with the ranges reported by Juárez Lagunes (n.d.), Muñoz-González *et al.* (2025) and Pasturas Tropicales (2023), who document values between 55% and 59% in tropical grasses of the genus Panicum such as Miyagui and Mombasa. This homogeneity suggests that both *Panicum maximum,* species: Megathyrsus maximum Cultivar: Miyagui and *Panicum maximum* Jacq. Cultivar: Mombaza, have equivalent nutritional

values in terms of cell wall components, an important aspect for estimating digestibility.

In determining crude protein (CP), no significant difference (P>0.05) was observed between Miyagui and Mombasa, with values of 9 and 8.5%, respectively (Graph 2). The CP values found in this study coincide with those reported by Rodríguez (2009), who mentions that the CP% ranges between 11 and 7% at a height of 20 cm in Mombasa grass. This coincides with Verdecia et *al. (*2013) and Patiño et *al.* (2018; cited by Santistevan-Veliz, 2023), who reported crude protein (CP) values of less than 12% for this same grass species with cutting ages between 25 and 30 days.

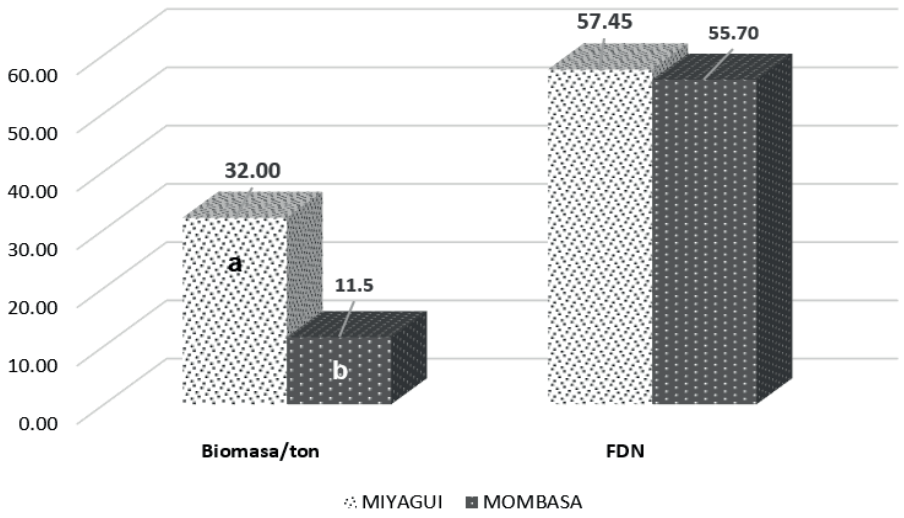
On the other hand, the results of this study are lower than those obtained in *Panicum maximum* cultivars in another study reported by Polo (2021), who mentions crude protein values of up to 11.30% in *Panicum maximum* cv. Massai. Therefore, the CP content in this study falls within the range of values mentioned by the different authors.

In the case of ash content, there was no significant difference (P>0.05), although a slightly higher numerical value was observed in the Mombasa cultivar with 16.63% (Graph 2). These values obtained in this study differ from those reported by Santistevan-Veliz (2023), who reports values of 10.9% and 10.8% for Mombasa grass at 60 and 75 days after cutting, respectively.

However, the ash content found in this study is comparable to that reported by Pincay-Ronquillo *et al*. (2024), who documented ash contents of 14.5% in tropical grasses of the genus *Megathyrsus maximus* under regrowth conditions in the province of Granma, Cuba. This similarity suggests stability in the concentration of structural minerals among tall cultivars, which reinforces their usefulness in grazing systems with strategic supplementation during the dry season

In terms of milk production, there was a significant effect (P<0.01), with supplementation with *S. cereviceae* having a positive effect, reaching a production of 2,973 liters/animal/day, while cows that were not supplemented with SC recorded lower values, in the range of 1,980 liters per day per animal (Graph 3). Milk production in November reported by CEIEGT FMVZ--UNAM during 2012 was 3 liters per animal per day. The values obtained in this study in November in this region are similar to those reported for the north-central region of the state of Veracruz, since the highest average value observed in this test was 3 liters/animal/day in cows supplemented with S. *cereviceae,* showing a coincidence.

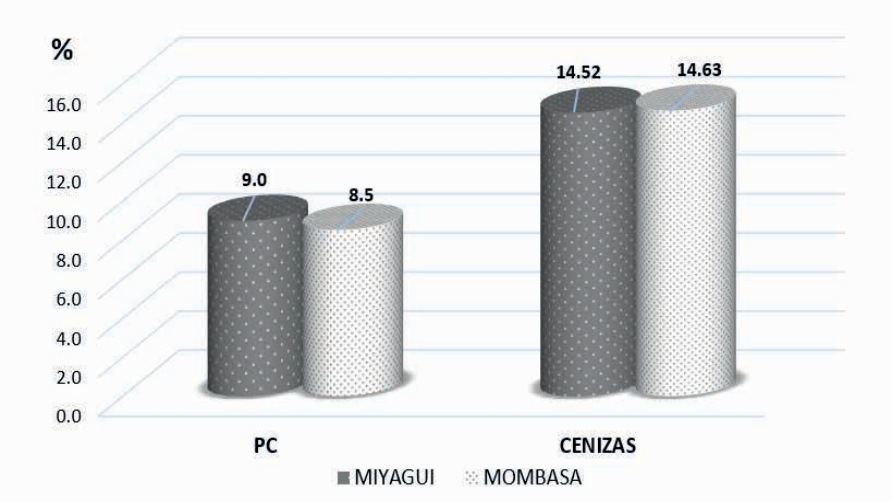
The same trend in milk production can be observed in both groups during a 16-day observation period. However, the highest production values are observed in T2 (with S. *cereviceae*), with values of up to 3.8 liters/day/cow (Graph 4). The maximum values observed in this study are very close to those reported by Pech *et al.* (2007; cited by Vargas 2023), who mention that dual-purpose livestock farming with limited technology produces an average of 4 liters/ s of milk per cow per day. The results of this study suggest that the inclusion of SC in feed supplementation promotes ruminal efficiency and nutrient utilization, as a significant increase (P<0.05) in milk yield under tropical grazing conditions in cows of different breeds, even during critical periods of low forage availability and quality, as observed in these results, with low biomass production and protein content in Miyagui and Mombasa pastures.



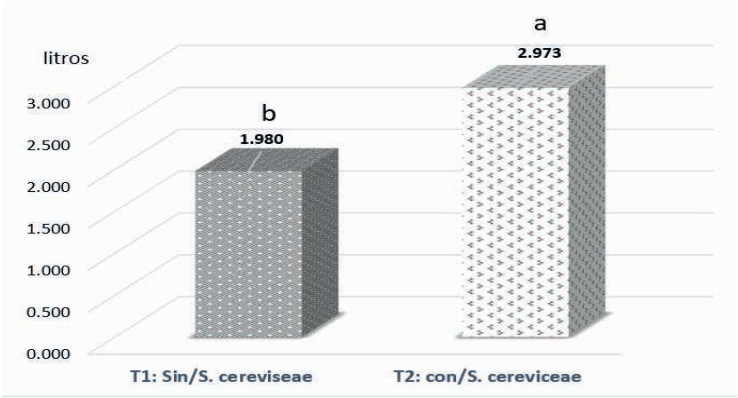
Miyagui and Mombasa during the summer season

[a, b] means in the same column with different letters show a difference (P<0.05)

Graph 1. Forage biomass (P<0.05) and neutral detergent fiber in Miyagui and Mombasa grass during the summer season.

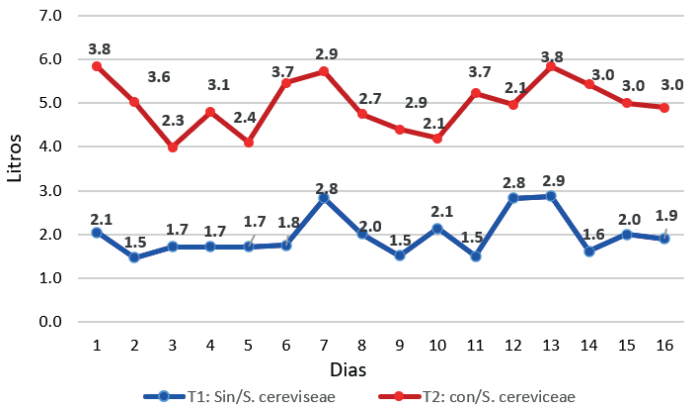


Graph 2. Crude protein and ash in Miyagui and Mombasa grass with native grass in the summer season

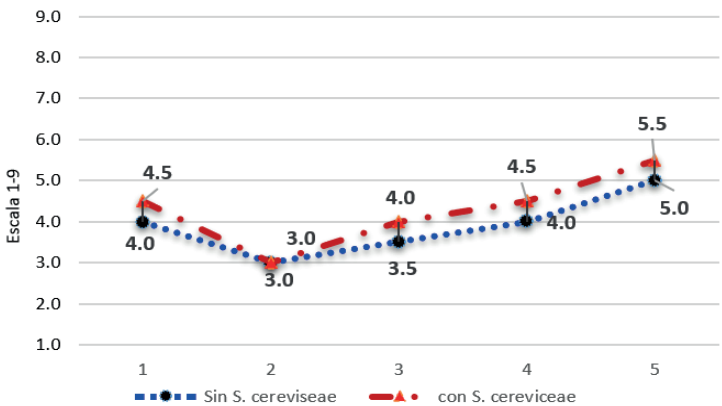


[a, b,] averages in the same column with different letters show a difference (P<0.01)

Graph 3. Milk production in grazing cows supplemented with *Saccharomyces cereviceae* during the dry season



Graph 4. Daily milk production of cows supplemented with and without S. *cereviceae* under grazing conditions during the dry summer season



Graph 5. Body condition (scale of 1 to 9) in cows supplemented with *Saccharomyces cereviceae* in tropical grass grazing

Body condition in this study, using a scale of 1 to 9, showed no difference (P>0.05) between cows supplemented with and without *Saccharomyces cerevisiae (*4.3 and 3.9, respectively) (Graph 5). This differs from the findings of Borges-Durán *et al.* (2024), who observed that animals supplemented with yeast showed an increase in average body condition, rising from 2.75 ± 0.12 to 3.15 ± 0.10 points on a scale of 1 to 5 over a period of 60 days.

The average body condition observed in this study for each treatment (3.9 to 4.3 on a scale of 1 to 9) is considered moderate and functional for cows in production under tropical systems. These values reflect sufficient body reserves to maintain productive activity without compromising health or reproductive efficiency, in accordance with what was reported by Lara-González (2023). These results could be related to nutrient utilization and observation time, so studies with larger sample sizes and longer durations would be necessary.

During the study, all animals grazed under homogeneous conditions using the same tropical cultivars: *Megathyrsus maximus* cv. Miyagui and *Panicum maximum Jacq*. cv. Mombasa. Bromatological analysis of the forages showed no significant differences in NDF, ash, or crude protein content (P > 0.05), confirming the nutritional uniformity of the base resource. This homogeneity in forage quality allows the effects observed in milk production to be attributed with greater certainty to the experimental factor evaluated: the inclusion of *Saccharomyces cerevisiae* in the feed supplement. The group supplemented with SC showed an increase of 1 liter per day in milk production (2.9 vs. 1.9 L), representing a 52.6% improvement over the control group. The probiotic action of SC has been widely documented as a modulator of ruminal fermentation, promoting fiber digestibility and nutrient synthesis efficiency. By eliminating variability in the forage, the internal validity of the study is strengthened and it is confirmed that the positive effect on milk production is exclusively due to the use of S. *cerevisiae* as a functional additive.

CONCLUSIONS

Supplementation with 1% *Saccharomyces cerevisiae* in the diet of dual-purpose cows under tropical grazing conditions significantly increased milk production during the dry summer season, reaching an average of 2.9 liters per day, compared to 1.9 liters in the control group. This 52.6% increase in milk production suggests an improvement in ruminal efficiency, attributable to the probiotic action of yeast, which promotes fiber digestibility and ruminal pH stability. The results obtained are consistent with other studies conducted in tropical systems, reinforcing the viability of including S. *cerevisiae* as a functional additive in strategic supplementation programs. The body condition of the animals remained within functional ranges (3.9–4.3 on a scale of 1 to 9), indicating that supplementation did not compromise nutritional status or animal welfare. It is recommended to continue evaluating the effect of S. *cerevisiae* at different times of the year, inclusion levels, and combinations with other additives to optimize its impact in tropical production systems.

Transparencia de los datos

Datos disponibles. El conjunto de datos que respalda los resultados de este estu-

dio está disponible a solicitud razonable al autor de correspondencia. Tras la aceptación del manuscrito, los autores considerarán depositar los datos anonimizados y sus metadatos en un repositorio público (repositorio institucional), indicando el identificador persistente en la versión final del artículo.

Contribución individual de los autores

EMR: Conceptualización; Trabajo de campo; Supervisión; Redacción borrador original, revisión y edición.

DILL: Análisis formal; supervisión de análisis de laboratorio, apoyo en redacción; Administración del proyecto.

JHGG: Curación de datos; Investigación; visualización; revisión redacción y edición.

VNOG: Metodología; Recursos; coordinación del trabajo de campo; redacción, revisión y edición.

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