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# Yeast culture added to the diet improves the performance of feedlot steers

# Cultura de levedura adicionada a dieta melhora o desempenho de novilhos confinados

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## Highlights

Yeast culture increased the average daily gain and body weight at slaughter.
Hot carcass weight and average daily carcass gain improved with yeast culture.
The addition of yeast culture to the diet is advised for ½ Angus x ½ Nellore steers.

## Abstract

To meet the growing demand for beef, various technologies have been adopted to improve cattle performance and feed efficiency, such as intensive systems and dietary additives. This study evaluated the productive performance of feedlot-finished steers with yeast culture (*Saccharomyces cerevisiae*), either combined with or without sodium monensin in their diet. The 140-day experiment used 240 ½ Angus x ½ Nellore steers from the same herd. The steers were 13.8 ± 1.0 months of age and had 421 ± 5 kg initial body weight. The completely randomized experimental design consisted of two treatments and six repetitions, with each repetition represented by a pen containing 20 animals. The treatments were (1) diet with sodium monensin (250 mg animal$^{-1}$ day$^{-1}$), and (2) diet with yeast culture plus sodium monensin (7 g animal$^{-1}$ day$^{-1}$ + 250 mg animal$^{-1}$ day$^{-1}$). The diets consisted of a mixture of 40% corn

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silage and 60% concentrate, provided *ad libitum.* Using yeast culture combined with sodium monensin promoted higher average weight gain (1.324 *vs.* 1.083 kg day$^{-1}$) and consequently higher body weight at slaughter (565.3 *vs.* 537.6 kg) and hot carcass weight (312.6 *vs.* 296.8 kg) compared to the diet with only sodium monensin. Furthermore, adding yeast culture to the diet promoted greater carcass gain (103.7 *vs.* 85.3 kg) and higher average daily carcass gain (0.947 *vs.* 0.819 kg day$^{-1}$) than the treatment with sodium monensin alone. The addition of yeast culture combined with sodium monensin to the diet increased the average daily gain by 22.2% and the daily carcass gain by 15.6%, so it is recommended for finishing steers in a feedlot.
**Key words:** Carcass fat. *Saccharomyces cerevisiae.* Weight gain.

## Resumo

Para suprir a crescente demanda por carne bovina, diversas tecnologias, como sistemas intensivos e aditivos na dieta, têm sido adotadas para melhorar o desempenho e a eficiência alimentar dos bovinos. O objetivo deste estudo foi avaliar o desempenho produtivo de novilhos de terminados em confinamento com cultura de levedura (*Saccharomyces cerevisiae*) associada ou não a monensina sódica à dieta. O experimento durou 140 dias e foram utilizados 240 novilhos inteiros, ½ Angus x ½ Nelore, provenientes de mesmo rebanho, com idade de 13,8 ± 1,0 meses e peso vivo inicial de 421 ± 5 kg. O delineamento experimental foi inteiramente casualizado, constituído de dois tratamentos e seis repetições, onde cada repetição foi uma baia com 20 animais. Os tratamentos foram (1) dieta com monensina sódica (MO) (250 mg animal$^{-1}$ dia$^{-1}$) e (2) dieta com cultura de leveduras mais monensina sódica (MO+CL) (7 g animal$^{-1}$ dia$^{-1}$ + 250 mg animal$^{-1}$ dia$^{-1}$). As dietas foram constituídas por uma mistura de 40% de silagem de milho e 60% de concentrado, sendo fornecidas *ad libitum.* O uso de cultura de levedura associada com monensina sódica promoveu maior ganho médio diário (1,324 *vs.* 1,083 kg dia$^{-1}$) e consequentemente maior peso vivo de abate (565,3 *vs.* 537,6 kg) e peso de carcaça quente (312,6 *vs.* 296,8 kg) em relação a dieta contendo apenas monensina sódica. Além disso, a adição de cultura de levedura na dieta promoveu maior ganho de carcaça (103,7 *vs.* 85,3 kg) e maior ganho médio diário de carcaça (0,947 *vs.* 0,819 kg dia$^{-1}$) comparado ao tratamento apenas com monensina sódica. A adição de cultura de levedura associada com monensina sódica na dieta aumentou em 22,2% o ganho médio diário e em 15,6% o ganho diário de carcaça e, portanto, é recomendada para bovinos terminados em confinamento.
**Palavras-chave:** Gordura na carcaça. *Saccharomyces cerevisiae.* Ganho de peso.

## Introduction

To meet the growing demand for beef, producers are adopting various technologies to improve their farms. According to Viana et al. (2020), these technologies include implementing different feeding practices, adopting intensive systems, and increasing the energy content of the diet. One approach is to include feed additives to improve performance and feed efficiency, resulting in greater animal productivity (Kholif et al., 2024).

In addition to feeding technologies, other factors directly influence animal performance. These factors include feedlot infrastructure, the environment, and management factors such as population density, herd composition, dominance hierarchy, and others (Richeson et al., 2018). These elements can reduce the efficiency with which dry matter is converted into carcass gain due to stress, which affects nutrient intake, animal immunity maintenance, depressive behaviors, feeding frequency, sodomy activity, and injuries resulting from fights. This increases the predisposition to metabolic and respiratory diseases (Mota & Marçal, 2019).

Some additives, such as yeasts and ionophores, establish symbiotic relationships with the ruminal microbiota. According to Costa et al. (2017), these additives increase fermentative processes and feed efficiency in cattle. These additives can improve fiber digestibility, increase the production of volatile fatty acids, and decrease greenhouse gas emissions. This results in improved animal performance and health under stressful confinement conditions (Cesar et al., 2024).

In Brazil, yeast-based products have been used as feed additives that offer benefits to animal health and well-being, as well as improved productive performance. According to Shurson (2018), these yeasts are unicellular organisms mainly belonging to the genus Saccharomyces and are primarily used in the production of alcoholic beverages and bread. Yeast cultures influence fermentative and digestive processes of the rumen, stimulating microbial growth and restricting problems such as rumen acidosis. This improves feed digestibility and animal performance (Oliveira et al., 2023).

Melo et al. (2023) reported that feedlot steers fed a yeast culture had a similar daily dry matter intake to the control group. However, the authors demonstrated that the average daily gain of the yeast culture group (1.644 kg day$^{-1}$) was higher than that of the control group (1.368 kg/day), indicating better feed conversion (5.94 vs. 7.05 kg day$^{-1}$). Thus, these results suggest improvements in the performance of feedlot cattle.

Therefore, this study evaluated the productive performance and carcass traits of feedlot-finished steers with yeast culture added to their diet.

## Material and Methods

The experimental procedures were previously submitted to the Animal Research Ethics Committee (CEUA/UNICENTRO) for review and were approved for execution in accordance with letter 001/2017 dated 07/04/2017.

The experiment was conducted at Chácara Bela Vista in the Entre Rios district by the Animal Production Center (NUPRAN) of the Agricultural and Environmental Sciences Sector at UNICENTRO, in Guarapuava, state of Paraná. The commercial confinement was half-covered, with precast concrete walls, a concrete floor, and 1.7-meter-high partitions between pens.

According to the Köppen classification, the climate of the Guarapuava region is humid subtropical mesothermal (Cfb), with cool summers, moderate winters, and no defined dry season. The municipality is located at an altitude of approximately 1,100 meters, with an average annual rainfall of 1,944 millimeters, an average annual minimum temperature of 12.7 °C, and an average annual maximum temperature of 23.5 °C, with a relative air humidity of 77.9%. The UNICENTRO meteorological station monitored daily the climatological data for minimum and maximum temperature and rainfall during the two experimental periods (Table 1).

**Table 1**
**Average maximum and minimum temperatures, and rainfall for the experimental periods**

| Parameters | Period | |
|---|---|---|
| | 10/02 to 30/06/2022 | 05/07 to 22/11/2022 |
| Average maximum temperature, °C | 23.33 | 21.73 |
| Average minimum temperature, °C | 12.35 | 10.34 |
| Rainfall, mm | 6.07 | 6.13 |

The experimental material consisted of 240 intact ½ Angus x ½ Nellore steers, from the same herd. The steers had an average age of 13.8 ± 1.0 months, an average initial body weight of 421 ± 5 kg, and had been previously dewormed. The completely randomized experimental design consisted of two treatments and six repetitions, with each repetition being a pen containing 20 animals. The treatments tested were a diet containing monensin sodium (MO) (250 mg animal$^{-1}$ day$^{-1}$) and a diet containing yeast culture plus monensin sodium (MO + YC) (7 g animal$^{-1}$ day$^{-1}$ + 250 mg animal$^{-1}$ day$^{-1}$).

Cultron®, produced by Aleris Nutrition, is a yeast culture (Saccharomyces cerevisiae) obtained from the fermentation of ethanol industry cereals using the Ethanol Red® strain in a controlled nutrient medium containing sugarcane molasses and corn derivatives. The fermentative medium and yeast are dried together after alcohol extraction. Consequently, it provides animals with higher energy content, primarily due to the presence of substrates for ruminal bacteria that degrade fiber. Its complete composition consists of: 92% dry matter, 45% crude protein, 5% ether extract, 7% crude fiber, 4% mineral matter, 0.05% Ca, 0.78% P, 0.38% K, 15–17% β-glucans, 8–10% mannan oligosaccharides, as well as fermentation metabolites containing various amino acids, vitamins, enzymes, and organic acids.

The product, Rumensin 200, is based on sodium monensin and is produced by Elanco Saúde Animal® (200 g kg$^{-1}$ of sodium monensin). It is registered with MAPA under the number SP-59410 30002 and is classified as an animal performance enhancer.

The total finishing period for the confined animals was 140 days, consisting of 33 days for adaptation to the experimental diets and facilities, and 107 days for evaluation. Animals were distributed into experimental units (pens) based on body weight (BW) and body condition score.

The facilities consisted of 12 confinement pens, each measuring 100 m2 (10 m x 10 m). Each pen had a concrete feeder measuring 10 m in length, 0.55 m in width, and 0.37 m in depth, and a concrete drinker regulated by an automatic float.

The experimental design for the parameters related to animal performance and carcass traits was completely randomized and consisted of two treatments with six repetitions over time. Each repetition corresponded to a pen with 20 animals. Three repetitions from each treatment were evaluated from 10/02 to 30/06/2022, and three repetitions were evaluated from 05/07 to 22/11/2022.

Feed was provided twice daily, at 07h30 and 17h30, as a total mixed ration (TMR). The diets consisted of 40% corn silage and 60% concentrate, on a dry matter basis (Table 2). Additives were diluted and homogenized in 500 g of ground concentrate and provided on the diet of each pen at the time of each meal.

**Table 2**
**Ingredients of the concentrate and chemical composition of the feedstuffs used in animal nutrition, and average values of the experimental diet, based on total dry matter**

| Concentrate composition | Inclusion % NM | | |
|---|---|---|---|
| Wheat bran | 20.00 | | |
| Soybean hulls | 9.10 | | |
| Barley rootlets | 10.00 | | |
| Ground corn grain | 16.60 | | |
| Ground barley grain | 20.00 | | |
| Corn germ | 20.00 | | |
| Calcitic limestone | 2.50 | | |
| Common salt | 0.40 | | |
| Livestock urea | 0.80 | | |
| Vitamin-mineral premix | 0.60 | | |
| Parameter | Concentrate | Corn silage | Experimental diet1 |
| Dry matter, % NM | 89.02 | 39.16 | 69.08 |
| Crude protein, % DM | 16.85 | 6.74 | 12.81 |
| Mineral matter, % DM | 8.54 | 3.30 | 6.44 |
| Ether extract, % DM | 3.93 | 3.90 | 3.92 |
| Non-fiber carbohydrates, % DM | 45.29 | 44.57 | 45.00 |
| Starch, % DM | 40.44 | 35.66 | 38.53 |
| Neutral detergent fiber, % DM | 25.39 | 41.49 | 31.83 |
| Acid detergent fiber, % DM | 10.66 | 21.86 | 15.14 |
| Lignin, % DM | 1.66 | 2.27 | 1.91 |
| Total digestible nutrients, % DM | 83.23 | 72.54 | 78.95 |

[1] Guaranteed levels of the premix per kg concentrate: vit. A: 16,000 IU; vit. D3: 2,000 IU; vit. E: 25 IU; S: 0.36 g; Mg: 0.74 g; Na: 3.6 g; Co: 0.52 mg; Cu: 22.01 mg; F: 18.00 mg; I: 1.07 mg; Mn: 72.80 mg; Se: 0.64 mg; and Zn: 95.20 mg.

Corn silage and concentrate samples were collected at the beginning and throughout the experiment. The samples were placed in a forced-air oven at 55°C for 72 hours to determine the partial dry matter. The pre-dried samples were ground in a Wiley mill with a 1 mm diameter sieve and subsequently sent for bromatological analysis.

The contents of dry matter (DM), mineral matter (MM), ether extract (EE), and crude protein (CP) were determined from the pre-dried feed samples according to the techniques described in Association of Official Analytical Chemists [AOAC] (1995). The neutral detergent fiber (NDF) content was obtained using the method of Van Soest et al. (1991) with thermostable α-amylase. The acid detergent fiber (ADF) and lignin (LIG) contents were determined using the method of Goering and Van Soest (1970). The total digestible nutrient (TDN) content was calculated using equations proposed by Weiss et al. (1992). To determine total dry matter, the samples were dried in an oven at 105 °C for 16 hours (Silva & Queiroz, 2009). Starch concentration in the diet was determined using the enzymatic method proposed by Bach Knudsen et al. (1997). The chemical composition of the concentrate, corn silage, and total ration provided to the animals is listed in Table 2.

Animal performance was evaluated by weighing the animals after a 10-hour fast from solids, including measurements taken at the beginning (BWi) and at the end of the experimental period. At the end of the confinement period, after fasting, the animals were weighed before shipment to the slaughterhouse (BWf), obtaining the farm weight. The average daily gain (ADG, kg $day^{-1}$ = (BWf - BWi) ÷ 107 days) was calculated from the weight measurements.

Carcass gain during the feedlot period (CG), expressed in kg, was obtained by subtracting the hot carcass weight at slaughter from the initial body weight (BWi) of the animals, assuming a theoretical carcass yield of 50% (National Academies of Sciences, Engineering, and Medicine [NASEM], 2016) Based on the 107-day feedlot period, the average carcass gain (ACG), expressed in kg $day^{-1}$, was also calculated using the ratio of CG to BW, as well as the Dressing percentage, which was obtained using the ratio of ACG to ADG (ACG ÷ ADG ), expressed as a percentage. Hot carcass weights were used for the calculations.

Carcass yield and subcutaneous fat thickness over the Longissimus dorsi muscle between the 12th and 13th ribs were measured in the carcasses, according to the methodology described by Müller (1987).

Animal performance data and carcass traits were tested using analysis of variance with the following statistical model:

$$Yijk = \mu + Ai + Pj + (A*P)\ ij + Eijk;$$

Where: Yijkl = dependente variables; μ = overall mean of all observations; Ai = additive type effect of order “i”, where 1 = sodium monensin diet, and 2 = sodium monensin + yeast culture diet; Pj = evaluation period effect of order “j”, where 1 = period 1, and 2 = period 2; (A*P) ij = interaction effect of additive type of order “i” and evaluation period of order “j”; and Eijk = residual random effect. The means were compared using an F-test at a 5% significance level with the SAS statistical program (Statistical Analysis System Institute [SAS Institute], 1993).

## Results and Discussion

During the first period (Figure 1), the temperature and rainfall data revealed significant variations. Maximum temperatures ranged from 14.8°C to 31.2°C, and minimum temperatures ranged from -1.8°C to 20.5°C. Rainfall was characterized by several days without rain until significant rainfall of 89.2 mm occurred. These climatic variations may have influenced the steers' performance in several ways. According to Pereira et al. (2017), periods of high temperatures, like those recorded at the beginning of the experimental period, may cause thermal stress in animals, affecting their feed intake and weight gain. On the other hand, days with milder temperatures may have created a more comfortable environment, favoring the health and performance of the animals.

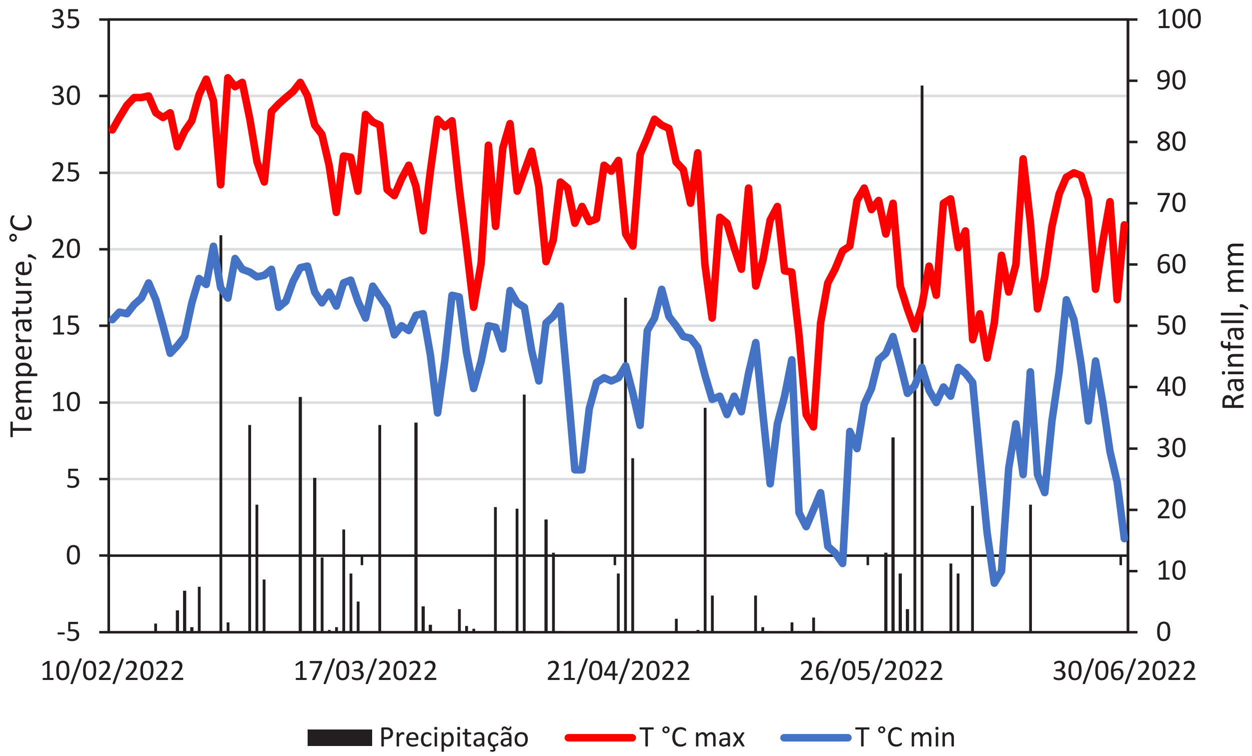


**Figure 1.** Maximum and minimum temperatures and rainfall during the first experimental period (Guarapuava, state of Paraná, February 10th to June 30th, 2022).

According to Instituto Nacional de Meteorologia [INMET] (2022), rainfall exceeding 60 mm is considered extreme and may cause adverse conditions in the feedlot area, such as increased humidity, increasing the risk of respiratory diseases, and negatively impacting the performance of the steers. For Argôlo et al. (2010), the variation in climatic conditions throughout the first period (10/02 to 30/06/2022) underscores the importance of properly managing animals in feedlots. This includes taking measures to mitigate the effects of heat stress and ensuring access to clean water and adequate drainage of the facilities to minimize negative impacts on the steers' performance and health.

During the second period from 05/07 to 22/11/2022 (Figure 2), the maximum temperature ranged from 13.8°C to 29.9°C, and the minimum from -0.8°C to 17.2°C. Maximum temperatures above 25°C can cause heat stress in animals, negatively affecting weight gain and feed efficiency. According to Bunning and Wall (2022), very low temperatures below 0°C can require animals to expend more energy to maintain their body temperature, thereby reducing the energy available for weight gain. The second experimental period had high rainfall, with 68.4 mm falling in a single day. This may have contributed to humid conditions that hindered the animals' access to feed and water and increased the risk of disease. Therefore, minimizing the impacts of climatic variations is key to ensuring the better performance and welfare of feedlot steers (Brown-Brandl, 2018).

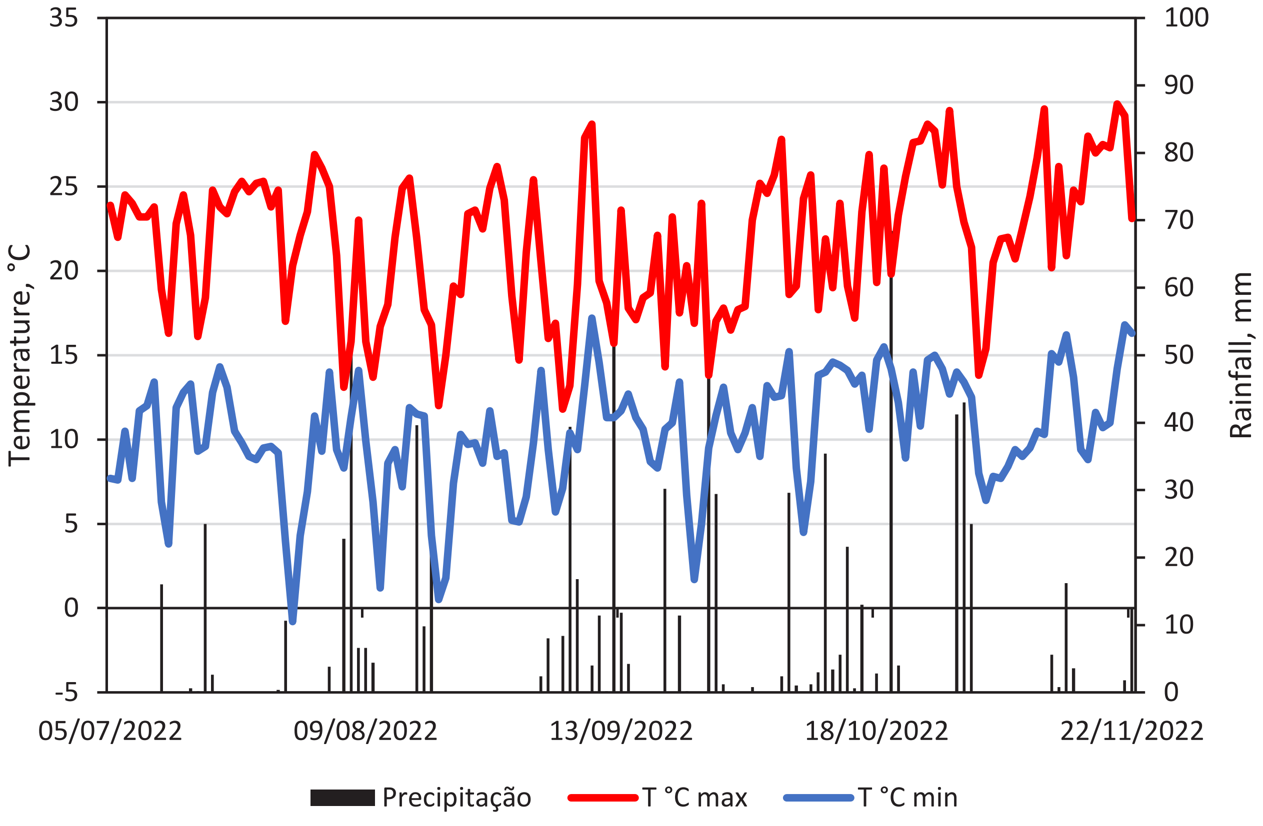


**Figure 2.** Maximum and minimum temperatures and rainfall during the first experimental period (Guarapuava, state of Paraná, July 5th to November 22nd, 2022).

Analysis of variance evidenced that there was no interaction (P > 0.05) between treatment and evaluation period for the studied variables. In general, at the end of the finishing phase, animals supplemented with sodium monensin combined with yeast culture had higher body weights (P < 0.05) at slaughter (565.3 kg versus 537.6 kg; Table 3) and hot carcass weights (312.6 kg versus 296.8 kg; Table 4). Consequently, they had greater weight gains (145.3 kg versus 114.6 kg; Table 3) and higher carcass weight gains (103.1 kg versus 85.3 kg; Table 4) than those supplemented solely with sodium monensin.

**Table 3**
**Performance of steers finished in a feedlot and receiving sodium monensin, with or without yeast culture**

| Parameter | Experimental feed | | Mean | CV | P-value |
|---|---|---|---|---|---|
| | MO | MO+YC | | | |
| Initial weight, kg | 423.0 | 419.0 | 421.0 | 10.44 | 0.879 |
| Body weight at slaughter, kg | 537.6 b | 565.3 a | 551.5 | 3.65 | 0.038 |
| Weight gain, kg | 114.6 b | 145.3 a | 130.5 | 17.37 | 0.030 |
| ADG, kg $day^{-1}$ | 1.083 b | 1.324 a | 1.203 | 8.75 | 0.003 |

ADG: average daily gain; CV: coefficient of variation.
MO: sodium monensin; MO+YC; sodium monensin + yeast culture
Means in the same row, followed by different lowercase letters, are significantly different from each other by the F-test at 5%.

**Table 4**
**Weight, gain, and carcass traits of steers finished in a feedlot and receiving sodium monensin, with or without yeast culture**

| Parameter | Experimental feed | | Mean | CV | P-value |
|---|---|---|---|---|---|
| | MO | MO+YC | | | |
| Hot carcass weight, kg | 296.8 b | 312.6 a | 304.7 | 3.64 | 0.034 |
| Carcass yield, % | 54.82 | 55.28 | 55.05 | 1.66 | 0.399 |
| CG, kg | 85.3 b | 103.1 a | 94.2 | 13.57 | 0.054 |
| ACG, kg $day^{-1}$ | 0.819 b | 0.947 a | 0.883 | 7.78 | 0.009 |
| ACG:$ADG^{-1}$, % | 75.71 | 71.93 | 73.82 | 7.67 | 0.276 |
| Fat thickness, mm | 4.19 | 4.44 | 4.32 | 3.61 | 0.118 |

CG: carcass gain during the feedlot period; ACG: average carcass gain; ADG: average daily gain; CV: coefficient of variation.
MO: sodium monensin; MO+YC; sodium monensin + yeast culture
Means in the same row, followed by different lowercase letters, are significantly different from each other by the F-test at 5%.

Neumann et al. (2020) demonstrated that yeast cultures can alter the ruminal pH by providing substrates for lactic acid-consuming bacteria, stabilizing the ruminal pH, and allowing the growth of cellulolytic bacteria that increase the ruminal degradability of food. This may increase the average daily gain of animals, as evidenced by higher slaughter weight and total weight gain values in animals fed yeast culture (Table 3).

Animals supplemented with sodium monensin combined with yeast culture showed higher ADG (P = 0.003), 1.324 versus 1.083 kg day$^{-1}$ (Table 3), and higher ACG (P = 0.009), 0.947 versus 0.819 kg day$^{-1}$ (Table 4), compared to those that received only sodium monensin in their diet, respectively.

There was no statistical difference (P > 0.05) between the treatments evaluated for the carcass yield and ACG: ADG parameters (Table 4), with mean values of 55.05% and 73.82%, respectively. However, it is worth mentioning that there was a statistical trend (P = 0.1182) of greater subcutaneous fat thickness in carcasses of animals fed a diet with yeast culture (4.44 versus 4.19 mm) compared to the diet with only sodium monensin.

According to Oliveira et al. (2023) and Cesar et al. (2024), the improved rumen degradability of feed caused by yeast cultures increases the production of short-chain fatty acids, such as propionic acid. Propionic acid is a glucose precursor, which makes more energy available to animals. This is evidenced by the improved ADG (Table 3), which is influenced by the addition of yeast culture, which consequently influenced the ACG (Table 4) during the experimental period and the hot carcass weight (Table 4) at the end of the experiment, suggesting better feed conversion.

Furthermore, Zeoula et al. (2011) state that sodium monensin typically decreases methane production and the acetate: propionate ratio. This shows that using sodium monensin improves feed efficiency and suggests that combining it with yeast culture may improve animal efficiency synergistically.

However, according to Neumann et al. (2016), although yeast cultures can alter the proportion of volatile fatty acids, including acetate production, an important precursor of subcutaneous fat deposition, no significant differences in fat deposition were found in the carcasses of animals that received the probiotic compared to the control group.

In addition, Swyers et al. (2014) demonstrated in their study that administering yeast culture or sodium monensin to animals did not result in statistically significant differences in fat thickness. This suggests that yeast byproducts and ionophores have little influence on this characteristic.

As described by Zdepski et al. (2023), yeast and its byproducts offer significant benefits to animal health. Their study evaluated feedlot steers that were fed either yeast culture or autolyzed yeast. They found that yeast culture reduced alterations in rumen papillae by 30%, compared to other treatments. This resulted in an improved immune response in the animals, as evidenced by decreased papillae inflammation and reduced neutrophil infiltration in the rumen walls. These improvements are associated with better nutrient absorption by the rumen papillae, leading to increased productivity in cattle treated with yeast culture.

Under certain conditions, as presented by Venancio et al. (2025), results showed that feedlot steers receiving yeast culture had increased ribeye area and rump fat thickness compared to animals treated with monensin. This suggests that a greater quantity of cellulolytic bacteria and an altered proportion of volatile fatty acids (precursors of glucose) lead to a positive energy balance, increasing carcass performance and fat deposition. These factors are crucial in classifying carcasses for elite markets.

According to Dian et al. (2020), reduced performance in feedlot steers can be associated with several factors, including microclimate stress around the feedlot. High temperatures and/or sudden temperature changes combined with excessive humidity can negatively impact the digestive behavior and welfare of animals, leading to reduced feed intake and weight gain. Further, Mota and Marçal (2019) state that inadequate infrastructure in feedlots, such as a lack of shade, poor ventilation, and overcrowding, can increase stress in steers, affecting their health and body development.

In general, the combined use of sodium monensin and yeast culture was efficient in the production of feedlot-finished steers under the conditions of this experiment, which took place in a half-covered commercial feedlot with a concrete floor and a history of low animal performance due to a continuously humid environment and inefficient ventilation.

## Conclusion

The addition of yeast culture to the diet in combination with sodium monensin improved average daily gain by 22.2% and daily carcass gain by 15.6% in ½ Angus x ½ Nellore cattle that were finished in feedlots and slaughtered at 18 months of age.

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