Balanced diets with *Saccharomyces cerevisiae* and organoleptic quality in free range chicken

Dietas balanceadas con *Saccharomyces cerevisiae* y calidad organoléptica en pollo campero

Dietas balanceadas com *Saccharomyces cerevisiae* e qualidade organoléptica em frango caipira

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Abstract

This research was developed at the "La María" Experimental Farm of the State Technical University of Quevedo (UTEQ), located in the province of Los Ríos, Ecuador. The objective was to evaluate the effect of supplementation with *Saccharomyces cerevisiae* in balanced diets on the organoleptic properties of free-range chicken meat. Two treatments were compared: UTEQ balanced and UTEQ + yeast balanced. The sensory evaluation included a descriptive attribute intensity test and a triangular discriminative test, with the participation of 50 panelists. The data were analyzed using the non-parametric Kruskal-Wallis test ($p \leq 0.05$). The results showed that there were no statistically significant differences ($p > 0.05$) between treatments for the attributes chicken flavor, fish flavor, chicken odor, fish odor, white color, yellow color, texture (juiciness) and general acceptability. The sensory profile showed a normal chicken flavor, slight characteristic aroma, slightly white color, moderate juiciness and high acceptability in both treatments. In the triangular test, 17 correct answers were recorded, a value lower than the minimum required (22) at 95 % confidence, confirming the absence of perceptible differences between the samples. It was concluded that supplementation with *Saccharomyces cerevisiae* does not modify the organoleptic characteristics of free-range chicken meat, maintaining its sensory quality and acceptability by the consumer.

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Resumen

La presente investigación se desarrolló en la Finca Experimental "La María" de la Universidad Técnica Estatal de Quevedo (UTEQ), ubicada en la provincia de los Ríos, Ecuador. El objetivo fue evaluar el efecto de la suplementación con *Saccharomyces cerevisiae* en dietas balanceadas sobre las propiedades organolépticas de la carne de pollo campero. Se compararon dos tratamientos: balanceado UTEQ y balanceado UTEQ + levadura. La evaluación sensorial incluyó una prueba descriptiva de intensidad de atributos y una prueba discriminativa triangular, con la participación de 50 panelistas. Los datos se analizaron mediante la prueba no paramétrica de Kruskal-Wallis ($p \leq 0,05$). Los resultados mostraron que no existieron diferencias estadísticas significativas ($p > 0,05$) entre tratamientos para los atributos sabor a pollo, sabor a pescado, olor a pollo, olor a pescado, color blanco, color amarillo, textura (jugosidad) y aceptabilidad general. El perfil sensorial evidenció un sabor normal a pollo, ligero aroma característico, color ligeramente blanco, jugosidad moderada y alta aceptabilidad en ambos tratamientos. En la prueba triangular se registraron 17 aciertos, valor inferior al mínimo requerido (22) al 95 % de confianza, confirmando la ausencia de diferencias perceptibles entre las muestras. Se concluyó que la suplementación con *Saccharomyces cerevisiae* no modifica las características organolépticas de la carne de pollo campero, manteniendo su calidad sensorial y aceptabilidad por parte del consumidor.

Palabras claves: nutrición animal, análisis sensorial, avicultura, carne, levaduras

Resumo

Essa pesquisa foi desenvolvida na Fazenda Experimental "La María" da Universidade Técnica Estatal de Quevedo (UTEQ), localizada na província de Los Ríos, Equador. O objetivo foi avaliar o efeito da suplementação com *Saccharomyces cerevisiae* em dietas equilibradas sobre as propriedades organolépticas da carne de galinha criada ao ar livre. Dois tratamentos foram comparados: UTEQ balanceado e UTEQ + levedura equilibrado. A avaliação sensorial incluiu um teste de intensidade descritiva de atributos e um teste discriminativo triangular, com a participação de 50 painelistas. Os dados foram analisados usando o teste não paramétrico de Kruskal-Wallis ($p \leq 0,05$). Os resultados mostraram que não houve diferenças estatisticamente significativas ($p > 0,05$) entre os tratamentos para os atributos sabor de frango, sabor de peixe, odor de frango, odor de peixe, cor branca, cor amarela, textura (suculenta) e aceitabilidade geral. O perfil sensorial mostrou sabor normal de frango, leve aroma característico, cor levemente branca, suculência moderada e alta aceitação em ambos os tratamentos; No teste triangular, foram registradas 17 respostas corretas, um valor menor que o mínimo exigido (22) com 95 % de confiança, confirmando a ausência de diferenças perceptíveis entre as amostras. Concluiu-se que a suplementação com *Saccharomyces cerevisiae* não modifica as características organolépticas da carne de frango de cria livre, mantendo sua qualidade sensorial e aceitabilidade pelo consumidor.

Palavras-chave: nutrição animal, análise sensorial, avicultura, carne, leveduras.

Introduction

Free-range chicken production is currently emerging as an alternative within the poultry sector to industrial intensive fattening systems (Zambrano *et al*., 2023). This model is carried out under semi-extensive conditions, which contrasts with the highly technified management of broiler chickens, resulting in a product with distinct sensory attributes, such as a more pronounced flavor, a firmer texture and characteristics associated with traditional rearing systems. These qualities have increased consumer preference for this type of meat, despite its higher cost compared to industrial chicken (Aguilar *et al*., 2024; Ferrer *et al*., 2022; Picot *et al*., 2025).

In this context, poultry production faces significant challenges related to production efficiency, with compound feed being the main component of production costs (Aucastro *et al*., 2019). This situation has prompted the search for nutritional strategies to optimise nutrient utilization and improve the quality of the final product, particularly in alternative production systems where management conditions may be more variable (Gaona *et al*., 2023; Reyes *et al*., 2025).

In recent years, the use of functional additives in poultry feed has gained prominence as a means of improving production performance and meat quality (Fernández *et al*., 2025). Among these, the yeast *Saccharomyces cerevisiae* has been used due to its ability to modulate the gut microbiota, improve nutrient digestibility and promote the physiological well-being of the birds. These effects may be reflected not only in production parameters but also in the sensory attributes of the meat, such as flavor, texture and acceptability (Dottavio *et al*., 2019; Rodríguez *et al*., 2018).

Despite these advances, the available information on the effect of including *Saccharomyces cerevisiae* on the sensory quality of free-range chicken meat is still limited, particularly in production systems under tropical conditions, where factors such as diet, management and the environment can significantly influence the organoleptic characteristics of the final product.

Therefore, the aim of this study was to evaluate the effect of including *Saccharomyces cerevisiae* in the diet of free-range chickens on the sensory properties of the meat, by comparing a balanced diet formulated by UTEQ and supplemented with yeast with a conventional diet, with the aim of determining possible changes in the organoleptic quality of the product.

Materials and methods

The research was carried out at the "La María" Experimental Farm, which belongs to the poultry department of the State Technical University of Quevedo (UTEQ), Ecuador, located at km 7.5 of the Quevedo–El Empalme road. In this setting, the sensory profile of free-range chicken meat was analyzed under two dietary treatments: the UTEQ balanced diet and the UTEQ balanced diet supplemented with yeast (*Saccharomyces cerevisiae*). This location was chosen because the farm has controlled facilities and standardized poultry management practices that ensure the homogeneity of the animals, thereby reducing potential biases associated with environmental or management conditions.

The free-range chickens were housed in the poultry farm's facilities under controlled conditions of temperature, ventilation and stocking density, ensuring consistent management throughout the experimental period. Three feeding phases were established: start (1–25 days), growth (25–40 days) and finish (40–65 days), during which the feed appropriate to each production stage was provided.

The balanced diet used corresponds to a formulation developed by UTEQ, comprising conventional ingredients such as maize, soya meal, energy sources and a vitamin-mineral concentrate, adjusted to meet the nutritional requirements of each production phase. The percentage composition of the ingredients and their nutritional content (crude protein, metabolisable energy, fat, fibre and minerals) are shown in Table 1.

Table 1. Formulation and nutritional composition of the balanced diet developed by UTEQ for free-range chickens (%).

Ingredient (%)	Start (1–25 days)	Growth (25–40 days)	Finish (40–65 days)
Yellow maize	55.0	58.0	62.0
Soya meal	30.0	26.0	22.0
Wheat bran	5.0	7.0	8.0
Vegetable oil	3.5	3.0	2.5
Fish meal	3.0	2.0	1.5
Calcium carbonate	1.2	1.2	1.2
Dicalcium phosphate	1.5	1.3	1.2
Vitamin and mineral supplement	0.5	0.5	0.5
Common salt	0.3	0.3	0.3
Total	100.0	100.0	100.0

The values shown represent the percentage (%) of each ingredient in the total feed formulation, adjusted to meet the nutritional requirements of each production stage.

Fifty adult panellists aged between 20 and 40 were selected for the sensory evaluation; they were students at the institution and were chosen on the basis of health criteria, availability and the absence of any dietary restrictions that might interfere with sensory perception. Recruitment was carried out using questionnaires that included questions on food preferences, history of participation in sensory panels, possible allergies and availability, following the recommendations of Quevedo *et al*. (2021) and Guzmán *et al*. (2024) to ensure the suitability of the participants and the homogeneity of the panel. A structured intensity scale was used to evaluate the sensory attributes, the criteria for which are presented in Table 2.

Table 2. Intensity scale of the sensory profile for chicken meat.

Atribute	Categories assessed
Color	White – Yellow
Flavor	Chicken – Fish
Smell	Chicken – Fish
Texture	Juiciness
Taste	Intensity

The sensory evaluation was carried out using a structured six-point scale, where 0 corresponds to 'none', 1 to 'almost none', 2 to 'some', 3 to 'slightly', 4 to 'normal' and 5 to 'quite a lot'. This scale enabled the standardisation of sensory assessment and facilitated comparison between experimental treatments.

The yeast used was commercial *Saccharomyces cerevisiae*, incorporated into the balanced feed at a rate of 2 $g.kg^{-1}$ of feed (0.2 %) throughout the experimental period. Supplementation was carried out by direct mixing with the feed, ensuring its homogeneous distribution in each ration supplied daily. Furthermore, the supplemented feed was prepared daily in order to prevent loss of viability of the additive and to ensure its stability during supply.

Once the fattening period was complete, the organoleptic assessment was carried out. The animals were slaughtered under standard conditions, and meat samples were taken for subsequent sensory analysis, ensuring the traceability of each treatment. The samples consisted of 5 kg free-range chicken breasts.$treatment^{-1}$, with a 100 g portion.$panelist^{-1}$, ensuring the representativeness of the batch and following stratified random sampling criteria to ensure that each portion included both the centre and the edges of the muscle, avoiding biases related to variations in texture or flavor within the same piece (Jenko *et al*., 2023). All samples were randomly coded (A for Balanced + Yeast, B for Balanced) and organised into random combinations for the triangular test (Gomez *et al*., 2019).

Sample preparation was carried out in accordance with standardized protocols, controlling critical factors such as the size and shape of the cuts, water volume and cooking temperature, cooking and resting times, as well as serving temperature, ensuring that each panelist received consistent portions and minimizing the influence of external factors on the sensory attributes being assessed (Navas *et al*., 2024). In addition, fresh water was provided for rinsing between samples, and the consecutive presentation of samples with potential residual flavors was avoided, in compliance with hygiene and biosafety standards for sensory testing (Paredes *et al*., 2021).

The sensory evaluation focused on attributes relating to taste, smell, colour, texture and acceptability (Table 2). Taste was assessed by distinguishing between the characteristic chicken flavor and any undesirable fishy notes. Smell was assessed in terms of the intensity of the natural aroma and the presence of off-odors. Color was assessed in terms of white and yellow. Texture was evaluated in terms of juiciness, and overall acceptability reflected the panelist's preference. The intensity scale used ranged from 0 to 5, where 0 corresponded to absence and 5 to maximum perceived intensity, following the criteria described by Ortega *et al*. (2025).

The statistical analysis included the Kruskal-Wallis multiple-range test to assess differences between treatments for each sensory attribute, with $p \leq 0.05$ set as the significance level. For the discriminative evaluation, the triangular test was employed, following the standards of Peña *et al*. (2023), where the minimum number of correct identifications required to determine significant differences between treatments at a 95 % confidence level was calculated. All data obtained were tabulated and processed using Infostat software version 2020. The results were represented graphically in spider-web-type sensory profiles, allowing for the joint visualization of all attributes evaluated per treatment (Juma *et al*., 2025).

Results and discussion

Sensory analysis

Table 3 shows the results of the descriptive sensory analysis. The chicken meat evaluated had a characteristic chicken flavor, with a slight chicken odor, a slightly white color, moderate juiciness and was well received by the panelists. The intensity of fishy flavor and odor was recorded as non-existent, indicating that the diets did not introduce any undesirable flavors or odors.

Sensory analysis of free-range chicken meat under the evaluated diets showed that supplementation with yeast (*Saccharomyces cerevisiae*) did not result in differences in the organoleptic characteristics assessed.

Table 3. Sensory evaluation of free-range chicken meat based on different feeding regimes.

Attribute	Balanced UTEQ	UTEQ Balanced + Yeast	H - Kruskal-Wallis
Chicken flavor	3.62	3.60	3.08
Fish flavor	0.80	0.92	3.00
Chicken odor	3.24	3.66	2.09
Fish odor	1.14	0.82	0.62
White color	3.46	3.32	0.32
Yellow color	1.18	1.18	3.00
Texture (juiciness)	3.14	3.34	0.72
Acceptability	4.16	4.06	0.03

The values correspond to means obtained on a sensory scale of 0 to 5 (0 = none; 5 = quite a lot). H: Kruskal-Wallis test statistic. No significant differences were detected between treatments ($p > 0.05$).

This suggests that the inclusion of yeast in the diet does not affect the flavor profile expected by consumers of free-range meat (Egbeyale *et al*., 2020).

The fishy taste variable showed low values (0.80 and 0.92), indicating a virtual absence of undesirable taste (Aguirre *et al*., 2024). This observation is relevant because it ensures that the supplemented diet does not introduce compounds that could generate unpleasant aromas or flavors, thereby maintaining the meat's natural sensory quality. The slight increase in the yeast treatment (0.92) was not significant. According to Mosquera *et al*. (2025), these findings may be attributed to individual variations in the panelists perception, with no practical implications for product acceptability.

As for the smell of chicken, the results for the yeast treatment were slightly higher (3.66 versus 3.24), but with no significant differences. Mendoza *et al*. (2023) indicate that supplementation could marginally improve the intensity of the natural chicken aroma, although not to a degree perceptible to the panelists, suggesting that yeast does not adversely affect the volatile compounds responsible for the characteristic odor of the meat (Velásquez *et al*., 2021).

The fishy odor, considered a negative attribute in free-range chicken meat, showed low values in both treatments (1.14 and 0.82), indicating that neither diet regimen generated undesirable odors. Ríos *et al*. (2022) note that this finding is consistent with the absence of significant differences in fishy flavor, reaffirming that yeast does not introduce altered flavors or aromas.

With regard to meat color, the variables 'whiteness' and 'yellowness' showed consistent results across treatments. Whiteness recorded mean values of 3.46 and 3.32, indicating a slightly white hue, whilst yellowness remained the same (1.18) for both treatments. According to Vallardi *et al*. (2022), color uniformity is an indicator of product homogeneity and the stability of the meat's physical characteristics, factors that are important for consumers' perception of freshness and quality. Yeast supplementation did not affect these visual properties, suggesting that the diet does not alter pigment deposition or the external appearance of the meat.

As for texture or juiciness, a slight variation was observed (3.14 vs 3.34), corresponding to scale 3, which indicates slight juiciness. Although the yeast treatment showed a slight increase, this difference was not significant and can be considered within the natural variability of the product. Puvača *et al*. (2022) indicate that juiciness is a key sensory attribute in the perception of meat quality, and its stability across treatments suggests that supplementation does not affect moisture retention or the muscle consistency of the breasts evaluated.

Finally, overall acceptability scored averages of 4.16 and 4.06, indicating that the panelists perceived the meat as pleasant in both cases. This supports the hypothesis that the inclusion of yeast does not alter the consumer's overall sensory perception, which is crucial from a commercial perspective and for the acceptance of functional products in poultry diets.

The sensory characteristics of the meat in terms of chicken flavor and overall acceptability were within the range corresponding to a normal and favorable perception, whilst fishy flavor and odor recorded minimal scores, indicating the absence of undesirable flavors or odors. Furthermore, color and texture remained consistent across the diets evaluated. These results demonstrate that supplementation with *Saccharomyces cerevisiae* does not alter the sensory properties of the meat, as can be seen in Figure 1.

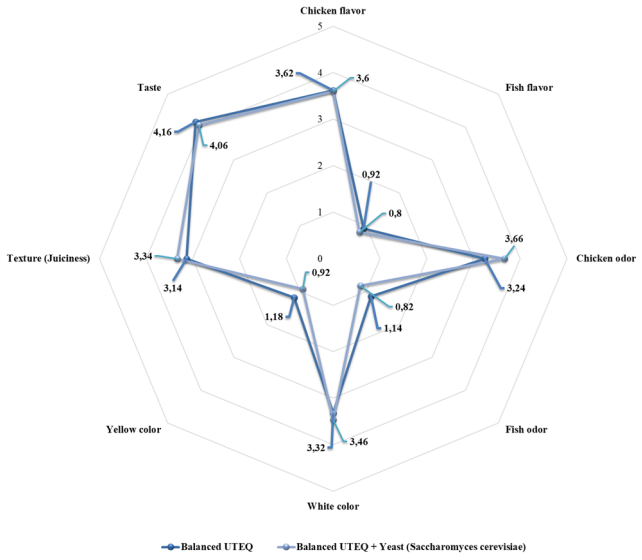

Figure 1. Sensory characterization of free-range chicken meat from birds fed a diet based on UTEQ compound feed supplemented with *Saccharomyces cerevisiae* yeast.

Discriminative assessment of free-range chicken meat from birds fed a diet of UTEQ compound feed + yeast (*Saccharomyces cerevisiae*)

The results obtained in the triangular test (Table 4) showed that, out of a total of 50 panelists, 17 were able to correctly identify the samples. When comparing this value with the minimum number of correct identifications required (22) for a significance level of 5 % (α=0.05), it was determined that there were no significant differences between treatments. This indicates that the inclusion of yeast (*Saccharomyces cerevisiae*) in the diet did not result in any perceptible variations in the sensory characteristics of the meat, consistent with the results obtained in the organoleptic evaluation (flavor, odor, color and texture).

These findings are consistent with those reported by Puvača *et al*. (2022) and Navas *et al*. (2024), who note that yeast supplementation in poultry diets does not significantly alter sensory attributes such as the flavor, odor, color and texture of the meat. According to these authors, the yeast *Saccharomyces cerevisiae* acts primarily by improving the digestibility of nutrients and the balance of the birds' gut microbiota, without producing compounds that alter the organoleptic profile of the muscle.

Table 4. Results of the triangular test for the discriminative assessment of free-range chicken meat.

Number of panelistas	Positive findings observed	Expected successes (α = 0.05)	Statistical result	Interpretation
50	17	22	17 < 22	There is no significant difference between the treatments

The critical value (22 correct answers) corresponds to α=0.05 in the triangular test (p = 1/3). As 17 correct answers were obtained (< 22), no significant differences were detected between treatments (p > 0.05).

In this regard, the absence of differences detected in the present study can be considered a favorable result, as it demonstrates that the inclusion of yeast in the diet of free-range chickens allows the sensory stability of the meat to be maintained and ensures its acceptability to the consumer, which supports its use as a nutritional alternative within poultry production systems.

Conclusions

The inclusion of *Saccharomyces cerevisiae* in the UTEQ balanced diet does not affect the sensory characteristics of free-range chicken meat, maintaining its quality in terms of flavor, aroma, color, texture and acceptability.

The chicken meat retains its characteristic flavor and inherent sensory attributes, without any undesirable characteristics that affect consumer perception.

In this regard, the use of *Saccharomyces cerevisiae* in the feed of free-range chickens is viable, as it does not compromise the sensory quality of the product or its acceptance.

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