Research Open Access

pyepez@uteq.edu.ec

Correspondence:

Addition of cabbage (*Brassica oleracea var. Capitata*) in a balanced diet for fattening American turkey

Adición de col (*Brassica oleracea var. Capitata*) en dieta balanceada para engorde del pavo americano

Piedad Francisca Yépez Macias
Master's Degree, Universidad Técnica Estatal de Quevedo, Ecuador, pyepez@uteq.edu.ec, http://orcid.org/0000-0002-8391-9527

Jairo Antonio Muñoz Montoya
Master's Degree, Universidad Técnica Estatal de Quevedo, Ecuador, jairoamon.munoz@uteq.edu.ec https://orcid.org/0000-0003-0357-6630

Ronny Javier Gaibor Carvajal
Master's Degree, Universidad Técnica Estatal de Quevedo, Ecuador, ronny.gaibor2014@uteq.edu.ec https://orcid.org/000-0002-2384-0585

Karina Patricia Arevalo Briones
Master's Degree, Universidad Técnica Estatal de Quevedo, Ecuador, karevalo@uteq.edu.ec https://orcid.org/0000-0001-7815-5561

Abstract

The research was carried out at the "La María" Experimental Farm, Quevedo State Technical University, located at km 7 ½ of the Quevedo - El Empalme road, with a duration of 43 days, the objective was to evaluate the addition of cabbage (Brassica oleracea var. capitata) in a balanced diet for fattening American turkeys. A completely randomized design was applied with three treatments, five replications, four turkeys, total 60 turkeys in the fattening phase, where in feed consumption, weight gain, feed conversion and carcass yield of T3 obtained the best productivity values, while in the control treatment the values were not very efficient in this research. The proximal analysis of the meat of the treatments showed that the highest percentage of protein was obtained in T2 with 24.8%; however, the lowest percentage of fat was in T3 with 0.60%, while in the analysis of ash, the lowest values were found with 1.04% in treatment T2 and 73.94% moisture in treatment T1. The non-parametric statistical analysis of affectivity with hedonic scales of intensity of attributes, which determined that T3 presented the best organoleptic characteristics. The economic analysis carried out for each of the treatments under study in this research shows that T2 was the one with the highest profitability with a profitability of 99.56% compared to the control treatment with a value of 88.63%.

http://centrosuragraria.com/index.php/revista, Published by: Edwards Deming Institute, Quito - Ecuador, January - March vol. 1. Num. 12, 2022, This work is licensed under a Creative Commons License, Attribution-NonCommercial-ShareAlike 4.0 International. https://creativecommons.org/licenses/by-nc-sa/4.0/deed.es

Received March 12, 2021
Approved: October 22, 2021

Keyword: Consumption, feeding, organoleptic, treatment, analysis.

Resumen
La investigación se desarrolló en la Finca Experimental "La María", Universidad Técnica Estatal de Quevedo, ubicada en el km 7 ½ de la vía Quevedo – El Empalme, con una duración de 43 días, el objetivo fue evaluar la adicción de col (Brassica oleracea var. capitata) en dieta balanceada para engorde del pavo americano. Se aplicó un diseño completamente al azar con tres tratamientos cinco repeticiones cuatros pavos, total 60 pavos en la fase de engorde, donde en el consumo de alimento, la ganancia de peso la conversión alimenticia y el rendimiento a la canal del T3 obtuvo los mejores valores de productividad, mientras que en el tratamiento testigo los valores fueron poco eficientes en esta investigación. El análisis proximal realizado a la carne de los tratamientos señala que el mayor porcentaje de proteína lo obtuvo el T2 con 24.8 % no obstante el menor porcentaje de grasa se presentó en el T3 con 0.60% mientras que en el análisis de ceniza se presentaron los valores más bajos con 1.04 % en el tratamiento T2 y humedad 73.94 % en el tratamiento T1. El análisis estadístico no paramétrico de afectividad con escalas hedónicas de intensidad de atributos, los cuales determinaron que el T3 presentó las mejores características organolépticas. El análisis económico realizado a cada uno de los tratamientos en estudio de la presente investigación demuestra que el T2 resulto ser el que mayor beneficio se obtuvo con una rentabilidad de 99.56 % en comparación del tratamiento testigo con un valor de 88.63 %.
Palabras clave: Consumo, alimentación, organoléptico, tratamiento, análisis.

Introduction

In the world market for cut flowers, this sector continues to grow, with the Netherlands being the main exporter of flowers with 45% of world exports, followed by Colombia with 16%, and finally Ecuador, Kenya and Belgium, which contribute 10, 8 and 3%, respectively, of total flower exports in the world (Manrique et al., 2014). This increase demands high production requirements, but in relation to quality, demanded in different markets, involving plant breeding material, soil and substrate management, fertilizer use, phytosanitary products, harvesting, as well as post-harvest treatments (Chen et al., 2013)

In Colombia, the floriculture sector is one of the pillars of the economy, it is characterized by its great contributions to the development of the national economy represented in its high level in the GDP and a potential generator of employment (Gutiérrez and Almanza, 2016) the departments of Antioquia and Cundinamarca are attributed to be the main producers of cut flowers with more than 8,000 ha in production, as of 2015 with about 10.9% average annual growth in exports, and are concentrated in the savannah of Bogotá with 66%, (Jabeen & Chadha, 2021)

Currently, with the evolution of markets, crops were diversified in order to increase competitiveness, which implies the export of more than 50 types of flowers and foliage. For 2016, rose represented 22% of the total exported, followed by pompon with 15%, carnation represented 14%, while foliages occupied 27% (CCB, 2016). This sector shows a strengthening process in the country, flower exports from Colombia reported US$75.5 million up to April 2018, with a volume of 14,415 t (Asocolflores, 2018) remaining as one of the first exporting countries despite the global oversupply and currently occupying the second place (Frank et al., 2019)

In the case of floriculture, sustainability is based on the efficient use of resources, where the concept of cleaner production (CP) is applicable. In every production system, waste is generated as a product of the processes of each system. CP is defined as the continuous application of preventive environmental strategies to processes, products and services in order to increase efficiency and minimize risks to human health and the environment Thus, the PML has a large number of benefits that contribute to the continuous improvement of the company, it contributes to support in different areas either in terms of production processes, products and services, in order to reduce costs, encourage innovations and reduce relevant risks to humans and the environment (Jun et al., 2015). LWP favors the reduction of operating costs and risks, waste management, optimization of resource use, elimination/reduction of waste, effluents and emissions, improvement of plant operational efficiency, energy efficiency, increases productivity and competitiveness with the improvement of the company's image (Peñas et al., 2012). A constant evolution in the efficiency of production systems and government policies has allowed the control of the environmental impact of production activities and has encouraged companies to develop strategies to achieve more sustainable operations by modifying current production and consumption patterns (Lapoujade, 2016)

Taking into account the environmental context, in recent years a growing awareness of sustainable production schemes and certified systems in agriculture emerged, and numerous scientific studies aimed at improving the environmental performance of these production processes have been carried out (Hanschen et al., 2018), the Colombian association of flower exporters, ASOCOLFORES, created the Florverde Sustainable Flowers certification program, as a tool that promotes social responsibility and seeks the adoption of good agricultural practices, minimization of the use of agrochemicals, protection of the fundamental rights of workers, product quality and managerial responsibility (SUN et al., 2018) in addition, the importance of Rainforest Alliance, homologous with the guidelines of the secretariat of the Sustainable Agriculture Network that manages certification systems (Perumal et al., 2021)

At present, the floricultural sector has adopted several techniques of good practices and LMP in its processes as certification requirements demand it, therefore, a research is proposed based on a descriptive bibliometric analysis, a methodology of quantitative analysis used with the purpose of studying the historical course of a field of knowledge from records such as periodical and non-periodical publications of the specialty (Joel et al., 2020) This review document aims to show the evolution of PML in the flower sector in the world and in Colombia since 2005, in order to compare the studies carried out in Colombia with respect to the world, taking into account its economic importance worldwide in the export of cut flowers.

Materials and methods

Location and duration of the investigation.

This research was conducted at the Experimental Farm "La María", Faculty of Livestock Sciences of the State Technical University of Quevedo (UTEQ), located at km 7 ½ of the road Quevedo - El Empalme, whose geographical location is 1º 6' 23" south latitude and 79º 29' 12" west longitude and at an altitude of 73 meters above sea level. The climatic conditions of the locality are: temperature 24.80 °C, relative humidity 88 %, rainfall 343.70 and average evaporation of 65.50 mm, this research had a duration of 43 days.

Experiment management

The research carried out was of an exploratory, formative, documentary and field type, which contributes to the research line: agronomic behavior, evaluation and improvement of the nutritional characteristics and conservation methods of grasses, legumes, fodder trees, agricultural by-products and agro-industrial residues for domestic animal feeding purposes. Exploratory type, the productive parameters, the improvement of the nutritional quality, as well as the organoleptic characteristics of the meat, on which the acceptability by the consumer depends, were measured. The quantitative method was used to evaluate the productive parameters of the variables under investigation, the qualitative method was used to evaluate the organoleptic characteristics of the meat, and the experimental method was used to determine the best feeding treatment with Tukey significance tests at 5% probability. A completely randomized design (CRD) was used with three treatments and five replicates, four unsexed turkeys per experimental unit. To analyze the organoleptic characteristics, they were evaluated by means of a nonparametric descriptive statistical analysis of affectivity with Hedonic scales of Attribute Intensity. Tables 1 and 2 show the ADEVA and the description of the research treatments. The statistical model, under which the response variables were analyzed, is as follows:

$$Yij= u + Ti + Eij$$

Table 1. *Analysis of variance (ADEVA).*

Source of variation	Formula	Degrees of freedom
Treatments	*t - 1*	2
Experimental error	*t (r- 1)*	12
Total	*tr - 1*	14

Prepared by: Authors.

Table 2. *Description of treatments.*

Treatments	Description	Diet application
T1	Balanced UTEQ (witness)	2400 g of balanced feed
T2	Balanced UTEQ + cabbage 5%.	2400 g of feed + 120 g of cabbage
T3	Balanced UTEQ + cabbage 10%.	2400 g of feed + 240 g of cabbage

Prepared by: Authors.

Result

Analysis of the data obtained from the production indexes

Food consumption

The results regarding the highest consumption ($P \leq 0.05$) were recorded by treatments T2 and T3 in each of the evaluated periods and in the total, with respect to the control treatment (see Table 3), these values may be related to the higher palatability of the cabbage, agreeing with what is stated in the Manual (Jun

et al., 2015) which considers that cabbage leaves are a food that these birds like because these animals are good foragers if they are supplied with green pasture. However, the results obtained in the present research agree with those reported by (Nurhidayati et al., 2016) who investigated the productive and economic evaluation of the fattening of turkeys of the Nicholas 700 strain, obtaining a feed consumption at week 15 of 4,052 g. Nurhidayati et al. (2016) in their turkey breeding and fattening manual reports similar values of feed consumed in sexed animals with an average value for females and males of 4,035 g, these results being relatively close to those obtained in the present study. Jun et al. (2015) in his research reported a total consumption of 20521.64 value lower than those obtained in this study. Frank et al. (2018) when evaluating zeolite in diets for turkeys under commercial production conditions showed a consumption of 4200 g with 0% clinoptilolite treatment and 5000 g of feed consumption in week 17, where no significant statistical differences were found between these treatments; however, the method without clinoptilolite addition presents values that agree with those obtained in this research. when evaluating Leucaena leucocephala meal in diets for growing and fattening turkeys, obtained the highest feed consumption in the treatment with 7.5% substitution of wheat flour for leucaena meal with pre-mixing, (4,980 and 6.135 g), the lowest feed consumption values were for the treatment with 15% substitution of soybean meal by leucaena meal plus pre-mix (4,457 and 5,600 g for males and females, respectively), being these values higher than those obtained in the present research work.

Table 3. *Averages and statistical significance for weekly and total feed consumption (g) in fattening Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)**.

Treat.	Feed consumption (g)						Total
	Weeks						
	13	14	15	16	17	18	
T1	4093,00 [a]	4093,80 [a]	4094,60 [a]	4096,20[a]	4103,00 [a]	4098,70[a]	24579,00 [a]
T2	4140,60 [b]	4137,00 [b]	4140,20 [b]	4153,80 [b]	4137,60 [b]	4139,80 [b]	24849,00 [b]
T3	4152,60 [c]	4147,60 [c]	4151,00 [c]	4096,90[a]	4155,20 [c]	4155,80 [c]	24859,10 [c]
CV (%)	0,03	0,05	0,02	0,07	0,02	0,04	0,01

***Means with a common letter are not significantly different (P≤0.05).**

Weekly live weight (kg)

The results obtained in terms of weekly live weight show that treatment T1 and T2 obtained the best averages of initial weight with respect to treatment T3 (see Table 4), while in final weight, treatment T2 obtained the best results, taking into account that the initial weight of treatment T2 was higher than that of treatment T3.

Table 4. *Averages and statistical significance for weekly live weight (kg) in fattening Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)*.*

Treat.	Live weight (kg)							Total
	Weeks							
	Initial Weight	13	14	15	16	17	Final Weight	
T1	8,92 [b]	9,93 [c]	11,01 [b]	12,08 [a]	13,16[a]	14,22 [a]	15,50[a]	75,88 [a]
T2	9,04 [b]	10,18 [c]	11,31 [c]	12,45 [c]	13,60 [c]	14,75 [a]	15,91 [c]	78,19 [a]
T3	8,54 [a]	9,73 [a]	10,92 [a]	12,11 [b]	13,30 [b]	11,61 [a]	15,69 [b]	73,33 [a]
CV (%)	0,93	0,81	0,24	0,11	0,14	27,69	0,12	4,91

***Means with a common letter are not significantly different (P≤0.05).**

Table 5 shows that the highest weight gain in weeks 13, 14, 15, 16 and total is presented by treatment T3 followed by treatments T2 and T1. These values coincide with those reported by Nurhidayati et al. (2016) in his line of feed for turkeys reporting values of 1100 g in the fattening phase. However, Jun et al. (2015) when performing the productive and economic evaluation of the fattening of Nicholas 700 turkeys, reports in week 15 a value of 1167 g, as well as Joel et al. (2020), in their study with zeolite in turkey diet recorded a weight at week 17 of 1200 g, a value that agrees with the data recorded in this research. Perumal et al. (2021) who evaluated the productive performance and carcass yield in turkeys fed feather meal treated with NaOH also reports results of 165.8, 127.0 and 144.0 g per day for the control treatment, 50 g of NaOH and 100 g of NaOH respectively, so that when the calculation is made for the seven days of the week it yields average values of 1160.60 g, 889.00 and 1008.00 g so that the control treatment agrees with the results of this study since the other treatments were not effective in terms of weight gain.

Table 5. *Averages and statistical significance for weekly and total weight gain (g) in fattening Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)*.*

Treat.	Weight gain (g)						Total
	Weeks						
	13	14	15	16	17	18	
T1	1061,40 [b]	1080,80 [a]	1066,80 [a]	1073,00[a]	1071,80 [a]	1072,40[a]	6426,20 [a]
T2	1035,40 [a]	1127,20 [b]	1145,20 [b]	1148,40 [b]	1156,20 [b]	1150,40 [b]	6762,80 [b]
T3	1185,60 [c]	1188,60 [c]	1188,40 [c]	1192,80[a]	1071,80 [a]	1072,10 [a]	6899,30 [c]
CV (%)	0,15	0,15	0,17	0,11	0,23	0,19	0,05

***Means with a common letter are not significantly different (P≤0.05).**

Feed conversion

The most efficient feed conversion (P<0.05) was recorded by treatment T3 in each of the periods 13, 15, 16 and total, followed by treatment T2 (see Table 6). These results are similar to those obtained by Hanschen et al. (2018) who evaluated the performance of growing turkeys fed diets with different agro-industrial by-products, reporting a feed conversion of 3.74. However, Peñas et al. (2012) when evaluating the use of forage soybean (Neonotonia Whightii) in the feeding of fattening turkeys and evaluation of the industrial process of their meat obtained a feed conversion of 3.92 for animals in confinement, 3.68 for animals in pasture and 3.77 for the control treatment, so these values are similar to those of this research LI et al., (2018) in their research on the effects of feeding turkeys with wet feed plus fresh vegetables (Chard, beta vulgaris; Cabbage, Brassica oleracea; Turnip, Brassica napus L) in the growth and fattening stage, obtained a feed conversion of 4.40 g in turkeys fed with cabbage (Brassica oleracea) in the fattening stage, while in the current study the conversion is more efficient as shown in (Table 6). While LI et al., (2018) investigated the productive indicators of Mexican turkeys in confinement conditions where these authors indicate that the feed conversion at weeks 4, 8, 12 and 16 was 3.47, 2.80, 3.71 and 2.58 respectively, data that disagree with the results of this study.

Table 6. *Averages and statistical significance for weekly and total feed conversion (g) in fattening Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)*.*

Treat.	Feed conversion						Total
	Weeks						
	13	14	15	16	17	18	
T1	3,86 [b]	3,79 [c]	3,84 [c]	3,82c	3,83 [b]	3,82 [b]	3,83 [c]
T2	4,00 [c]	3,67 [b]	3,62 [b]	3,62 [b]	3,58 [a]	3,60 [a]	3,68 [b]
T3	3,50 [a]	3,79 [a]	3,49 [a]	3,44[a]	3,88 [c]	3,88 [c]	3,60 [a]
CV (%)	0,17	0,19	0,17	0,15	0,20	0,22	0,14

***Means with a common letter are not significantly different (P≤0.05).**

Carcass yield (%)

The best carcass yield in percentage was recorded by treatment T2 (see table 7) in comparison to treatment T3, it is worth mentioning that treatment T2 obtained an initial weight of 9.04 kg, while treatment T3 started with a weight of 8.54 so it is considered that treatment T3 was the best, these values are higher than those reported by Chauca, (2015) in his study using diets with different levels of protein plus essential and semi-essential amino acids in the initial, growth and finishing phases in Hybrid turkeys registering a yield of 83.Meanwhile, it reported a carcass weight of 13.61 kg in birds that consumed a diet with 19% protein, which were the animals that reached the best average, as well as the T3 treatment that reached a carcass weight of 13.20 kg. Taking into account that the average initial weight of the birds under study was 9.14 kg, these values are similar to those of this study. The carcass yield percentages of the birds in this study were higher than those obtained by Jabeen & Chadha (2021)

who reported a yield of 78.94 % in native Mexican turkeys fed a balanced commercial diet, combined with grazing, starting at 16 weeks of age. On the other hand Chen et al. (2013) who carried out the comparison of weight gain in turkey poults fed a commercial diet and two diets supplemented with 4 and 6 % of California red worm (Eisenia foetida), reached final weights of 13.20 kg for turkeys fed with 4 % of California red worm, followed by a weight of 13.04 kg for the birds fed with 6% worm and a weight of 11.81 kg for the control treatment. It is worth mentioning that these results of the 6% worm treatment started with 60 g less than those of the control treatment and 90 g with respect to the 4% worm treatment, results lower than those shown in (Table 7) in terms of the final weight of the birds. While Jabeen & Chadha (2021) in their work Global Vision of Current Turkey Meat Production reports values of final weights with 15.8 kg being these values similar to those obtained in the present study.

Table 7. *Averages and statistical significance for carcass yield (g) in fattening Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)*.*

Treat.	Carcass yield (%)		
	Live Weight (kg)	**Carcass weight**	**% Channel**
T1	15,50 [a]	13,24 [a]	85,37 [a]
T2	15,90 [c]	14,15 [c]	89,02 [c]
T3	15,69 [b]	13,92 [b]	88,72 [b]
CV (%)	0,08	0,09	0,09

***Means with a common letter are not significantly different (P≤0.05).**

Economic analysis

The economic analysis of the treatments is detailed in Table 8. The best gross income value was generated by treatment T2 with (1774.41 USD), but the lowest income was generated by treatment T1 with a value of (1660.30 USD). For the total costs of the treatments of this research, it can be seen that with the addition of 10% cabbage, the highest cost (895.18 USD) is produced, while the lowest production cost was generated by treatment T1 (880.18 USD). The highest net benefit was presented by treatment T2 (885.23 USD) and the lowest benefit was obtained by treatment T1 (780.12 USD). The highest benefit/cost ratio was for treatment T2 (99.56) and the lowest profitability was for the control treatment (88.63).

Table 8. *Economic analysis of treatments in the fattening of Big-6 American turkeys supplemented with cabbage (Brassica oleracea var. Capitata)*.*

ITEMS	TREATMENTS		
	T1	**T2**	**T3**
Fixed costs			
Turkeys	140.00	140.00	140.00
Electricity and water	5.00	5.00	5.00
Health	6.75	6.75	6.75

Labor	2.50	2.50	2.50
Balanced feed	725.93	725.93	725.93
Variable costs			
Col	0.00	9.00	15.00
TOTAL COST	**880.18**	**889.18**	**895.18**
Income			
Average weight slaughtered (kg)	13.24	14.15	13.92
Number of birds	20	20	20
Total weight (kg)	264.80	283.00	278.40
Value of kg USD	6.27	6.27	6.27
GROSS INCOME (USD)	**1660.30**	**1774.41**	**1745.57**
NET PROFIT	**780.12**	**885.23**	**850.39**
B/C RATIO	**0.89**	**1.00**	**0.95**
PROFITABILITY (%)	**88.63**	**99.56**	**95.00**

Prepared by: Authors.

Proximate analysis of turkey meat

Table 9 shows the proximate analysis of turkey meat where treatment T2 presents the highest amount of protein, while treatment T3 presents the lowest amount of fat followed by the lowest amount of ash of treatment T2 with 1.04, therefore treatment T3 presents the highest amount of moisture. Souci *et al*. (2008) reported values of protein, fat, ash and moisture with 24.6, 0.65, 1.2 and 74.12 respectively, results that coincide with those obtained in this research. Jun et al. (2015) reported 1.11 ash in turkey meat, while Frank et al. (2018) in his study obtained a value of 21.8 protein in improved turkeys.

Table 9. *Proximal analysis of turkey meat.*

Calculated analysis (%)	T1 Skinless breast	T2 Skinless breast	T3 Skinless breast
Protein	24.5	24.8	24.70
Grease	0.63	0.72	0.60
Ash	1.12	1.04	1.22
Humidity	73.94	74.69	74.88

Prepared by: Authors

Organoleptic characteristics of turkey meat

Meat texture

According to the data obtained regarding the texture of the meat in treatment T1, we have as a result that, of the total number of panelists, 40% indicated that they like it very much, while 42% responded that they like it, therefore, 18% indicated that they neither like it nor dislike it. As for treatment T2, we found that 44% of the responses indicated that they liked the texture very much, 40% indicated that they liked it, while 16% indicated that they neither liked nor disliked the texture. The results obtained

for treatment T3 indicate that 50% of the panelists like the texture of the turkey meat in this treatment very much, while 36%, according to their criteria, indicate that they like the texture of this meat, however, 40% indicated that they neither like nor dislike it (see Table 10).

Meat flavor

The data collected for T1, regarding the flavor of the meat, show that 16% of the panelists said they liked the flavor very much (see Table 11), while 58% indicated that they liked it, but 26% stated that they neither liked nor disliked the flavor. Regarding T2, the data obtained as a result of the organoleptic analysis survey, it can be seen that 46% indicated that they liked the flavor very much, however, 34% indicated that they liked it, therefore, 20% of the panelists were of the opinion that they neither liked nor disliked it. With respect to the analysis of T3, 54% of the panelists indicated that they liked the flavor very much, but 30% liked it, while 16% stated that they neither liked nor disliked it.

Meat odor

According to the data obtained from the survey conducted for the T1 sample, with regard to odor, it can be seen that 6% indicated that they liked it very much (see Table 12), while 32% of the panelists indicated that they liked it, however, 44% stated that they neither liked nor disliked it, while 18% indicated that they did not like the odor of the meat from this treatment. With respect to the T2 samples, the following results were obtained: 12% indicated that they like the smell of this meat very much, 36% indicated that they like it, therefore, the majority of the panelists, corresponding to 42%, indicated that they neither like nor dislike it, while 10% stated that they do not like the smell of turkey meat from this treatment. In T3, 22% indicated that they liked the odor very much, however, 44% of the panelists indicated that they liked the odor, 34% indicated that they neither liked nor disliked it, therefore, 8% considered that they did not like the odor of this meat. Regarding the color of the turkey meat in T1, 18% indicated that they liked it very much, 42% considered that they liked it, while 40% stated that they neither liked nor disliked it, as shown in (Table 13). In relation to T2, 28% indicated that they liked the color of the meat very much, while 46%, which is where most of the responses for this treatment are concentrated, considered that they liked the color, and 26% indicated that they neither liked nor disliked the color of the meat. In T3, 24% of the panelists indicated that they liked it very much, while 56% of the panelists stated that they liked the color of the meat, although 20% neither liked nor disliked it.

Meat juiciness

According to the data obtained from the analysis of the organoleptic characteristics in terms of juiciness of T1 meat, the result is that 2% of the panelists like it very much (see Table 14), 30% indicate that they like it, while the majority (68%) indicate that they neither like nor dislike the juiciness of this meat. Regarding T2, the results show that 12% of the panelists like the juiciness very much, while 38% indicate that they like it, however, it can be observed that 50%, which corresponds to the highest percentage, indicate that they neither like nor dislike it. The results obtained for T3, through the analysis of the responses of the panelists, show that 8% like the juiciness very much, while 34% indicate that they like it; therefore, 58% state that they neither like nor dislike the juiciness of the meat of this treatment.

Conclusions

Feed intake, weight gain, feed conversion and carcass yield in T3 obtained the best productivity values, while in the control treatment the values were not very efficient in this research. The proximal analysis of the meat of the treatments showed that the highest percentage of protein was obtained in T2 with 24.8%; however, the lowest percentage of fat was in T3 with 0.60%, while in the analysis of ash the lowest values were found with 1.04% in treatment T2 and 73.94% humidity in treatment T1. The methodology applied in this research allowed obtaining a better quality meat, as demonstrated by the non-parametric statistical analysis of affectivity with hedonic scales of intensity of attributes, which determined that T3 presented the best organoleptic characteristics. The economic analysis carried out for each of the treatments under study in this research shows that T2 resulted in the highest profitability with a profitability of 99.56 % compared to the control treatment with a value of 88.63 %.

References

Chen, C., Zhuang, M., Fang, Z. yuan, Wang, Q. biao, Zhang, Y. yong, Liu, Y. mei, Yang, L. mei, & Cheng, F. (2013). A Co-Dominant Marker BoE332 Applied to Marker-Assisted Selection of Homozygous Male-Sterile Plants in Cabbage (Brassica oleracea var. capitata L.). *Journal of Integrative Agriculture*, *12*(4), 596–602. https://doi.org/10.1016/S2095-3119(13)60277-4

Frank, D., Piyasiri, U., Archer, N., Jenifer, J., & Appelqvist, I. (2018). Influence of saliva on individual in-mouth aroma release from raw cabbage (Brassica oleracea var. capitata f. rubra L.) and links to perception. *Heliyon*, *4*(12), e01045. https://doi.org/10.1016/j.heliyon.2018.e01045

Frank, D., Piyasiri, U., Archer, N., Jenifer, J., & Appelqvist, I. (2019). Corrigendum to "Influence of saliva on individual in-mouth aroma release from raw cabbage (Brassica oleracea var. capitata f. rubra L.) and links to perception" [Heliyon 4 (12) (December 2018) e01045] (Heliyon (2018) 4(12), (S2405844018353659), (10.1016/j. *Heliyon*, *5*(3), e01258. https://doi.org/10.1016/j.heliyon.2019.e01258

Hanschen, F. S., Kühn, C., Nickel, M., Rohn, S., & Dekker, M. (2018). Leaching and degradation kinetics of glucosinolates during boiling of Brassica oleracea vegetables and the formation of their breakdown products. *Food Chemistry*, *263*(April), 240–250. https://doi.org/10.1016/j.foodchem.2018.04.069

Jabeen, A., & Chadha, S. (2021). A triple test cross analysis to detect epistatic gene effects in cabbage (Brassica oleracea var. capitata L.): An updated methodology. *Saudi Journal of Biological Sciences*, *28*(11), 6153–6157. https://doi.org/10.1016/j.sjbs.2021.06.067

Joel, E. B., Mafulul, S. G., Adamu, H. E., Goje, L. J., Tijjani, H., Igunnu, A., & Malomo, S. O. (2020). Peroxidase from waste cabbage (Brassica oleracea capitata L.) exhibits the potential to biodegrade phenol and synthetic dyes from wastewater. *Scientific African*, *10*. https://doi.org/10.1016/j.sciaf.2020.e00608

Jun, T., Dongming, L., Zezhou, L., Limei, Y., Zhiyuan, F., Yumei, L., Mu, Z., Yangyong, Z., Honghao, L., Dengxia, Y., & Peitian, S. (2015). Preliminary Study of the Characteristics of Several Glossy Cabbage (Brassica oleracea var. capitata L.) Mutants. *Horticultural Plant Journal*, *1*(2), 93–100. https://doi.org/10.16420/j.issn.2095-9885.2015-0009

Lapoujade, A. L. (2016). Dieta saludable, alimentos puros y purificación en el mundo grecolatino. *Nova Tellus*, *34*, 109–121. http://www.redalyc.org/pdf/591/59146029007.pdf

LI, X., YU, H., LI, Z., LIU, X., FANG, Z., LIU, Y., YANG, L., ZHUANG, M., LV, H., & ZHANG, Y. (2018). Heterotic Group Classification of 63 Inbred Lines and Hybrid Purity Identification by Using SSR Markers in Winter Cabbage (Brassica Oleracea L. var. capitata). *Horticultural Plant Journal*, *4*(4), 158–164. https://doi.org/10.1016/j.hpj.2018.03.010

Nurhidayati, N., Ali, U., & Murwani, I. (2016). Yield and Quality of Cabbage (Brassica oleracea L. var. Capitata) Under Organic Growing Media Using Vermicompost and Earthworm Pontoscolex corethrurus Inoculation. *Agriculture and Agricultural Science Procedia*, *11*, 5–13. https://doi.org/10.1016/j.aaspro.2016.12.002

Peñas, E., Pihlava, J. M., Vidal-Valverde, C., & Frias, J. (2012). Influence of fermentation conditions of Brassica oleracea L. var. capitata on the volatile glucosinolate hydrolysis compounds of sauerkrauts. *LWT - Food Science and Technology*, *48*(1), 16–23. https://doi.org/10.1016/j.lwt.2012.03.005

Perumal, S., Waminal, N. E., Lee, J., Koo, H. J., Choi, B. soon, Park, J. Y., Ahn, K., & Yang, T. J. (2021). Nuclear and chloroplast genome diversity revealed by low-coverage whole-genome shotgun sequence in 44 Brassica oleracea breeding lines. *Horticultural Plant Journal*, *7*(6), 539–551. https://doi.org/10.1016/j.hpj.2021.02.004

SUN, B., ZHANG, F., XUE, S., CHANG, J., ZHENG, A., JIANG, M., MIAO, H., WANG, Q., & TANG, H. (2018). Molecular Cloning and Expression Analysis of the ζ-Carotene Desaturase Gene in Chinese kale (Brassica oleracea var. alboglabra Bailey). *Horticultural Plant Journal*, *4*(3), 94–102. https://doi.org/10.1016/j.hpj.2018.03.005