Original Article

Production Performance Of Broiler Chickens With The Use Of Ginger (Zingiber Officinale) As A Natural Probiotic And Its Effect On Organometric Parameters

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Abstract

This research aimed to evaluate the productive behavior of broilers and organometrics using different levels of ginger (Zingiber officinale) inclusion in the feed, carried out at the Rio Verde Support Center of the UPSE. A total of 200 broilers of 15 days of age and homogeneous weights were used. The study was established in a completely randomized design distributed in 4 treatments with 20 replicates each: T0, T1, T2 and T3, where 0, 0.25, 0.50 and 0.75 g of ginger were fed in 1 kg of feed. The variables evaluated were: final weight (g), weight gain (g), feed conversion and carcass yield (%) and measurements of the organs that belong to the digestive tract with its annexed glands. The results obtained show that T3 was the most efficient achieving a final weight of 3 191.5 g, a weight gain of 2 767.8 g and a feed conversion of 1.45 g; T0 was registered as the least favorable treatment presenting a final weight of 2 969.65 g, obtained a weight gain of 2 546.7 g and a feed conversion of 1.56 g, for these two treatments, T3 was the one with the highest inclusion of ginger with 0.75 g per kg of feed. In contrast, T0 was fed only with feed, establishing that the inclusion of Zingiber officinale positively influences poultry production, thus determining that the treatment with excellent results was T3 with 0.75 g of ginger per kg of feed, while T0 was fed only with feed.75 g of ginger per kg of feed, generating higher weight gain and, therefore, better carcass yield, showing that including ginger in the diet of broiler chickens increases adequate assimilation of feed and positively influences the development, growth and weight (organometry) of the organs of the gastrointestinal tract. The results conclude that ginger can be used as a growth promoter in broiler production under the conditions of the province of Santa Elena; the greater the inclusion of ginger, the better results will be obtained.

Keywords: feeding, fattening, dressing, organometry, gastrointestinal tract.

INTRODUCTION

The increase in broiler production generates many impacts and responsibilities on poultry farmers who must adopt sustainable production models due to high demand (Quevedo et al., 2021).

Pomboza et al. (2018) posit that, in terms of poultry development, the breeds used have changed in poultry production over time. Initially, poultry production emerged as a complement to the agricultural system feeding the birds with excess crop seeds and natural food (earthworms) from their environment.

Because of intensive methods nowadays, birds have become sensitive to intestinal microbial imbalances, resulting in inadequate feed conversion rates. For such reason, and to overcome this and more difficulties, the diet is supplemented with antibiotics, according to Barros (2018).

Poultry farming in Ecuador has gone through different processes that have led to an increase in productivity and the consumption of meat, which has a high protein value and a low amount of fat compared to pork and beef (Herrera, 2016).

One of the practices to induce the improvement of the economy in the countryside has been the poultry industry, achieving an increase in the gross domestic product in the agricultural sector, positioning itself as a key sector for its evolution (Fenavi, 2017)
Gonzalez (2020) states that animal production diseases are complicated by the excessive use of antibiotics, resulting in generations of drug-resistant bacteria, and there is a transfer of this in the food chain.

Probiotics are now recognized as possible alternatives to antibiotics used as growth promoters because of their advantage since they do not leave residues in eggs or poultry meat and do not produce a risk of resistance towards antibiotics, which ensures timely utilization of nutrients provided in the diet, according to Barros (2018).

Feed additives implemented in low doses have been used for many years to increase animal productivity for different purposes, boosting growth, increasing feed efficiency and reducing mortality and morbidity. Also, ginger (Zingiber officinale) can reduce the incidence of diseases. (Guerrero, 2018).
The use of products such as ginger (Zingiber officinale) as a growth promoter, in addition to its antibacterial effect due to the zingerone and gingerol present in it, act beneficially to the microbial ecosystem of the intestines affecting toxins and pathogenic bacteria resulting in adequate digestion of nutrients improving the quality of the carcass and organometric characteristics (Herrera, 2016).

Faced with the need to increase the performance of broilers, producers have opted to abuse synthetic additives such as enzymes, vitamins, and probiotics, among others and several of these synthetics benefit the productivity of poultry farms. However, less emphasis is placed on animal welfare and food safety by producing animals safe for human consumption (Gonzalez, 2020).

The use of ginger in animal production has been little analyzed due to various factors. However, there is limited research that mentions that its use is viable in terms of poultry production; according to those mentioned above, this research promotes the use of natural products as an alternative to the production of broilers to help assimilate the nutrients that make up each feed as well as resistance to various diseases caused by the properties of this supplement as it is currently prohibited the use of some antibiotics as growth promoters in feed.

MATERIALS AND METHODS

The research was carried out at the Rio Verde Support Center of the Santa Elena Peninsula State University, located in the municipality of Rio Verde, canton and province of Santa Elena, at an altitude of 54 m.a.s.l. approximately, its geographical coordinates WGS84 are Latitude -2.304865º and Longitude -80.698966º, with a temperature 16-31°C, relative humidity 75%, with rainfall in rainy season 110mm/month and in dry seasons 0.2mm/month.

For the research, 200 chickens were evaluated, and the house walls and exteriors were cleaned and then completely washed with detergent, chlorine and water. Next, the floor and walls were flamed with a flamethrower to contribute to biosecurity; lime was placed covering the entire floor of the house, then wood shavings were distributed on the floor with a thickness of 10 cm, which served as bedding for the chickens.

Finally, a footbath with lime was placed at the house's entrance; the temperature and air in the house were controlled with the help of curtains placed on the outside surrounding the entire house.

Once the chicks were installed in the house, vaccines such as bronchitis at 14 days and new castle + Hepatitis at 21 days were used. Fifteen days after the arrival of the chicks, the weights were recorded and the different treatments were placed.

Information such as weights at different stages and feed consumption is collected through elaborate diagrams.

To obtain the ginger flour (Zingiber officinale Rosoce), the root was cut into small parts for the drying process, ground and distributed in the respective proportions specified in the treatments. The drying was carried out in the oven for 12 hours at 60 ºC. Then, with the help of a mill, the ginger was ground to obtain a fine powder used in the research process.

The variables evaluated were: Weight gain (g), the weight of the birds was taken every seven days in each of the treatments, average daily gain, final weight gain, final gain, feed consumption (g), feed conversion (CA) (g), live weight, carcass weight, carcass yield and organoleptic characteristics. For these variables, measurements were taken of weight (g) and length (cm) of the large intestine, small intestine, cecum, liver, heart, kidney and gizzard, using a tape measure and an analytical scale.

The study considered four treatments with different amounts of ginger per kg of feed: T0: 100% feed, T1: 0.25 g of ginger in 1 kg of feed, T2: 0.50 g of ginger in 1 kg of feed, T3: 0.75 g of ginger in 1 kg of feed, T3: 0.75 g of ginger in 1 kg of feed. T2: 0.50 g of ginger in 1 kg of feed, T3: 0.75 g in 1 kg of feed.

For the analysis of the data collected in the research, a run was performed in the IBM SPSS Statistics software, and a significance test (Tukey) at 5% was applied to identify the difference between the means of the treatments.

RESULTS AND DISCUSSIONS

Table 1 presents the main results where, for the initial weight, these do not present significant differences ($P > 0.05$), indicating that there are homogeneous weights presenting averages of 422.95 g; 420.5 g; 419.5 g; 423.75 g for each treatment. The values obtained in the present investigation are higher than those mentioned by Andrade et al. (2017), who evaluated productive parameters of broiler chickens in the Amazon of Ecuador, where they established that the chickens reach an average weight of 342.09 g at the age of 15 days, under meticulous management with the help of brooders and ventilators that manage to maintain a required temperature between 30-33 ºC.

At six weeks of life of broiler chickens, significant differences ($P < 0.05$) were recorded in the final weight, it is observed that the birds with the highest weight are those of T3, where 0.75 g of ginger was included per kg of feed, the treatment with 0.50 g of ginger in a kg of feed shows a final weight of 3 101.45 g, Herrera (2016) presents lower weights than those obtained using 0.1%, 0.2% and 0.3% ginger inclusion in the fattening stage where the mean recorded is 2 663.87 g showing significant differences ($P < 0.05$) being the treatment with higher inclusion of ginger meal the one that generates higher weight.

The results of the evaluation of the final weight in broilers at 28 days of age showed a highly significant difference in weight ($P < 0.001$) due to the inclusion of different levels of ginger in their balanced diet, T2 presents higher values than the other treatments with 1 623.9 g, evidencing a higher weight where they were fed with a ginger inclusion of 0.50 g per kg of a balanced diet during the growth stage, in the four treatments there were higher weights compared to the research of Lisintuña (2020), where broiler chickens at 28 days of age presented weights from 925 to 1 026 g, with an overall average of 978.2 when evaluating ginger meal levels of 0%, 1%, 2% and 3%, while the present research shows an average of 1 533.13 g among the

treatments.
In the growth stage, the results obtained in broiler chickens regarding weight gain show significant differences ($P < 0.05$) due to the inclusion of ginger in their feed. Although it is determined that T2 generates the best results obtaining 86 g, in T3, it is shown that the chicken gains 81.3 g of weight, showing that a higher inclusion of ginger in the feed generates a higher weight gain in broilers. Lisintuña (2020) indicates in his research that he obtained an average weight gain of 23.91 g, where the treatment with the best result was the inclusion of 4% ginger flour with 30.33 g, values much lower compared to the present research, which has an average weight gain of 79.39 g.

As Table 11 shows in the weight gain variable, there are no significant differences ($P > 0.05$) between the treatment means; the best weight gain in the fattening stage corresponds to T3, where it shows a gain of 116.4 g, followed by T0 where a gain of 111.6 g is registered, without much difference, the treatment where 0.25 g of ginger is added per kg of feed, with 110.1 g, and the least favorable weight gain value with 105.5 g is T2.25 g of ginger per kg of feed, with 110.1 g and the least favorable weight gain value with 105.5 g is T2 The data obtained in weight gain are higher than those presented by Herrera (2016), where he records an average weight gain of 106.96 g in the fattening stage showing significant differences ($P < 0.05$) between treatments with the highest being T3 with 1 042.46 g.

The feed conversion showed significant differences ($P < 0.01$) between the means; the highest was T0, which requires 1.47 g and decreases the higher the inclusion of ginger in the feed, and the most favorable conversion was the T2 conversion rate of 1.17 g, showing that when more ginger is used, lower conversions are obtained, due to this the chicken converts more kg of meat for a more significant amount of ginger incorporated in its feed. The average feed conversion in the growth stage is 1.28 g, which is higher than that presented by Medina (2016), who obtained a conversion of 1.01 g in this stage, achieving a better conversion of kg of meat.

For the fattening stage, there are no significant differences ($P > 0.05$) in the feed conversion variable, T2, needs more feed to produce 1 kg of live weight, obtaining an index of 2.23 g, and T3 is considered the lowest index with 2.11 g and 2.05 g respectively. Therefore, the feed conversion values presented by Lisintuña (2020) are lower than those of the present study, which obtained in the fattening stage the best conversion of 1.74 g with a higher percentage of ginger inclusion, the similar case presented where a better feed conversion of 2.05 g was obtained.

Table 1. Productive behavior of broiler chickens with the inclusion of different levels of ginger in the production phases.

Production phases	**T0**	**T1**	**T2**	**T3**	**P-Value**
Growth phase, day 15 to 28.					
Initial weight (g)	422.95	420.5	419.5	423.75	0.997
Final weight (g)	1407	1539.05	1623.9	1562.55	0.000
Daily food consumption	1380	1380	1380	1380	
Weight gain (g)	70.3	79.9	86	81.34	0.001
Feed conversion	1.47	1.26	1.17	1.23	0.001
Fattening phase from day 29 to 42.					
Initial weight (g)	1407	1539.1	1623.9	1562.6	0.000
Final weight (g)	2969.65	3080.55	3101.45	3191.55	0.015
Daily food consumption	3220	3220	3220	3220	
Weight gain (g)	111.6	110.1	105.5	116.4	0.351
Feed conversion	2.18	2.11	2.23	2.05	0.533
Total phase, day 15 to 42.					

Initial weight (g)	422.95	420.5	419.5	423.75	0.997
Final weight (g)	2969.7	3080.6	3101.5	3191.55	0.015
Daily food consumption	4600	4600	4600	4600	
Weight gain (g)	91		95.8	98.9	0.023
Feed conversion	1.56	1.5	1.49	1.45	0.018
Live weight (g)	2969.65	2380.55	3101.45	3191.55	0.0154
Carcass weight (g)	2179.65	2316.57	2505.87	2633.03	0.000
Carcass yield (%)	73.21	75.11	80.64	82.41	0.000

P-value >0.05: no significant differences; **P-value <0.05:** significant differences; **P-value <0.01:** highly significant differences.

Taking into account that the research began when the chicks were 15 days old with an almost uniform weight, after separating them by treatment and evaluating weekly weights, it can be seen that after four weeks as the final phase, there are significant differences (P < 0.05). As shown in Table 1, the treatment with the highest weight recorded is T1, which after 42 days presents a live weight of 3 192 g. On the other hand, in the fattening phase presented in the research of Mashianda (2018), higher values were presented being the 5% inclusion of Arachis pintoi meal, the treatment with the highest weight of 4 001.35 g, the difference in weight is due to the days that considered weights until day 48 as the final production stage.

Table 1 indicates significant differences (P < 0.05) between the treatments, showing that T3 obtained a higher weight gain of 98.9 g. Cruz (2021) does not agree with the data obtained; although there are significant differences (P < 0.05) in both studies, the weight gain varies since an average daily weight gain of 58 g is obtained throughout the broiler chickens' productive stage when moringa is included in their feed. For feed conversion, there are significant differences (P < 0.05) among the four treatments, the highest conversion rate is T0 with 1.56 g, where the percentage of ginger inclusion is 0%, it decreases in T1 and T2 with a conversion rate of 1.5 g in both cases, and the treatment with a lower rate is T3 with 1.45. The results of Herrera (2016) also agree with the research in their treatments, obtaining the best feed conversion in T3 of 0.3% inclusion with an index of 1.68 g.
Through the evaluation of the carcass yield variable and the data obtained, it was determined that there are highly significant differences (P < 0.01) between treatments, the most productive yield is obtained in T3 with a percentage of 82.41%. The results obtained are lower than those proposed by Herrera (2016), where T3 generates a yield of 87.23%, being the highest value, while T2 has the lowest yield of 82.16%.
Regarding organometry, the results shown in Table 2 in the variable full stomach show that there are highly significant differences (p<0.001) in which T3 reflects having the highest weight obtained at 27.60 g and T1 the lowest 21.40 gr which agrees with Shiva et al. (2012) which indicates that in trials in broiler chickens using dehydrated ginger in the diets, slight advantages were obtained in terms of weight and feed consumption of the birds.
Regarding the empty stomach variable, the results showed significant differences (p<0.05) with weight for T1 17 gr, T2 20.80 gr, and T3 24.50. In the stomach width, the differences were highly significant, while in the numerical values, there were no major differences between the control and T1 (Lorenzano, 2010). The results of this study show that knowledge of animal physiology is of vital importance since it allows explaining part of the responses and the incidence that the use of a new feed component may have on production and animal health.

Table 2 Organometry of broiler chickens' digestive tract and adnexal glands supplemented with different percentages of ginger meal in Rio Verde parish.

Variable	**Treatments**				
	T0	**T1**	**T2**	**T3**	**P-value**

ELl (gr)	19.60±4.58	21.40±5.56	25.70±5.08	27.60 ±5.56	0.0017
V (gr)	16.90±3.28	17.00±4.94	20.80±5.67	24.50±5.13	0.0029
A.E (cm)	2.68±0.46	2.86±0.61	3.15±0.40	3.43±0.47	0.0089
LE (cm)	5.09±0.86	5.05±0.77	4.76±0.71	4.38±0.78	0.173
LIG (cm)	40.37±4.84	41.42±7.15	45.40±6.29	48.30±5.03	0.0174
PIG (g)	30.20±10.7	36.40±10.46	38.60±7.96	39.90±5.24	0.0892
LID (cm)	177.86±23.23	194.70±23.57	208.00±29.64	213.40±25.69	0.018
PID (g)	30.20±10.7	36.40±10.46	38.60±7.96	39.90±5.24	0.0892
PVB(g)	0.35±0.15	0.52±0.19	0.39±0.10	0.41±0.18	0.1088
PH(g)	64.60±7.47	65.00±6.32	69.00±6,32	72.90±3.70	0.0139
PC(g)	16.00±3.80	18.10±3.14	20.20±3.79	20.40±3.50	0.0297

ELl=Full Stomach; **EV**=Empty Stomach; **AE**=Width of Stomach; **LE**=Length of Stomach; **LIG**=Length of Large Intestine; **PG**=Weight of Large Intestine; **LID**=Small Intestine Length; **PID**=Small Intestine Weight, **PVB**=Gallbladder Weight; **PH**=Liver Weight; **PC**=Heart Weight.

The values obtained show that there are significant differences (p<0.05) for the large intestine length variable, thus showing that the control treatments T0 and T1 did not present a major difference in their means, while variability was observed with treatments T2 and T3 with 45, 40 and 48.30 cm respectively. Regarding the weight of the large intestine, there are no significant differences (p>0.05). However, there is variability in its measurements, increasing its weight in grams, with T1 having 36.40 g, T2 38.60 g and T3 39.90 g. The intestine is a complex section that belongs to the gastrointestinal tract where nutrients circulate in an obligatory way, the basis for metabolism, growth and maintenance to administer resources for the nervous, skeletal and immunological systems (Agostinho et al., 2012). The results of small intestine length indicate that they present highly significant differences (p<0.01), in which the longest length that was presented was in the T3 treatment with a measure of 213.40 cm, agrees with Chavez (2016), who mentions that the small intestine has a length that goes from 150 to 230 cm. (Leon, 2019). The study mentions that the longitudinal development of the small intestine could be because if there is a protein of non-conventional origin, it promotes greater length. According to Stanley et al. (2013), the maintenance of the health and development of the gastrointestinal tract is of utmost importance to maintain adequate productivity of farm animals such as poultry and thus be able to study the weight parameter, according to the statistical analysis the weight of the small intestine shows that it is not significant for (p>0.05) while in its numerical values it does present a difference to the control resulting in a weight of 36.40 g, 38.60 g, 39.90 g for treatments T1, T2 and T3 respectively.

The weight of the gallbladder did not present significant differences (p>0.05); however, it can be appreciated that T1 0.52 g presented a relevance in weight compared to the other treatments. Robles (2014) In Table 2, the results of the liver weight variable are significant (p<0.05), with T3 presenting the highest weight (0.52 g) and T1 the lowest (0.39 g), which differs from those that included soybean meal in Table 2 (Chavez, 2016). Those who included soybean meal in the poultry diet showed an average liver weight of 76 g, while the inclusion of chili in the diet showed an average liver weight of 0.52 g, while the T1 showed the lowest with 0.39 g. (Londoño and Sánchez, 2019). The inclusion of chili in the broiler diet reflected a liver weight of 57.57 g. For the heart, the values obtained are significant (p<0.05), reflecting in their results variation between the control treatment and T1, while T2 20.20 also showed an increase equal to T3, which differs from the results of a study carried out by the researchers who placed the same values in T1 and T2 20.20 in the control treatment (Chekani et al., 2007). The results of a study in which natural additives such as fish oil were added to the broiler diet showed no change in heart weight.

Conclusions

In the total production phase, statistical differences were recorded in the final weight among the different treatments, demonstrating that greater inclusion of ginger in the broiler chickens' feed generates greater weight, considering it a possible growth promoter. When evaluating the weights at the beginning and end of each stage of the research, in the growth stage, the best final weight was obtained in T3, and in the fattening stage, the final weight of T1, in the weight gain variable was the best treatments were T2, in the growth stage, while in the fattening stage T1, and T3 presented the best results, and in feed conversion, T3 presented a better result in all the productive stage. Therefore, it is determined that the best treatment to replace a normal production is T3, including 0.75 g of ginger per kg of feed in the fattening stage, since the animal gains more weight and obtains a better feed conversion.

In the carcass yield of the different treatments, determining that the treatment with the best results was T3, generating higher weight gain and, therefore, better carcass yield, showing that including ginger in the diet of broilers increases good assimilation of feed. Furthermore, the supply of ginger in the diet positively intervened in the development, growth and weight of the organs of the gastrointestinal tract of broilers, especially in the small intestine, optimizing the absorption of nutrients and thus improving the health of the bird, concluding that ginger can be included in the diet of broilers as a growth promoter.

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