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Effect of *Plectranthus amboinicus* on carcass and visceral parameters of Cobb 500 chicken

Efecto de *Plectranthus amboinicus* sobre parámetros de la canal y visceral del pollo Cobb 500

***Angel Roberto Sánchez-Quinche*[1]*, *Erika María León-Armijos*[2], *Dervin Bartolo Dean-Gutiérrez*[3]**

[1]*Universidad Técnica de Machala, Faculty of Agricultural Sciences, Veterinary Medicine Career. Research Group on Food Production and Animal Health (GIPASA). Seedbed for Animal Production Research (SIPA). Machala, El Oro, Ecuador.*
[2]*Universidad Técnica de Machala, Faculty of Agricultural Sciences, Veterinary Medicine Career, Seedbed for Animal Production Research (SIPA). Machala, El Oro, Ecuador.*
[3]*Universidad del Zulia, Faculty of Veterinary Sciences. Maracaibo, Zulia, Venezuela.*
**Corresponding Author: arsanchez@utmachala.edu.ec*

ABSTRACT

The aim of this research was to evaluate the effect of the inclusion of *Plectranthus amboinicus* in the feed of Cobb 500 broilers, on carcass and visceral parameters, using an open house located at the "Santa Inés" farm of the Faculty of Agricultural Sciences of the Technical University of Machala (Ecuador). A Completely Randomized Design was used, where 6 treatments were evaluated, each with 4 Experimental Units of 10 birds·m^2, for a total of 240 broilers. Treatments (T) arrangement were as follows: T1, consumed a basal diet with Antibiotic as a Growth Promoter (GPA) (Bacitrazine zinc 15%) and coccidiostat (LERBEK® "Clopidol 20% + Methylbenzoquate 1.67%"), while in T2, T3, T4 and T5 contained the dehydrated ground leaf of *P. amboinicus* at 0.25, 0.50, 0.75 and 1.00%, respectively and, finally, T6 or Control, which did not include APC, coccidiostat or dehydrated *P. amboinicus* in the balanced mixture. The variables evaluated were: *antemortem* weight, expressed in kg; in percentage, blood, feathers, evisceration, carcass yield, thighs, against-thighs, breast, shoulder, wings, neck, paws, head, heart, liver, gizzard, spleen, intestines and gizzard fat, in relation to *antemortem* weight; and thickness of abdominal fat in mm. To discriminate the results, an ANOVA was applied prior to assumptions of normality and homogeneity, using Tukey's honest significant difference (HSD) procedure, with a confidence level of 95%. All data were processed using the PROC GLM (General Linear Model) procedure of the SAS statistical package. The results confirm that *P. amboinicus* does not have a detrimental effect on the carcass or viscera, which shows the margin of safety and potential use in feed.

Key words: *Plectranthus amboinicus*; carcass yield; abdominal fat; chicken

RESUMEN

El objetivo de esta investigación fue evaluar el efecto de la inclusión de *Plectranthus amboinicus* en la alimentación de pollos de engorde Cobb 500, sobre parámetros de canal y viscerales, utilizando una nave abierta ubicada en la finca "Santa Inés" de la Facultad de Ciencias Agropecuarias de la Universidad Técnica de Machala (Ecuador). Se utilizó un Diseño Completamente al Azar, donde se evaluaron 6 tratamientos (T), cada uno con 4 Unidades Experimentales de 10 aves·m^2, para un total de 240 pollos de engorde. La disposición de los T fue la siguiente: T1, consumió una dieta basal con Antibiótico Promotor de Crecimiento (APC) (Bacitracina zinc 15 %) y coccidiostático (LERBEK® "Clopidol 20 % + Metilbenzocuato 1,67 %"), mientras que en T2, T3, T4 y T5 contenían la hoja molida deshidratada de *P. amboinicus* al 0,25; 0,50; 0,75; y 1,00 % respectivamente y, finalmente, T6 o Control, que no incluía APC, coccidiostato ni *P. amboinicus* deshidratado en la mezcla balanceada. Las variables evaluadas fueron: peso *ante mortem*, expresado en kg; en porcentaje, la sangre, plumas, evisceración, rendimiento de la canal, muslos, contra-muslos, pechuga, espaldilla, alas, cuello, patas, cabeza, corazón, hígado, molleja, bazo, intestinos y grasa de molleja, en relación con el peso *ante mortem*; y espesor de grasa abdominal en mm. Para discriminar los resultados se aplicó un ANOVA previo supuestos de normalidad y homogeneidad, utilizando el procedimiento de diferencia significativa honesta (HSD) de Tukey, con un nivel de confianza del 95 %. Todos los datos fueron procesados mediante el procedimiento PROC GLM (General Linear Model) del paquete estadístico SAS. Los resultados confirman que *P. amboinicus* no tiene un efecto perjudicial sobre la canal o las vísceras, lo que muestra el margen de seguridad y uso potencial en la alimentación.

Palabras clave: *Plectranthus amboinicus*; rendimiento de canal; grasa abdominal; pollo

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INTRODUCTION

Awareness of Animal and Human Health has led to a breakthrough in organic food production, in regard to the environment and animal welfare, two of the main reasons for its progress, which is why the poultry industry is ideal to implement organic farming and has become an attractive gateway for many consumers of such products [1]. Although there is an increase in organic production, it does not have the desired increment in their use, due to socioeconomic factors such as increased production costs, lower yields, lack of industries and marketing channels for livestock products that encourage this area [2]. It is mentioned that in poultry productions without antibiotics there is a greater bacterial proliferation (*Campylobacter, Escherichia coli*, among others.) in the digestive tract of the birds and in the final product (meat or eggs), but in traditional production systems, although there is not so much risk of contamination, it is known with certainty that microorganisms resistant to antibiotics will be found in their products [3].

Bacterial resistance is a serious Public Health problem; there is an increase of pathogenic microorganisms resistant to a great variety of antibiotics, finding large traces of antimicrobials in animal products for human consumption. In conventional breeding, the use and abuse of antibiotics is observed, not only as bacterial treatments, but also as preventive and growth promoters (GPA), being the consumers the most affected, because in human health there is a need to seek new antibiotics and better treatments for patients who do not respond to traditional treatments because they are no longer effective, in addition new digestive problems arise due to an imbalance of the intestinal microbiota and there is an increase in chronic diseases [4].

Natural alternatives to replace GPA are varied, among them, are highlighting phytobiotic additives, these are derived from herbs, plants and / or spices that are used to improve animal performance, with good effects on growth, immunity and stress [5], is so, *Plectranthus amboinicus* is a plant that has shown diuretic, anti–inflammatory, antimicrobial, analgesic, antioxidant, anticancer, larvicidal, with nephroprotective, hepatoprotective, antihelmintic, antileishmania, antidiarrheal, antipsoriasis, antidiabetic action and that can be used as an additive in animal feed [6].

The objective of this research was to evaluate the effect of the inclusion of *P. amboinicus* in the feed of Cobb 500 chickens on carcass and visceral parameters.

MATERIALS Y METHODS

Location of research

The present experiment was carried out on the farm "Santa Inés" belonging to the Faculty of Agricultural Sciences of the Technical University of Machala, located at kilometer 5 ½ via Machala – Pasaje, at a Longitude of: 79°54'05", Latitude: 3°17'16", altitude: 5 meters above sea level, and with a temperature ranging from 22 to 35°C.

Bird management and experimental design

For the management of the birds, everything described by González–Eras *et al*. [7] and Ramírez–Rojas *et al*. [8] was used throughout the experiment, with the difference that the open house was adapted to contain 240 broilers (more treatments, more experimental units, equipment and materials), with an average weight of 46 g at reception (FIG.1).

FIGURE 1. Reception of the baby chick

A Completely Randomized Design (CRD) was used (FIG. 2), where 6 treatments were used, each with 4 Experimental Units (EU) of 10 birds·m^{-2}. Treatments were as follow: T1 birds fed a basal diet with Antibiotic as Growth Promoter "GPA" (Bacitrazine zinc 15%) and coccidiostat (LERBEK® "Clopidol 20% + Methylbenzoquate 1.67%"), while T2, T3, T4 and T5 included the dehydrated ground leaf of *P. amboinicus* at 0.25%, 0.50% 0.75% and 1.00% respectively. And finally, T6 or Control, which did not contain GPA, coccidiostat and *P. amboinicus* dehydrate.

For the formulation of diets, the Excel Solver tool was used, using the data published in the FEDNA 2019 tables by De Blas *et. al* [9] and the 2018 FEDNA poultry manual by Santomá and Mateos [10], using the maximum and minimum nutritional requirements according to their physiological stage. For which three formulas were administered: Starting diet, from 0 to 21 d, with 21.2% of Crude Protein (CP) and 2860 kcal·kg^{-1} of Metabolizable Energy (ME); Growing diet, fed from 22 to 28 d, with 20% of CP and 2990 kcal·kg^{-1} of ME; and, Finishing diet, fed

FIGURE 2. Distribution of treatments and Experimental Units

from 29 to 35 d, with 18.5 % of CP and 3050 kcal·kg^{-1} of ME, ensuring that all treatments received isoproteic and isoenergetic diets. Balanced food formulas published by Sánchez-Quinche *et al.* [11].

Sacrifice methodology and description of variables evaluated

The methodology for slaughtering the birds and the data obtained for the analyzed variables, followed the methodology used by Ramírez-Rojas *et al*. [8], with the difference that 48 birds were slaughtered at random (2 animals per EU, 8 in total per T). For all weight measurements, a Camry digital scale with a margin of error ± 1 g (Model EK9332-F302, China) was used. To obtain abdominal fat thickness data, moderate pressure was applied to the local fat with a caliper (PRETUL TRUP-21455, VER-6P, México), with a capacity of 150 mm.

Slaughter variables evaluated

Antemortem weight

Variable obtained in kg, prior to animal slaughter (day 35) (FIG. 3).

Blood (%)

It was measured by weighing the blood obtained, and was taken as a percentage in relation to the antemortem weight. It was obtained with the following formula:

$$Blood\,(\%) = \frac{Antemortem\ \ weight\ \ (g) - Weight\ \ after\ \ bleeding\ \ (g)}{Antemortem\ \ weight\ \ (g)} \times 100$$

FIGURE 3. *Antemortem* weighing of birds at day 35

Feathers (%)

It was obtained by weighing the bird after plucking and then the data is converted to a percentage. It was obtained with the following formula:

$$Feathers\,(\%) = \frac{Weight\ \ after\ \ bleeding\ \ (g) - Weight\ \ after\ \ plucking\ \ (g)}{Weight\ \ after\ \ bleeding\ \ (g)} \times 100$$

Variables obtained with evisceration (%)

Immediately after plucking the bird, the viscera (crop, heart, liver, gizzard with its fatty covering, spleen and intestines) were manually extracted, the resulting carcass was weighed and the difference with respect to the initial weight and this result were calculated was transformed to percentage. It was obtained with the following formula:

$$Evisceration\,(\%) = \frac{Weight\ \ with\ \ viscera\ \ (g) - Weight\ \ without\ \ viscera\ \ (g)}{Weight\ \ with\ \ viscera\ \ (g)} \times 100$$

Carcass yield (%)

It was obtained by dividing the weight of the eviscerated bird carcass (including legs, head, neck, heart, liver, gizzard and spleen) over the ante mortem weight, multiplied by 100, with the following formula:

$$Carcass\ \ yield\,(\%) = \frac{Eviscerated\ \ weight\ \ (g)}{Antemortem\ \ weight\,(g)} \times 100$$

Abdominal fat thickness (mm)

This data was obtained by measuring the thickness of the fat in the abdomen with the caliper.

Carcass variables

These data were generated by cutting the carcass, were weighed and the thighs, against-thighs, breast, shoulder, wings, neck, paws and head were recorded separately. They were converted to percentages, using the following formula:

$$Carcass\ \ part\,(\%) = \frac{Carcass\ \ part\ \ weight\ \ (g)}{Antemortem\ \ weight\ \ (g)} \times 100$$

Viscera variables

After the removal of the viscera (heart, spleen, liver, gizzard, intestines), they were separated and weighed. To obtain data on the gizzard fat, all the fat covering the organ was extracted. The following formula was applied:

$$Viscera\,(\%) = \frac{Viscera\ \ weight\,(g)}{Antemortem\ \ weight\ \ (g)} \times 100$$

Statistical Analysis.

An ANOVA was applied for all variables analyzed in the experiment, prior to assumptions of normality and homogeneity, to discriminate between averages, Tukey's honest significant difference (HSD) procedure was used with a confidence level of 95%. All data were analyzed using the PROC GLM (General Linear Model) procedure of the SAS statistical package [12].

RESULTS AND DISCUSSION

TABLE I shows that there was not significant statistical difference in the in the percentage of slaughter variables and even in the thickness of abdominal fat, these results are similar to those found by Rewatkar *et al.* [13], who in their research "Assessment of supplementation of oregano oil and probiotic on carcass yields of broiler chicken (*Gallus gallus domesticus*)" with 240 Ven–Cobb 400Y broilers, where they used among others Oregano (*Origanum vulgare* L.) essential oil, slaughtering 2 birds per replicate at day 42, did not find differences in the variables evaluated in that study. Similarly, when the carcass yield was analyzed by Campozano–Marcillo *et al.* [14], in their study " Aceite esencial de orégano (*Origanum vulgare* L.) y sexo como factores en la respuesta productiva en pollos de engorde", used 400 Cobb 500 broilers where they tested different concentrations of oregano essential oil, slaughtering 40 birds of 42 d of age, did not find + differences, it should be noted that they used a treatment with APC; this also differs from the findings of Batista *et al.* [15], in their study "Antibioterapia natural para el tratamiento de la coccidiosis y su repercusión en el comportamiento productivo del broiler", using 120 broilers and evaluating for 45 d, and found differences when using the mother tincture (mixture tincture) at 20%, assuming that the garlic + Oregano combination was effective in this percentage mentioned above, emphasizing that there was a treatment with commercial coccidiostat. Regarding abdominal fat, Sandra *et al.* [16], in their research "Oregano extract (*Origanum vulgare*) in female broiler chickens of free–range strain raised in the Western Amazon", using 300 female Heavy red broilers, where they tested different amounts of oregano extract, sacrificing 30 birds of 70 d of age, found differences, with a tendency to present a higher percentage of abdominal fat (5.81%) at a dose of 450 mg·kg^{-1}.

FIG. 4 shows that there was not significant statistical difference when comparing the different treatments in their respective variables; these results are similar to those found by Campozano–Marcillo *et al.* [14], regarding breast and thigh–leg, considering that they used Bacitracin Zinc as APC. Regarding the other study variables, no current information was found for discussion.

FIG. 5 shows that there is no significant statistical difference between treatments with respect to viscera, these results in the liver

TABLE I
Averages obtained with the sacrifice of the birds at the end of the experiment

Variables	T1	T2	T3	T4	T5	T6	CL	Sig.
Ant. weight (Kg)	2.32	2.39	2.33	2.35	2.22	2.27	0.13	NS
Yield (%)	81.80	82.72	81.25	81.00	82.77	81.46	1.58	
Blood (%)	3.64	4.13	4.13	4.27	3.92	3.41	0.77	
Feathers (%)	3.79	3.73	3.76	3.52	3.95	3.69	0.62	
Viscera (%)	14.79	13.88	15.13	15.05	13.69	15.81	1.59	
Abd. Fat. (mm)	1.68	1.24	2.56	1.88	1.91	1.87	0.70	

Variables: Ant.weight (Kg), Antemortem weight; Yield (%), representation of the carcass yield; all expressed in percentage with respect to the antemortem weight; Abd. Fat.(mm): Abdominal fat. Treatments: T1 feed with APC; T2, T3, T4, T5 feed with 0.25, 0.50, 0.75 and 1.00 % of *Plectranthus amboinicus* respectively and T6 feed without APC or *P. amboinicus*. CL: Confidence limit. Sig. NS o *: statistically significant difference (*P*–value<0.05).

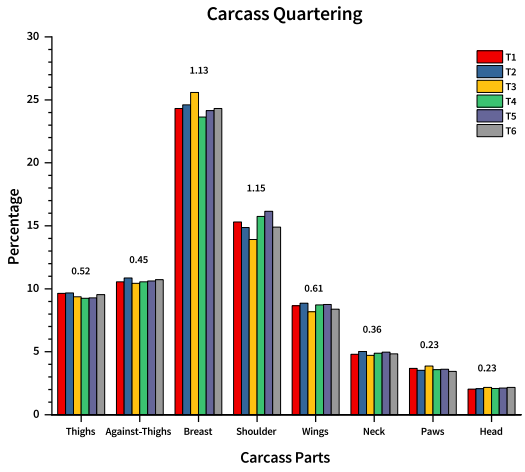

FIGURE 4. Comparison of carcass parts expressed in percentage and their confidential limits

percentage are similar to those found by Languido *et al.* [17], in Bounty Fresh chickens, who in their experiment "Performance of Bounty Fresh Broiler Chicken Fed Diet Supplemented with Oregano (*Plectranthus amboinicus* L.) Leaf Meal", where they included *P. amboinicus* leaf meal in the diet in different percentages did not show any effect, although they differed from the findings of Sandra *et al.* [16], who found lower percentages in the treatments with 350 and 450 mg·kg^{-1} of Oregano extract, these same authors did not report statistical differences in the data of heart, gizzard and intestinos. For the spleen and gizzard fat variables, no information was found to contrast the results.

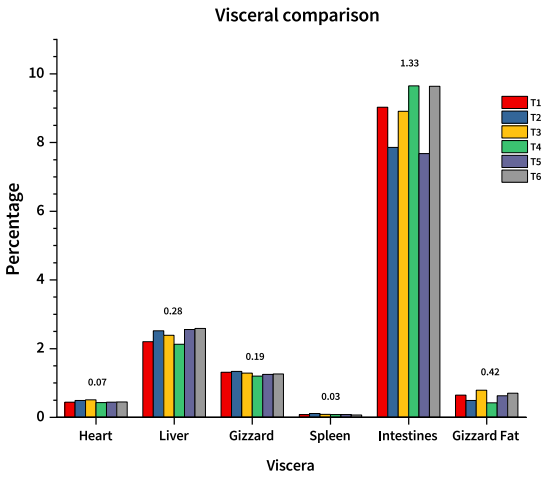

FIGURE 5. Comparison of viscera expressed in percentage and their confidential limits

CONCLUSIONS

The use of *P. amboinicus* as an alternative to replace GPA as growth promoters in broilers feed had no effect on the evaluated slaughter, carcass and visceral variables, due to the aforementioned and according to the results of this experiment, it could work with doses of 0.25% or more of inclusion of the dehydrated product in the animal's diet.

Despite of being a pure phytobiotic (ground dehydrated leaf), *P. amboinicus* does not have a detrimental effect on the proportions or percentages of red and white viscera, which confirms its safety margin and its potential use in feed for the safety of broilers.

The results obtained suggest that *P. amboinicus* can be used without impacting the final product (poultry protein).

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Conflict of interest

The authors declare no conflict of interest.

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