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Use of *Plectranthus amboinicus* in chickens and its effect on productive and economic parameters

Uso de *Plectranthus amboinicus* en pollos y su efecto en parámetros productivos y económicos

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ABSTRACT

This research was carried out at the Santa Inés Farm of the Faculty of Agricultural Sciences of the Universidad Técnica de Machala, El Oro Province, Ecuador. The aim was to evaluate the effect of *Plectranthus amboinicus*, commonly called oreganon, on the productive and economic parameters of Cobb 500 broilers. For the well-being of the birds, the management established for open house systems in the area was used. A Completely randomized design was applied, where 6 treatments were used, each with 4 Experimental Units of 10 birds, for a total of 240 chickens evaluated. The treatments arrangement was: T1 or control which was based on a commercial type basal diet, while, to the balanced diets of treatments T2, T3, T4 and T5, the dehydrated-ground leaf of *P. amboinicus* was added at 0.25, 0.50, 0.75 and 1.00%, respectively, in replacement of the Growth Promoter Antibiotic (GPA); the T6 or blank, which did not contain GPA and dehydrated *P. amboinicus* in the balanced mixture. The variables evaluated were live weight gain (LWG), feed consumption (FC), accumulated water consumption (AWC), feed conversion ratio (FCR), mortality (M), productive efficiency factor (PEF), kg of standing meat per m^2, economic expenses and cost per kg of standing meat. For all the variables, an ANOVA was used, previous assumptions of normality and homogeneity, and to discriminate between the means, 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. The results showed that oreganón could works as a replacement alternative to the GPA in broilers, without harming the productive and economic parameters.

Key words: Broilers; productive parameters; economic parameters; *Plectranthus amboinicus*

RESUMEN

Esta investigación se realizó en la Finca Santa Inés de la Facultad de Ciencias Agropecuarias de la Universidad Técnica de Machala, provincia de El Oro, Ecuador. El objetivo fue evaluar el efecto de *Plectranthus amboinicus*, comúnmente llamado oreganón, sobre los parámetros productivos y económicos de pollos de engorde Cobb 500. Para el bienestar de las aves se utilizó el manejo establecido para sistemas de casa abierta en la zona. Se aplicó un Diseño Completamente al Azar, donde se utilizaron 6 tratamientos, cada uno con 4 Unidades Experimentales de 10 aves, para un total de 240 pollos evaluados. El arreglo de tratamientos fue: T1 o testigo el cual se basó en una dieta basal tipo comercial, mientras que, a las dietas balanceadas de los tratamientos T2, T3, T4 y T5, fue adicionada la hoja deshidratada-molida de *P. amboinicus* al 0,25; 0,50; 0,75 y 1.00 %, respectivamente, en reemplazo del Antibiótico Promotor de Crecimiento (APC); el T6 o blanco, que no contenía en la mezcla balanceada APC y *P. amboinicus* deshidratado. Las variables evaluadas fueron: ganancia de peso vivo (GPV), consumo de alimento (CA), consumo de agua acumulado (CAA), índice de conversión alimenticia (ICA), mortalidad (M), factor de eficiencia productiva (FEP), kg de carne en pie por m^2, gastos económicos y costo por kg de carne en pie. Para todas las variables se utilizó un ANOVA, previos supuestos de normalidad y homogeneidad, y para discriminar entre las medias se utilizó el procedimiento de diferencia significativa honesta (HSD) de Tukey, con un nivel de confianza del 95 %. Todos los datos fueron analizados utilizando el procedimiento PROC GLM (General Linear Model) del paquete estadístico SAS. Los resultados mostraron que oreganón podría funcionar como una alternativa de reemplazo del APC en pollos de engorde, sin perjudicar los parámetros productivos y económicos.

Palabras clave: Pollos de engorde; parámetros productivos; parámetros económicos; *Plectranthus amboinicus*

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INTRODUCTION

Currently, the demand for animal protein continues to increase, being directly proportional to the growth of the population, this is explained by the demands of the market, which finally is what makes the difference, showing an increasingly demand in quality and safety of the products. This last factor faces some challenges, which encourages the transformation of the productive matrix, especially in the poultry industry, which under pressure from the Goverment, has seen the need to improve management and genetics, make optimal use of resources and in more extreme cases, remove chemicals that were traditionally used in the feed consumed by animals, added to the growing practice of sustainable and sustainable production [1]

In Ecuador, the poultry industry, has been one of the main bases of food production of animal origin, and it growing, even though the pandemic directly affected consumers and producers' income [2]. On the other hand, the growing trend of using alternative management on farms has generated satisfactory results, as it does not remain in the past, and regarding to food, research has demonstrated the possibility of producing food free of artificial chemicals, as well as ecological, and with potential in the broiler industry [3].

The prohibition of the use of Antibiotics as Growth Promoters (AGP) in the European Union caused a change in the productive structure, the challenge was to produce protein of animal origin in the same quantity and quality, free of these chemicals, which encouraged research on the topic, but the controversy broke out, with the appearance of superbugs, which, in the other hand, was an inevitable consequence of banning of therapeutic or subtherapeutic use of AGP [4].

With this restriction on the use of AGP, researchers started to evaluate alternative replacements, including those of natural origin, such as the use of medicinal plants, like *Plectranthus amboinicus*, also known as oreganón, which has similar properties to those of the common oregano (*Origanum vulgare*), although it is a perennial herbaceous plant, robust, with fleshy and very fragrant leaves, easy to propagate and produce and with characteristics that allow it to be used in the culinary art, as well as, in the medicinal area, showing in the latter outstanding results [5].

The aim of this research was to evaluate the effect of *P. amboinicus* on the productive and economic parameters of Cobb 500 broilers**.**

MATERIALS AND METHODS

Research location

The research was carried out at the "Santa Inés" farm of the Faculty of Agricultural Sciences belonging to the Universidad Técnica de Machala, Coastal Region of Ecuador, at kilometer 5 ½ via Machala–Pasaje; Its geographic coordinates are: Longitude 79°54'05", Latitude 3°17'16", altitude 5 meter above sea levels (FIGS. 1 and 2).

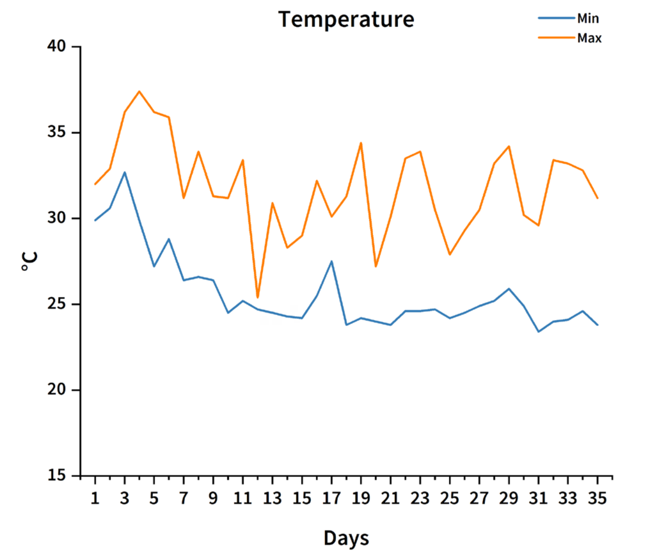

FIGURE 1. Temperature recording (7:30 a.m.) during the experiment, maximum (orange color) and minimum (blue color), using a digital thermohygrometer brand: LWH model: HTC–2 "China"

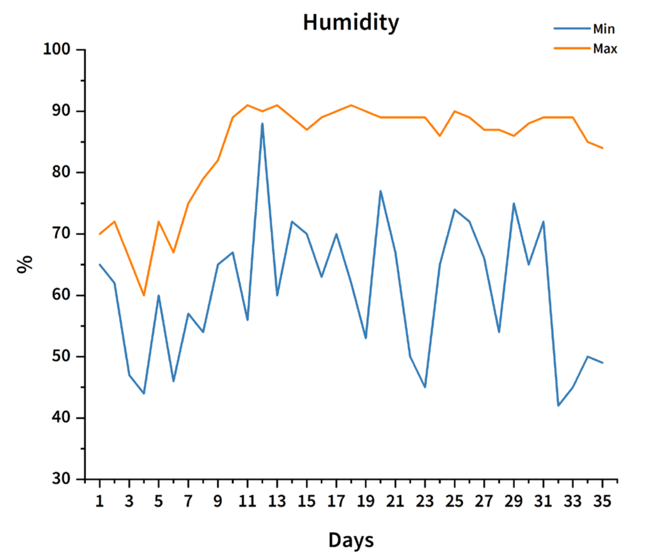

FIGURE 2. Humidity record (7:30 a.m.) during the experiment, maximum (orange color) and minimum (blue color), using a digital thermo–hygrometer brand: LWH model: HTC–2 "China"

House characteristics and bird management

Throughout the experiment, the birds were managed as described by Agrocalidad [6] and González–Eras *et al.* [7] with the difference that, the warehouse were adapted to house 240 broilers (galvanized mesh cage, Protmec brand, MESH 3 model "Ecuador"; plastic drinkers with a capacity of 4.0 liters, code AP–0570, and plastic feeders with a capacity of 4.5 kg, code AP–0590, manufacturer Chempro "China"), with an average weight of 46 g upon receipt, placing a total of 10 birds·m^2 o Experimental United (EU). For those in which the weight was recorded, a CAMRY brand electronic scale (model EK9332-F302 "China") with a maximum capacity of 5 kg and a margin of error of ±1 gram was used.

Formulation of the feed diet

To prepare the balanced formulas, the Excel Solver tool was used, following the same procedure described by González–Eras *et al.* [7], formulating 3 diets in every treatment, adjusting the nutrient concentration according to the bird's requirements in each growing phase (TABLE I):

TABLE I
Ingredients Diets (%) *

Ingredients	Starting						Growth						Finishing					
	T1	T2	T3	T4	T5	T6	T1	T2	T3	T4	T5	T6	T1	T2	T3	T4	T5	T6
L–lysine monohydrochloride	0.30	0.30	0.30	0.30	0.32	0.30	0.23	0.23	0.23	0.23	0.39	0.24	0.20	0.20	0.20	0.19	0.19	0.20
DL–methionine	0.39	0.39	0.39	0.39	0.40	0.39	0.34	0.34	0.34	0.34	0.36	0.34	0.29	0.29	0.29	0.29	0.29	0.29
L–threonine	0.11	0.11	0.11	0.11	0.11	0.11	0.08	0.08	0.08	0.08	0.09	0.08	0.06	0.06	0.06	0.06	0.06	0.06
Soybean	38.55	38.60	38.70	38.78	38.78	38.51	35.13	35.19	35.29	35.36	34.96	35.10	31.59	31.64	31.74	31.84	31.84	31.56
Corn	49.80	49.49	48.97	48.47	48.03	50.01	55.45	55.13	54.59	54.13	54.18	55.66	57.41	57.09	56.56	56.02	55.97	57.61
Soybean oil	6.40	6.50	6.68	6.85	7.00	6.32	4.53	4.64	4.83	5.00	5.00	4.45	5.48	5.60	5.79	5.98	6.00	5.41
Robavio Max Advanced[1]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
MIKRO–MIX broilers	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Iodized salt	0.37	0.37	0.37	0.37	0.37	0.37	0.32	0.32	0.32	0.32	0.32	0.32	0.29	0.29	0.29	0.29	0.29	0.29
Calcium carbonate	1.10	1.10	1.10	1.10	1.09	1.11	1.32	1.32	1.31	1,28	1.18	1.32	1.10	1.10	1.09	1.09	0.87	1.10
Dicalcium phosphate	1.58	1.58	1.58	1.58	1.60	1.58	1.20	1.20	1.20	1.21	1.22	1.19	1.18	1.18	1.18	1.19	1.19	1.18
Zinc bacitrazine 15%	0.05						0.05						0.05					
LERBEK®[2]	0.05						0.05						0.05					
Dehydrated *P. amboinicus*		0.25	0.50	0.75	1.00			0.25	0.5	0.75	1.00			0.25	0.50	0.75	1.00	
Zeolite	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00

*Formulas designed by lead author
[1]Enzyme preparation of endo–1,4–xylanase, endo –1,3(4)–β–Glucanase, 6–phytase enzyme.
[2]Coccidiostat: Clopidol 20% + methylbenzoquate 1.67%

Starting: Nutritional values provided for all diets: 2860.00 Kcal·kg^{-1} ME; 212.00 CP; 33.20 CF; 9.80 Ca; 6.60 P; 1.90 Na; 2.95 Cl; 13.80 Lys; 10.20 Met + Cys y 9.00 Thr; all expressed in g·kg^{-1}

Growth: Nutritional values provided for all diets: 2990.00 Kcal·kg^{-1} ME; 200.00 CP; 32.37 CF; 9.50 Ca; 5.80 P; 1.70 Na; 2.50 Cl; 12.50 Lys; 9.50 Met + Cys y 8.30 Thr; all expressed in g·kg^{-1}

Finishing: Nutritional values provided for all diets: 3050.00 Kcal·kg^{-1} ME; 185.00 CP; 30.70 CF; 8.50 Ca; 5.60 P; 1.60 Na; 2.28 Cl; 11.30 Lys; 8.60 Met + Cys y 7.50 Thr; all expressed in g·kg^{-1}

Starting diet: fed from day 0 to 21. Growth diet: fed from day 22 to 28. Finishing diet: fed from day 29 onwards. At all times, it was guaranteed that the treatments received isoproteic and isoenergetic formulations depending on their phase.

Preparation and dehydration of *P. amboinicus* leaves

For the elaboration of this natural additive, fresh leaves without petiole of 52 days old plants were harvested according to the recommendation of Ayala *et al.* [8], were weighed using a CAMRY brand electronic scale (model EK9332–F302 "China"), washed, drained and then placed in the trays of the food dehydrator ("Ronco®" EZ–Store 5 trays, USA), at a temperature of 62°C., for 24 h, obtaining a 5.60% (with 0.11 SD) of partially dry matter (PDM), samples were removed and allowed to stabilize for 48 h in the environment, in a sealed container, after this time it was subjected to two grindings and packed in oxygen–free sealed bags (FIG. 3).

Evaluated variables

All were quantitative and those of weight expressed in kg.

Live weight gain

These data were obtained from the difference between the weekly live weight and the arrival weight of the baby chicks, up to day 35 (Week 5), registering a total of approximately 1200 data (6 "T" Treatments × 4 EU × 10 Chickens "C" × 5 weeks "w").

FIGURE 3. Distribution of *Plectranthus amboinicus* leaves on the trays of the turbo food dehydrator

Cumulative feed intake

Data was recorded weekly, a total of 120 data (6T × 4EU × 5w) were generated.

Accumulated water consumption

All the water consumption during every week was measured and summarized to obtain the corresponding data, thereby generating 120 data (6T × 4EU × 5w).

Feed conversion

This data was recorded weekly, obtaining 120 data (6T × 4EU × 5w).

Mortality

For this data, the number of deceased birds during the entire investigation was recorded, it was expressed as a percentage.

Productive efficiency factor (PEF)

This data was obtained at the end of the production of the animals, this allows the flock to be qualified, the larger it is, the better its productivity. To obtain it the following formula was applied:

$$PEF = \left(\frac{viability\ "\%" \times final\ weight\ "kg"}{FCR \times age\ "days"} \right) \times 100$$

Kg of standing meat per m²

This data was obtained by adding the final live weight of the birds that were in the EU, expressed in kg and in a square meter of space.

Economic expenses

To obtain this data, the reference for the experiment, the sum of all the material and equipment expenses was made, and finally the cost of feed consumed by the birds in each one of the EU. To obtain it, the following formula was applied:

$$Expenses \big/ _{EU} = \sum material\ and\ equipment\ cost\ per\ EU + cost\ od\ feed\ consumed$$

Cost per kg of live meat

This data was the result of the difference between the handling cost (without taking into account the equipment of the pens), and the kg of live weight obtained per m², it is expressed in US Dollars and it is obtained with the following formula:

$$Expenses \big/ _{kg} = \frac{EU\ maintenance\ cost\ "USD \cdot m^2"}{total\ live\ weight\ "kg \cdot m^2"}$$

Experimental design

A completely randomized design (CRD) was applied, where 6 treatments were used, each with 4 EU of 10 birds, for a total of 240 chickens evaluated (FIG. 4). The T1 or control was a basal diet with AGP (Bacitrazine zinc 15%) and coccidiostat (LERBEK® "Clopidol 20% + Methylbenzoquate 1.67%"), while, to the balanced diets of treatments T2, T3, T4 and T5, the dehydrated–ground leaf of *P. amboinicus* was added at 0.25; 0.50; 0.75 and 1.00%, respectively, in replacement of the Growth Promoter Antibiotic (GPA); the T6 or blank, which did not contain GPA and dehydrated *P. amboinicus* in the balanced mixture (TABLE I).

FIGURE 4. Distribution of the 6 treatments, randomly, in each replicate

Statistical analysis

An ANOVA was used to analyzed the data obtained, previous assumptions of normality and homogeneity, and to discriminate between the means, 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 [9].

RESULTS AND DISCUSSION

Productive variables

Live weight gain (kg)

TABLE II shows the results obtained weekly on the average weight gain for every treatment, recorded throughout the investigation (week, day 35: T1: 2.24, T2: 2.21, T3: 2.26, T4: 2.21, T5: 2.15 and T6: 2.19), no significant effects were detected among treatments. These results are similar to those found by Hosseinzadeh *et al.* [10], in broilers of the Ross 308 line, who evaluated the effect of "*Plectranthus amboinicus* and rosemary (*Rosmarinus officinalis* L.) essential oils, on performance, antioxidant activity, intestinal health, immune response, and plasma biochemistry", where they used essential oil of *P. amboinicus* (100 mg·kg^{-1} of food and 200 mg·kg^{-1} of food) and *R. officinalis* (100 mg·kg^{-1} of food), not finding significant differences in the study variable, contrasting the groups (*P. amboinicus* "100 mg": 2.51, *P. amboinicus* "200 mg": 2.37 y *R. officinalis* "100 mg": 2.35) with those who received a normal basal diet (control: 2.33), said experiment lasted 42 d. They differ from the findings made by Languido *et al.* [11], in Bounty Fresh chickens, in their experiment "Performance of Bounty Fresh Broiler Chicken Fed Diet supplemented with Oregano (*P. amboinicus* L.) Leaf Meal", who reported that the diet containing 6% *P. amboinicus* (1.96), at week 7, presented the best weight gain when compared to the other treatments (control: 1.74, 3% *P. amboinicus*: 1.85 and 9% *P. amboinicus*: 1.82), which showed a significant difference, demonstrating in this study that all the diets that included oreganon differ from the control, pointing out that they use a higher percentage from *P. amboinicus*.

Cumulative feed intake (kg)

When contrasting the average data obtained across all treatments showed in TABLE III, were not observed statistical differences week by week, nor at the end of the experiment, the treatment that presents

TABLE II
Weekly live weight gain expressed in kg, obtained by discounting the live weight of the baby chick at the time of its reception

Week	T1	T2	T3	T4	T5	T6	CL	Sig.
1	0.14	0.13	0.14	0.14	0.13	0.13	0.01	
2	0.45	0.45	0.43	0.45	0.43	0.45	0.02	
3	0.95	0.96	0.96	0.97	0.94	0.96	0.04	NS
4	1.71	1.64	1.74	1.64	1.59	1.69	0.16	
5	2.24	2.21	2.26	2.21	2.15	2.19	0.13	

Week 1, 2, 3, 4, 5: Weeks of the experiment. Treatments: T1 feed with APC; T2, T3, T4, T5 feed with 0.25, 0.50, 0.75 and 1.00% of *P. amboinicus* respectively and T6 feed without APC or *P. amboinicus*. CL: Confidence limit. Sig. NS o *: statistically significant difference (P< 0.05)

the lowest feed intake was the one containing 1% oreganon (3.00) compared to the Treatment containing the GPA (3.07). Similar results were found by Hosseinzadeh *et al.* [10], on their findings (Control: 4.06, *P. amboinicus* "100 mg": 4.25, *P. amboinicus* "200 mg": 4.18 y *R. officinalis* "100 mg": 4.16) and by Chiriboga Chuchuca *et al.* [5], who in their research, where they experimented with the addition of vinegar (Acetic acid) and infusion of 10% oreganon to the drinking water (T1 "vinegar": 2.52, T2 "vinegar + infusion of 10% *P. amboinicus*": 2.39, T3 "infusion of 10% *P. amboinicus*": 2.60 and T4 "control": 2.40), they found no relevant differences in the feed intake. However those differed from the research carried out by Languido *et al.* [11], in which the treatments that received 3% (4.65) and 6% (4.75) inclusion of *P. amboinicus* in the feed showed differences when compared with the control (4.54), the interesting fact in this research is that 9% (4.51) did not present it.

TABLE III
Average weekly cumulative feed consumption expressed in kg/week

Week	T1	T2	T3	T4	T5	T6	CL	Sig.
1	1.51	1.58	1.54	1.56	1.47	1.53	0.08	
2	5.13	5.28	5.13	5.21	4.92	5.13	0.25	
3	11.41	11.74	11.79	11.87	10.88	11.55	0.61	NS
4	19.40	20.56	20.60	20.39	19.31	20.01	1.48	
5	30.71	31.31	31.42	30.79	30.03	30.42	2.40	

Week 1, 2, 3, 4, 5: Weeks of the experiment. Treatments: T1 feed with APC; T2, T3, T4, T5 feed with 0.25, 0.50, 0.75 and 1.00% of *P. amboinicus* respectively and T6 feed without APC or *P. amboinicus*. CL: Confidence limit. Sig. NS o *: statistically significant difference (P< 0.05)

Accumulated water consumption

TABLA IV shows the accumulated water consumption. No significant differences were observed among treatments, however, the treatment that carries GPA (83.52 kg) in week 5, presents the lower consumption, for the discussion of this variable, no investigations were found that measure it.

Feed conversion ratio (FCR)

TABLE V shows that there is no significant statistical difference in the variable analyzed, although in the first week it should be noted that Treatment 1 showed the highest conversion, but with the passage of time this difference disappeared, as such, results similar to those found by Languido *et al.* [11], and by Sanchez *et al.* [12] who in their research included different percentages of *P. amboinicus* in the feed (0.25, 0.50, 0.75) in 49-day-old fattening pigs (F1. crosses Topic Landrace + Pietrain), being evaluated for 8 weeks, without finding significance in this variable.

TABLE IV
Average weekly accumulated water consumption expressed in kg

Week	T1	T2	T3	T4	T5	T6	CL	Sig.
1	3.82	4.17	4.12	4.20	4.20	4.09	0.29	
2	12.12	12.49	12.38	12.86	12.59	12.99	0.56	
3	27.21	27.59	27.72	28.76	27.89	28.15	0.99	NS
4	50.56	51.44	51.51	53.18	52.07	51.94	2.00	
5	83.52	86.54	86.10	88.39	87.76	86.59	4.42	

Week 1, 2, 3, 4, 5: Weeks of the experiment. Treatments: T1 feed with APC; T2, T3, T4, T5 feed with 0.25, 0.50, 0.75 and 1.00% of *P. amboinicus* respectively and T6 feed without APC or *P. amboinicus*. CL: Confidence limit. Sig. NS o *: statistically significant difference (P< 0.05)

TABLE V
Average weekly feed conversion ratio

Week	T1	T2	T3	T4	T5	T6	CL	Sig.
1	0.83	0.90*	0.85	0.84	0.86	0.85	0.03	*
2	1.05	1.07	1.07	1.04	1.03	1.05	0.04	
3	1.15	1.17	1.17	1.17	1.11	1.15	0.03	NS
4	1.13	1.22	1.16	1.21	1.18	1.16	0.08	
5	1.34	1.39	1.36	1.37	1.37	1.40	0.08	

Week 1, 2, 3, 4, 5: Weeks of the experiment. Treatments: T1 feed with APC; T2, T3, T4, T5 feed with 0.25, 0.50, 0.75 and 1.00% of *P. amboinicus* respectively and T6 feed without APC or *P. amboinicus*. CL: Confidence limit. Sig. NS o *: statistically significant difference (P< 0.05)

Mortality

Although no mortality was recorded in the treatments that received 0.25 and 1.00% of *P. amboinicus*, there was no significant difference despite the fact that those that carried AGP and T6 (free of GPA and oreganon) obtained 5% mortality, although, the difference in mortality presented by the treatments that use oreganon is notorious (FIG. 5). Similar findings are shown by Sanchez *et al.* [12] who did not register mortality for which they did not report significant differences in this variable.

Productive efficiency factor

It can be seen that in FIG. 6, there are no significant differences with respect to the PEF obtained in each treatment; however, mathematically, it can be noted that the treatment with 0.50% oreganon (471.6) presents the best result, clarifying that all the treatments were excellent, higher than the standard of 300 according to what was shown by Itzá [13], in his article "Parámetros productivos en la avicultura" (FIG. 6).

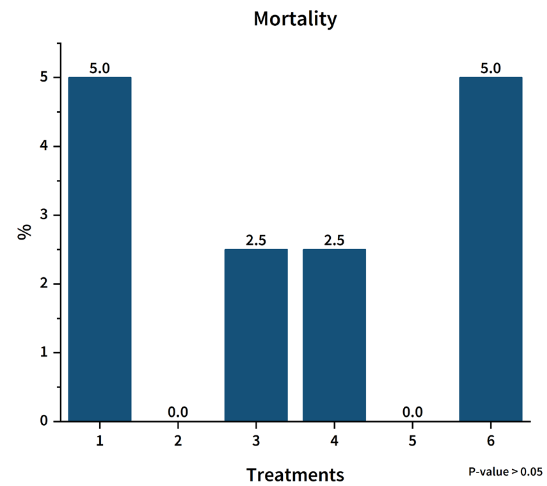

FIGURE 5. Final mortality recorded by treatment

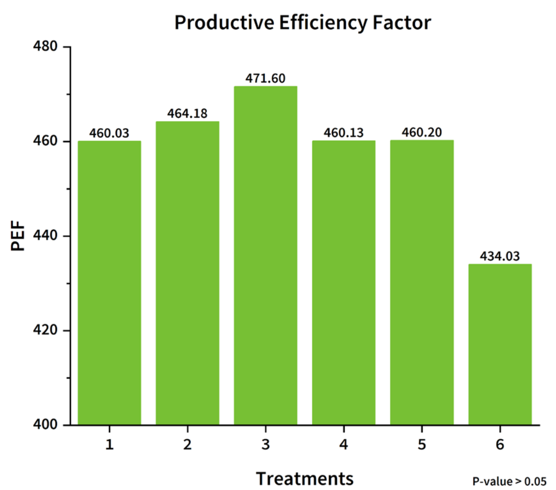

FIGURE 6. Results of the PEF by treatments

Kilograms of standing meat per m²

FIG. 7 shows the total amount of kilograms of standing meat without discounting the initial weight of the baby chick, obtained in each treatment, expressed per square meter, in which no statistical differences are recorded, but it can be observed that, the groups that contain oreganon in the feed, recorded the best data at the end of the experiment on d 35, indicating that all of them are good, since they exceed what was reported by Yucailla *et al.* [14], who in their article "Evaluación de parámetros productivos de pollos Broilers Coob 500 y Ross 308 en la Amazonía de Ecuador", obtain for the Cobb 500 line about 19.97 kg of meat per square meter and being evaluated for 49 d

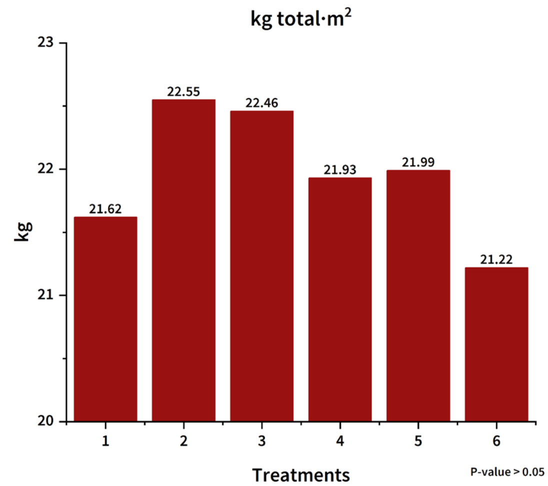

FIGURE 7. Kilograms of live weight obtained at the end of the experiment per m²

Economic Variables

Economic expenses

FIG. 8 shows the average cost reported by each experimental unit in the research, taking into account animals, inputs, materials and equipment, there was no statistically significant difference, although, the treatment that carries GPA (USD 91.1) resulted be the most expensive.

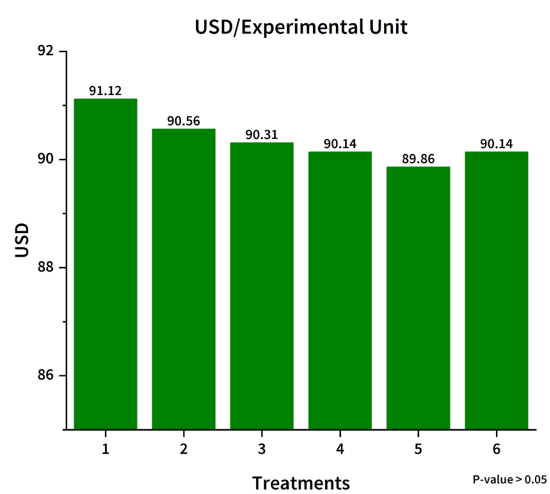

FIGURE 8. Cost data expressed in US Dollars obtained by the Experimental Unit according to treatments

Cost per kg of live meat

FIG. 9, recorded the average result of the cost of 1 kg of live chicken, there was no significant difference, although the treatments that use *P. amboinicus* stand out, being the most economical, which would result in a better economic margin at the time of product sale.

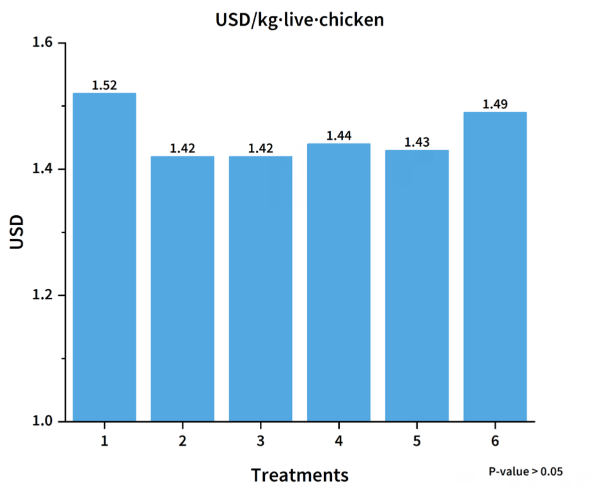

FIGURE 9. Cost in US Dollars to produce one kg of live chicken meat according to treatment

CONCLUSIONS

The inclusion of *P. amboinicus* leaf meal does not have a detrimental neither harmful nor beneficial on the productive parameters and is even beneficial, because it does not affect the economic parameters. However, the use of oreganon showed better results, although not statistically significant in the variables mortality, kg of standing meat per m^2, economic expenses and cost per kg of live meat.

The most notorious thing is that according to the results obtained, doses of 0.25 to 1.00% work as an alternative to GPA replacement, this is interesting, since it is possible to work with low doses compared to other published reports.

The result obtained in the group of animals that did not receive GPA or oreganon is interesting, since it shows that acceptable results can be obtained in normal breeding.

The results open up the possibility of transferring the research to a larger number of animals and observing the effects on a large scale.

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Conflict of interest

There is no conflict of interest between the authors.

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