OPEN ACCESS
Journal of Animal Health and Production

Research Article

Oregano (*Origanum vulgare* L.) Powder as a Phytobiotic Alternative to Antibiotics for Optimizing Broiler Growth, Cell-mediated Immunity, Carcass Yield, and Economic Traits

Nathalie Jean D. Batiancila[1], Keiven Mark B. Ampode[2*]

[1]College of Agriculture, Sultan Kudarat State University – Lutayan Campus, 9803, Philippines; [2]College of Agriculture, Forestry and Environmental Sciences, Western Philippines University, 5302 Palawan, Philippines.

Both authors contributed equally to this work and share first authorship.

Abstract | The overuse of antibiotics in poultry as a growth promoter has led to drug residues in meat and eggs, posing health risks such as allergies and antibiotic resistance. This has prompted bans in many countries and a shift toward phytobiotics as safer, natural alternatives. Hence, this study investigated the potential of oregano (*Origanum vulgare* L.) powder as a phytobiotic to enhance growth performance, cell-mediated immunity, carcass yield, and economic traits in broiler chickens. A total of seventy-five broiler chicks were used in the study, arranged in a completely randomized design experimental set-up with five treatments. Each treatment was replicated three times, with five birds in every replication. The experimental rations containing graded levels of Oregano Powder (OP) (1%, 3%, and synthetic antibiotic) were formulated and fed ad libitum in a 38-day feeding trial, and the treatments were as follows: $T_{1:}$ negative control, $T_{2:}$ homemade ration positive control, $T_{3:}$ homemade ration with 1% OP, $T_{4:}$ homemade ration with 3% OP and $T_{5:}$ homemade ration with synthetic antibiotic. The cumulative result in 11-38 days indicated that broiler chickens fed with OP showed numerical improvements in body mass, body mass gain, average daily gain, feed conversion ratio, and feed intake ($p>0.05$) However, feed intake in 11-24 days is significantly lower ($p<0.05$) in birds with OP in the diet. The cell-mediated immunity had no significant effect ($p>0.05$) in the bursa weight and bursa index, but showed a significant effect ($p<0.05$) on the spleen weight and spleen index. In terms of dressing percentage, no significant effect among the treatment means were observed. In terms of net income, 3% of OP got the highest with 95.72 PhP, and the lowest is the negative control with 73.91 PhP only. In conclusion, oregano powder demonstrates significant potential as a natural and effective alternative to synthetic antibiotics in broiler production, thereby promoting sustainable practices.

Keywords | Phytogenic, Dressing percentage, Net income, Lymphoid organ, Cell-mediated immunity

Received | May 30, 2025; **Accepted** | June 24, 2025; **Published** | February 09, 2026
***Correspondence** | Keiven Mark B. Ampode, College of Agriculture, Forestry and Environmental Sciences, Western Philippines University, 5302 Palawan, Philippines; **Email:** keivenmark.ampode@wpu.edu.ph
Citation | Batiancila NJD, Ampode KMB (2026). Oregano (*Origanum vulgare* L.) powder as a phytobiotic alternative to antibiotics for optimizing broiler growth, cell-mediated immunity, carcass yield, and economic traits. J. Anim. Health Prod. 14(1): 333-338.
DOI | https://dx.doi.org/10.17582/journal.jahp/2026/14.1.333.338
ISSN (Online) | 2308-2801

INTRODUCTION

Chicken meat is increasingly favored worldwide due to its high-quality protein, low fat content, and elevated levels of polyunsaturated fatty acids (PUFAs): Making it a healthier alternative to red meats such as beef and pork (Brenes and Roura, 2010; Ahmed *et al*., 2013; Suiryanrayna and Ramana, 2015). In the Philippines, poultry production remains a vital component of the livestock sector, contributing significantly to food security and the agricultural economy. In 2023, chicken liveweight production was recorded at 1.95 million metric tons (MMT): Reflecting a 4.3% increase from the previous year's output of 1.87 MMT, highlighting steady growth in the sector (Philippine Statistics Authority, 2024). In the same year, the average Filipino consumed about 15.95

kilograms of poultry meat per year, totaling 1.934 MMT in national consumption (OECD-FAO, 2021). This is forecasted to increase by 9.6% to 2.12 MMT by 2025 and further to 2.287 million metric tons by 2030, with per capita consumption expected to reach 16.30 kilograms (OECD-FAO, 2021; IndexMundi, 2025). These trends underscore the growing demand for poultry meat and the need for sustainable and safe production practices.

Historically, antibiotics have been employed in animal production since the 1940s to enhance growth rates and feed efficiency (Castanon, 2007; Al-Khalaifah, 2018). The administration of antibiotics through animal feed, drinking water, or at sub-therapeutic levels has been widely adopted to enhance animal growth performance and productivity (Kumar *et al*., 2018). In poultry and livestock production, antibiotics are commonly utilized to improve growth rates, improve feed conversion efficiency, and prevent disease and treatment of *E. coli* infections, thereby enabling producers to achieve higher meat yields within shorter periods (Mehdi *et al*., 2018; Ghimpeteanu *et al*., 2022; Widodo *et al*., 2022; Ampode, 2024). However, the prolonged use of antibiotics has led to the emergence of antibiotic-resistant bacteria, posing significant public health challenges due to its contribution to the emergence and spread of antimicrobial resistance (AMR) (Tang *et al*., 2017; Kirchhelle, 2018; Nazeer *et al*., 2021; Xu *et al*., 2022).

The World Health Organization (WHO) estimates that bacterial antimicrobial resistance (AMR) was directly responsible for 1.27 million global deaths in 2019 and contributed to 4.95 million deaths. Projections suggest that, without effective interventions, AMR could lead to over 39 million deaths between 2025 and 2050 (WHO, 2025; Institute for Health Metrics and Evaluation, 2024). In response to these concerns, several countries have implemented bans on the use of antibiotic growth promoters (AGPs) in animal feed, including Sweden in 1986, the European Union in 2006, the USA in 2017, and China in 2020 (Grave *et al*., 2006; Thanner *et al*., 2016; Wen *et al*., 2022; EU, 2003). This has spurred research into sustainable alternatives, such as probiotics, enzymes, and phytobiotics, with dietary acidifiers showing potential as substitutes for antibiotics in poultry production (Hume, 2011; Rahman *et al*., 2022).

Phytobiotics, or plant-derived bioactive compounds, are increasingly studied for their potential to enhance poultry health and performance (Ampode and Mendoza, 2022). Among these, phytochemicals and phytogenics are particularly promising due to their immunomodulatory, antimicrobial, and antioxidant properties (El-Sayed *et al*., 2024). Their complex modes of action have prompted ongoing research into their effects on animal health and productivity (Kumar *et al*., 2022). Oregano (*Origanum vulgare* L.) is a notable example, rich in phenolic compounds and essential oils such as thymol and carvacrol, which exhibit strong antimicrobial, antioxidant, and anti-inflammatory activities (Zaazaa *et al*., 2022; Alagawany et al., 2018). Dietary inclusion of oregano in poultry has been associated with improved feed efficiency, digestion, and disease resistance, potentially reducing economic losses. However, its effects on broiler performance as an alternative to antibiotics remain underexplored. Hence, this study investigates the potential of oregano leaf powder as a phytobiotic alternative to synthetic antibiotics to enhance broiler growth, cell-mediated immunity, carcass yield, and economic traits, contributing to more sustainable poultry production systems.

MATERIALS AND METHODS

Experimental birds, design and treatments

The study was conducted in accordance with the standard rearing practices outlined in the Philippine National Standards for Good Animal Husbandry Practices, specifically addressing animal farming, health, and welfare (PNS/BAFPS, 2008). Seventy-five day-old broiler chicks, regardless of sex, were used in the study. The experiment employed a Completely Randomized Design (CRD) with five (5) dietary treatments, with three replicates per treatment and five birds per replicate. The treatments were as follows: T_1: negative control (commercial ration); T_2: Positive control (homemade ration [HMR] without oregano powder [OP] and without synthetic antibiotics [SA]); T_3: HMR with 1% OP; T_4: HMR with 3% OP; and T_5: HMR supplemented with the recommended amount of synthetic antibiotic.

Preparation of brooder pen and cages

All facilities were cleaned and disinfected a week before the arrival of broiler chicks to prevent any potential disease outbreaks. The brooder pen was made of a plastic screen with a dimension of 1m x 2m which was used from day 1 to the 10th day. The commercial disinfectant was used to thoroughly clean and disinfect the pen before the experiment began or as needed. The broiler chicks were moved to experimental cages after the 10th day of the brooding period, with each bird receiving a standard floor space of one square foot per bird (PNS/BAFPS, 2008). The experimental cages were constructed in an elevated colony type made from bamboo and plastic screen with dimensions of 80cm x 100 cm.

Brooding and health management

Broiler chicks were housed in a brooding pen for 10 days with a 50-watt electric bulb as an artificial heat source to maintain body temperature. Chicks were also observed for behavioral indicators of health and stress, such as activity levels, vocalizations, and feeding behavior. Any abnormal behavior prompted immediate environmental adjustments. A commercial feed booster mash was provided *ad libitum* for 10 days, along with clean water. Feeding trays were cleaned regularly to support healthy growth and prevent disease. A commercial disinfectant solution was used to disinfect experimental pens. Proper sanitation and cleanliness were practiced during the study period. To ensure the experimental area was secure from disturbances, appropriate biosecurity precautions, such as erecting fences to keep out unauthorized persons or stray animals, were employed.

Preparation of oregano powder

Oregano leaves were collected from Brgy, Blingkong, Lutayan, Sultan Kudarat. The collected leaves were sun-dried for 5 days before grinding using a mechanical grinder. The powdered leaves were sent to Lipa Quality Control Center Inc., 001 J.P. Laurel, National Highway, Lipa City, Batangas, 4217 for the proximate analysis (AOAC, 2016).

Feed formulation

Proximate analysis was conducted on all feedstuffs, and the resulting data served as the basis for formulating the broiler diets. The nutritional requirements of the broiler chicks were considered in accordance with the Philippine Recommends for Livestock Feed Formulation to ensure a balanced and appropriate nutrient intake throughout the experimental period. The feed formulation process followed a trial-and-error method tailored to the two physiological stages of broiler chickens: The starter phase (20% crude protein [CP]) and the finisher phase (18% CP). The homemade rations were composed of ground yellow corn, rice bran D1, U.S. soybean meal, fish meal, copra meal, dicalcium phosphate, limestone, lysine HCl, DL-methionine, L-tryptophan, vitamin premix, salt, and vegetable oil. The calculated nutrient composition is presented in Table 1.

Feeding and water management

All experimental birds were fed ad libitum throughout the 38-day study period. Diets were administered according to the assigned treatments, which included homemade rations and oregano-supplemented feeds from the starter (11–24 days) to the finisher phase (25–38 days). Each treatment group was provided with a separate feed container to avoid cross-contamination. Feeders were monitored regularly, and once a significant reduction in feed volume was observed, additional feed was added promptly to maintain consistent availability. All feeds provided were weighed accurately to monitor and record feed intake per group, following standard practices in feed intake measurement (NRC, 1994; Leeson, 2007). Fresh, clean drinking water was provided *ad libitum* to all experimental groups. Feed and water containers were cleaned daily to maintain hygiene and minimize the risk of disease outbreaks, in line with proper poultry management protocols (FAO, 2003).

Table 1: Composition and calculated analysis of starter and finisher ration

	Starter 11–24 days	Finisher 25–38 days
Calculated analysis		
Crude Protein, %	20.00	18.00
Metabolizable Energy, Kcal	2848.91	2883.31
Avail P, %	0.49	0.49
Calcium, %	0.87	0.99
Lysine, %	1.35	1.08
Methionine, %	0.45	0.45
Met+Cys, %	0.64	0.67
Tryptophan, %	0.35	0.37
Vit. Premix[1], %	0.80	0.80

[1]Vitamin Premix (fine quality/texture; 500 g contains) dicalcium phosphate 97%, Vit. 150,000 units, Vit. D3 30,000 units, Vit. E 500 I.U., Potassium Iodine 100mg, Carrier q.s. ad 500mg, Manganese Sulfate 3,500mg, Ferrous Sulfate1,500mg, Copper Sulfate 1,500 mg, Cobaltous Sulfate 30mg, Zinc Sulfate 200mg.

Statistical analysis

All collected data were subjected to a one-way Analysis of Variance (ANOVA) using the Statistical Tool for Agricultural Research (STAR). Means with significant differences were further compared using the Tukeys Honest Significant (HSD) test. A p-value of <0.05 is considered significant.

RESULTS AND DISCUSSION

Body weight

The effect of oregano powder (OP) as a phytobiotic alternative to synthetic antibiotics on broiler growth performance is presented in Table 2. Body weight showed no significant differences among treatments throughout the experimental period (11–24 days, 25–38 days, and 11–38 days) ($p > 0.05$). At day 11, all treatment groups had statistically similar body weights, indicating initial uniformity and ensuring that any subsequent variation could be attributed to the dietary interventions. During the early growth phase (11–24 days): birds supplemented with 1% OP (T_3) and 3% OP (T_4) recorded the highest body weights, followed by those in the synthetic antibiotic group (T_5). The negative control (T_1) and the homemade ration without additives (T_2) exhibited slightly lower weights. In the later phase (25–38 days): T_4 maintained the highest body weight, followed by T_3, suggesting that higher OP inclusion may support sustained growth. A similar trend was observed for final with T_4 (1470.40 g) outperforming all other groups, followed by T_3 (1434.93 g): T_1 (1398.33 g): T_5 (1394.67 g): and T_2 (1358.13 g). Although these differences were not statistically significant, the numerical trends suggest that 3% OP supplementation may enhance growth performance comparably or even more effectively than synthetic antibiotics. These findings contrast with previous studies (Barreto *et al*., 2008; Avila-Ramos *et al*., 2012; Kirkpinar *et al*., 2014), which reported no growth-promoting effects of oregano or its essential oil constituents. Similarly, Ri *et al*. (2017) found no significant differences between birds fed antibiotics and those receiving OP; however, a notable improvement in growth was observed in OP-treated birds, particularly during the grower phase. The current results support the potential of OP as a viable alternative to antibiotics in promoting broiler growth.

Body weight gain and average daily gain

Statistical analysis revealed no significant differences in body weight gain (BWG) and average daily gain (ADG) among the treatment groups (P>0.05; Table 2). However, numerical trends suggest a potential benefit of oregano powder (OP) supplementation. Broilers fed 3% OP (T_4) achieved the highest cumulative BWG (1181.47 g) and ADG (84.39 g/day): followed by the 1% OP group (T_3) with 1146.33 g BWG and 81.88 g/day ADG. These gains surpassed those of the control group (T_1: 1109.27 g BWG, 79.23 g/day ADG) and the 0% OP group (T_2: 1068.47 g BWG, 76.32 g/day ADG): which showed the lowest performance. Interestingly, broilers fed synthetic antibiotics (T_5) displayed growth metrics (1105.13 g BWG, 78.94 g/day ADG) comparable to the control but slightly lower than those in the OP-supplemented groups. This suggests that dietary supplementation of OP at 3% inclusion may offer superior physiological benefits compared to synthetic antibiotic growth promoters.

The parallel trends in BWG and ADG across treatments highlight their biological linkage, as ADG provides a daily measure of BWG. These improvements may stem from oregano's bioactive compounds, such as thymol and carvacrol, which enhance digestive enzyme activity, nutrient absorption, and gut health (Zaazaa *et al*., 2022; Giannenas *et al*., 2018). The superior performance of the 3% OP group may also be attributed to oregano's antimicrobial,

Table 2: Growth performance of broilers fed with graded levels of oregano powder as a phytobiotic alternative to synthetic antibiotic.

Parameters	Treatments					P-value	CV
	T_1	T_2	T_3	T_4	T_5		
Body weight, g							
Initial weight	289.07	289.67	288.60	288.93	289.53	0.626 ^{ns}	0.32
11-24, days	869.33	863.20	879.67	878.87	871.87	0.894 ^{ns}	1.60
25-38, days	1398.33	1358.13	1434.93	1470.40	1394.67	0.127^{ns}	3.44
11-38, days	1398.33	1358.13	1434.93	1470.40	1394.67	0.127^{ns}	3.44
Body weight gain, g							
11-24, days	580.27	573.53	591.07	589.33	582.33	0.865^{ns}	1.97
25-38, days	529.00	494.93	555.27	592.13	522.80	0.135^{ns}	7.85
11-38, days	1109.27	1068.47	1146.33	1181.47	1105.13	0.121^{ns}	4.31
Average daily gain, g							
11-24, days	41.45	40.97	42.22	42.10	41.60	0.865^{ns}	1.97
25-38, days	37.79	35.35	39.66	42.30	37.34	0.135^{ns}	7.85
11-38, days	79.23	76.32	81.88	84.39	78.94	0.121^{ns}	4.31
Feed intake, g							
11-24, days	970.60^{ab}	977.47^{ab}	933.00^{b}	934.60^{b}	1010.07^{a}	0.019*	1.26
25-38, days	1030.33	1018.27	1061.80	1066.33	1034.07	0.743^{ns}	4.97
11-38, days	2000.93	1995.73	1994.80	2000.93	2044.13	0.817^{ns}	2.91
Feed conversion ratio							
11-24, days	1.68	1.71	1.58	1.59	1.74	0.069^{ns}	3.95
25-38, days	1.96	2.09	1.91	1.80	1.98	0.523^{ns}	9.87
11-38, days	1.80	1.88	1.74	1.69	1.85	0.184^{ns}	5.30

CV: Coefficient of variation; ^{ab} superscripts within row indicates significant difference at p<0.05; ^{ns}not significant (p>0.05); *means with different superscripts within row is significantly different (P<0.05); T_1: Commercial Ration (Negative Control); T_2: HMR (Homemade Ration) without OP (Oregano Powder) and SA (Synthetic Antibiotic); T_3: HMR + 1% OP; T_4; HMR + 3% OP; T_5; HMR+ SA antioxidant, and anti-inflammatory effects (Ampode and Mendoza, 2022; Al-Kassie, 2010): which likely reduce intestinal pathogen load and oxidative stress, improving energy utilization. As expected in broiler physiology, growth rates were generally higher during the starter phase (11–24 days) than the finisher period (25–38 days): aligning with findings by Ri *et al.* (2017): who noted that early rapid growth is associated with more efficient feed conversion, which diminishes with age.

Feed intake

As shown in Table 2, the feed intake of broiler chickens showed a significant difference during the early growth phase (11–24 days; $p < 0.05$): but no significant differences were observed during the finisher phase (25–38 days) or over the entire period ($p > 0.05$). During the early phase, birds fed the synthetic antibiotic (SA) treatment (T_5) had the highest feed intake (1010.07 g): significantly greater than those receiving 1% OP (T_3, 933.00 g) and 3% OP (T_4, 934.60 g). The negative control group (T_1) and the homemade ration without SA and OP group (T_2) had intermediate values (970.60 g and 977.47 g, respectively). The elevated early feed intake in the SA group may be attributed to improved gut health and reduced pathogenic load, enhancing appetite. However, this increased intake did not translate to improved growth performance or feed efficiency, suggesting possible suboptimal nutrient utilization or digestibility in the antibiotic-fed birds compared to those receiving oregano supplementation.

In contrast, birds supplemented with 1% and 3% oregano powder consumed less feed during the early phase but achieved higher body weight gains and better feed conversion ratios. This indicates more efficient nutrient utilization, likely due to oregano's bioactive compounds, such as carvacrol and thymol, which are known to enhance digestive enzyme activity, improve intestinal morphology, and modulate gut microbiota (Giannenas et al., 2018). The absence of significant differences in feed intake during the later phase and overall trial period suggests that early-phase dietary responses had a lasting impact on broiler growth performance. These findings highlight the importance of early gut development and feed efficiency in shaping long-term productivity (NRC, 1994; Azeem *et al*., 2023; Shani and Ilani, 2024). Overall, the results support the potential of oregano powder as an effective alternative to antibiotics in broiler diets, aligning with current efforts to reduce antibiotic use in poultry production.

Feed conversion ratio

The feed conversion ratio (FCR) was not significantly affected by dietary supplementation of oregano powder (Table 2). Although no significant differences were observed among treatments across all growth phases ($p > 0.05$): The numerical trends offer meaningful insights into feed efficiency associated with the different supplementation strategies. These trends may reflect subtle influences of OP inclusion levels on nutrient utilization and growth dynamics, even in the absence of statistically detectable effects. The lowest cumulative FCR (11–38 days) was recorded in broilers fed 3% oregano powder (T_4 = 1.69): followed closely by those on 1% OP (T_3 = 1.74). These values were better than the control group (T_1 = 1.80) and notably better than the synthetic antibiotic group (T_5 = 1.85) and the homemade ration with no OP (T_2 = 1.88). This trend suggests that oregano powder improved feed efficiency, allowing birds to convert feed more efficiently into body mass. Improved FCR in oregano-supplemented groups is likely due to oregano's bioactive compounds, which exhibit antimicrobial, antioxidant, and anti-inflammatory properties. These compounds can enhance gut health by reducing pathogenic bacteria, improving intestinal morphology, and stimulating digestive enzyme secretion (Giannenas et al., 2018). Enhanced digestive function increases the efficiency of nutrient absorption, which translates into better growth per unit of feed intake.

In contrast, birds fed the synthetic antibiotic-supplemented homemade ration (T_5) had a poorer FCR despite consuming the most feed during the early phase. This indicates that higher feed intake did not produce proportional weight gain, suggesting suboptimal nutrient utilization. Antibiotics primarily function as growth promoters by altering gut microbiota; however, they may lack the multifunctional metabolic support provided by phytogenic additives like oregano (Zampiga and Calini, 2021) The numerically higher FCR in the control group further supports the performance-enhancing effects of dietary supplementation, especially with oregano. The slightly better FCR in 3% OP than 1% OP suggests a dose-dependent effect. However, performance did not improve further at higher OP concentrations in some parameters, indicating an optimal inclusion level of around 3%.

Dressed weight and dressing percentage

The dressed weight of broiler chickens was not significantly affected by dietary supplementation with oregano powder (Table 3; $p > 0.05$). However, numerically, birds fed 3% OP (T_4) recorded the highest dressed weight (1031.00 g): followed by T_2 (1002.33 g): T_1 (961.00 g): T_5 (937.33 g): and T_3 (899.93 g). Although these differences were not statistically significant, the higher dressed weight observed in T_4 suggests a potential positive effect of the 3% OP inclusion on carcass yield. Similarly, the dressing percentage did not differ significantly among treatments ($p>0.05$): but a numerical trend was observed. The highest dressing percentage was recorded in T_4 (72.76%): followed by T_5 (71.80%): T_3 (71.45%): T_1 (70.89%): and the lowest in T_2 (69.72%).

Table 3: Dressed weight (g) and dressing percentage (%) of broilers fed with graded levels of oregano powder as a phytobiotic alternative to synthetic antibiotic

Parameters	Treatments					P-value	CV
	T_1	T_2	T_3	T_4	T_5		
Dressed wt., g	961.00	899.00	1002.30	1031.67	937.33	6.52	0.07[ns]
Dressing percentage, %	70.89	69.72	71.45	72.76	71.80	5.01	0.87 [ns]

ns: not significant; CV: Coefficient of Variance; T_1: Commercial Ration (Negative Control); T_2: HMR (Homemade Ration) without OP (Oregano Powder) and SA (Synthetic Antibiotic); T_3: HMR + 1% OP; T_4; HMR + 3% OP; T_5; HMR+ SA

Table 4: Cell-mediated immunity of broilers fed with graded levels of oregano powder as a phytobiotic alternative to synthetic antibiotic.

Parameters	Treatments					CV	P value
	1	2	3	4	5		
Bursa of Fabricius, g	2.33	1.67	2.67	4.17	2.33	37.66	0.097 [ns]
Bursa Index, %	0.17	0.13	0.19	0.29	0.18	39.76	0.194 [ns]
Spleen Weight, g	1.67[b]	1.33[b]	3.00[a]	3.33[a]	2.50[ab]	28.34	0.020[*]
Spleen Index, %	0.12[b]	0.11[b]	0.21[a]	0.23[a]	0.19[ab]	29.64	0.044[*]

[ab,*] superscripts within row indicates significant difference at p<0.05: T_1: Commercial Ration (Negative Control); T_2: HMR (Homemade Ration) without OP (Oregano Powder) and SA (Synthetic Antibiotic); T_3: HMR + 1% OP; T_4; HMR + 3% OP; T_5; HMR+ SA.

The findings align with those of Haliru *et al.* (2024): who reported no significant differences (p>0.05) in the mean weights of internal and external offal, except for the skull. This suggests that oregano supplementation may have a limited effect on carcass composition. Furthermore, similar conclusions were drawn in previous studies (Botsoglou *et al.*, 2002; Lewis *et al.*, 2003; Demir *et al.*, 2003; Barreto *et al.*, 2008; Marcinčák *et al.*, 2008; Vlaicu *et al.*, 2018): which found that oregano powder or oil had minimal impact on broiler growth performance and carcass yield.

Cell-mediated immunity

In this study, the inclusion of oregano powder (OP) in broiler diets did not result in a statistically significant difference (P>0.05) in the bursa index (Table 4). Numerically, birds in the T4 group (3% OP) showed the highest bursa weight (4.17 g) and bursa index (0.29%): while the lowest values were recorded in T2 (1.67 g and 0.13%, respectively). These results align with findings from Ampode and Mendoza (2022): who similarly reported no significant changes in immune organ indices with OP supplementation. In contrast, both spleen weight and spleen index were significantly influenced (P<0.05) by dietary treatments. The T4 group exhibited the highest spleen index (0.23%): while the T2 group had the lowest (0.11%). This suggests that higher levels of OP (3%) may enhance immune organ development, particularly of the spleen. The enhancement may be attributed to the bioactive compounds in oregano, especially thymol and carvacrol, which are known for their antimicrobial, antioxidant, and immunomodulatory properties (Giannenas *et al.*, 2018; Al-Kassie, 2010).

The bursa of Fabricius is a primary lymphoid organ in birds responsible for the maturation of B-lymphocytes, critical for humoral immunity. Its size and weight are often used as indicators of immunocompetence. Meanwhile, the spleen plays a central role in both innate and adaptive immunity by filtering blood, removing senescent erythrocytes, and facilitating antigen presentation and lymphocyte proliferation (Wang *et al.*, 2023). Therefore, increased spleen index may indicate elevated immune activation or responsiveness. Interestingly, the findings contrast with those of Ri *et al.* (2017): who reported no significant changes in immune organ indices following supplementation with antibiotics or oregano powder. These discrepancies may be due to differences in dosage levels, oregano variety, or experimental conditions.

Net income

The net income refers to the amount gained using the treatment of the study. It shows that the given treatment had a positive or negative impact on profit-gaining 9. Among the five dietary treatments, T_4 with 3% OP had the highest return of Php 95.72, T_3 followed this with Php 90.17; T_5 with Php 80.04; T_2 with Php 77.91, and T_1 with Php 73.9 (Table 5). T_4 (3% oregano powder) had the highest net income of Php 95.72 out of the five dietary treatments, closely followed by T_3 (Php 90.17). This implies that adding oregano powder, especially at 3%, not only promotes the growth of healthy broilers but also improves financial returns. Improved feed conversion, better general health, and possibly a reduced reliance on synthetic antibiotics could all contribute to T_4's strong return on investment and, ultimately, cheaper production costs.

Table 5: Net income and return on investment of broilers fed with graded levels of oregano powder as a phytobiotic alternative to synthetic antibiotic.

Parameters	Treatments				
	T_1	T_2	T_3	T_4	T_5
Final live weight, kg	1398.33	1358.13	1434.40	1470.40	1394.60
Price/kg live weight, PhP	160.00	160.00	160.00	160.00	160.00
Gross return/head, PhP	223.73	217.30	229.50	235.26	223.14
Cost of DOC/head, PhP	38.00	38.00	38.00	38.00	38.00
Feed Consumption, kg/head					
a. CBM, g	0.64	0.64	0.64	0.64	0.64
b. Starter, kg	970.60	977.47	933.00	934.60	1010.07
c. Finisher, kg	1030.33	1018.27	1061.80	1066.33	1034.07
Price/kg of Feed, PhP					
a. CBM, g	49.00	49.00	49.00	49.00	49.00
b. Starter, kg	41.50	35.41	35.41	35.41	35.41
c. Finisher, kg	39.00	34.78	34.78	34.78	34.78
Total Feed Cost, PhP					
a. CBM, g	31.36	31.36	31.36	31.36	31.36
b. Starter, kg	40.28	34.61	33.04	33.04	37.77
c. Finisher, kg	40.18	35.42	36.93	37.09	35.97
Total Cost, PhP	149.82	139.39	139.33	139.54	143.10
Net Income, PhP[1]	73.91	77.91	90.17	95.72	80.04
ROI, %[2]	49.33	59.89	64.72	68.60	55.93

[1]Net Income was computed by adding all the total costs (chick cost, feed cost); [2]ROI: Return on Investment; T_1: Commercial Ration (Negative Control); T_2: HMR (Homemade Ration) without OP (Oregano Powder) and SA (Synthetic Antibiotic); T_3: HMR + 1% OP; T_4; HMR + 3% OP; T_5; HMR+ SA; CBM: Chick Booster Mash

While T_2 and T_1 (control groups) produced returns of Php 77.91 and Php 73.90, respectively, T_5 (with an additional inclusion level of synthetic antibiotic) also demonstrated a positive return of Php 80.04. Even though T_4 produced the largest return, the fact that all treatments produced profitable outcomes shows that oregano powder, in different amounts, may be a good way to increase broiler profitability.

CONCLUSION

Despite the absence of statistical significance, 3% oregano powder (OP) supplementation consistently yielded the most favorable outcomes in growth performance, carcass yield, bursa index, and profitability. Notably, birds supplemented with 3% OP exhibited a stronger cell-mediated immunity, as evidenced by a higher spleen index compared to other treatments. These findings suggest that 3% OP inclusion is a promising phytobiotic alternative to synthetic antibiotics for enhancing broiler productivity, immunity, and economic efficiency. Therefore, incorporating 3% oregano powder in broiler diets is recommended to support antibiotic-free poultry production.

ACKNOWLEDGEMENT

The authors gratefully acknowledge Dr. Ne Velasco and Professor Eva Rea Fame V. Inocente for their invaluable guidance and dedicated efforts in reviewing and correcting the manuscript.

NOVELTY STATEMENT

This investigation offers novel insights into the physiological and economic benefits of oregano powder supplementation in broilers, positioning it as a potential alternative to synthetic antibiotics. While previous studies have examined oregano at varying inclusion levels, the current research focuses on its potential as a substitute for synthetic antibiotics a perspective not thoroughly explored in earlier studies. By directly evaluating its impact on growth performance, immunity, and carcass yield, the study bridges a crucial gap in context-specific nutritional strategies. It contributes to sustainable poultry production by aligning animal health and profitability in light of increasing concerns over antibiotic resistance.

AUTHORS CONTRIBUTION

The authors contributed equally to the conceptualization data gathering, statistical analysis, and manuscript writing and served as co-first authors of this manuscript.

Generative AI and AI-assisted technology statement

The authors declare that AI-assisted tools (Grammarly and ChatGPT) were used solely to improve English language quality and grammar. All outputs were reviewed by the authors. No AI tools were used for data analysis or interpretation.

Conflict of interest

The authors have declared no conflict of interest.

REFERENCES

Ahmed ST, Hossain ME, Kim GM, Hwang JA, Ji H, Yang CJ (2013). Effects of resveratrol and essential oils on growth performance, immunity, digestibility and fecal microbial shedding in challenged piglets. Asian Aust. J. Anim. Sci., 26(5): 683–690. https://doi.org/10.5713/ajas.2012.12683

Alagawany M, Elnesr SS, Farag MR, Tiwari R, Yatoo MI, Karthik K, Michalak I, Dhama K (2021). Nutritional significance of amino acids, vitamins and minerals as nutraceuticals in poultry production and health–a comprehensive review. Vet. Quart., 41(1): 1-29. https://doi.org/10.1080/01652176.2020.1857887

Alagawany M, El-Hack MEA, Farag MR, Shaheen HM, AbdelLatif MA, Noreldin AE, Patra AK (2018). The usefulness of oregano and its derivatives in poultry nutrition. Worlds Poult. Sci. J., 74(3): 463–474. https://doi.org/10.1017/S0043933918000454

Al-Kassie GAM (2010). The effect of thyme and cinnamon on the microbial balance in gastro intestinal tract on broiler chicks. Int. J. Poult. Sci., 9(5): 495-498. https://doi.org/10.3923/ijps.2010.495.498

Al-Khalaifah HS (2018). Benefits of probiotics and/or prebiotics for antibiotic-reduced poultry. Poult. Sci., 97(11): 3807-3815. https://doi.org/10.3382/ps/pey160

Ampode KMB (2024). Oregano leaf meal as phytogenic feed supplements: A potential antibiotic alternative in broiler chicken diets. Adv. Anim. Vet. Sci., 12(7): 1362-1370. https://doi.org/10.17582/journal.aavs/2024/12.7.1362.1370

Ampode KMB, Mendoza FC (2022). Oregano (*Origanum vulgare* Linn.) powder as phytobiotic feed additives improves the growth performance, lymphoid organs, and economic traits in broiler chickens. Adv. Anim. Vet. Sci., 10(2): 434-441. https://doi.org/10.17582/journal.aavs/2022/10.2.434.441

AOAC (2016). Official methods of analysis of the association of official analytical chemists. 20th ed. Washington, D.C., USA.

Avila-Ramos F, Pro-Martınez A, Sosa-Montes E, Cuca-Garcıa JM, Becerril-Perez CM, Figueroa-Velasco JL, Narciso-Gaytan C (2012). Effects of dietary oregano essential oil and vitamin E on the lipid oxidation stability of cooked chicken breast meat. Poult. Sci., 91: 505–511. https://doi.org/10.3382/ps.2011-01731

Azeem N, Madkour M, Hashem N, Alagawany M (2023). Early nutrition as a tool to improve the productive performance of broiler chickens. World's Poult. Sci. J., 80: 171-185. https://doi.org/10.1080/00439339.2023.2262443

Barreto MSR, Menten JFM, Racanicci AMC, Pereira PWZ, Rizzo PV (2008). Plant extracts used as growth promoters in broilers. Rev. Bras. Cienc. Avic., 10: 109115. https://doi.org/10.1590/S1516-635X2008000200006

Botsoglou NA, Florou-Paneri P, Christaki E, Fletouris DJ, Spais AB (2002). Effect of dietary oregano essential oil on performance of chickens and iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. Br. Poult. Sci., 43: 223-230. https://doi.org/10.1080/00071660120121436

Brenes A, Roura E (2010). Essential oils in poultry nutrition: Main effects and modes of action. Anim. Feed Sci. Tech., 158(1): 1–14. https://doi.org/10.1016/j.anifeedsci.2010.03.007

Castanon JIR (2007). History of the use of antibiotic as growth promoters in European poultry feeds. Poult. Sci., 86: 2466–2471. https://doi.org/10.3382/ps.2007-00249

Demir E, Sarica Ş, Özcan MA, Sui Mez M (2003). The use of natural feed additives as alternatives for an antibiotic growth promoter in broiler diets. Br. Poult. Sci., 44(S1): 44-45. https://doi.org/10.1080/713655288

El-Sayed Y, Khalil W, Fayez N, Mohamed Abdel-Fattah AF (2024). Enhancing effect of oregano essential oil and Bacillus subtilis on broiler immune function, intestinal morphology and growth performance. BMC Vet. Res., 20(1): 112. https://doi.org/10.1186/s12917-024-03960-w

European Union (2003). Regulation (EC) No 1831/2003 of the European Parliament and of the Council of 22 September 2003 on additives for use in animal nutrition (Text with EEA relevance) Off. J. Eur. Union, L 268 of 18.10.2003, 29-43.

FAO (2003). Good practices in planning and management of integrated commercial poultry production in South Asia. Food and Agriculture Organization of the United Nations. https://www.fao.org/4/y4991e/y4991e00.pdf

Ghimpețeanu OM, Pogurschi EN, Popa DC, Dragomir N, Drăgotoiu T, Mihai OD, Petcu CD (2022). Antibiotic use in livestock and residues in food. A public health threat: A review. Foods, 11(10): 1430. https://doi.org/10.3390/foods11101430

Giannenas I, Bonos E, Christaki E, Florou-Paneri P (2018). Oregano: A feed additive with functional properties. In: Therapeutic Foods, pp. 179-208. https://doi.org/10.1016/B978-0-12-811517-6.00006-4

Grave K, Jensen VF, Odensvik K, Wierup M, Bangen M (2006). Usage of veterinary therapeutic antimicrobials in Denmark, Norway and Sweden following termination of antimicrobial growth promoter use. Prevent. Vet. Med., 75(1-2): 123-132. https://doi.org/10.1016/j.prevetmed.2006.02.003.

Haliru MI, Garba S, Umar AA, Sirajo G, Omojola AB (2024). Effect of graded levels of oregano powder (Origanum vulgare) on carcass characteristics of broiler chicken meat. J. Agric. Environ., 20(1): 165-173. https://doi.org/10.4314/jagrenv.v20i1.17

Hume ME (2011). Historic perspective: Prebiotics, probiotics, and other alternatives to antibiotics. Poult. Sci., 90(11): 2663-2669. https://doi.org/10.3382/ps.2010-01030

IndexMundi (2025). Philippines chicken meat domestic consumption by year. Retrieved from https://www.indexmundi.com/agriculture/?commodity=chicken-meat&country=ph&graph=domestic-consumption

Institute for Health Metrics and Evaluation (IHME) (2024). Antimicrobial resistance (AMR). Retrieved: https://tinyurl.com/2zbp6pyp.

Kirchhelle C (2018). Pharming animals: A global history of antibiotics in food production (1935–2017). Palgrave Commun., 4(1). https://doi.org/10.1057/s41599-018-0152-2

Kirkpinar F, Unlu HB, Serdaroglu M, Turp GY (2014). Effects of € dietary oregano and garlic essential oils on carcass characteristics, meat composition, colour, pH and sensory quality of broiler meat. Br. Poult. Sci., 55: 157–166. https://doi.org/10.1080/00071668.2013.879980

Kumar A, Patyal A, Panda AK (2018). Sub-therapeutic use of antibiotics in animal feed and their impact on environmental and human health: A comprehensive review. J. Anim. Feed Sci. Technol., 6(15): 25.

Kumar K, Dey A, Rose MK, Dahiya S (2022). Impact of dietary phytogenic composite feed additives on immune response, antioxidant status, methane production, growth performance and nutrient utilization of buffalo (*Bubalus bubalis*) calves. Antioxidants, 11(2): 325. https://doi.org/10.3390/antiox11020325

Leeson S (2007). Vitamin requirements: is there basis for re-evaluating dietary specifications? World's Poult. Sci. J., 63(2): 255-266. https://doi.org/10.1017/S0043933907001444

Lewis MR, Rose SP, Mackenzie AM, Tucker LA (2003). Effects of dietary inclusion of plant extracts on the growth performance of male broiler chickens. British Poultry Science, 44(S1), 43-44. https://doi.org/10.1080/713655281

Marcinčák S, Cabadaj R, Popelka P, Šoltýsová L (2008). Antioxidative effect of oregano supplemented to broilers on oxidative stability of poultry meat. Slov. Vet. Res., 45(2): 61-66.

Mehdi Y, Létourneau-Montminy MP, Gaucher ML, Chorfi Y, Suresh G, Rouissi T, Godbout S (2018). Use of antibiotics in broiler production: Global impacts and alternatives. Anim. Nutr., 4(2): 170-178. https://doi.org/10.1016/j.aninu.2018.03.002

National Research Council (1994). Nutrient requirements of poultry, 9th Ed. NAS-NRC, Washington D.C.

Nazeer N, Uribe-Diaz S, Rodriguez-Lecompte JC, Ahmed M (2021). Antimicrobial peptides as an alternative to relieve antimicrobial growth promoters in poultry. Br. Poult. Sci., 62(5): 672-685. https://doi.org/10.1080/00071668.2021.1919993

OECD-FAO (2021). OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris,

Philippine Statistics Authority (2024). Technical Notes on 2023 Chicken Situation Report. https://psa.gov.ph/content/2023-technical-notes-chicken.

PNS/BAFPS (2008). Code of good animal husbandry practices. Philipp. Natl. Stand. Bureau Agric. Fish. Prod. Stand., 60: 1-14.

Rahman MRT, Fliss I, Biron E (2022). Insights in the development and uses of alternatives to antibiotic growth promoters in poultry and swine production. Antibiotics, 11(6): 766. https://doi.org/10.3390/antibiotics11060766

Ri CS, Jiang XR, Kim MH, Kim MH, Wang J, Zhang HJ, Wu SG, Bontempo V, Qi GH (2017). Effects of dietary oregano powder supplementation on the growth performance, antioxidant status and meat quality of broiler chicks. Ital. J. Anim. Sci., 16(2): 246-252. https://doi.org/10.1080/1828051X.2016.1274243

Shani M, Irani M (2024). Feeding strategy and prebiotic supplementation: Effects on immune responses and gut health in the early life stage of broiler chickens. Res. Vet. Sci., 171: 105226. https://doi.org/10.1016/j.rvsc.2024.105226

Suiryanrayna MVAN, Ramana JV (2015). A review of the effects of dietary organic acids fed to swine. J. Anim. Sci. Biotechnol., 6(1): 45. https://doi.org/10.1186/s40104-015-0042-z

Tang KL, Caffrey, NP, Nóbrega DB, Cork SC, Ronksley PE, Barkema HW, Polacheck AJ, Ganshorm H, Shrma N, Kellner JD, Ghali WA (2017). Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis. Lancet Planetary Health, 1(8): e316-e327. https://doi.org/10.1016/S2542-5196(17)30141-9

Thanner S, Drissner D, Walsh F (2016). Antimicrobial resistance in agriculture. MBio, 7(2): 10-1128. https://doi.org/10.1128/mBio.02227-15

Vlaicu PA, Panaite TD, Olteanu M, Turcu RP, Saracila M, Criste RD (2018). Effect of the dietary oregano (Origanum vulgare L.) powder and oil on the performance, carcass and organs development of broilers reared under heat stress (32° C). Sci. Papers Ser. Anim. Sci., 69: 207–2013.

Wang J, Tang J, Li X, Ning X, Sun C, Zhang N, Zhang S (2023). Curcumin alleviates spleen immunotoxicity induced by decabrominated diphenyl ethers (BDE-209) by improving immune function and inhibiting inflammation and apoptosis in broilers. *Ecotoxicol. Environ. Saf.*, 259: 115048. https://doi.org/10.1016/j.ecoenv.2023.115048

Wen R, Li C, Zhao M, Wang H, Tang, Y (2022). Withdrawal of antibiotic growth promoters in China and its impact on the foodborne pathogen *Campylobacter coli* of swine origin. Front. Microbiol., 13: 1004725. https://doi.org/10.3389/fmicb.2022.1004725

Widodo A, Lamid M, Effendi MH, Khairullah, AR, Riwu KHP, Yustinasari LR, Kurniawan SC, Ansori ANM, Silaen OSM, Dameanti FNAEP (2022). Antibiotic sensitivity profile of multidrug-resistant (MDR) Escherichia coli isolated from dairy cow's milk in Probolinggo, Indonesia. Biodiversit. J. Biol. Diver., 23(10). https://doi.org/10.13057/biodiv/d231002

World Health Organization (WHO) (2025). Global call to action to address antimicrobial resistance (AMR). pp. 1-32. Retrieved: https://tinyurl.com/4decucvm

Xu C, Kong L, Gao H, Cheng X, Wang X (2022). A review of current bacterial resistance to antibiotics in food animals. Front. Microbiol., 13: 822689. https://doi.org/10.3389/fmicb.2022.822689

Zaazaa A, Mudalal S, Alzuheir I, Samara M, Jalboush N, Fayyad A, Petracci M (2022). The impact of thyme and oregano essential oils dietary supplementation on broiler health, growth performance, and prevalence of growth-related breast muscle abnormalities. Animals, 12(21): 3065. https://doi.org/10.3390/ani12213065

Zampiga M, Calini F, Sirri F (2021). Importance of feed efficiency for sustainable intensification of chicken meat production: implications and role for amino acids, feed enzymes and organic trace minerals. World's Poultry Science Journal, 77, 639 - 659. https://doi.org/10.1080/00439339.2021.1959277.