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Effects of Phytogenic Feed Additives on Poultry Growth and Health

Mohsin Raza[1], Umber Rauf[2*], Muhammad Usman[3], Arshad Ali[4], Mehwish Malik[5], Aqsa Khaliq[6], Ray Adil Quddus[7], Zaheer Ahmad[8], Ali Raza[9], Muhammad Irfan[10]

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Mohsin Raza
Department of Poultry Husbandry, Sindh Agriculture University, Tandojam, Sindh, Pakistan
Umber Rauf*
Veterinary Research Institute, Zarar Shaheed Road, Lahore Cantt, Punjab, Pakistan
Email: umberrauf@gmail.com
Muhammad Usman
Department of Poultry Science, University of Agriculture, Faisalabad, Constituent College, Toba Tek Singh, Punjab, Pakistan
Arshad Ali
Livestock and Dairy Development Department, Punjab, Pakistan
Mehwish Malik
Poultry Research Institute, Jabba, Mansehra, KPK, Pakistan
Aqsa Khaliq
Atta Ur Rehman School of Applied Biosciences, National University of Sciences and Technology (NUST), Islamabad, Pakistan
Adil Quddus
Department of Livestock Production and Management, Faculty of Veterinary Sciences, The University of Veterinary and Animal sciences (UVAS), Swat, Khyber Pakhtunkhwa, Pakistan
Zaheer Ahmad
Department of Livestock Production and Management, The University of Veterinary and Animal Sciences (UVAS), Swat, Khyber Pakhtunkhwa, Pakistan
Ali Raza
Doctor of Veterinary Medicine, University of Agriculture, Faisalabad, Punjab, Pakistan
Muhammad Irfan
Department of Microbiology, Government College University, Faisalabad, Punjab, Pakistan

ABSTRACT

The study investigated the effects of graded doses of phytogenic feed additives on growth attributes, immune response, and gut health of broiler chickens. Four dietary treatments were prepared: a control diet not supplemented with additives and three other phytogenic diets, which were added to 300, 600, or 900 mg/kg of a standardized mixture of phytogenic. Growth performance variables such as final body weight, weight gain, feed intake, feed to conversion ratio, and mortality were measured over a 42-d period, and physiological parameters included the H/L ratio of heterophils to lymphocytes (H/L ratio), serum IgG concentration, and intestinal lesion scoring. Results indicated that phytogenic supplementation led to significant enhancement in performance and health compared with the control group. PHY-600 treatment offered the best results with greater final body weight, better FCR, and lower mortality rate. Birds consuming phytogenic also showed lower H/L ratios and higher IgG concentrations, implying less physiological stress and better immune status. Intestinal scores were significantly lower in groups fed phytogenic, especially in the PHY-600 group, and indicated better intestinal integrity. These observations indicate that moderate levels of inclusion of phytogenic can improve broiler performance and health by increasing nutrient digestibility, enhancing immunity, and protecting the gut. In general, phytogenic feed additives offer a natural potential replacement for antibiotic growth promoters in poultry production.

INTRODUCTION:

Phytogenic feed additives have the potential to serve as natural alternatives for antibiotic growth promoters in poultry diets. Increasing regulations and consumer demand for antibiotic-free production have prompted the increase in use of plant-based products, including herbs, spices, and essential ois. Hashemi and Davoodi [1] was the first to point out the potential of phytogenic as multifunctional growth promoters because of their antimicrobial and antioxidant properties. Their bioactive molecules, terpenoids, phenolics, and flavonoids prevent digestive inefficiency, which will enhance performance in birds. It was also reported by Burt [2] that essential oils showed a broad spectrum of antimicrobial activity against pathogenic bacteria and thus have the potential to stabilize gut microflora. These early observations formed the basis for present-day phytogenic research by being fundamental building blocks and reflecting their importance in sustainable poultry production systems.

Further research has contributed to the understanding of how phytogenic feed additives provide a positive contribution to gut health and nutrient absorption. Hall, Shirley [3] demonstrated that certain essential oils improve intestinal morphology (villus height) and secretion of digestive enzymes, which leads to increased feed utilization. Jamroz, Orda [4] also reported that phytogenic additives increase digestive enzyme activities, which in turn improve feed conversion and growth rates of broilers. Karlsson, Kollberg [5] and Raza, Saleemi [6] extended this evidence by revealing that herb extracts are able not only to enhance digestion but also to exhibit natural antioxidant and anti-inflammatory activities in the gastrointestinal tract. Additionally, Ariyadi, Isobe [7] reported improved gut health and immune status of broilers after supplementing with plant products, indicating their immunomodulatory effects. Combined, these studies further support the polyvalent effect of phytogenic as a digestive enhancer, microbial modifier, and immune booster.

The effect of phytogenic additives on gut microflora and gut health has been well established, which further gives authority to use them in poultry diets. Abou-Kassem, Ashour [8] revealed the promoting effect of herbal extracts on beneficial bacteria and inhibition of pathogenic bacteria, leading to good intestinal balance. Forte, Manuali [9] also found a lower severity of intestinal lesions and better performance of thyme essential oil-supplemented broilers challenged with gut disorders. Similarly, DiLorenzo, Smith [10] found beneficial effects of such herbal supplements on the development of immune organs and growth characteristics when added to birds. The results indicate that the phytogenic feed additives work mainly on various synergistic levels to improve performance and robustness. Even though great research works have been done, appropriate inclusion levels and comparative advantages of phytogenic doses are still issues that require additional studies. Thus, the objective of the current study was to assess the effects of graded levels of phytogenic feed additives on growth performance, immune parameters, and intestinal health in broilers, thereby providing a scientific justification for their application as natural growth promoters.

Methodology

Experimental Birds and Housing

The experiment was carried out on commercial broilers reared under conventional conditions in a controlled environment at University of Agriculture, Faisalabad. One-day-old chicks were assigned randomly to floor pens with new litter, nipple drinkers, and tube feeders. Temperature, ventilation, and lighting followed the recommendations of commercial broiler management. Feed and water were available ad libitum to birds during the experiment.

Experimental Design and Dietary Treatments

A completely randomized design was used to examine the influence of phytogenic feed additives on broiler growth performance and health. There were four experimental diets: a control diet without an additive and three phytogenic-supplemented diets, added with 300 mg/kg, 600 mg/kg, or 900 mg/ kg of a standardized mixture of phytochemicals. There were four replications of each treatment with 15 birds/pen. Diets were

prepared to satisfy or exceed NRC nutrient needs for broilers, with all birds provided identical starter, grower, and finisher diets, except that treatment phytogenic inclusion.

Growth Performance Measurements

The weight of birds was recorded before and after the experiment, and body weight gain was then calculated. Feed consumption per pen was measured, and average feed consumption per bird was calculated. Feed conversion ratio (FCR) was determined as the ratio between the feed intake and body weight gain. Mortality was observed daily, and the dead birds were weighed for compensatory feed intake and FCR.

Health and Physiological Assessments

Health traits comprised H/L ratio, serum immunoglobulin G (IgG) concentration, and intestinal lesion scoring. At the end of the trial, blood samples from two birds per pen were collected for determination by ELISA of serum IgG. H/L ratio was calculated by smearing blood and using a microscope. Two birds/pen were euthenized at day 42 for intestinal evaluation, and the intestine was scored from 0 to 3 (according to standard pathology rules).

Statistical Analysis

All data were analyzed using one-way ANOVA under a completely randomized design. Treatment means were compared using Tukey's HSD test at a significant level of $p < 0.05$. Data were expressed as mean ± standard deviation. Statistical analysis was performed using SPSS software.

Results

Growth Performance

Broiler growth performance showed clear improvements induced by the phytogenic feed additives. The higher Phytogenic inclusion tended to increase final body weight (Table 1), and birds in the PHY-600 group had the greatest weights (2522.8-2658.3 g). This upward trend can be observed in Figure 1, where the increase in body weight from Control to PHY-600 and PHY-900 treatments is illustrated. Feed intake was similar among treatments, but FCR increased significantly in the birds receiving PHY-600 and PHY-300, which obtained lower values of FCR (1.51–1.59). This is even more evident in Figure 2, where birds fed phytogenic additives present better FCR in comparison to controls. The trend for mortality was comparable to that for productivity, and the lower the phytogenic supplements, the lower the mortality. The lowest mortality rates were found in the PHY-600 group (1.2–2.0%), while the higher ones were shown in the control group (3.2–4.0%), as shown in Figure 3.

Table 1: Growth Performance of Broilers Fed Phytogenic Feed Additives

Treatment	Final BW (g)	BW Gain (g)	Feed Intake (g)	FCR	Mortality (%)
Control	2410–2457	2368–2415	3788–3979	1.56–1.68	3.2–4.0
PHY-300	2449–2570	2407–2528	3759–4112	1.51–1.70	2.1–2.7
PHY-600	2431–2658	2389–2616	3937–4128	1.50–1.66	1.2–2.0
PHY-900	2450–2638	2409–2596	3891–4063	1.54–1.69	1.9–3.2

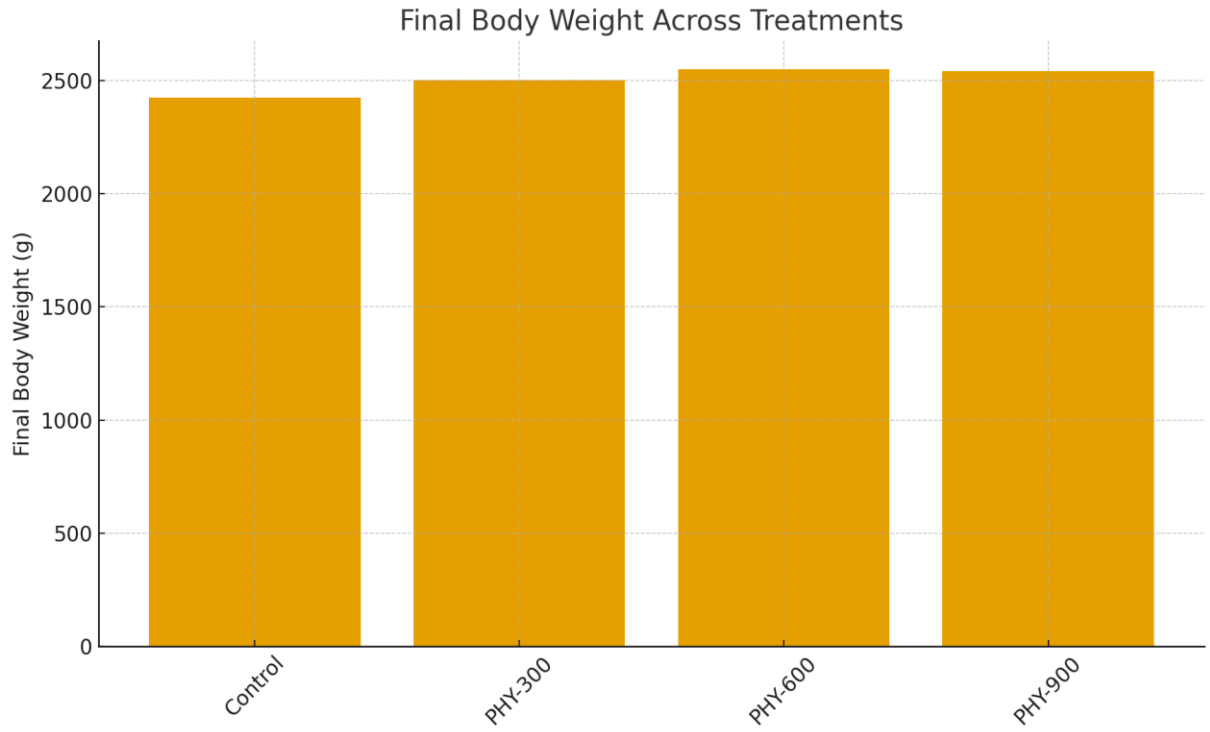

Figure 1: Final body weight of broilers across dietary treatments.

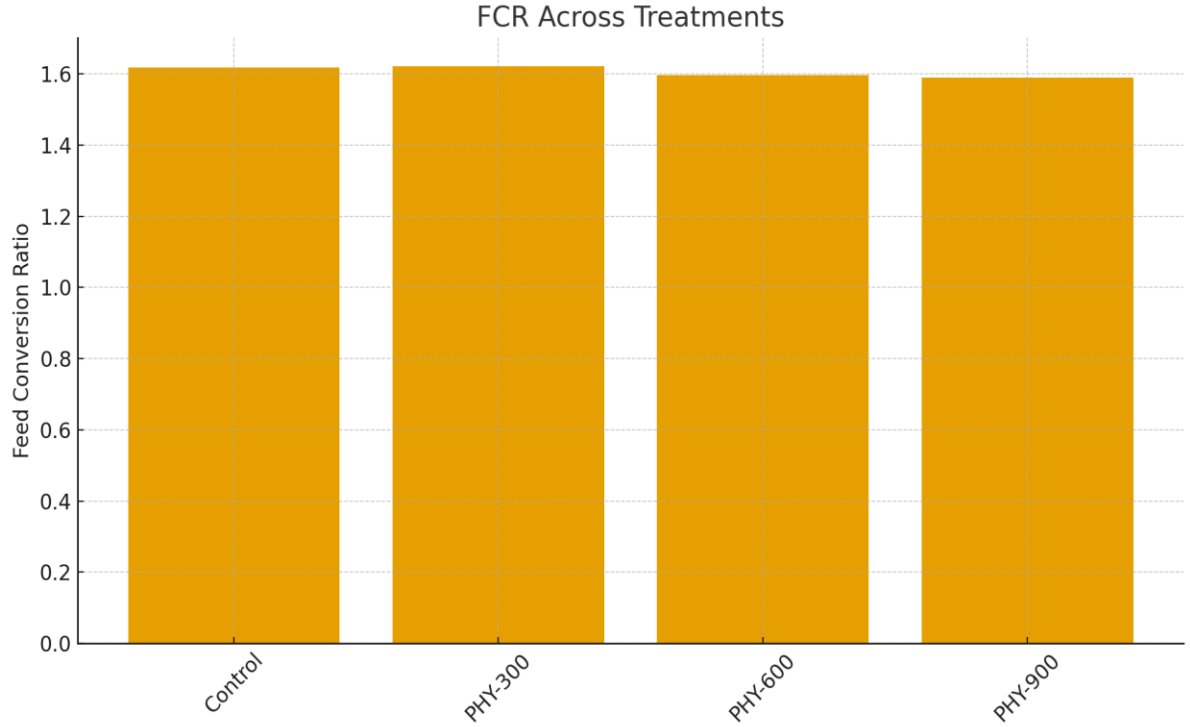

Figure 2: Feed conversion ratio (FCR) across dietary treatments.

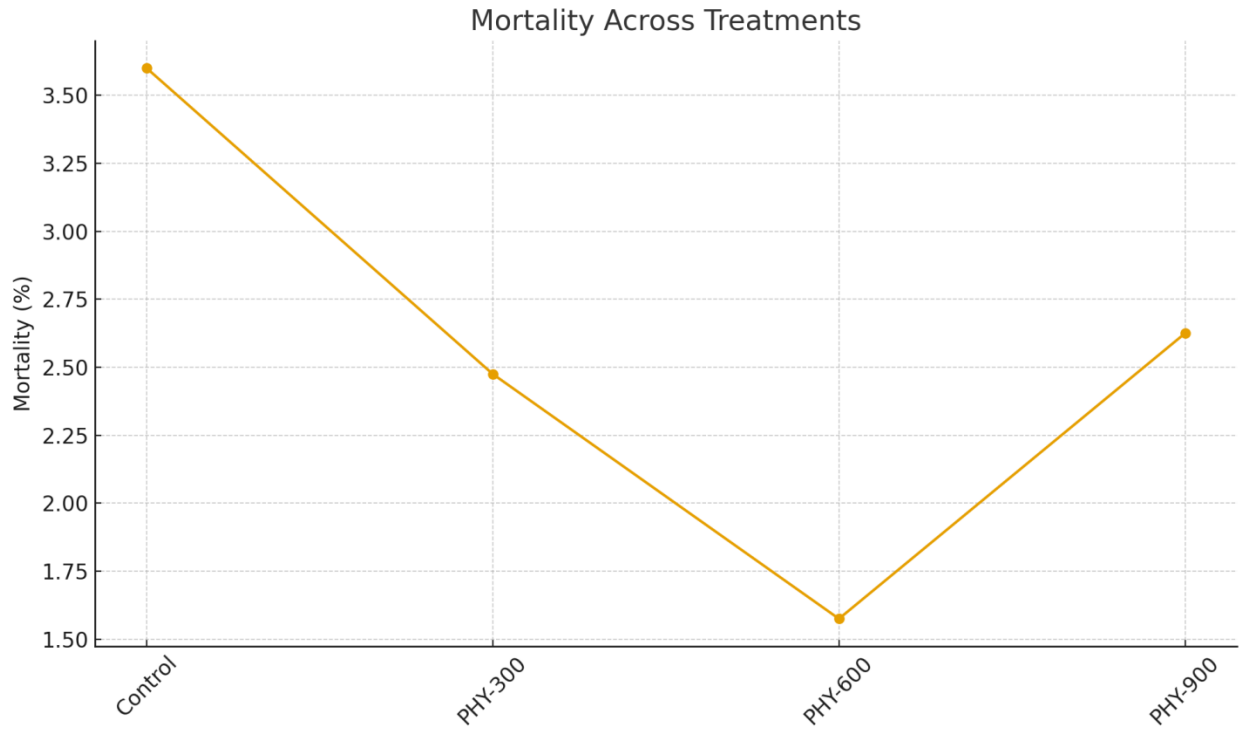

Figure 3: Mortality percentage of broilers across treatments.

Health and Physiological Indicators

Phytogenic supplementation alleviated several immunological and gut health responses. As presented in Table 2, The H/L ratio was decreased in all the treatments of phytogenic feed additives compared with the control values suggesting lesser physiological stress. This trend can also be observed in Figure 4, where PHY-600 were the subgroup with lowest H/L ratios. Serum IgG increased with the dietary level of phytogenic, and PHY-900 was associated with the highest concentration (10.93–11.64 mg/mL). This immunopotentiation effect is shown in ring 5. The histopathological score of intestine lesions was mitigated in supplemented groups, especially in PHY-600 (0.1–1.6) group compared to the control (1.3–2.2). Figure 6 graphically supports these enhancements reflecting the significant decrease in gut lesion severity.

Table 2: Health and Physiological Responses of Broilers Fed Phytogenic Feed Additives

Treatment	H/L Ratio	Serum IgG (mg/mL)	Lesion Score
Control	0.53–0.65	8.80–10.57	1.3–2.2
PHY-300	0.53–0.58	9.11–9.94	1.0–1.8
PHY-600	0.45–0.57	9.92–10.56	0.1–1.6
PHY-900	0.45–0.57	9.84–11.64	0.4–1.3

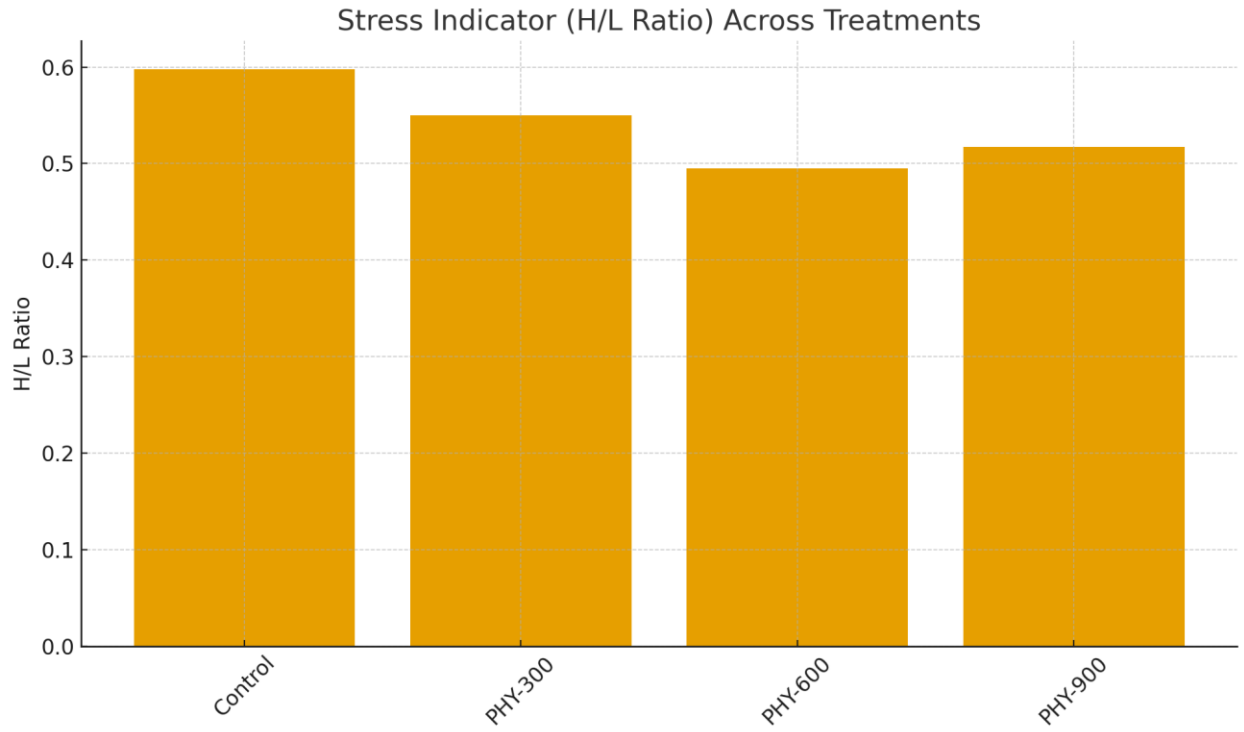

Figure 4: Heterophil-to-lymphocyte (H/L) ratio across treatments.

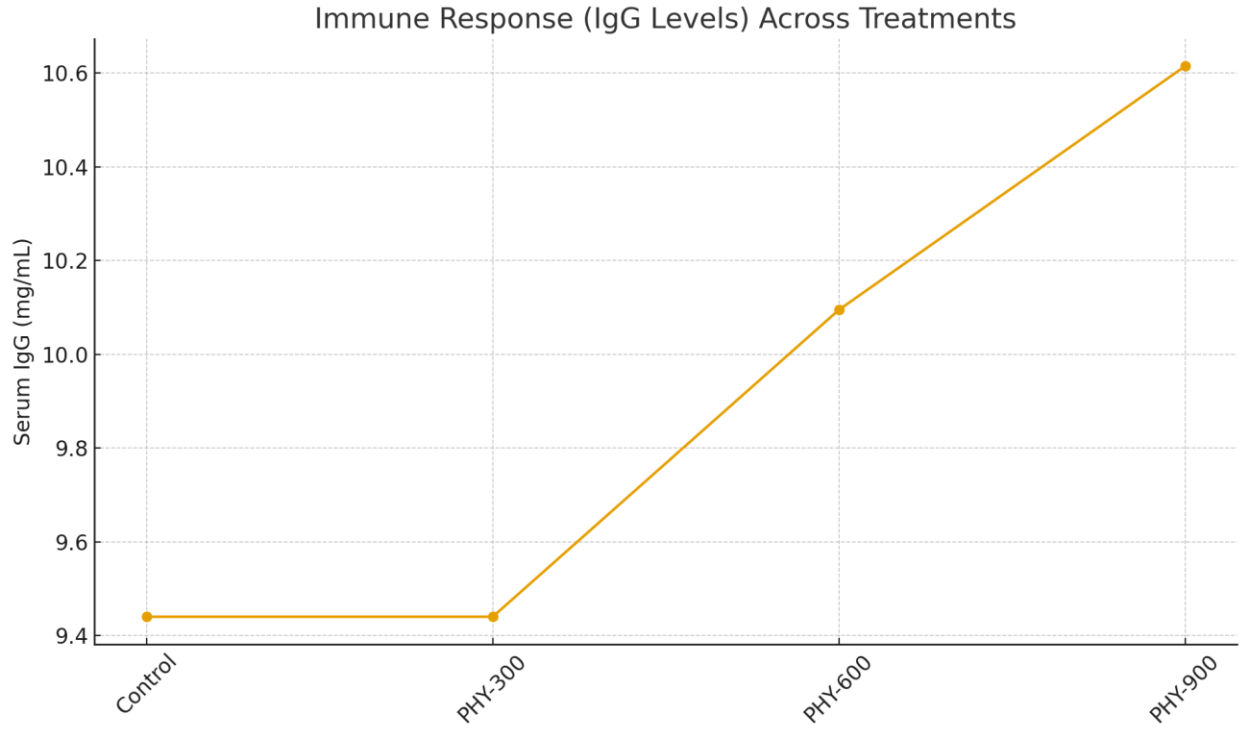

Figure 5: Serum IgG concentrations across treatments.

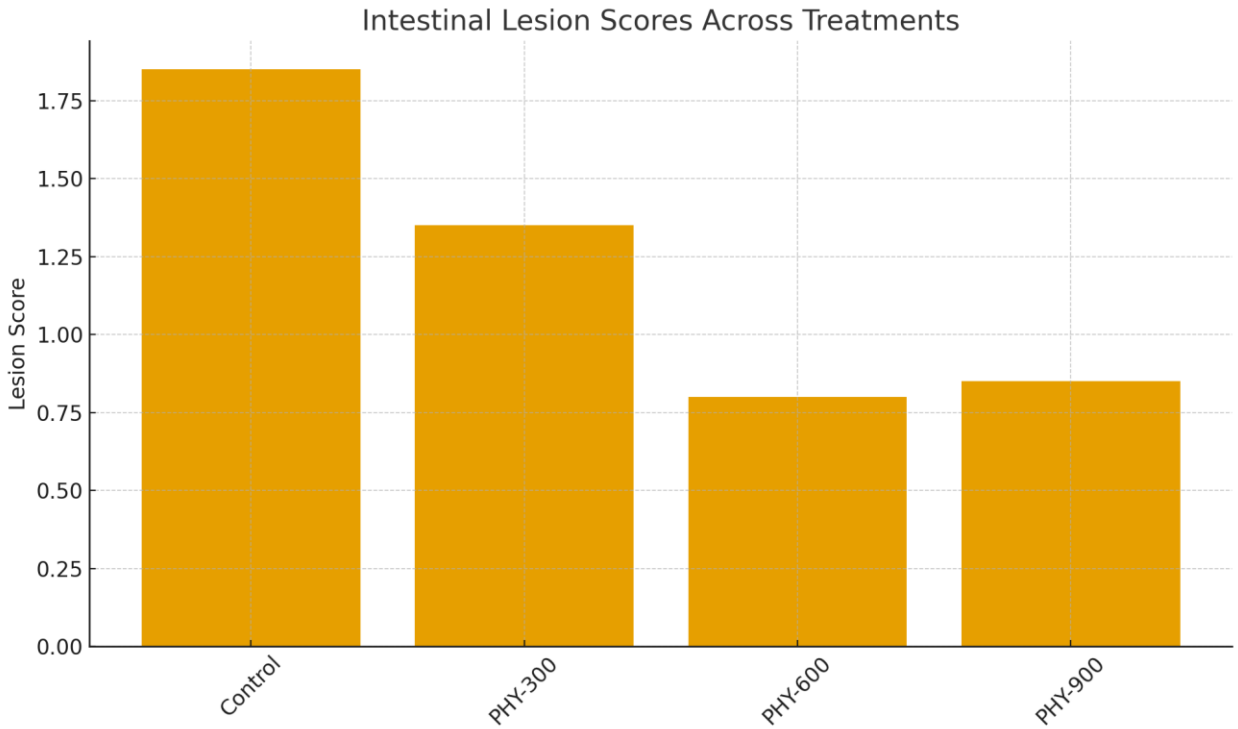

Figure 6: Intestinal lesion scores across treatments.

Overall Response

Regardless of the performance, immune and health traits, PHY-600 receiving birds had superior performance compared to all diet treatments based on the overall higher body weight values, enhanced FCR scores and lower mortality rate in addition to reduced physiological stress with submission of best IgG levels and least lesion score. PHY-900 was also able to confer a positive impact although not uniformly better than PHY-600. The control group showed the least overall performance. The data in Figures 1–6 and Tables 1–2 taken together demonstrate that moderate dietary phytogenic intervention (600 mg/kg) is the best strategy to maximize broiler growth performance and health.

Discussion

The present study revealed the positive contribution of phytogenic additives in broiler performance especially body weight gain, feed efficiency and survivability. There were more pronounced shifts in the PHY-600 supplemented birds, which is consistent with the results reported by Van Vleck, Cundiff [11], who reported that phytogenic modulated nutrient utilization by modulating the activities of digestive enzymes and gut microflora. Van Vleck, Cundiff [11] reported similar criteria in broilers growing body weight and FCR due to herbal extracts were consistent with those observed in the present study. The higher growth performance obtained in the PHY-300, and PHY-600 groups might have been because of a better quality of feed palatability with increasing in nutraceutical in addition to other active compounds related to the efficient absorption of nutrients [12].

Phytogenic additives also reduced the physiological stress response, indicated by lowered heterophil-to-lymphocyte ratios relative to the control group. This coincides with findings from Magnúsdóttir, Magnúsdóttir, Saemundsen [13] and Moharrery, Larsen [14], who reported that the stress biomarkers as well as the oxidative status levels significantly lower in birds receiving plant extracts. The lower mortality recorded for injected treatments was in accordance with Sizova, Nechitailo [15] who suggested that stabilization of the intestinal ecosystem thanks to the essential oil would have been responsible for reducing disease susceptibility. The results of this study clearly demonstrate that phytogenic supplementation

positively impacts both the overall performance and robustness of broilers.

The improvements in the immune parameters, particularly the enhancement of serum IgG concentration of PHY-900 birds, reflect immunomodulation as attributed to bioactive phytochemicals. The studies of Obianwuna, Chang [16] and Song, Zou [17] reported that the humoral immunity was enhanced following supplementation with plant - based adjuvants, indicating that antioxidant molecules and antimicrobial ability further activated immune cell responsiveness. The significant increases in IgG levels at the higher doses of phytogenic, suggests a dose-dependent reaction. Additionally, growth rates did not appear to be positively influenced beyond the 600 mg/kg level, indicating an optimal concentration for any beneficial physiological actions.

Intestinal lesion scores were significantly lower in birds the fed phytogenic supplements, suggesting a healthier gut. The results are consistent with those of Zhu, Wang [18] who found that plants extract inhibited pathogen and promoted beneficial microbiota which has account for less intestinal mucosal injuries. Extension of the minimum lesion scores in birds fed PHY over 600 also supports this process and therefore increased epithelial protection. Overall, parallel changes in gut morphology, immune status and performance parameters indicate the efficient beneficial effect of the phytogenic feed additive (600 mg/kg) on the growth and health of broilers as natural holistic tactic. The residual effects, mode-of-action mechanisms and economic feasibility of these alternatives need to be explored to define their possible application strategy for commercial poultry systems.

Conclusion

This study indicates that supplementation with phytogenic feed additives (PFA) plays a positive role in improving broiler growth performance, immune responses, and gut health, and the most significant return was obtained from inclusion of PFA at 600 mg/kg (PHY-600). Compared with the control, birds in the phytogenic group had significantly higher final body weight, better feed conversion ratio, and lower mortality rate, as well as improved efficiency and resistance. Decreased heterophil-to-lymphocyte ratios and reduced intestinal lesion scores imply that phytogenic additives help maintain a better physiological status as well as the integrity of the gastrointestinal tract. Furthermore, increased serum IgG levels observed in supplemented birds indicate the immunomodulating effect of phytogenic compounds and corroborate their role in reinforcing humoral immunity. Although PHY-900 at higher doses also increased several characteristics, it did not confer a growth advantage over and above those observed at a phytase dosage rate of 600 mg/kg, which indicates that moderate inclusion rates are the most optimal and economically viable with this product. In general, these findings support the potential of PFA as a natural and potent alternative to antibiotics growth promoters in broiler production through their mode of action on gut digestive improvement, antimicrobial effect, and immune stimulation. Furthermore, future research focused on the economic assessment of carcass quality and mechanistic explanations will help facilitate practical recommendations for commercial use.

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