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A sustainable nutritional approach for improving growth performance and feed efficiency in broiler chickens

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Abstract

The present study was conducted to evaluate the effect of dietary supplementation of a phytobiotic feed additive on the growth performance and economic efficiency of broiler chickens under farmers' field conditions. The phytobiotic feed additive was supplemented at the recommended inclusion level of 250 g/ton of feed. The study comprised two experimental groups, viz., control (T₁) and phytobiotic-supplemented treatment (T₂). Productive performance parameters including average initial body weight, average daily gain (ADG), average total body weight gain, mortality rate, feed conversion ratio (FCR) and benefit-cost (B:C) ratio were evaluated. The results revealed that the average initial body weight did not differ significantly ($p > 0.05$) between the experimental groups. Dietary supplementation of the phytobiotic feed additive significantly ($p < 0.05$) improved average daily gain (55.14 ± 0.52 g) and average total body weight gain (2315.88 ± 21.84 g) in the treatment group as compared to the control group (53.04 ± 0.22 g and 2227.68 ± 9.28 g, respectively). The treatment group exhibited a 3.96% increase in body weight gain over the control group. Mortality percentage, feed conversion ratio and benefit-cost ratio showed numerical improvements in the phytobiotic supplemented group; however, the differences were statistically non-significant ($p > 0.05$). The feed conversion ratio improved from 1.59 ± 0.02 in the control group to 1.55 ± 0.01 in the treatment group, while the benefit-cost ratio increased from 1.23 ± 0.02 to 1.26 ± 0.03 . It can be concluded that dietary supplementation of phytobiotic feed additive has the potential to improve growth performance and production efficiency in broiler chickens. The findings suggest that phytobiotic feed additives may have the potential to reduce dependence on antibiotic growth promoters in poultry production systems.

Keywords: Broiler chicken, phytobiotic feed additive, growth performance, feed conversion ratio, economic efficiency

Introduction-

The poultry industry is one of the fastest-growing sectors of animal agriculture and plays a significant role in supplying affordable, high-quality animal protein to the rapidly increasing human population. Broiler production has expanded considerably due to its short production cycle, rapid growth rate, and superior feed conversion efficiency. Nevertheless, modern intensive production systems expose birds to nutritional, environmental, and microbial stressors that adversely affect intestinal health, nutrient utilization, growth performance, and overall farm profitability (Karangiya *et al.*, 2016) ^[1].

For several decades, antibiotic growth promoters (AGPs) were routinely incorporated into broiler diets to improve growth performance, feed efficiency, and disease resistance. Although AGPs substantially enhanced production efficiency, their indiscriminate and prolonged use has contributed to the emergence of antimicrobial-resistant bacteria and antibiotic residues in poultry products, posing serious concerns for both animal and public health. Consequently, restrictions on AGP use in many countries have accelerated the search for safe, sustainable, and residue-free alternatives for poultry production (Windisch *et al.*, 2008; Hashemi and Davoodi, 2010) ^[2, 3].

Among the available alternatives, phytobiotics, also known as phytogenic feed additives, have emerged as one of the most promising natural feed additives in modern poultry nutrition. Phytobiotics are plant-derived products obtained from herbs, spices, essential oils, oleoresins, and plant extracts containing numerous biologically active compounds such as phenolics, flavonoids, terpenoids and alkaloids. These bioactive constituents possess antimicrobial, antioxidant, anti-inflammatory, digestive stimulant, and immunomodulatory properties that improve gut microbial balance, stimulate digestive enzyme secretion, enhance intestinal integrity, and increase nutrient

digestibility, ultimately leading to improved feed efficiency and productive performance (Brenes and Roura, 2010; Yang *et al.*, 2015) [4, 5].

Several studies have demonstrated that dietary supplementation of phytogenic feed additives positively influences broiler performance by improving body weight gain, feed conversion ratio, immune response, intestinal morphology, and antioxidant status. Furthermore, phytobiotics suppress the proliferation of pathogenic microorganisms while promoting beneficial intestinal microflora, thereby enhancing nutrient absorption and reducing production losses (Murugesan *et al.*, 2015) [6]. Herbal feed additives such as garlic, ginger, turmeric, *Aloe vera*, and tulsi have also been reported to improve growth performance and economic returns in broiler chickens, supporting their potential as natural substitutes for antibiotic growth promoters (Karangiya *et al.*, 2016; Sethy *et al.*, 2016; Hasan *et al.*, 2016; Yadav *et al.*, 2017) [1, 7-9].

Phytobiotic feed additives have gained considerable attention in poultry nutrition owing to their antimicrobial, antioxidant, digestive stimulant and immunomodulatory properties. Their use in broiler diets has been associated with improved growth performance, feed efficiency and overall production efficiency, making them promising and sustainable alternatives to antibiotic growth promoters in poultry production systems (Hashemi and Davoodi, 2010; Murugesan *et al.*, 2015) [3, 6].

Although numerous experimental studies have demonstrated the beneficial effects of phytobiotics, relatively limited information is available regarding their performance under farmers' field conditions. Scientific validation of phytobiotic feed additives through on-farm trials is essential before recommending their large-scale adoption by poultry producers. Therefore, the present study was undertaken to evaluate the effect of dietary supplementation of a phytobiotic feed additive on the growth performance, feed conversion ratio, mortality, and economic returns of broiler chickens under farmers' field conditions, considering their potential as sustainable alternatives to antibiotic growth promoters in poultry production..

Materials and Methods

The present on-farm trial was conducted under the supervision of Krishi Vigyan Kendra, Chandauli, Uttar Pradesh, India, to evaluate the effect of dietary supplementation of a phytobiotic feed additive on the productive performance of broiler chickens under farmers' field conditions. Five poultry farmers practicing commercial broiler farming with similar management conditions were selected for the study. A total of 1000 day-old commercial broiler chicks were randomly allocated into two experimental groups comprising 500 birds each. Birds in the control group (T₁) were fed a standard commercial broiler diet without any feed additive, whereas birds in the treatment group (T₂) received the same basal diet supplemented with a commercially available phytobiotic feed additive at the rate of 250 g per metric ton of feed. The feeding trial was conducted for 42 days covering both starter and finisher phases.

Throughout the experimental period, birds were reared under deep-litter housing system following standard commercial management practices. Feed and fresh drinking water were offered *ad libitum*, while brooding, vaccination schedule, lighting programme, litter management, ventilation and biosecurity measures were maintained uniformly in both treatment groups. No antibiotic growth promoter was included in the diets of either group during the study period.

Body weight of the birds was recorded at the beginning and at the end of the experimental period using a digital weighing balance. Average daily gain (ADG) was calculated from the body weight records. Feed consumption was recorded on a flock basis, and feed conversion ratio (FCR) was calculated as the amount of feed consumed per unit body weight gain. Mortality was monitored daily, and cumulative mortality percentage was calculated for each treatment. Economic performance was assessed by estimating the cost of production, gross return, net return per bird and benefit:cost (B:C) ratio using prevailing market prices.

The data generated during the study were expressed as mean $\pm$ standard error (SE) and analysed using IBM SPSS Statistics. The significance of differences between the control and phytobiotic-supplemented groups was determined using an independent samples *t*-test, and differences were considered statistically significant at $p < 0.05$.

Results and Discussion-

The present study was undertaken to evaluate the effect of dietary supplementation of a phytobiotic feed additive on the growth performance and economic efficiency of broiler chickens under farmers' field conditions. The phytobiotic feed additive was supplemented at the rate of 250 g/ton of feed. The productive performance parameters indicated that phytobiotic supplementation positively influenced body weight gain and production efficiency without adversely affecting the health and survivability of broiler birds.

The average initial body weight of broiler chicks did not differ significantly ($p > 0.05$) between the control (42.00 $\pm$ 0.84g) and treatment groups (44.00 $\pm$ 0.54g), indicating proper randomization and uniformity of experimental birds at the commencement of the trial. Similar findings were reported by Hasan *et al.* (2016) [8], who observed comparable initial body weights among tulsi supplemented and control broiler groups, suggesting that subsequent improvements in growth performance can be attributed primarily to dietary interventions rather than inherent differences in chick weight.

Dietary supplementation of the phytobiotic feed additive significantly ($p < 0.05$) improved average daily gain (ADG) in broiler chickens. Birds receiving phytobiotic supplementation recorded an ADG of 55.14 $\pm$ 0.52 g compared to 53.04 $\pm$ 0.22g in the control group. Consequently, the average total body weight gain was significantly ($p < 0.05$) higher in the treated group (2315.88 $\pm$ 21.84g) than in the control group (2227.68 $\pm$ 9.28 g). The treatment group exhibited 3.96% greater body weight gain than the control group. The improved growth performance may be attributed to the bioactive phytogenic compounds present in phytobiotic feed additives, which are known to possess antimicrobial, antioxidant, anti-inflammatory and digestive stimulant properties. These compounds improve intestinal microbial balance, stimulate digestive enzyme secretion and enhance nutrient digestibility and absorption.

The findings of the present study are in agreement with those of Karangiya *et al.* (2016) [1], who reported significant improvements in body weight gain following dietary supplementation of garlic and ginger in broiler chickens. Similarly, Sethy *et al.* (2016) [7] demonstrated that turmeric supplementation significantly increased body weight gain in broilers. Hasan *et al.* (2016) [8] also reported significantly higher live body weights in tulsi supplemented broilers compared with controls. Previous studies have established that phytobiotics improve growth performance by promoting gastrointestinal

health and reducing microbial competition for nutrients within the digestive tract.

Phytogenic feed additives have gained considerable attention as potential alternatives to antibiotic growth promoters due to their beneficial effects on nutrient utilization and bird health. Hashemi and Davoodi (2010) [3] reported that phytobiotics act as natural growth promoters by enhancing digestive enzyme activity, improving feed palatability and modulating intestinal microflora. Likewise, Windisch *et al.* (2008) [2] suggested that phytogenic compounds improve nutrient digestibility and support intestinal eubiosis, thereby improving productive performance in poultry.

Mortality percentage was numerically lower in phytobiotic supplemented birds ($3.20 \pm 0.37\%$) than in the control group ($3.80 \pm 0.37\%$), although the difference was statistically non-significant ($P > 0.05$). Lower mortality in treated birds may be associated with the immunomodulatory, antimicrobial and antioxidant properties of phytogenic compounds that improve disease resistance and physiological well-being. Similar trends have been reported by Hasan *et al.* (2016) [8] and Yadav *et al.* (2017) [9], who observed improved livability and lower mortality in broilers supplemented with herbal feed additives. Reduced mortality contributes positively to production economics, particularly under commercial farming conditions. Feed conversion ratio (FCR) is an important indicator of feed utilization efficiency in broiler production. In the present study, phytobiotic supplementation numerically improved FCR from 1.59 ± 0.02 in the control group to 1.55 ± 0.01 in the treatment group, although the difference was statistically non-significant ($P > 0.05$). Improved FCR indicates more efficient conversion of feed into body mass and suggests enhanced nutrient utilization in phytobiotic supplemented birds. The numerical improvement observed in the present study corroborates earlier findings by Ürüshan and Bölükbaşı (2017) [10], who reported improved FCR following turmeric supplementation in broiler diets. Similarly, Karangiya *et al.* (2016) [1] observed better feed efficiency in broilers supplemented with garlic and ginger. Gautam *et al.* (2021) [11] also reported significantly lower FCR in broilers supplemented with phytobiotic mixtures and organic acids. Although the improvement was not statistically significant in the present study, the observed trend clearly indicates the beneficial influence of phytobiotics on feed utilization.

The economic analysis revealed that the benefit-cost ratio was numerically higher in the treatment group (1.26 ± 0.03) compared to the control group (1.23 ± 0.02), suggesting better economic returns from phytobiotic supplementation. Improved profitability may be attributed to enhanced body weight gain, better feed efficiency and reduced mortality. Similar economic benefits associated with herbal supplementation have been documented by Hasan *et al.* (2016) [8] and Yadav *et al.* (2017) [9], who reported higher net profits in phytobiotic supplemented broilers. Improved economic efficiency is particularly important for poultry farmers, where even modest improvements in production parameters can substantially influence farm profitability.

The observed improvements in growth performance may also be explained by the bioactive phytogenic compounds present in phytobiotic feed additives. These compounds are known to improve gut health, stimulate digestive enzyme secretion, enhance nutrient digestibility and suppress pathogenic microorganisms in the gastrointestinal tract. Several researchers, including Platel and Srinivasan (2004) [12], Giannenas *et al.* (2005) [13], Kirkpinar *et al.* (2010) [14] and Gregacevic *et al.* (2014) [15], have reported that phytobiotics

enhance intestinal health and productive performance in poultry birds through improved nutrient utilization and modulation of gut microflora.

Overall, the results of the present investigation demonstrate that dietary supplementation of a phytobiotic feed additive significantly enhanced average daily gain and total body weight gain of broiler chickens while numerically improving feed conversion ratio, mortality percentage and economic returns. The present findings support the growing body of evidence suggesting that phytobiotic feed additives have the potential to serve as safe, residue-free and sustainable alternatives to antibiotic growth promoters in commercial broiler production systems.

Table 1: Effect of phytobiotic mixture supplementation on performance and economics of broiler chickens

No.	Parameters	Control Group (T ₁)	Treated Group (T ₂)
1.	Average initial body weight (g)	42.00 ± 0.84	44.00 ± 0.54
2.	Average daily gain (g)	$53.04^b \pm 0.22$	$55.14^a \pm 0.52$
3.	Average total weight gain (g)	$2227.68^b \pm 9.28$	$2315.88^a \pm 21.84$
4.	Increase in average body weight (%)	-	3.96
5.	Mortality rate (%)	3.80 ± 0.37	3.20 ± 0.37
6.	FCR (Feed Conversion Ratio)	1.59 ± 0.02	1.55 ± 0.01
7.	B:C Ratio	1.23 ± 0.02	1.26 ± 0.03

Conclusions

The present study demonstrated that dietary supplementation of a phytobiotic feed additive positively influenced the productive performance of broiler chickens under farmers' field conditions. Supplementation significantly improved average daily gain and total body weight gain, indicating improved growth performance in broiler chickens..

Although feed conversion ratio (FCR), mortality percentage and benefit-cost (B:C) ratio were not statistically different between the control and treatment groups, numerical improvements were observed in the phytobiotic supplemented birds, suggesting improved feed utilization efficiency, survivability and economic returns. These findings indicate that phytobiotic feed additives can enhance broiler productivity without adversely affecting bird performance.

The beneficial effects observed in the present study are likely attributable to the bioactive phytogenic compounds present in phytobiotic feed additives, which may improve digestive function, gut health and nutrient absorption. Therefore, supplementation of phytobiotic feed additives may be considered a safe, practical and sustainable nutritional strategy for improving growth performance in commercial broiler production and may serve as a suitable alternative to antibiotic growth promoters.

Further investigations involving larger flock sizes and evaluation of carcass traits, immune response and gut health parameters are recommended to better understand the long-term benefits of phytobiotic supplementation in poultry nutrition.

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