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Effect of dietary supplementation of Non-Antibiotic growth promoter on performance parameters in Cobb 430 broiler chickens

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Abstract:*Replacing antibiotic growth promoters (AGPs) with alternative feed additives is of significant research interest in the poultry industry. The present study aimed to evaluate the effect of Non-Antibiotic growth promoter (NAGP), a phytogenic feed additive, on growth performance parameters in Cobb 430 commercial broiler chickens. In this study, 180 (age, 1 day) Cobb 430 male broiler chickens were allocated equally into three groups (6 replicates/group; 10 birds/replicate): group 1 (G1) acted as a control; group 2 (G2) received NAGP (500 g/ton); and group 3 (G3) received a conventional AGP (cAGP; 125 g/ton). All birds were raised on a normal commercial broiler feed and concurrently supplemented with NAGP (500 g/ton) and cAGP (125 g/ton) to G2 and G3, respectively. Growth performance parameters, such as body weight, average daily gain (ADG), feed intake (FI), and feed conversion ratio (FCR) were evaluated on days 1, 7, 14, 21, and 35. The study was conducted for 35 days. The results of the present study revealed that there was 22.70 and 30.60 g increase in the body weight in the groups treated with NAGP and cAGP on days 21 (starter phase) and 35 (finisher phase), respectively. Moreover, FCR improved in the birds treated with NAGP compared with the birds in the control and cAGP groups; that is, the birds supplemented with NAGP consumed 30 and 24 g less feed per unit body weight gain compared with those in the control and cAGP groups, respectively. It is evident from the present study results those properties of NAGP are comparable to that of AGPs as supplementation of NAGP augmented growth performance parameters, such as body weight, ADG, FI, and FCR, in Cobb 430 broiler chickens. Hence, NAGP, at a dose of 500 g/ton, could be administered as a phytogenic feed additive, an alternative to AGP in commercial broiler diet to improve broiler performance.*

I. INTRODUCTION

Commercial broiler rearing had been developing quickly over the most recent couple of decades for the expanded interest to provide a protected and modest wellspring of animal proteins [1]. This circumstance guided the broiler rearing activities to serious raising. Shockingly, this serious framework prompted the advancement of a few difficulties such as overcrowding, rapid disease transmission, low immunity, and further financial losses [2]. To beat these issues, the broiler keepers were drifted toward utilizing antibiotics for either treatment or counteraction of irresistible infections and as a simple path for advancement. In any case, an enormous number of examinations explained that exorbitant consideration of antibiotics in animal feed will heighten the possible danger of bacterial obstruction in human. Thus, this bacterial opposition and anti-infection buildups in animal byproducts prompted the worry in utilizing antibiotics as growth promoters and brought about the restriction in utilizing in-feed antibiotics globally. In any case, forbidding the utilization of antibiotics has brought about an expanded spread of bacterial diseases and intensified FCR among poultry flocks [3].

The literature of veterinary sciences delineated that gut health is a comprehensively debated topic of research interest in the poultry sector. The wellbeing of the gastrointestinal system plays a pivotal role in accomplished optimal production performance of broiler birds mainly through augmentation of two vital functions of the gut, that is, digestion and absorption of nutrients and immunity. Microbiota, immune system, and nutrition are the three pivotal constituents of the gut, which could interdependently play a vital role in working efficiency of the gut [4,5]. Stable equilibrium of the gut microbiota, especially commensal microbiota, is crucial in determining the gut health, such as development of gut structure and morphology, inhibition of invading pathogens, and assistance in enhanced digestion and optimal absorption of nutrients in the intestine [6].

Finding alternatives to antibiotic growth supplement is one of the main challenges in the poultry research industry. The antibiotic alternatives should be obtained from natural sources without toxic effects and have no residual effect in meat, for example, probiotics, prebiotics, symbiotic, acidifiers, and phytobiotics [7]. Phytobiotics are a class of plant-derived chemical constituents and could be added to commercial broiler feed for the augmentation of production performances through abiding feed properties and quality of food derived from animals supplemented with phytobiotics [8]. Therefore, phytobiotics as feed additives have favorable effects on either growth performance, immunity, or production of superior quality products, which have gained immense research attention since these are known as organic products [9]. Furthermore, addition of essential oils in commercial broiler feed caused enhancement of growth and production performance through improvement of feed efficiency. The augmentation of growth and production performance following addition of essential oils in broiler diets could be attributed to the superior palatability and quality of the diet through their antioxidant properties and antimicrobial action, resulting in amelioration of intestinal pathogen pressure, augmentation of the digestibility of nutrients, and enhancement of gut tissue morphology [10].The present study aimed to evaluate the effect of NAGP, a phytogenic feed additive, on growth performance parameters in Cobb 430 commercial broiler chickens.

II. Materials and methods

Phytogenic feed additive

PhytoGrow is a proprietary polyherbal NAGP formulation developed by Himalaya Wellness Company (Bengaluru, Karnataka, India), which contains parts of *Azadirachta indica*, *Curcuma longa*, *Andrographis paniculata*, and *Cinnamomum zeylanicum* herbs.

Preparation of experimental diet

The experimental diet was prepared as per prevailing industry standard specifications (Table 1). Raw materials (Table 2) were mixed to develop a feed mixture formula proprietary to Himalaya Wellness Company. The nutritional values of the feed mixture are presented in Table 3. The experimental product, NAGP, and a conventional antibiotic growth promoter (cAGP) were added to the feed mixture at 500 g/ton and 125 g/ton, respectively, and mixed thoroughly.

Table 1. Specifications of experimental diet

Type of feed	Metabolizable energy (kcal/kg feed)	Crude protein (%)
Pre-starter feed	3020	22.00
Starter feed	3110	21.50
Finisher feed	3270	19.50

Table 2. Raw materials used to develop a feed formula

Ingredient	Pre-starter	Starter	Finisher
Maize (kg)	618.000	638.000	675.000
Oil (mL)	10.000	17.000	36.000
Hypro soya (kg)	244.000	268.000	244.000
Sunflower de-oiled cake (kg)	89.000	42.000	13.000
L-lysine HCl (g)	3.593	2.189	1.580
DL-methionine (g)	2.796	2.428	1.909
L-threonine (g)	0.853	0.200	0.255
LSP/calcium carbonate (g)	17.233	16.455	13.700
Monocalcium phosphate (g)	9.680	8.733	9.841
Sodium bicarbonate (g)	3.143	3.540	3.704
NSP enzyme (g)	0.968	0.000	0.000
Phytase 5000 EC (g)	0.500	0.500	0.500
Protease 6 Lac IU	0.125	0.125	0.125
Vitamin premix (g)	0.600	0.500	0.500
Toxin destroyer (g)	0.250	0.250	0.250
Liver tonic (mL)	1.000	1.000	1.000
Choline chloride (g)	1.000	1.000	1.000
Anticoccidial (g)	0.100	0.100	0.100
Organic TM (g0)	0.750	0.750	0.750
Probiotic (g)	0.200	0.100	0.100
SEL premix (g)	0.100	0.350	0.100
Vitamin E 50% (g)	0.100	0.100	0.100
Antioxidant (g)	0.125	0.125	0.125
Emulsifier (g)	0.500	0.500	0.500
Tylosin 10% (g)	1.000	0.500	0.500
Acidifier (g)	1.000	1.000	1.000
LSP, limestone powder; NSP, non-starch polysaccharide; TM, trace minerals			

Table 3. Approximate nutrient values of the feed mixture

Ingredient	Pre-starter	Starter	Finisher
ME, kcal/kg	3.02	3.11	3.27
Crude protein, %	22.00	21.50	19.50
Fiber %	4.00	3.50	3.00
Digestible amino acids, %			
Lysine	1.23	1.14	1.00
Methionine	0.60	0.55	0.47
Cysteine	0.30	0.30	0.28
Methionine + cysteine	0.90	0.85	0.74
Arginine	1.34	1.31	1.16
Histidine	0.52	0.52	0.48
Leucine	1.65	1.66	1.56
Isoleucine	0.81	0.80	0.73
Threonine	0.77	0.70	0.65
Tryptophan	0.22	0.22	0.20
Valine	0.90	0.89	0.81
Calcium	0.90	0.85	0.75
Phosphorus	0.50	0.48	0.45
ME, metabolizable energy			

General broiler husbandry practices

A male flock of 180 Cobb 430 commercial broiler chickens were divided into three groups, and each group had six replicate pens and each pen housed 10 birds. The approximate size of an individual pen was 4.25 × 6 × 2 inches (length × width × height). Each pen was fitted with a brooder, drinker, and feeder. Each bird was provided a floor space of 1.25 sq ft. The size and floor space of each pen were modified based on the number of birds housed in it, with the help of PVC sheet. The trial lasted for 35 days, and the birds were fed with a Pre-starter (1–14 days), starter (15–28 days), and finisher (29–35 days) mash feed with ad libitum supply of drinking water.

Standard vaccination and management practices were followed throughout the experiment for all experimental groups. The birds were vaccinated against infectious bronchitis (Nobilis® IB Ma5, MSD Animal Health; administered on day 0 of age at the hatchery), Newcastle disease (live vaccine, Nobilis® ND Clone 30, MSD Animal Health; on the 5th and 20th days of age), and infectious bursal disease (Nobilis® Gumboro 228E, MSD Animal Health; on the 12th day of age). Lighting was provided for 24 h for the first week of birds' age and then for 20 h till the end of the trial.

Ethical approval

The present study was conducted according to guidelines laid down for the care and use of animals, and the study protocol was approved by the Institutional Animal Ethics Committee, Himalaya wellness Company, Bangalore (Protocol No. AHP/P/09/17).

Study design

A total of 180 Cobb 430 male broiler chickens (age, 1 day) were allocated equally into three groups (6 replicates/group; 10 birds/replicate): group 1 (G1) was the control group; group 2 (G2) received NAGP; and group 3 (G3) received cAGP. The birds in all three groups were raised on a normal commercial broiler feed and concurrently supplemented with NAGP and cAGP at the recommended doses of 500 g/ton and 125 g/ton to the birds in G2 and G3 groups, respectively (Table 4).

Table 4. Study design

Group	Dose/treatment, g/ton feed	No. of birds/replicate	No. of replicates/group	No. of birds/group	Duration of treatment
G1 (control)	—	10	6	60	35 days
G2 (NAGP)	500	10	6	60	
G3 (cAGP)	125	10	6	60	

Assessment of growth performance parameters

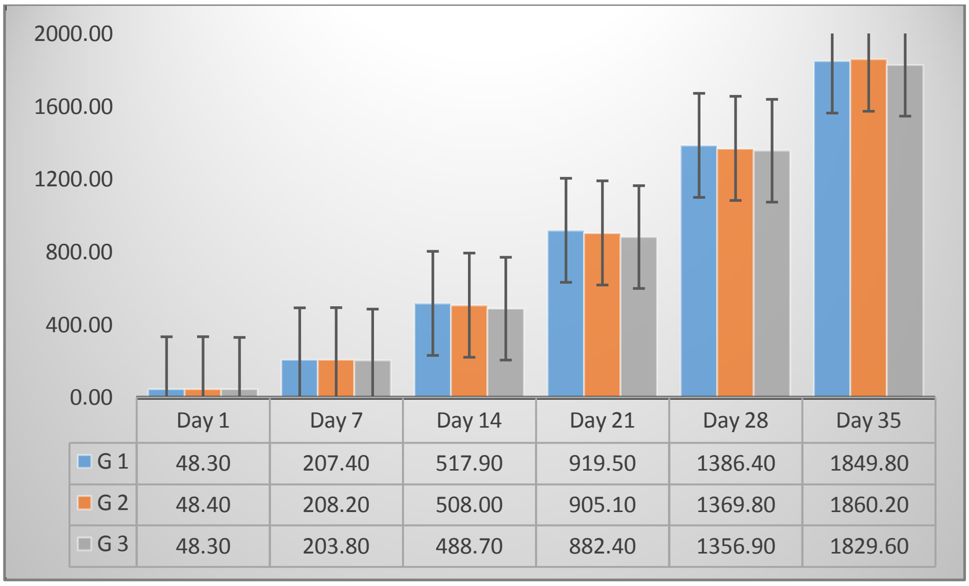
Body weight of the birds was recorded pen wise at weekly intervals at the same time of the day. A measured quantity of feed was offered to each pen, daily, in two equal portions, and cumulative feed intake (FI) was calculated at weekly intervals by subtracting the quantity of the orts left in each pen from the total quantity of the feed offered. Average daily gain (ADG) in body weight and FI were calculated for the respective feeding periods, which is 1–7 days (week 1), 8–14 days (week 2), 15–21 days (week 3), 22–28 days (week 4), and 29–35 days (week 5). FCR was calculated as a ratio between total quantity of feed consumed by all birds in a replicate (kg) and total body weight of all birds in a replicate on a weekly basis, that is, 1–7 days (week 1), 8–14 days (week 2), 15–21 days (week 3), 22–28 days (week 4), and 29–35 days (week 5). Mortality was recorded, and the weight of the dead birds was recorded to adjust the data accordingly.

Statistical analysis

Data were analyzed using analysis of variance (ANOVA), according to a completely randomized design, followed by Dunnett multiple comparison post hoc test [11]. A P-value$< .05$ was considered statistically significant.

III. Results

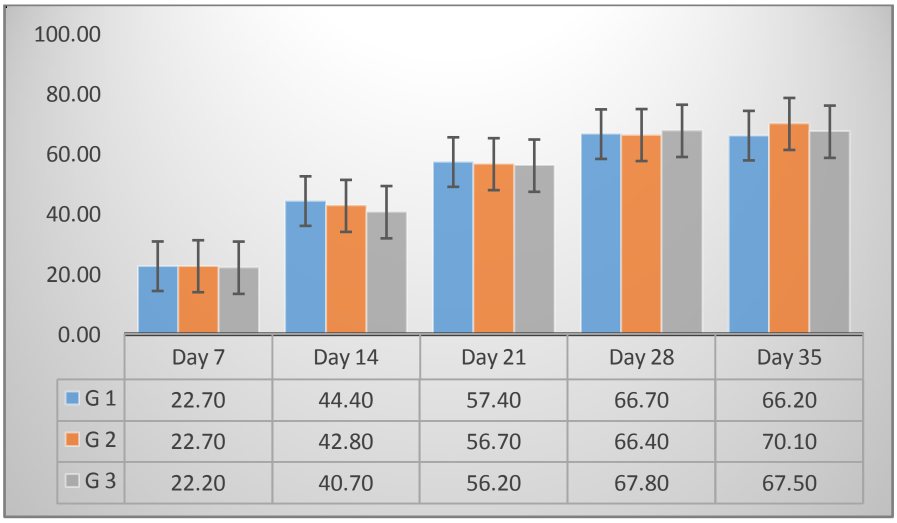
There was no significant difference in the initial body weight of the birds in both the control and treatment groups, which indicates uniformity in the weight of the birds used in the study. By days 21 (starter phase) and 35 (finisher phase), there was an increase in the body weight of the birds in G2 compared with those in G3 (Fig. 1). ADG also gradually increased in the birds in G2 as observed on days 14, 21, and 35 compared with those in G3 (Fig. 2). On days 21, 28, and 35, FI decreased in the birds in G2 compared with those in G1 and increased in G2 compared with those in G3 (Fig. 3). FCR improved in the birds in G2 compared with those in G1 and G3 (1.594 vs. 1.624 and 1.618, respectively) (Fig. 4).



	Day 1	Day 7	Day 14	Day 21	Day 28	Day 35
G 1	48.30	207.40	517.90	919.50	1386.40	1849.80
G 2	48.40	208.20	508.00	905.10	1369.80	1860.20
G 3	48.30	203.80	488.70	882.40	1356.90	1829.60

Values are expressed as mean (*N* = 180).
P >.05, compared with G1, based on one-way ANOVA followed by Dunnett multiple comparison post hoc test

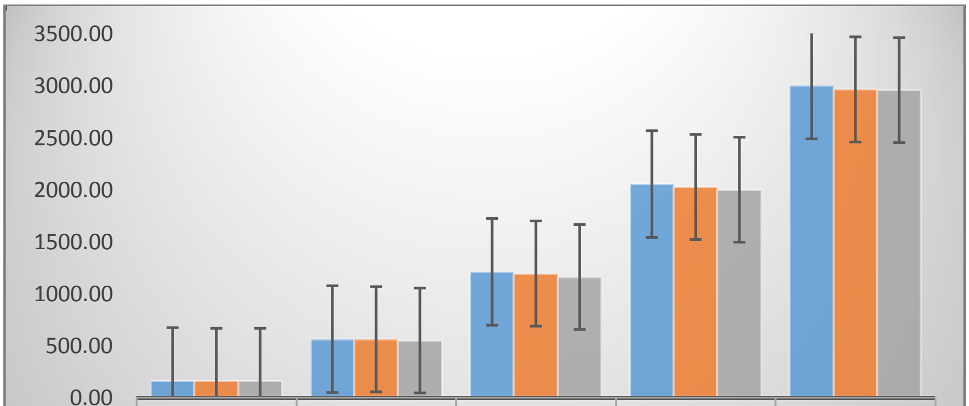
Figure 1. Effect of NAGP on body weight in Cobb 430 broiler chickens



	Day 7	Day 14	Day 21	Day 28	Day 35
G 1	22.70	44.40	57.40	66.70	66.20
G 2	22.70	42.80	56.70	66.40	70.10
G 3	22.20	40.70	56.20	67.80	67.50

Values are expressed as mean (*N* = 180).
P >.05, compared with G1, based on one-way ANOVA followed by Dunnett multiple comparison post hoc test.

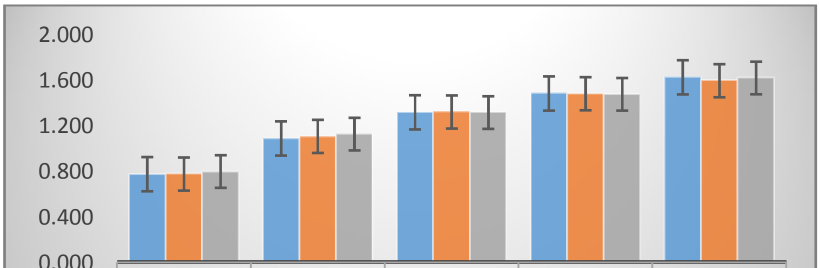
Figure 2. Effect of NAGP on average daily gain in Cobb 430 broiler chickens



	Day 7	Day 14	Day 21	Day 28	Day 35
G 1	160.60	563.30	1211.20	2054.90	3003.60
G 2	161.60	562.00	1194.60	2027.40	2965.90
G 3	162.70	550.40	1160.50	2001.50	2959.60

Values are expressed as mean (*N* = 180).
P >.05, compared with G1, based on one-way ANOVA followed by Dunnett multiple comparison post hoc test.

Figure 3. Effect of NAGP on feed intake in Cobb 430 broiler chickens



	Day 7	Day 14	Day 21	Day 28	Day 35
G 1	0.775	1.088	1.317	1.482	1.624
G 2	0.776	1.106	1.320	1.480	1.594
G 3	0.798	1.126	1.315	1.475	1.618

Values are expressed as mean (*N* = 180).
P >.05, compared with G1, based on one-way ANOVA followed by Dunnett multiple comparison post hoc test.

Figure 4. Effect of NAGP on feed conversion ratio in Cobb 430 broiler chickens

IV. Discussion

The main elective approach to fortify the intestinal defensive system of broiler birds is by utilizing growth promoters, such as phytobiotics, probiotics, and prebiotics, as feed supplements. They help improve the host mucosal immunity and resistance against pathogenic microorganisms [12]. Literature delineates that supplementation of phytobiotics or phytogenics along with a commercial diet helps improve growth performance by stimulating FI, stabilizing the gastrointestinal tract microbiota, and augmenting their resistance [13-17].

Our study results show that there was a gradual increment in the body weight of the birds throughout the study duration, that is, 35 days, following supplementation of NAGP compared with those in cAGP group. Furthermore, there was 22.70 and 30.60 g increase in body weight in the NAGP treatment group compared with cAGP group at the starter and finisher phases, respectively. Moreover, an ADG of 2.60 g was achieved in the

NAGP treatment group compared with the cAGP group. Following supplementation of NAGP,the birds consumed 16.60 and 37.7 g less feed compared with those in the control group. FCR improved in the birds supplemented with NAGP compared with those in the control and cAGP groups. Evaluation of FCR depicted that the birds supplemented with NAGP consumed 30 and 24 g less feed per unit body weight gain compared with those in the control and cAGP groups, respectively.

In summary, the results of the present study demonstrated that addition of NAGP with a commercial broiler feed has beneficial effects on the growth performance parameters (i.e., body weight, ADI, FI, and FCR) in broiler chickens. These findings are in concurrence with findings reported by Mohammadi et al [9].The beneficial effects of NAGP on growth performance parameters in Cobb 430 commercial broiler chickens can be attributed to herbs *A. indica*, *C. longa*, *A. paniculata*, and *C. zeylanicum* present in it.

Many studies have reported that dietary supplementation of *C. longa* has positive effects on weight gain and feed efficiency at marketing age [18-20]. These positive effects might be because of well-known anti-inflammatory, antioxidant, and antibacterial properties [21] or prebiotic-like effects of curcumin [22]. Emadi and Kermanshahi [23] reported in their study that *C. longa* improved FCR in broilers. According to Patel and Srinivasan [24], dietary spices can enhance secretions of amylase, trypsin, chymotrypsin, and lipase enzymes in albino rats.

Some studies [25,26] have reported that *A. indica* comprises bioactive compounds that possess antimicrobial and antiprotozoal properties that help limit the growth and colonization of pathogenic and nonpathogenic bacteria in the gastrointestinal tract of chickens. Thus, poultry gut can have a higher digestion efficiency and feed utilization that in turn improve FCR [27,28]. A study conducted by Nety et al. [29] reported that methanolic extract of *A. paniculata* exerts potent immunomodulatory effect in broiler chickens. In another study by Sunder et al. [30], supplementation of extract of *A. paniculata* resulted in augmentation of B-cell and T-cell responses in Nicobari fowls' broiler Japanese quail.

Literature reports revealed that essential oils have an appetizing effect because they stimulate taste buds, which further helps increase FI [31]. These oils also help improve digestibility by increasing the secretion of digestive enzymes and improving liver function [7]. Such materials have conventionally been used to enhance the release of endogenous secretions in the small intestine mucosa, pancreas, and liver, which in turn improve digestion and prevent adhesion of pathogens [32]. Furthermore, essential oils form absorbing environment inside the intestine through their antimicrobial potential [33]. Along with the specific impact of essential oils on the intestinal morphological parameters by expanding villus height and villus height-to-crypt ratio and diminishing the crypt depth, which is legitimately associated with appropriate ingestion and positive execution responses [34]. Abd El-Hack et al. [35] reported that using cinnamon essential oil as a feed additive in poultry diets has beneficial effects on the growth performance, antioxidant status, immunity, and antibacterial activity of poultry. Furthermore, the findings of Chowlu et al. [36] revealed that supplementing cinnamon along with broiler diet positively affects performance in terms of body weight gain, FI, and FCR because of its antioxidant, antimicrobial, and anti-inflammatory properties.

V. Conclusion

It was evident from the present study results that NAGP, which comprises *A. indica*, *C. longa*, *A. paniculata*,and *C. zeylanicum*, mimics the properties of AGPs because supplementation of NAGP (at a dose of 500 g/ton) played a crucial role in augmenting growth performance parameters, such as body weight, ADG, FI, and FCR, in Cobb 430 commercial broiler chickens.

To the best of our knowledge, this is the first study to demonstrate growth-enhancing effects of NAGP in Cobb 430 broiler chickens. Further studies should be conducted to evaluate the growth performance-enhancing effects of NAGP with biochemical, carcass traits, and histomorphometry parameters to elucidate the exact mechanism of action. Hence, NAGP, a phytogenic feed additive, can be recommended to enhance production performance in broiler chickens.

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