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Effect of Dietary Supplementation of Phytogenic Mixture Containing Garlic, Tulsi and Black Cumin on Growth Performance and Economics of Broilers

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ABSTRACT

Recent era has witnessed a growing interest in scientific community for utilising phytogenic mixture due to their novel attributes of improving performance of broilers. However, the search of economical phytogenic mixture is continuous. This experiment was formulated to study the effect of dietary supplementation of phytogenic mixture containing *Nigella sativa*, *Allium sativum* and *Ocimum sanctum* (1:1:1 ratio) in broilers. For this research, three comparable groups were formed viz. Control (no supplementation), T_1 (supplementation @0.25% of feed) and T_2 (supplementation @0.50% of feed) and this experiment lasted for 28 days. A total of 48 Cobb 400 broiler chicks were distributed randomly into three groups and each group contained 16 broiler chicks of same body weight. Statistical analysis of data revealed that T_1 and T_2 group had significantly higher overall body weight ($P<0.001$), feed conversion ratio ($P<0.001$) and feed conversion efficiency ($P<0.001$) than control group. However, T_1 and T_2 groups differed non-significantly ($P>0.05$). However, there was no significant difference in feed intake across all the groups. Economic analysis of production of broilers under three different feeding regimes revealed that T_1 and T_2 group broilers performed better than control group. Therefore, based on the findings of this study, it may be concluded that dietary supplementation of phytogenic mixture containing *Nigella sativa*, *Allium sativum* and *Ocimum sanctum* (1:1:1 ratio) @0.25% may economically improve the performance of broilers.

HIGHLIGHTS

- We studied the effect of phytogenic mixture on growth and economics of broilers.
- Phytogenic mixture had *Nigella sativa*, *Allium sativum* and *Ocimum sanctum* (1:1:1).
- Phytogenic mixture improved overall growth performance of broilers.

Keywords: Broilers, Economics, Performance, Phytogenic mixture

Poultry industry is considered as one of the fastest growing sectors in agricultural Gross Domestic Products (GDP) of India. Total poultry population in India is 851.81 million in the year 2019 (Singh *et al*., 2021a). Poultry meat is considered as one of the highest quality animal protein source to human (Singh *et al*., 2021b, Singh *et al*., 2021). Poultry meat consumption in Indian market is rapidly increasing especially in case of Indian Youth. Share of poultry meat in Indian meat market is nearly 50% (BAHS, 2019). Per capita meat consumption of meat per year in USA is around 100 kg while under Indian conditions, the per capita meat consumption is only 5 kg (Ritchie and Roser, 2017; Nagar *et al*., 2020; Nagar *et al*., 2021). However, production cost of broilers is increasing at high pace. The major reason for elevated cost of broiler production is rapid increase in cost of different feed ingredients and furthermore; poultry industry directly competes with human for production and availability

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of food grains (Mengesha, 2012; Thakur *et al*., 2020a; Thakur *et al*., 2020b).

Scientific community in Animal science field is continuously working to devise economical and feed efficient methods for producing broilers with improved body weights (Amsathkumar *et al*., 2019; Ayalew *et al*., 2022; Singh *et al.,* 2022). Improved body weights have been achieved through dietary addition of phytogenic mixture in broiler diets (Thakur *et al*., 2020a; Thakur *et al*., 2020b). In addition to that, phytogenic mixture do not impose risk of residual effects unlike antibiotic growth promoters and they are environment friendly and also they are easily adopted by farmers however, the studies suggested these phytogenic mixtures to be economical (Singh *et al*., 2023a; Singh *et al*., 2023b). Phytogenic mixtures works majorly by improving digestive activities, nutrient utilization, antioxidant nature and antimicrobial nature when supplemented in host animal (Palani *et al*., 2014; Puvaca *et al*., 2015; Prajapat *et al*., 2018). Phytogenic mixture is blend of two or more plant derived substances (Amsathkumar *et al*., 2019). Studies showed that *Nigella sativa* individually or in combination of other herbs improved the final body weights and feed conversion efficiency of broilers and similar results were observed in case of *Allium sativum* and *Ocimum sanctum* in broilers when supplemented individually or in combination with other herbs (Palani *et al*., 2014; Puvaca *et al*., 2015; Prajapat *et al*., 2018). Furthermore, earlier studies showed that synergistically improved performance may be achieved in broiler performances through combination of suitable herbs into a phytogenic mixture (Ali *et al*., 2014; Amsathkumar *et al*., 2019).

To the knowledge of authors there exists no study done to find out the effect of phytogenic mixture containing *Nigella sativa*, *Allium sativum* and *Ocimum sanctum* on growth performance and economics of boiler production. Therefore, this experiment was conducted to study the nutrient composition of ingredients of phytogenic mixture, its effect on growth performance and economics of broilers.

MATERIALS AND METHODS

Approval from animal experimentation committee

This research study was conducted after the approval of animal experimentation committee and Head of Department of Animal Husbandry & Dairying, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India.

Site of the study

The present experiment was carried out in small animal laboratory of the Department of Animal Husbandry & Dairying, SHUATS, Prayagraj-211007.

Pre-experimental preparations

Prior to placement of the chicks in the cages, the entire poultry house and its premises were thoroughly cleaned with water and disinfected followed by fumigation with formalin and potassium permanganate ($KMnO_4$ @0.02%). To ensure the maintenance of the bio-safety security of the house, a disinfectant (lime powder) was always provided as a foot dip at the entrance of the house.

Preparation of phytogenic mixture

Garlic (cloves), Tulsi (leaves) and black cumin (seeds) were purchased from the local market. All three ingredients were procured fresh from the local market. The bulb portion of garlic was peeled followed by slicing into small pieces, fresh Tulsi leaves were washed with clean water and seeds of black cumin seeds were taken together and dried at 40°C for 24 hours in hot air oven. Dried samples were converted to powder using electric blender and then transferred to separate and labelled air tight vessels and kept in a cool dry place away from sunlight till further usage.

Experimental animals and management

A total of 48 straight run Cobb 400 broiler chicks were purchased from a corporate hatchery firm. Chicks were then administered anti-stress (sugared solution and multivitamins) after their arrival and were distributed according to the treatment groups and identified individually by means of wing tags. Battery type cages were used for rearing birds and they were provided with standard farm managemental practices providing 1.2 sq. ft. /bird space from day-old to four weeks of age. Fresh feed and clean water were served *ad libitum*. Birds were

reared under the same environmental conditions. During the brooding, chicks were kept under the maintained temperature at 35° C during the first week, followed by lowering the temperature by 3° C every week till temperature of room was adjusted to 25° C in following days. One bulb of 100 watt was provided in each cage for light and to maintain the temperature in the room. The experimental period was for 28 days from starting week of February 2022 to second week of March 2022.

Experimental design and treatments

The birds were assigned into three comparable treatment groups. Each treatment group had 16 birds comprising 4 replicates in each group with 4 birds per replicate in a complete randomized design. Each group was fed with corresponding experimental diet-

1. **Control:** Chicks were provided with standard ration as per NRC, 2007 standards, without any supplement.
2. T_1: Standard ration supplemented with 0.25% of phytogenic mixture per kg of feed.
3. T_2: Standard ration supplemented with 0.50% of phytogenic mixture per kg of feed.

Phytogenic mixture contained Garlic (*Allium sativum*), Tulsi (*Ocimum sanctum*) and Black Cumin (*Nigella sativa*) powder mixed in equal proportions 1:1:1 and then supplemented in the desired amount in respective treatment groups. The broiler starter diet (Table 1) contained 22% crude protein (CP) with 3, 000 ME kcal/kg whereas, the broiler finisher diet had 20% CP and 3, 150 ME kcal/kg in accordance with NRC standards. The feeding and watering was made available *ad-libitum* to the birds.

Nutrient composition analysis

All the ingredients were oven dried at 40 degree centigrade for 24 hours and the readings were taken for consecutively two times when both the reading showed no difference. These oven dried ingredients were powdered using mechanical grinder. Dried powder form of the ingredients of phytogenic mixture viz. Black cumin, Garlic and Tulsi were analysed following the standard procedures as per AOAC (1990) for crude protein, ash content, and crude fibre and ether extract contents as shown in table 2.

Analysed dry matter in ingredients of phytogenic mixtures:

1. 33.49% dry matter in raw Garlic
2. 8.28% dry matter in Tulsi leaves
3. 94.84% dry matter in *Nigella sativa* seeds

Since, 33.49% is the dry matter or powder present in raw Garlic which will be powdered:

- This implies that about 335 g of dry matter is present in 1000 g of raw Garlic
- Which means that 1000 g powder may be obtained by powdering raw Garlic = (1000*1000)/ 335 = 2985.07 g = 2.99 kg
- The dry matter in Tulsi leaves is 8.28% which will be powdered
- This implies that about 83g of dry matter or powder is present in 1000 g Tulsi leaves
- Which means that 1000 g powder may be obtained by powdering Tulsi leaves = (1000*1000)/83 = 12048.19 g = 12.05 kg
- The dry matter in *Nigella sativa* seeds is 94.84% which will be powdered
- This implies that about 950 g of dry matter or powder is present in 1000 g *Nigella sativa* seeds
- Which means that 1000g powder may be obtained by powdering *Nigella sativa* seeds = (1000*1000)/950 = 1052.63 g = 1.05 kg

In order to prepare 3 kg phytogenic mixture containing dry powder of Garlic, Tulsi and *Nigella sativa* in 1:1:1 ratio 1 kg dry powder of Garlic, Tulsi and *Nigella sativa* will be needed:

- Cost of 1kg Garlic powder (made from 2.99 kg raw Garlic) @ ₹ 100/kg = ₹ 299.00
- Cost of 1 kg Tulsi powder (made from 12.05 kg Tulsi leaves) @ ₹ 40/kg = ₹ 482.00
- Cost of 1 kg *Nigella sativa* powder (made from 1.05 kg *Nigella sativa* seeds) @ ₹ 300/kg = ₹ 315.00

Total cost of 3 kg phytogenic mixture containing dry powder of Garlic, Tulsi and *Nigella sativa* in 1:1:1 ratio = ₹ 1096.00

Per kg cost of phytogenic mixture = ₹ (1096/3) = ₹ 365.33

Cost of phytogenic powder for 1 gram = ₹ 0.365

- Since, broiler in T_1 group consumed on an average 2.19 kg feed

Which means that at supplementation of 0.25% of feed supplied to them, they consumed total of phytogenic mixture per broiler = 0.25% of 2.19 kg = 5.5 grams

- Cost of supplementing phytogenic mixture in group T_1 = ₹ (5.5*0.365) = ₹ 2.00

Similarly, broiler in T_2 group consumed on an average 2.23 kg feed

- Which means that at supplementation of 0.50% of feed supplied to them, they consumed total of phytogenic mixture per broiler = 0.50% of 2.23 kg = 11.2 grams
- Cost of supplementing phytogenic mixture in group T_2 = ₹ (11.2*0.365) = ₹ 4.08

STATISTICAL ANALYSIS

All data collected were analysed meticulously for analysis of variance (ANOVA) using Statistical Analysis System software of IBM (SPSS 22). Microsoft Excel was used for statistics and graphical representations. Duncan Multiple Range Test was performed for determining the significant differences among different groups. Difference was considered significant when the value of *P* was lower or equal to 0.05.

RESULTS AND DISCUSSION

Nutrient composition of ingredients of phytogenic mixture

Table 2 shows the nutrient composition of ingredients of phytogenic mixture. Nutrient analysis (on dry matter basis) showed that dry matter, ash, crude fibre, crude protein and ether extract content in black cumin seeds was 94.84%, 3.94%, 5.20%, 19.96% and 36.33%. While, dry matter, ash, crude fibre, crude protein and ether extract content in Garlic cloves was 33.49%, 1.73%, 2.06%, 12.62% and 2.41%. However, dry matter, ash, crude fibre, crude protein and ether extract content in Tulsi leaves was 8.28%, 13.11%, 9.17%, 18.36% and 3.51% respectively. Similar results were observed in different studies (Mohan *et al*., 2011; Ali *et al*., 2012; Javed *et al*., 2012; El-Hack *et al*., 2016; Vidhani *et al*., 2016; Kumar *et al*., 2017; Espinoza *et al*., 2020).

Ingredients such as Black cumin, Garlic and Tulsi are considered as effective phytogenic herbs which may improve the performance of broilers upon their dietary supplementation (Kumar *et al*., 2017; Amsathkumar *et al*., 2019; Ayalew *et al*., 2022). These ingredients have been used widely in medicines and in preparation of culinary dishes (Mohan *et al*., 2011; Ali *et al*., 2012; Javed *et al*., 2012).

Table 1: Ingredient and nutrient composition of experimental diet (%DM)

Ingredients (%)	Broiler starter (0 – 21 day)	Broiler finisher (22 – 28 days)
Corn	53.53	59.58
Soyabean meal (44 %CP)	38.95	33.33
Monodibasic Phosphate	1.44	1.22
Limestone	1.34	1.37
Vegetable oil	3.85	3.53
Salt	0.40	0.41
DL- Methionine	0.208	0.215
L-Lysine- HCL	0.128	0.196
Choline HCL (60%)	0.06	0.05
Mineral- Vitamins premix	0.01	0.01
Total	100	100
Calculated Nutrients		
Crude protein %	22	20
ME, Kcal/kg	3000	3,150
Calcium %	0.91	0.88
Available phosphorus %	0.40	0.36
Sodium %	0.21	0.22
Chloride %	0.26	0.28
Digestible Lys. %	1.17	1.08
Digestible Met. %	0.48	0.49
Digestible Met+ Cys %	0.82	0.78
Digestible Thr, %	0.79	0.73
Choline, mg/kg	1,422	1,312

Table 2: Nutritional composition of different ingredients used in phytogenic mixture

Parameters %Dry matter	Composition (%)		
	Nigella sativa	***Allium sativum***	***Ocimum sanctum***
Moisture	5.16 ± 0.09	66.51 ± 0.20	91.72 ± 0.04
Dry matter	94.84 ± 0.09	33.487± 0.16	8.28 ± 0.04
Ash content	3.94 ± 0.03	1.73 ± 0.01	13.11 ± 0.08
Crude Fibre	5.20 ± 0.01	2.06 ± 0.02	9.17 ± 0.08
Crude Protein	19.96 ± 0.5	12.62 ± 0.05	18.36 ± 0.10
Ether Extract	36.33 ± 0.22	2.41 ± 0.02	3.51 ± 0.09

Table 3: Overall performance of broilers fed with phytogenic mixture

Parameters	Control	T_1	T_2	SEM	Statistical significance
Feed Intake (g)	22123.56	2193.00	2231.75	14.82	NS, P=0.192
Initial body weight (g)	45	43.5	44.5	0.55	NS, P=0.530
Final body weight (g)	1482.75^a	1595.06^b	1632.25^b	14.02	S, P<0.000
FCR	1.54^a	1.41^b	1.41^b	0.01	S, P<0.000
FCE (%)	64.98^a	70.74^b	71.12^b	0.56	S, P<0.000

Means bearing different superscripts differ significantly; NS- Non significant; S-Significant.

Feed intake and body weight of broilers

Results as showed in table 3, indicated a significantly higher (P<0.001) overall body weights in treatment groups (T_1 and T_2) than control group birds. Whereas, T_1 and T_2 groups differed non-significantly (P>0.05) for body weight. However, overall feed intake in all the groups was found statistically similar (P>0.05). The reason behind the increased body weights in broilers of phytogenic mixture supplemented groups may be majorly due to better digestive capacities, nutrient utilization, antioxidant nature and antimicrobial nature of phytogenic ingredients (Puvaca *et al*., 2015; Prajapat *et al*., 2018; Amsathkumar *et al*., 2019; Nagar *et al*., 2020; Nagar *et al*., 2021; Ayalew *et al*., 2022).

The findings of present study are in line with earlier studies which also showed significantly improved overall body weights of broiler supplemented with phytogenic mixture (Al-Beitawi and El-Ghousein, 2008; Amsathkumar *et al*., 2019; Thakur *et al*., 2020a; Thakur *et al*., 2020b; Ayalew *et al*., 2022). However, some studies showed no change in body weights of broilers on supplementation of herbs (El-Deek *et al*., 2002; Kumar *et al*., 2017). Furthermore, in contrast of findings of this study, feed intake was increased in broilers supplemented with herbs (Khalaji *et al*., 2011; Ghasemi *et al*., 2014; Kumar *et al*., 2017). While our findings are in line with some studies which showed no change in feed intake in broilers fed with phytogenic feed mixture (Amad *et al*., 2011; Amad *et al*., 2013; Asli and Ghanaatparast-Rashti, 2017).

Feed efficiency of broilers

As shown in the table 3, our study showed a significantly improved (P<0.001) feed conversion ratio in broilers which were in supplemented groups T_1 (1.41) and T_2 (1.41) than control (1.54) groups. However, T_1 and T_2 group differed non-significantly. Furthermore, feed conversion efficiency was found significantly higher (P<0.001) in T_1 (70.74%) and T_2 (71.12%) than control (64.98%) groups but, T_1 and T_2 groups had no significant differences. The reason behind improved FCR and FCE despite of non-significant feed intake may be attributed towards better utilization of nutrients available, better digestibility of feed, antioxidant and antimicrobial properties of phytogenic mixture fed to the broilers (Puvaca *et al*., 2015; Prajapat *et al*., 2018; Amsathkumar *et al*., 2019; Nagar *et al*., 2020; Nagar *et al*., 2021; Ayalew *et al*., 2022). The findings of this study are in corroboration with earlier study who reported improved feed efficiencies in supplemented broilers (Al-Beitawi

Table 4: Economical analysis of phytogenic mixture in broilers diet

Description	T_0	T_1	T_2
Cost/chick (₹)	34	34	34
Average feed consumed/chick (kg)	2.21	2.19	2.23
Required phytogenic mixture (g)	—	5.48	11.15
Feed price/Kg (₹)	44.66	44.66	44.66
Total feed cost/bird (₹)	98.70	97.80	99.59
Cost of phytogenic mixture (₹)	0.00	2.00	4.08
Miscellaneous (₹)	25	25	25
Total cost/broiler (₹)	157.70	158.80	162.67
Average live body weight (kg)	1.48	1.60	1.63
Sale price/kg live weight (₹)	150	150	150
Sale price/broiler (₹)	222.41	239.26	244.84
Net profit/broiler (₹)	64.71	80.46	82.17
Profit/kg live weight (₹)	43.72	50.29	50.41
Net Profit/ Feed cost	0.66	0.82	0.82
Profit over control group /broiler	—	15.75	17.46

and El-Ghousein, 2008; Hassan *et al*., 2015; Hafeez *et al*., 2016). Whereas, findings of some studies are in contrast with the findings of some earlier studies (Asli and Ghanaatparast-Rashti, 2017; Nagar *et al*., 2020; Nagar *et al*., 2021).

Economical analysis

As shown in table 4, in overall, it can be said that treatment groups T_1 (50.29) and T_2 (50.41) fetched more profit than that of control (43.72) group after feeding phytogenic mixture in treatment groups. Interestingly, the treatment groups T_1 and T_2 performed better than control group T_0 however, T_1 and T_2 produced similar amount of profit per kg of live weight selling. Hence, from economic point of view, T_1 can be recommended as less phytogenic mixture and similar labour and time is required in T_1 than T_2 group for producing similar profit from this experiment. In different studies (Pandey *et al*., 2013; Ali *et al*., 2014; Patel *et al*., 2017; Chaudhari *et al*., 2020) conducted on different herbals or mixtures, an increase in profit margin per kg of live body weight was observed. The reason behind this was the increase in feed efficiency for production of per kg live body weight of broilers.

CONCLUSION

This study showed that higher overall body weight and feed efficiency was achieved in phytogenic mixture supplemented groups (T_1 and T_2) than control group. Economic analysis of production of broilers under three different feeding regimes revealed that T_1 and T_2 group broilers performed better than control group. Therefore, based on the findings of this study, it may be concluded that dietary supplementation of phytogenic mixture containing *Nigella sativa*, *Allium sativum* and *Ocimum sanctum* (1:1:1 ratio) @ 0.25% of broilers feed may economically improve the performance of broilers.

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