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Performance of Broiler Chicken Fed Diets Supplemented with a Phytogenic Mixture

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ABSTRACT

Two hundred fifty (Vencobb-400Y strain), day old broiler chicks were randomly divided into 5 groups of 50 birds each. Each group was further divided in to 5 replicates of 10 birds each. These were kept either on basal diet without any supplement (NCON), basal diet with antibiotic (PCON), basal diet with 1% phytogenic mixture (LPH), basal diet with 2% phytogenic mixture (MPH) and basal diet with 3% phytogenic mixture (HPH) for 35 days in order to evaluate the effect of a phytogenic mixture on the performance of broiler chicken. The phytogenic mixture supplemented group's birds had higher body weight than the control group birds and the mean body weight of LPH, MPH and HPH was higher (P<0.05) than NCON group. After 35 days of experimental period, it was found that the total feed intake of phytogenic supplemented birds was similar to NCON group but higher than that of PCON birds. Among the phytogenic mixture supplemented birds, lowest feed intake was observed in MPH group. Among the herbal supplemented groups, lowest FCR was found in MPH group and it was similar to PCON group. The energy efficiency ratio (EER) of herbs supplemented groups was higher (P<0.05) than NCON group but lower than that of PCON group. The protein efficiency ratio (PER) of phytogenic mixture supplemented birds was better (P<0.05) than NCON group and lower than that of PCON group. Among herbal groups, the highest PER was found in MPH group. The performance index of phytogenic mixture supplemented birds was higher (P<0.05) in comparison to NCON birds. Rearing of broilers supplemented with phytogenic mixture was more economical than NCON group but less economical than the birds reared on conventional system of rearing *i.e.* on AGP. Therefore, 2% phytogenic mixture was economical and has potential to use as an alternative to AGP in broiler rearing.

Key words: Broiler, Chicken, Economics, Growth Performance, Phytogenic mixture

INTRODUCTION

Broiler chicken grow very fast and it is ready for marketing within 35-42 days. The rapid growth rate in broilers imposes severe stress on birds which leads to poor performance, immuno-suppression and high mortality (Xie and Song, 2005). To reduce stress in birds, antibiotics are added in feed. But the European Union in January, 2006 banned the majority of commercial antibiotic growth promoters used in poultry feed in order to protect consumer health. This has led to the interest in finding alternatives to antibiotics for poultry production (Hassan *et al.,* 2011).

Herbs can serve as safer alternatives as growth promoters due to their suitability and preferences, reduced mortality, reduced risk of diseases, minimum health hazards and environment friendliness. Our country abounds in herbal plants having pharmacological properties which needs exploitation by the modern methods. Tulsi (O*cimum sanctum*) is an analgesic and antistress agent and has antimicrobial, anti-inflammatory, immuno-stimulant and anti-oxidative property (Singh *et al.,* 2014). Neem (*Azadirachta indica*) leaves have different medicinal properties like immunostimulant, antiviral, antibacterial, antifungal, hepatoprotective and antiprotozoal, and has no side effects (Ong *et al.,* 2014). Sahijan (*Moringa oleifera*) leaves are good sources of fats, proteins, minerals and have antimicrobial effects (Olugbemi *et al.,* 2010). Eucalyptus is a well known medicinal plant because of its biological and pharmacological properties. It has antibacterial activities against *Salmonella, Klebsiella, Streptococcus, Proteus, Staphylococcus and Escherichia* coli (Hassan *et al.,* 2011). Giloy *(Tinospora cardiofolia)* also known as guduchi has immune-potentiating, antibacterial, antidiabetic, analgesic and antioxidant properties. It has hepatoprotective effect

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(Ganguly and Prasad, 2011). Most of polyherbal mixtures could be used as an alternative to antibiotic growth promoters (AGP). Considering the above facts, a phytogenic mixture was formulated by using tulsi, neem, sahijan, eucalyptus leaves and its effect on performance of birds was evaluated.

MATERIALS AND METHODS

Day-old commercial Vencobb-400Y broiler chicks (n=250) were distributed in a completely randomized design into five groups of 50 chicks each and they were further subdivided into five replicates of ten birds each. The chicks were placed on one of the five dietary treatments *i.e.* either a basal diet (NCON) or that supplemented with antibiotic noseheptide (PCON), phytogenic mixture at level of 1% (LPH), 2.0% (MPH) and 3% (HPH). The indigenous economical phytogenic mixture containing blend of neem, tulsi, sahijan and eucalyptus leaves and giloy stem powder. The experimental diets were formulated for pre-starter (1-7 d), starter (8-21 d) and finisher (22-35 d) phases separately as per BIS (2007) and ingredients composition of diets has been presented in Table 1.

The chicks were kept hygienically on floor litter system in separate pens. All the birds were reared adopting uniform management conditions. Replicatewise body weight of chicks was recorded at day 0 and then at weekly intervals upto 35 d. Replicatewise total feed consumed during the experimental period was recorded weekly. These data were used to calculate feed conversion ratio (FCR).The energy efficiency ratio (EER; g of weight gain ×100/total ME intake) and protein efficiency ratio (PER; grams of weight gain/g of protein intake) were calculated. Performance index (PI) was calculated (North and Bell, 1990). To find out the commercial viability of phytogenic mixture as an alternative of antibiotic growth promoters, economic efficiency was also calculated. The diets were analysed for proximate principles (AOAC, 2000).

Table 1. Ingredients and chemical composition of basal diet

Ingredient	Pre-starter (1-7 d)	Starter (8-21 d)	Finisher (22-35 d)
Ingredient composition (% as fed basis)			
Maize	50.42	55.52	59.82
Soybean meal	42.00	36.40	27.40
Rice polish	-	-	5.00
Vegetable fat	4.48	5.18	5.43
Dicalcium phosphate	1.15	0.97	0.80
Limestone powder	0.90	1.04	0.75
Common salt	0.40	0.38	0.36
DL-Methionine	0.25	0.18	0.16
Choline chloride	0.15	0.08	0.03
Vitamin premix[1]	0.05	0.05	0.05
Mineral premix[2]	0.10	0.10	0.10
Nutrient composition (% DM basis)			
Dry matter	87.15	87.77	89.22
Crude protein	23.14	22.09	20.30
Crude fiber	3.05	3.25	3.45
Ether extract	4.98	5.80	7.78
Metabolizable energy[*] (kcal/kg)	3003	3107	3203

[1]Supplies (per kg diet): vitamin A 16500 IU; vitamin D_3 3200 ICU; vitamin E 12 mg; vitamin K 2 mg; vitamin B_2 10 mg; vitamin B_6 2.4 mg; vitamin B_{12} 12 mg; niacin 18 mg and pantothenic acid 12 mg; [2]Supplies (per kg diet): manganese 90 mg; zinc, 72 mg; iron, 60 mg copper, 10 mg and iodine 1.2 mg; [*]Calculated value

Data were subjected to statistical analysis using completely randomized design employing one way analysis of variance (Snedecor and Cochran, 1989). The means of different treatments were compared with Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical composition of diets has been presented in Table 1. The information on effect of phytogenic mixture supplementation on body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) has been presented in Table 2. The overall body weight gain of birds from d 1 to 35 in phytogenic mixture as well as in antibiotic supplemented chicks was similar and higher (P<0.05) than the NCON group. Body weight gain was not affected by treatments during prestarter period. However, in starter period BWG in phytogenic mixture supplemented groups was higher (P<0.05) than PCON and NCON groups. the BWG in LPH and MPH groups in finisher phase was higher (P<0.05) than NCON group but similar to that of PCON group. The present findings of higher body weight gain of broilers due to indigenous polyherbal mixture supplementation are in concurrence with the reports of Bhattacharya and Bhattacharya (2013) and Alam *et al.* (2015). Similarly, Khatun *et al.* (2013) supplemented tulsi and neem leaves extract @ 1, 2 and 3 ml/L drinking water of broiler chicken and found that the chicks supplemented with herbal extracts had higher live weight. Rahman *et al.* (2014) also reported that supplementation of neem, turmeric, cinnamon extracts in the feed of broiler chicken improved (P<0.05) the mean live weights of birds in comparison to control group birds. Tazi (2012) showed a positive effect of moringa on body weight gain of broiler chicken. On the contrary, Namagirilakshmi (2005) and Varaprasad *et al.* (2007) found no effect on body weight gain of chicks due to supplementation of herbal mixture. The differences reported in other studies could be attributed to difference in inclusion level of herbs, sources of herbs, basal diet composition or microbial environment in which the birds were reared.

In phytogenic mixture supplemented groups total feed intake were comparable to NCON group but was higher (P<0.05) than PCON group. In different phases of growth, it was found that in initial phase *i.e*. prestarter period, feed intake of phytogenic mixture supplemented groups was similar to PCON but lower (P<0.05) than NCON group. In starter and finisher phase, feed intake of HPH group was higher than PCON group and

Table 2. Effect of experimental diets on body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) of broiler chicken

Period	Attribute	Group*					SEM
		NCON	PCON	LPH	MPH	HPH	
1-7 d (Pre-starter)	BWG (g/bird)	170.60	169.20	163.40	165.30	164.90	1.699
	FI (g/bird)	149.60^{a}	126.00^{b}	127.40^{b}	127.20^{b}	128.40^{b}	2.19
	FCR	0.88^{a}	0.77^{b}	0.78^{b}	0.75^{b}	0.78^{b}	0.010
8-21 d (Starter)	BWG (g/bird)	725.60^{b}	758.00^{b}	808.40^{a}	808.60^{a}	849.20^{a}	10.99
	FI (g/bird)	979.00^{ab}	964.40^{b}	949.40^{bc}	937.00^{c}	999.60^{a}	10.51
	FCR	1.35^{a}	1.14^{b}	1.18^{b}	1.16^{b}	1.18^{b}	0.017
22-35 d (Finisher)	BWG (g/bird)	963.60^{c}	1092.00^{a}	1063.20^{ab}	1060.60^{ab}	992.60^{bc}	15.90
	FI (g/bird)	1976.00^{ab}	1921.00^{b}	2003.00^{a}	1972.00^{ab}	2037.00^{a}	12.97
	FCR	2.05^{a}	1.77^{b}	1.89^{b}	1.87^{b}	2.05^{a}	0.030
1-35 d (Overall)	BWG (g/bird)	1859.80^{b}	2019.20^{a}	2035.00^{a}	2034.50^{a}	2006.70^{a}	20.32
	FI (g/bird)	3104.60^{ab}	2911.40^{c}	3079.80^{ab}	3036.20^{b}	3165.00^{a}	23.18
	FCR	1.67^{a}	1.45^{d}	1.51^{c}	1.50^{cd}	1.58^{b}	0.017

^{a,b,c,d}Means with different superscripts in a row differ between groups significantly (P<0.05); *NCON- basal diet; PCON- basal diet+ antibiotic; LPH- basal diet + 1% phytogenic mixture; MPH- basal diet + 2% phytogenic mixture; HPH- basal diet + 3% phytogenic mixture

similar to that of NCON group. The higher feed intake in HPH group and NCON group birds than PCON might be due to the less efficient utilization of nutrient for energy need of birds, because birds feed intake is directly influenced by its energy requirements. Singh *et al.* (2014) observed that incorporation of tulsi leaf powder in broiler diet did not affect feed intake. Rahman *et al.* (2015) also revealed no significant differences in feed consumption of broiler chicken due to supplementation of neem leaf and ginger. Contrary to these findings, Nath *et al.* (2012) reported that supplementation of herbal formulation containing tulsi @ 1 ml/L in drinking water exhibited significant positive effect on the feed intake. Qamar (2015) reported that supplementation of a commercial herbal products showed a significant positive effect on the feed consumption of broilers. However, Iheukwumere *et al.* (2008) reported decline in feed intake by supplementing neem leaf meal in broiler feed. Ogbe and Affiku (2012) found decline in feed intake in broilers by supplementing a poly-herbal extract that have high concentration of *M. oleifera* leaves extract.

The overall FCR of phytogenic mixture supplemented groups was better (P<0.05) than NCON group and in MPH group FCR was comparable to PCON group. In prestarter and starter period, FCR of phytogenic mixture and antibiotic supplemented birds was similar and lower (P<0.05) than NCON group. However, this FCR trend was only observed in LPH and MPH group in finisher period. The positive results in indigenous polyherbal supplemented groups are compatible with the earlier findings in which broilers fed rations containing tulsi had better feed conversion ratio (Singh *et al.,* 2014; Nath *et al.,* 2012) compared to its absence in ration. Similarly, it was also reported that supplementation of neem and ginger in diet of broilers reduced FCR (Rahman *et al.,* 2015). Chicks fed on moringa based diets performed better (P<0.05) in term of FCR (Ebenebe *et al.,* 2012). Hasan *et al.* (2011) found that FCR was significantly improved by using both eucalyptus and antibiotic and their mixtures when compared with control group in laying quail. However, non-significant change in FCR of broiler chickens was reported on supplementation of neem leaf powder (Sabeeha *et al.,* 2015).

In the prestarter and starter phase EER and PER of phytogenic mixture supplemented birds were similar to PCON group and higher (P<0.05) than NCON group

Table 3. Effect of experimental diets on energy efficiency ratio (EER), protein efficiency ratio (PER) and performance index (PI) of broiler chicken

Period	Attribute	Group					SEM
		NCON	PCON	LPH	MPH	HPH	
1-7 d (Pre-starter)	EER	38.07^{b}	44.74^{a}	42.72^{a}	43.25^{a}	42.74^{a}	0.560
	PER	4.94^{b}	5.81^{a}	5.54^{a}	5.61^{a}	5.55^{a}	0.073
	PI (%)	23.75^{b}	27.00^{a}	25.76^{ab}	26.92^{a}	26.00^{ab}	0.400
8-21 d (Starter)	EER	23.91^{b}	28.27^{a}	27.45^{a}	27.84^{a}	27.40^{a}	0.358
	PER	3.36^{b}	3.97^{a}	3.85^{a}	3.91^{a}	3.85^{a}	0.050
	PI (%)	69.22^{c}	84.73^{b}	86.00^{b}	87.25^{b}	89.34^{a}	1.810
22-35 d (Finisher)	EER	15.23^{b}	17.73^{a}	16.60^{a}	16.77^{a}	15.22^{b}	0.262
	PER	2.40^{b}	2.80^{a}	2.62^{a}	2.65^{a}	2.40^{b}	0.042
	PI (%)	92.52^{c}	117.06^{a}	110.15^{ab}	111.65^{ab}	99.64^{bc}	2.550
1-35 d (Overall)	EER	18.94^{d}	21.89^{a}	20.89^{b}	21.16^{b}	20.03^{c}	0.231
	PER	2.88^{d}	3.34^{a}	3.19^{b}	3.23^{b}	3.05^{c}	0.036
	PI (%)	113.74^{c}	142.62^{a}	137.09^{ab}	138.85^{ab}	129.59^{b}	2.650

^{a,b,c,d}Means with different superscripts in a row differ between groups significantly (P<0.05)

(Table 3). In finisher phase, EER, PER and PI of LPH and MPH groups was similar to that of PCON group and higher (P<0.05) in comparison to NCON group. The overall EER and PER values of phytogenic mixture supplemented groups were lower (P<0.05) than PCON group and higher than NCON group. The overall PI was similar in LPH and MPH groups compared to traditional antibiotic supplement *i.e*. PCON and higher (P<0.05) than NCON group. Among the phytogenic mixture supplemented groups, the highest PI value was found in MPH group. The improvement in performance indices *i.e.* BWG, FCR, EER, PER and PI of broilers supplemented with a phytogenic mixture might be due to the synergistic action of the active principles of the herbs blend to prepare the herbal product. It could be partly explained by the increase in the apparent digestibility of dietary protein and the pre-caecal digestive capacity in general which increased the intestinal availability of nutrients for absorption and consequently birds grew faster (Windisch *et al.,* 2008). Another mode of action of growth-promoting herbs arises from stabilizing the ecosystem of the gastrointestinal microbiota (Windisch *et al.,* 2008) by decreasing microbial activity and controlling potential pathogenic microorganisms in the gastrointestinal tract of animals (Castillo *et al.,* 2006). In fact, animals receiving feed supplemented with polyherbal preparation had more stabilized intestinal health and less exposed to microbial toxins and other undesired microbial metabolites such as ammonia and biogenic amines (Jamroz *et al.,* 2003; Windisch *et al.,* 2008). Moreover, decreasing microbial activity led to reduced production of VFA which contributed to the stabilization of the intestinal pH and ensured an optimum activity of digestive enzymes (Jamroz *et al.,* 2003). In addition, Jamroz *et al.* (2006) demonstrated that essential oils present in some herbs improved the absorptive capacity of the intestinal mucosa by increasing intestinal villi size and crypt depth.

Total expenditure to rear an individual bird in different groups ranged from ₹ 107.82 to ₹ 118.69 and exhibited that rearing of birds on phytogenic mixture

Table 4. Economics of broiler production kept under different treatments from one day old to 5 weeks age

Attribute	Group					SEM
	NCON	PCON	LPH	MPH	HPH	
Chick cost (₹)	20.00	20.00	20.00	20.00	20.00	0.000
Feed cost (₹)						
a. Prestarter	4.61^{a}	3.88^{b}	3.92^{b}	3.92^{b}	3.95^{b}	0.068
b. Starter	27.41^{ab}	24.20^{d}	26.58^{bc}	26.24^{c}	27.99^{a}	0.294
c. Finisher	56.51^{ab}	54.94^{b}	57.28^{a}	56.40^{ab}	58.25^{a}	0.371
d. Total	88.53^{ab}	83.03^{c}	87.79^{ab}	86.55^{b}	90.20^{a}	0.660
Herbal/antibiotic cost (₹)	0.00^{e}	0.29^{d}	1.29^{c}	2.55^{b}	3.99^{a}	0.303
Miscellaneous (₹)	4.50	4.50	4.50	4.50	4.50	0.000
Total expenditure (₹)	113.03^{b}	107.82^{c}	113.59^{b}	113.60^{b}	118.69^{a}	0.833
Total expenditure/ kg live wt. (₹)	59.58^{a}	52.51^{c}	54.81^{b}	54.94^{b}	58.09^{a}	0.580
Total gain (₹)	119.52^{b}	129.58^{a}	130.55^{a}	130.51^{a}	128.77^{a}	1.285
Net profit (₹)	6.42^{b}	10.49^{a}	8.19^{b}	8.06^{b}	4.91^{c}	0.580
Economic efficiency	0.08^{d}	0.26^{a}	0.19^{b}	0.19^{b}	0.11^{c}	0.015
Relative economic efficiency	0.00^{d}	2.73^{a}	1.77^{b}	1.78^{b}	0.59^{c}	0.224

^{a,b,c,d,e}Means with different superscripts in a row differ significantly (P<0.05)

was costlier than the birds reared on antibiotics (Table 4). It was also observed that cost of rearing on this phytogenic mixture in LPH and MPH groups was not higher than the birds reared only on basal diet (NCON). However, production cost/kg live weight in LPH (₹ 54.81) and MPH (₹ 54.94) groups was lower (P<0.05) in comparison to NCON group (₹ 59.58). The net profit per bird ranged from ₹ 4.91 to 10.49 and it showed no variation among LPH, MPH and NCON groups. However, net profit was lower (P<0.05) in phytogenic mixture supplemented groups than PCON group. The economic efficiency and relative economic efficiency data revealed that rearing of broilers on phytogenic mixture was more economical than NCON group but less economical than the birds reared on conventional system of rearing *i.e*. AGP. The results of the present study are in line with the findings of Mahmood *et al.* (2014) who reported that supplementation of various commercial herbal growth promoters in the ration exhibited an increase in the profit margin of broilers as compared to those using ration without supplementation. Similarly, Ahmad (2005) reported that dietary inclusion of polyherbal mixture in the feed was more economical in broiler production. Singh *et al.* (2014) found lower cost of production per broiler in 1% tulsi leaf powder supplemented group in comparison to control group. Reddy *et al.* (2012) also reported that the feed cost per kg live weight gain was lower (P<0.01) in 0.25% tulsi and 0.25% herbals combination supplemented birds. Sabeeha *et al.* (2015) reported that neem leaf powder supplementation @ 100 g/50 kg diet was more economical than other groups.

CONCLUSION

The dietary supplementation of a phytogenic mixture @ 2% showed potential as an alternative of antibiotic growth promoters and improved the overall performance of broiler chickens.

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