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Effect of dietary inclusion of ginger (*Zingiber officinale*) and thyme (*Thymus vulgaris*) powder on growth performance, carcass traits, blood metabolites and economics of Giriraja

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Abstract
In order to evaluate effect of dietary inclusion of ginger and thyme powder on growth performance, carcass traits, blood metabolites and economics of Giriraja. Eighty (day old) Giriraja chicks were randomly distributed to four treatments with 20 chicks in each group. The dietary treatments consisted of one basal diet as control (T_1), 0.5% ginger powder (T_2), 0.5% thyme powder (T_3), and 0.5% ginger + 0.5% thyme powder (T_4), added to basal diet. The experiment was conducted for 8 weeks. Body weight, weight gain and feed intake were recorded weekly and accordingly feed conversion ratio was calculated. Blood samples were taken on 39 day of age from the wing vein of birds from each treatment. At the end of 8th week, 5 birds per replicate were sacrificed to determine the carcass characteristics. The result revealed that inclusion of ginger powder at 0.5% level improved the weight gain and feed conversion ratio and dressing percentage and there were no significant differences in the percentages of heart, liver and gizzard in all the treated groups compared to the control groups. Blood parameters data revealed that inclusion of thyme powder at 0.5% level increase level of total protein, Albumin and Globulin, and decreased the cholesterol, triglyceride LDL-cholesterol level and increased HDL-cholesterol level compared to control group. Higher net profit and cost benefit ratio was higher in T_2 (0.5% ginger powder).

Keywords: Giriraja, ginger, thyme, growth performance, carcass traits, blood metabolites, economics

Introduction
Nowadays poultry industry has moved to minimize the use of antibiotics as growth promoter in diets. Overuse of antibiotics may lead to adverse and harmful effects on human health by development of microbial resistance to specific products. As result of the ban of antibiotics products, there has been evaluating the possible alternatives to use of antibiotics we can use multi-herbal products such as ginger, thyme, etc. These are producing same effects as antibiotics without any side effects. The herbals will be useful to increase poultry production and protect health of birds. Ginger and Thyme are popular medicinal plants.

The use of Ginger (*Zingiber officinale*) as substitute for antibiotic growth promoters is desirable for greater productivity of poultry, increased palatability of feed, nutrients utilization appetite stimulation, increase in the flow of gastric juice and piquancy of tasteless food (Owen and Amakiri, 2012) [16]. The major components of thyme oil are thymol (40%), carvacrol (15%) and phenol, (Mikaili *et al*., 2010) [13]. thyme used for several medicinal purposes - respiratory diseases, antimicrobial, antioxidant, antinoseptic, Digestion stimulant (Demir *et al*., 2008) [7]. So, the present study was executed to investigate the effect of graded levels of ginger and thyme powder on growth performance of Giriraja chicken.

Materials and Methods
Treatments and experimental design
Eighty, day old commercial Giriraja chicks were procured from Government Hatchery, khadki, Pune. Each bird was weighed on arrival and randomly assigned to 4 different dietary treatment groups *viz*. T_1, T_2, T_3, and T_4 with twenty chicks in each group using completely randomized design. All the chicks were properly reared on deep litter system. The dietary treatments consisted of one basal control (T_1), supplemented with 0.5% ginger powder (T_2), 0.5% thyme powder (T_3), and 0.5% ginsger + 0.5% thyme powder (T_4). Feed and water were provided *ad libitum* throughout the experimental period. Birds were fed in three phases, *viz*., pre-starter (0-

2 wks), starter (3-4 wks), and finisher (5-8 wks). Individual body weight and feed intake were recorded at weekly interval. Weight gain and Feed conversion ratio (FCR) were calculated as per formula at weekly interval.

Collection of blood sample

Blood samples were taken on 39 days of age from the wing vein of birds from each treatment. Gel and clot activator tube glass was used for blood collection. Total protein, albumin, globulin, Cholesterol, triglyceride, HDL-Chol. and LDL-Cholesterol were measured with an automatic analyzer commercial test kits (Mindray BS 200, PRC) at Chaitanya laboratories, Multi-species Diagnostic and Research Services, Baner, Pune.

After 56 days of age five birds from each dietary treatment were selected for carcass studies. The carcass weight was recorded and after removal of skin the dressing percentage was calculated.

To assess economy, calculate cost of feed based on market price and the birds were sold as per the NECC rate. The data obtained during the experimental period were statistically analyzed by CRD given by Snedecor and Cochran (1994) [19].

Results and Discussion

The mean (±) weekly body weight up to 8 weeks' period presented in (Table 1). There was no significant difference between body weight at 1st week and 2nd week of age. At 3rd week of age there were significant (p<0.05) differences between treatments. However, the mean body weight at 8th week of age was significantly (P<0.05) higher in T_2 group (1577.45±10.93) as compared to other groups. Similar observations were also reported by (Moorthy *et al*., 2009; Rahimi *et al*., 2011; Mohamed *et al*., 2012) [12, 14, 17] who mentioned that adding ginger into the broiler diet had a significantly positive effect on the live body weight of chicks while adding thyme powder or essential oil into the broiler`s diet or drinking water did not affect the live body weight.

The mean (±) weekly body weight gain up to 8 weeks' period presented in (Table 2). There was no significant difference between body weight at 1st week and 2nd week of age. At 3rd week of age there were significant (p<0.05) differences between treatment groups. However, the mean body weight at 8th week of age was significantly (P<0.05) higher in T_2 group (315.10±11.23) as compared to other groups. Similar observations were also reported by (Rahimi *et al*., 2011; Mohamed *et al*., 2012; Arshad *et al*., 2012) [5, 12, 17] who stated that using ginger through diet or drinking water in broilers had a significantly positive effect on the body weight gain compared to the control while using thyme through diet or drinking water did not have any effect on the body weight gain in the broiler chicken.

Table 1: Effect of ginger and thyme (powder) on cumulative average body weight (g) of giriraja

Groups	Initial weight	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8
T_1	31.71 ±0.58	79.13 ±1.07	173.58 ±2.20	300.10 ^{a} ±4.55	458.08 ^{a} ±6.86	619.10 ^{a} ±7.39	867.93 ^{a} ±11.81	1119.25 ^{a} ±11.95	1385.85 ^{a} ±16.94
T_2	32.98 ±0.60	82.68 ±1.18	179.28 ±2.37	326.25 ^{b} ±6.50	503.95 ^{b} ±8.22	693.95 ^{c} ±8.48	975.45 ^{c} ±7.26	1262.35 ^{c} ±6.19	1577.45 ^{c} ±10.93
T_3	33.31 ±0.46	79.60 ±1.21	172.43 ±2.68	305.15 ^{a} ±6.15	455.45 ^{a} ±10.93	611.10 ^{a} ±9.24	852.38 ^{a} ±9.28	1101.23 ^{a} ±9.78	1357.90 ^{a} ±16.52
T_4	32.59 ±0.71	79.33 ±1.31	173.68 ±2.12	313.80 ^{ab} ±5.65	489.73 ^{b} ±7.68	668.83 ^{b} ±7.09	926.75 ^{b} ±11.51	1202.45 ^{b} ±11.68	1507.20 ^{b} ±18.38

$^{a, b, c}$ Means value with different superscripts are significantly different (P<0.05)

Table 2: Effect of ginger and thyme (powder) on average body weight (g) gain in giriraja

Groups	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8
T1	47.42 ±0.88	94.45 ±2.46	126.53 ^{a} ±4.66	157.98 ^{a} ±6.54	161.03 ^{a} ±6.37	248.83 ^{a} ±7.09	251.33 ^{a} ±6.48	266.60 ^{a} ±12.60
T2	49.79 ±1.28	96.60 ±2.46	146.98 ^{b} ±5.57	177.70 ^{b} ±7.49	190.00 ^{b} ±8.21	281.50 ^{b} ±9.25	286.90 ^{b} ±7.26	315.10 ^{b} ±11.23
T3	46.29 ±1.34	92.83 ±2.53	132.73 ^{a} ±5.94	150.30 ^{a} ±10.17	156.25 ^{a} ±7.15	240.68 ^{a} ±5.59	248.85 ^{a} ±7.36	256.98 ^{a} ±12.82
T4	46.74 ±1.32	94.35 ±2.39	140.13 ^{ab} ±5.25	175.93 ^{b} ±7.24	179.10 ^{b} ±9.66	257.93 ^{a} ±9.33	275.75 ^{b} ±10.70	304.74 ^{b} ±17.94

$^{a, b, c}$ Means value with different superscripts are significantly different (P<0.05)

The mean weekly feed intake and feed conversion ratio (Table 3 and 4) of different experimental groups differed significantly (P<0.05) in all weeks except up to second week of age. However, the mean feed intake observed from T2 were 3917.52±2.07 g/bird which was lowest feed intake than other treatment groups. Similar observation were also reported by (Mansoub and Myandoab, 2011.) [11] who concluded that dietary supplementation of broilers diets with ginger and thyme did not affect the feed consumption compared to the control group.

Result also shows a significantly lower (P<0.05) feed conversion ratio with ginger powder 0.5% (T2) when compared with other treatments; this implies that there was a significant difference in feed conversion ratio between the different treatment groups.

Table 3: Effect of ginger and thyme (powder) on feed intake (g) of Giriraja

Groups	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	Overall avg. feed intake
T1	112.18 ±1.79	159.08 ±2.89	291.90 ^{b} ±3.85	362.25 ^{b} ±1.74	467.95 ^{c} ±2.40	680.23 ^{c} ±3.15	954.10 ^{c} ±3.60	1091.33 ^{d} ±3.77	4119.02 ±2.79
T2	112.00	153.85	277.38 ^{a}	346.98 ^{a}	443.45 ^{a}	657.30 ^{a}	930.83 ^{a}	995.73 ^{a}	3917.52

	±1.74	±1.99	±3.58	±1.34	±1.67	±1.62	±2.62	±2.09	±2.07
T3	111.30 ±1.64	157.50 ±2.73	285.60 ^{ab} ±3.37	359.48 ^{b} ±1.79	455.35 ^{b} ±2.23	670.43 ^{b} ±2.13	946.58 ^{bc} ±2.01	1063.70 ^{c} ±6.32	4049.94 ±2.40
T4	112.53 ±1.49	155.93 ±2.47	280.35^{a} ±3.13	351.40 ^{a} ±1.69	455.18 ^{b} ±2.48	669.73 ^{b} ±2.20	938.53 ^{ab} ±3.26	1020.38 ^{b} ±5.35	3984.03 ±2.52

$^{a, b, c}$ Means value with different superscripts are significantly different (P<0.05)

FCR of T_2 (2.44±0.07) was significantly superior over other treatments. These results agree with the previous results obtained by (Herawati and Marjuk, 2011; Mohamed *et al*., 2012) [11, 12] who found that using dietary supplementation of ginger alone in broilers had a significant positive effect on the feed conversion ratio compared to the control. (Abo-El-Maaty *et al*., 2014) shown that broilers fed ginger-based diets at 0.25 and 0.5 gm per kg feed for 28 days had improved feed conversion ratio efficiency.

Table 4: Effect of ginger and thyme (powder) on feed conversion ratio in giriraja

Groups	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	Overall mean
T1	2.38 ±0.05	1.70 ±0.05	2.36 ^{c} ±0.08	2.38 ^{b} ±0.11	3.00 ^{b} ±0.13	2.77 ^{b} ±0.08	3.84 ^{b} ±0.09	4.28 ^{b} ±0.21	2.83 ±0.11
T2	2.29 ±0.07	1.61 ±0.05	1.93 ^{a} ±0.07	2.01 ^{a} ±0.08	2.41 ^{a} ±0.09	2.37 ^{a} ±0.06	3.28 ^{a} ±0.08	3.24 ^{a} ±0.11	2.73 ±0.08
T3	2.44 ±0.07	1.72 ±0.05	2.23 ^{bc} ±0.10	2.57 ^{b} ±0.15	3.04 ^{b} ±0.15	2.81 ^{b} ±0.06	3.86 ^{b} ±0.11	4.43 ^{b} ±0.34	3.3 ±0.14
T4	2.44 ±0.06	1.67 ±0.05	2.05 ^{ab} ±0.07	2.06 ^{a} ±0.08	2.69 ^{a} ±0.15	2.66 ^{b} ±0.09	3.50 ^{a} ±0.13	3.71 ^{a} ±0.35	2.76 ±0.09

$^{a, b, c}$ Means value with different superscripts are significantly different (P<0.05)

Carcass traits

Table (5) revealed that the effect of ginger, thyme, their mixture on visceral organs percentage of Giriraja chicks at 56th days of age. There were no significant differences in the percentages of heart, liver and gizzard in all the treated groups compared to the control groups. These results agree with those of (Ademola *et al*., 2009; Moorthy *et al*., 2009; Rahimi *et al*., 2011) [2, 14, 17] who did not find any significant differences in the relative weights of visceral organs of broilers fed on diet or drank water containing ginger and thyme.

Dressing percentage and meat bone ratio at 56 days of age in Giriraja presented in (Table 6) However, dressing percentage was significantly (P<0.05) higher in T_2 group (68.41±0.38) as compared to other groups, and meat bone ratio was significantly (P<0.05) lower in T_1group (6.57±0.07) as compared to other. Similar finding by (Herawati and Marjuki 2011; Zomrawi *et al*., 2013) [11, 21] who reported that improved dressed carcass weight and breast weight in broilers when fed with aqueous extract of ginger at 0.25% as compared to control groups.

Table 5: Effect of ginger and thyme on carcass traits in Giriraja (live weight basis in gram

Parameter / Treat.	Heart	Liver	Gizzard
T_1	7.75 ±0.25	28.55 ±0.55	52.23 ±2.23
T_2	9.35 ±0.66	24.50 ±0.50	50.00 ±1.00
T_3	7.25 ±0.25	27.56 ±1.95	46.75 ±2.75
T_4	9.06 ±0.86	25.00 ±1.00	53.33 ±2.77

Table 6: Effect of ginger and thyme (powder) on dressing percentage and Meat bone ratio on live weight basis

Parameter / Treat.	Dressing percentage (%)	Meat bone ratio (%)
T_1	66.00 ^{b} ± 0.01	6.57 ^{a} ± 0.07
T_2	68.41^{c} ± 0.38	8.60 ^{b} ± 0.05
T_3	62.63 ^{a} ± 0.34	7.32 ^{a} ± 0.63
T_4	67.68 ^{bc} ± 1.10	7.99 ^{ab} ± 0.03

$^{a, b, c}$ Means value with different superscripts are significantly different (P<0.05)

Blood metabolites: Table (7) shows blood serum parameters of Giriraja. However, total protein, albumin, globulin (g/dl) 3.46±0.06, 1.95±0.05, and 1.55±0.02 respectively was significantly (P<0.05) higher in T3 (0.5% thyme) group as compared to other groups.

The results were agreement with Al-Kassie (2009), Toghyani *et al*., (2011) and Saleh *et al*., (2014) who reported that serum total protein and globulin concentrations increased significantly in birds fed diet supplemented with thyme powder. They attributed this increase to the components of thyme oil thymol and carvacrol which possess potent antioxidant properties and consequently, elevate immune responses of chicks.

Table 7: Effect of ginger and thyme (powder) on blood serum parameters

Groups	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Cholesterol (g/dl)	Triglycerides (g/dl)	LDL-Chol (g/dl)	HDL-Chol (g/dl)
T_1	2.84 ^{a} ±0.01	1.48 ^{a} ±0.03	1.19 ^{a} ±0.02	142.18 ^{c} ±1.15	195.90 ^{d} ±1.10	35.75 ^{c} ±0.25	106.25 ^{a} ±0.70

T_2	2.93 [a] ±0.03	1.71 [b] ±0.01	1.34 [b] ±0.01	132.30 [a] ±1.20	162.30 [b] ±0.70	23.80 [a] ±0.20	108.4 [ab] ±0.75
T_3	3.46 [b] ±0.06	1.95 [c] ±0.05	1.55 [c] ±0.02	130.20 [a] ±0.55	122.15 [a] ±0.85	22.95 [a] ±0.55	111.2 [c] ±0.70
T_4	2.89 [a] ±0.01	1.62 [b] ±0.02	1.28 [b] ±0.02	138.15 [b] ±1.00	186.25 [c] ±2.25	29.50 [b] ±0.50	109.00 [b] ±0.41

[a, b, c] Means value with different superscripts are significantly different (P<0.05)

Effect of ginger, thyme, their mixture on the blood serum lipids cholesterol and triglycerides of Giriraja chickens. Significantly lower cholesterol, triglyceride and LDL-Cholesterol concentration was recorded in group T_3 as compared to other groups. Significantly higher HDL-chol concentration was recorded in group T_3 as compared to other groups. The results were agreement with Lee *et al*., (2003b) [13] who reported that the reduction of cholesterol noticed by thyme in animal studies has been attributed to the lowering effect of thymol or carvacrol on HMG-Co A reductase the rate limiting enzyme of cholesterol synthesis. Gumus *et al.*, (2017) reported that LDL had significantly decreased in thyme treated groups compared to other groups. Toghyani *et al*., (2010) reported that adding thyme powder 5 and 10g/kg diet increased HDL-Cholesterol concentration significantly (P<0.05) compared to the control groups.

Economical data (Table 8) of experiment shows that the average feed consumption of birds 4.05, 3.91, 3.99 and 3.97 respectively in T_1, T_2, T_3 and T_4, treatment groups. It shows that higher feed consumed by T_1 group than others. Similarly, there were higher body weight at the end of 8th week also observed in T_2 (1.577 Kg.) group than other. Finally, it results to get the higher net profit was obtained in T_2 (₹ 120.74/bird) as compared to other treatment groups and also cost benefit ratio (2.09) was higher in the same group. Therefore, the treatment T_2 were economically significantly superior.

These results were in agreement with Karangiya *et al*., (2016) who reported that the income from selling of the birds was significantly (p<0.05) higher in birds fed with 1% ginger than the control group.

Table 8: Effect of ginger and thyme (Powder) on the cost of giriraja rearing

Sr. No.	Particulars	T1	T2	T3	T4
1.	Cost of day old chick (₹)	16.00	16.00	16.00	16.00
2.	Cost of feed (₹/kg)	20.79	20.79	20.79	20.79
3.	Cost of Ginger & Thyme (Powder) (₹/Kg of feed)	00.00	2.00	2.15	4.15
4.	Total cost of feed (₹/kg)	20.79	22.79	22.94	24.94
5.	Average total feed consumed per bird (Kg)	4.119	3.917	4.049	3.984
6.	Cost of feed consumed per bird (₹) (4x5)	85.63	89.26	95.17	99.26
7.	Average body weight at the end of 8th week (Kg)	1.385	1.577	1.357	1.507
8.	Feed consumption per kg live weight gain (Kg)	2.97	2.48	2.98	2.64
9.	Cost of feed per kg live weight gain (₹)	61.74	56.51	68.36	65.84
10	Rearing Cost (vaccines, water, electricity, labour charge, etc.) per bird (₹)	5.00	5.00	5.00	5.00
11.	Total cost of production (₹)(1+6+10)	106.63	110.26	116.17	120.26
12.	Average price realized @ Rs. 150 per kg live weight (₹)	207.75	231	201.15	176.7
13.	Net profit per bird (₹) (12-11)	101.12	120.74	88.42	56.64
14.	Cost benefit ratio	1.94	2.09	1.73	1.46

Conclusion

From this study, it can be concluded that supplementation of 0.5% ginger powder to basal ration was beneficial in Giriraja chicks to improve average body weight, body weight gain and feed conversion ratio (FCR) in Giriraja, also improve dressing percentage and meat bone ratio and supplementation of 0.5% thyme powder increased the blood serum protein, albumin, globulin concentration and decreased the cholesterol, triglyceride and LDL-Cholesterol level and increased HDL-cholesterol level compared to control group. The best contribution ratio of net income was recorded by 0.5% ginger powder.

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