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## Efficacy of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder as phytogetic feed additives in diet of broiler chickens

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**Abstract**

Phytogetic feed additives are gaining importance as an alternative to antibiotics in broiler production. To assess the efficacy of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder as phytogetic feed additives in diet of broiler chickens, a total 180 broiler chicks (Cobb 400) were randomly assigned to four treatments based on a completely randomized design. The treatments were as; T<sub>1</sub>: (control) was fed with standard diet as per BIS (1992); T<sub>2</sub>: control diet + 0.1% ginger powder + 0.2% garlic powder; T<sub>3</sub>: control diet + 0.25% ginger powder + 0.5% garlic powder and T<sub>4</sub>: control diet + 0.5% ginger powder + 1.0 garlic powder. The results showed that there was no significant effect of addition of mixture of ginger and garlic on average weekly body weights and final body weights. However, body weight gain at seventh week was significantly ( $P < 0.05$ ) higher in treatments T<sub>2</sub> and T<sub>3</sub> as compared to T<sub>1</sub> and T<sub>4</sub> groups. Feed intake, feed conversion ratio and carcass characteristics were similar ( $P > 0.05$ ) among the different treatment groups. Return over feed cost (Rs./bird) was highest in T<sub>2</sub> (54.44) group followed by T<sub>1</sub> (51.74) and T<sub>3</sub> (47.63) groups and lowest in T<sub>4</sub> (36.11) group. From the current findings, it was concluded that dietary addition of mixture of ginger (0.1%) and garlic (0.2%) has improved body weight gain and return over feed cost in broiler chickens.

**Keywords:** phytogetic feed additives, *Zingiber officinale*, *Allium sativum*, broiler, growth, carcass characteristics

**Introduction**

In recent years there has been an increase of consumer demand for food that is perceived to be fresh, wholesome, free of hormones, antibiotics and harmful chemicals, and produced in a way that is sustainable environmentally. Moreover, due to the residual effects of antibiotics as a growth promoter, a wide range of feed additives had been used as an alternative to improve the performance of birds. Plant-derived additives used in animal nutrition to improve performance have been called “phytogetic feed additives” (Windich *et al.*, 2008) [27]. Phytogetic feed additives have been tested recently by research workers (Bhosale *et al.*, 2015; Joshi *et al.*, 2015; Patel *et al.*, 2016; Belal *et al.*, 2018) [6, 10, 18, 5] in broiler chickens as a natural growth promoters as replacement of antibiotic growth promoters. Garlic is one of the most traditionally used plants as a spice and herb. Garlic has been used for a variety of reasons, most of which have been approved scientifically: anti-atherosclerotic, antimicrobial, hypolipidemic, antithrombosis, anti-hypertension, anti-diabetes etc. (Mansoub, 2011) [14]. There are a lot of active components in garlic like ajoene, s-allyl cysteine, diallyl sulphide and the most active one allicine (Rahmatnejad and Roshanfekar, 2009) [23]. In broilers, it was reported that garlic, as a natural feed additive, has improved broiler growth and feed conversion ratio, and decreased mortality rate (Puvača *et al.*, 2014; Makwana *et al.*, 2015; Karangiya *et al.*, 2016; Patel *et al.*, 2017; Belal *et al.*, 2018) [21, 13, 11, 19, 5]. Ginger is the rhizome of the plant (*Zingiber officinale*), consumed as a delicacy, medicine, or spice. Ginger contains several enzymes including gingerdiol, gingerol, gingerdione and shogaols (Rivlin, 2001; Zhao *et al.*, 2011) [24, 29]. These compounds have been reported to have antimicrobial, antioxidative and pharmacological effects (Al-Amin *et al.*, 2006; Tapsell *et al.*, 2006; Ali *et al.*, 2008) [2, 25, 3]. Recent research works on use of ginger as feed additives have shown encouraging results in regards to weight gain, feed efficiency, lowered mortality in broilers (Issa and Omar, 2012; Oleforuh-Okoleh *et al.*, 2014; Youssef *et al.*, 2016; Belal *et al.*, 2018) [9, 16, 28, 5]. However, there are very few studies carried out with use of combination of garlic and ginger in broilers. Therefore, the present study was carried out to evaluate the efficacy of mixture of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder as phytogetic feed additives in diet of broiler chickens.

## Materials and Methods

The present study was conducted at Sub-department of Avian Production and Management of Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar which is located in semi arid region of Banaskantha District of North Gujarat having latitude of 24.35° North and longitude of 72.59° East. The in house mean temperature during experimental period was ranged from 18.3 to 32.8 °C, while the relative humidity was ranged from 26 to 81%. The present experiment was carried out after approval for use of chicks and experimental procedures by Institutional Animal Ethics Committee. A total 180 broiler chicks (Cobb 400) purchased from a local hatchery were weighed and randomly assigned to four treatments with three replicates of 15 chicks based on a completely randomized design. The treatments were as; T<sub>1</sub>: (control) was fed with standard diet as per BIS (1992)<sup>[7]</sup>; T<sub>2</sub>: control diet + 0.1% ginger powder + 0.2% garlic powder; T<sub>3</sub>: control diet + 0.25% ginger powder + 0.5% garlic powder and T<sub>4</sub>: control diet + 0.5% ginger powder + 1.0% garlic powder. The garlic and ginger used in this study were purchased from a local market in raw form. Then, it was cut into smaller pieces and dried sufficiently in the sunlight. After drying, required amount of ginger and garlic was prepared by fine grinding and passing through 1 mm sieve. The ingredients and chemical composition of basal diet are presented in Table 1. The chemical composition of starter and finisher diets were determined as per the procedures of AOAC (1995)<sup>[4]</sup>. Broilers were raised in deep-litter housing system. Feed and water were provided *ad libitum* throughout the experiment. Chicks were individually weighed at weekly intervals. Feed consumption and feed conversion ratio (FCR=feed intake/weight gain) were calculated at weekly intervals. Mortality was recorded daily.

At the end of experimental feeding, two birds from each replicate were randomly selected, starved over night with the provision for *ad libitum* water and sacrificed by cervical dislocation. The dressing percentage was calculated as the per cent of the carcass weight to the body weight after removing the feathers, neck, legs and internal viscera. Weights of different organs *viz.*, heart, liver, gizzard and spleen were recorded. The economics of feeding return over feed cost in different treatment groups was calculated based on current market price of various particulars. The data were analysed by one-way ANOVA procedures using SPSS (Version 16.0, SPSS Inc, Chicago, USA) and the significant mean differences were tested as per Duncan's multiple range test and significance was declared at  $P < 0.05$ .

## Results and Discussion

### Effect of ginger and garlic on growth performance and feed intake

The average weekly body weights (g/bird) and body weight gain (g) of broilers under different treatment groups are given in Table 2. The final body weights at the end of seventh week were 2228.0±64.6, 2251.7±66.5, 2221.2±80.5 and 2072.0±76.4 g/bird in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups, respectively. The higher body weights were expected in broiler birds fed diets added with garlic and ginger as the active components existent in the ginger triggers the digestive enzymes and increases overall digestion and absorption of some valuable nutrients and consequently boost the body weight gain. Additionally, allicin in garlic acts as antibacterial compound which inhibits the pathogenic bacteria and fungi results into

the improved gut environment and growth performance. Though the body weight gain at seventh week was significantly ( $P < 0.05$ ) higher in treatments T<sub>2</sub> and T<sub>3</sub> as compared to T<sub>1</sub> (control) and T<sub>4</sub> groups; the dietary addition of mixture of ginger and garlic powder at different levels in broiler rations in present study did not have any significant effect on average weekly body weights and final body weights. This finding was in line with Hossain *et al.* (2014)<sup>[8]</sup> and Kidane *et al.* (2017)<sup>[12]</sup> who reported that inclusion of garlic and ginger in diet of broiler chickens had no significant effect on body weights.

Feed intake and feed conversion ratio in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> groups were similar and did not differ significantly ( $P > 0.05$ ) at different week intervals (Table 3). It has shown that there is no adverse effect of smell and/or taste of garlic and ginger on the palatability of feed in the diets of broilers. Similarly, some researchers have observed non-significant effect of garlic and ginger supplementation on feed intake (Onu, 2010; Aji *et al.*, 2011; Rahimi *et al.*, 2011)<sup>[17, 1, 22]</sup> and feed conversion ratio (Mansoub and Nezhady, 2011; Thayalini *et al.*, 2011; Puvaca *et al.*, 2015)<sup>[14, 26, 20]</sup> in broilers.

### Effect of ginger and garlic on carcass characteristics

The effect of dietary addition of different levels of garlic and ginger powder on carcass characteristics of broiler chickens is represented in Table 4. Carcass characteristics showed non-significant ( $P > 0.05$ ) effect of dietary addition of mixture of garlic and ginger at different levels among the treatments on dressing percent, yields of breast, back, drumstick, neck and wing along with weights of liver, gizzard, heart and spleen. Similar response was observed Patel *et al.* (2017)<sup>[19]</sup> in broilers fed with garlic supplementation in diet. In contrast, Belal *et al.* (2018)<sup>[5]</sup> reported that the dressing percentage was significantly ( $P < 0.05$ ) higher in broilers when ginger and garlic were fed in powder form in the diet.

### Effect of ginger and garlic on return over feed cost

Feed cost economics of broiler chickens production in terms of returns over feed cost (ROFC) under different treatment groups given in Table 5. The income (Rs./bird) from selling of the birds was highest in T<sub>2</sub> (180.16) group followed by T<sub>1</sub> (178.24) and T<sub>3</sub> (177.68) groups and lowest in T<sub>4</sub> (165.76) group. The highest income in T<sub>2</sub> group was due to numerically higher final body weights than T<sub>1</sub> and T<sub>3</sub> groups and lowest in T<sub>4</sub> group because of comparatively lower body weight (Table 2). Total cost of feeding (Rs./bird) was almost similar in groups T<sub>1</sub> and T<sub>2</sub>, but was higher in groups T<sub>3</sub> and T<sub>4</sub> due to added cost of garlic and ginger supplementation. ROFC (Rs./bird) and ROFC (Rs./kg live weight) was highest in T<sub>2</sub> (54.44 and 24.17) group followed by T<sub>1</sub> (51.74 and 23.22) and T<sub>3</sub> (47.63 and 21.45) groups and lowest in T<sub>4</sub> (36.11 and 17.43) group; suggesting higher economic returns in T<sub>2</sub> (control diet + 0.1% ginger powder + 0.2% garlic powder) group.

## Conclusion

From the current findings, it was concluded that dietary addition of mixture of ginger (0.1%) and garlic (0.2%) has improved body weight gain and return over feed cost in broiler chickens. Moreover, these supplements did not have any adverse influence on feed intake and the carcass characteristics of the birds. Thus, ginger and garlic powder can be used as phyto-genic feed additives alternative to the commercial used antibiotics for better growth and performance of broiler chickens.

**Table 1:** Ingredients and chemical composition of basal diet

Ingredients (%)	Starter diet	Finisher diet	Chemical Composition (%)	Starter diet	Finisher diet
Yellow Maize	53.90	54.08	Crude protein	23.02	20.21
De-oiled Rice Bran	1.15	9.15	Ether extract	3.81	4.47
Soybean (DOC)	39.76	30.50	Crude fiber	4.62	5.96
Di-calcium phosphate	2.00	1.39	Total ash	2.89	3.47
Shell Grit	2.20	1.70	Calcium	0.87	0.68
Salt	0.30	0.30	Phosphorus	0.56	0.47
Trace Minerals	0.10	0.10	Lysine*	1.27	1.05
BVzyme	0.05	0.05	Methionine*	0.43	0.38
Neftin	0.03	0.05	Threonine*	0.89	0.76
Lipocare	0.10	0.10	ME (kcal/kg)*	2880.47	3007.05
Toxin binder	0.10	0.10	*calculated values as fed basis		
Madhuramicine	0.05	0.05			
Zigbir	0.03	0.03			
Merivet 100	0.01	0.02			
Vegetable oil	-	2.19			
Groblend	0.24	0.20			

**Table 2:** Effect of dietary addition of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder on growth performance of broiler chickens (n = 180)

Age in weeks	Treatments			
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
<b>Body weight changes (g/bird)</b>				
W <sub>1</sub>	79.67±1.55	78.54±1.35	77.67±1.17	79.95±0.99
W <sub>2</sub>	177.09±6.50	166.89±5.38	178.61±5.62	166.60±4.39
W <sub>3</sub>	367.4±17.3	349.8±15.9	368.8±16.9	335.8±12.6
W <sub>4</sub>	679.0±35.8	673.5±33.3	701.1±34.4	631.2±29.2
W <sub>5</sub>	1168.2±54.0	1160.6±47.6	1169.2±53.9	1074.0±47.8
W <sub>6</sub>	1753.3±63.5	1698.0±62.3	1694.0±66.4	1603.6±66.4
W <sub>7</sub>	2228.0±64.6	2251.7±66.5	2221.2±80.5	2072.0±76.4
<b>Gain in body weight (g)</b>				
W <sub>1-2</sub>	97.45±6.63	88.13±4.66	100.77±5.00	86.64±4.25
W <sub>2-3</sub>	190.3±11.7	183.0±11.5	190.7±12.0	169.0±9.33
W <sub>3-4</sub>	311.6±20.3	320.0±18.2	331.5±18.7	293.3±18.0
W <sub>4-5</sub>	475.5±20.7	476.5±17.1	468.0±22.0	442.8±21.4
W <sub>5-6</sub>	576.0 <sup>b</sup> ±15.2	531.8 <sup>ab</sup> ±17.7	505.7 <sup>a</sup> ±18.3	522.4 <sup>a</sup> ±20.6
W <sub>6-7</sub>	447.9 <sup>a</sup> ±12.5	536.5 <sup>b</sup> ±11.5	528.8 <sup>b</sup> ±20.5	479.2 <sup>a</sup> ±17.9

<sup>a,b</sup>Means within a row bearing different superscripts differ significantly ( $P < 0.05$ )

**Table 3:** Effect of dietary addition of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder on feed intake and feed conversion ratio in broiler chickens (n = 180)

Age in weeks	Treatments			
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
<b>Feed intake (g)</b>				
W <sub>0-4</sub>	1277.3	1188.1	1219.7	1234.3
W <sub>0-5</sub>	2248.2	2120.2	2181.7	2127.4
W <sub>0-6</sub>	3432.5	3303.3	3377.5	3246.8
W <sub>0-7</sub>	4599.5	4510.3	4569.2	4405.6
<b>Feed conversion ratio</b>				
W <sub>0-5</sub>	2.19±0.15	2.02±0.13	2.18±0.19	2.24±0.16
W <sub>0-6</sub>	2.10±0.11	2.10±0.11	2.21±0.16	2.27±0.16
W <sub>0-7</sub>	2.15±0.08	2.09±0.08	2.23±0.14	2.32±0.14

**Table 4:** Effect of dietary addition of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder on carcass characteristics of broiler chickens (n = 180)

Parameters	Treatments			
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Dressing %	78.61±0.01	77.36±0.01	77.67±0.01	78.60±0.01
Breast %	30.23±1.07	30.52±0.32	32.52±1.33	32.99±0.86
Back %	34.97±0.68	35.30±0.60	35.49±0.67	33.94±0.68
Drumstick %	12.52±0.65	11.75±0.42	12.51±0.71	12.98±0.33
Neck %	5.86±0.68	6.17±0.49	5.86±0.68	5.49±0.67
Wing %	8.66±0.17	9.04±0.32	9.17±0.42	9.60±0.48
Heart <sup>¶</sup>	0.51±0.02	0.60±0.02	0.53±0.02	0.53±0.01
Liver <sup>¶</sup>	1.59±0.06	1.73±0.09	1.59±0.08	1.61±0.07
Gizzard <sup>¶</sup>	1.96±0.14	2.17±0.09	2.30±0.06	2.05±0.14

Spleen <sup>f</sup>	0.10±0.01	0.12±0.01	0.13±0.01	0.14±0.01
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<sup>f</sup>expressed as percentage of live body weight

**Table 5:** Effect of dietary addition of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) powder on feed cost economics of broiler chickens production (n = 180)

Particulars	Treatments			
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Income through sale of birds (Rs./bird)	178.24	180.16	177.68	165.76
Cost of garlic powder (Rs./bird)	0.00	0.53	1.37	2.64
Cost of ginger powder (Rs./bird)	0.00	1.17	3.03	5.84
Total cost of feeding (Rs./bird)	126.50	125.72	130.05	129.65
Return over feed cost (Rs./bird)	51.74	54.44	47.63	36.11
Return over feed cost/kg live wt. (Rs.)	23.22	24.17	21.45	17.43

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