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Effect of Supplementation of Tulsi (*Ocimum sanctum*) Leaf and Ginger (*Zingiber officinale*) Powder as Feed Additive on Daily Weight Gain, Comparative Economics and Mortality Percent of Broiler Chicks

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Abstract

A study was undertaken to evaluate the effect of tulsi and ginger as feed additives on comparative economics of broiler chicks. Two hundred and ten day-old chicks divided into 7 groups and each group having 30 chicks. Control group was fed on basal diet and T_1 and T_2 group were supplemented with 0.5% and 1% of tulsi leaf powder in the ration, respectively. Likewise, G_1 and G_2 group were supplemented with 0.5% and 1% of ginger powder in the ration, respectively. T_1G_1 and T_2G_2 treatment groups were supplemented with 0.5% and 1% of both herbs in combination, respectively. The statistical analysis of data revealed highly significant (p<0.01) effect of tulsi leaf and ginger powder on average daily body weight gain. Highest average daily body weight gain during starter phase was recorded in T_2G_2 group fed with tulsi leaf and ginger powder @ 0.5% each, which was comparable with G_2 group. During finisher phase of trial statistical analysis revealed highest (p<0.01) average daily body weight gain in T_2G_2 group. Lowest average daily body weight gain was observed in control group during starter and finisher period. Statistical analysis of data revealed highly significant (p<0.01) effect on comparative economics of broilers due to supplementation of tulsi leaf and ginger powder. Highest net profit per kg of live weight was observed in T_2G_2 group supplemented with 0.5% tulsi leaf and ginger powder each and lowest net profit per kg of live weight was observed in T_2 group which was comparable with control group. The overall mortality per cent of chicks under different treatment groups was observed to be 16.17% in control group and 6.66% in T_1 and T_2, and in G_1, G_2, T_1G_1, T_2G_2 groups observed no mortality. It may be concluded that supplementation tulsi leaf and ginger powder as feed additives improves daily weight gain, comparative economics and reduced mortality of broiler chicks.

Keywords: Tulsi, ginger, comparative economics, broiler, mortality

1. Introduction

Indian poultry farming occupies an important position due to its enormous potential for rapid economic growth, benefiting the weaker sections in particular because of their low investment requirements (Anonymous, 2014). It provides employment to approximately 8.8% of India's population and livestock sector contributes 4.11% of GDP and 25.6

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per cent of the total agricultural GDP. Apart from this, poultry meat is an important source of protein, minerals and vitamins and can fulfill the demand of protein of growing Indian population. Improving productivity, reducing the impact on the environment, rising animal welfare and reducing mortality are main goals for the poultry industry sector.

The main limitation of the production of broilers is the cost of feed, which accounts for up to 70% of the total cost of production. To boost animal performance, to reduce feed cost, to combat these enteric infections and to improve the gut health, antibiotic growth promoters are widely used in poultry feed since last 50 years. But due to development of resistant organisms European Union banned the use of antibiotics since January 2006 (Yegani and Korver, 2008) and this led to performance problems (Huyghebaert et al., 2011). Furthermore, peoples are more aware about antibiotic residues in animal product and the potency of evolving antibiotic resistant bacteria leads the production of safer poultry products without any microbic and chemic residues in an economic manner. To overcome these problems the feed additive could be added to the ration with the purpose to boost animal performance. Feed additives are commonly described as non-nutrient substances which accelerate growth, feed conversion ratio, beneficial for health or biotransformation of the animals (Church and Pond, 1988). Incorporation of such type of feed additives with feed is mainly aimed to improve digestibility and bioavailability of various nutrients, thereby, rising economic gains by decreasing the input expenditure. Herbs could be anticipated to serve as feed additives due to their suitability and preference, reduced threat of virulence and minimum health hazards (Devegowda, 1996).

Herbals, spices and various plant extracts have received higher attention as feasible antibiotic growth promoter replacements. Recent investigation studies on herbal formulations as feed additives have shown inspiring results with regards to gain in weight, feed efficiency, lowered mortality and increased livability in poultry chicks (Kumar, 1991; Babu et al., 1992; Mishra and Singh, 2000; Deepak et al., 2002; Jahan et al., 2008). Herbs develop their initial activity in the feed of farm animals as flavour and can therefore influence the eating pattern, secretion of digestive juice and total feed consumption include improving nutrient utilization and absorption or the stimulation of the immune system.

Throughout India, Tulsi (*Ocimum sanctum*) is considered the most sacred herb and Ayurveda has well described the use of Tulsi as an aromatic herb, belongs to the Labiateae family. In Sanskrit, the name "Tulsi" means "incomparable" and the entire plant is used as a remedy source (Bansod et al., 2008) the leaves contain an essential oil containing eugenol, eugenic, carvacrol, methyl chavicol, limatrol and caryophylline. This plant has been studied pharmacologically for antimicrobial, immune-modulatory, anti-stress, anti-inflammatory, antipyretic, anti-asthmatic, hypoglycemic, hypotensive and analgesic activities (Chiang et al., 2005).

Ginger is the *Zingiber officinale* plant rhizome, belongs to the Zingiberaceae family, condiment or spice (Khan et al., 2012) and is being used as a medicinal herb for disease prevention or growth (Chrubasik et al., 2005). Gingerol, gingerdiol and gingerdione are main compounds that have the potential to activate or quicken digestive system enzymes, stimulate microbial activity and have antioxidant activity (Dieumou et al., 2009) and may have improved growth potential. Ginger (*Zingiber officinale*) has been found to be an alternate antibiotic growth promoter (Demir et al., 2003) and has been reported to increase growth, decrease the mortality rate and improve the use of feed (Issa and Omar, 2012; Oleforuh Okoleh et al., 2014). Keeping the aforesaid facts in view, the present investigation was planned to explain the possibilities of utilization of Tulsi leaf (*Ocimum sanctum*) and Ginger (*Zingiber officinale*) as feed additive alone or in combination on daily weight gain, comparative economics and mortality percent of broiler chicks.

2. Materials and Methods

The study was undertaken to study the effect of supplementation of tulsi (*Ocimum sanctum*) leaf and ginger (*Zingiber officinale*) powder as feed additive on comparative economics and mortality percent in broilers at poultry farm of College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur, Rajasthan, India. Two hundred and ten day-old, unsexed, apparently healthy broiler chicks (Cob-400 strain) procured from commercial hatchery were divided into 7 groups and each group of 30 chicks was subdivided into three subgroups having 10 chicks each. Routine vaccination against Ranikhet disease (F_1 strain) and Infectious Bursal Disease were carried out on 7th and 14th day of procurement of chicks. Commercially available readymade broiler starter and broiler finisher rations were procured and feed additives such as Tulsi and Ginger were supplemented. The experimental feed will be analyzed for proximate constituents by procedures of Anonymous (2016). Control group was fed on basal diet and T_1 and T_2 treatment group were supplemented with 0.5% and 1% of Tulsi leaf herb in the experimental broiler starter and finisher ration, respectively. Likewise, G_1 and G_2 treatment group were supplemented with 0.5% and 1% of Ginger herb in the experimental broiler starter and finisher ration, respectively. T_1G_1 and T_2G_2 treatment groups were supplemented with 0.5% and 1% of both herbs in combination, respectively. During the course of the study, identical standard management practices concerning brooding, feeding, watering and control of diseases *etc.* were followed for each group. As bedding material, clean and dry wheat straw was used. A feeding trial of 42 days was carried out from April 2018 to May 2018. Commercial broiler starter and finisher ration were provided to broiler chicks from day 1-21 and day 22-42, respectively. Ad libitum feeding was ensured throughout the feeding trial. At the beginning as well as at the end of study, the experimental broiler's body weight was recorded

to determine the change in body weight due to dietary regimen. The weighing of the chicks was carried out early in the morning before feeding, using an electronic balance. By dividing the total body weight gain by number of days, ADG in grams was estimated. Economics of broiler production in the present study was carried out by considering the prices of inputs prevalent at the time of experiment in the market. Inputs consist of cost of day old chicks, cost of feed, cost of tulsi, cost of ginger, medicines, vaccines and other expenses. Net profit per bird was calculated from the sell of the birds in the local market on live body weight basis. Similarly net profit per kg body weight was calculated for all treatment groups. Regular observation was performed to record the mortality in broiler chicks if any. The mortality rate was calculated from the dead bird record to the end of the study against the total number of chicks on the basis of treatment.

2.1. Statistical analysis

Data collected during the current research work was subjected to statistical analysis by implementing standard methods of variance analysis as defined by statistical package for social science (SPSS), version 20. Significance of mean differences (F-values) was calculated by Dunken's multiple-range test as updated by Kramer (1956).

3. Results and Discussion

3.1. Average daily body weight gain

Phase wise daily body weight gain of broilers observed in various treatment groups have been presented in Table 1. Average daily body weight gain (g) of broilers during starter phase were recorded to be 36.25, 38.53, 37.47, 37.56, 38.92, 38.40 and 39.69 g in C, T_1, T_2, G_1, G_2, T_1G_1 and T_2G_2, respectively. Whereas, during finisher phase, average daily body weight gain was found to be 58.28, 65.19, 62.03, 63.09, 68.18, 65.04 and 73.26 g in C, T_1, T_2, G_1, G_2, T_1G_1 and T_2G_2, respectively.

The weekwise daily weight gain has been shown in Figure 1. During I week of trial, the average daily body weight gain was significantly higher in T_2G_2 groups as compared to others and lowest average (p<0.01) daily body weight gain was observed in control. At II week, highest (p<0.01) average daily gain was observed in G_2 group, which was comparable with rest of the group except control and T_2 group however lowest body weight gain was observed in control group which was comparable with T_2 and G_1. At III week of experiment, no significant difference in average daily gain was observed among the treatment group but numerically highest body weight gain was observed in T_2G_2 group and lowest in control group. During IV week of experiment, highly significant difference in average daily gain was observed and highest (p<0.01) average daily gain was observed in T_2G_2 group, which didn't vary significantly with T_1, G_1, G_2 and T_1G_1 and lowest average body weight gain was observed in T_2 group which was comparable with control group. At the end of V week, highest (p<0.01) average daily weight gain was recorded

Table 1: Effect of tulsi leaf and ginger root powder on daily weight gain (g) in broiler chicks at different phases

Treatment groups	Period (phases)	
	Starter	Finisher
Control	36.25^{a}	58.28^{a}
T_1	38.53^{bc}	65.19^{c}
T_2	37.47^{b}	62.03^{b}
G_1	37.56^{b}	63.09^{bc}
G_2	38.92^{cd}	68.18^{d}
T_1G_1	38.40^{bc}	65.04^{c}
T_2G_2	39.69^{d}	73.26^{e}
SEm±	0.35	0.79

Note: The means bearing different superscript in a column differ significantly (p<0.05); C: Basal diet (Control); T_1: Basal diet supplemented with 0.5% tulsi; T_2: Basal diet supplemented with 1% tulsi; G_1: Basal diet supplemented with 0.5% ginger; G_2: Basal diet supplemented with 1% ginger; T_1G_1: Basal diet supplemented with 0.25% tulsi and 0.25% ginger; T_2G_2: Basal diet supplemented with 0.5% tulsi and 0.5% ginger

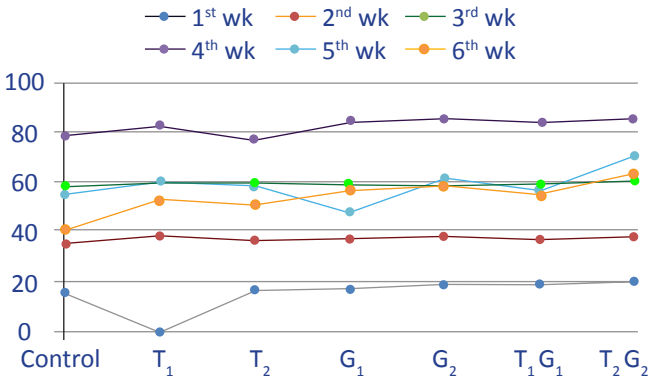

Figure 1: Weekly observation on the daily body weight gain

in T_2G_2 group, which was significantly higher as compared to control, however G_1 group showed lowest average daily weight gain. At VI week, highly significant (p<0.01) difference in average daily gain was observed among the treatment group and highest (p<0.01) average daily gain was observed in T_2G_2 group which was comparable with T_1, G_1, G_2 and T_1G_1 and lowest average daily gain was observed in control group.

The statistical analysis of data revealed highly significant (p<0.01) effect of tulsi leaf and ginger powder on average daily body weight gain. Highest average daily body weight gain during starter phase was recorded to be 39.69 g in T_2G_2 group fed with tulsi leaf and ginger powder @ 0.5% each, which was comparable with G_2 group. Lowest average daily body weight gain recorded to be 36.25 g in control group. During finisher phase of trial statistical analysis revealed highest (p<0.01) average daily body weight gain (73.26 g) in T_2G_2 group while lowest average daily body weight gain (58.28 g) was observed

in control group.

Significant increase in daily body weight gain observed in the present study corroborates with the findings of Olefaruh and Okoleh (2014) who revealed significant effect of 1.4% ginger supplementation in birds as compared to control. Onu (2010) recorded significant (p<0.05) increase in daily body weight gain with addition of ginger and garlic alone and in combination @ 0.25% of feed. Increase in daily body weight gain due to supplementation of combination of tulsi leaf and ginger observed in the present study are in accordance with findings of Umaram (2018), who reported significant (p<0.05) increase in daily body weight gain (g) on incorporation of ginger and turmeric @ 0.75% each to basal diet as compared to control group. Further, Sa'aci et al. (2018) observed maximum daily body weight gain in ginger supplemented group. In contrast to the present study, Zhang et al. (2009), Mohammed and Yusuf (2011), Andriyanto et al. (2016) revealed non-significant differences in average daily body weight gain in broiler birds supplemented with ginger powder.

3.2. Comparative economics

Economics of broiler production in the present study was carried out by considering the prices of inputs prevalent at the time of experiment in the market. Cost of day-old chicks, cost of feed, cost of tulsi, cost of ginger, medicines, vaccines, other expenses, net profit per bird and net profit per kg of live body weight have been presented in Table 2.

From the results, it was observed that total cost of feed

Table 2: Effect of tulsi leaf and ginger root powder on comparative economics in broiler chicks

Parameters	Treatment groups						
	C	T_1	T_2	G_1	G_2	T_1G_1	T_2G_2
Chick cost (₹)	39.00	39.00	39.00	39.00	39.00	39.00	39.00
Feed consumed (kg)	3.92	3.83	3.82	3.61	3.72	3.70	3.75
Feed cost ₹ kg^{-1}	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Cost of feed additives (₹)	0.00	5.75	11.46	5.41	11.16	5.55	11.25
Total feed cost with cost feed additive (₹)	117.59	120.79	126.20	113.76	122.83	116.42	123.66
Miscellaneous cost	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total Expenditure on bird (₹ $bird^{-1}$)	120.59	123.79	129.20	116.76	125.83	119.42	126.66
Cost of Production per bird	159.59	162.79	168.20	155.76	164.83	158.42	165.66
Final body weight (kg)	2.03	2.23	2.14	2.16	2.30	2.22	2.42
Total Selling cost $bird^{-1}$ @ ₹ 80 kg^{-1}	162.67	178.07	171.00	172.92	183.78	177.62	193.57
Net profit (₹ $bird^{-1}$)	3.08	15.28	2.80	17.16	18.95	19.20	27.91
Net profit kg^{-1} body weight	1.52^{d}	6.86^{c}	1.31^{d}	7.94^{bc}	8.25^{b}	8.65^{b}	11.54^{a}

Note: The means bearing different superscript in a row differ significantly (p<0.05); 1US$= INR 67.53; C: Basal diet (Control); T_1: Basal diet supplemented with 0.5% tulsi; T_2: Basal diet supplemented with 1% tulsi; G_1: Basal diet supplemented with 0.5% ginger; G_2: Basal diet supplemented with 1% ginger; T_1G_1: Basal diet supplemented with 0.25% tulsi and 0.25% ginger; T_2G_2: Basal diet supplemented with 0.5% tulsi and 0.5% ginger

after addition of tulsi and ginger was highest in T_2 followed by T_2G_2, G_2, T_1, T_1G_1 and control. Cost of production (₹ $bird^{-1}$) for treatment C, T_1, T_2, G_1, G_2, T_1G_1 and T_2G_2 were Rs 159.59, 162.79, 168.20, 155.76, 164.83, 158.42 and 165.66 respectively. The net profit (₹ kg^{-1}) of live weight in C, T_1, T_2, G_1, G_2, T_1G_1 and T_2G_2 were 1.52, 6.85, 1.30, 7.94, 8.23, 8.64, and 11.54 respectively. Statistical analysis of data revealed highly significant (p<0.01) effect on comparative economics of broilers due to supplementation of tulsi leaf and ginger powder. Highest net profit per kg of live weight was observed in T_2G_2 group supplemented with 0.5% tulsi leaf and ginger powder each and lowest net profit per kg of live weight was observed in T_2 group which was comparable with control group. Increase in profit margin of the chicks fed ration supplemented with tulsi leaf and ginger powder alone and in combination of both might be attributed to the better efficiency of feed utilization, which resulted in more growth and better feed to gain ratio, ultimately leading to higher profit margin in broilers.

The findings of the present study was in agreement with the observation of Bhosale et al. (2015) who stated that dietary addition of tulsi leaf powder @ 5 g kg^{-1} increased net profit per bird compared to the basal diet fed group. Similarly, Eltazi (2014) observed the effect of feeding broiler chicks diets containing different levels of ginger powder as natural feed additive on economic efficiency and highest profitability ratio was obtained by the diet with 1% ginger powder. Rio et al. (2019) reported the use of ginger powder at 7.5 g kg^{-1} of feed was found most economical in terms of production and

the net profit per kg live weight. Likewise, Khatun et al. (2013) reported supplementation with neem and tulsi extract was more profitable than control group but the difference was not significant (p>0.05). Supplementation with ginger was found to be more profitable than the control and tulsi supplemented group of broiler rearing. Tanwar (2018) also reported highest net profit with addition of aloe Vera and tulsi leaf alone and in combination @ 0.5%. Yadav (2018) reported significant effect of tulsi leaf powder along with combination of organic acid on net profit of bird.

3.3. Per cent mortality

The per cent mortality in the broiler chicks of different treatment groups have been presented in Table 3. Out of total of 210 chicks reared in the present study, 9 chicks died. Thus, total mortality during the entire experimental period was 4.28%. The overall mortality per cent of chicks under different treatment groups was observed to be 16.17% in control group and 6.66% in T_1 and T_2 and in G_1, G_2, T_1G_1, T_2G_2 groups observed no mortality.

Table 3: Effect of tulsi leaf and ginger root powder on mortality per cent in broiler chicks at different weeks

Treatment groups number	Initial	Mortality in different weeks							
		I	II	III	IV	V	VI	0-VI	Mortality (%)
C	30	1	0	0	0	0	4	5	16.17a
T_1	30	1	0	0	0	0	1	2	6.66b
T_2	30	1	0	0	0	0	1	2	6.66b
G_1	30	0	0	0	0	0	0	0	0.00c
G_2	30	0	0	0	0	0	0	0	0.00c
T_1G_1	30	0	0	0	0	0	0	0	0.00c
T_2G_2	30	0	0	0	0	0	0	0	0.00c
Total	210	3	0	0	0	0	6	9	4.28

The means bearing different superscript in a row differ significantly (p<0.05); C: Basal diet (Control); T_1: Basal diet supplemented with 0.5% tulsi; T_2: Basal diet supplemented with 1% tulsi; G_1: Basal diet supplemented with 0.5% ginger; G_2: Basal diet supplemented with 1% ginger; T_1G_1: Basal diet supplemented with 0.25% tulsi and 0.25% ginger; T_2G_2: Basal diet supplemented with 0.5% tulsi and 0.5% ginger

The results obtained in the present study on mortality per cent are in line with the findings of Andriyanto et al. (2016) showed reduction of mortality per cent with supplementation of jamu ginger extract @ 1 ml l^{-1} of drinking water as compared to control. Mawahib et al. (2016) observed that feeding of mixture of ginger and garlic supplemented diet had significant effect on mortality percentage. Further Tanwar (2018), Yadav (2018) reported reduced mortality in tulsi supplemented group as compared to control.

The lower mortality percentage may be due to antibacterial and immunomodultory activity of Tulsi (Al-Kassie, 2010). Improvement in mortality rate of broilers fed with ginger might be due to the stimulated lactic acid bacteria and decreases pathogenic bacteria such as mesophilic aerobic, coliform and *Escherichia coli* (Tekeli et al., 2011).

4. Conclusion

Supplementation of the herbs tulsi (*Ocimum sanctum*) leaf and ginger (*Zingiber officinale*) powder as feed additives at 0.5% of both herbs could be important to improve performance, comparative economics and to reduce mortality percent of broilers.

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