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Effect of dietary supplementation of fenugreek seed powder on carcass characteristics, immune organs yield and meat quality in broiler chicken#

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Abstract

This study assessed the influence of dietary supplementation of fenugreek seed powder (FSP) on carcass characteristics and meat quality in broiler chicken. A total of 160 day-old commercial broiler chicks (Vencobb-430Y) were randomly allotted to five dietary treatment groups with each group comprising four replicates of 8 birds each, ensuring a completely randomised design (CRD): T1 (control), T2 (2.5 g FSP/kg basal diet), T3 (5 g FSP/kg basal diet), T4 (7.5 g FSP/kg basal diet) and T5 (10 g FSP/kg basal diet). Data collected were analysed by one-way ANOVA using SPSS (version 24.0). The statistical analysis revealed that supplementation of fenugreek seed powder (FSP) did not have a significant effect on carcass characteristics such as pre-slaughter weight, carcass weight, cut-up part weight, giblet weight and abdominal fat, as well as on the yield of immune organs and meat quality parameters including pH, water-holding capacity, cooking loss and drip loss. These results indicate that the inclusion of fenugreek seed powder (FSP) at these levels in the basal diet did not have a significant effect on the above mentioned parameters.

Keywords: *Fenugreek seed powder, broiler chicken, carcass characteristics, meat quality*

The rising demand for poultry meat products worldwide has led to a constant focus on methods that guarantee farmers' profitability while simultaneously improving growth performance, carcass output, meat quality and flock health. Initially, the chicken industry used antimicrobial growth promoters extensively as a result of this demand (Dibner and Richards, 2005). However, concerns over antimicrobial resistance in poultry products and preference for antibiotic-free meat have resulted in restrictions on their use, thereby creating a pressing need for safe, natural and cost-effective alternatives to sustain broiler production without compromising bird health.

One promising approach is the use of phytogenic feed additives, among which fenugreek (*Trigonella foenum-graecum*) has recently gained attention for its diverse biological properties. It is also rich in bioactive compounds such as saponins, flavonoids, alkaloids and galactomannans, which are reported to possess antimicrobial, antioxidant,

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hypolipidemic and hypocholesterolemic activities (Visuvanathan *et al.,* 2022). Several studies have reported improvements in broiler growth performance due to the improved digestion and enhanced feed utilisation when fenugreek seed powder is included in broiler diets (Abdel-Azeem, 2006; Alloui *et al*., 2012). However, most research has primarily focused on growth parameters, which has limited exploration of its potential impact on carcass characteristics and meat quality. Addressing this gap could provide valuable insights into the application of fenugreek in poultry meat production.

Therefore, the present study investigates the effect of dietary supplementation of FSP on carcass characteristics, immune organ yield and meat quality in broiler chickens, aiming to contribute to the development of efficient and sustainable poultry production systems without reliance on antibiotics.

Materials and methods

An experiment was conducted in the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy, Thrissur. A total of 160 day-old commercial broiler chicks (Vencobb-430Y) were procured from Venkateshwara Hatcheries Private Ltd., Dhoni, Palakkad for this study. All chicks were wing banded, weighed individually and randomly allotted to five dietary treatment groups, each group consisting of four replicates of eight birds each, in a completely randomised design. The experiment was conducted over 42 days, from one day old to 42 days of age.

Treatment groups

The five dietary treatments are detailed in Table 1. Each treatment group received its respective diet throughout the experimental period.

Table 1. Treatment groups and their respective diet

Treatments	Diets	Number of birds
T1	Basal diet	32
T2	Basal diet + 2.5 g FSP/kg diet	32
T3	Basal diet + 5.0 g FSP/kg diet	32
T4	Basal diet + 7.5 g FSP/kg diet	32
T5	Basal diet + 10.0 g FSP/kg diet	32
	Total	160

Basal diets

Standard basal diets were formulated as per BIS (2007) guidelines. The birds were fed with pre-starter diet up to seven days of age, followed by starter diet from eight to 21 days of age and then finisher diet till 42 days of age. The ingredient compositions of the basal diets are presented in Table 2.

Table 2. Ingredient composition of basal diets, per cent

Ingredients	Pre-starter	Starter	Finisher
Yellow maize	55.50	56.50	60.00
Soya bean meal	38.40	35.86	30.90
Rice bran oil	2.28	3.60	4.84
Dicalcium phosphate	1.80	1.90	1.90
Calcite	1.40	1.40	1.40
Salt	0.37	0.36	0.50
[1]L-Lysine	0.10	0.19	0.21
[2]DL -Methionine	0.15	0.19	0.25
Total	100.00	100.00	100.00

Carcass characteristics

At the end of the experiment (42 days of age), eight birds from each treatment (two birds per replicate) were randomly selected and slaughtered humanely (Order no: 25/573/2010-AWD Dated: 12-06-2024) to study the carcass characteristics. Data on pre-slaughter weight, carcass weight, cut up part weight, giblet weight, abdominal fat and weight of bursa and spleen were collected.

$$\text{Carcass yield (\%)} = \frac{\text{Carcass weight} \times 100}{\text{Pre-slaughter weight}}$$

$$\text{Ready to cook yield (\%)} = \frac{\text{Carcass weight + Giblet weight} \times 100}{\text{Pre-slaughter weight}}$$

Weight of immune organs

The bursae of Fabricius and spleen were collected, weighed and recorded individually.

Meat quality

At the end of the experiment (42 days of age), eight birds from each treatment (two bird per replicate) were randomly selected and slaughtered humanely to study the meat quality. Hundred grams of breast muscle were collected from each for estimating the pH, water holding capacity, cooking loss (%) and drip loss (%).

The pH of the breast muscle was measured using a digital pH meter (Model 361, Systronics, India). About 5g of meat was homogenised in a tissue homogeniser with 45 mL of distilled water for about one minute. The pH was recorded by immersing the combined glass electrode of the digital pH meter into the homogenate.

The water holding capacity of muscle was determined using filter paper press method as per Grau and Hamm (1957). Whatman filter paper No. 1 was placed on a plexiglass plate (10 × 10 cm) and 0.3 g of meat was placed on its centre. A second plexi-glass plate was placed on top. A 50 kg weight (0.5 kg/cm^2 pressure) was applied

for five minutes. After removing the top plate, the meat film area and total area were measured by super positioning a grid of clear plastic over filter paper and then counting the number of squares in plastic grid fitting to zone of interest. Total number of squares counted was multiplied by unit area of a square to estimate the total area. Water holding capacity was then expressed as the ratio of meat film area to the total area.

The cooking loss (per cent) was estimated following the method described by Benli (2016) with slight modifications. Weights of the thawed chicken breast samples were recorded prior to cooking. The samples were then cooked to an internal temperature of 74 °C in an aluminium vessel, covered with aluminium foil to ensure uniform heat retention. After cooking, the meat was cooled to room temperature, the exuded fluid was discarded, and the samples were gently blotted dry without applying pressure. The weight of the dried, cooked meat was recorded, and cooking loss was expressed as a percentage.

$$\text{Cooking loss (per cent)} = \frac{\text{Initia weight} - \text{Weight after cooking} \times 100}{\text{Initial weight}}$$

Drip loss of the chicken breast muscle was determined by recording the initial weight of the samples before freezing at -18°C and then recording the weights of the samples thawed with various methods until the temperature in the centre of the meats reached 4°C, as per the method suggested by Benli (2016). Drip loss was expressed as per cent of moisture lost.

$$\text{Drip loss (per cent)} = \frac{\text{Initial weight} - \text{Final weight} \times 100}{\text{Initial weight}}$$

Results and discussion

Carcass characteristics

The data on carcass characteristics including pre-slaughter body weight (g), weights of carcass, giblet (liver, heart, gizzard), abdominal fat, breast, wings, neck, back, thighs and drumstick were recorded. Carcass yield, ready to cook yield and yields of different portions (per cent) were calculated and are presented in Table 3.

Analysis of the results indicated that supplementation of FSP at different doses did not produce any significant differences in the above mentioned carcass characteristics. These findings are in agreement with the results of Alloui *et al.* (2012), who reported that supplementation of fenugreek seed at a rate of 3 g per kg in the broiler diet did not cause any significant changes in dressing percentage or abdominal fat percentage. Similarly, Purushothaman *et al.* (2014) also reported a non-significant effect of fenugreek residue at a rate of 2 per cent on carcass parameters. Even at doses of 0.5, 1 and 1.5 per cents, fenugreek was not able to produce significant differences in carcass traits or internal organ weights (Osman *et al*., 2023). The supplementation of fenugreek at rates of 1 and 2 percent did not have a significant effect on the yields of thigh, drumstick, wing and back meat. When fenugreek seed extract was supplemented at different concentration of 10, 20 and 30 ml/L there was

Table 3. Carcass characteristics of broilers in different dietary treatments

Particulars	Treatments					p value
	T1 (Basal diet)	T2 (Basal diet + 2.5 g FSP / kg diet)	T3 (Basal diet + 5 g FSP / kg diet)	T4 (Basal diet + 7.5 g FSP / kg diet)	T5 (Basal diet + 10 g FSP / kg feed)	
Pre-slaughter body weight (g)	2290.88± 119.50	2319.88 ± 61.08	2565.88 ± 113.35	2405.88 ± 62.54	2547.13 ± 57.65	0.101
Carcass yield (%)	75.63 ± 2.86	73.72 ± 2.06	75.52 ± 1.73	75.00 ± 0.43	74.62 ± 4.75	0.300
Giblet (%)	2.86 ± 0.13	2.78 ± 0.08	2.95 ± 0.06	2.93 ± 0.12`	2.84 ± 0.13	0.917
Liver (%)	1.11 ± 0.10	1.07 ± 0.06	1.21 ± 0.08	1.09 ± 0.08	1.03 ±0.08	0.917
Heart (%)	0.45 ± 0.04	0.36 ± 0.02	0.35 ± 0.02	0.35 ± 0.03	0.36 ± 0.03	0.109
Gizzard (%)	1.37 ± 0.10	1.32 ± 0.08	1.47 ± 0.14	1.49 ± 0.10	1.45 ± 0.12	0.749
Abdominal fat (%)	1.20 ± 0.14	1.01 ± 0.21	1.21 ± 0.12	1.27 ± 0.08	1.22 ± 0.11	0.440
Breast (%)	29.64 ± 0.61	28.52 ± 1.36	29.44 ± 1.66	29.24 ± 0.29	29.29 ± 0.75	0.957
Wings (%)	7.92 ± 0.48	7.72 ± 0.24	7.65 ± 0.27	7.78 ± 0.22	7.31 ± 0.20	0.680
Neck & back (%)	16.84 ± 2.30	16.96 ± 0.87	17.70 ± 1.41	16.37 ± 0.53	17.28 ± 0.47	0.964
Thighs (%)	10.13 ± 0.56	10.40 ± 0.39	9.71 ± 0.29	9.71 ± 0.21	9.78 ± 0.42	0.657
Drumstick (%)	10.23 ± 0.52	10.29 ± 0.23	10.31 ± 0.32	10.83 ± 0.18	10.10 ± 0.16	0.529
Ready to cook yield (%)	78.56 ± 2.93	76.49 ± 2.01	78.55 ± 1.86	77.91 ± 0.41	77.49 ± 0.70	0.925

Table 4. Mean (±SE) yield of immune organs of broilers in different dietary treatments, per cent

Particulars	Treatments					p-value
	T1 (Basal diet)	T2 (Basal diet + 2.5 g FSP / kg diet)	T3 (Basal diet + 5 g FSP / kg diet)	T4 (Basal diet + 7.5 g FSP / kg diet)	T5 (Basal diet + 10 g FSP / kg feed)	
Bursa	0.10 ± 0.02	0.06 ± 0.01	0.05 ± 0.01	0.06 ± 0.01	0.08 ± 0.01	0.136
Spleen	0.11 ± 0.01	0.09 ± 0.01	0.10 ± 0.01	0.09 ± 0.01	0.08 ± 0.01	0.368

Table 5. Meat quality of broilers at six weeks of age in different dietary treatments

Particulars	Treatments					p-value
	T1 (Basal diet)	T2 (Basal diet + 2.5 g FSP / kg diet)	T3 (Basal diet + 5 g FSP / kg diet)	T4 (Basal diet + 7.5 g FSP / kg diet)	T5 (Basal diet + 10 g FSP / kg feed)	
pH	6.06 ± 0.07	6.05 ± 0.07	6.03 ± 0.05	6.10 ± 0.07	6.15 ± 0.08	0.789
Cooking loss (%)	28.72 ± 0.78	30.21 ± 0.79	30.13 ± 0.99	30.41 ± 1.33	31.15 ± 1.99	0.743
Dripping loss (%)	4.78 ± 0.20	5.31 ± 0.51	4.19 ± 0.14	5.06 ± 0.25	4.96 ± 0.40	0.197
Water holding capacity (%)	32.8 ± 2.36	35.00 ± 2.28	35.49 ± 1.19	35.59 ± 2.13	33.62 ± 1.66	0.156

no significant effect ($p<0.05$) on carcass characteristics of broiler chicks, particularly on the relative weights of liver, gizzard and overall giblet weight, indicating that fenugreek inclusion did not markedly influence the development of visceral organs (Khan *et al.,* 2009).

Immune organ yield

The weights of immune organs (bursa and spleen) of broilers were expressed as percentage of body weight at six weeks of age across different dietary treatments (Table 4).

The statistical analysis revealed that all values were statistically comparable among the dietary treatments. These findings align with the results of Nagnath (2021), who reported that the supplementation of fenugreek seed powder at 1 and 1.5 per cent in the diet of broilers had no significant effect on the relative weight of spleen when compared with the control group. Dakhil and Al-Shammari (2023) reported that dietary supplementation with 0.5 per cent FSP or its combination with symbiotic powder did not exert a significant effect on the relative weights of the spleen and bursa of Fabricius when compared with the control group in a study conducted in 300 broiler chicks. The supplementation of fenugreek seed extract at the rates of 50, 100, 200, 400 and 800 mg per kg also did not have a significant effect on the spleen and bursa of Fabricius index (Huang *et al*., 2022).

Meat quality

The data on meat quality like meat pH, cooking loss, dripping loss and water holding capacity (per cent) analysed in meat of broilers among different treatment groups are presented in Table 5.

The statistical analysis of the data revealed that the supplementation of different dietary treatments did not significantly affect the meat quality of the birds. These results align with the findings of Tao *et al.* (2017), who reported that birds fed a broiler diet supplemented with 9 per cent fenugreek powder did not make a significant effect on cooking loss, drip loss or pH of the meat when compared to other dietary and control groups.

Conclusion

Dietary supplementation of FSP at different inclusion levels did not exert any significant effect on meat quality parameters such as pH, cooking loss, drip loss and water-holding capacity. Similarly, carcass characteristics including carcass yield, giblet weights, cut-up parts and ready-to-cook yield remained unaffected across treatment groups. In addition, the relative weights of immune organs like the bursa of Fabricius and thymus were not significantly influenced by fenugreek supplementation.

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Conflict of interest

The authors declare that they have no conflict of interest

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