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Effect of tulsi leaf powder (*Ocimum sanctum*) as feed additives on carcass and proximate analysis of broilers

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Abstract
A research trial was conducted during the year 2022-2023 at the Poultry Unit of the Veterinary Polyclinic and Artificial Insemination Center, under the Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India. A total of 120 day-old chicks were randomly assigned to different dietary treatments. The control group (T_0) was provided a standard basal diet, while the experimental groups T_1, T_2, and T_3 received the same basal diet supplemented with tulsi (*Ocimum sanctum*) leaf powder at levels of 1.0%, 1.5%, and 2.0%, respectively. The analysis of carcass traits revealed a statistically significant variation in dressing percentage across the different treatment groups. The highest breast meat yield was observed in the T_2 group, with statistically significant differences noted among the treated groups. While minor variations were recorded in the giblet and drumstick percentages relative to carcass weight across the various treatment groups, these differences were not statistically significant. Thigh meat yield was found to be highest in group T_2. The treatments had no significant impact on the proximate composition of both breast and thigh muscles. The benefit-cost (B:C) ratio for the control and treatment groups T_0, T_1, T_2, and T_3 was recorded as 1.13, 1.16, 1.20, and 1.17, respectively.

Keywords: Tulsi leaf, carcass, *Ocimum sanctum*, proximate analysis, tulsi leaf powder

1. Introduction
The Indian poultry sector is currently challenged by widespread immunosuppression, which arises from multiple factors including suboptimal management practices, nutritional imbalances, high-intensity production systems, dense stocking rates, and the prevalence of infectious diseases. Therefore, improving immune function through dietary interventions has become a crucial area of focus for sustaining bird health and productivity. Both qualitative and quantitative data in existing literature highlight the administration of vitamins, minerals, amino acids, and their various combinations to improve poultry performance. With the restricted use of antibiotics in poultry production, there is an increasing need to incorporate alternative nutritional strategies, particularly immune-enhancing supplements, into poultry diets (Mode *et al*., 2009) [8].

In India, the use of herbs for medicinal and nutritional purposes has deep roots in the ancient Ayurvedic system. With growing consumer concerns over synthetic drugs, there is a noticeable shift toward natural and plant-based alternatives. This trend has gained significant traction not only in India but also across Western countries, where plant-derived ingredients are increasingly favored in both therapeutic and dietary applications. In recent years, numerous herbs have been explored as feed additives, serving roles such as growth promotion and immune system modulation (Gupta *et al*., 2007) [4]. A wide variety of plant-based feed additives-including Amla, Tulsi, Cinnamon, Shatavari, Basil, and Garlic have been utilized in broiler diets to enhance productivity by promoting growth, improving feed conversion efficiency, and reducing mortality rates (Salman, 2019) [10]. In recent times, concerns over antibiotic residues in animal-derived foods and the emergence of antibiotic-resistant bacteria have led to restrictions on the use of antibiotics as growth promoters in poultry nutrition (Zomrawi *et al*., 2012) [11]. Tulsi (*Ocimum sanctum*) is known to contain a range of bioactive compounds such as volatile oils, alkaloids, glycosides, saponins, and tannins.

Its leaves help preserve cellular membrane integrity by reducing degranulation and limiting histamine release. The primary active compound found in the dried leaves is eugenol (1-hydroxy-2-methoxy-4-allyl benzene), which contributes significantly to the plant's medicinal efficacy. Other notable constituents include β-caryophyllene, β-elemene, and caryophyllene oxide. Tulsi has been credited with numerous therapeutic effects in humans, including antimicrobial, antifungal, antispasmodic, hepatoprotective, cardioprotective, antioxidant, antiemetic, analgesic, and anti-stress properties (Prakash and Gupta, 2005) [9].

Methodology

For the present investigation, a total of 120 day-old broiler chicks (Ven Cobb 400 strain) were obtained from Venky's Hatcheries Pvt. Ltd., Pune and Maharashtra. Upon arrival, the chicks were randomly assigned to four dietary treatment groups T_0, T_1, T_2, and T_3 based on uniform body weight, with 30 chicks allocated per group. The birds were reared for a period of 42 days and housed in individual pens designated for each treatment. Throughout the six-week trial, the birds were fed experimental diets containing varying levels of Tulsi (*Ocimum sanctum*) leaf powder, specific to their treatment group. Treatment details are as under.

T_0	Basal diet (control)
T_1	Basal diet + 1.00 % Tulsi leaf powder
T_2	Basal diet + 1.50 % Tulsi leaf powder
T_3	Basal diet + 2.0 % Tulsi leaf powder

Observations recorded

Carcass traits

The following observations were made on different measurement of carcass and cut-up parts.

1. Live weight: Birds were weighted before slaughtering using an electronic balance.

2. Dressed weight: After slaughtering, the dressed birds were weighted and dressed weight was calculated as follows:-

$$\text{Dressed weight (\%)} = \frac{\text{Weight of dressed bird (g)}}{\text{Live weight of bird (g)}} \times 100$$

3. Giblet weight

$$\text{Giblet weight (\%)} = \frac{\text{Giblet weight (g)}}{\text{Live weight of bird (g)}} \times 100$$

The eviscerated weight with weight to giblet accounts for edible weight while weight of blood, feathers, offal's, head and shank comprise of non-edible weight.

4. Weight of carcass cut up parts (g): Neck, Back, Wing, Breast, Drumstick, Thigh, Head, and Leg weight constitutes carcass cut-up parts.

Proximate Analysis of feed and meat

1. Moisture Content

$$\text{Moisture (\%)} = \frac{\text{Fresh weight (g)} - \text{Dry weight (g)}}{\text{Fresh weight (g)}} \times 100$$

2. Determination of Nitrogen and Crude Protein

$$\text{Nitrogen (\%)} = \frac{V_1 - V_2 \times 0.0014}{b} \times 100$$

Where,

V_1 = Volume (ml) of 0.1 N HCl used for titration of sample

V_2 = Volume (ml) of 0.1 N HCl used for titration of blank

b = Weight sample taken for digestion on DM basis

0.0014 = Molecular weight of nitrogen (g) equivalent to Neutralize 1 ml of 0.1 N HCl.

Crude Protein (%) = N (%) x 6.25

3. Determination of Ether Extract

$$\text{Ether extract (\%)} = \frac{c - a}{b} \times 100$$

Where,

a = Initial weight of extraction cups (g)

b = Weight of samples on DM basis (g)

c = Weight of extraction cups with ether extract (g)

4. Determination of Total Ash

$$\text{Total ash (\%)} = \frac{a - b}{c} \times 100$$

Where,

a = Weight of silica crucible with ash (g)

b = Weight of empty silica crucible (g)

c = Weight of dry sample taken for ash (g)

Results and Discussion

Carcass traits

Carcass traits (%) due to different dietary treatments of tulsi leaf powder during experimental period is tabulated in Table 1.

Table 1: Effect of feeding tulsi leaf powder on carcass traits (%) of broiler

Carcass traits (%)	Treatments				Mean (±) SE	CD @ 5 %
	T_0	T_1	T_2	T_3		
Live body weight	1998.18^{cd}	2046.42^{c}	2186.76^{a}	2080.23^{b}	2077.89±21.24	60.45
Dressing (%)	68.26^{b}	68.78^{b}	69.87^{a}	69.45^{a}	69.09±0.34	0.95
Breast (%)	28.12^{c}	28.66^{b}	29.58^{a}	28.97^{b}	28.83±0.18	0.52
Giblet (%)	4.19	4.31	4.66	4.52	4.41±0.16	NS
Drumstick (%)	14.20	14.69	15.54	15.02	14.86±0.38	NS
Thigh (%)	15.50	15.83	16.54	16.17	16.01±0. 35	NS

The average dressing percentages for the different dietary treatments were recorded as 68.26%, 68.78%, 69.87%, and 69.45% for T_0, T_1, T_2, and T_3 groups, respectively. Statistical analysis revealed that the variation among treatments was significant. The highest dressing percentage was observed in the T_2 group, followed by T_3, T_1, and T_0, suggesting that dietary inclusion of Tulsi leaf powder positively influenced carcass yield.

Breast meat yield was significantly improved in groups T_2 and T_3, which were statistically at par. In contrast, the proportions of giblet, thigh, and drumstick relative to carcass weight did not differ significantly among the treatment groups.

These findings are in agreement with the study conducted by Arshad *et al*. (2013) [1], who evaluated the carcass traits of Japanese quails fed with diets supplemented with neem and tulsi. Their results demonstrated significant differences ($p<0.05$) in most carcass parameters, except liver weight ($p>0.05$). The T_3 group showed the highest values for pre-slaughter weight, slaughter weight, and dressing percentage, followed by T_2 and T_1, while the control group recorded the lowest values. Heart weight was significantly greater in the T_3 group compared to the control, and gizzard weights were similar in birds from the T_2 and T_3 groups.

Comparable outcomes were reported by Islam *et al*. (2017) [6], who found no significant difference in dressing percentage across treatment groups. Their study also revealed that relative gizzard weights were not significantly affected, though statistically significant differences at the 1% level were noted for heart, liver, spleen, and pancreas weights, depending on whether tulsi leaf extract was included in drinking water. These findings align with earlier research by Harnandes *et al*. (2004) [5], reinforcing the potential benefits of herbal supplementation in poultry diets.

Meat composition

1. Meat Composition in Breast Muscle

The influence of Tulsi leaf powder supplementation on the proximate composition of breast muscle is summarized in Table 2. Moisture content in the breast meat was found to be 71.41%, 71.73%, 71.68%, and 71.63% in treatment groups T_0, T_1, T_2, and T_3, respectively. The corresponding protein content was 19.54%, 19.50%, 19.62% and 19.61%, while fat content measured 3.31%, 3.32%, 3.23%, and 3.24%. Ash content was recorded as 1.18%, 1.19%, 1.23%, and 1.26% across the same treatment groups.

Although minor numerical differences were observed among the treatments, statistical analysis indicated that these variations in meat composition were not significant. This suggests that while tulsi leaf powder supplementation may have contributed to improve feed conversion efficiency, it did not have a measurable impact on the overall quality of breast meat in terms of its proximate nutrient profile.

Table 2: Effect of supplementation of Tulsi leaf powder on broiler's meat composition (Breast muscles)

Treatment	Parameters			
	Moisture	Protein	Fat	Ash
T_0	71.41	19.54	3.31	1.18
T_1	71.73	19.50	3.32	1.19
T_2	71.68	19.62	3.23	1.23
T_3	71.63	19.61	3.24	1.26
Mean ± SE	71.61	19.56	3.27	1.21
CD @ 5 %	NS	NS	NS	NS

2. Meat Composition in Thigh Muscle

Table 3 presents the impact of tulsi leaf powder inclusion in the diet on the proximate composition of thigh muscle in broilers. The moisture content observed in T_0, T_1, T_2, and T_3 groups was 68.31%, 68.30%, 68.26%, and 68.34%, respectively. Protein levels were measured at 19.34%, 19.46%, 19.48%, and 19.56% in the same order. Fat content was recorded as 4.70%, 4.55%, 4.74%, and 4.60%, while ash content was found to be 1.34%, 1.38%, 1.38%, and 1.35%.

Although slight variations were noted in moisture, protein, fat, and ash contents among the treatments, statistical analysis confirmed that these differences were not significant. This indicates that dietary supplementation with tulsi leaf powder did not markedly affect the chemical composition of thigh meat in broilers.

Table 3: Effect of tulsi leaf powder on thigh muscle composition (%) of broiler

Treatment	Parameters			
	Moisture	Protein	Fat	Ash
T_0	68.31	19.34	4.70	1.34
T_1	68.30	19.46	4.55	1.38
T_2	68.26	19.48	4.74	1.36
T_3	68.34	19.56	4.60	1.34
Mean ± SE	68.30	19.46	4.64	1.35
CD @ 5 %	NS	NS	NS	NS

Economics of broiler production

The economic analysis of broiler production was carried out by considering the cost of day-old chicks along with the feed consumed during the experimental period. The findings are detailed in Table 4. The total production cost per bird, including the price of chicks and feed, was calculated as ₹152.86, ₹155.04, ₹158.79, and ₹157.48 for the T_0, T_1, T_2, and T_3 groups, respectively. The corresponding net profit per bird was ₹21.36 for T_0, ₹28.74 for T_1, ₹33.90 for T_2, and ₹29.81 for T_3. These results suggest that birds receiving Tulsi leaf powder, particularly at the 1.5% inclusion level (T_2), yielded higher profitability compared to the control group.

Table 4: Economics of broiler production under different dietary treatment

Sr. No.	Particulars	Treatments			
		T_0	T_1	T_2	T_3
1.	Cost of day-old chick (Rs)	30	30	30	30
2.	Cost of feed (Rs/kg)	32	32	32	32
3.	Average total feed consumed by bird (g)	3547.61	3617.34	3737.51	3695.43
4.	Total Feed cost (Rs. / Bird)	110.86	113.04	116.79	115.48
5.	Overhead charge	12	12	12	12
6.	Total cost of production Rs. / bird (1+4+5)	152.86	155.04	158.79	157.48
7.	Body weights at end of 6thweek, kg/bird	1.990	2.038	2.171	2.078
8.	Selling rate @ Rs. 90/-per kg. body wt.	179.10	183.78	192.69	187.29
9.	Net profit Rs. / bird	21.36	25.74	33.9	29.81
10.	Net profit Rs. /Kg. live wt.	10.73	14.10	15.6	14.34
11.	B:C ratio (8/6)	1.17	1.18	1.21	1.18

Table 4 presents detailed information regarding the cost components and economic returns associated with each treatment group. Parameters include the price of day-old chicks (₹), feed cost per kilogram (₹/kg), total feed intake, feed cost per bird, overhead expenses, overall production cost per bird, final body weight at the end of the sixth week (kg/bird), net profit per kilogram of live weight, and the benefit-cost (B:C) ratio.

As observed from the data, the highest net profit per bird was achieved in the T_2 group (₹32.93), which received 1.5% tulsi leaf powder. This was followed by T_3 (₹27.66) with 1% supplementation, T_1 (₹25.75) with 0.5% supplementation, and the lowest profit in the control group T_0 (₹21.36). These results suggest that dietary inclusion of Tulsi leaf powder at 1.5% per kg is the most cost-effective option, likely due to improved growth performance, lower feed intake, and enhanced feed efficiency.

These findings are consistent with those reported in earlier studies. Gohel *et al*. (2019) [3] found increased profit margins over the control group, recording ₹3.57, ₹2.63, and ₹0.02 profit per bird in groups T_4, T_3, and T_2, respectively. Similarly, Biswas *et al*. (2017) [2] reported higher economic returns in broilers administered Tulsi leaf extract (1 ml/litre of drinking water), with a net profit of 13.33 T.K/kg compared to 5.33 T.K/kg in the control group. Supporting this, Lanjewar *et al*. (2008) [7] observed that supplementation of Tulsi leaf powder at 1% in broiler diets resulted in greater profitability than 0.5% or control diets.

Conclusion

Tulsi leaf powder was used at the level of 1.0, 1.5 and 2.0 per cent in the diets of the first, second and third treatment groups, respectively. From the present investigation, the following conclusion were drawn. The inclusion of Tulsi leaf powder had significant positive influence on the dressing percentage and breast percentage while non-significant effect on proximate composition of chicken.

Conflict of Interest: Not available

Financial Support: Not available

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