International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
NAAS Rating (2025): 4.61
VET 2025; 10(9): 320-324

www.veterinarypaper.com
Received: 20-06-2025
Accepted: 24-07-2025

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Effect of dried orange peel powder on growth performance of Giriraja poultry birds

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DOI: https://www.doi.org/10.22271/veterinary.2025.v10.i9e.2573

Abstract
The present study was conducted to investigate the effect of dried orange peel powder on growth performance of Giriraja poultry birds. A total 150 day-old Giriraja poultry birds randomly assigned to 5 dietary treatments namely T_1 basal diet (control), T_2 (1% DOPP), T_3 (2% DOPP), T_4 (3% DOPP), T_5 (4% DOPP). Each treatment consisted of 3 replications with 10 birds per replication reared, for 7th week of age. The experimental birds reared up to 7th week of age.

This result indicated that live body weight and body weight gain were influence by dried orange peel powder, with non-significant differences observed in the 1st week of age ($p>0.05$) and significant variations from the 2nd week onwards ($p<0.05$). The supplementation of DOPP at T_2 (1%) and T_3 (2%) resulted in higher live body weight and body weight gain from second week onwards up to the seventh week of age. Moreover, a reducing trend was observed with 3% and 4% DOPP in treatments T_4 and T_5, respectively. These results indicated that 1% DOPP was the optimum level with respect to live body weight and body weight gain.

The feed conversion ratio was significantly different throughout the experimental period, except in the first week ($p<0.05$). The T_1 group (control) consistently exhibited the highest values, whereas T_2 maintained the lowest across most weeks, confirming its effectiveness in enhancing feed utilization efficiency. These results clearly indicated that dietary inclusion of 1% DOPP did not have negative effects and beneficial for Giriraja poultry birds.

Keywords: Dried orange peel powder (DOPP), Live body weight, Body weight gain, Feed conversion ratio (FCR), Growth performance

Introduction

India's poultry sector stands out as one of the most rapidly expanding areas within its agriculture industry. As per 2024 data from Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), India rank 8th globally in meat production and 3rd in egg production. Egg output in the country has witness significant growth, increasing at a Compound Annual Growth Rate (CAGR) of 6.87%, rising from 78.48 billion in 2014-2015 to 142.77 billion in 2023-2024. For the year 2023-2024, the estimated per capita egg availability is 103 eggs per billion. Likewise, meat production has shown a steady upward trend, growing from 6.69 million tonnes in 2014-2015 to 10.25 million tonnes in 2023-2024.

Agriculture by product can play a significant role in poultry nutrition on an alternative to traditional ingredient resource. Orange peel meal has the potential to be a source of essential nutrients and reduce oxidative stress in chicken.

Citrus fruits, particularly oranges, are widely cultivated and generate substantial amounts of by-products during juice and processing industries. Among these, orange peels constitute a significant proportion, often considered waste. However, orange peels are rich in bioactive compounds, including flavonoids, polyphenols, essential oils, vitamins, and dietary fiber, which possess antioxidant, antimicrobial, and growth-promoting properties. These compounds have the potential to enhance gut health, nutrient utilization, and immunity in poultry, making dried orange peel powder (DOPP) a promising natural feed additive.

Recent studies have demonstration that dietary inclusion of DOPP can improve feed efficiency, body weight gain, and overall performance in broilers and other poultry species, while also potentially meat quality and sensory attributes. Further, orange peels are a primary by-product produced by the fruit processing industry, so attempts were made to use DSOP as natural feed additive, and even as medicinal supplement for animals (Callaway *et al.* 2008) [9].

Material and Method

A total of 150-day-old Giriraja chicks were obtained from a Government hatchery to investigate the potential of dried orange peel powder (DOPP) as a natural feed additive. The chicks were randomly divided into five treatment groups, with each group receiving a basal poultry diet supplemented with different concentrations of DOPP. This study aimed to evaluate the influence of DOPP supplementation on the growth performance and general health of the birds.

Each treatment consisted of three replications group, with 10 birds assigned to each replication (e.g., T_1R1, T_2R2, T_3R3), totaling 30 birds per treatment. The experiment was designed following a Completely Randomized Design (CRD). Feed and water were provided *ad libitum* throughout the 7-week experimental period. Weekly measurements of live body weight and body weight gain were recorded for all birds. Commercially available standard feed was used for feeding the experimental chicks. The chicks were provided with a pre-starter ration from 0–7 days of age, a starter ration from 7–21 days, and a finisher ration from 22–60 days, according to BIS (2007) specifications.

Table 1: Treatment Details

Treatments	Standard Rations	Dried Orange Peel Powder%
T_1	SR	(Control)
T_2	SR	1%
T_3	SR	2%
T_4	SR	3%
T_5	SR	4%

Table 2: Assignment of bird to treatments and details of replication

	Replication group			
Treatment	R_1	R_2	R_3	Total
T_1	10	10	10	30
T_2	10	10	10	30
T_3	10	10	10	30
T_4	10	10	10	30
T_5	10	10	10	30
	50	50	50	150

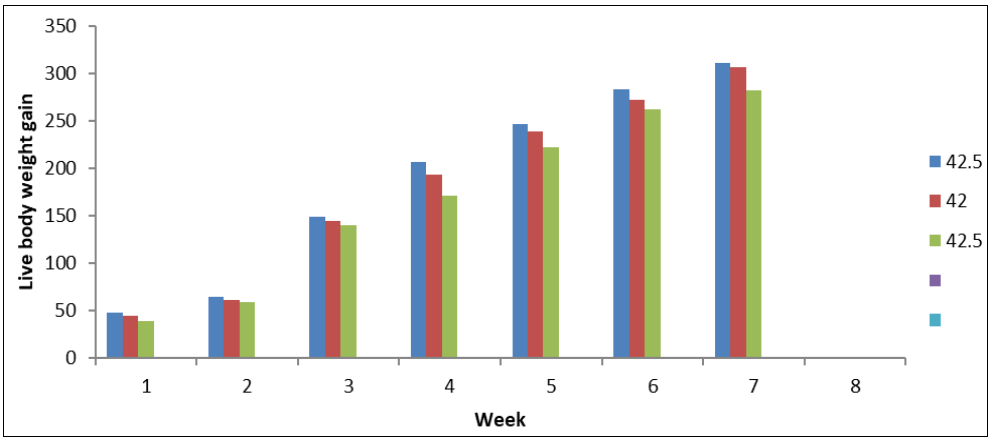

Fig 1: Effect of dried orange peel powder on live body weight of Giriraja poultry birds

Table 3: Effect of DOPP supplementation on live body weight of Giriraja poultry birds

Treatments	Week							
	Initial	1st	2nd	3rd	4th	5th	6th	7th
T_1	43.1	78.8	137.5	266.1	422.3	630.6	885.3	1152.30
T_2	42.1	96.6	165.1	315.8	530.4	783.4	1072.5	1393.60
T_3	42.5	90.8	155.4	304.2	510.2	756.8	1040.1	1351.20
T_4	42.0	86.7	147.8	292.4	485.6	724.3	996.6	1303.40
T_5	42.5	81.9	141.1	281.0	452.2	674.2	936.7	1218.80
SE (m) ±	0.40	0.71	1.10	1.62	0.71	0.70	0.87	0.57
CD@ 5%	NS	2.07	3.08	4.81	2.21	2.01	2.42	1.58
'F' test	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig

Result and discussion

The live body weight of Giriraja poultry birds presented in table 3, at the first week of age show non- significant differences ($p<0.05$), whereas from second week onward, significant variations ($p<0.05$) were observed. The dietary treatments with dried orange peel powder (DOPP) showed that T_1 (control) and T_5 (4%) recorded the lowest final body weights of 1152.30 g and 1218.80 g, respectively. In contrast, T_2 (1%) exhibited the highest live body weight at 1393.60 g, followed by T_3 (2%) and T_4 (3%), which achieved 1351.20 g and 1303.40 g, respectively. These findings clearly indicate that supplementation at the 1% level of DOPP was optimal and beneficial for digestion, thereby producing a positive effect on growth performance and live body weight of Giriraja poultry birds.

These findings agreement with previous studies, Abbas Ebrahimi *et al.* (2012) [1], reported higher feed intake and body weight at 1.5% DSOP, whereas 3% reduced growth. Ani A. O. *et al.* (2013) [7], observed significant effects of processed orange peel on live body weight, with 5% POP better that 10% and 15%, while the control had the lowest growth. Similarly, Oluremi *et al.* (2017) [13], found that higher level of fermented sweet orange fruit meal did not support broiler growth. Ahmed ST (2022) [3], reported that dried orange peel (DOPP) at 1% effectively promotes growth in broilers. Ether Taiwo *et al.* (2023), also noted that higher SOP levels did not enhance starter broiler growth. Thus, these result showed that dietary inclusion of 1% DOPP did not affect on Giriraja poultry birds.

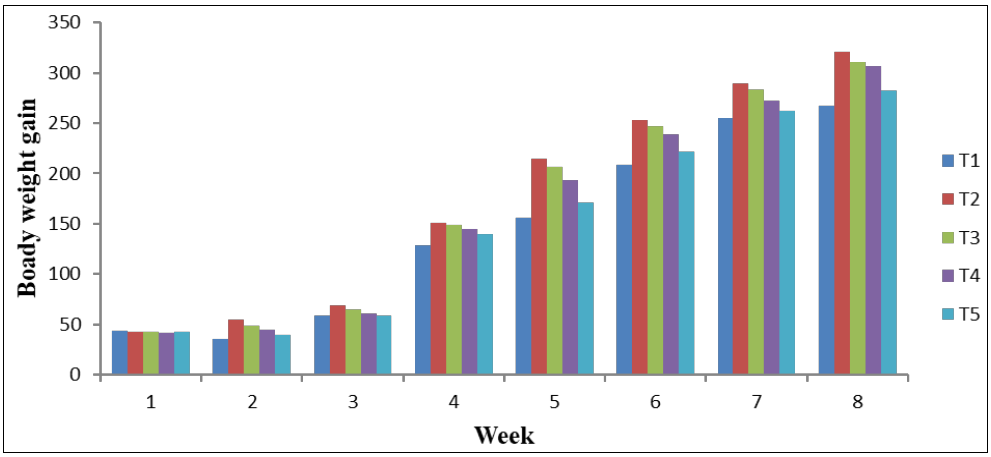

Fig 2: Effect of dried orange peel powder on body weight gain of Giriraja poultry birds.

Table 4: Effect of DOPP supplementation on body weight gain of Giriraja poultry birds

Treatments	Week							
	Initial	1st	2nd	3rd	4th	5th	6th	7th
T_1	43.1	35.7	58.7	128.6	156.2	208.3	254.7	267.00
T_2	42.1	54.5	68.5	150.7	214.7	253.0	289.1	321.10
T_3	42.5	48.3	64.6	148.8	206.0	246.7	283.3	311.10
T_4	42.0	44.7	61.0	144.6	193.2	238.7	272.3	306.77
T_5	42.5	39.4	59.1	139.9	171.2	222.0	262.5	282.13
SE (m) ±	0.40	0.84	1.20	1.80	8.05	0.99	0.95	1.0
CD@ 5%	NS	2.35	3.51	5.28	23.87	2.76	2.78	2.88
'F' test	NS	Sig	Sig	Sig	Sig	Sig	Sig	Sig

Result and Discussion

Similarly, the present result in table 4, suggested that the differences in body weight gain during the initial week were non-significant (p>0.05), while from second week onwards significance differences were observed (p<0.05). During the final week, the lowest body weight gain was recorded in T_1 (267 g) and T_5 (282.13 g), whereas the highest gain was observed in T_2 (321.10 g) and T_3 (311.10 g), followed by T_4 (306.77 g). Throughout the experimental period, it was observed that the optimum levels of dried orange peel powder T_2 and T_3 (1 and 2%) exerted a beneficial effect on the body weight gain of Giriraja poultry birds. In contrast, dietary inclusion at higher levels (3% and 4%) significantly depressed body weight gain, which could be attributed to the higher crude fiber fraction limiting nutrient digestibility and energy availability.

These results were also aligned with Oluremi *et al.* (2006) [14], who reported no significant effect of sun-dried sweet orange rind on broiler growth up to 10%, though higher levels reduced body weight gain. Siyal *et al.* (2016) [18] also confirmed that inclusion of 1.5–3.0% orange peel significantly enhanced weight gain compared with control. In contrast, Akbarian *et al.* (2013) [5] found no significant effect of orange or lemon peel extracts.

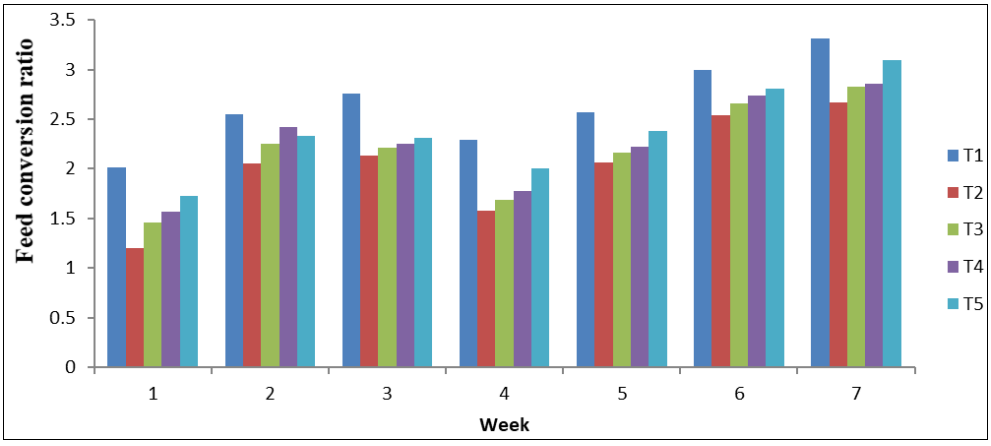

Fig 2: Effect of dried orange peel powder on feed conversion ratio of Giriraja poultry birds.

Table 5: Effect of DOPP supplementation on feed conversion ratio of Giriraja poultry birds

Treatments	Weeks						
	1st	2nd	3rd	4th	5th	6th	7th
T_1	2.01	2.55	2.76	2.29	2.57	3.00	3.31
T_2	1.20	2.05	2.13	1.58	2.06	2.54	2.67
T_3	1.46	2.25	2.21	1.69	2.16	2.66	2.83
T_4	1.57	2.42	2.25	1.78	2.22	2.74	2.86
T_5	1.73	2.33	2.31	2.00	2.38	2.81	3.09
SE (m) ±	0.041	0.049	0.101	0.021	0.012	0.001	0.018
CD @ 5%	0.114	0.137	0.283	0.058	0.034	0.034	0.049
'F' Test	NS	Sig	Sig	Sig	Sig	Sig	Sig

Results and Discussion

Theses results in table 5, suggested that the effect of DOPP on the feed conversion ratio (FCR) of Giriraja poultry birds during the first week was non- significant (P>0.05). However, from the second to the seventh week of age significance difference (p<0.05) were recorded. At the last week the FCR values were highest in T_1 (3.31) and T_5 (3.09), average in T_3 (2.83) and T_4 (2.86) and lowest in T_2 (2.67). These finding indicated that Giriraja poultry birds could tolerate up to 1% DOPP in their diet without any adverse effect on feed utilization and survivability.

Similar observation were reported by Alefzadeh *et al.* (2016)

[6] non- significant (P>0.05) effect on FCR, though feed intake and weight gain were influenced. Siyal *et al.* (2016) [18], Ahaotu *et al.* (2017) [4] and Odunlade *et al.* (2020) [12] found excessive inclusion of orange peel products impaired feed utilization due to high fiber and residual anti-nutritional factors, while moderate levels enhance performance. Also the result aligned with Ahmed ST (2022) [3], who reported significant difference ($p<0.05$) improvement in FCR with citrus peel supplementation during the both starter and finisher phases. Latif *et al.* (2023), reported that orange peel meal enhanced the FCR without any adverse effect on growth performance.

Conclusion

- Supplementation of dried orange peel powder (DOPP) influenced the growth performance of Giriraja poultry birds.
- Live body weight and body weight gain were non-significant (P>0.05) in the first week, but significant variations ($p<0.05$) appeared from the second week onward.
- The highest final body weight (1393.60 g) and weight gain (321.10 g) were observed in T_2 (1% DOPP), followed by T_3 (2%), while lowest values occurred in T_4 (3%) and T_1 (control) and T_5 (4%).
- Feed conversion ratio (FCR) differed significantly with the best efficiency in T_2 (2.67), followed by T_3 (2.83) and T_4 (2.86), whereas the poorest values were in T_1 (3.31) and T_5 (3.09).
- Overall, supplementation up to 1% DOPP was optimal, enhancing growth performance, feed efficiency, and survivability, whereas higher inclusion levels greater than or equal to 3% depressed growth due to excess fiber limiting nutrient digestibility.

Acknowledgement

The author acknowledges sincere thanks to Head, Department of Animal Husbandry and Dairy Science, Dr. PDKV, Akola (Maharashtra) for providing poultry farm facilities to conduct present research trails.

Conflict of Interest

The author declares that they have no conflict of interest**.**

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How to Cite This Article
Palkantiwar SS, Shegokar SR, Nage SP, Bidwe KU, Wade MR, Kahate PA, *et al*. Effect of dried orange peel powder on growth performance of Giriraja poultry birds. International Journal of Veterinary Sciences and Animal Husbandry. 2025; 10(9): 320-324.