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Impact of dietary supplementation of pomegranate peel powder on growth metrics of Giriraja poultry birds under intensive system of rearing

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Abstract
The present study was conducted to evaluate the effect of pomegranate peel powder meal (PPPM) supplementation on the growth performance of Giriraja poultry birds. A total of 150-day-old chicks were randomly distributed into five treatment groups, each comprising 30 birds, under a Completely Randomized Design (CRD). The dietary treatments included a standard poultry ration supplemented with varying levels of PPPM: 0% (T_1 - control), 0.3% (T_2), 0.6% (T_3), 0.9% (T_4), and 1.2% (T_5). All birds were provided *ad libitum* access to feed and water for a period of seven weeks. Weekly live body weight and body weight gain were recorded to assess growth performance.
The results revealed a significant improvement in growth performance in birds supplemented with 0.3% PPPM (T_2), which exhibited the highest weekly weight gain and final body weight compared to other treatment groups. However, higher inclusion levels (0.6-1.2%) showed a decreasing trend in growth, with the lowest performance recorded in the T_5 group. The study concludes that pomegranate peel powder meal, when used at a 0.3% inclusion rate, can serve as an effective and sustainable natural growth promoter in poultry feed without any adverse effect on body.

Keywords: Pomegranate peel powder, Giriraja birds, body weight gain, poultry feed, growth performance

Introduction
India's poultry sector stands out as one of the most rapidly expanding areas within its agricultural industry. As per 2024 data from the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), India ranks 8th globally in meat production and 3rd in egg production. Egg output in the country has witnessed significant growth, increasing at a Compound Annual Growth Rate (CAGR) of 6.87%, rising from 78.48 billion in 2014-15 to 142.77 billion in 2023-24. For the year 2023-24, the estimated per capita egg availability is 103 eggs per year. Likewise, meat production has shown a steady upward trend, growing from 6.69 million tonnes in 2014-15 to 10.25 million tonnes in 2023-24.
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In recent years, there has been growing interest in the use of natural feed additives in poultry nutrition, particularly those derived from plant sources with functional bioactive properties. Among these, pomegranate (*Punica granatum L.*) peel has emerged as a promising candidate due to its potential as a prophylactic agent and growth enhancer in broiler diets. Pomegranate is a deciduous, non-climacteric, and ornamental plant widely cultivated across various regions, including South Africa, and is renowned for its resilience to adverse climatic and environmental conditions (Dhinesh & Ramasamy, 2016) [3]. The peel of the pomegranate fruit, often considered an agricultural by-product, is rich in a variety of bioactive compounds that contribute to its significant pharmacological properties. Numerous studies have highlighted the antioxidant, antimicrobial, hypoglycaemic, hypolipidemic, hepatoprotective, and anti-inflammatory effects of pomegranate peel (Naveena *et al.*, 2008) [8].

These beneficial properties are attributed to the presence of hydrolysable tannins such as ellagitannins, gallotannins, and gallagyl esters (including punicalagin, punicalin, and pedunculagin) as well as a diverse array of polyphenols, flavonoids, catechins, ellagic acid, flavonones, flavones, and anthocyanidins. Given its high nutritional value and therapeutic potential, the incorporation of pomegranate peel into poultry feed formulations offers a sustainable and health-promoting alternative to synthetic additives (Arendse *et al.*, 2017) [1]. This study aims to explore the efficacy and potential applications of pomegranate peel as a functional feed additive in broiler production.

Materials and Methods

A total of 150-day-old Giriraja chicks were obtained from a government hatchery to investigate the potential of pomegranate peel powder 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 pomegranate peel powder. This study aimed to evaluate the influence of pomegranate peel meal supplementation on the growth performance and general health of the birds. Each treatment consisted of three replications, with 10 birds assigned to each (e.g., T_1R_1, T_2R_2, T_3R_3), totalling 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 duration. Weekly measurements of live body weight and body weight gain were taken for all birds. Commercially available standard feed was used for feeding to the experimental chicks. All the chicks were fed with pre- starter ration up to 0-7 days, starter ration up to 7-21 days and finisher ration from 22 to 60 days of age as per BIS (2007) specification.

Table 1: Diet Composition and feeding practices

Treatments	Standard Ration (SR)	Pomegranate peel powder
T_1	SR	Control
T_2	SR	0.3%
T_3	SR	0.6%
T_4	SR	0.9%
T_5	SR	1.2%

Table 2: Assignment of birds to treatments

Treatments	Replications			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
				150

Statistical analysis

Treatment	Week							
	initial	1st	2nd	3rd	4th	5th	6th	7th
T_1	42.0	97.2	179.4	296.2	472.4	656.4	921.3	1170.20
T_2	41.2	105.1	199.0	352.0	554.8	778.1	1113.3	1380.27
T_3	41.8	99.3	185.7	320.0	508.0	714.4	1028.2	1280.80
T_4	42.4	100.3	178.0	305.0	486.6	689.4	1009.6	1243.37
T_5	41.1	98.0	167.6	288.6	459.2	642.2	939.4	1165.20
SE(m)±	0.32	1.58	2.35	2.32	2.38	4.26	3.91	2.82
CD	NS	4.70	7.00	6.49	7.10	12.70	11.70	8.46
F-Test	NS	S	S	S	S	S	S	S

The data collected on live body weight and weekly weight gain were statistically analyzed using the Completely Randomized Design (CRD) method, as outlined by Ample (1975), to determine the significance of treatment effects.

Results and Discussion

Weekly live body weights of Giriraja poultry birds.

The average weekly live body weight data of Giriraja poultry birds, recorded from day-old to seven weeks of age across all treatment groups, were statistically analyzed, summarized in Table 3, and illustrated graphically in Figure 1.

The data presented in the table indicate that the average initial (day-old) live body weights of Giriraja chicks were 42.0, 412, 41.8, 42.4, and 41.1 grams for treatments T_1, T_2, T_3, T_4, and T_5, respectively. These values demonstrate minimal variation among the treatment groups, suggesting a uniform and homogenous distribution of birds at the start of the experiment. From the first to the third week of age, the average body weights of chicks remained comparable across all treatment groups, indicating no significant early differences in growth performance. However, a numerical reduction in body weight was observed in the group supplemented with 0.3% pomegranate peel powder meal, as compared to the control group, although the difference was not statistically significant.

At the end of the 7th week, the average live body weights of Giriraja poultry birds were recorded as 1170.20 g (T_1), 1380.27 g (T_2), 1280.80 g (T_3), 1243.37 g (T_4), and 1165.20 g (T_5). Statistically significant differences in weekly body weight emerged from the second week onward. The birds in T_2 exhibited the highest final body weight (1380.27 g), followed by T_3 (1280.80 g), with both groups showing significantly better growth performance during the fifth to seventh weeks. In contrast, the lowest final body weight was observed in T_5 (1165.20 g), which was statistically at par with T_1 (1170.20 g).

The findings of the present study agree with several previous reports evaluating the impact of pomegranate-derived supplements on broiler growth performance. Saleh *et al.* (2017) [9] investigated the effects of dietary supplementation with α-tocopherol (α-Toc), pomegranate peel extract (PPE), and pomegranate peel (PP) on broiler performance over a 42-day period. The study employed eight dietary treatments, including a control, and α-Toc diet (200 mg/kg), PPE diets (100, 200, and 300 mg/kg), and PP diets (1, 2, and 3 g/kg). Their results showed that supplementation with 0.2 g/kg of PPE significantly improved daily weight gain.

The present finding agrees with the Hamad *et al.* (2019) [7] observed that the control group (T_1) exhibited the highest live body weight at 35 days of age (161.66 g), indicating that the inclusion of pomegranate peel powder at 1% and 1.5% did not enhance growth performance in comparison to the unsupplemented control. This indicate that, as the level of PPP increase the growth decrease.

Similarly, Elsebai *et al.* (2022) [5] reported comparable findings in a study assessing the effects of dietary pomegranate peel powder (PPP) on broiler chicks. Treatments included a control (T_1), and increasing levels of PPP: 0.25% (T_2), 0.50% (T_3), 1.0% (T_4), and 1.5% (T_5). After a 6-week feeding period, the recorded average live body weights were 1880.22 g (T_1), 2240.12 g (T_2), 2290.00 g (T_3), 2200.80 g (T_4), and 2199.55 g (T_5), suggesting a positive response to PPP supplementation, particularly at the 0.5% inclusion level.

Table 5: Live body weight response of Giriraja birds to pomegranate peel powder (g/bird)

Treatment	Week							
	initial	1st	2nd	3rd	4th	5th	6th	7th
T_1	42.0	97.2	179.4	296.2	472.4	656.4	921.3	1170.20
T_2	41.2	105.1	199.0	352.0	554.8	778.1	1113.3	1380.27
T_3	41.8	99.3	185.7	320.0	508.0	714.4	1028.2	1280.80
T_4	42.4	100.3	178.0	305.0	486.6	689.4	1009.6	1243.37
T_5	41.1	98.0	167.6	288.6	459.2	642.2	939.4	1165.20
SE(m)±	0.32	1.58	2.35	2.32	2.38	4.26	3.91	2.82
CD	NS	4.70	7.00	6.49	7.10	12.70	11.70	8.46
F test	NS	S	S	S	S	S	S	S

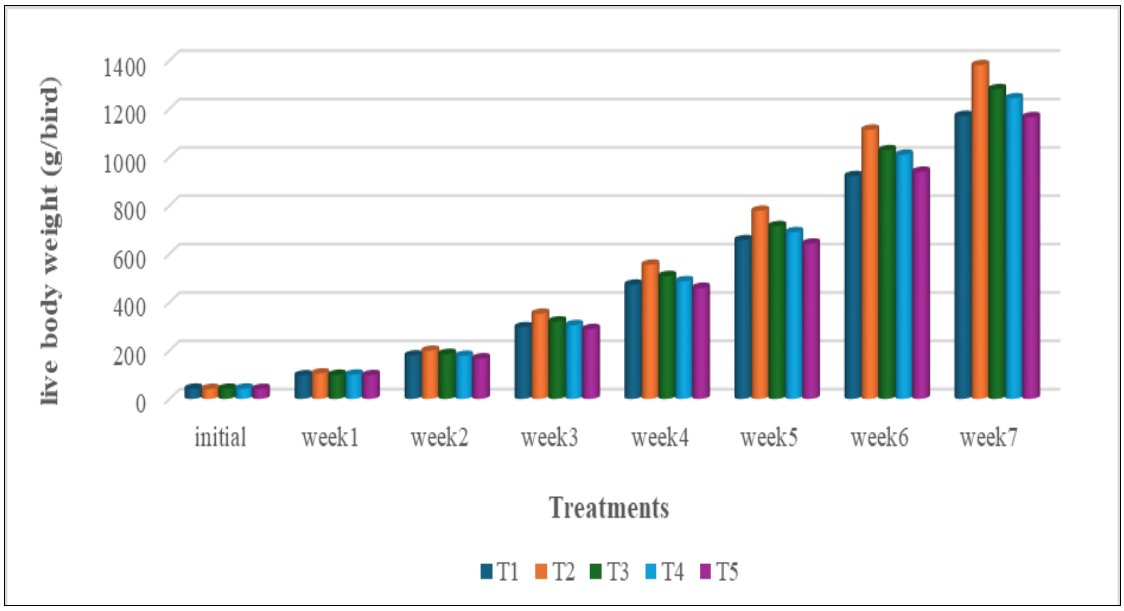

Fig 1: Live body weight (g/bird) response of Giriraja birds to pomegranate peel powder

Weekly body weight gain of Giriraja poultry birds

The average weekly weight gain of Giriraja poultry birds from the first to the seventh week across all treatment groups is summarized in Table 4 and visually represented in Figure 2. A statistically significant difference in weekly body weight gain was observed starting from the third week. During the sixth week, the trend of improved growth performance was evident, with the highest gains recorded in T_2 (335.20 g), followed by T_4 (320.30 g), T_1 (313.80 g), T_5 (297.20 g), and T_3 (264.90 g). During the seventh week, the average body weight gain of Giriraja poultry birds was recorded as 252.60 g (T_1), 266.93 g (T_2), 248.90 g (T_3), 233.73 g (T_4), and 225.80 g (T_5) per bird. The results indicated that birds in the T_2 group exhibited the highest weight gain, which was statistically at par with the control group (T_1). A decreasing trend in body weight gain was observed with increasing levels of pomegranate peel powder supplementation. The lowest weight gain was recorded in the T_5 group, which was statistically comparable to T_4, suggesting that higher inclusion levels of pomegranate peel powder may negatively affect growth performance. These findings are consistent with the results of Baset *et al* (2022) [2], who reported that broilers supplemented with 2 g/kg of pomegranate peel powder achieved the highest live body weight (64.51 g) after five weeks, outperforming both control and antibiotic-treated groups. Similarly, El-Rays *et al*. (2023) [4] found that Japanese quails supplemented with 300 g/ton of pomegranate peel powder exhibited the greatest body weight gain (235.47 g) over a 5-week period, indicating that moderate levels of PPP inclusion may be more favorable for promoting growth.

Table 6: Average weekly weight gain (g) of Giriraja birds as affected by pomegranate peel powder

Treatments	Week						
	1st	2nd	3rd	4th	5th	6th	7th
T_1	57.5	86.4	134.3	188.0	206.4	313.8	252.60
T_2	63.9	93.9	153.0	202.8	223.3	335.2	266.93
T_3	55.2	82.8	116.9	176.0	184.0	264.9	248.90
T_4	57.9	77.6	127.1	181.5	202.8	320.3	233.73
T_5	56.9	69.6	121.0	170.6	183.0	297.2	225.80
SE(m)±	1.63	3.02	2.79	3.39	4.91	6.04	4.99
CD	4.56	9.00	8.30	10.12	14.72	18.00	14.94
F test	S	S	S	S	S	S	S

Supporting evidence also comes from Yassein *et al.* (2015) [10], who evaluated the effects of PPP and butylated hydroxytoluene (BHT) on the growth of Japanese quails. Their study showed that diets supplemented with 10 g and 15 g/kg PPP resulted in significantly higher body weight gains ($P \leq 0.01$) compared to both the control and the BHT-supplemented groups, suggesting that natural antioxidants like PPP may be more effective than synthetic alternatives in enhancing growth performance. This indicate that low level supplementation of PPP could be beneficial for growth performance of poultry birds.

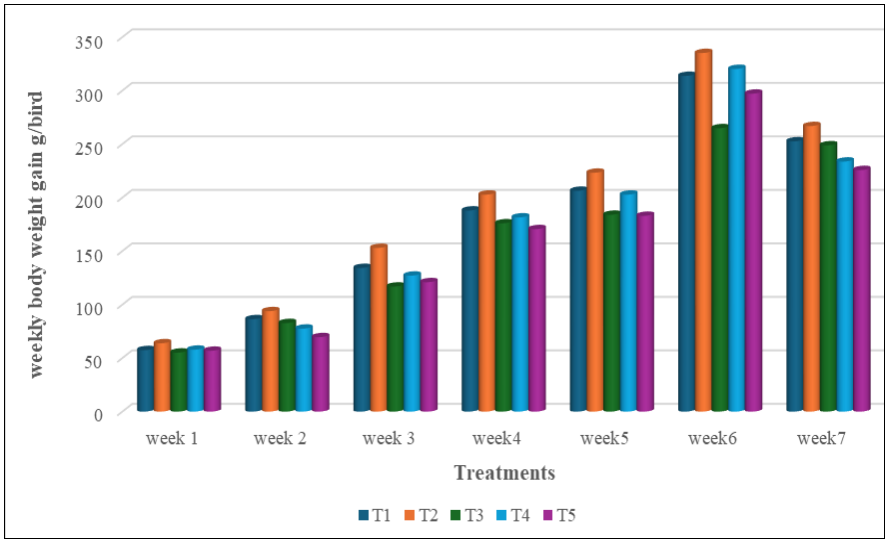

Fig 2: Weekly body weights gain (g) of Giriraja birds as effected by pomegranate peel power

Conclusion

The findings of the present study indicate that supplementing standard poultry feed with pomegranate peel powder meal (PPPM) at a 0.3% inclusion level significantly improved the growth performance of Giriraja poultry birds. Birds in this group showed higher weekly weight gains and final live body weights compared to both the control and higher supplementation levels. This improvement can be attributed to the bioactive compounds present in pomegranate peel, such as antioxidants and polyphenols, which are known to enhance nutrient utilization and support overall bird health.

However, higher inclusion levels (0.6% to 1.2%) resulted in a decline in performance, suggesting that excessive amounts of PPPM may negatively affect palatability or feed efficiency. Therefore, it can be concluded that pomegranate peel powder meal, when used at an optimal level (0.3%), serves as an effective natural growth promoter and can be recommended as a sustainable alternative to synthetic additives in poultry diets.

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Conflict of Interest

The author declares that they have no conflict of interest

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