International Journal of Bio-resource and Stress Management https://ojs.pphouse.org/index.php/IJBSM

Crossref

IJBSM June 2025, 16(6): 01-06 **Article** AR5989

Research Article *Natural Resource Management*

DOI: HTTPS://DOI.ORG/10.23910/1.2025.5989

Effect of Pomegranate (*Punica granatum*) Peel Powder and Eucalyptus (*Eucalyptus globulus*) Leaves Powder on Growth Performance and Haemato-biochemical Study on Broilers

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0009-0009-2684-0765

ABSTRACT

The experiment was conducted during August to October, 2024 at livestock farm complex, college of veterinary and animal science Navania, Udaipur, Rajasthan, India to evaluate the effect of dietary supplementation of pomegranate peel powder and eucalyptus leaves powder on growth performance and haemato-biochemical parameters of broilers for boosting poultry industry production. 120, day-old chicks were randomly assigned into four dietary treatment groups consisting of 30 chicks in each. The C group fed basal diet only, while T_1 fed basal diet+eucalyptus leaves powder @ 0.5%, T_2 fed basal diet+pomegranate peel powder @ 0.5% and T_3 fed basal diet+combination of both powder @ 0.5%. Highest body weight was observed in T_2 group which was comparable to T_1 group and lowest body weight was observed in control group. Highly significant (p<0.01) effect on body weight gain, daily weight gain and performance index were noticed in T_2 group supplemented with pomegranate peel powder which was comparable to T_1 group and lowest was observed in Control group supplemented with basal diet. Lowest feed conversion ratio was observed in T_2 group which was comparable with T_1 and T_3 group and highest feed conversion ratio was observed in control group. Significant effect was found in cholesterol and triglyceride level in T_2 group as compared to control group. Significant increase in WBC was observed in T_2 group which showed non-significant difference with T_1 and T_3 group. It can be concluded that supplementing broiler diet with pomegranate peel powder @ 0.5% could be beneficial for improving broiler chick growth performance.

KEYWORDS: Broiler, growth parameters, haemato-biochemical

***Citation* (VANCOUVER):** Choudhari et al., Effect of Pomegranate (*Punica granatum*) Peel Powder and Eucalyptus (*Eucalyptus globulus*) Leaves Powder on Growth Performance and Haemato-biochemical Study on Broilers. *International Journal of Bio-resource and Stress Management*, 2025; 16(6), 01-06. HTTPS://DOI.ORG/10.23910/1.2025.5989.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 13th December 2024 RECEIVED in revised form on 02nd June 2025 ACCEPTED in final form on 13th June 2025 PUBLISHED on 23rd June 2025

1. INTRODUCTION

The India poultry market has witnessed substantial based food products sourced from poultry. Poultry products, such as eggs and meat, are an essential source of protein, vitamins, and minerals, contributing significantly to human nutrition. The demand for poultry products in India has been growing steadily, driven by the rising population, increasing disposable incomes, and changing dietary preferences. The shift towards protein-rich diets has resulted in a heightened demand for poultry meat and eggs, both of which are excellent sources of protein.

Poultry meat is an easily available source of good quality protein and other nutrients that are necessary for proper body function. Now a days the increasing demand for high quality protein, the poultry industry focused on selection of fast-growing broilers, which reach a body mass of about 2 to 2.5 kg body weight within 6-week intensive fattening (Kralik et al., 2017). Fresh chicken meat and chicken product are universally popular. Poultry meat is an important component of healthy diet. Poultry meat is widely consumed worldwide due to its desirable nutritional and organoleptic properties over red meat. It is more acceptable by nonvegetarian group of people, being an excellent source of protein.

One of the important tools in poultry nutrition are feed additives, which are used to increase feed conversion ratio, growth rate and improve disease resistance. They also promote ingestion, absorption, nutrient assimilation, and growth of animals by affecting physiological processes such as immune function and stress resistance (Mandey et al., 2021).

Pomegranate peel is among the spectrum of natural feed additives that has received increased attention over the years as prophylactics and growth enhancers in broiler nutrition (Dhinesh and Ramasamy, 2016). Punica granatum peels which represent about 50% of the fruit weight (Tozzi et al., 2022), are an important source of phenolic compounds (flavonoids, phenolic acids, and tannins), protein and bioactive peptides, and polysaccharides (Smaoui et al., 2019). Pomegranate by-products have attracted worldwide research attention due to their significant amounts of polyphenols such as ellagic tannins, ellagic acid, gallic acid and punicalagin (Jami et al., 2012), which have antimicrobial, antioxidant, anti-inflammatory, antimitotic, and immunomodulatory properties (Kotsampasi et al., 2014). Furthermore, the pomegranate peel is an important source of organic acids, e.g. citric acid, malic acid, acetic acid, oxalic acid, tartaric acid, lactic acid, ascorbic acid, and fumaric acids, and many other nutrients (Poyrazoglu et al., 2002). The organic acids could acidify the digestive tract to generate the low pH level in the local environment, thereby improving the chicken's resistance to pathogens and creating an unfavorable environment for the proliferation of certain intestinal pathogens such as *E. coli* (Khan et al., 2022).

Eucalyptus (*Eucalyptus globulus*) is the another most extensively grown evergreen tree in subtropical and mediterranean regions. It contains various significant chemicals such as p-cymene, 1, 8-cineole, phellandrene, spathulenol, cryptone aldehydes, cuminal, phellandral, and phellandrene, which have antibacterial, anti-inflammatory, and antioxidative activities (Barra et al., 2010). Leaves of eucalyptus also contain polyunsaturated fatty acids, it's high in vitamin E and vitamin C, both of which help with oxidative stress resistance also comprising omega-3 and omega-6 due to their generalized beneficial health effects (Guimaraes et al., 2009). In addition, the leaves contain minerals like Zn, Cu, Mn, Na, K, P, Fe, Ca and Mg, which may help a good balance of nutrients (Leite et al., 2011).

Keeping the aforesaid facts in view, the present investigation was planned to study the effect of pomegranate (*Punica granatum*) peel powder and eucalyptus (*Eucalyptus globulus*) leaves powder on growth performance and gut microbial study of broilers.

2. MATERIALS AND METHODS

2.1. Experimental birds and design

The experiment was conducted during August to October 2024 at livestock farm complex, college of veterinary and animal science Navania, Udaipur, Rajasthan, India. The study was conducted on one hundred and twenty day-old (120), unsexed, apparently healthy broiler chicks (VENCOBB-430Y strain) in year 2024 for six weeks (approved by CPCSEA committee, IAEC/RES/04/08), at Poultry Unit in Livestock Farm Complex of College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur, Rajasthan, India. The chicks were individually weighed and randomly divided using completely randomized block design into four dietary treatment groups of 30 chicks each having relatively equivalent average body weight. Each group of 30 chicks was subdivided into three replicates (R_1, R_2 and R_3) having 10 chicks replicate^{-1}. The ISO certified (Anonymous, 2007) commercial basal feed in the form of broiler starter and broiler finisher was used in the experiment. Pomegranate peel powder was obtained in moist form then dried it and ground to pass through 1mm sieve in Department of Animal Nutrition and stored in air tight plastic containers for further use. Same as eucalyptus leaves powder was obtained in dried form and ground to pass through 1 mm sieve in Department of Animal Nutrition and stored in air tight plastic containers for further use. The proximate composition of broiler starter, broiler finisher and pomegranate peel powder and eucalyptus leaves powder are showed in Table 1.

The treatment groups were as follows: C group fed basal

Table 1: Proximate composition of broiler starter, finisher ration, pomegranate peel powder and eucalyptus leaves powder

Proximate principle	Pre-starter	Starter	Finisher	PPP	ELP
Dry matter (%)	92.11	92.21	92.22	89.50	94.10
Crude protein (%)	23.04	22.00	20.15	5.12	7.22
Ether extract (%)	04.07	04.20	05.00	7.68	7.60
Crude fibre (%)	04.36	04.60	05.20	8.16	15.46
Total ash (%)	08.4	08.50	08.10	4.12	4.00
Nitrogen free extract (%)	60.13	60.20	62.00	74.92	65.72

PPP: pomegranate peel powder; ELP: eucalyptus leaves powder

diet (Control), T_1 group fed eucalyptus leaves powder @ 0.5%, T_2 fed pomegranate peel powder @ 0.5% and T_3 fed pomegranate peel powder @ 0.25% and eucalyptus leaves powder @ 0.25% (1:1), along with basal diet. Feed and clean water were supplied ad libitum. Live body weight on individual basis and feed intake from each replicate were measured at weekly intervals. From the observations, weekly body weight gain, daily body weight gain, weekly feed conversion ratio, weekly performance index and protein efficiency ratio were calculated.

2.2. Blood sample collection

At 42nd day of experimental trial, blood samples were collected by puncturing wing vein, from randomly selected birds in each replicate of treatment groups (six birds treatment group^{-1}), in two set of tubes viz. labeled sterile tubes containing EDTA for hematology and another tubes without anticoagulant for biochemical. EDTA containing tubes were analyzed for hemoglobin, red blood cell, white blood cell, hematocrit, with the help of an automatic hematology analyzer. Serum total protein, cholesterol, triglyceride, glucose, AST and ALT were analyzed by using commercially available kits as per mentioned protocols.

2.3. Statistical analysis

The data obtained were analyzed by subjecting them to ANOVA as per Snedecor and Cochran (1994). Mean difference was tested by Duncan's new multiple range test (DNMRT) as modified by Kramer (1956), in results having significant treatment effects. The level of statistical significance was kept at $p<0.01$.

3. RESULTS AND DISCUSSION

3.1. Growth performance

The effect of adding pomegranate peel powder and eucalyptus leaves powder in broiler chicks on growth performance are presented in Table 2. Significant ($p<0.01$) effect was observed on growth performance of broiler. The highest ($p<0.01$) live body weight, weekly body weight gain, daily body weight gain, weekly performance index and protein efficiency ratio were observed in T_2 group which was supplemented with pomegranate peel powder (PPP) @0.5%. The feed conversion ratio was significantly ($p<0.01$) low in T_2 group. However, feed intake was found non-significantly among the treatment and control group.

The aforementioned data demonstrate an improvement in growth performance that is highly significant ($p<0.01$) as a result of the addition of pomegranate peel powder and eucalyptus leaves powder along and in combination, which is in line with the findings of Elnaggar et al. (2022), who observed the highly significant ($p<0.01$) improved live body weight, body weight gain, feed conversion ratio and non-significant effect was observed on increased feed intake among the treatment groups in broiler chicks supplemented with pomegranate (*Punica granatum*) peel powder. Gosai et al. (2023) found significant ($p<0.05$) effect on increase body

Table 2: Effect of pomegranate peel powder and eucalyptus leaves powder on growth performance traits of broiler chicks

Parameters/groups	C	T_1	T_2	T_3
Initial body weight	47.20±0.06	47.37±0.19	47.60±0.10	47.13±0.12
Final body weight	2118.60^{c}±10.79	2458.87^{ab}±1.95	2462.17^{a}±4.30	2442.17^{b}±1.74
Body weight gain	2071.40^{a}±10.80	2411.50^{b}±2.11	2414.57^{b}±4.31	2395.03^{b}±1.63
Daily gain	49.32^{b}±0.26	57.42^{a}±0.05	57.49^{a}±0.10	57.02^{a}±0.04
Feed intake	3854.33±18.57	3912.77±21.00	3865.73±10.11	3881.48±27.65
Feed conversion ratio	1.86^{b}±0.00	1.62^{a}±0.01	1.60^{a}±0.01	1.62^{a}±0.01
Performance index	1113.21^{a}±6.45	1486.36^{b}±10.62	1508.21^{b}±9.32	1478.01^{b}±12.17
Protein efficiency ratio	2.70^{a}±0.02	2.96^{c}±0.03	3.06^{d}±0.01	2.87^{b}±0.01

a, b, c, d: means superscripted with different letters within a row differ significantly from each other ($p<0.01$), All values are represented as Mean±SEM

weight, body weight gain @ 1% pomegranate peel powder non-significant effect was observed on feed intake, feed conversion ratio in broiler chicks. El-Rayes et al. (2023) observed significant ($p \leq 0.05$) effect on improved body weight, body weight gain, feed intake and feed conversion ratio in broilers due to diet supplemented with pomegranate peel powder in quail. Mustafa et al. (2019) investigated that significant ($p<0.05$) effect on improved body weight and feed conversion ratio and non-significant ($p>0.05$) effect was observed on feed intake and body weight gain in broilers due to diet supplemented with eucalyptus leaves powder. Ayoob et al. (2023) observed that significant ($p<0.01$) effect on improved live body weight, feed conversion ratio and decreased feed intake in broilers due to diet supplemented with eucalyptus leaves powder.

This improvement in the body weight of birds may perhaps be due to the growth promoting benefits of pomegranate peel which has been linked to its antioxidant and antimicrobial properties. The antioxidant effect of pomegranate peel is due to its possession of proanthocyanidin. The presence of proanthocyanidin in pomegranate peel enables it to improve pancreatic and small intestinal digestive enzyme functions, and prevent the deleterious influence of free radicals on intestinal enterocytes; thus, leading to enhanced nutrient absorption and use (Tavarez et al., 2011; Middha et al., 2013; Reddy et al., 2014).

Eucalyptus globulus has a high ability to secrete digestive and pancreatic enzymes (Hashemipour et al., 2013). In addition, flavonoids have antimicrobial activity (Boukhalfoun, 2012) due to their detrimental effect on the growth of harmful bacteria in the digestive tract (Gabriel et al., 2013), antioxidant activity, and the ability to scavenge free radicals (Ghedira, 2005). The role of appetite stimulators and the antimicrobial effect of eucalyptus leaves powder also explain the improvement of growth performance in the chicks treated during the study because bacteria compete with the chickens on the utilization of the feed (Windisch et al., 2008).

3.2. Haemato-biochemical parameters

The effect of adding pomegranate peel powder and eucalyptus leaves powder in broiler chicks on haemato-biochemical parameter are presented in Table 3. There was statistically non-significant ($p>0.05$) effect on Hb, RBC, PCV (Hematocrit), glucose, total protein, AST and ALT due to diet supplemented with pomegranate peel powder and eucalyptus leaves powder. They also found highly significant ($p<0.01$) effect on decreased cholesterol and triglyceride level in T_2 groups due to pomegranate peel powder and increased WBC count in all treated groups as compared to control group.

These results were in accordance to the findings of Gosai et al. (2023) found non-significant effect on hemoglobin, RBC and PCV in broiler diet supplemented with pomegranate peel powder. Kamel et al. (2021) observed non-significant ($p>0.05$) effect on hemoglobin, RBC and significant ($p<0.05$) effect on increased WBC count in Japanese quail diet supplemented with pomegranate peel powder. Mashayekhi et al. (2018) observed significant ($p<0.05$) effect on increased WBC count and non-significant effect on hemoglobin, RBC and PCV in broiler due to fed eucalyptus powder.

Table 3: Effect of pomegranate peel powder and eucalyptus leaves powder on haemato-biochemical parameters of broiler chicks (n=6)

Haemato-biochemical parameters				
Haemato-biochemical parameters	C	T_1	T_2	T_3
Hb (g %)	10.82±0.12	10.70±0.33	10.95±0.35	10.75±0.35
RBC (10^6 cum^{-1})	3.24±0.19	3.13±0.03	2.97±0.09	3.13±0.07
WBC (10^3 cumm^{-1})	20.84c±0.19	22.59^{a}±0.24	22.22^{ab}±0.30	21.56^{bc}±0.18
PCV (%)	30.08±0.33	30.07±0.28	30.37±0.22	30.13±0.27
Total Protein (g dl^{-1})	3.02±0.20	3.05±0.13	3.07±0.13	3.10±0.09
Glucose (mg dl^{-1})	200.17±0.93	200.83±2.68	201.17±1.64	200.83±2.40
Cholesterol (mg dl^{-1})	147.83^{a}±0.44	142.83^{a}±2.95	114.17^{b}±1.92	142.17^{a}±1.01
Triglyceride(mg dl^{-1})	118.33^{a}±1.17	112.17^{ab}±3.06	104.83^{b}±2.52	111.17^{ab}±2.33
AST (U l^{-1})	256.33±3.67	251.67±3.09	250.00±0.87	252.33±0.73
ALT (U l^{-1})	5.57±0.10	5.75±0.19	5.58±0.19	5.37±0.22

a, b, c - means superscripted with different letters within a row differ significantly from each other ($p<0.01$), All values are represented as Mean±SEM

Ayoob et al. (2023) found non-significant (p>0.05) effect on hemoglobin and RBC and significant effect (p<0.05) on increased WBC count in broiler diet supplemented with eucalyptus leaves powder. Elnaggar et al. (2022) found significant (p<0.05) effect on increased WBC count due to diet supplemented with pomegranate peel powder in broilers chicks. Gosai et al. (2023) found significant (p<0.05) effect on decreased cholesterol and also found highly significant (p<0.01) on decreased triglyceride, non-significant (p>0.05) effect on glucose and total protein in broiler chickens due to supplementation of pomegranate peel powder. El-Rayes et al. (2023) reported significant (p<0.05) effect on decreased cholesterol and triglyceride level and non-significant (p>0.05) effect on AST and ALT level in Japanese quail diet fed pomegranate peel powder. El-Motaal et al. (2008) reported non-significant (p>0.05) effect on total protein in laying hens given diet supplemented with eucalyptus leaf powder @ 1, 2 and 3 g kg^{-1} feed.

The lower cholesterol in the blood and triglycerides by PPP could possibly be due to phenol compounds such as pontiacagen and pontiacin, in particular and it may stimulate pomegranate polyphenols and promote cholesterol metabolism by modifying HDL transport (Esmaillzadeh et al., 2004).

4. CONCLUSION

Supplementation of 0.5% pomegranate peel powder was quite effective and could be potential feed supplement in broiler production.

5. ACKNOWLEDGEMENT

The facilities required to complete this work were generously provided by the Head of the Department of Animal Nutrition at College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Navania, Udaipur-313 601, Rajasthan, India.

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