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Research Article

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Orboroi (*Phyllanthus acidus*) leaf powder: An alternative to antibiotic supplements for the growth of broiler chickens

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ABSTRACT

The study was conducted to evaluate the effectiveness of *Phyllanthus acidus* leaf powder (PALP) administered through drinking water as an alternative to antibiotics for improving growth performance, blood parameters, and carcass characteristics in broiler chicks. A total of 120 day-old Indian River broiler chicks were randomly assigned to four dietary treatments, with three replications per treatment. The control group (T_1) received a basal diet, while groups T_2, T_3, and T_4 received 0.1 g/L of renamycin (antibiotic), 1.5 g/L PALP, and 3 g/L PALP, respectively. Body weight, drumstick size, bursa weight, serum lipid profile, and hematological parameters were recorded on days 21 and 35, while body weight was monitored weekly. The results showed that both body weight and weight gain significantly increased ($p<0.05$) in the 3 g/L PALP group compared to the control. The outcomes of the 1.5 g/L PALP and antibiotic-treated groups were comparable. Feed conversion ratio was significantly improved ($p<0.05$) in the 3 g/L PALP group compared to the control and antibiotic groups, although the control and antibiotic groups had higher feed intake. No significant differences ($p>0.05$) were observed in dressing percentage among the dietary treatments. However, 3 g/L PALP group exhibited a significantly lower ($p<0.01$) bursa weight compared to the other groups. Additionally, the serum lipid profile ($p<0.05$) and serum glutamic pyruvic transaminase levels ($p<0.01$) showed significantly favorable results in 3 and 5-week-old broilers treated with 3 g/L PALP. Overall, 3 g/L PALP treatment revealed the most beneficial effects and resulted in the highest profit per bird.

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INTRODUCTION

Antibiotics have been used for decades to promote growth and maintain health in livestock and poultry, ultimately boosting profitability. To meet the rising demand for animal-based proteins such as milk, meat, and eggs, new strategies to enhance the productivity of livestock and poultry must be explored. Broiler meat plays a vital role in many economies, as it is among the most affordable sources of protein.

Farmers often add antibiotics and other growth enhancers to poultry feed to improve growth rates, feed efficiency, and reduce mortality. However, these substances can harm the health of chickens and leave residues in meat, posing risks to human health. Following the World Health Organization's recommendations, antibiotics should be gradually removed from poultry feed and replaced with safer alternatives (Bywater, 2005). In line with this, the European Union has banned the use of antimicrobial growth promoters (Castanon, 2007). Additionally, the misuse of antibiotics-using inappropriate types or incorrect dosages-can lead to microbial resistance and the presence of drug residues in food products (Hashemi and Davoodi, 2011).

Over the past decade, the use of plants to promote animal health and preserve feed has increased. This trend is driven by the growth of organic livestock systems and concerns about drug resistance, high input costs, and toxic residues in food (Escosteguy, 2014). Moreover, modern drugs may cause side effects, and many are ineffective in treating chronic illnesses or combating microbial resistance. As a result, herbs and spices are now commonly used as natural supplements in poultry diets (Guo, 2003).

Phyllanthus is a large plant genus known for its beneficial properties. In the search for effective alternatives to antibiotic growth promoters (AGPs), hormones, and enzymes commonly used to boost broiler performance, medicinal plants like *Phyllanthus acidus* also known as orboroi or harfarauri, or star gooseberry-may offer promising results. These plants contain various phytochemicals, such as tannins, terpenes, alkaloids, glycosides, saponins, and flavonoids. Their leaf extracts exhibit antimicrobial and anti-protozoan effects, particularly against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans* (Jagessar and Mars, 2008).

Phyllanthus has long been used in Ayurvedic, Unani, and homeopathic medicine, and is now being studied for its potential in developing modern drugs with strong antioxidant properties (Chakraborty *et al.*, 2012). Compounds isolated from its leaves include tannins, terpenes, alkaloids, glycosides, saponins, and flavonoids (Pangestika *et al.*, 2020). The leaves are carminative and help with digestion (Sugiharto, 2020). Additionally, aqueous extracts of orboroi leaves have antibacterial and anti-inflammatory properties, making them useful in reducing airborne bacterial contamination in homes (Manikandan *et al.*, 2017).

Research has also shown that *P. acidus* leaves possess pharmacological properties such as hypocholesterolemic (Binita *et al.*, 2016), cytotoxic (Habib *et al.*, 2011), antioxidant and anti-inflammatory (Hossen *et al.*, 2015), antimicrobial (Jagajothi *et al.*, 2013), immunostimulant (Kamble *et al.*, 2018), growth-promoting (Mohammed, 2021), and hematological effects (Talubmook and Buddhaka, 2013).

Although orboroi leaves are widely used in traditional medicine, their application as poultry feed additive in Bangladesh is still uncommon. Given their bioactive properties, they could serve as a natural alternative to conventional antibiotics and growth enhancers. However, to promote the adoption of such practices in commercial broiler production, the poultry feed industry in Bangladesh needs more scientific data. This study aims to provide additional insights into the effects of orboroi leaves on broiler performance.

MATERIALS AND METHODS

Birds, housing and feeding management

In this study, 120-day-old, unsexed Indian River (IR) broiler chicks from Provita Hatchery Limited were examined over a period of 1-35 days. Chicks were weighed and the average body weight was recorded daily. At 3rd week, chicks were randomly assigned into 4 treatment groups, with three replications. Group 1 served as a control, group 2 was treated with antibiotic, while group 3 and 4 were treated with 1.5g/l and 3g/l of *Phyllanthus acidus* leaf powder (PALP), respectively. There was an automatic waterer and a feeder in every cage. During the first week, the birds were brooded at 33ºC. The temperature was lowered by 3ºC per week until the ultimate temperature reached 24ºC (week 4). Incandescent bulbs were used to continuously supply light. At 1st day and 7th days of age, all birds received vaccinations against infectious bursal disease (IBD) and new-castle disease (ND). They were fed a commercial starter diet throughout the beginning and a commercial grower diet from Nahar Agro Feed during the growing season (Table 1).

Table 1: The nutritional makeup of the grower and starter diets (Nahar Agro Group)

Nutrients	Starter diet (0-14 days)	Grower diet (15-35 days)
Metabolizable energy (kcal/kg)	3035	3200±50
Crude protein %	22.00	22±1
Crude fibre %	3.00	4.00
Crude fat %	4.50	6.00
Lysine %	1.32	1.30
Methionine %	0.50	0.55
Methionine + cysteine %	0.98	0.66
Calcium %	0.90	0.95
Phosphorous %	0.45	0.50

Preparation of *Phyllanthus acidus* leaf

Mature and disease-free clean leaves were collected from Germ Plasm Centre (GPC) of Patuakhali Science and Technology University. Leaves were cleaned with running fresh water and excess water was removed. The leaves were subsequently sun dried and ground with a grinder (All-purpose High Quality Smashing Machines-FW100 Model). The fine mesh was preserved in a plastic container until used. A widely used antibiotic, oxytetracycline with a trade name of Renamycin (oxytetracycline hydrochloride USP 227.2 mg) was purchased commercially and used according to the manufacturer's instructions-Biomin.

Measurement of body weight

At 1st, 7th, 14th, 21st, 28th and 35th days of age, body weight was measured and the average daily growth rate was computed. Body weight gain was measured on 7th, 14th, 21st, 28th and 35th days and average daily feed intake and feed conversion ratio were calculated weekly over the period of 1st–35th. Throughout the experiment, mortality was noted every day.

Blood constituents' assay

By using the enzymatic colorimetric test (CHOD-PAP technique), cholesterol levels were ascertained. It was carried out using a BIOGEN-5500 Semi-auto Chemistry Analyzer. The triglyceride content of blood serum was determined by spectrophotometer (Spectronic, Genesis 5, USA) according to the technique described by (Trinder, 1969). This process was carried out using a BIOGEN-5500 Semi-auto Chemistry Analyzer. Triglyceride was determined after enzymatic hydrolysis with lipase. High density lipoprotein (HDL) was examined using a BIOGEN-5500 Semi-auto Chemistry Analyzer.

Statistical analysis

A completely randomized design was employed to conduct the experiment, where all analyses were run in triplicate. Statistical analysis was conducted by means of analysis of variance (ANOVA) (St and Wold, 1989), where mean values were assessed by the Duncan Multiple Range Test (DMRT) (Tallarida *et al*., 1987). All statistical analyses were carried out using the SIGMA-PLOT 14 program. A significance level of was defined as p<0.05 and p<0.01.

RESULTS

Assessment of body weight

The effects of varying PALP levels on body weight (BW) are shown in Table 2. To determine the impact of including PALP in the broiler diet on body weight and weight gain, weekly body weight was monitored. At 3rd week, the 3g/L PALP group showed a significant (*p*<0.05) difference relative to the control group. At 4th week, all treatment groups showed significant changes (*p*<0.05) relative to the control group. At 5th week, antibiotic, 1.5g/L PALP and 3g/L PALP treatment groups showed increases in body weight that were significantly (*p*<0.05) greater than the control group. Furthermore, significance changes (*p*<0.01) were also evident in the group that was given 3g/L PALP and antibiotics relative to the control. Final body weight was higher at 3g/L PALP group (1850.67g) followed by the 1.5g/L PALP group (1740.33g), antibiotic group (1700.64g) and the control group (1605.67g), respectively.

Table 2: Body weight of broiler in different treatment groups

Age of birds	Treatments			
	Control	**Renamycin**	**1.5 g/L PALP**	**3 g/L PALP**
Initial body weight	41.79±0.96	41.81±0.22	41.50±0.19	41.77±0.50
1st week	193.42±6.17	233.8±3.46	225.34±3.77	200.38±3.30
2nd week	494.04±10.55	514.39±13.37	553.05±3.64	449.88±8.01
3rd week	902.29^{c}±15.10	1054.67^{c}±26.91	1075.79^{c}±34.48	1110.49^{c}±7.99
4th week	1306.17^{b}±7.32	1402.21^{b}±36.44	1472.17^{b}±38.27	1552.32^{b}±8.06
5th week	1605.67^{a}±6.02	1700.64^{a}±5.37	1740.33^{a}±31.60	1850.67^{a}±10.11

Significant differences exist between $^{a,\,b,\,c}$ values with different superscripts in the same row (*p*<0.05; *p*<0.01).

Figure 1 shows that at the third week, the 3g/L PALP treatment group's body weight gain differed considerably (p<0.05) from the control groups. At 4th week, the 1.5g/L PALP and 3g/L PALP treatment groups showed significantly (*p*<0.05) increased body weights relative to the control group. Furthermore, at 5th week, the body weight gain in the 1.5g/L PALP, 3g/L PALP, and antibiotic groups differed considerably (*p*<0.05) relatively to the control group, while the 3g/L PALP treatment group differed significantly (*p*<0.05) to the antibiotic group.

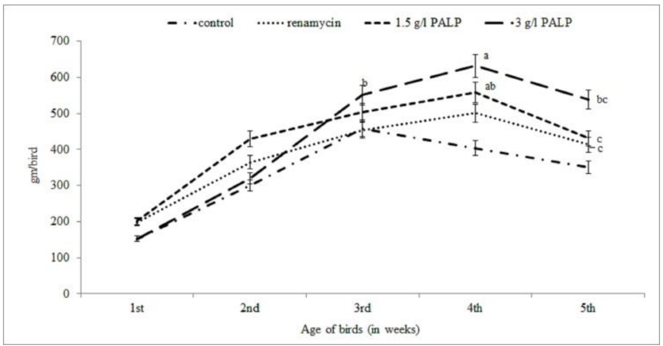

Figure 1. Body weight gain of different treatment groups

Feed intake and Feed conversion ratio (FCR) evaluation

Data revealed that there were no statistically significant effects of feed intake among the dietary groups (Table 3). The total feed intake of all treatment groups was very similar. Table 4 indicates that there is a significant difference (*p*<0.05) between the 3g/L PALP treatment group and the control group in terms of feed conversion ratio (FCR) at 5th week. The 1.5g/L PALP and 3g/L PALP groups showed numerically superior total feed conversion ratio (FCR) relative to the antibiotic and control groups.

Table 3: Feed intake (g/bird)

Age of bird	Treatments			
	Control	**Renamycin**	**1.5 g/L PALP**	**3 g/L PALP**
1st week	190.94	187.89	191.86	190.67
2nd week	387.43	395.56	390.54	391.44
3rd week	661.34	665.76	667.89	668.00
4th week	860.45	855.00	858.23	855.23
5th week	675.88	680.87	670.55	662.34
Total	2771.69	2750.63	2730.50	2710.52

Table 4: Feed conversion (FCR) of broiler in different treatment groups

Age of birds (weeks)	Treatments			
	Control	**Antibiotic**	**1.5 g/L PALP**	**3 g/L PALP**
1st week	0.98±0.02	0.96±0.01	0.95±0.02	0.99±0.03
2nd week	1.25±0.02	1.24±0.03	1.22±0.01	1.27±0.02
3rd week	1.41±0.06	1.38±0.04	1.38±0.08	1.37±0.05
4th week	2.02±0.05	1.85±0.04	1.80 ±0.05	1.70±0.01
5th week	2.97^{a}±0.44	2.64^{a}±0.33	2.60^{a}±0.54	2.00^{a}±0.70
Average	1.73±0.04	1.61±0.03	1.59±0.04	1.45±0.02

$^{a,\,b}$ values with different superscripts in the same row differ significantly (*p*<0.05)

Dressing parameters of broiler

According to Table 5, there was a significant variation (*p*<0.01) in bursa weight between the 3g/L PALP treated groups and the control group. But there were no significant differences (*p*>0.05) in head, feather, wings, liver, heart, gizzard, thigh and shank weights among the different dietary groups.

Table 5: Dressing parts development of broiler in different treatment groups

Parameters	Treatments			
	Control	**Antibiotic**	**1.5 g/L PALP**	**3 g/L PALP**
Head	39.33±3.05	39.33±3.05	47.00±5.00	40.00±2.00
Feather	89.33±13.65	145.67±46.65	96.00±12.49	118.00±29.86
Shank	55.33±3.51	58.67±7.76	67.33±15.30	53.00±4.00
Drumstick	146.67±12.34	170.33±20.55	169.33±24.48	166.33±16.25
Liver	45.33±2.51	46.33±0.57	43.00±1.00	42.67±6.42
Heart	6.76±0.69	7.58±0.99	8.02±1.64	7.12±0.96
Wings	130.67±12.05	132.00±4.58	135.67±14.97	134.67±4.50
Gizzard	35.67±4.04	35.67±14.01	30.67±4.04	40.00±1.73
Bursa	1.46^{a}±0.2	1.15^{c}±0.2	1.42^{b}±0.14	0.88^{d}±0.06

N.B.: All data were measured in gm

$^{a, b, c, d}$ values with different superscripts in the same row differ significantly(p<0.01).

Cholesterol (total) level of different treatment groups (mg/dl)

Figure 2's findings indicate that there is no discernible variation in the dietary groups' total cholesterol levels at the 3rd week. With respects to 5th, these differences were significant (p<0.05); the control group showed the highest figures compared to other groups. Cholesterol levels were lower in the 3g/L PALP group at 5th week than 3rd compared to other dietary groups.

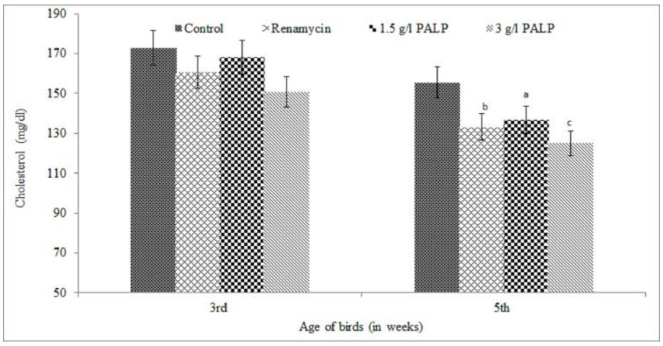

Figure 2. Cholesterol (Total) level of different treatment groups at 3rd and 5th weeks of age

Triglycerides (TG) level of different treatment groups (mg/dl)

Table 6 demonstrates that there are no notable major changes in the TG levels at 3rd week relative to the other dietary groups. But significantly lower (p<0.05) TG values were evident in the 1.5 g/L PALP and 3 g/L PALP treatment groups relative to the values of the control groups at 5th week. The 3 g/L PALP treated group shows significantly (p<0.01) positive variation relative to the antibiotic group. The TG levels are lower at 5th week compared to 3rd week in the dietary groups.

Table 6: Triglycerides level of different treatment groups (mg/dl)

Age of birds	Treatments			
	Control	**Antibiotic**	**1.5 g/L PALP**	**3 g/L PALP**
3rd week	116.22±5.19	114.05±0.87	111.26±1.17	106.59±1.67
5th week	105.93^{a}±4.92	103.19^{b}±1.79	87.37^{c}±1.35	85.36^{d}±3.97

Significant differences exist between values $^{a, b, c, d}$ with different superscripts in the same row (p<0.05; p<0.01).

N.B.: Broiler Tg levels typically range from 80 to 150 mg/dl. (Trinder P, 1996)

HDL (High Density Lipoprotein) and LDL (Low Density Lipoprotein) levels (mg/dl)

Results indicate that, at 3rd week, birds that were given the 3g/L PALP treatment, there was significant (p<0.05) differences in HDL levels relative to the control group (Figure 3). The variations in the LDL levels of the different treatment categories within the same age group were not statistically significant (p>0.05).

Figure 4 shows that the 1.5g/L PALP and 3g/L PALP treatment groups differ significantly (p<0.05) from the control. However, there is also a significant difference (p<0.05) between the 3g/L PALP treatment group and antibiotic group at 5th week. Statistically insignificant differences were observed between the dietary groups with respects to the LDL levels.

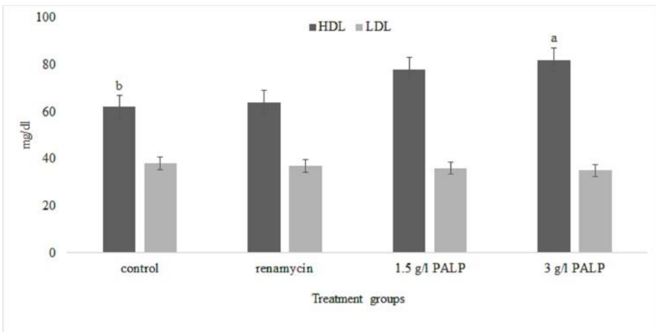

Figure 3. HDL and LDL level of different treatments group at 3rd weeks

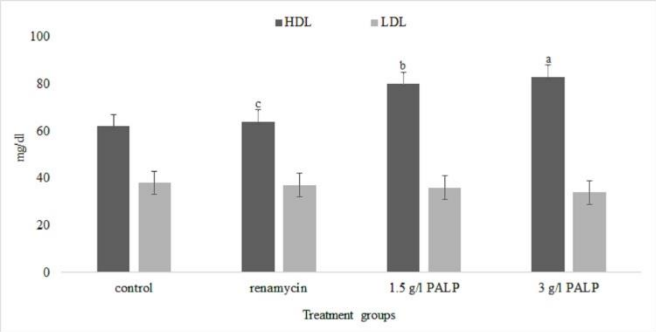

Figure 4. HDL and LDL level of different treatments group at 5th weeks

Serum glutamic-pyruvic transaminase (SGPT) levels at 3rd and 5th weeks

Figure 5 denotes that the difference in SGPT levels between the 3g/L PALP treatment group and the control group at 3rd week is significant (p<0.05). At 5th week, 3g/L PALP treatment group differed significantly (p<0.01) from the control group. However, the results also show that the SGPT levels in the treated groups was lower at 5th week compared to 3rd week.

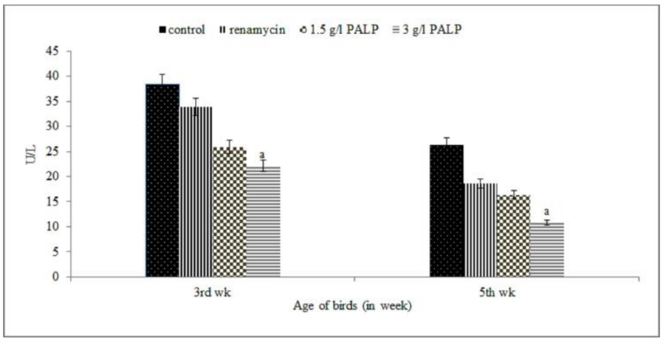

Figure 5. SGPT level of different treatment groups at 3rd and 5th weeks

DISCUSSION

Body weight and body weight gain

This study's findings showed that, in comparison to the control, adding PALP to water at varying concentrations had a good impact on the broilers' body weight and body weight gain. These outcomes are consistent with those of Rao and Gurram (2021), who found that supplementing broilers with 3% *P. acidus* leaves, vitamin E and Selenium improved their body weight and weight gain significantly (p<0.05) when compared to the control group. These outcomes might be the consequence of *P. acidus's* antibacterial and anti-protozoal characteristics, which have been demonstrated in investigations applying ethanolic leaf extracts (0.18 mg/10 mL) *against Candida albicans*, *Staphylococcus aureus*, and *Escherichia coli* (Jagessar and Mars, 2008). Findings are also consistent with a study by Giannenas *et al.* (2018) found that broiler chickens supplemented with varying amounts of herbal feed additives, such as aloevera, orboroi, and bilimbi, had better body weight gains (p<0.05) and tended to have better feed conversion ratios (0.05≤p≤0.01) than control groups, this could be because the caecal lactic acid bacteria counts increased (0.05≤p≤0.01). The results of current study are inconsistent with the findings of Reddy *et al.* (2012) who reported that body weight and body weight gain above (0.25%) following treatment with a herbal preparation (orboroi, tulsi and turmeric) decreased along with lower feed intake. Eevuri and Putturu, (2013) reported that turmeric, tulsi, orboroi, aloevera preparations increased the body weight gain, feed efficiency and decreased feed intake. The mortality rate and feed cost dropped from 6.2% to 13.5% as a result of these measures. Different amounts of stressroak liquid (a mixture of herbal leaves) resulted in significantly higher (p<0.05) body weight growth and better feed efficiency (1.49) (Krishna *et al.*, 2017). Because of its antibacterial qualities, PALE (*Phyllanthus Acidus* Leaf Extract) has been shown to increase broiler performance when added to their drinking water at varying concentrations. PALE demonstrated a statistically significant impact (p<0.01) on the inhibition zones of both pathogenic and non-pathogenic bacterial species in comparison to the standard antibiotic zinc bacitracin. A 2% concentration of PALE resulted in the largest clear zones, in comparison to the 1.5% and 1% concentrations (Pangestika *et al.*, 2020). Cytotoxicity tests carried out with BHK cells indicated that *P. acidus* extracts showed no harmful effects on mammalian cells at concentrations as high as 200 µg/ml (Andrianto *et al.*, 2017). Additionally, there is promise for using leaf extracts to treat cystic fibrosis (Sousa *et al.*, 2007). According to research by Langhout (2000), the herbal plant Sumac (Rhus coriaria) can improve liver function, boost pancreatic digestive enzymes, and stimulate the digestive tract in birds, all of which can improve metabolism.

Feed Intake and feed conversion Ratio

The results demonstrate that birds those were given feed containing different levels of PALP had comparatively lower feed intakes relative to the control and antibiotic treatment groups. This result is consistent with the findings of Kumar and D'Mello, (1995) who reported that most soluble polyphenols have a bitter and astringent taste. Similar views were earlier expressed by (Iheukwumere *et al.*, 2008). The findings also concur with those of Aljumaily *et al.* (2019), who found that broilers fed diets containing *P. acidus* leaf had lower feed intake (p<0.001). These findings contrast with those of Rao and Gurram, (2021) who found that supplementing broiler feed with 3g/L *P. acidus* leaves, vitamin E, and selenium improved feed intake significantly (p<0.05) as compared to the control group. The microbial load of birds was decreased by the antimicrobial and antiprotozoal qualities of *P. acidus* leaves, which enhanced the birds' feed efficiency and consumption. Compared to birds given drinking water without growth promoters, the birds given drinking water supplemented with herbal growth promoters, like powdered *P. acidus* leaves, used their meal more effectively. Compared to birds given drinking water without growth promoters, the birds given drinking water supplemented with herbal growth promoters, like powdered *P. acidus* leaves, used their meal more effectively. The findings also concurred with those of Giannenas *et al.* (2018), who found that when broilers were fed herbal concoctions, they increased their body weight the most and had the best feed conversion ratio when compared to the control. The findings of Bagno *et al.* (2018), who found that broiler feed containing phytobiotic preparations from herbal plants like *P. acidus* improves feed conversion and digestibility, were likewise consistent with the results. These results are in line with those of Nidaullah *et al.* (2010), Portugaliza and Fernandez (2012), and Sarwar (2013), who found that broilers that were given drinking water supplemented with leaf extracts from *Azadirachta indica, Moringa oleifera,* and *Cichorium intybus* as well as *Phyllanthus acidus* performed better in terms of growth. These results, however, contradicted those of Gatne *et al.* (2010), who found that, in comparison to the control group, there was no discernible improvement in the performance metrics and FCR of broilers fed feed supplemented with polyherbal formulation stresroak (orboroi, tulsi, and neem leaves).

Different dressing parameters of broiler

The findings showed that among the dietary groups, only the bursa weight showed a significant (p<0.01) decrease. These results run counter to a study by Sundaresan *et al.* (2007) that found that adding 1% aflatoxin to *phyllanthus* leaves did not reduce bursa weight but rather significantly (p<0.05) decreased the relative weight of livers. Additionally, they stated that the dressing parameters had not changed significantly. Ahmad *et al.* (2014) reported that, leaves of medicinal plants such as *Moringa oleifera, Phyllanthus acidus*, *Glycyrrhiza glabra* and *Eugenia jambolana* had significantly (p<0.05) antiviral potential against Infectious Bursal Diseases (IDB) in broilers. The results also differed to the findings of Zuhra *et al.* (2018) who reported that supplementation of herbal preparation (Corolla, *P. acidus)* of leaves increased the size of bursa and other lymphoid organs. MUSA (2021) who reported that there is no significant variation on carcass characteristics of broilers fed 15g and 100g of commercially available herbal preparation with water. The results of this study were slightly different from the findings of Eevuri and Putturu, (2013) who studied the effects of feeding different medicinal leaf meals and its relation to broiler performance, survival and meat yield. They reported that increased dressing percentage, liver weight and other parameters in broilers.

Serum lipid profile

The findings are also consistent with those of Sopandi and Herupradoto, (2012) who found that chickens fed 5g powdered leaf *phyllanthus* in feed had significantly lower levels of intracellular lipid accumulation, serum leptin levels, meat fat and cholesterol, and abdominal fat weight than chickens fed a control diet. In comparison to the control, the herbal supplemental groups that contained *Withania somnifera*, *Phyllanthus acidus*, *Glycrrhiza glabra*, *Tribulus terrestris*, and *Asparaga racemosus* had significantly (p<0.05) lower levels of lipid peroxidation, serum cholesterol, and *E. coli* in the small intestine (Gurram and Rao, 2021). Hence, immunoregulatory plant extracts and compounds could be used as an alternative means to reinforce immune response against avian coccidiosis (Wondimu *et al.*, 2019). The results are opposite to the findings of Thirumurugan (2007) who reported that the total cholesterol level of broilers was increased when supplied aflatoxin with Phyllanthus leaf powder. The main objective of this test was to check for any toxicity or negative effects of PALP on broiler health, cause sometimes provision of herbal treatment may not be beneficial because of its bitter taste. These results are comparable to those of Zuhra and Paul (2018), who found that giving broilers phytoextracts containing probiotics considerably (0.01). Herbs can be added to feed, stimulate development, increase immunity, encourage animal reproduction, and help reduce methane and ammonia emissions (Prajakta and Kuralkarb, 2021).

CONCLUSION

Supplementation of PALP in feed could be one of the best alternatives to antibiotic and growth promoters' supplementation in broilers. It can be concluded that PALP supplementation in drinking water accelerated the desired parameters in broilers, although meat yield parameters were similar. The lowest bursal weights were observed in the 3g/L PALP group demonstrated positive effects with respect to immune-modulating properties. Therefore, 3g/L PALP can be used safely for broiler production.

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Conflict of Interest

No competing interests are raised by the authors.

REFERENCES

Ahmad W, Ejaz S, Anwar K, Ashraf M 2014: Exploration of the in vitro cytotoxic and antiviral activities of different medicinal plants against infectious bursal disease (IBD) virus. *Central European Journal of Biology* **9**:531-542. doi:10.2478/s11535-013-0276-8.

Aljumaily TK, Yasir Mk, Taha AT 2019: Effect of addition of amla (*Phyllanthus emblica*) and vitamin-C powder on some physiological and production performance of broiler. *Plant Archives* **19**(1): 1117-1120.

Andrianto D, Widianti W, Bintang M 2017: Antioxidant and cytotoxic activity of *Phyllanthus acidus* fruit extracts. IOP Conference of Series and Earth Environmental Science **58**(1):012022. doi:org/10.1088/1755-1315/58/1/012022.

Bagno OA. Prokhorov ON, Shevchenko SA, Shevchenko AI, Dyadichkina TV 2018: Use of phytobiotics in farm animal feeding. *Agricultural biology* **53**(4):687-697. doi:10.15389/agrobiology.2018.4.687.

Binita S, Ajoy B, Phukan S, Singha B 2016: Hypolipidemic activity of *Phyllanthus acidus* leaves in Hypercholesterolemic diet-induced hyperlipidemia in rats. Scholars *Journal of Applied Medical Sciences (SJAMS)* **4**(10B): 3648-53.

Bywater RJ 2005: Identification and surveillance of antimicrobial resistance dissemination in animal production. *Poultry science* **84**(4): 644-648. doi:org/10.1093/ps/84.4.644.

Castanon JIR 2007: History of the use of antibiotic as growth promoters in European poultry feeds. *Poultry* *science* **86**(11): 2466-2471. doi.org/10.3382/ps.2007-00249.

Chakraborty R, Biplab D, Devanna N, Sen S 2012: Antiinflammatory, antinociceptive and antioxidant activities of *Phyllanthus acidus* L. extracts. *Asian pacific journal of tropical biomedicine* **2**(2): S953-S961. doi.org/10.1016/s2221-1691.

Eevuri TR, Putturu R 2013: Use of certain herbal preparations in broiler feeds-A review. *Veterinary World* **6**(3). doi: 10.5455/vetworld.2013.172-179.

Escosteguy A 2014: Potential use of medicinal plants in animal production: results in Brazil. *Building Organic Bridges* **1**, 81-84. doi:10:3220/REP_20_1_2014.

Gatne MM, Patil R, Ravikanth K, Shivi M, Rekhe DS 2010: Evaluation of immunodulatory effect of stresroak premix in broiler chick. *Veterinary World* **3**(3):122. URL={https://api.semanticscholar.org/CorpusID:10198198}.

Giannenas I, Bonos E, Skoufos I, Tzora A, Stylianaki I, Lazari D, 2018: Effect of herbal feed additives on performance parameters, intestinal microbiota, intestinal morphology and meat lipid oxidation of broiler chickens. *British Poultry Science* **59**(5): 545-553. doi:org/10.1080/00071668.2018.1483577.

Guo F 2003: Mushroom and herb polysachariides as alternative for antimicrobial growth promotors in poultry. Wageningen University and Research. doi:org/10.18174/121423.

Habib MR, Sayeed MA, Rahman MM, Hasan MR, Saha A 2011: In vitro evaluation of cytotoxic, antibacterial, antioxidant and phytochemical screening of petroleum ether extract of *Phyllanthus acidus*. *International Journal of Pharmaceutical Sciences and Research* **2**(4): 875. ISSN: 0975-8232.

Hashemi SR, Davoodi H 2011: Herbal plants and their derivatives as growth and health promoters in animal nutrition. *Veterinary research communications* 35:169-180. doi:org/10.1007/s11259-010-9458-2.

Hossen MJ, Jeon SH, Kim SC, Kim JH, Jeong D, Sung NY, Cho JY 2015: In vitro and in vivo anti-inflammatory activity of *Phyllanthus acidus* methanolic extract. *Journal of Ethnopharmacology* **168**: 217-228. doi:org/10.1016/j.jep.2015.03.043.

Iheukwumere FC, Ndubuisi EC, Mazi EA, Onyekwere MU 2008: Performance, nutrient utilization and organ characteristics of broilers fed cassava leaf meal (*Manihot esculenta Crantz*). *Pakistan Journal of nutrition* **7**(1):13-16. doi:10.3923/pjn.2008.13.16.

Jagajothi A, Manimekalai G, Evanjelene VK, Nirmala A, Vasanthi P 2013: Antimicrobial activity and phytochemical analysis of *Phyllanthus acidus*. *Journal of Today's Biological Sciences: Research and Review* **2**(2), 55-62. URL={https://api.semanticscholar.org/CorpusID:98152316}.

Jagessar RC, Mars A, Gomes G 2008: Selective Antimicrobial properties of *Phyllanthus acidus* leaf extract against *Candida albicans, Escherichia coli* and *Staphylococcus aureus* using Stokes Disc diffusion, Well diffusion, Streak plate and a dilution method. *Nature and science* **6**(2):24-38. URL={https://api.semanticscholar.org/CorpusID:10685009}

Kamble MT, Yakupitiyage A, Salin KR, Chavan BR 2018: Effect of *Psidium guajava* and *Phyllanthus acidus* leaf extract on immunostimulant response of Nile tilapia against *Streptococcus agalactiae* infection. http://hdl.handle.net/10524/59398.

Krishna D, Srinivas G, Raghunandan T, Ravi T, Kumar MK, Prasad CS 2017: Effect of Herbal Antistressor Products on the Growth Parameters and Carcass Traits of Broilers under Heat Stress. *International Journal of Livestock Research* **7**(10). doi:org/10.5455/ijlr.20170801054327.

Kumar R, D'mello JPF 1995: Anti-nutritional factors in forage legumes. Tropical legumes in animal nutrition 95-133 ref. 128. ISBN (Hardback): 978-0-85198-926-6.

Kuralkar P, Kuralkar SV 2021: Role of herbal products in animal production–An updated review. *Journal of Ethnopharmacology* 278: 114246. doi:org/10.1016/j.jep.2021.114246.

Langhout P 2000: New additives for broiler chickens. *World's Poultry* **16**(3):22-27.

Manikandan R, Beulaja M, Thiagarajan R, Palanisamy S, Goutham G, Koodalingam A, Arumugam M 2017: Biosynthesis of silver nanoparticles using aqueous extract of *Phyllanthus acidus* L. fruits and characterization of its anti-inflammatory effect against H_2O_2 exposed rat peritoneal macrophages. *Process Biochemistry* **55**:172-181. doi:org/10.1016/j.procbio.2017.01.023.

Mohammed A, Alsahli SA, Alzahrani FM, Almatroudi A, Alfheeaid H, Khan AA, Khaled S, Allemailem SAA, Rahmani AH 2021: Health promoting effect of *Phyllanthus emblica* and *Azadiractha indica* against advanced glycation end products formation. *Journal of Applied Science* **11**(19):8819. https://doi.org/10.3390/app11198819.

Musa H 2021: The efficacy of a commercial herbal formulation in the prevention of coccidiosis under natural exposure to Eimeria species (Doctoral dissertation). Federal University of Technology, Mania.

Nidaullah H, Durrani FR, Ahmad S, Jan IU, Gul S 2010: Aqueous extract from different medicinal plants as anticoccidial, growth promotive and immunostimulant in broilers. URL: http://www.arpnjournals.com/jabs/research_papers/rp_2010/jabs_0110_175.pdf.

Pangestika AR, Widodo E, Sudjarwo E 2020: Evaluation of Gooseberry (*Phyllanthus acidus* L. Skeels) leaf extract based on phytochemical, total flavonoid, and antibacterial activity as potential feed additive in Broiler. *Engineering Science* **5**(4):305307. ISSN(Online):24559024. URL={https://api.semanticscholar.org/CorpusID:251922262}.

Portugaliza HP, Fernandez TJ 2012: Growth performance of Cobb broilers given varying concentrations of Malunggay (*Moringa oleifera* Lam.) aqueous leaf extract. *Online Journal of Animal Feed Resources* 2, 465469. URL: http://www.ojafr.ir/main/attachments/article/91/Online%20J.%20Anim.%20Feed%20Res.,%202(6)%20465-469;%20B86.pdf.

Rao H, Gurram S 2021: Effect of herbal feed additives on performance, immunity, serum parameters and E. coli counts of broilers under heat stress. *Indian Journal of Animal Nutrition* **38**(1):61-67. doi:10.5958/2231-6744.2021.00009.8.

Reddy ET, Reddy PS, Shakila S 2012: Effect of herbal preparations (*Phyllanthus emblica*, *Curcuma longa* and *Ocimum sanctum*) on the performance of broilers. URL: http://www.tanuvas.ac.in/tnjvas/vol8(4)/209-214.pdf.

Sopandi T, Herupradoto EBA 2012: Reduction of intracellular lipid accumulation, serum leptin and cholesterol levels in broiler fed diet supplemented with powder leaves of *Phyllanthus buxifolius. Asian Journal of Agricultural Research* **6**(3):106-117. URL:http://repository.unair.ac.id/id/eprint/113054.

Sousa M, Ousingsawat J, Seitz R, Puntheeranurak S, Regalado A, Schmidt A 2007: An extract from the medicinal plant *Phyllanthus acidus* and its isolated compounds induce airway chloride secretion: a potential treatment for cystic fibrosis. *Molecular Pharmacology* **71**(1): 366-376. doi.org/10.1124/ mol.106.025262

St L, Wold S 1989: Analysis of variance (ANOVA). *Chemometrics and intelligent laboratory systems*, **6**(4), 259-272.

Sugiharto S 2020: The potentials of two underutilized acidic fruits *(Averrhoa bilimbi L.* and *Phyllanthus acidus* L.) as phytobiotics for broiler chickens. *Journal of Advanced Veterinary Research* **10**(3):179-185. https://www.advetresearch.com/index.php/AVR/article/view/464.

Sundaresan NR, Thirumurugan R, Jayakumar S, Purushothaman MR 2007: Protective effectiveness of *Phyllanthus niruri* against short-term experimental aflatoxicosis in broiler chicken. *Indian Journal of Poultry Science* **42**(2):153-156.

Tallarida RJ, Murray RB, Tallarida RJ, Murray RB 1987: Duncan multiple range test. *Manual of Pharmacologic Calculations: With Computer Programs*, 125-127. doi.org/10.1007/978-1-4612-4974-0_38

Talubmook C, Buddhakala N 2013: Hypoglycemic and hypolipidemic properties of leaf extracts from *Phyllanthus acidus* (L.) Skeels, *Leucaena leucocephala* (Lam.) de Wit. and *Psidium guajava* (L.) in streptozotocin-induced diabetic rats. *GSTF Journal of BioSciences* **2**(2):30-4. doi:10.5176/2251-3140_2.2.38.

Thirumurugan R, Sundaresa NR, Purushothaman MR 2007: Protective effectiveness of *Phyllanthus niruri* against short-term experimental aflatoxicosis in broiler chicken. *Indian Journal of Poultry Science* **42**(2), 53-56.

Trinder P 1969: Determination of blood glucose using an oxidase-peroxidase system with a non-carcinogenic chromogen. *Journal of clinical pathology* **22**(2):158-161. doi.org/10.1136/jcp.22.2.158.

Wondimu A, Mesfin E, Bayu Y 2019: Prevalence of poultry coccidiosis and associated risk factors in intensive farming system of Gondar Town, Ethiopia. *Veterinary medicine international* 2019(1): 5748690. doi:org/10.1155/2019/5748690.

Zuhra FT, Paul AK, Riad MM, Ahmed MS 2018: Effects of probiotics and phytoextracts on growth and immunomodulating performances of broiler chickens. *Bangladesh Journal of Veterinary Medicine* **16**(1): 13-21. doi: https://doi.org/10.3329/bjvm.v16i1.37368.