Research Article

Influence of Phytobiotic Essential Oils on Growth Performance and Hematological Parameters of Broiler Chickens

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Abstract | The poultry industry fulfils the nutritional gap in many nations at a lower cost than other animal meat sources. Concerns about the extensive use of Antibiotic Growth Promoters (AGPs), stimulated consumer demand for antibiotic-free animal yield. We investigated the applicability of the phytobiotic Essential Oils (EOs) and their influence on the overall performance, appetite, and food digestion. We aimed to assess the effects of dietary phytobiotic supplements containing black pepper, fennel, and turmeric EOs on the performance of Broiler chickens. The study used 280; 70-day-old chicks. The birds were divided into seven experimental groups; one control and six were fed on phytobiotics EOs at rates of 1% and 0.5% and monitored for 8 weeks. The results revealed that the inclusion of 0.5% black pepper and 0.5% fennel combination, as well as a 1% turmeric, significantly ($P < 0.05$) improved body weights in birds. Black pepper and a combination of turmeric and fennel revealed slower growth compared to the other treatments. The combined diet of black pepper and turmeric significantly ($P < 0.05$) improved feed intakes. The hemoglobin concentration, Mean Corpuscular Volume (MCV), and Mean Corpuscular Hemoglobin (MCH) values of birds fed with 0.5% black pepper and 0.5% turmeric, as well as 1% black pepper, were found to be higher. The Red Blood Cell (RBC) counts were increased with 0.5% black pepper and 0.5% fennel. The study concluded that phytobiotic EOs are cost-effective and safe natural growth enhancers for broiler chickens with health-promoting properties.

Keywords | Feed intake, Health, Impact, Phytobiotics, Poultry

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INTRODUCTION

The Indian Poultry Industry was introduced as the fastest-growing industry in the world over the last three decades. Antibiotic Growth Promoters (AGPs) are widely used in animal diets, resulting in the emergence of a diverse range of antibiotic-resistant microbes. Because of AGP's contribution to improved growth performance, they were used more in animal feeding. However, limiting antibiotic usage in livestock animals can reduce the generation of antibiotic-resistant bacteria by up to around 39% (Koirala et al., 2021). Antimicrobial resistance diseases cause 50,000 mortalities each year in the United States and Europe. According to the United Kingdom reports, antibiotic-resistant bacteria infection might be incriminated as the reason for the death of 10 million people by 2050. The World Health Organization (WHO) has already published information regarding the increasing number of cases of antibiotic resistance in Asia (Alkindi et al., 2019; WHO, 2017; Selaledi et al., 2020). Except in Europe, many developed and developing countries have included sub-curative antibiotic dosages in poultry

diets as prophylactics from time to time. Concerning the widespread usage of AGPs, which may have contributed to the continuous rise in consumer demand for antibiotic-free livestock (Abou-Elkhair et al., 2018).

Phytobiotics should be used instead of antibiotics to maintain a high level of animal yield by promoting growth and ensuring consumer and environmental health with low mortality rates (Mehdi et al., 2018). Incorporating black pepper, turmeric, and fennel into the diet of poultry birds might boost body weight and feed consumption, and could be a viable alternative to antibiotic growth promoters (Pavuca et al., 2020). Phytobiotics, also known as phytogenics, are naturally occurring compounds such as essential oils, oleoresins, and herbs that may be used in poultry industry to increase overall performance and meat quality. Because of the favorable influence, improved development, and immunological response in birds, phytobiotics are gaining popularity. According to Bajagai et al. (2020), phytobiotic feed diets might be advantageous for birds without the use of antibiotic growth promoters.

Essential oils can be considered as growth performance enhancers along with body weights, growth, hematological, and feed intakes for the poultry industry (Gilani et al., 2021). Black pepper is a spice that belongs to the herb family and is well-known for its effects on increasing the flow of digestive fluid (Abdulsahib et al., 2019). Supplementation with black pepper and fennel increases growth performance, average quality, nutritional digestibility, and meat quality (Sugiharto et al., 2020; Liu et al., 2021). Fennel, an aromatic herb, is beneficial and effective in increasing the synthesis of digestive enzymes and improving liver function. Turmeric may be used as an alternative feed additive because of its antioxidant, anti-inflammatory, immunomodulatory, and enzymatic activities, all of which benefit the nutrition, and physiological status of birds (Abou-Elkhair et al., 2018; El-Ghany, 2020), and it is considered safe for use by the European Commission's EFSA panel.

Therefore, we are investigating the influence of three herbal essential oils of black pepper, turmeric, and fennel and their combinations as feed additives with the aim of comparing the growth performance, feed intake, and hematological parameters of Broiler chickens.

MATERIALS AND METHODS

Experimental site and birds

The research was carried out at Centurion University of Technology and Management, Bhubaneswar, Odisha, from August to November 2021. The 70 day old chicks were purchased from a local hatchery. After being weighed, the birds were randomly placed in a poultry house (25W×30L×10H ft) and divided into seven groups. Each group was further divided into four replicates (each with 10 birds) under controlled climatic circumstances.

Experimental bird management and feed

During the experiments, daily high (31 °C- 29 °C) and low (26 °C - 22 °C) room temperatures were rarely below 18 °C or beyond 33 °C, and were monitored by an electronic control panel (Temptron 607, AgroLogic). Exhaust fans and fans to force air in and out of the poultry house were used to regulate the ventilation system. Birds were given 5 birds/ 1.5 m^2 of floor space. The natural 14-L: 10-D cycle was maintained by using a simple timer on the light bulbs (9-watt compact florescent bulb, warm white color, Luminous Flux). Feed and water were provided via manual feeder barrels and manual jar drinkers and were cleaned regularly. The bedding (wheat straw bedding system) was washed on a regular basis, and spills, dirt, and poops were swept up daily. During the experiment, all birds were vaccinated against Marex on the first day (intraocular) of life in hatcheries, and against Ranikhet on the 7th day, administered with drinking water. Chicks were fed a conventional balanced diet, as recommended by the National Research Council in 1994 (Table 1). The Centurion University Ethics Committee for Experiments with Animals approved all the experimental procedures relating to the use of live animals.

Every week, the growth performance, weight gains, feed intakes, and the mortalities were monitored and recorded. One group (D0) was provided with a control diet and the other six groups were provided with three oral dietary phytobiotic supplements of 6 different compositions: D0) fed on basal diet with no additive (control), D1) treated with 1% black pepper (10g/1 Kg feed), D2) treated with 1% turmeric (10g/1 Kg feed), D3) treated with 1% fennel (10g/1 Kg feed), D4) treated with 0.5% black pepper and 0.5% turmeric (10g/1 Kg feed), D5) treated with 0.5% black pepper and 0.5% fennel (10g/1 Kg feed), D6) treated with 0.5% turmeric and 0.5% fennel (10g/1 Kg feed).

Essential oils

The solid-liquid extraction for essential oils of black pepper, turmeric, and fennel were extracted using the supercritical CO_2 extraction method (Table 2) at the Centurion University Research and Development Laboratories at Paralakhemundi (Tran et al., 2019; Neves et al., 2020). The dried phytobiotics were collected and milled into fine powders using a grinder (SS Pulverizer, 3HP, India) for further analysis. The weight of these powders were estimated and stored in air-tight vacuum-sealed bag. The phytobiotic powders were cooled (at 10 °C) in a refrigerator (SSU-168, India) for 2 hours before milling, to reduce the loss of essential oils during the process. The phytobiotic powders were then separately filtered using a wire mesh. Cylindrical vessels were used for the

extraction process. CO_2 was the extracting supercritical fluid. Each phytobiotic powder (1000g) was added to the high-pressure equilibration vessel in a known proportion. A reciprocating pump was used to charge liquid CO_2 into the system at a constant flow rate of 10 ml/min, and it was compressed to the appropriate pressures in the extraction range of 60 °C and 300 bar/ 3 h for black pepper (Tran et al., 2019; Shityakov et al., 2019), 60 °C and 250 bar/2.5 h for turmeric (Neves et al., 2020; Gopalan et al., 2000), and 32 °C and 82 bar/ 2 h for fennel (Hammouda et al., 2013). The precipitated fractions were collected in a trapping flask for each phytobiotic essential oil. The collected samples were stored individually in amber bottles at 4 °C for further use. Extraction yields were determined gravimetrically.

Table 1: Composition and chemical content of diets used in the experiment, g/kg.

Items	Control diet D_0	Experimental diet (D_1- D_6)					
	Basal diet	D_1	D_2	D_3	D_4	D_5	D_6
Maize	355	353	352	353	351	355	347
Wheat	254	252	252	251	250	249	252
Soybean meal	244	242	243	243	245	243	245
Milet	40	39	40	39	40	39	38
Peanut meal	81	78	77	77	77	78	82.6
Black pepper	-	10	-	-	5	5	-
Turmeric	-	-	10	-	5	-	5
Fennel	-	-	-	10	-	5	5
DL-methionine	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Dicalcium phosphate	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Sodium chloride	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Vitamin mineral complex[1]	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Metabolisable energy (MJ/kg)[2]							
Crude protein[3]	176	181	178	177	180	179	176
Lys	8.4	8.5	8.5	8.5	8.6	8.5	8.4
Met	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Thr	6.5	6.6	6.6	6.5	6.5	6.6	6.5
Ca	39.0	40.1	40.2	39	40.1	40.1	39
Total P	3.2	3.2	3.1	3.4	3.1	3.3	3.3
Na	1.8	1.8	1.9	1.9	1.8	1.9	2.0
DEB[4] (mEq)	175	177	178.1	178	177	179	179

[1]The supplied premix/kg of diet: 3.45 mg retinyl acetate; 2 mg menadione (K3); 20 mg DL-alpha-tocopheryl acetate; 0.075 mg cholecalciferol; 2 mg thiamine; 2 mg riboflavin; 0.015 mg cyanocobalamin; 25 mg niacin; 8mg 11 mg d-pantothenic acid; 1.1 mg folic acid; 0.13 mg biotin; 12,300 IU vitamin A, 4,500 IU vitamin D3; [2]Calculated according to (Cerrate et al., 2019; Barzegar et al., 2019) as a sum of ME content of components; [3]Calculated according to the chemical content of feed; [4]Dietary Electrolyte Balance.

Statistical analyses

All analysis were subjected to statistical analysis by one-way ANOVA. The statistical analysis of data was performed by using SAS- Statistical Analysis System (SAS Institute Inc., 2012). The level of significance was considered at $P < 0.05$. Each analysis was done in triplicates and the average values were considered for representation purposes.

Blood parameters

Blood samples from 7 experimental groups were taken in 5 replicates on the 21st and 42nd days of the experiment for hematological analysis to determine blood cell characteristics and hematological values. Blood samples (1 mL) were collected from the left-wing of each bird and collected in an EDTA tube (Hemotube, K3 EDTA, MA LAB Consumable, India) for hematological analysis using sterilized needles and disposable syringes (Dispovan, 2.5 mL, Hindustan Syringes and Medical Devices Ltd, India). The auto hematology analyzer (BC 2800, Mindray, India) was used to estimate blood parameters.

RESULT AND DISCUSSION

The effects of different supplemented diets on body weights (Table 3) were studied for 8 weeks at weekly intervals. The initial mean body weights of the D5 (0.5% black pepper and 0.5% fennel) was 360.6±1.19 g, and the 8th week age body weights were up to 589.34±1.60 g. The D5 and D4 (0.5% of black pepper and 0.5% of turmeric) groups showed higher body weights.

The average body weight gains were significantly different ($P < 0.05$) fed with the D4 and D6 diets, (Table 4) revealing a linear increase in body weights. Birds fed with D4 and D6 (0.5% turmeric and 0.5% fennel) diet had a significant effect ($P < 0.05$) on feed consumption compared to the control (Table 4). This might contribute to the growth improvement in of the birds fed with D5 and D6 in the study (Figure 1b).

In comparison to 1% black pepper and 1% turmeric, the 1% turmeric diet had shown moderate body weights increases. But birds fed with the D3 (1% fennel) diet had a comparatively higher body weight gain in the 8th week than D1 and D2 (Figure 1a). Al-Sagan et al. (2020) reported that adding phytobiotic fennel 1% improved final body weight gains, in agreement with Liu et al. (2021), who concluded that fennel added dietary feed may be incorporated with promoting bird growth. The D4 and D5 diets showed significant ($P < 0.05$) weight gains, but the weight gain of birds fed with the D5 diet surpassed all other diets by the 8th week and had the highest weight gains of all experimental diets (Figure 1b). Birds fed with diet D1 showed the least weight gains.

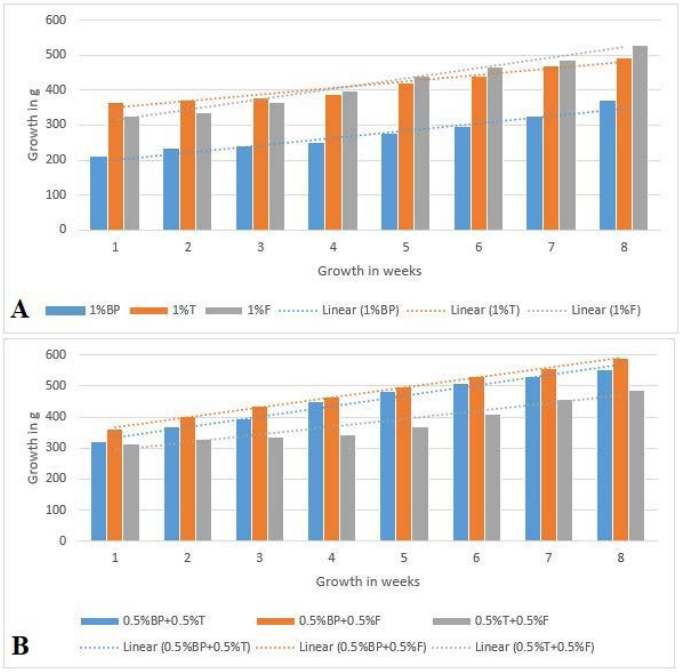

Figure 1: The relative growth rate of poultry birds in terms of weight (in grams) with respect to different diet composition. (A) Growth rate of birds when feeded with diet D1 (BD+1% of Black pepper); D2 (BD+1% of Turmeric); D3 (BD 1% of Fennel). (B) Growth rate of birds when feeded with diet D4 (BD+ 0.5% of Black pepper+ 0.5% of Turmeric); D5 (BD+0.5% of Black pepper+0.5% of fennel); D6 (BD+0.5% of Turmeric+ 0.5% of fennel). *BP: black pepper; T: Turmeric; F: Fennel.

The body weight gains of control D0 and D6 were significantly similar ($P < 0.05$). The study results are similar to those of (Liu et al., 2021; Nm et al., 2018; Abou-Elkhair et al., 2014) reported similar results for body-weight gains. At weeks 4,5, and 6, the observed values for the body-weight gains of D1 (1% black pepper) were lower than the other experimental diets (Figure 1a). The weekly body weight gains of the D4 (0.5% black pepper and 0.5% turmeric) and D5 (0.5% black pepper and 0.5% fennel) were lower than the expected ones at week-8, although growth with the D4 diet was higher at weeks 4, 5, and 6. In both diets, the observed values were almost similar during week-3 of the study (Figure 1b). From week 4 onwards, the growth rates in terms of weight gains began to increase, peaking at weeks 5-6. However, there are few publications on the trend of body weight rise in the literature to compare.

Table 5 shows the effect of phytobiotic feed supplements on blood chemical parameters. The D0 had considerably lower MCV and MCH concentrations than the experimental phytobiotic treated groups. The highest values for blood parameters of birds were found in D1 (1% black pepper) and D5 (0.5% black pepper and 0.5 % fennel) for both MCV and MCH. Erythrocyte (RBC) counts were lowest in the D0 and highest in the D3 (1% fennel). However, the lowest leucocytes (WBC) counts were found in the D0 and D2 groups. Whereas the highest values for WBC were found with the D3 on the 21st day and D1 on the 42nd day. The hemoglobin (HGB) (g/dL) and MCH values are the most important factors in determining anemia and erythrocyte circulation (Imaseun and Ijen, 2017). The number of red blood cells in a bird's blood influences its overall health. The increase in HGB and MCH values reflects the oxygen-carrying capacity of birds.

Table 2: Major bioactive components of used phytobiotics.

Phytobiotics	Latin name	Plant family	Main constituents	Sources
Black pepper	Piper nigrum	Piperaceae	Capsaicin, Dihydrocapsaicin	Ashokkumar *et al.*, 2021
Turmeric	Curcuma longa	Zingiberaceae	Curcumin, Curcuminoids	Nasri *et al.*, 2014
Fennel	Foeniculum vulgare	Apiaceae	3-caffeoylquinic acid, Chlorogenic acid, 1,3- Di-caffeoylquinic acid, Eriocitrin, Rutin, Miquelianin	Rather *et al.*, 2016

Table 3: Average body weight (g) of birds reared with different diet.

Treatment diet[1]	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week	F value
D_0	301 ± 0.58	328.33 ±1.55	359.33 ±1.44	370.34±1.20	387.33±2.75	424±0.37	461.34± 2.08	482±2.64	1.97*
D_1	210 ± 1.89	230 ± 1.34	238.33 ± 0.77	248.67±1.33	274±2.08	295±1.67	322.66±2.18	368.34±1.76	0.01
D_2	365 ± 1.65	372.66 ± 1.78	379.34 ± 2.11	388.67±1.45	421±2.21	439.66±1.85	468.33±1.76	492±2.21	0.16
D_3	326.6 ± 2.40	334.65 ± 1.78	366.34 ± 2.22	397.34±1.17	441.66±2.04	468±1.45	485±2.21	528±1.52	2.15*
D_4	320.5± 1.32	370 ± 0.34	394.34 ±1.55	449±2.08	484±2.64	509.66±2.72	530.34±2.40	554.34±2.84	0.08*
D_5	360.6 ± 1.19	400.65 ± 1.55	434.34 ±2.00	464±3.75	496.66±2.62	529.33±3.38	557±2.78	589.34±1.60	1.56*
D_6	315 ± 1.84	327.34± 1.11	337 ± 1.33	344.67±1.66	370±2.04	411±1.16	456.34±3.28	487.67±3.23	0.5*

[1]D_0- Basal diet(BD) control); D_1- BD+1% of black pepper; D_2 -BD+1% of turmeric; D_3 BD 1% of fennel; D_4 -BD+ 0.5% of black pepper+ 0.5% of Turmeric; D_5 BD+0.5% of Black pepper+0.5% of fennel; D_6 BD+0.5% of Turmeric+ 0.5% of fennel. * indicates $P < 0.05$ probability level.

Table 4: Weekly feed consumption (g/ bird) of birds.

Treatment diet[1]	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week	F value
D_0	222.48±1.04	231.09 ±0.27	245±0.69	273±1.96	308±1.19	338.34±1.01	364±1.77	382.67±1.14	0.14
D_1	194.06±0.13	217.23 ±0.33	229.37±0.33	254.34±1.44	296.34±1.07	324.34±0.36	340.67±0.39	371±1.16	0.31
D_2	220.78 ±0.96	230.11 ±1.68	248.45±1.69	278.01±1.26	330.16±1.32	353.27±0.69	383.13±2.14	415.34±1.36	0.73*
D_3	208.36 ±1.56	220.73 ±0.39	242.9±1.36	290.85±1.08	346.03±1.51	375.67±1.44	407.16±1.48	442.16±1.47	0.05*
D_4	214.36±0.57	230.69 ±0.69	254.03±1.01	296.91±0.91	344.17±0.87	358.17±1.32	393.17±1.14	419.76±1.36	0.07*
D_5	225.12 ±1.56	242.85±1.34	270.83±1.89	317.34±0.89	340.67±0.99	365.17±1.15	394.34±1.06	422.8±1.41	0.13*
D_6	203.11 ±0.45	210.11 ±1.39	231.12±1.67	267.17±1.03	314.54±1.17	354.2±1.23	386.17±0.96	418.83±0.39	0.19*

[1]D_0- Basal diet(BD) control); D_1- BD+1% of black pepper; D_2 -BD+1% of turmeric; D_3 BD 1% of fennel; D_4 -BD+ 0.5% of black pepper+ 0.5% of turmeric; D_5 BD+0.5% of black pepper+0.5% of fennel; D_6 BD+0.5% of turmeric+ 0.5% of fennel. * indicates P < 0.05 probability level.

Table 5: Blood biochemical parameters at 21st day and 42th day.

Blood biochemical parameters	Sampling day- 21st day						
	Control diet	Experimental diet[1]					
	D_0	D_1	D_2	D_3	D_4	D_5	D_6
Haemoglobin (HB) (g/dl)	7.16±0.29	7.96±0.2	7.89±0.32	7.74±0.65	7.16±0.12	8.06±0.24	7.42±0.53
Erythrocyte (RBC) (×10⁶)	2.05±0.04	2.25±0.10	3.17±0.18	3.32±0.63	3.16±0.74	3.45±0.19	2.96±0.19
Haematocrit (%)	29.67±1.40	29±0.50	29.77±0.28	24.32±0.32	25.48±0.42	29.68±0.86	24.02±1.78
MCV	73.29±0.84	128.93±3.92	77.6±1.63	79.36±1.74	80.63±1.17	86.31±2.64	81.14±1.23
MCH	23.87±0.48	30.07±1.74	24.88±2.90	23.31±0.59	22.65±1.34	23.36±2.41	25.06±1.36
MCHC	21.15±1.55	23.3±0.54	28.41±1.78	29.4±1.95	28.1±1.12	27.34±1.45	30.89±1.74
Leucocyst (WBC) (×10³/µL)	171±2	180±1.4	171±1.2	189±1.2	175±1.01	178.8±3.16	179.6±2.34
Basophil (%)	1.25±0.11	1.23±0.09	1.31±0.15	1.11±0.16	1.37±0.11	1.26±0.18	1.19±0.19
Neutrophil (%)	82.96±3.12	82.63±5.63	83.15±3.66	81.95±2.45	85.6±3.47	82.17±2.54	81.14±3.36
Lymphocyte (%)	14.89±1.25	14.87±2.59	13.91±1.34	12.4±0.58	14.81±1.66	15.6±2.46	13.45±2.64
Monocyte (%)	1.29±0.15	1.27±0.34	1.15±0.23	1.61±0.45	1.74±0.31	1.39±0.21	1.25±0.11
	Sampling Day- 42nd Day						
Haemoglobin (HB) (g/dl)	7.78±0.71	9.18±0.34	9.90±0.45	8.86±0.12	9.04±0.08	10.94±0.78	8.77±0.67
Erythrocyte (RBC) (×10⁶)	2.15±0.08	3.37±0.12	4.56±0.31	4.63±0.66	4.67±0.43	4.87±0.21	3.65±.16
Haematocrit (%)	30.31±0.12	29.76±0.13	35.67±0.19	27.47±0.6	30.73±1.14	35.00±1.06	29.81±0.73
MCV	76.03±0.94	88.30±1.86	81.64±0.73	59.33±0.45	65.80±1.12	71.86±1.85	81.67±2.13
MCH	23.56±0.09	27.24±0.31	27.71±1.58	19.13±0.45	19.35±0.31	22.46±0.84	24.02±2.03
MCHC	26.26±0.69	30.84±0.35	30.30±1.03	32.25±0.98	29.41±0.18	31.25±5.71	29.41±0.29
Leucocyst (WBC) (×10³/µL)	175±1.41	203±1.6	198±1.1	184±2.16	201±1.8	202±1.9	193±2.5
Basophil (%)	1.70±0.13	1.85±0.29	2.03±0.21	1.99±0.2	1.86±0.28	2.66±0.12	2.01±0.14
Neutrophil (%)	91.01±1.00	96±1.36	101±4.9	99±4.36	97±3.36	98±4.8	96±6.5
Lymphocyte (%)	18.75±1.96	19±3.27	19.56±1.63	20.21±0.78	19.72±1.00	20.55±0.66	18.63±1.74
Monocyte (%)	1.89±0.04	1.87±0.10	1.96±0.17	1.88±0.24	1.63±0.25	1.68±0.11	1.98±0.44

[1]D_0- Basal diet(BD) control); D_1- BD+1% of Black pepper; D_2 -BD+1% of Turmeric; D_3 BD 1% of Fennel; D_4 -BD+ 0.5% of Black pepper+ 0.5% of Turmeric; D_5 BD+0.5% of Black pepper+0.5% of fennel; D_6 BD+0.5% of Turmeric+ 0.5% of fennel. Hb=Haemoglobin concentration; RBC-Red blood cells; MCV= Mean corpuscular volume; MCH =Mean cell haemoglobin; MCHC= Mean cell haemoglobin concentration, WBC=White blood cell.

On the 42nd day, the RBC and MCH counts of birds increased, indicating that diets D5 and D4 had a positive influence on bird performance (Table 5). In comparison to the control group, the D1 group showed an increase in hemoglobin, as well as MCHC concentrations, which are also reported by (Imasen and Ijeh, 2017). Birds

treated with D2 had higher hemoglobin content on the 42nd day than those birds fed with D0, and (Daramola et al., 2020) projected similar results. Eko et al. (2020) and Ayodele et al. (2021) found a similar trend of results for both monocyte (%) and erythrocyte (RBC). On the 21st and 42nd days, hematocrit values of birds were higher in the D2. Lower values for hematocrit were observed in the D6 treated group on the 21st day as well as the D3 treated group on the 42nd day, and these findings were supported by (Sugiharto et al., 2011; Nayaka et al., 2013).

The highest weights of poultry birds were gained by a combination of 0.5% phytobiotics supplemented with black pepper, turmeric, and fennel, as reported by Nwogor et al. (2020) and Abou-Elkhair et al. (2018). Puvaca et al. (2020) and Sugiharto et al. (2020) reported that black pepper and turmeric improve digestion by stimulating stomach digestive enzymes and removing pathogenic microorganisms from the gut. The effect of the combination of black pepper and turmeric, which affects the digestive abilities, may be responsible for the improvement in body weight and feed intake.

CONCLUSION

The study showed that dietary phytobiotic supplementation of black pepper, turmeric, and fennel at 0.5% and 1% concentration had a beneficial impact on poultry bird growth performance, weight gain, hematological parameters, and feed intake. Phytobiotics might be used as a low-cost, safe natural growth promoter in the Broiler chickens's diet. However, further research is needed to discover the optimal concentration of phytobiotics for usage in bird diets as a potential substitute to antibiotic growth promoters.

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NOVELTY STATEMENT

The EOs of black pepper, turmeric, and fennel can be recommended as a cost-effective alternative to the AGPs. Finally, phytobiotic EOs can be given to poultry birds to improve their overall growth performance, feed intake status, and blood parameters.

AUTHOR'S CONTRIBUTION

LS conceptualized the paper, contributed to writing, reviewed, fieldwork, and edited the manuscript. YN compiled information and prepared the draft of the manuscript. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Qualified veterinarians adhering to the regulations and guidelines on animal husbandry and welfare and performed all handling practices aimed at identification, and weighing of birds. No action involving pain or suffering was practiced. Hence approval of any ethical committee or subsidiary body thereof is not needed in this case.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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