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PERFORMANCE TRAITS, BLOOD BIOCHEMISTRY, IMMUNE RESPONSE AND ECONOMIC APPRAISAL OF BROILERS FED DIFFERENT LEVELS OF POULTRY BYPRODUCTS COMPOST

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ABSTRACT

The effect of including poultry house byproducts compost in the diet of broiler chickens was evaluated. A total of 300 newly hatched broiler chicks (Cobb-500) were randomly stratified to five treatment groups in a completely randomized design. Compost was added at four different concentrations i.e. 0, 2.5%, 5%, 7.5%, and 10%. Treatment without any addition of compost (0%) was kept as control. Performance traits, blood biochemistry, immune antibody response, and economic appraisal of broiler chickens were monitored for a period of 35 days. Addition of compost in broiler diet had no effect on feed intake (FI), live weight gain (LWG), feed efficiency (FE), and mortality of birds (P>0.05). Increase in compost inclusion level (10%) caused a marked decrease in abdominal fat content compared to control and 2.5% compost diet. However, carcass yield and relative weights of breast, thigh, wing, liver, gizzard, and heart were not significantly different across treatments (P>0.05). Similarly, there were no differences in serum biochemical indices and immune-related parameters in birds fed the different diets. Birds fed the 10% compost diet, however, showed the lowest feed cost per kg weight gain compared to those fed the control diet (P>0.05). These results indicate that compost can be utilized at levels up to 10% in broiler diets without any detrimental effects on performance traits, serum biochemistry, and immune response. Furthermore, the utilization of compost as a feed resource may reduce feed cost (FC) per kg live weight gain.

Key words: broiler, poultry byproducts compost, growth performance, immune response, economic appraisal.

INTRODUCTION

Intensification and rapid growth of poultry industry, and the associated production of large amount of wastes, including litter, manure, and dead birds, has given rise to certain environmental concerns (Bolan *et al.,* 2010). Improper disposal of poultry waste may lead to contamination or degradation of the environment, and surrounding ecosystems (Coufal *et al.,* 2006). Land application of poultry waste as an organic fertilizer has often given rise to environmental problems, such as production of phytotoxic substances, odor, and emission of greenhouse gases (Borugadda *et al.,* 2012; Seidavi *et al.,* 2019). Hauling to rendering plants is considered to be the most viable method of carcasses disposal, but the possibility of disease transmission during the hauling process and associated transportation cost needs careful considerations (Bonhotal *et al.,* 2014). Incineration is the most bio-secure method and involves minimum labor to operate, but rising fuel costs and more stringent air quality regulations are major concerns with this disposal option (Bonhotal *et al.,* 2014). Burial is the simplest and the most cost-effective way of handling mortality losses (Wilkinson, 2011); however, disposal by burial creates nuisance complaints and underground water quality concerns (Seidavi *et al.,* 2019). Therefore, an acceptable carcass disposal route, with potential benefits, is essential for sustainable operation of any poultry farm.

Recycling of poultry waste, including its byproducts (litter, dead birds), as a feedstuff for use in livestock feed offers a potential solution for this problem, and could be achieved through proper composting of the litter and dead birds. Recycling poultry waste could be beneficial for individual farmers and the broiler industry. Research has shown that normal mortality can be handled efficiently and safely by composting without harming environment (Kumar *et al.,* 2007; Seidavi *et al.,* 2019).

Composting is a natural biodegradation process (Wilkinson, 2011) in which naturally occurring mesophilic and thermophilic aerobic microorganisms reduce and transform organic waste (litter, dead birds) into a value-added end product called compost (Miller *et al.,* 2016). The decomposition of solid poultry waste is performed by naturally occurring aerobic microorganisms, such as bacteria, protozoa, and fungi (Ahmed *et al.,* 2012; Seidavi *et al.,* 2019). High temperatures during the process result in decreased concentration of organic pesticides (Kawata *et al.,* 2006) and inactivate both animal and human-related pathogens (Miller *et al.,* 2016). As a result, a bio-secure, less toxic,

and environmentally friendly product is obtained (Ahmed *et al.,* 2012; Khan *et al.,* 2019). Several studies have documented the use of hen carcasses and rendered spent hens in poultry feed (Xavier *et al.,* 2011); however, to our knowledge, application of compost in hen diet has been studied in a limited way. It was hypothesized that up to 10% compost can be added in the diet of broilers. Present study aimed to determine the effect of including compost in the diet on performance traits, blood biochemistry, immune response, and economic appraisal of broiler chickens.

MATERIALS AND METHODS

Compost preparation, experimental design, and birds housing: A detailed description of compost preparation can be found in Khan *et al.* (2019). The feeding trial was conducted at the Experimental Broiler House, Department of Poultry Production, University of Veterinary and Animal Sciences (UVAS), Ravi Campus under experimental animal care procedures approved by the Ethical Review Committee (vide letter No. DR/1053) as well as Advanced Studies and Research Board (ASRB) of the UVAS, Lahore. A total of 300 newly hatched broiler chicks (Cobb-500) with an average weight of 40 grams per chick were randomly stratified to five treatment groups. Each treatment group contained 10 birds and experiments were replicated six times according to a completely randomized design (CRD). The experimental diets were added with compost from 2.5 to 10% concentrations, all diets were iso-nitrogenous and iso-caloric (Table 2 and 4). Treatment without any addition of compost was used as control. The chicks were vaccinated in the hatchery for Newcastle disease (ND) and infectious bronchitis (IB). Chicks were maintained in 30 floor pens on a deep litter system with rice husk as bedding material. Each pen (1×1 m^2) was furnished with two round feeders and a nipple drinker for *ad libitum* feeding and availability of clean, fresh drinking water. Brooding temperature and relative humidity (RH) were maintained at 34±1.1^{o}C and 62±3%, respectively, for the first week after hatching, after which, temperature was reduced gradually until it reached 24^{o}C on day 21 with RH 65%. A lighting program of 23L:1D was implemented throughout the study. Treatment diets were formulated to meet the nutritional requirements of broilers for the starter (1 to 21 day of age) and finisher (22 to 35 day of age) phases (NRC, 1994).

Measurements

Growth performance and carcass characteristics: The data collected regarding growth performance included FI, LWG, FE, and percent mortality. Feed consumption and LWG were recorded weekly on pen basis. Feed intake was measured as the difference between total feed offered and feed refused, and LWG was obtained by subtracting the initial body weights from the final body weights. Feed efficiency was measured as the ratio between LWG and total feed consumed. Birds were observed twice daily, and the dead ones were removed and their body weights were included in the FE calculation. Mortality percentage was calculated as the number of birds died as relative to the total number of birds multiplied by 100. At the end of trial, three broilers per replicate nearest to the average weight of the same replicate were selected, kept off-feed for four hours, and then slaughtered according to Halal standards, allowing bleeding for approximately 3 to 4 minutes. Thereafter, carcasses were defeathered and eviscerated, and breast, thigh, wing, liver, gizzard, heart, and abdominal fat were immediately weighed. Carcass yield (without skin, shanks, and head) and breast, thigh, wing, liver, gizzard, heart, and abdominal fat relative weights were determined as percentages of live weight. Feed cost per kg live weight gain was calculated as the FC per unit multiplied by FCR (g/g).

Serum biochemistry and immune response: Blood samples (3ml/sample) were collected from two birds per experimental unit (12 birds/ treatment) at the time of slaughter, using 5ml disposable syringe without anticoagulant. Blood was centrifuged at 3,000 × g for 10 minutes, after which, serum was separated and preserved in 1.5-mL Eppendorf tubes at –20°C until further analysis. Thereafter, serum was thawed (4°C) and analyzed spectrophotometrically using commercially available diagnostic kits from Merck Specialties Pvt. Ltd (Kumar and Kumbhakar, 2015) for total protein, albumin, globulin, glucose, cholesterol, triglycerides, and uric acid (Rehman *et al.,* 2017). One week before sampling, all the birds were vaccinated, using commercially available ND (La Sota) and IB (H 120) vaccines, via drinking water, and the antibody responses to ND and IB vaccines were obtained by HI (hemagglutination inhibition) and ELISA techniques, respectively, using commercially available diagnostic kits (BioChek, Gouda, the Netherlands) (Rehman *et al.,* 2017).

Statistical analysis: The data were analyzed according to CRD by one-way ANOVA with the help of Statistical Analysis System (SAS Institute Inc., Cary, NC, 2002-2003). Duncan's Multiple Range (DMR) test was applied to separate treatment means at 5% probability level.

RESULTS AND DISCUSSION

Proximate composition of compost: Proximate analysis and amino acid composition of the compost is given in Khan *et al.* (2019). In brief, the finished compost contained 15.40% CP, 6.54% calcium, 2426 kcal/kg gross energy, 1940 kcal/kg metabolizable energy, and undetectable levels of *Salmonella* and *E. coli*. The undetectable levels of *Salmonella* and *E. coli* in the finished compost may be the result of subjecting organic

waste into two heating cycles as reported by some other studies as well (Das *et al.,* 2002; Berge *et al.,* 2009; Vinodkumar *et al.,* 2014). Similarly, gradual decline in CP content was likely related to the microbial degradation and mineralization of organic matter during composting process.

Growth performance and carcass characteristics: Data on live performance are shown in Table 5. No significant differences in FI, LWG, FE, and mortality were detected across treatments (P>0.05). Compost was added at four different concentrations i.e. 0, 2.5%, 5%, 7.5%, and 10%. Comparable results (P>0.05) of compost addition up to 10% in the diet with that of the control indicate that poultry byproducts compost used in this study was safe and did not negatively impact birds' health and performance. As mentioned above, compost was prepared by subjecting the organic waste into two heating cycles, which might have reduced pathogenic bacterial counts in the end product, making the end product safe for broiler consumption. Endorsing the current findings, a recent study by Khan *et al.* (2019) also concluded that the addition of compost up to 10% in laying hens diet did not negatively affect hens' health and performance. However, there is evidence that contaminated diet may lower birds live performance (Wang and Hogan, 2019). The lack of any significant difference in feed consumption, LWG, and FE among the birds fed compost at different levels may be linked to the relatively similar chemical composition and physical form of the diets. Similar to these findings, Christmas *et al.* (1996) observed no differences (P>0.05) in the performance of broiler chickens when spent hen meal (SHM) was included at the 12% level into broiler diets. Escalona and Pesti (1987) reported that poultry by-product meal (PBM) and hatchery waste can be incorporated into broiler diet up to 5% without affecting (P>0.05) growth performance. Mendonca and Jensen (1989) found that broilers fed a diet containing 100 g/kg PBM had similar (P>0.05) weight gain, feed utilization, and feed conversion ratio to those fed a maize- soybean control diet, suggesting that various poultry by-product meals, such as feather meal (Ochetim, 1993), feather and blood meal (Xavier *et al.,* 2011), feather and viscera meal (Klemesrud *et al.,* 1997), SHM (Kersey and Waldroup, 1998), and hatchery waste meal (Abiola *et al.,* 2012), can be utilized in broiler rations with no effect on growth performance. Furthermore, improved (P<0.05) growth performance due to the inclusion of animal origin by-products in the diets of broiler has also been reported (Laboissiere, 2008).

The effects of different compost inclusion levels on carcass traits are shown in Table 6. Increase in compost inclusion level (10%) caused a significant decrease (P=0.028) in abdominal fat content when compared with the control and 2.5% compost diet. However, carcass yield and relative weights of breast, thigh, wing, liver, gizzard, and heart were not affected (P>0.05) by the level compost supplement included in the diet. Carcasses with low abdominal fat values are associated with better meat quality (Azizi-Shotorkhoft *et al.,* 2015). Reasons for decreased fat percentages in the birds fed a diet containing 10% compost compared to those fed control diet could not be readily ascertained. However, it can be speculated that reduced abdominal fat values in birds fed compost at 10% level in the diet may be a result of increased lipogenesis, greater nutrient digestibility, or a combination of these factors. The similar carcass yield and breast, thigh, wing, liver, gizzard, and heart relative weights among the birds fed compost at any level are likely due to the similar feed consumption and weight gain. In line with these results, Shahriar *et al.* (2008) reported lower abdominal fat content in carcasses of broilers fed diets containing hatchery waste. Talib and Ahmed (2008) reported a trend of decreasing fat percent in carcasses of bulls fed rations containing poultry litter. Kersey and Waldroup (1998) found that including SHM in broiler diets did not significantly affect carcass characteristics, such as carcass yield, leg quarter yield, breast meat yield, wing yield, or abdominal fat, when compared to the control diet. Hossain *et al.* (2003) fed broiler chickens rations containing 0, 4, and 8% broiler offal, all of them iso-caloric and iso-nitrogenous. No marked differences were observed in carcass characteristics (P>0.05) between diets. Shahriar *et al.* (2008) fed male broiler chicks diets containing 0, 2, 4, 6, and 8% processed hatchery waste for a period of 7-56 days. No differences in carcass yield values (P>0.05) were observed among birds fed the different diets. Similarly, Ochetim (1993) included processed feather meal in broiler diets, and observed no significant differences in dressing percentages. Abiola *et al.* (2012) concluded that 10% of fish meal can be replaced with whole hatchery waste meal in broiler diets without detrimental effects on carcass characteristics.

Serum biochemistry and immune response: Serum biochemistry is a good indicator of health status of birds (Kamal *et al.,* 2007). Season, nutrition, trauma, stress level, behavioral activities, general management, and physiological status of the birds are non-genetic factors influencing serum biochemistry (Etim *et al.,* 2014). Data on serum biochemical indices are presented in Table 7. The results indicated that total protein, albumin, globulin, glucose, cholesterol, triglyceride, and uric acid were not significantly different across treatments (P>0.05). These results suggested that feeding diets with different compost levels produced no adverse effects (P>0.05) on the blood biochemistry as all blood profile data of birds obtained in the various treatment groups were within the normal range, indicating that compost, when properly balanced with other ingredients, can be utilized in broiler

diet up to the level of 10% without any detrimental effects on blood metabolites. Among the blood parameters, serum albumin, total protein, and uric acid have commonly been used as indicators of nutritional deficiency in chickens, and the blood glucose, cholesterol, and triglyceride are used as stress indicators in birds (Yilmaz Dikmen *et al.,* 2016). The lack of any differences in blood parameters among all treatment groups implied that birds did not face any kind of nutritional deficiency or nutritional stress. Little information exists showing the effect of feeding poultry waste on serum biochemistry in broilers. Shahriar *et al.* (2008) fed broiler chicks (male) rations containing 0, 2, 4, 6, and 8% processed hatchery waste for a period of 7-56 days. Their results indicated that triglyceride and cholesterol values were not different (P>0.05) between the birds fed the different diets at 35 day of age, but glucose value of serum significantly increased with the increase in inclusion rate of hatchery waste.

The purpose of the immune system is to defend against diseases. Determination of immune responses against specific antigens is an important tool to assess the general health condition of animals. Immune antibody response for the entire study period suggested comparable antibody titers against NDV and IBV for birds fed compost with the control birds (Table 8). The nature of an optimal immune response is influenced by several factors, such as nutritional status, environment, age, genetics, and infectious status of the bird (Kogut, 2009). The effect of diet on immune response is of utmost importance (Kogut, 2009). There is evidence that inadequate diet may lower immunity and decrease immune antibody response (Faluyi *et al.,* 2015). In the present study, feeding compost, however, produced no detrimental effects on the bird's immune reaction as seen by the normal values of antibody titers against ND and IB vaccines in all treatment groups. The results of previous studies suggest that birds' growth performance and stimulation of immune system are negatively correlated (Klasing, 2004); however, the current data indicate that feeding compost not only maintained optimum growth performance, but did not impact the bird's ability to recognize and react to foreign antigens. These results, therefore, suggest that the diet irrespective of the compost inclusion level is adequate and can provide nutritive benefits without any adverse effects on immune system.

Table 1. Ingredient composition of experimental diets for starter phase.

Ingredient (%)	Treatment[1]				
	T1	T2	T3	T4	T5
Corn	52.00	52.00	52.00	52.00	52.00
Rice tips	4.90	3.35	2.25	1.25	0.00
Canola Meal 36 %	4.10	2.10	1.20	0.50	0.00
Corn Gluten 60 %	2.00	2.00	2.00	2.00	2.00
Soybean Meal 44%	30.00	31.0	31.00	31.00	31.00
Canola oil	2.00	2.20	2.20	2.20	2.20
$CaCO_3$	1.20	1.00	.50	0.00	0.00
$DCP.2H_2O$	2.20	2.20	2.20	2.20	2.20
Lysine-SO_4	0.60	0.60	0.60	0.60	0.60
DL-Methionine	0.15	0.15	0.15	0.15	0.15
Threonine	0.10	0.10	0.10	0.10	0.10
Sodium chloride	0.20	0.20	0.20	0.20	0.20
Sodium bicarbonate	0.10	0.10	0.10	0.00	0.00
Vitamin premix[2]	0.20	0.20	0.20	0.20	0.20
Minerals premix[3]	0.30	0.30	0.30	0.30	0.30
Compost	0.00	2.50	5.00	7.50	10.00

[1]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

[2]Provided per kg of diet: vitamin A, 11,000 IU; vitamin D_3, 2,560 IU; vitamin E, 44 IU; vitamin K, 4.2 mg; riboflavin, 8.5 mg; niacin, 48.5 mg; thiamine, 3.5 mg; d-pantothenic, 27 mg; choline, 150 mg; vitamin B_{12}, 33 µg.

[3]Provided per kg of diet: copper, 8 mg; zinc, 75 mg; manganese, 55 mg; iodine, 0.35 mg; selenium, 0.15 mg.

Table 2. Nutrient composition of experimental diets for starter phase[1].

Nutrient	Treatment[2]				
	T1	T2	T3	T4	T5
Dry Matter (%)	88.78	88.82	88.84	88.87	88.87
Metabolizable Energy (kcal/kg)	2900	2900	2900	2900	2900
Crude Protein (%)	21.0	21.0	21.0	21.0	21.0
Ether Extract (%)	4.58	4.60	4.62	4.62	4.63
Ash (%)	6.80	6.81	6.83	6.81	6.81
Crude Fiber (%)	3.95	4.00	4.05	4.04	4.15
Calcium (%)	1.04	1.05	1.04	1.05	1.05
Phytic Phosphorus (%)	0.82	0.83	0.82	0.83	0.84
Sodium (%)	0.19	0.19	0.20	0.20	0.20
Potassium (%)	0.91	0.91	0.92	0.94	0.96
Chloride (%)	0.17	0.17	0.17	0.17	0.16
Lysine (%)	1.38	1.38	1.37	1.36	1.36
Methionine (%)	0.50	0.50	0.50	0.50	0.50
Threonine (%)	0.89	0.89	0.88	0.88	0.88
Cystine (%)	0.37	0.37	0.36	0.36	0.35
Methionine+Cystine (%)	0.87	0.87	0.86	0.86	0.85
Arginine (%)	1.39	1.39	1.38	1.37	1.37
Valine (%)	1.00	1.00	1.00	1.00	1.00
Isoleucine (%)	0.89	0.89	0.89	0.89	0.88
Leucine (%)	1.90	1.90	1.90	1.90	1.90
Histidine (%)	0.57	0.57	0.57	0.56	0.56
Phenyl alanine (%)	1.06	1.06	1.06	1.05	1.05
Linoleic Acid (%)	1.55	1.56	1.56	1.55	1.55

[1]Diets were formulated on total amino acid basis (TAA).
[2]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 3. Ingredient composition of experimental diets for finisher phase.

Ingredient (%)	Treatment[1]				
	T1	T2	T3	T4	T5
Corn	57.00	57.00	57.00	57.00	57.00
Rice tips	5.34	4.20	3.50	2.20	0.00
Canola meal 36 %	5.00	2.00	0.80	0.00	0.00
Corn gluten 60 %	2.00	2.00	2.00	3.00	3.00
Soybean meal 44 %	22.00	24.00	24.00	22.90	22.30
Canola oil	4.20	4.15	4.15	4.15	4.45
$CaCO_3$	0.90	0.70	0.20	0.00	0.00
$DCP.2H_2O$	2.10	2.10	2.10	2.10	2.10
Lysine-SO_4	0.40	0.40	0.40	0.40	0.40
DL-Methionine	0.12	0.12	0.12	0.12	0.12
Threonine	0.04	0.04	0.04	0.04	0.04
Sodium chloride	0.30	0.20	0.20	0.13	0.10
Sodium bicarbonate	0.10	0.10	0.00	0.00	0.00
Vitamin premix[2]	0.20	0.20	0.20	0.20	0.20
Minerals premix[3]	0.30	0.30	0.30	0.30	0.30
Compost	0.00	2.50	5.00	7.50	10.00

[1]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.
[2]Provided per kg of diet: vitamin A, 11,000 IU; vitamin D_3, 2,560 IU; vitamin E, 44 IU; vitamin K, 4.2 mg; riboflavin, 8.5 mg; niacin, 48.5 mg; thiamine, 3.5 mg; d-pantothenic, 27 mg; choline, 150 mg; vitamin B_{12}, 33 µg.
[3]Provided per kg of diet: copper, 8 mg; zinc, 75 mg; manganese, 55 mg; iodine, 0.35 mg; selenium, 0.15 mg.

Table 4: Nutrient composition of experimental diets for finisher phase[1].

Nutrient	Treatment[2]				
	T1	T2	T3	T4	T5
Dry matter (%)	88.80	88.83	88.85	88.87	88.92
Metabolizable energy (kcal/kg)	3100	3100	3100	3100	3100
Crude protein (%)	18.0	18.0	18.0	18.0	18.0
Ether extract (%)	6.90	6.88	6.88	6.89	6.89
Ash (%)	6.00	6.00	6.05	6.00	6.00
Crude fiber (%)	3.61	3.61	3.62	3.64	3.66
Calcium (%)	0.90	0.90	0.90	0.91	0.91
Total phosphorus (%)	0.77	0.78	0.78	0.80	0.83
Sodium (%)	0.20	0.20	0.20	0.20	0.21
Potassium (%)	0.78	0.78	0.81	0.81	0.83
Chloride (%)	0.23	0.21	0.21	0.20	0.19
Lysine (%)	1.09	1.09	1.09	1.09	1.09
Methionine (%)	0.44	0.44	0.44	0.44	0.44
Threonine (%)	0.73	0.72	0.71	0.71	0.71
Cystine (%)	0.33	0.32	0.32	0.31	0.31
Methionine+Cystine (%)	0.77	0.76	0.76	0.75	0.75
Arginine (%)	1.15	1.15	1.14	1.14	1.12
Valine (%)	0.87	0.87	0.87	0.86	0.86
Isoleucine (%)	0.75	0.75	0.75	0.75	0.74
Leucine (%)	1.70	1.70	1.68	1.72	1.69
Histidine (%)	0.50	0.49	0.49	0.48	0.48
Phenylalanine (%)	0.91	0.92	0.91	0.91	0.90
Linoleic acid (%)	2.02	2.01	2.00	2.00	2.03

[1]Diets were formulated on total amino acid basis (TAA).
[2]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 5. Effect of including compost in the diet on live performance and economics of broiler chickens[1].

Treatment[3]	Parameters[2]				
	CFI (g/bird)	LWG (g/bird)	FE (g/g)	MT (%)	FC (PKR)
T1	3573.00	2177.40	0.61	3.33	72.21[a]
T2	3581.00	2169.00	0.60	3.33	66.05[b]
T3	3571.00	2166.40	0.61	3.33	63.64[c]
T4	3582.00	2154.20	0.60	6.67	59.88[d]
T5	3566.00	2141.40	0.60	3.33	56.64[e]
SEM	19.30	13.86	0.001	1.45	1.10
P-value	0.999	0.947	0.197	0.945	0.0001

[a-e] Treatment means within a column bearing the different letters are significantly different (P<0.05).
[1]Data are means ± SEM representing 6 replicates (n=6) with 10 birds per replicate.
[2]CFI: cumulative feed intake, LWG: live weight gain, FE: feed efficiency, MT: mortality, FC: feed cost per kg weight gain, PKR: Pakistani rupee.
[3]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 6. Effect of including compost in the diet on carcass characteristics of broiler chickens[1].

Treatment[3]	Parameters[2]							
	CY (%)	BR (%)	TH (%)	W (%)	L (%)	G (%)	H (%)	ABF (%)
T1	67.93	25.48	21.55	8.03	2.31	1.79	0.46	0.89[a]
T2	68.15	25.03	21.30	8.04	2.30	1.81	0.45	0.87[a]

T3	66.55	24.96	20.76	7.99	2.29	1.78	0.44	0.84[a,b]
T4	67.08	23.79	20.66	7.86	2.28	1.75	0.44	0.83[a,b]
T5	66.32	23.83	20.65	7.80	2.27	1.78	0.43	0.77[b]
SEM	0.36	0.33	0.34	0.04	0.007	0.01	0.005	0.01
P-value	0.427	0.386	0.900	0.293	0.448	0.386	0.606	0.028

[a-b] Treatment means within a column bearing the different letters are significantly different (P<0.05).
[1]Data are means ± SEM representing 6 replicates (n=6) with 10 birds per replicate.
[2]CY: carcass yield, BR: breast, TH: thigh, W: wing, L: liver, G: gizzard, H: heart, ABF: abdominal fat.
[3]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 7. Effect of including compost in the diet on serum biochemistry of broiler chickens[1].

Treatment[3]	Parameters[2]						
	TP (g/dL)	AB (g/dL)	GB (g/dL)	GL (mg/dL)	CH (mg/dL)	TR (mg/dL)	UA (g/dL)
T1	4.11	2.20	1.51	133.83	162.42	91.57	3.98
T2	4.12	2.20	1.50	133.02	161.75	90.89	4.01
T3	4.07	2.18	1.48	132.42	159.86	89.76	3.95
T4	4.05	2.15	1.45	129.87	156.71	87.58	3.91
T5	4.04	2.15	1.44	129.90	154.92	87.48	3.87
SEM	0.01	0.008	0.01	0.78	1.25	0.74	0.02
P-value	0.145	0.100	0.132	0.381	0.261	0.277	0.338

[1]Data are means ± SEM representing 6 replicates (n=6) with 10 birds per replicate.
[2]TP: total protein, AB: albumin, GB: globulin, GL: glucose, CH: cholesterol, TR: triglyceride, UA: uric acid.
[3]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Table 8. Effect of including compost in the diet on immune antibody response of broiler chickens[1].

Treatment[3]	Antibody titer[2]	
	ND (HI titer, log_2)	IB (ELISA titer)
T1	4.27	3524.92
T2	4.25	3506.43
T3	4.25	3484.78
T4	4.18	3392.77
T5	4.16	3413.38
SEM	0.06	29.06
P-value	0.974	0.556

Treatment means within a column bearing the same letter are not significantly different (P>0.05).
[1]Data are means ± SEM representing 6 replicates (n=6) with 10 birds per replicate.
[2]Birds were vaccinated via drinking water using commercially available ND (La Sota) and IB (H 120) vaccines, one week before blood samples were taken.
[3]T1: diet containing 0% compost (control), T2: diet containing 2.5% compost, T3: diet containing 5% compost, T4: diet containing 7.5% compost, T5: diet containing 10% compost.

Conclusions: Results of the present study indicate that compost can be utilized in diets for broiler chickens at up to 10% inclusion level without compromising performance traits, blood biochemistry, and immune response. The use of such poultry house byproducts compost as a feed resource may reduce feed cost and improve overall profitability of broiler production, further we may put it in the list of non-conventional feed ingredients for use under severe scarcity of certain poultry feed ingredients.

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