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Effect of Vitamin E Supplementation in Diet Containing Herbal Mixture on Performance and Carcass Quality of Broiler Chickens

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ABSTRACT

The present study was conducted to evaluate the effect of vitamin E supplementation in diet containing herbal mixture on performance, meat quality, hematological status and fat deposition of broiler chickens. Eighty 15-day-old female broilers were distributed into 2 treatment groups with 4 replications (10 female broilers of each replication) as follows. Feed with FSBL plus 1 g of turmeric and 2 g garlic (P1) and Feed of P1 plus vitamin E (P2). Vitamin E supplementation had no effect on performance, carcass weight, meat bone ratio, drip loss and cooking loss, gizzard, spleen, proventriculus, gallbladder, heart, caecum, intestine, fat depot in abdomen, sartorial, neck, heart, proventriculus, and liver as expressed by fatty liver score, blood triglyceride, cholesterol, LDL and HDL concentrations, moisture, and fat and ash contents of meats. However, it reduced liver weight, toxicity score, gizzard fat depot and meat protein. In conclusion, vitamin E supplementation in diet containing herbal mixture reduced meat protein, toxicity score, and gizzard fat depot.

Key words: vitamin E, performance, meat quality, broilers

ABSTRAK

Penelitian ini dilakukan untuk mengevaluasi pengaruh suplementasi vitamin E pada pakan yang mengandung herbal terhadap performa, kualitas daging, status hematologi dan akumulasi lemak pada ayam broiler. Sebanyak 80 ekor ayam broiler betina umur 15 hari dibagi menjadi 2 kelompok perlakuan dengan 4 ulangan (10 ekor betina setiap ulangan) sebagai berikut. Pakan dengan katuk-salam fermentasi plus 1 g kunyit dan 2 g bawang putih (P1) dan; Pakan P1 ditambah vitamin E (P2). Suplementasi vitamin E tidak berpengaruh terhadap performa, bobot karkas, rasio daging dan tulang, *drip loss* dan susut masak, *gizzard*, limfa, proventrikulus, kantong empedu, jantung, sekum, usus, depot lemak di perut, paha, leher, jantung, proventrikulus, dan hati yang ditunjukkan oleh skor perlemakan hati, trigliserida darah, kolesterol, kadar LDL dan HDL, kadar air, serta kandungan lemak dan abu daging. Namun, penambahan vitamin E menurunkan berat hati, skor toksisitas, depot lemak pada *gizzard*, dan kadar protein daging. Kesimpulannya, suplementasi vitamin E di dalam pakan yang mengandung herbal menurunkan protein daging, skor toksisitas, dan depot lemak *gizzard*..

Kata kunci: vitamin E, performa, kualitas daging, ayam broiler

INTRODUCTION

Indonesia is a tropical area where temperatures range between 18°C-38°C. High temperatures can cause stress due to heat. Broilers that are exposed to heat stress will result in suboptimal performance and carcass quality. Heat stress stimulates the release of corticosterone and catecholamines and initiates lipid peroxidation in cell membranes (Freeman and Crapo, 1982), including membranes of T and B lymphocytes.

Santoso *et al.* (2020) reported that herbal mixture supplementation was less able to improve performance and carcass quality in broilers raised in tropical areas, which are basically high temperatures, and cause heat stress. Therefore, it is necessary to add other ingredients that can improve the performance and carcass quality. One of the potential ingredients is vitamin E. Dalolio *et al.* (2015) concluded that vitamin E could decrease the undesirable effects of exposure of broilers to high temparatures. Vitamin E plays a role in protecting cell membranes against lipid peroxidation and its deficiency causes reduction on survival index, deformations in erythrocyte membranes, high in vitro hemolysis, loss of appetite, low feed conversion efficiency, muscular dystrophy and shortening of the opercula (Chien *et al*., 1999; Garcia *et al.,* 2007; Hamre *et al.,* 1997; Sau *et al*., 2004; Tocher *et al.*, 2002), increased α-tocopherol contents of breast and thigh muscles, reduced drip loss and improved

tenderness (Zhao *et al.,* 2013), lower saturated fatty acids and greater polyunsaturated fatty acids proportions in breast muscle than control (Li *et al.*, 2009), reduced meat fat content (Rusmana *et al.*, 2008).

The herbal mixture in this study was rich in antioxidants, while vitamin E was also an antioxidant. The problem is that when feed ingredients that are rich in antioxidants are mixed, there will be interactions of antioxidant compounds, both positive or negative interactions. There has been no research on the addition of vitamin E to herbal mixtures and its effect on performance and carcass quality in broilers. It was hypothesize that vitamin E inclusion to the diet containing herbal mixture improve performance and carcass quality. Therefore, the objective of this study was to analyze the effect of vitamin E to the diet containing herbal mixture on performance, meat quality and fat deposition in broiler chickens.

METERIALS AND METHODS

Fermentation of Herbal Mixture

Herbal mixture consisted of turmeric, garlic, *Sauropus androgynus* and bay leaves. *Sauropus androgynus* and bay leaves were fermented to decrease antinutrients (Cui *et al.*, 2012) and crude fiber, and to increases nutritive value (Cui *et al.*, 2012) and nutrient digestibility (Salem *et al.*, 2015). Fermentation was carried out using the method of Santoso *et al.* (2015) using cassava yeast.

Animals and Diets

The experiment was done at Livestock Experiment Unit, Faculty of Agriculture, Bengkulu University. The house, brooder guards, feeders and waterers were cleaned before arriving the chicken. Two hundred broiler chickens aged one day were placed into the brooder and reared with a good hygienic condition. Brooder temperature was maintained at 32-33^{o}C in the first week and was gradually reduced in the second week, and in the third week, the temperature of the brooder was under the temperature of the enclosure environment Newly arrived broilers were given coconut sugar containing water to eliminate stress due to travel. At 4 and 21 days, broilers were vaccinated with ND. At the age of 1-14 days, broilers were given a commercial diet. Broilers spent 14 days of the brooding period.

At the age of 15 days, 80 female broilers were selected, and distributed into experimental plots and given experimental diet up to the age of 35 days. The composition of experimental diets are presented in Table 1. Turmeric supplementation at 1 g/kg (Samarasinghe *et al.*, 2003) was able to increase body weight and reduce fat deposition in broilers so that this level was used in this study.

Table 1. Composition of experimental diets

Feedstuffs (g/kg)	P1	P2
Yellow corn	579.5	579.44
Rice bran	40	40
Broiler concentrate	332	332
Fish oil	15	15
Mineral mixture	17	17
Salt	1	1
Fermented *Sauroups androgunus* leaves	3.125	3.125
Fermented bay leaves	9.375	9.375
Turmeric powder	1	1
Garlic powder	2	2
Vitamin E, mg/kg	0	60
Total	100	100

This study compared mean values between two groups. Experimental units were completely randomized. We compared the broiler groups which were fed a diet with FSBL plus 1 g of turmeric and 2 g garlic (P1) with the broiler groups which were fed a diet of P1 plus vitamin E (P2). Each group contained 4 replicates of 10 broilers each. Broilers were given diet and drinking water *ad libitum*. Broilers were kept in a 1 x 1 x 0.7 m bamboo enclosure on a rice husk base of 5 cm thickness for 21 days.

Sampling

At 35 days of age, 4 female broilers for each group were slaughtered. The accumulation of fat in the abdomen, gizzard, leg meats, heart, and neck were taken and weighed. To measure fatty liver scores, the colors of the broiler livers were compared with the standard colors from 1 to 5 (from dark brown (value 1) to yellowish-white (value 5). The higher the value, the higher the fat content. The broiler thigh meats were taken, milled and frozen before analysis.

DSM broiler fan was used to measure carcass color. Twenty semi-trained sensory panelists were asked to compare the relative

palatability of taste, odor, and texture of meats from grades 1 through 5. The meat color was assessed by comparing the color of the breast meat with the standard ID-DLO reference scale of 1-5. The meat odor was judged from very fishy (score 1) to not fishy (score 5). The meat taste was measured according to the method of Santoso *et al*. (2018). Texture test was done by biting boiled meat using the teeth, and scored from 1 (not soft) to 5 (very soft). Fat content was analyzed by Soxhlet extraction; moisture content was analyzed by drying the samples at 105^{o}C, and protein content was analyzed using macro kjeldahl (AOAC, 1990).

The results were analyzed using t test except for fatty liver score, carcass color, meat color and organoleptic status, which were qualitatively analyzed.

RESULTS AND DISCUSSIONS

Performance and Carcass quality

The effect of vitamin E supplementation on performance, carcass quality and organoleptic properties are presented in Table 2. Vitamin E supplementation had no effect on body weight, body weight gain, feed intake, feed conversion ratio, carcass weight, meat bone ratio, drip loss and cooking loss (P>0.05). Based on descriptive analysis, vitamin E supplementation did not change meat color, carcass color, meat odor, meat taste, and meat texture.

The inclusion of vitamin E in the present study was 60 mg/kg. This level did not reduce feed intake. To reduce feed intake, vitamin E might have to be included at 500 mg, as Garcia *et al.* (2011) reported that 500 mg vitamin E/kg inclusion reduced feed intake of fish. Pompeu *et al.* (2018) using meta-analysis showed that vitamin E inclusion did not increase body weght of broiler. Lin and Chang (2006) also reported that adding vitamin E at 40-120 mg/kg did significantly not increase body weight of broiler breeder.

Tugiyanti *et al.* (2014) reported that vitamin E supplementation at 600 mg/kg reduced cooking loss, thiobarbituric acid reactive substances (TBARS) and myoglobin content of Muscovy duck meat. Zhang *et al.* (2013) reported that vitamin E inclusion at 200 mg/kg reduced cooking loss and shear force, and improved meat colour in broiler chickens. Cheng *et al.* (2016) reported that the inclusion of vitamin E at 20 IU/kg or 13.34 mg/kg did not reduce cooking loss and drip loss but improved redness of broiler meats. In comparison with Zhang *et al.* (2013), Cheng *et al.* (2016), and the present study, it might need vitamin E inclusion above 60 mg, for example 200 mg/kg to reduce cooking loss. Zhao *et al.* (2013) who reported that vitamin E supplementation of male 'Tan' sheep lambs significantly reduced drip loss. Furthermore, O'neill *et al.* (1998) and Lu *et al.* (2014) reported that supplementation of vitamin E at 200 mg/kg reduced drip loss of broiler meats. Thus, spesies and vitamin E level might be the factors influencing drip loss. In addition, drip loss is influenced by storage time, environmental humidity, and meat pH (Berri *et al.,* 2008). They found that an increase in meat pH reduced drip loss of broiler meats.

Table 2. Effect of vitamin E supplementation on performance and carcass quality

Variables	P1	P2	P
Body weight, kg/bird	1386.3±69.1	1416.2±29.1	0.458
Body weight gain, kg/bird	971.3±78.7	977.2±26.0	0.934
Feed intake, kg/bird	1878.6±129.7	1858.1±116.4	0.821
Feed conversion ratio	1.94±0.09	1.90±0.08	0.763
Carcass weight, %	70.22±0.49	69.00±1.20	0.114
Meat bone ratio	6.08±0.20	6.45±0.33	0.109
Cooking loss	36.89±1.00	36.13±0.99	0.320
Drip loos	6.44±1.76	6.13±1.91	0.821
Carcass color	103±0.71	102.63±0.48	
Taste	3.01±0.23	3.16±0.25	
Odor	2.90±0.26	3.14±0.14	
Texture	3.11±0.03	3.11±0.27	
Meat color	3.12±0.48	3.12±0.60	

Feed with FSBL plus 1 g turmeric, 2 g garlic (P1); P1 plus vitamin (P2).

Internal Organ Weights

Effect of vitamin E supplementation on relative internal organ weight of female broiler chickens and toxicity score are presented in Table 3. Experimental results show that vitamin E supplementation had no effect on gizzard, spleen, proventriculus, gallbladder, heart, caecum, intestine, but it reduced liver weight and toxicity score ($P<0.05$). The reduced number of toxicity score indicates a decrease in toxic compounds in the body so that the liver works lighter in detoxification efforts. This causes the liver to lose weight.

Fat Deposition and Blood Lipid Profiles

Effect of vitamin E supplementation on fat deposition and lipid blood concentration are presented in Table 4. Experimental results shows that vitamin E supplementation had no effect on fat depot of abdomen, sartorial, neck, heart, proventriculus, and liver as expressed by fatty liver score ($P>0.05$ but it significantly reduced gizzard fat deposition. It also did not change blood triglyceride, cholesterol, LDL and HDL concentration ($P>0.05$).

Table 3. Effect of vitamin E on internal organ weights

Variables	P1	P2	P
Liver, %	2.03±0.08[b]	1.89±0.04[a]	0.022
Spleen, %	0.096±0.021	0.086±0.017	0.502
Proventriculus, %	0.360±0.044	0.377±0.043	0.590
Gizzard, %	1.64±0.10	1.76±0.13	0.195
Gallbladder, %	0.103±0.015	0.093±0.017	0.119
Heart, %	0.259±0.024	0.274±0.016	0.336
Intestine, %	3.02±0.06	3.13±0.24	0.404
Caecum, %	0.740±0.105	0.626±0.141	0.239
Intestine length, cm/100 g BW	15.00±0.73	14.99±1.16	0.986
Toxicity, %	2.12±0.06	1.98±0.05	0.009

Feed with FSBL plus 1 g turmeric, 2 g garlic (P1); P1 plus vitamin E (P2).

Table 4. Effect of vitamin E supplementation on fat deposition and blood lipid

Variables	P1	P2	P
Neck	0.098±0.028	0.092±0.022	0.747
Heart	0.09±0.02	0.11±0.01	0.080
Proventriculus	0.101±0.015	0.112±0.016	0.365
Gizzard	0.39±0.04[b]	0.24±0.07[a]	0.007
Sartorial	0.25±0.08	0.23±0.04	0.551
Abdomen	0.75±0.05	0.76±0.11	0.865
Total fat deposition	1.68±0.12	1.53±0.17	0.209
Fatty liver score	1.88±0.63	1.56±0.66	0,518
Triglyceride	40.25±6.60	42.50±6.46	0.643
Cholesterol	98.00±10.10	92.50±5.45	0.375
HDL	80.00±8.89	75.50±10.80	0.945
LDL	18.50±7.93	17.00±5.45	0.588

Feed with FSBL plus 1 g turmeric, 2 g garlic (P1); P1 plus vitamin E (P2).

The mechanism of the reduction of gizzard fat depot by vitamin E is unkown. Zhao *et al.* (2013) reported that the inclusion of vitamin E reduced subcutaneous fat deposition in sheep. The reduction effect of vitamin E on fat deposition might be due to vitamin E stimulation of the immune system, which may cause lower energy or substrates availability for lipid synthesis. Rizvi *et al.* (2014) stated that vitamin E stimulates the body's defences, enhances humoral and cell immune responses and increases phagocytic functions.

The present study agrees with the observation of Choi *et al.* (2010) reported that vitamin E supplementation did not change serum cholesterol, HDL and LDL concentrations. Mensink *et al.* (1999) also reported that vitamin E inclusion did not change cholesterol, HDL, LDL and trigliceride concentrations in men.

Meat Composition

Effect of vitamin E supplementation on meat composition is presented in Table 5. Experimental results shows that vitamin E supplementation had no effect on moisture, fat and ash ($P>0.05$, but it significantly reduced protein content ($P<0.01$). It is unknown why vitamin E reduced meat protein content.

Table 5. Effect of vitamin E supplementation on meat composition

Variables, %	P1	P2	P
Fat	4.56±1.00	4.54±0.99	0.976
Moisture	74.91±1.27	75.89±0.89	0.250
Protein	19.32±0.34^{b}	18.43±0.33^{a}	0.000
Ash	1.21±0.09	1.16±0.10	0.503

Feed with FSBL plus 1 g turmeric, 2 g garlic (P1); P1 plus vitamin E (P2).

Azman *et al.* (2001) reported that the inclusion of vitamin E itself increased lean mass of rats. It is assumed that the antioxidants contained in mixed herbs may be antagonist with vitamin E. Some antioxidants could have antagonism responses. For example, when flavonoid and trolox (a water-soluble analog of vitamin E and has an antioxidant like vitamin E) were mixed, the concentration of flavonoid becomes lower resulting in lower antioxidant activity (Tavadyan and Minasyan, 2019). Lower antioxidant activity may result in higher protein oxidation that may cause a reduction of meat protein in the present study. Choi *et al.* (2010) reported that supplementation of vitamin E to feed containing garlic decreased levels of meat protein and TBARS. Furthermore, it was reported that vitamin E supplementation did not change cholesterol, HDL and LDL, but increased yellow color without changing the reddish color of the meat.

CONCLUSION

In conclusion, vitamin E supplementation reduced meat protein, liver wieght, toxicity score, and gizzard fat depot of broiler meat.

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