Research Article

Impact of Phytocee™ Supplementation on Heat Stress Condition in Broiler Chicken

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Abstract | Background and Aim: Heat stress is one of the factor that can induces oxidative stress then releasing the number of free radicals, which can damage cells and disturb the hormonal system directly affect livestock productivity. This research expected the effect of Phytocee™ on mitigating the risk induced by heat stress and its productivity of broiler chicken.**Materials and Methods:**Broiler chicken were divided to six groups (normal control, negative control, heat stress treated vitamin C 200 g/ton and 400 g/ton, heat stress treated Phytocee™ 200 g/ton and 400 g/ton). Its productivity was measured in different parameters including early – weekly - final body weight, feed consumption ratio (FCR). Each group were also evaluated through hematology and biochemical analysis. **Results:** Pyhtocee™ dose 200 g/ton of feed had higher final weight and body weight gain with lower FCR, increase the valuesof RBC, HTC, lymphocytes, HDL and lowest mortality ratesamong the groups. While, the triglycerides, cholesterol, LDL and cortisolvalues were lower compared to others group, also the data of SGPT and SGOT values were similar to normal control. **Conclusion:** The data showed that Phytocee™ 200 g/ton of feed had the best results among the groups.This study inferred that Phytocee™ 200 g/ton of feed can mitigatesthe adverse effect of heat stress and enhances the productivity of broiler chicken exposed to heat stress. Thus, the supplementation of phytocee™ preparation in broiler diet were proven to be safe.

Keywords | Broiler, Heat stress, Livestock, Phytocee™, Supplementation

Received | April 28, 2023; **Accepted** | May 20, 2023; **Published** | June 01, 2023
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Citation | Wiono AA, Wijayanti MEN, Primacitra DY, Purnawarman T, Andriyanto, Mustika AA, Fadholly A (2023). Impact of phytocee™ supplementation on heat stress condition in broiler chicken. Adv. Anim. Vet. Sci. 11(7): 1152-1158.
DOI | https://doi.org/10.17582/journal.aavs/2023/11.7.1152.1158
ISSN (Online) | 2307-8316

INTRODUCTION

Poultry is one of the fastest growing segments of agricultural sector in Indonesia today. People depend on poultry production as the source of food and livelihood. Broiler chicken is one of the animals that rapidly growth in early age. The production of chicken meat in Indonesia in 2012 to 2016 were increasing and followed by broiler chicken population increased significantly (Manju et al., 2010). High demand for this chicken mostly due to its high protein content, affordable price, also easy availability. Among many key factors, responsible for driving recent growth of the Indonesian poultry sector, the foremost is the rise in consumers demand on poultry, which is driven by both income growth and changes in process of poultry meat relative to other goods (Triawan et al., 2013). In broiler production, feed accounts for 65-70 percent of the cost of production, which is the major constraint in broiler enterprise. Therefore, every effort is directed to maintain feed quality, reducing the feed cost in order to ensure maximum conversion of feed to food of high biological value (Syahrudin et al., 2012).

Feed quality is not only one the problem for broiler. They are also sensitive to infectious diseases, weather changesand management practices. The improvement in of these issues have been main factors for this achievement. These conditions required good maintenance practices for the industry players. The practice implementation will support optimal productivity of broiler chicken (Alfian, 2015). Optimal production of broiler chicken is characterized by rapid growth and development of chicken including good health, and low mortality. The rapid growth of broiler chicken in quite short of time causes high metabolic stress (heat stress) that triggers the oxidative stresses in the body (Abidin and Khatoon, 2013). The humidity of tropical climate in Indonesia also leads the emergence of oxidative stress in the broiler chicken. Enhancement of oxidative stress can increase production of free radicals and reactive oxygen species (ROS) in the chicken body. ROS is an umbrella term for an array of derivatives of molecular oxygen that occur as a normal attribute of aerobic life.The higher amount of ROS in the body can damage cells, disrupt the hormonal system, and affect the livestock productivity (Tawfeek et al., 2014).

Administration of antioxidant is one of the effective ways to eliminate the free radicals and ROS. Antioxidantsare able to counteract free radicals and ROS by neutralizing the molecules. Interestingly, high antioxidant content products can be obtained from natural products (Parwatim et al., 2019). PhytoceeTM is a natural formulation product consisting of Emblica officinalis, Ocimum sanctum, and Withaniasomnifera. It is standardized botanical powder and helps in controlling the detrimental effect of stress caused by multiple stressors. This polyherbal formulation contains active phytochemicals like polyphenols, with anolides, and triterpenoid. Hence, phytoceeTM work as a natural defense enhancer, including endurance and optimizes cell mediated immunity (Ahiwe et al., 2019). Some of the previous study also reported that using polyherbal formulation improve the performance of animal model which challenged into a disease (Sabdoningrum et al., 2020; Hidanah et al., 2020).

This study was conducted to evaluate the effects of PhytoceeTM in resolving the heat stress condition and its productivity of broiler chicken. This research is expected to provide information the PhytoceeTM product as a supplement addition on broiler chicken feed that undergo to heat stress condition.

MATERIALS AND METHODS

Ethical approval

This study was approved by the Animal Ethics Committee of School of Veterinary Medicine and Biomedical Sciences (reference number: 013/KEH/SKE/II/2022).

Study period and location

This study was conducted from October 2023 to March 2023 at Laboratory Animal Management Unit (UPHL), School of Veterinary Medicine and Biomedical Sciences, IPB University, Bogor, West Java, Indonesia.

Preparation of housing and feeding

Housing system using colony cage with rice husk litter. The optimum temperature was maintained with brooding lamps, fiery charcoal fumes, and water sprinklers installed on the roof of the shed depending on the environmental temperature and time of the day. Feed and water were ad libitum.

Experimental animals

We use broiler as experimental animals. They were 450 day-old-chick (DOC). Shortly after entering the cage, they were given water containing 4% sugar water for two days to restore the condition of the broiler after transportation. They were acclimatized for 5 days and also vaccinated with ND1st, IBD, and ND2ndat the of 4, 11, 18 days respectively. They were reared for 35 days.

Induction of heat stress

The broilers were raised 21 days then exposed to heat stress into 32°C - 34°C. Stress induction was given for 15 days, started day 21 to 35 days. Induction was carried out using artificial heating. The temperature and humidity were monitored with a thermohygrometer.

Experimental design

The experimental groups were divided into 6 groups with 75 experimental chickens in each group. The treatment of this study was used synthetic vitamin C and PhytoceeTM. Group 1 was normal control (P0). This group were without exposure to heat stress without treatment. Group 2 was heat stress control (P1). This group were exposure to heat stress without treatment. Group 3 & 4 were vitamin C supplemented groups (P2& P3). These groups were exposure to heat stress supplemented with vitamin C 200 & 400 g/ton feed respectively. Group 5 & 6 werePhytoceeTM supplemented groups (P4& P5). These groups were exposure to heat stress supplemented with PhytoceeTM 200 & 400 g/ton feed respectively.

Additional Parameters

Three main additional parameters to evaluate the impact of

Table 1: The results of weekly weight gain in experimental chickens

Week	P0	P1	P2	P3	P4	P5
1	123.6±1.8^{b}	121.9±4^{d}	119.8±1.7^{d}	122.2±2.5^{c}	127.4±1.6^{a}	120.4±1.2c
2	302.6±10^{c}	280.3±5^{e}	318.2±5.6^{d}	325.2±2.1^{b}	328.9±6.8^{a}	319.2±5.5^{d}
3	308.7±15^{a}	270±2.5^{e}	297.2±4.6^{d}	283.6±9.1^{d}	289.1±5.3^{c}	303.1±6.4^{b}
4	261.8±11.5^{e}	279.8±4.9^{c}	268±9.1^{d}	265.1±6^{b}	309.3±5^{a}	265.2±6.7^{b}
5	223.7±12^{d}	183.7±4.4^{e}	243±9.7^{c}	220.4±16.3^{d}	265.7±17.8^{a}	250.2±21.8^{b}

Notes: different superscript on the same line showed significantly different results ($p<0.05$)

Table 2: The results of experimental chickens' productivity

Parameters	P0	P1	P2	P3	P4	P5
BW (g)	1259.5±14.7^{c}	1175±3.7^{d}	1286.1±7.8^{b}	1255.7±17.8^{c}	1359.6±20.4^{a}	1297.4±16.1^{b}
FCR	1.58±0.02^{ab}	1.65±0.03^{a}	1.58±0.04^{ab}	1.65±0.23^{a}	1.42±0.14^{b}	1.65±0.18^{a}

Notes: different superscript on the same line showed significantly different results ($p<0.05$)

Table 3: The results of hematology evaluations on experimental chicken

Before heat stress induction (day 21)						
Parameters (%)	**P0**	**P1**	**P2**	**P3**	**P4**	**P5**
RBC	2.55±0.01^{a}	2.58±0.01^{a}	2.45±0.02^{a}	2.37±0.28^{a}	2.58±0.09^{a}	2.66±0.04^{a}
HTC	33.80±0.00^{a}	33.45±0.21^{a}	31.80±0.99^{a}	30.85±2.62^{a}	33.50±1.13^{a}	33.45±0.07^{a}
HGB	14.25±0.21^{a}	14.20±0.14^{a}	13.80±0.57^{a}	13.05±1.20^{a}	14.35±0.64^{a}	14.25±0.21^{a}
WBC	9.14±0.28^{a}	9.60±0.17^{a}	9.80±0.57^{a}	8.82±0.31^{a}	9.44±0.23^{a}	9.44±0.34^{a}
LMP	73.39±1.39^{a}	71.03±2.30^{a}	71.13±2.50^{a}	71.21±0.94^{a}	75.81±3.88^{a}	73.22±3.61^{a}
MNC	3.09±0.42^{a}	3.09±1.49^{a}	2.66±1.99^{a}	4.27±3.94^{a}	3.18±1.06^{a}	2.72±0.21^{a}
HTP	23.52±0.97^{a}	22.55±0.19^{a}	23.50±3.33^{a}	22.33±3.77^{a}	17.57±2.03^{a}	21.35±3.91^{a}
EOS	0.00±0.00^{a}	3.33±1.00^{a}	2.71±3.84^{a}	2.19±1.10^{a}	2.75±3.89^{a}	2.70±1.10^{a}
BAS	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.68±0.97^{a}	0.00±0.00^{a}
H/L	0.32±0.02^{a}	0.32±0.01^{a}	0.33±0.04^{a}	0.31±0.06^{a}	0.23±0.02^{a}	0.29±0.07^{a}
After heat stress induction (day 35)						
RBC	3.30±0.32^{a}	3.15±0.22^{a}	3.39±0.24^{a}	3.23±0.51^{a}	3.56±1.0^{a}	3.08±0.29^{a}
HTC	41.20±3.21^{a}	40.34±3.20^{a}	42.48±3.22^{a}	40.88±6.46^{a}	42.58±1.24^{a}	38.62±3.95^{a}
HGB	13.58±0.38^{a}	12.92±0.71^{a}	15.52±1.12^{a}	15.04±2.72^{a}	15.38±0.69^{a}	14.48±1.69^{a}
WBC	12.3±0.69^{a}	12.5±0.26^{a}	12.5±0.35^{a}	12.5±0.41^{a}	11.90±0.60^{a}	12.3±0.66^{a}
LMP	66.12±3.35^{b}	57.21±1.68^{c}	66.73±4.50^{b}	66.55±2.06^{b}	74.47±4.02^{a}	65.53±2.07^{b}
MNC	4.67±1.26^{a}	2.51±0.85^{b}	2.34±0.43^{b}	1.77±0.57^{b}	1.92±0.54^{b}	2.24±1.46^{b}
HTP	29.01±3.15^{bc}	40.07±2.37^{a}	30.34±4.62^{b}	30.48±1.54^{b}	23.41±3.44^{c}	30.54±4.22^{b}
EOS	0.19±0.43^{a}	0.20±0.45^{a}	0.60±0.89^{a}	1.20±1.10^{a}	0.20±0.46^{a}	1.28±1.39^{a}
BAS	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.64±1.44^{a}
H/L	0.44±0.07^{bc}	0.70±0.06^{a}	0.46±0.10^{b}	0.46±0.04^{b}	0.32±0.06^{c}	0.47±0.08^{b}

Notes: different superscript on the same line showed significantly different results ($p<0.05$)

Table 4: The results of biochemical value of experimental chickens.

Parameters	P0	P1	P2	P3	P4	P5
Before stress induction (day 21)						
Trigelycerides (mg/dL)	73.0±5.66^{a}	58.5±21.9^{a}	99.0±14.10^{a}	78.0±2.86^{a}	66.0±19.8^{a}	99.0±38.2^{a}
Total cholesterol (mg/dL)	126±13.4^{a}	120.5±3.54^{a}	126.5±7.78^{a}	111.5±10.6^{ab}	83.5±2.12^{ab}	112.5±6.36^{ab}
HDL (mg/dL)	88.5±6.36^{a}	88.5±0.71^{a}	73.0±29.7^{a}	73.0±11.31^{a}	53.0±5.66^{a}	73.0±4.24^{a}
LDL (mg/dL)	33.0±4.24^{a}	24.0±1.41^{b}	21.50±0.71^{b}	26.0±0.00^{ab}	20.0±1.41^{b}	25.5±0.71^{ab}

After heat stress induction (day 35)						
Trigelycerides (mg/dL)	106±48.4 [a]	100±23.8[a]	83.8±18.46 [a]	78.40±36.7 [a]	84.60±31.1 [a]	127±38.7 [a]
Total cholesterol (mg/dL)	128±9.94 [a]	163±18.8 [a]	153±12.0 [a]	173±31.8 [a]	135±21.8[b]	162±45.6 [a]
HDL (mg/dL)	80.0±4.95 [a]	100±16.7 [a]	97.4±10.78 [a]	109±22.4 [a]	108±9.47 [a]	91.6±29 [a]
LDL (mg/dL)	34.0±4.71 [a]	41.6±5.37 [a]	41.6±8.71 [a]	46.0±12.81 [a]	33.8±4.82 [a]	46.6±17.42 [a]
Cortisol (pg/dL)	10.7±0.49[b]	12.41±0.53 [a]	10.47±0.44[b]	10.22±0.46[b]	8.83±0.42[c]	10.82±0.52[b]

Notes: different superscript on the same line showed significantly different results (p<0.05)

Table 5: The results of safety evaluation on liver and kidney

Parameters	P0	P1	P2	P3	P4	P5
Before stress induction (day 21)						
SGOT (U/L)	182.0±2.83[a]	180.5±6.36[a]	179.5±3.5[a]	171.5±14.8[a]	176.0±25.5[a]	196.0±0.00[a]
SGPT (U/L)	2.0±0.00[b]	3.5±0.71[ab]	2.50±0.71[ab]	3.0±0.00[ab]	3.5±0.71[ab]	4.0±0.00[a]
Ureum (mg/dL)	1.4±0.04[a]	1.9±0.20 [a]	2.6±0.10[a]	1.9±0.16[a]	2.3±0.73[a]	1.7±0.00[a]
Kreatinin (mg/dL)	0.3±0.05[a]	0.3±0.04[a]	0.4±0.42[a]	0.4±0.01[a]	0.37±0.01[a]	0.39±0.00[a]
After heat stress induction (day 35)						
SGOT (U/L)	246.6±30.3[a]	299.0±32.7[a]	296.8±49.4[a]	252.0±16.7[a]	247.4±19.0[a]	282.6±25.6 [a]
SGPT (U/L)	1.8±0.56[a]	2.1±0.29[a]	1.7±0.00[a]	1.6±0.37[a]	1.8±0.31[a]	1.6±0.29[a]
Ureum (mg/dL)	3.2±0.42 [a]	3.9±0.61[a]	3.6±0.72[a]	3.1±0.44[a]	3.64±1.03[a]	3.6±0.64[a]
Kreatinin (mg/dL)	0.4±0.04[b]	0.5±0.05[a]	0.4±0.06[b]	0.3±0.04[b]	0.4±0.05[b]	0.4±0.06[b]

Notes: different superscript on the same line showed significantly different results (p<0.05)

PhytoceeTM were measured. The first parameter was performance analysis including body weight (evaluated weekly), feed consumption ratio (FCR). Secondly, the blood analysis was including red blood cells count (number of red blood cells, hematocrit, hemoglobin), white blood cellsdifferentials (white blood cells count, lymphocytes, monocytes, heterophils, basophils, eosinophils), heterophils / lymphocytes ratio. The third one was serum biochemical analysis including cortisol, triglycerides, total cholesterol, high density lipoprotein (HDL), liver (SGPT, AST) and kidney (urea, creatinine) functions.

Data analysis

Each samples data from experimental chickens were analyzed with one-way ANOVA followed by turkey's multiple comparison post-hoc test using Microsoft excel and Minitab 18. P<0.05 were considered as statistically significant.

RESULTS

Body weight and productivity evaluation

The data of the experimental chicken body weightwere evaluated every week. The results of each group were significantly different (p<0.05). However, as compared to P0, the results of P4 had the highest body weight gain. The results of weekly body weight gain in experimental chickens were shown in Table-1. The final body weight of experimental animals was also evaluated in each group. The results showed that P1 compared P0 showed relatively less body weight. Both P2 and P3 compared P0 showed no significant results. Interestingly, P4 has the highest number of body weight compared to all treatment. Productivity efficiency showed that FCR values in all groups were not significantly different (p>0.05). However, when the data compared in all groups, P4 had the lowest FCR value. The results of final body weight and FCR value are shown in Table-2.

Hematology evaluation

Evaluation of the red blood count value (RBC) in all groups did not show a significant difference when the data compared to P0 (P>0.05). The highest number of RBC wasobserved in P4 group. Hemoglobin (HGB) value in all groups was within the range of 10.20 – 15.10 %; P4 had the highest number compared to all groups. Hematocrit (HTC) value did not show significant differences in all groups (p>0.05). The highest value of HTCwasobserved in P4 group, while the lowest value of HTCwasobserved in P0 group. The white blood cells (WBC) value and its differentiation in all groups before heat stress induction were not significantly different (p>0.05), however after the induction of heat stress the value of WBC increased in all groups. Lymphocytesvalue of P4 was significantly different when compared to all groups (p<0.05). P0 of monocytes and heterophiles showed significantly different (p<0.05) compared to P1 group. While, both eosinophils and basophils values did not show a significant difference (p>0.05). P1 data of heterophils and lymphocytes values showed significantly different (p<0.05) when compared to all groups.

Theresults of hematology evaluations on experimental chicken are shown in Table-3.

Blood Biochemistry Evaluation

In order to analyze the impact of PhytoceeTM in controlling heat stress, blood biochemical, some evaluation tests wereperformed.The data of triglycerides level showed that P2, P3 & P4 were relatively loweredas compared to P0& P1. In cholesterol evaluation, the data showed that P4 had lower compared to P1. The data of high-density lipoprotein (HDL) showed that P3, P4 had high value compared to all groups, while the data of low-density protein (LDL) showed P4 had low value compared in all groups. The data of cortisol value was also evaluated to heat stress control. The data showed that P4 were significantly different ($p<0.05$) compared to all groups. The results of the blood biochemical evaluation were shown in Table-4.

PhytoceeTM safety evaluation

The PhytoceeTM safety value were evaluated on liver (SGOT/ SGPT) and kidney(urea/ creatinine) function. At week 35, the data showed that SGOT value were increased in P1, P2, P3 compared to P0, while the P0 and P4 had similar value. The urea level of P4 was higher as compared to all groups, while the creatinine value was higher value in P1 compared to all groups. The analysis data of liver and kidney function were shown in Table-5.

DISCUSSION

Heat stress is defined as an imbalance the amount of heat release by the body into the environment compared to the heat generated by the body. Broiler chicken's body heat will increase as the growth progressed. Heat stress can negatively affect the body weight, FCR and mortality rates (Kieronczyk et al., 2017). The supplementation ofPhytoceeTM in feed to overcome the heat stress issue in broiler chicken were assessed from its productivity which are consist of several indicators, like body weight gain, final body weight, mortality percentage and FCR. In general, lower FCR value means the higher the efficiency of feeding (Mahanta et al., 2017). In this area, P4 group showed high final weight and body weight gain with lowFCRand mortality rates when compared to all groups. Earlier studies evidence that these conducive effects of PhytoceeTM on performance parameters of broiler through mitigation of heat stress could be ascribed to the individual herbal ingredients like Emblica officinalis, Ocimum sanctum, Withaniasomnifera present in the product (Malpotra et al., 2017). The mortality percentage was also observed to evaluate the feasibility of feed given to broiler chicken. The farms that have good management, the percentage of mortality during the maintenance does not exceed 4% (Hayajneh, 2019). The results showed that group given PhytoceeTM dose 200g/ ton feed and vitamin C dose 400 g/ton feed have the lowest mortality compared to groups, which means these supplementations were good for broiler. Over 20 days, broilersrequired an ambient temperature of 20-25 °C and humidity of 50 – 70%, and when it comes to more than 32 °C, the side effects to them might have appeared like unbalance its physiological condition. This study showed thathigher temperature can induce heat stress consequently reduce feed consumption and body weight gain ratio, increase mortality rates, reduce immune system and reduce the quality of broiler carcasses (Kumar et al., 2020).

Heat stress also affect the hematological status and create disturbances in the body's defense system. Blood component are very sensitive to environmental changes and it can be used as an indicator of changes in chicken physiology (Kathirvelan et al., 2016). The data showed that P4 has the highest value of RBC, HTC, and lymphocytes. RBC were influenced by several factors, including protein, vitamin, iron and hormone erythropoietin. Heat stress can trigger increasing corticosterone hormone which plays a role in converting protein into glucose, thus reducedthe availability of protein for the formation of reduced erythrocytes (Masoud-Moghddam et al., 2021). Hemoglobin acts as a binder of oxygen and its level are directly proportional to the number of RBC. The results showed hemoglobin values in all groups were within the normal ranges, 10.20 – 15.10 g %. The lower level of HGB in P1indicates that hemoglobin levelwas slightlyaffected by heat stress (Jing et al., 2022). Hematocrit value was evaluated the ratio the quantity of solids to the volume of total blood. These results clearly indicate that this product can overcome disorder of RBC homeostasis.Leukocyte was included on this product evaluation. It plays a role defense mechanism when there is infection like, viruses, bacteria, parasites and tumor cell proliferation. Increasing the lymphocytes percentage could be due to the active compound of PhytoceeTMproduct (Caekebe et al., 2020). Monocytes are precursors of myelocyte cells that are phagocytic, and it became macrophages when it enters the tissue. The percentage of monocytes showed that normal group have the highest value. This happens due to monocytes play a role in chronic infection (Starˇcevi´c et al., 2015). Heterophiles are components of leukocytes of poultry and amphibians. The data showed that P1 has the highest value. It indicates that heat stress increased the secretion of heterophiles, while group exposed to heat stress treated with PhytoceeTM were able to maintain heterophiles value similar to P0. Eosinophils is evaluated in parasitic infection in the body, while basophiles have role in anallergic reaction (Oian et al., 2021). The data showed that eosinophils and basophils did not show a significant different, however within the normal range. The last evaluation in hematological values was comparison of heterophile and lymphocyte ratio as a stress indicator in poultry. The higher ratio means the higher stress level in poultry. The data showed that P4 had the lowest value. It indicates that active ingredients of PyhtoceeTM play an important role in mitigating heat stress. Earlier studies also showed that the ingredientscontributed as antistress, antidepressant, antioxidant properties (Ramirez et al., 2021).

Health abnormalities in broiler can also be determined by analyzing the biochemical of blood components. The data showed that triglycerides, cholesterol and LDL level in group of broilers in P4 were relatively lower compared to others group. Decreasing triglycerides and cholesterol value occur as a result of tannin present in PhytoceeTM which have ability to act as hypolipidemic agentson the sympathetic-adrenal axis, thereby decreased the corticosterone synthesis and increased the cholesterol clearance endogenous (Salami et al., 2015; Yang et al., 2019). LDL contains high cholesterol and is easily attached to the walls of blood vessel. LDL value inferred that the PhytoceeTM does not cause deposition of cholestrol in blood (Li et al., 2019). Meanwhile, the value of HDL in P4 had higher value compare to other groups. Increasing HDL levels in the body can reduce the level of cholesterol in broiler. HDL will transport the remaining cholesterol that is not used in the blood periphery to the liver. Cortisol value in P4 also have lower number among the groups. The less cortisol value means the lower stress index of broiler (Gunya et al., 2019; Bollido, 2021).

Liver is organ that functions in detoxifying materials that enter the body. Liver function can be monitored by measuring the levels of SGPT and SGOT in serum of broiler blood. The data showed that SGPT and SGOT values in P4 were similar to P0. Higher value of these parameter showed higher stress. It indicates that PhytoceeTM was effectively in controlling heat stress and have no harmful effect on liver functions (Song et al., 2022). Otherwise, for kidney evaluation, urea and creatinine values in P1 have higher value compared to all groups. These results occur due to there were no treatment to control heat stress. Heat stress will induce a series of cascade reactions in nervous and endocrine system that stimulates releasing corticotropin hormone. Dehydrations, kidney failure, toxins, and impaired excretion urine also lead to increase these parameters (Long et al., 2020; Marimuthu et al., 2020).

To our knowledge, the current study provides new evidence of PhytoceeTM supplementation at the dose of 200 g/ton of feed can mitigate the adverse effects of heat stress and augment its productivity without the toxic effects in broiler chicken. Metabolizable of nutrient reported from these herbal supplementations was with equal competence as that of control group. Based on these finding, it is assumed that PhytoceeTM could be the choice for broiler chicken supplementation in either normal or fluctuated environmental conditions. The other polyherbal formulation for study is very abroad to explore and develop to be a supplement.

ACKNOWLEDGEMENTS

This study was supported by NATURAL REMEDIES PVT. LTD., INDIA.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

NOVELTY STATEMENT

Phytocee™ could be the choice for broiler chicken supplementation in either normal or fluctuated environmental conditions.

AUTHORS CONTRIBUTION

TP, AA, AAM designed and performed the study. TP, AA, AAM, AGW, MENW, DYP providing materials and critical reviews.AGW, MENW, DYP, AF literature search and preparation of manuscript. All authors read approved the final draft of the manuscipt.

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