ISSN 2756-4444
E-ISSN 2756-4452

RESPONSE OF BROILER BIRDS FED TUMERIC FOR HEAT STRESS ALLEVIATION

BY

Aiyelabegan A.B, Lawal, W.S & Suleiman, S.
Department of Statistics, Kwara State Polytechnic, Ilorin, Nigeria
Department of Agricultural Technology, Kwara State Polytechnic, Ilorin, Nigeria
Email: aiyelabeganadijat45@gmail.com

Abstract

One hundred and eight Ross broiler birds were used for this heat stress experiment that lasted 6 weeks, chicks were allotted to pen randomly, there were two treatments all together with a control, each treatment was replicated three times and there are twenty (20) chicks per replicate making. The chicks were raised in a metrological controlled pen where the temperature is set at 34^{0}C for period of 7hours from 10am to 5pm after brooding (22-42days). The stress was then mitigated using Tumeric herb made into powdered form and administered into at 3g and 5g per litre of water T1 and T2 respectively, making two treatments with a control experiment. At the end of the six weeks experiments, it was discovered that those chicks that took T2 treatments (5 had (g) had the highest feed intake ($P<0.05$) meaning they are relieve of stress and this makes them to feed better than others but those in control had better body weight and feed to gain ratio ($P<0.05$)

Keyword: Tumeric, Heat stress, Alleviation, oxidative stress and Reative oxygen series

Introduction

Heat stress (HS) is one of the most significant stressors in the broiler industry in hot regions. In order to provide complete information on the impact of turmeric powder (TP) on hamartiology, biochemistry and thyroid hormones of broilers under thermoneutral conditions (TN) (22 ± 4°C) and heat stress (HS) (34 ± 2° C), the present research was carried out. A 60 of one-day-old (Cobb) broiler chicks, 15 birds in each replicate either control (basal diet) or 0.5% turmeric. Chronic HS at 42 d of age resulted in significant decrease in HGB, PCV, RBCs, total protein, Albumin, serum whereas increased H/L, triglycerides, cholesterol, LDL-cholesterol, uric acid, AST, ALT, ALP, TBIL, DBIL and creatinine significantly. Supplementation of 0.5% TP significantly increased HGB, PCV, total protein, while significant decrease in AST, ALT, ALP, uric acid, total cholesterol and emperature often contributes to impaired status of antioxidants and causes poultry oxidative stress. Additionally, parameters of red blood cells (RBCs) and WBCs serve as references of animal's immune system. AL-Sultan SI (2003 In conjunction, physiological and metabolic responses such as changes in blood parameters, concentrations of plasma hormones, oxidative stress, and meat acidity have been identified a consequence of high temperature Asai et.al., (1999) . Valuable information about animal health and immune status is given in the serum biochemical profile Azad et.al., (2010). Metabolic characteristics and oxidative damage to skeletal muscle in broiler chickens expose. In broiler chicks, elevated temperature raises serum aspartate aminotransferase (AST) and alanine aminotransaminase (ALT), cholesterol, triglycerides and low-density lipoproteins (LDLC) Azad et.al., (2010). Chronic heat stress in warm-blooded animals causes various hormonal responses, including impairment of endocrine functions. Thyroid hormones are of particular concern: triiodothyronine (T3) and thyroxine (T4). Triglycerides.

The rate of growth of broiler birds is very high, this is why their metabolic system is faster to support the growth, therefore alot of heat is generated in their body and in addition to heat from environment as a result of climate change causes heat stress for birds, also, most of the birds are exotic, they are breeds that are made from temperate countries so adapting to tropical environment is a challenge. Poultry has no sweat glands and respiratory hyperventilation meant to be Poultry birds' primary mechanism of dissipating heat Tesseraud et. al., (2019). There has been growing concerns on the impacts of climate change on livestock production especially on broiler birds, in tropical countries and this includes, increased respiration rates (panting), reduced feed intake, and impaired immune responses, it exacerbates oxidative stress, causing damage to cellular structures, which further compromises the birds' health. Heat-stressed in broilers often display poor growth performance, higher morbidity, and increased mortality rates. Prolonged exposure to high temperatures can induce chronic stress, discomfort, and suffering, raising ethical concerns about poultry management practices Rahimi et al., (2020).

The problem of heat stress can be alleviated by using substance that can supply the body with antioxidant substance. Antioxidants help prevent or delay cell damage by scavenging for radicals that causes harm in the body as a result of heat stress. They can be found in many foods, including fruits and vegetables, and are also available as dietary supplements. Antioxidants are molecules that can help your body fight off harmful free radicals. Saleh (2021). Antistress or antiaging are those substance that can reduce stress especially physical stress. Anti-stress agents can improve growth performance and immune function in broilers under immune-stress conditions. They can also reduce serum adrenocorticotropic hormone (ACTH) and cortisol (CORT) levels. Herbal plants and products can improve body weight in broilers. Taiye et. al., (2019). Attempts have been made to alleviate problem of heat stress, ranging from the use of synthetic veterinary drugs (Antioxidant e.g betaine) to manipulation of poultry feed, improving ventilation by using evaporative cooling, systems but achieved some level of success because all these are often costly and not universally applicable. Nyoni et. al., (2019).

However, a method that is environmentally friendly, cheap and can solve most of the physiological problems caused by heat stress without any side effect could be employed. Hence herbal plants are considered appropriate and can be used to mitigate heat stress in broilers because of their inherent antioxidant and antistress properties, they are also abundant in environment and some are rich in vitamins and minerals. Moreover, development of drug resistance is reduced and it is cost effective with no side effect to birds. Therefore, this research work focuses on exploitation of antioxidant and antistress potentials of selected herbal plants (SHP) namely: *Adasonia digitata* (Baobab tree), *Pakia baglobosal* (Locust bean tree), *Moringa olifera*, *Tumeric* and *Tamarind* for heat stress alleviation in broiler chickens. The herbs will be administered through water in powdered form, extract and nano particles. Nano technology is concerned with the phenomenon of converting larger-size molecules to a particle as small as nano size, while converting these larger compound to smaller ones results in a modified chemical and physical properties of the base material, so as to sustain the release of the composition of the particles is taken to the targeted organ Safaei-Ghomi *et.al.,* and Sahin *et. al.,(*2018)

Heat stress in broilers represents a significant challenge in the poultry industry, impacting both animal welfare and economic productivity. As global temperatures continue to rise above 27^0C due to climate change, poultry farmers in tropical and subtropical regions face increasingly frequent and severe episodes of heat stress. Broilers, being fast-growing meat-type birds, are particularly susceptible to heat stress because of their high metabolic rates and relatively limited ability to dissipate excess heat. Consequently, heat stress can lead to a host of physiological, economic and environmental factors, posing major threats to sustainable poultry production**.** The physiological impact includes increased respiration rates (panting), reduced feed intake, and impaired immune responses, it exacerbates oxidative stress, causing damage to cellular structures, which further compromises the birds' health. Heat-stressed in broilers often display poor growth performance, higher morbidity, and increased mortality rates. Prolonged exposure to high temperatures can induce chronic stress, discomfort, and suffering, raising ethical concerns about poultry management practices**.** The economic impact includes poor feed digestion and nutrient metabolism with the resultant slower growth rates and lower feed conversion efficiency, the latter is one of the those with critical factors in broiler production profitability. Additionally, heat stress can lead to lower carcass quality, with potential decreases in meat yield and alterations in meat composition and yield. Moreover, the increased mortality rates during heat waves directly translate to financial losses for producers. This economic burden is further compounded by the additional costs incurred for cooling systems, energy consumption and veterinary care aimed at mitigating the effects of heat stress.

To alleviate low protein intake, Nworgu *et al.*,(2020) suggested that broiler production is the fastest and easiest route since they are prolific, possess a high feed conversion ratio and areaccepted by all, irrespective of religion. Poultry production is unique in that it offers the highest turn-over rate and the quickest returns to investment outlay in the livestock enterprises (Osman,2017). Broiler production gives very high promises of increasing quality and quantity of animal protein intake in Nigeria since it gives high economic value, short generative interval and fast growth rate that can result in production of broiler chicken in 8 weeks (Onu and Otuma, 2018). The authors further emphasized by (Onu and Otuma, 2018) that the most efficient and economic means of providing high quality animal protein in developing countries is through the expansion and sustenance of the poultry industry. Daghir (2019) reported that the growth experienced in poultry production cannot be compared with any other type of meat production during the past decade with increase in the rate of chicken meat averaged 5.7% per year since 1990. Ilo (2017) reported that the expansion in Nigeria commercial poultry holds a great promise to bridging the animal protein gap in the country within the shortest possible time. Poultry industry played a major role in alleviating animal protein deficiency in the last few decades throughout the world via increased availability of poultry meat and eggs (Parvez and Abdul, tetfund 2019).

Material and methods

One hundred and eighty (180) day-old male Arian broiler chicks were randomized into Feed (three times per day) and water were provided ad libitum. Birds were maintained on a photoperiod of 23:1. The corn-soybean meal basal diet (mash form) was formulated to meet or exceed the nutritional requirements of chicks from hatch to six weeks as recommended by the Arian catalog (Table 1). Dietary treatments were included the basal diet (control). A completely randomized design was used with three replicates of 20 chicks per replicate. Birds were maintained under recommended environmental temperature of Arian strain from day 22 to 42. Heat stress was applied from 10am to 5pm daily for all the birds from day 28 to 42. The daily temperature was 34°C. Data were collected and analyzed as a completely randomized design using the general linear model of SAS software (SAS Institute Inc., 2002). The statistical differences between means were analyzed by Tukey's test ($P<0.05$)

Result and Discussion

The first three week was for brooding, the result from three to six weeks is therefore presented in table 1, it was noticed that significant difference occurred in feed intake, weight gain and feed to weight gain ($P<0.05$). Feed intake was higher in the control, this is because birds are always unconfortable under heat stress and will not feed hence the feed intake of those under heat stress are lesser to those in the control ($P<0.05$). The weight gain of those in T2 and those in control are same because significant difference did not occure between the two of them, though those in T2 are under heat stress but with the help of turmeric at 5g/litrer of water they were able to attain the weight gain. The feed to weight gain was better in T1 because they could feed much because they are under heat stress. Therefore, the the inclusion level of T2 which is 5g/liter of water is recommended

Table 1. Effect of dietary turmeric powder (TP) on performance parameters of broiler chickens

Parameter	(Ctrl)	T1	T2	SEM
Heat stress (After brooding)				
Body weight (g:bird)	2080.78^{a}	1955.91^{b}	200.71^{a}	27.76
Feed intake(g:bird)	4591.1^{a}	3659.5^{b}	3668.1^{b}	96.90
FCR (g:g)	2.207	1.878	1.860	0.049

a,b,c , Row with no common superscript differ significantly ($P<0.05$).

Conclusion and Recommendation

Supplementation of turmeric powder to broiler diets as antioxidant components could improve the antioxidant status; liver function via reduction in the activity of dehydrogenases enzyme, reduction in the stressor index and abdominal fat deposition of heat stressed broilers without affecting the performance.

References

AL-Sultan SI (2003). The effect of Curcuma longa (Tumeric) on overall performance of broiler chickens. Int. J. Poult. Sci. 2(5):351-353.

Asai HP, Nakagawa K, Miyazawa T (1999). Antioxidative effects of turmeric rosemary and capsicum extracts on membrane phospholipids peroxidation and live lipid metabolism in mice. Biosci. Biotechnol. Biochem. 63:2118-2122.

Ashayerizadeh O, Dastar B, Shams Shargh M, Rahamatnejad E, Ashayerizadeh A (2009). Influence of prebiotic and two herbal additives on interior organs and hematological indices of broilers. J Anim. Vet. Adv. 8(9):1851-1855

Azad MAK, Kikusato M, Maekawa T, Shirakawa H, Toyomizu M (2010). Metabolic characteristics and oxidative damage to skeletal muscle in broiler chickens exposed to chronic heat stress. Comp. Biochem. Physiol. 155(A):401-406.

Abioye, V and Aka, M (2015). Proximate composition and sensory properties of moringa fortified maize-ogiNutr. Food Sci. (2015), [10.4172/2155-9600.S12-001](10.4172/2155-9600.S12-001)

Adhikari, P., Kiess, A., Adhikari, R., Jha, R., 2020. An approach to alternative strategies to control avian coccidiosis and necrotic enteritis. Journal of Applied Poultry Research 29, 515–534.

Al-Abdullatif, A and Azzam, M.M. (2023): Effects of Hot Arid Environments on the Production Performance, Carcass Traits, and Fatty Acids Composition of Breast Meat in Broiler Chickens. Life 13, 1239.

Arnér E.S and Holmgre*n A. (2020):Physiological functions of thioredoxin and thioredoxin reductase. Eur. J. Biochem. ;267:6102–6109. doi: 10.1046/j.1432-1327.2000.01701.x*

Chelikani P., Fita I., Loewen P.C. (2017):Diversity of structures and properties among catalases. *Cell.Mol. Life Sci.* ;61:192–208. doi: 10.1007/s00018-003-3206-5.

Dawwam, G.E., Al-Shemy, M.T., El-Demerdash, A.S., 2022. Green synthesis of cellulose nanocrystal/ZnO bio-nanocomposites exerting antibacterial activity and downregulating virulence toxigenic genes of food-poisoning bacteria. Sci. Rep. 12, 1–18

Gilgun-Sherki Y., Melamed E., Offen D.(2020) Oxidative stress induced-neurodegenerative diseases: The need for antioxidants that penetrate the blood brain barrier. Neuropharmacology.;40:959–975. doi: 10.1016/S0028-3908(01)00019-3.

Ekmekci G, Somer G and Sendil, O (2021): Simultaneous determination of copper, zinc and selenium in chicken liver by differential pulse polarography.Turkish. J. Chem., 27, pp. 347-356.

Halliwell B. (2018):*Role of free radicals in the neurodegenerative diseases. Drug.Aging;18:685–716. doi: 10.2165/00002512-200118090-00004.*

Hillyer J.F, Albrecht R.M (2019) : Gastrointestinal persorption and tissue distribution of differently sized colloidal gold nanoparticles.J. Pharm. Sci., 90 (2001), pp. 1927-1936

Mangan, M.; Siwek, M. (2023) Strategies to combat heat stress in poultry production.

VOL. 4, NO 2, DECEMBER, 2024
ISSN 2756-4444
E-ISSN 2756-4452

Mujahid A Yoshiki, Akiba Y, Toyomizu Y. M. (2017): Superoxide radical production in chicken skeletal muscle induced by acute heat stress.Poult. Sci., 84, pp. 307-314.

Nawaz, A.H., Amoah, K., Leng, Q.Y., Zheng, J.H., Zhang, W.L., Zhang, L., 2021. Poultry response to heat stress: Its physiological, metabolic, and genetic implications on meat production and quality including strategies to improve broiler production in a warming world. Front. Vet. Sci. 8, 699081 .

Nordberg J., Arner E.S.(2019*): Reactive oxygen species, antioxidants, and the mammalian thioredoxin system. Free Radic. Biol. Med. ;31:1287–1312. doi: 10.1016/S0891- 5849(01)00724-9.*

Rice M.E. (2020):*Ascorbate regulation and its neuroprotective role in the brain. Trends Neurosci.;23:209–216. doi: 10.1016/S0166-2236(99)01543-X*

Ritchie M. (2017): Neuroanatomy and physiology of the avian hypothalamic/pituitary axis: clinical aspects.Vet. Clin. North Am. Exot. Anim. Pract., 17, pp. 13-22.

Safaei-Ghomi J, Ghasemzadeh M.A., Zahedi. S. (2018): ZnO nanoparticles: a highly effective and readily recyclable catalyst for the one-pot synthesis of 1, 8-dioxo-decahydroacridine and 1, 8-dioxooctahydro-xanthene derivatives.J. Mexican Chem. Soc., 57 (2013), pp. 01-07.

Sahin K, Kucuk, O. (2018): Zinc supplementation alleviates heat stress in laying Japanese quail. J. Nutr., 133 (2003), pp. 2808-2811.

Sahin, K. Kucuk O (2022): Zinc supplementation alleviates heat stress in laying Japanese quail.J. Nutr., 133, pp. 2808-2811.

Saleh Albarrak M (2021): Antioxidant and immune responses of broiler chickens supplemented with Rhazya stricta extract in drinking water. 4;14(6):1437–1449. doi: 10.14202/vetworld.2021.1437-1449

Shaheen, A.A. and El-Fattah A.A (2015): Effect of dietary zinc on lipid peroxidation, glutathione, protein thiols levels and superoxide dismutase activity in rat tissues. Int. J. Biochem. Cell Biol., 27, pp. 89-95.

Sharma V, Singh P, Pandey A.K and Dhawan A. (2019): Induction of oxidative stress, DNA damage and apoptosis in mouse liver after sub-acute oral exposure to zinc oxide nanoparticles. Mutat. Res. Gen. Tox. En., 745 (2012), pp. 84-95.

Sharaf, M., Sewid, A.H., Hamouda, H.I., Elharrif, M.G., El-Demerdash, A.S., Alharthi, A., Hashim, N., Hamad, A.A., Selim, S., Alkhalifah, D.H.M., Hozzein, W.N., Abdalla, M., Saber. T., (2022). Rhamnolipid-Coated Iron Oxide Nanoparticles as a Novel Multitarget Candidate against Major Foodborne E. coli Serotypes and Methicillin-Resi ant S. aureus. Microbiol. Spectr. 10, e00250-22.

Stef D.G and Gergen I. (2019): Effect of mineral-enriched diet and medicinal herbs on Fe, Mn, Zn, and Cu uptake in chicken. Chem. Cent. J., 6 (2012), p. 19.

Taiye O, Ubosi C.O and Esuga N. H (2019): Response of Broilers to Antibiotic and Antistress Dietary Inclusion. Pakistan Journal of Nutrition, DOI:10.3923/pjn.2004.262.263

Tan D.X., Manchester L.C., Reiter R.J., Qi W.B., Karbownik M.,(2020): Calvo J.R.Significance melatonin in antioxidative defense system: Reactions and products. Neurosignals ; 9; :137–159. doi: 10.1159/000014635.

Tona, G.O. Current and future improvements in livestock nutrition and feed resources. Anim. Husb. Nutr. 2018

Wedekind K.J, Hortin A.E, Baker D.H (2020):Methodology for assessing zinc bioavailability: efficacy estimates for zinc-methionine, zinc sulfate, and zinc oxide. J. Anim. Sci., 70 , pp. 178-187.

Xu, Y.Q., Xing, Y.Y., Wang, Z.Q., Yan, S.M., Shi, B.L., 2018. Pre-protective effects of dietary chitosan supplementation against oxidative stress induced by diquat in weaned piglets. Cell Stress Chaperones 23, 703–710.

ISSN 2756-4444
E-ISSN 2756-4452

Yin, H., Du, Y., Zhang, J., 2019. Low molecular weight and oligomeric chitosans and their bioactivities. Curr. Top. Med. Chem. 9, 1546– 1559.

Zelko I.N., Mariani T.J., Folz R.J. (2022):Superoxide dismutase multigene family: A comparison of the CuZn-SOD (SOD1), Mn-SOD (SOD2), and EC-SOD (SOD3) gene structures, evolution, and expression. Free Rad. Biol. Med. ;33:337–349. doi: 10.1016/S0891-5849(02)00905X.

Zulkifli, P. Liew, D. Israf, Omar A., M. Hair-Bejo (2019):Effects of early age feed restriction and heat conditioning on heterophil/lymphocyte ratios, heat shock protein 70 expression and body temperature of heat-stressed broiler chickens.J. Therm. Biol, 28, pp. 217-222.