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EFFECT OF ADDING BIO-FACTOR ON PRODUCTIVE AND PHYSIOLOGICAL PERFORMANCE OF JAPANESE QUAIL UNDER HEAT STRESS CONDITIONS. 1. DURING GROWING PERIOD

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ABSTRACT: This work aimed to investigate the effect of Biofactor (BF) as a water additive antioxidant to avoid the harmful effect of heat stress on productive performance, improving the immunity status and meat quality of Japanese quails. Three hundred and fifty, one-day-old Japanese quails were randomly allotted to five dietary treatments (each7 replicate with 10 birds/rep). The experimental period lasted for 6 weeks. The first treatment was reared in a separate room with 22-24°C 45-55% RH and used as a negative control (NC). The other treatment groups were reused under heat stress (39°C ± 1; 55-65% RH) for three successive days per week from 11.00 am to 15.00 pm). The second treatment was used as positive control (PC) and supplied with tap water without any supplementation while, the third, fourth, and fifth treatments were reared under the same condition and the other experimental groups were supplied with tap water with additional of 25; 50 and 75 ml BF/liter of water, respectively. The results indicated that Japanese quail exposed to HS significantly decreased of the PC group BW, BWG, FI by 17.1, 19.5 and 10.6 %, and impaired the FCR by 7.22% compared with NC group, at the end of the experiment (6wks.). However, supplementation of 75ml BF significantly increased the BW and BWG by 31.8 and 37.9%, respectively compared with PC group, and complete recovery of the reduction in FI which was statically equal with NC group, also, the FCR was significantly improved by17.02% compared with PC group. Also, exposure to HS significantly decreased the carcass, abdominal fat, pancreas, and intestinal weight and length of PC by 2.11, 1.72, 12.5, 2.36, and 6.05 %, respectively compared with NC group. On the other hand, the addition of different levels of BF significantly improved carcass and significantly increased intestinal weight and length compared with that recorded for PC group. Exposure to HS significantly decreased the meat content of CP in HS group from 22.43 to 21.84 by 3.1% compared with NC group, while supplementation 25, 50, and 75 ml/letter of drinking water) the content of CP was increased by 4.72, 12.41 and 14.65 %, respectively compared with the CP content in meat of PC group. Increasing supplementation of BF increased the meat content of EAAs and Non-EAA. Results indicated that PC group exposed to HS had a significant increase in plasma total lipid, total cholesterol, and triglyceride constituents and the total count coliform, anaerobic, and aerobic while the activity of GPx, TAC, LP, AST, and ALP, while, HDL, T3, and T4 were significantly decreased HDL, T3, and T4 activity compared to the other experimental groups. However, increasing supplementation of BF recovery the activity of GPx, TAC, LP, AST, and ALP for the groups under HS and improved all the intestinal microbiota hosts compared to NC and PC groups. Conclusion: Biofactor is a safe product and can used as an anti-heat stress reagent, and oral supplementation of Biofactor by 50 and 75 ml/letter improved the growth performance, biochemical parameters and improved the health of growingJapanese quail.

Key wards: Japanese quail, Biofactor, performance, biochemical and Immunity

INTRODUCTION

The climate is one of the most important factors influencing production efficiency (Renaudeau et al., 2011; Attia and Hassan, 2017), and heat stress is one of the most important environmental stressors, especially in warmer regions of the world (Lara and Rostagno, 2013). Because of their limited capacity to regulate their body temperature, birds may be at risk for irreversible thermoregulatory events that might affect their life if their body temperature rises due to an increase in temperature or excessive metabolic activity (Abbas et al., 2017). Also, (Defra 2005 and Ayo et al. 2011). indicated that increased temperature and humidity can become lethal. An increase in the environmental temperature results in decreasing FI, BWG and increasing FCR and body temperature in birds reared for egg-type and meat-type chicken (Attia et al., 2011; 2012;2018; Attia and Hassan, 2017; Awad et al., 2015; Barrett et al., 2019; Ani and Okpara, 2019). (Aswathi et al. 2019) indicated that broiler breeder hens exposed to 37±1°C and RH 70% for 6 hours daily for 10 days reduced BWG by 8.3% compared to the control group.

Several strategies have also been adopted to alleviate the detrimental effects of high environmental temperature on oxidative stress and the performance of poultry, dietary manipulations are preferable to other methods because of their practicability and lower cost (Singh et al. 2012 and Attia et al., 2018), rearing systems with improved ventilation (Abo Ghanima et al., 2020), Supplementation of various dietary additives such as amino acids (Li et al., 2015; Saeed et al., 2018a and b; Jafari et al., 2021), vitamins C, E as natural antioxidant, (Daghir, 2008 and Attia et al., 2009), Betaine as an antioxidant multi-nutritional agent, (Daghir, 2008 and Attia et al., 2009), dietary manipulation on electrolyte dietary balance (Attia et al., 2021), probiotics and postbiotic (Klemashevich et al., 2014 and Johnson et al., 2019) and bioactive compounds (Kucuk et al., 2003; Sohail et al., 2011) .

Natural substances have been the subject of several researches to avoid the HS to reduce animal mortality, increase meat yield and consumer health. Liquid Biofactor (BF) combines synbiotics; acids; enzymes and immunostimulants (saccharomyces cerevisiae extract, beta-glucan, mannan oligosaccharides, organic acids, types of vitamins, and types of minerals) as alternative feed additives to animal diets or drinking water. However, (Bortoluzzi et al., 2021) reported that broiler chickens undergoing early life stress dietary supplementation of BF + antioxidant (BF+AOx) significantly increased broiler BWG by 3.6, 3.8% and 4%, respectively from 1-21d, 1-28 d, and 1-35d, and significantly improved FCR by 1.2 and 1.8%, respectively from 1-21d and -28 d. The supplementation of (BF +AOx) improves growth performance by promoting a general anti-inflammatory and antioxidant response in chickens undergoing early life stress. Also, (Bossila et al.,2023) indicate that adding a Biofactor to water is an alternative to antibiotics to enhance the productive performance and meat quality in - Arbor Acres-broiler chicks. This work aims to investigate the power effect of Biofactor (BF) as a water fed additive to avoid the harmful effect of HS on productive performance parameters, as well as the possibility of used as an antioxidant; improving the immunity status and meat quality of Japanese quails.

MATERIALS AND METHODS

Three hundred and fifty, one-day-old Japanese quails were randomly allotted to five dietary treatments (7 pens/treatment and 10 birds/pen) and were provided with individual feeders and drinkers. Birds were kept in galvanized wire cages in batteries (50*90*50) with standard dimensions in an environmental-controlled lightproof house. Feed and water were provided ad-libitum throughout the experimental period. The experimental diets were formulated to meet the National Research Council recommendation (NRC, 1994). The birds were reared (in door) either at an optimum temperature of 22-24°C with relative humidity (RH) of 45-55% serving as a negative control (NC) and fed with a basal diet (Table 1) or under heat stress (39°C ± 1; 55-65% RH) for three successive days a week from 11.00 am to 15.00 pm. The first treatment group was reared under normal conditions and fed a basal diet and tap water without any supplementation and used as a

negative control (NC). The other experimental groups (NC; BF25; BF50 and BF75) were fed the same basal diet, while the drinking water was supplied with 0.0; 25; 50 and 75 ml BF/liter of water, respectively. The management and medical program were done according to common veterinarian care practice. The Biofactor (BF) agent composition was presented in Table 2.

Growth Performance

Body weight (BW) and feed intake (FI) were documented for each pen at 14; 28 and 42 d of age. Mortality was documented daily for FI correction. Body weight gain (BWG) and feed conversion ratio (FCR) were calculated by using the documented data of BW, FI, and mortality

Carcass and Meat Quality

At 42 d of age, three birds randomly selected from each pen were slaughtered. `Carcass, abdominal fat, liver, heart, pancreas, intestinal weight and length, spleen and bursa were documented.

Amino acid analyses

The amino acid composition of the meat samples was determined using an automatic amino acids analyzer after acid hydrolysis with 6 N HCL (reflux for 23 h), according to AOAC (2005).

Hematological Characteristics

At 42 days of age, blood samples were withdrawn from the brachial vein from each replicate per treatment. Blood samples were collected in the morning from the overnight-fasted birds . Each sample was collected in two tubes; one without anticoagulant to determine the hematological parameters, while the second blood sample with heparin was used as an anticoagulant. Blood plasma and serum were obtained by centrifugation of blood at 1500 rpm g for 20 min and kept at -20°C until used for analysis. Packed cell volume (PCV) was calculated in a fresh blood sample using microhematocrit capillary tubes, according to (Blaxhall and Daisley, 1973), Hemoglobin (Hgb) according to Drubkin (1964), Red blood cells (RBCs) and White blood cell counts (WBCs) as the method described by Hawkey and Dennett (1989) and blood film was prepared according to the method described by (Lucky, 1977). Triodothyronine (T3, µg/dl) and Thyroxine (T4, µg/dl) were determined using RIA kits manufactured by Diagnostic Systems Laboratories USA by Automatic 1275 mini–Gamma Counter LKB according to the method described by Hollander and Shenkman (1974). Plasma alkaline phosphatase (ALP) according to Belfield and Goldberge (1971), uric acid (Ure) by the method of Bartles et al., (1972), plasma total lipids (Tlp) by way of Zollner and Krisch (1962), plasma triglycerides(Trg, mg/dl) by the method of Fossati and Prencipe (1982), total plasma cholesterol (Chol, mg/dl) by the method of Stein (1986), plasma HDL-cholesterol by the method of Lopez-Virella (1977), plasma LDL- cholesterol calculated according to Friedewald et al., (1972) {LDL= total cholesterol – HDL- (triglycerides/5)}. Biochemical constituents were determined using commercial kits produced by Diamond Diagnostics Company (29 Tahreer St. Dokki Giza Egypt). Based on commercially available kits developed by Pasteur Lab Oratorios Clnicos de Colombia S.A., Reitman and Frankle (1957) assessed the activity of serum aspartate aminotransferase (AST) and serum alanine aminotransferase (ALT) in the blood. On the other hand, ALT to ALT Ratio and the activity of glutathione peroxidase (GPx) were calculated according to Ricard et al., (1992).

Intestinal microbiota counts: The small intestine (from the distal end of the jejunum to the ileocecal junction) was removed from each bird to determine the number of total aerobic bacteria, coliform bacteria, and anaerobic bacteria, according to Clench and Mathias (1995)

Statistical Analysis: Data were statistically analyzed using one-way ANOVA of SAS® (SAS, 2009). Variables having significant differences were compared using the Tukey test (SAS, 2009). The statistical model used was as follows:

Yij= µ+Ti+eij, Where, Yij= the dependent variable, µ= the overall mean;

Ti= the effect of treatments and eij= the random error.

RESULTS

Growth Performance

The effect of heat stress (HS) and supplementation of different levels of Bio-Factor (BF) through drinking water body weight (BW) and body weight gain (BWG) of

Japanese quail during growing periods 2-6 wks of age are shown in (Table 3). The results indicated no significant differences were observed on the body weight (BW) at 2 wk of age. However, continues subjected to HS, the BW and BWG of the birds on positive control group (PC) was significantly decreased compared with the negative control (NC), the BW was decreased by 13.4 and 17.1%, respectively at and BWG was decreased by 19.5 % during 2-6 wk of age. On the other hand, the groups under HS witch supplemented with different levels of BF recorded significantly increased on BW and BWG during different experimental periods (2 and 6 wk; 2-4, 4-6 and 2-6 wks). The highest BW was recorded for the groups supplied with 50 and 75 ml BF/ liter at 4 and 6 wks of age and the group supplied with75 ml/letter at 6 wks of age. Also, the highest BWG was recorded for the groups supplied by 50 and 75 ml BF/ liter during 2-4 wks and by 25, 50 and 75 ml BF during 4-6 wks and by 75 ml BF during 2-6 wks of age. Generally, grower group exposed to HS (PC) recorded the lowest amount of FI compared with the NC group by 19.3, 11.5 and 10.3 % during 2-4, 4-6 and 2-6 wks of age, respectively. Also, the same trend were observed, since the PC group was significantly recorded the lowest amount of FI compared to the other experimental groups under HS and supplied with BF during the same periods. Harmony, with the previous results the PC group had significantly worst FCR compared with the NC group during different experiment periods. The reduction of CHS (PC) on FCR during 2-4, 4-6 and 2-6 wks of age are 51.5, 6.74 and 7.22%, respectively compared with that recorded on NC group.. However, the experimental groups under HS and supplied with BF by different levels observed an improvement on the FCR during different periods compared with that recorded for PC group.

Carcass treats

The effect of HS and supplementation of different levels BF through drinking water on the on the carcass traits of Japanese quail are shown in (Table 4). The results indicated that, HS significantly decreased percentage of carcass, abdominal fat, pancreas and intestinal weight and length of PC by 2.11, 1.72, 12.5, 2.36 and 6.05 %, respectively compared with NC group. However, the other carcass treats (liver, heart, spleen, thymus and bursa %) were not differed and statistically equals with the values recorded for NC group. However, the results showed that, addition of different levels of BF significantly improved and complete recovery of carcass % and significantly increased intestinal weight and length compared with that recorded for PC group. On the other hand, the concentration of malondialdehyde (MD) in meat after 0 h and after 48 h of storage in the refrigerator was not differed and statistically equal among different experimental groups.

Meat (breast + thigh) amino acids quality

Results in Tables (5) summarized the content of total protein and amino acids (AAs) deposition in meat (breast + thigh) of Japanese quail at fed different levels of BF. The results indicated that, HS significantly decreased CP content in HS group from 22.43 to 21.84 by 3.1% compared with NC group. However, with the increased of BF supplementation 25, 50, and 75 ml/letter of drinking water) the content of CP was increased by 4.72, 12.41 and 14.65 %, respectively compared with the CP content in meat of PC group also with the previous supplementation levels the content of CP was increased by 1.51, 9.0 and 11.14 %, respectively compared with the content in meat of NC group.

The results of EAAs content of meat indicated that HS significantly decreased percentage of Meth and IsoL content in HS group From 19.74 and 7.59 % compared with NC group, while the other EAAs were not affected and statistically equal with the content of NC group. However, increasing supplementation of BF increased the meat content of EAAs, and the highest content almost recorded for the groups supplied with 50 and 75 ml BF/letter compare the other experimental groups. Also, the results indicated that the nonessential amino acids measured on meet tissue was statistically equal for the NC and PC groups, except the content of aspartic acids which was significantly decrees due exposing to HS. Harmony, with the results of EAAs, increasing supplementation of BF increased the meat content of NAAs and the total NEAAs, the highest content recorded for the groups

supplied with 50 and 75 ml BF compare the other experimental groups.

Blood hematology and biochemical constituents:

Results presented in Table (6) showed that NC quail group exposed to HS had a significant decreased on RBCs count by 8.83% compared with the count of NC group. On the other hand, the RBCs count was gradually increased by increased supplementation of BF, but not achieved complete recovery as NC group. Otherwise, the PC group under HS had a significant increased on eosinophils % and H/L ratio compared with the count of NC group and gradually decreased by increased supplementation of BF. However, the PCV, Hgb, WBCs count, heterophils, basophils, monocytes and lymphocytes % were statistically equals with the NC group.

The results indicated that PC group exposed to HS had significantly increasing in plasma total lipid, total cholesterol and triglyceride constituents compared to the other experimental groups, while high density lipoprotein (HDL) was significantly decreced, Table (7). In generally supplementation the quale groups under HS by BF improved the lipid profile, while low density lipoprotein (LDL) was not deferred among different experimental groups. However, the concentration of glutathione peroxidase (GPx), total antioxidant (TAC), lipid peroxide (LP), aspartate amino transferase (AST) and alkaline phosphatase activity (ALP) were significantly increased in blood of the PC group compared to the concentrations in NC group. Counteractively, exposing to HS significantly decreased the activity of triodothyronine (T3) and thyroxin (T4) in PC group compared to the activity on NC group. Otherwise, the concentration of uric acid and the activity of alanine amino transferase (ALT), were not significantly differed among all experimental groups (Table 7). However, increasing supplementation of BF recovery the activity of GPx, TAC, LP, AST and ALP for the groups under HS.

Intestinal microbiota

Table (8) represented the effect of heat stress (HS) and supplementation of different levels of (BF) through drinking water on the on the intestinal microbiota. However, the PC group (exposing to HS) increased on the total count coliform, anaerobic and aerobic compared to the count on NC group. On the other hand continues suspected to HS with supplementation of BF lowered and improved all the intestinal microbiota host compared to NC and PC groups.

DISCUSSION

Considering the enhancement in environmental temperature, it is essential to identify the adverse effects of high ambient temperature on poultry. Heat stress (HS) occurs when the ambient temperature goes over 27 C^0 (Bollengier-Lee et al., 1999; Attia et al., 2006). Goblet warming and climate change represent a new important challenge for poultry breeders (Attia et al., 2009, 2012; Munonye et al., 2023). In this respect, the current research indicated that exposed Japanese quail to HS significantly decreased BW and BWG at the end of the experiment (6 wks) by 31.76 and 37.86 %, respectively, compared with PC group. Also FI and FCR were significantly decreased by 10.3 and 7.22% at 6 wks of age compared with PC group. However, supplementation of the 75 ml BF/letter significantly increased both BW and BWG by 31.76 and 37.57%, respectively, and complete recovery of the amount of FI and improved the FCR by 17.0%, respectively, compared with PC group, at the end of the experimental period (6 wks of age). The results obtained were in agreement with the previous study, that exposure to HS reduced growth rate (Attia et al., 2011; Aswathi et al., 2019). (El-Sheikh et al. 2004) documented that laying Japanese quails subjected to solar radiation temperature in summer significantly decreased body weight and FI compared to the unsubjected group. Also, (El-Habbak et al. 2011) indicated that body weight and BWG, FI, and FCR of Arbor Acer broiler were negatively affected by HS. However, the herein results indicated that the groups under HS and supplemented with 50 and 75 ml BF/ liter at 4 and 6 wks of age significantly increased BW compared with NC and PC groups by 20.5, 22.7%, respectively at 4wks of age, and by 9.27 and 31.8%, respectively at 6 wks of age. Also, the BWG for the group supplied with 75 ml BF/ liter during 2-4 wks and 4-6 wks and by 75 ml BF were

significantly improved compared with NC and PC groups by 13.1 and 36.6% respectively during 4-6 wks of age and by 10.9 and 37.9 % respectively during 2-6 wks of age. Also, supplemented with 25, 50 and 75 ml BF/ liter during 4 -6 and 4-6 wks of age were significantly recovery the amount of FI and statistically equal with NC and significantly improved compared with NC groups. Moreover, FCR was significantly improved during different periods of the experimental compared with NC and PC groups by 8.76 and 39.4 %, respectively during 2-4 wks of age, 29.4 and 20.6 %, respectively during 4-6 wks of age and by 11.03 and 17.02 %, respectively during 2-6 wks of age. These results are in agreement with (Bortoluzzi et al., 2021) that broiler chickens under early life stress dietary supplementation of BF + antioxidant (BF+AOx) significantly improved FCR by 1.2 and 1.8%, respectively, from 1-21d and -28d, and increased broiler BWG by 3.6, 3.8%, and 4%, respectively, from 1-21d, 1-28d, and 1-35d. By encouraging a broad anti-inflammatory and antioxidant response in hens experiencing early life stress, BF +AOx supplementation enhances growth performance.

However, (Bortoluzzi et al., 2021) found that broiler chickens under early life stress dietary supplementation of BF + antioxidant (BF+AOx) increased broiler BWG by 3.6, 3.8%, and 4%, respectively, from 1-21d, 1-28d, and 1-35d, and significantly improved FCR by 1.2 and 1.8%, respectively, from 1-21d and -28d. Supplementing with BF+AOx improves growth performance in hens under stress in their early lives through the stimulation of a wide anti-inflammatory and antioxidant response.

However, Bacillus subtilis and Bacillus licheniformis, which have been widely used as a cell factory for microbial production of chemicals, enzymes, and antimicrobial materials for industry, agriculture, and medicine, may be responsible for the improvement in Japanese quality over time that resulted from BF supplementation (Su et al., 2020; Ramiez-Olea, et al., 2022). The use of bacterial probiotic strains and their metabolic products is thought to be a novel strategy for the management and prevention of a variety of infectious diseases (Yang et al., 2014). Bacillus subtilis and Bacillus brevis produce 66 derived antimicrobials and 23 peptide antibiotics, respectively (Stoica et al., 2019). Additionally, according to (Shleeva et al. 2023), Bacillus licheniformis generates a variety of antibiotic compounds, such as bacteriocins, which are effective against fungal pathogens, amoeba cells T., and both Gram-positive and Gram-negative bacteria. Therefore, adding Bacillus subtilis and Bacillus licheniformis enhanced animal development, avoided illness, and improved intestinal function in mice (Su et al., 2020; Lee et al., 2019). It is produced as endospores, which enter the animal's digestive tract and rapidly reactivate to release highly active proteases, such as lipases and amylases in the upper intestinal tract. These enzymes aid in the breakdown of complex carbohydrates found in plant feed. Additionally, B. subtilis is capable of producing polypeptides that efficiently increase feed digestibility by acting antagonistically against gut infections. Additionally, according to (Kovacs et al., 2019), B. subtilis may form biofilms and stimulate the production of nitric oxide (NO) and quorum-sensing pentapeptide, both of which can postpone the host's ageing process. These findings align with Table 9's findings, which showed that the PC group exposed to HS had higher intestinal total coliform, anaerobic, and aerobic counts than the NC group, while the intestinal microbiota host was improved by supplementing HS groups with BF. These findings concur with those of (Attia and Hassan 2017), who found that exposure to HS impairs digestive function, alters hypothalamic peptides implicated in appetite regulation, reduces the activity of trypsin, chymotrypsin, and amylase, and reduces the absorption of nutrients, and changes in intestinal morphology. Additionally, (Johnson et al., 2019) found that postbiotics could decrease the mortality of hens and the detrimental impacts of infections such Clostridium perfringens. However, by concurrently improving the Disease activity index, reducing the length of the mice's colon, significantly lowering the microbiota, reducing the infiltration of neutrophils and macrophages

into the colonic tissue, and avoiding physical mucosal damage in mice, salicin (one of BF's components) significantly decreased intestinal inflammation (Verma et al., 2019). Similarly, salicin may lower the amount of lung bacteria in mice, according to (Jiang et al., 2023). The lectins presented on BF cued on factors of the ability to improve intestinal colonization and immune response. These findings concur with those of numerous researchers, including (Lutful Kabir 2009), who found that feeding chicken a diet containing different Lactobacillus species can stimulate several immune response components. (Kobierecka et al., 2017 and Neal-McKinney et al., 2012) showed that a chicken meal supplemented with Lactobacillus species, such as L. crispatus, L. salivarius, L. helveticus, and L. gallinarum, decreased the amount of Campylobacter colonisation in the avian cecum. Additionally, lactobacilli fermentum decreases the colonisation of C. jejuni in hens and hinders its capacity to infiltrate intestinal epithelial cells and survive (Taha-Abdelaziz et al., 2019). Similarly, postbiotics have been used to identify compounds generated during the metabolic processes of microbes and lessen the detrimental effects of infections (such Clostridium perfringens) on hens and mortality, according to (Johnson et al., 2019). Additionally, according to (Sefcova et al., 2020 a,b), providing L. fermentum to 4-day-old hens enhances the intestinal architecture of birds who have been exposed to infections. Concerning the AAs effect on elevating the harmful of HS, consequent supplementation of BF which contains some AAs (lysine, methionine, valine, threonine, tryptophan, and arginine) cud presented on the solution of the degradation of the harm effect of HS recorded in the current study. However, amino acids are well-documented to function not only as protein constituents but also as important physiological and behavioral regulators, and this includes the regulation of stress responses (Asech et al., 2006; Erwan et al., 2014). The results are in agreement with several research in this respect, increased dietary levels of certain amino acids could be useful to counteract the negative effects of heat stress in chickens. These results are in agreement with (Temim et al., 2000a, b) who indicated that amino acid metabolism and protein pools are gradual changes during hyperthermia. Additionally, (Habashy et al., 2017) reported that the HS group consumed and retained AAs at significantly lower levels than the control group. Accordingly, a number of researchers found that supplementing hens with AA improved their performance (Saeed et al., 2018a and Saeed et al., 2018b). (Jafari et al. 2021) indicated a reduction in the plasma concentration of amino acids as a result of heat stress exposure. However, previous research documented that amino acids affected several physiological functions, including stress responses (Chowdhury et al., 2020). For example,(Han et al., 2020) showed that dietary methionine supplementation improved protein deposition and improved growth of broilers under heat stress in acute heat-exposed broilers. Incorporation of cysteine is necessary since it is a major component of glutathione (GSH) which has a greater role as an antioxidant in the body (Lin et al., 2006; Azad et al., 2010). Also, (Kalvandi et al., 2019) suggest that dietary supplementation with Met could improve the performance, immunity, and antioxidant status of quails by reducing the negative effects of HS. (Yahav 2015) reported that broilers treated with L-Leu might be considered to be an adaptive strategy under continuous heat stress.Balnave and (Oliva 1991) reported that exposure to heat stress significantly decreased the absorption of arginine (Arg). The findings of this study indicated the same results, since the deposition of several AAs in meat was decreased due to exposing quail to HS, and supplementation of BF could recover the degradation of meat AAs content Table (4). The current results indicated that total EAA and NEAAs have significantly increased in quail supplies with 50 and 75 ml BF/liter. (Han et al., 2020) showed that dietary methionine supplementation improved protein deposition in acute heat-exposed broilers. Therefore, amino acids could play an important role in protecting the growth of broilers under heat stress. (Kalvandi et al., 2022) concluded that supplementation of Arg at a higher level than NRC (1994) recommendation can alleviate the adverse effects caused by HS in breeder quails.in agreement with these results exposure to HS,

the carcass, abdominal fat, pancreas, and intestinal weight and length for the PC group were significantly decreed by 2.11, 1.72, 12.5, 2.36, and 6.05 %, respectively compared with NC group. Otherwise, the addition of different levels of BF significantly improved and complete recovery of carcass % and significantly increased intestinal weight and length compared with that recorded for PC group (Table 4). These findings agree with those of (Attia and Hassan 2017), who found that HS impairs digestive function, including altering hypothalamic peptides that regulate appetite, reducing the rate at which feed residue passes, lowering trypsin, chymotrypsin, and amylase activity, influencing intestinal morphology, and affecting nutrient absorption. However, as thyroid hormones promote intestinal development, the decrease in intestinal weight can be a reflection of the decreased T3 synthesis under HS (McNabb, 1993). Also, (Bossila et al., 2023) indicate that adding Biofactor to water enhances the meat quality in -Arbor Acres-broiler chicks. Moreover, the quality of the meat was not degraded, since the meat concentration of malondialdehyde (MD) in fresh meat at 0 h and after 48 h of storage in the refrigerator were statistically equal (Table 4). However, exposure to HS causes several changes in the blood chemistry and biochemical changes, in the current study the PC group had a significant decrease in RBCs count by 8.83%. Also PCV was numerically decreased compared with the count of NC group. These results are in agreement with (Attia and Hassan 2017) who indicated that exposure to HS significantly decreased PCV compared to the thermoneutral group. In the same line, the results obtained indicated that exposure to HS significantly increased the heterophil/lymphocyte ratio (H/L) compared with the NC group Table (6). However, supplementation HS groups with BF courses gradually decrease the H/L ratio. These results are compatible with (Felver-Gant et al., 2012) and Tamzil et al., 2014). Also, (Altan et al., 2003) observed that blood lymphocytes decrease and increase on heterophils, which led to increasing in blood H/L ratio from 0.24 to 0.42 in heat-stressed broilers. (Harmony, Olfati et al., 2018) found that H/L ratio was increased by 45% in the broiler chickens exposed to stress in comparison to birds in the thermal natural group. The increase in H/L ratio may be due to exposure to HS increases the release of corticosterone which causes the dissolution of lymphocytes in lymphoid tissues, leading to lymphopenia and an increase in heterophil release by the bone marrow (Borges et al., 2004). The improvement in H/L ratio and the other parameters may be due to the supplementation of AAs (some component on BF) may have rule on alleviating the harmful of HS, as the results obtained by (Asech et al., 2006; Erwan et al., 2014) who indicated that amino acids had an important to regulator the physiological and behavioral, and this includes the regulation of stress responses. However, the current results are compatible with the previous research, that exposure to HS significantly impaired the physiological parameters since the PC group exposed to HS had a significant increase in plasma total lipid, total cholesterol, and triglyceride constituents, while HDL was significantly decreased (Table 7). These results are compatible with (Attia and Hassan 2017 and Aswathi et al., 2019) who indicated that chronic HS had a significant increase in plasma cholesterol. (Li et al.2019) documented that the concentration of triglycerides was increased in response to acute heat stress. Consequently, (Kalvandi et al., 2019) indicated that the high-density lipoprotein (HDL-cholesterol) was significantly lower in the HS group compared to the group under the natural environmental group. Generally, supplementation of the quale groups under HS by BF improved the lipid profile. The current results indicated that the AST and ALP activity were significantly increased compared to the NC group (Table 7). These results agree with (Attia et al., 2017; 2018 and Attia and Hassan 2017) who demonstrated that chronic HS significantly increases the aspartate aminotransferases compared to the control group. Also, (Badran and Abd-Elaal 2020) observed that exposure to HS significantly increased the activity of Alk-P enzyme. On the other hand, (Attia et al., 2018) indicated that the activity of serum ALT enzyme was greatest in hens reared under heat stress. Furthermore, known that heat stress can

enhance the antioxidant enzyme activities which have a protective response against oxidative stress, in this concept, the current results indicated that the antioxidant parameters and immunity function for the PC group were significantly increased. The results indicated that the concentration of glutathione peroxidase (GPx), total antioxidant (TAC), lipid peroxide (LP), aspartate aminotransferase (AST), and alkaline phosphatase activity (ALP) were significantly increased in blood of the PC group compared to the concentrations in NC group, while the activity of triiodothyronine (T3) and thyroxin (T4) significantly decreased. These results were in agreement with observations reported in several researches conducted by (Devi et al., 2000 and Thomas 2000) who documented that antioxidant enzyme activities have been increased under HS conditions as a protective response against oxidative stress. Also, El-(Sheikh et al., 2009) indicated that the immune function of birds may depress the immune function in HS conditions. The same results were observed by (Tan et al., 2010; Habashy et al., 2019),

(Altan et al., 2003, and Perederiy 2023). (Mujahid et al., 2007 and Tan et al., 2010) reported that reusing the environmental temperature led to an increase the lipid peroxidation which causes oxidative stress and tissue damage. In the same respect, (He et al. 2018) observed that serum antioxidant enzyme activities and MAD concentration significantly increased under HS and significantly decreased the levels of Catalase enzyme compared with the group under normal conditions. As regarded in our study (Badran and Abd-Elaal 2020) indicated that thyroid hormones T3 and T4 concentrations were significantly lowered in heat-stressed hens as compared with the control ones. In the same line, (Wolde et al., 2011) documented that exposure to warm temperatures led to an alteration in the activity conversion of T4 to T3, and both T3 and T4 are depressed following. Also, (Anjum et al., 2016) reported the production of T3 under HS was decreased, while T4 production was also affected either towards decline, increase, or no change. Counteractively, some research indicated the opposite results, as reported by (Sohail et al., 2010 and Wan et al. ,2017) that T4 concentrations did not change or decrease in the high-temperature. Also, (He et al., 2018) reported that T3 concentration was increased under HS conduction and thus may be due to the increase in the concentration of adrenocorticotropic hormone (ACTH), also they reported that T4 had a varying effect on its concentration. Also, (Perederiy, 2023) found a significant increase in glutathione peroxidase activity and this decrease in GSH-Px seems quite logical, based on the known fact that GSH-Px protects the body's cells from oxidative stress, inhibits inflammation and oxidant-induced regulated cell death, catalyzes the breakdown of hydrogen peroxide, and oxidizes glutathione. Moreover, (Zulkifi et al. ,2002 and El-Sheikh et al., 2009) showed that environmental stress might depress the immune function and inflammatory cytokines of birds due to impeding the production of antibodies and effective cell-mediated immunity. Also, (Sahin et al., 2010) found that quail suffering from chronic heat stress had reduced hepatic GSH-Px activity. However, supplementation of Bf improved the immunity and antioxidant function (table 7) incompatible with the observation of (Bortoluzzi et al., 2021) who documented that BF supplementation significantly reduced the expression of IL-1b in the broiler lungs on d 7 and significantly increased the expression of IL-6 and IL-10 ($P = 0.03$) in the liver. In the same respect, (Rahimnejad et al., 2020) indicated that biofactors as metabolites from a yeast cell hydrolysate showed antioxidant effects in fish hepatocytes by enhancing the activity of superoxide dismutase, catalase, and glutathione peroxidase. Also, (Johnson et al., 2019) reported that postbiotics predominantly affect the innate immune response and appear immunomodulatory. As regarded, probiotics are referred to in animal production as direct-fed microbial and it is not digestible by the host and are specifically selected to foster the growth of beneficial gut bacteria and have a positive impact on host health (Klemashevich et al., 2014). Also, (Blacher, et al., 2017) mention that microbial metabolites of beneficial gut bacteria (as postbiotics) have a role in the regulation of the immune system. In the same line, (Verma et al., 2019) indicated that salicin one of BF components suppressed the

pathological conditions and significantly reduced intestinal inflammation by simultaneously improving in disease activity index DAI in mice and preventing physical mucosal damage. Also, Bacillus subtilis (one of BF components and the key Gram-positive model bacterium) is a highly efficient protein secretion system and adaptable metabolism, thus it has excellent physiological characteristics and highly adaptable metabolism (Su, et al., 2020). Additionally, B. subtilis and Probiotic B. licheniformis are effective multipurpose probiotics that have the ability to improve nutrient absorption and inhibit the growth of harmful bacteria (Olmos et al., 2020; Shleeva et al., 2023).As a result, B. subtilis is commonly used as a microbial addition to enhance animal intestinal function, enhance development, and resist against illnesses (Lee NK, Kim WS, Paik HD ،2019). Also, according to (Romo-Barrera et al., 2021), probiotics belonging to the genus Bacillus, including B. subtilis and B. licheniformis, are harmless bacteria that also improve health via the generation of metabolites.

CONCLUSION

Biofactor is a safe product and can used as an anti-heat stress reagent through its components (AAs; Baciilus sabtilis; Bacillus licheniformis; Lactin and Salicin). The oral supplementation of Biofactor by 50 and 75 ml/letter of drinking water can improve the growth performance, biochemical parameters and improve the health of growing Japanese quail.

Table (1): Composition and calculate analysis of the experimental diets through the growing period:

Ingredients	**Basal diet (%)**	**Calculated analyses**[***]	**Percentages**
Corn yellow	52.90	Crude protein (%)	24.08
Soybean meal (44%)	33.15	ME (Kcal/kg diet)	2970
Concentrate (50%)*	10.0	Ether extract (%)	2.43
Di-calcium phosphate	0.75	Crude fiber (%)	1.16
Limestone	1.00	Lysine (%)	1.42
Soya-Oil	1.40	Methionine (%)	0.76
Vit.and min mix.**	0.30	Calcium (%)	1.08
NaCl	0.5	Av. Phosphorus	0.49
Total	100		

* Concentrate: ME (K cal/kg) 2550, Crude protein 50%, Crude fiber 1.19%, Crude fat 6.16%, Calcium 7.3%, Phosphorus 3.2%, NaCl 1.44%, Methionine 1.65%, Methionine & Cystine 1.98%, Lysine 2.58%.

** Each kg of vitamin and minerals mixture contained: Vit. A, 4,000,000 IU; Vit. D3, 500,000 IU; Vit, E, 16.7 g., Vit. K, 0.67 g., Vit. B1, 0.67 g., Vit. B2, 2 g., Vit. B6, 0.67 g., Vit. Bi2, 0.004 g., Nicotinic acid, 16.7 g., Pantothenic acid, 6.67 g., Biotin, 0.07 g., Folic acid, 1.67 g., Choline chloride, 400 g., Zn, 23.3 g., Mn, 10 g., Fe, 25 g., Cu,1.67 g., I, 0.25 g.,Se, 0.033 g.,Mg, 133.4 g.

*** According to NRC (1994).

Table (2): Biofactor analysis (each 1000 ml contains):

Ingredients	**Value**
(Amino acid)	
Lysine	7.690 mg
Methionine	3.950 mg
Valine	1.100 mg
Threonine	11.000 mg
Tryptophan	1.110 mg
Arginine	1.389 mg
(Bacteria)	
Baciilus sabtilis	2.5^{10} cfu
Bacillus licheniformis	2.5^{10} cfu
(Acids)	
Lactin	16.000 mg
Salicin	0.975 mg

Table (3): Effect of Bio-Factor on some productive performance traits of Japanese quail during growing periods

Treatment Items	**NC**	**Heat stress groups (HS)**				**SEM**	**P Value**
		PC	**BF, 25**	**BF, 50**	**BF,75**		
Body weight (g)							
2 Wk	30.4	30.1	30.4	30.8	30.8	0.646	0.979
4 Wk	127^{b}	110^{c}	129^{b}	136^{a}	135^{a}	2.049	0.042
6 Wk	205^{b}	170^{c}	217^{ab}	218^{ab}	224^{a}	3.110	0.039
Body weight gain (g/chick/period)							
2-4 Wk	93.3^{b}	81.1^{b}	98.9^{ab}	105^{a}	104^{a}	1.982	0.0392
4-6 Wk	78.9^{b}	65.3^{c}	87.5^{a}	82.5^{ab}	89.2^{a}	2.095	0.043
2-6 Wk	174^{c}	140^{d}	186^{b}	187^{b}	193^{a}	3.109	0.025
Feed consumption(FC) (g/chick/period)							
2-4 Wk	187^{a}	151^{b}	188^{a}	186^{a}	183^{a}	3.083	0.041
4-6 Wk	269^{a}	238^{b}	269^{a}	267^{a}	257^{a}	1.235	0.042
2-6 Wk	456^{a}	409^{b}	458^{a}	453^{a}	451^{a}	4.016	0.039
Feed conversion ratio(FI) (g feed/g weight gain)							
2-4 Wk	1.94^{b}	2.92^{a}	1.90^{b}	1.77^{c}	1.77^{c}	0.049	0.0298
4-6 Wk	3.41^{b}	3.64^{a}	3.08^{b}	3.24^{b}	2.89^{c}	0.210	0.0425
2-6 Wk	2.63^{b}	2.82^{a}	2.46^{bc}	2.42^{bc}	2.34^{c}	0.055	0.035

^{a,b,c} means having different superscripts in the same row are significantly different ($P<0.05$). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress

Table (4): Effect of Bio-Factor on some carcass traits of Japanese quail at 6 weeks of age

Treatment / Items	NC	Heat stress groups (HS)				SEM	P Value
		PC	BF, 25	BF, 50	BF,75		
Carcass (%)	74.42^{ab}	72.85^{b}	74.95^{ab}	76.95^{a}	77.73^{a}	0.641	0.035
Abdominal fat (%)	1.16^{b}	1.14^{c}	1.20^{ab}	1.27^{a}	1.29^{a}	0.173	0.028
Liver (%)	1.872	1.980	1.995	1.962	2.013	0.270	0.233
Heart (%)	0.753	0.790	0.833	0.857	0.911	0.070	0.429
Pancreas (%)	0.321^{b}	0.281^{c}	0.342^{a}	0.327^{a}	0.326^{a}	0.212	0.032
Intestines weight (g)	8.47^{b}	8.27^{c}	8.30^{b}	9.60^{a}	9.80^{a}	0.355	0.0021
Intestineslength(cm)	75.25^{b}	70.70^{c}	80.29^{a}	84.50 ^{a}	84.89 ^{a}	0.565	0.0001
Spleen (%)	0.069	0.073	0.079	0.069	0.074	0.058	0.890
Thymus (%)	0.194	0.185	0.186	0.0181	0.180	0.103	0.655
Bursa (%)	0.127	0.133	0.122	0.131	0.129	0.084	0.086
MD (nmol/g tissue, 0h)	9.886	9.676	9.423	10.140	10.068	0.462	0.049
MD (nmol/g tissue, 48 h)	12.503	12.316	12.233	11.954	12.433	0.424	0.053

^{a,b,c} means having different superscripts in the same row are significantly different ($P<0.05$). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress, WHC=Water holding capacity (Cm^2) MD (0 h)= Malondialdehyde in meat on fresh carcass MD (48 h)= Malondialdehyde in meat after 48 hours storage in the refrigerator

Table (5): Effect of Bio-Factor on meat (breast + thigh) amino acids contents of Japanese quail at 6 weeks of age**.**

Treatment Items	NC	Heat stress groups (HS)				SEM	P Value
		PC	BF, 25	BF, 50	BF,75		
Total protein content	22.53^{bc}	21.84^{c}	22.87^{bc}	24.55^{a}	25.04^{a}	0.14	0.001
EAA (g/100 g protein)							
Methionine	0.67^{b}	0.52^{c}	0.52^{b}	0.70^{a}	0.71^{a}	0.06	0.001
Lysine	2.18^{b}	2.02^{b}	1.99^{b}	2.97^{a}	2.96^{a}	0.13	0.001
Leucine	2.12^{b}	2.16^{b}	2.18^{ab}	2.20^{ab}	2.22^{a}	0.08	0.001
Isoleucine	1.45^{a}	1.34^{b}	1.33^{b}	1.46^{s}	1.48^{s}	0.06	0.001
Threonine	0.99^{b}	0.92^{b}	1.03^{a}	1.04^{a}	1.03^{a}	0.0015	0.001
Phenylalanine	0.94^{b}	0.93^{b}	0.98^{a}	0.97^{a}	0.98^{a}	0.0018	0.001
Valine	1.31^{b}	1.33^{b}	1.32^{b}	1.41^{a}	1.39^{a}	0.05	0.001
Histidine	0.97^{b}	0.96^{b}	1.005^{a}	1.005^{a}	1.004^{a}	0.06	0.001
Total. EAA	10.63^{b}	10.18^{b}	10.37^{b}	11.50^{a}	11.77^{a}	0.59	0.001
Non-EAA (g/100g P)							
Arginine	1.34^{b}	1.36^{b}	1.49^{a}	1.49^{a}	1.48^{a}	0.05	0.001
Glycine	1.11^{b}	1.27^{ab}	1.27^{ab}	1.29^{ab}	1.31^{a}	0.07	0.001
Serine	0.56^{b}	0.53^{b}	0.58^{b}	0.58^{b}	0.61^{a}	0.51	0.001
Aspartic acid	2.29^{a}	2.16^{b}	2.01^{b}	2.19^{b}	2.23^{a}	0.06	0.001
Glutamine	3.89^{b}	3.73^{b}	4.22^{a}	4.29^{a}	4.28^{a}	0.05	0.001
Proline	0.71^{b}	0.76^{b}	0.91^{a}	0.98^{a}	1.13^{a}	0.05	0.001
Alanine	1.18^{b}	1.02^{b}	1.17^{b}	1.28^{a}	1.30^{a}	0.06	0.001
Histidine	0.97^{b}	0.96^{b}	1.005^{a}	1.005^{a}	1.004^{a}	0.06	0.001
Tyrosine	0.62^{b}	0.63^{b}	0.64^{b}	0.69^{a}	0.69^{a}	0.04	0.001
Cysteine	0.20^{c}	0.20^{c}	0.21^{bc}	0.23^{b}	0.24^{a}	0.0014	0.001
Total Non-EAA	11.90^{bc}	11.66^{c}	12.47^{b}	13.05^{a}	13.27^{a}	0.33	0.001

^{a,b,c} means having different superscripts in the same row are significantly different ($P<0.05$). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress

Table (6): Effect of Bio-Factor on some hematological parameters of Japanese quail at 6 weeks of age**.**

Treatment Items	NC	Heat stress groups (HS)				SEM	P Value
		PC	BF, 25	BF, 50	BF,75		
RBCs(10^6/mm^3)	1.70^a	1.55^b	1.53^b	1.65^a	1.65^a	0.06	0.043
PCV (%)	31.3	29.3	29.01	29.1	29.7	1.566	0.840
Hemoglobin (g/dl)	10.7	10.0	10.0	9.02	10.0	0.504	0.973
WBCs (10^3/mm^3)	18.0	17.5	17.7	17.9	17.6	0.973	0.581
Heterophils (H)	56.2	57.8	56.8	55.8	56.9	1.469	0.563
Eosinophils%	0.331^c	1.31^a	1.01^{ab}	0.341^c	0.371^c	0.351	0.024
Basophils%	0.881	0.67	0.514	0.671	0.672	0.213	0.210
Monocytes%	8.32	7.99	7.97	8.07	7.06	0.451	0.498
Lymphocytes (L, %)	34.3	32.2	33.7	35.1	35.0	1.028	0.474
H/L ratio	1.64^b	1.80^a	1.69^b	1.59^b	1.63^b	0.544	0.041

^{a,b,c} means having different superscripts in the same row are significantly different (P<0.05). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor 0.0% bio-factor (HS); BF25= 25cm/liter bio-factor (HS); BF50= 50cm/liter bio-factor (HS); BF75HS= 75 cm/liter bio-factor (HS), HS: Heat stress

Table (7): Effect of Bio-Factor on some biochemical parameters of Japanese quail at 6 weeks of age**.**

Treatment Items	NC	Heat stress groups (HS)				SEM	P Value
		PC	BF, 25	BF, 50	BF,75		
T.lipids mg/dl	310^b	382^a	313^b	322^b	326^b	4.71	0.0390
T-Chol mg/dl	156^c	184^a	172^b	170^b	169^b	13.13	0.0001
Triglycerides mg/dl	144^b	170^a	167^a	136^{bc}	105^c	1.602	0.0001
HDL mg/dl	97.0^a	91.5^b	97.4^a	104.0^a	102.0^a	1.025	0.0310
LDL mg/dl	20.4	17.9	18.8	17.2	17.0	1.080	0.5890

^{a,b,c} means having different superscripts in the same row are significantly different (P<0.05). .SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress, T-Chol=Total cholesterol (mg/dl), TLip=Total lipids (mg/dl), LDL=Low density lipoprotein (mg/I), HDL= High density lipoprotein (mg/I)

Table (8) : Effect of Bio-Factor on liver and kidney functions, some hormones and enzymes of Japanese quail at 6 weeks of age**.**

Treatment Items	NC	Heat stress groups (HS)				SEM	P Value
		PC	BF, 25	BF, 50	BF,75		
GPx (mu/ml)	28.2 ^{b}	31.8 ^{a}	30.0 ^{ab}	30.4 ^{ab}	29.9 ^{b}	0.608	0.042
TAC (mg/dl)	0.790^{b}	0.827^{a}	0.830^{b}	0.780^{b}	0.787^{b}	0.095	0.045
LP U/L	1.10^{b}	1.25^{a}	1.09^{b}	1.07^{b}	1.01^{b}	0.300	0.0001
(AST) U/L	156^{b}	185^{a}	164^{b}	170^{b}	175^{b}	0.177	0.0411
(ALT) U/L	10.9	11.2	11.0	11.7	11.3	0.235	0.062
(ALP) U/L	75.1^{b}	81.6^{a}	74.2^{b}	60.4^{c}	60.5^{c}	0.750	0.001
Uric acid (mg/dl)	3.26	2.94	3.22	2.96	2.95	0.320	0.221
T3(ng/ml^{-1})	6.6 ^{a}	5.59 ^{b}	5.64 ^{b}	6.1 ^{ab}	6.06 ^{ab}	0.355	0.039
T4(ng/ml^{-1})	12.4^{a}	10.2 ^{b}	10.4 ^{b}	10.7 ^{b}	10.9 ^{b}	0.713	0.032

^{a,b,c} means having different superscripts in the same row are significantly different (P<0.05). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress, GPx=glutathione peroxidase (mu/ml), TAC=total antioxidant capacity (mg/dl) LP= lipid peroxide (nmol/ml), AST=Aspartate Amino Transferase ALT=Alanine Amino Transferase, ALP=Alkaline Phosphatase,T3=Triiodothyronine and T4=Thyroxine

Table(9): Effect of Bio-Factor on intestinal microbiota of Japanese quail at 6 weeks of age**.**

Treatment Items	NC	Heat stress groups (HS)			
		PC	BF, 25	BF, 50	BF,75
Total coliform count	13x10^{2}	12x10^{2}	10x10^{2}	11x10^{2}	9x10^{2}
Total anaerobic count	4x10^{1}	3x10^{2}	3x10^{1}	-ve	-ve
Aerobic plate count	5x10^{1}	5x10^{1}	3x10^{1}	3x10^{1}	3x10^{1}

^{a,b,c} means having different superscripts in the same row are significantly different (P<0.05). SEM: standard error of means, P value: probability level. NC= negative control group without supplementation of bio-factor; PC = positive control group under HS without supplementation of bio-factor; BF25= 25 ml bio-factor /liter; BF50 = 50ml/liter bio-factor (HS); BF75= 75 ml /liter; Heat stress

REFERENCES

Abbas, G.; Mahmood, S.; Nawaz H. 2017. Effect of dietary inclusion of sodium bicarbonate on blood profile of caged layers during summer. Pakistan Journal of Agricultural Sciences 2017; 54 (2): 443-450.

Abo Ghanima, M. M., M. E. Abd El-Hack, S. I. Othman, A. E. Taha, and A. A. Allam. 2020. Impact of different rearing systems on growth, carcass traits, oxidative stress biomarkers, and humoral immunity of broilers exposed to heat stress. Poult Sci. 99:30703078.

Altan et al. (2003). observed that blood lymphocytes decrease and increase on heterophils, which led to increasing in blood H/L ratio from 0.24 to 0.42 in heat-stressed broilers

Altan, O.; Pabuçcuoğlu, A.; Altan, A.; Konyalioğlu, S.; Bayraktar, H. 2003. Effect of heat stress on oxidative stress, lipid peroxidation and some stress parameters in broilers. British Poultry Science, 44:545-550.

Ani, A.O. and Okpara, M.O. 2019. Effect of Ambient Temperature on the Performance of Shaver Brown Hens in Hot Humid Environment. Asian Journal of Advances in Agricultural Research 9(3): 1-10,

Anjum NA, Sharma P, Gill SS, et al. 2016. Catalase and ascorbate peroxidase – representative-H2O2-detoxifying heme

enzymes in plant. Environ Sci Pollut Res 23:19002–29.

AOAC, 2005. Association of Official Analytical Chemists International. Officials methods of analysis. 18th ed. (Washington: Association of Analytical Communities International).

Asechi M, Tomonaga S, Tachibana T, Han L, Hayamizu K, Denbow DM,2006. Intracerebroventricular injection of Lserine analogs and derivatives induces sedative and hypnotic effects under an acute stressful condition in neonatal chicks. Behav Brain Res. (2006) 170:71–7. doi: 10.1016/j.bbr.2006.02.005.

Aswathi, P.B.; S.K. Bhanja; Puneet Kumar1, T.S. Shyamkumar, Manish Mehra. 2019.. Effect of acute heat stress on the physiological and reproductive parameters of broiler breeder hens – A study under controlled thermal stress. Indian J. Anim. Res., 53(9) 2019: 1150-1155. Print ISSN: 0367-6722 / Online ISSN:0976-0555.

Attia ,Y.A;Hassan, S.S . 2017. Broiler tolerance to heat stress at various dietary protein/energy levels. Europ Poult Sci:81: DOI:10.1399/eps.171.

Attia, Y. A.; Al-Harthi, M. A. and Hassan, S. Sh. 2021. Responses of broiler chicken to different oil levels within constant energy levels from 20 to 40 days of age under hot weather conditions. Ital J. Anim. Sci. 20, 664–676. https://doi.org/10.1080/1828051X.2021.1906169-Q1.

Attia, Y.A.; A.A.Abedalla.; M.A.Berika.; A.E.Abd El-Hamid and B. M. Abou-Shehema 2012. Effect of Betaine with or without two antioxidants on the performance of dual purpose breeding hens exposed to heat stress. J. Agric. And Environ. Sci.Egypt. Des 2012

Attia, Y.A.; M.Böhmer Barbara and D.A. Roth-Maier 2006. Responses of broiler chicks raised under constant relatively high ambient temperature to enzymes, amino acid supplementations, or diet density. Archiv Für Geflügelkunde., 70: 80-91.

Attia, Y.A.; Mohammed, A. Al-Harthi and Asmaa Sh. Elnaggar. 2018. Productive, physiological and immunological responses of two broiler strains fed different dietary regimens and exposed to heat stress. Ita J. of Animal Science, 2018: 17(3):686-697.

Attia, Y.A.; R.A.Hassan and E.M.Qota 2009. Recovery from adverse effects of heat stress on slow-growing chicks in the tropics 1: Effect of ascorbic acid and different levels of betaine. Tropical Animal health and Production, 41: 807-818.

A**ttia, Y.A.; R.A.Hassan.; A.E.Tag El-Din and B.M.Abou-Shehema 2011.** Effect of ascorbic acid or increasing metabolizable energy level with or without supplementation of some essential amino acids on productive and physiological traits of slow-growing chicks exposed to chronic heat stress. Journal of Animal Physiology and Animal Nutrition., 95: 744-755.

Attia, Y.A.;, Asmaa Sh. El-Naggar; Abou-Shehema, B.M. and Abdella, A.A., 2019. Effect of Supplementation with Trimethylglycine (Betaine) and/or Vitamins on Semen Quality, Fertility, Antioxidant Status, DNA Repair and Welfare of Roosters Exposed to Chronic Heat Stress. Animals. 9, 547; doi:10.3390/ani9080547

Awad, E. A.; Zulkifli, I.; Soleimani, A. F. and Loh, T. C. 2015. Individual non-essential amino acids fortification of a low-protein diet for broilers under the hot and humid tropical climate. Poult. Sci., 94:2772–2777.

Ayo, J.O; Obidi,J.A; Rekwot, P.I . 2011. Effects of heat stress on the well-being, fertility, and hatchability of chickens in the northern guinea savannah zone of Nigeria: a review. ISRN Veterinary Science 1-10. Available from: http://doi.org/10.5402/2011/838606.

Azad MA, 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 A Mol Integr Physiol. (2010) 155:401–6. doi: 10.1016/j.cbpa.2009.12.011.

Badran, A. M. and Abd-Elaal, S. A. 2020. Effect of acute heat stress conditions on egg production, egg shell quality, intestinal calcium transport and calbindin of the laying hens. Egypt. Poult. Sci., Vol. (40) (I): (291-303).

Balnave D, Oliva AG.1991. The influence of sodium bicarbonate and sulfur amino acids on the performance of broilers at moderate and high temperatures. Aust J Agric Res. (1991) 42:1385–97. doi: 10.1071/AR9911385.

Barrett, N. W.; Rowland, K.; Schmidt, C. J.; Lamont, S. J.; Rothschild, M. F.; Ashwell, C. M. and Persia, M. E. 2019. Effects of acute and chronic heat stress on the performance, egg quality, body temperature, and blood gas parameters of laying hens. Poult. Sci., Dec 1; 98(12):6684-6692. Doi: 10.3382/ps/pez541.

Bartles, H., Bohmer, M. and Heirli, C., 1972. Serum creatinine determination without protein precipitation.Clin, Chem, Acta. 37, 193.

Belfield, A. and Goldberg, D, M., 1971. Human serum glucose-6-phosphatase activity: confirmation of its presence and lack of diagnos c value. Clin. chim. Acta, 31: 81-85.

Blacher, E.; Levy, M.; Tatirovsky, E.; Elinav, E.2017. Microbiome-Modulated Metabolites at the Interface of Host Immunity. J. Immunol. 2017, 198, 572–580. [CrossRef].

Blaxhall, P.C. and Daisley, K.W., 1973. Routine haematological methods for use with fish blood. J. Fish Biol., 5: 771-781.

Bollengier-Lee, S.; P.E. Williams and C.C. Whitehead. 1999. Optimal dietary concentration of vitamin E for alleviating the effect of heat stress on egg production in laying hens. Br. Poult. Sci., 40: 102-107.

Borges, S.A.; D.A.Fischer.; A.V.Silva.; A.Majorka.; D.M.Hooge and K.R. Cummings 2004. Physiological responses of broiler chickens to heat stress and dietary electrolyte balance (sodium plus potassium minus chloride, milliequivalents per kilogram). Poult. Sci., 83: 1551-1558.

Bortoluzzi,CC.; L. Lahaye,* F. Perry,y R. J. Arsenault,y E. Santin,*,1 D. R. Korver,z and M. H. Kogutx, 2021. A protected complex of biofactors and antioxidants improved growth performance and modulated the immunometabolic phenotype of broiler chickens undergoing early life stress. Poultry Science 100:101176 https://doi.org/10.1016/j.psj.2021.101176

Bossila, E.A.; Y. A. Dowidar; K. R.; Mohamed and A. M. El Refy, 2023. Comparative Effectiveness of Organic Additives and Antibiotics in Enhancing Meat Quality and Production Performance of Broiler Chickens. Al-Azhar Journal of Agricultural Research V. (48) No. (1)

Chowdhur, S.D.; Ray, B.; Khatun, A.; Redoy, M.R. and Afsana, A., 2020. Application of probiotics in layer diets: a review. Bangladesh J Anim Sci., 49:1-12. https://doi.org/10.3329/bjas.v49i1. 49372.

Clench, M.H. and Mathias, J.R., 1995. The avian cecum: a review. Wilson Bull 107:93–121

Daghir NJ. Nutrient requirements of poultry at high temperature. In: Daghir NJ, editor.2008. Poultry Production in Hot Climates. 2nd ed. Wallingford: CABI (2008). p. 132–59. doi: 10.1079/9781845932589.0132.

Daghir, N.J. 2008. Poultry Production in Hot Climates, 2nd Edition, Published by CAB International, Wallinford, Oxfordshire, UK, pp. 387**Devi, G. S., M. H. Prasad, I. Saraswathi, D. Raghu, D. N. Rao, and P. P. Reddy. 2000.** Free radicals antioxidant enzymes and lipid peroxidation in different types of leukemias. Clin. Chim. Acta 293:53–62.

Drubkin, D. 1964. Spectrophotometric methods XIV. The crystographic and optical properties of the haemoglobin of man in comparison with those of other species. J. Biol. Chem., 164: 703-723.

El_ Habbak, M.M.; El-Ghamry , A.A., and El-Mallah, G.M., 2011. Influence of dietary Vitamin E and C supplementation on performance and some metabolic response of broiler chicks subjected to heat stress. Uganda Journal of Agricultural Sciences 7(3):258-269

El-Sheikh, A.M.H.; M.H.Maysa.; A.A.Amer and M.H.Khalil 2004. physiological responses in females of Japanese quail to solar radiation temperature. Egy.Poult.Sci.Vol. 24: 767-786.

El-Sheikh, T.M.; E.A.Abdalla and M.Hanafy 2009. Study on productive performance, hematological and immunological performance in a local strain of chicken as affected by mannan oligosaccharide under

hot climate conditions. Egypt. Poult. Sci., 29: 287-305.

Erwan E, Chowdhury VS, Nagasawa M, Goda R, Otsuka T, Yasuo S, 2014. Oral administration of D-aspartate, but not Laspartate, depresses rectal temperature and alters plasma metabolites in chicks. Life Sci. (2014) 109:65– 71. doi: 10.1016/j.lfs.2014.05.015.

Felver-Gant, J. N., Mack, L. A., Dennis, R. L., Eicher, S. D., & Cheng, H. W. 2012. Genetic variations alter physiological responses following heat stress in 2 strains of laying hens. Poultry Science, 91, 1542–1551. https://doi.org/10.3382/ps.2011-01988.

Fossati, P. and Prencipe, L.,1982. Colorimetricaly with an enzyme that produce hydrogen peroxide . Clin. Chem., 28: 2077-80.

Friedewald ,W.T., Levy, R.I. and Fredrickson, D.S., 1972. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin. Chem. 18:499– 502.

Habashy, W. S.; Milfort, M. C.; Rekaya , R. and Aggrey, S. E. 2019. Cellular antioxidant enzyme activity and biomarkers for oxidative stress are affected by heat stress. Int. J. Biometeorol. 63(12):1569-1584. Doi: 10.1007/s00484-019-01769-z.

H**abashy, W. S.; Milfort, M. C.; Rekaya , R. and Aggrey, S. E. 2019.** Cellular antioxidant enzyme activity and biomarkers for oxidative stress are affected by heat stress. Int. J. Biometeorol. 63(12):1569-1584. Doi: 10.1007/s00484-019-01769-z.

Habashy, W.S.; M. C. Milfort, K. Adomako, Y. A. Attia,, R. Rekaya, and S. E. Aggrey, 2017. Effect of heat stress on amino acid digestibility and transporters in meat-type chickens. Poultry Science 96:2312–2319 http://dx.doi.org/10.3382/ps/pex027

Han G, Ouchi Y, Hirota T, Haraguchi S, Miyazaki T, Arakawa T, 2020. Effects of l-leucine in ovo feeding on thermotolerance, growth and amino acid metabolism under heat stress in broilers. Animal. (2020) 14:1701– 9. doi: 10.1017/S1751731120000464.

Hawkey, C.M., and Dennett, T.B., 1989. A color atlas of comparative veterinary hematology. Wolf Publishing limited, London, England.

He, X.; Lu, Z.; Ma, B.; Zhang, L.; Li, J.; Jiang, Y.; Zhou, G. and Gao, F. 2018. Effects of chronic heat exposure on growth performance, intestinal epithelial histology, appetite-related hormones and genes expression in broilers. J. Sci. Food Agric. 98: 4471–4478.

Hollander, C.S. and Shenkman, L., 1974. Radiimmunoassay for triiodothyronine and thyroxine. in rothfeld B, editor. nuclear medicine in vitro. philadelphia: lippincott.

Jafari,M.J.; Iranpour, S.; Gravandi, S.; Tehrani, B.J.; Askari, M.; Omidi, A., and Nasori, M. 2021. The effects of heat stress exposure on free amino acid concentrations within the plasma and the brain of heat-exposed chicks: A systematic review and meta-analysis. Journal of Thermal Biology, 97: 102872

Jiang, Y.; Juan Hou, Chang Liu, Chunhui Zhao, Yangming Xu, Dr. Wu Song, Zunhua Shu, Prof. Bingmei Wang, 2023. Inhibitory Effect of Salicin on Staphylococcus aureus Coagulase. ChemMedChen. 18, Issue 22 e202300302. https://doi.org/10.1002/cmdc.202300302

Johnson, C.N.; Kogut, H.K.; Genovese, K.; He, H.; Kazemi, S. and Arsenault, R.J., 2019. Administration of a Postbiotic Causes Immunomodulatory Responses in Broiler Gut and Reduces Disease Pathogenesis Following Challenge. Microorganisms 2019, 7, 268; doi:10.3390/microorganisms7080268

Kalvandi, O.; Sadeghi, A. and Karimi, A. 2019. Methionine supplementation improves reproductive performance, antioxidant status, immunity and maternal antibody transmission in breeder Japanese quail under heat stress conditions. Arch. Anim. Breed., 62, 275–286.

Kalvandi, O.; Sadeghi, A. and Karimi, A., 2022. Arginine supplementation improves reproductive performance, antioxidant status, immunity and maternal antibody transmission in breeder Japanese quail under heat stress conditions, Italian Journal of Animal Science, 21:1, 8-17, DOI: 10.1080/1828051X.2021.2013136 To link to

this article: https://doi.org/10.1080/1828051X.2021.2013136

Klemashevich, C.; Wu, C.; Howsmon, D.; Alaniz, R.C.; Lee, K.; Jayaraman, A.2014. Rational identification of diet-derived postbiotics for improving intestinal microbiota function. Curr. Opin. Biotech. 2014, 26, 85–90. [CrossRef] [PubMed].

Kobierecka, P. A., Wyszynska, A. K., Aleksandrzak-Piekarczyk, T., Kuczkowski, M., Tuzimek, A., Piotrowska, W., et al. 2017. In vitro characteristics of Lactobacillus spp. strains isolated from the chicken digestive tract and their role in the inhibition of Campylobacter colonization. MicrobiologyOpen 6:e00512. doi: 10.1002/mbo3.512.

Kovacs AT, Dragos A.2019. Evolved bioflm: review on the experimental evolution studies of Bacillus subtilis pellicles. J Mol Biol. 2019;431:4749–59.

Kucuk, O; Şahin, N. and Kazim Sahin, K, 2003. Supplemental Zinc and Vitamin A Can Alleviate Negative Effects of Heat Stress in Broiler Chickens.Biological Trace Element Research 94(3):225-35. DOI: 10.1385/BTER:94:3:225.

Lara, L.J.; Rostagno, M.H. 2013. Impact of heat stress on poultry production. Animals 3, 356–369. Leeson, S., Summers, J.D., 2001. Scott's Nutrition of the Chicken, fourth ed. University Books, Guelph, Ontario, Canada.

Lee NK, Kim WS, Paik HD.2019. Bacillus strains as human probiotics: characterization, safety, microbiome, and probiotic carrier. Food Sci Biotechnol. 2019;28:1297–305

Li, C; Yunfeng, W.; Guocheng, W.; Yining, C.; Jinqiang, G.; Chenglong, P.; Enguang, L.and Qufei, L., 2019. Physicochemical changes in liver and Hsc70 expression in pikeperch Sander lucioperca under heat stress. Ecotoxicol Environ Saf 181:130–137

Li, M.; Wu. J. and Chen, Z. 2015. Effects of Heat Stress on the Daily Behavior of Wenchang Chickens. Braz. J. Poult. Sci. 559-566.

Lin H, Jiao H, Buyse J, Decuypere E.2006. Strategies for preventing heat stress in poultry. Worlds Poult Sci J. (2006) 62:71–86. doi: 10.1079/WPS200585.

Lopez-Virella, M. F. et al. 1977. Cholesterol determination in high-density lipoproteins separated by three different methods. Clin. Chem. Vol (23), 882-884.

Lucky, Z., 1977. Methods for the diagnosis of fish diseases. Ameruno Publishing Co, PVT, Ltd. New Delhi, Bomby, New York.

Lutful Kabir, S. M. 2009. The role of probiotics in the poultry industry. Int. J. Mol. Sci. 10, 3531–3546. doi: 10.3390/ijms10083531.

McNabb, F.M. and D.B. King. 1993. Thyroid hormones effect on growth development and metabolism. In: M.P. Schreibman, C.G. Scanes and P.K.T. Pany,(Eds.) The endocrinology of growth development and metabolism in vertebrates. PP. 3 93-417(New York, Academic Press).

Mujahid, A., N. R. Pumford, W. Bottje, K. Nakagawa, T. Miyazawa, Y. Akiba, and M. Toyomizu. 2007. Mitochondrial oxidative damage in chicken skeletal muscle induced by acute heat stress. Jpn. Poult. Sci. 44:439–445.

Munonye 2023. Goblet warming and climate change represent a new important challenge for poultry breeders.

Neal-McKinney, J. M., Lu, X., Duong, T., Larson, C. L., Call, D. R., Shah, D. H., et al. 2012. Production of organic acids by probiotic lactobacilli can be used to reduce pathogen load in poultry. PLoS One 7:e43928. doi: 10.1371/journal. pone.0043928.

NRC. 1994. Nutrient requirements of poultry. 9 rev. ed. Natl. Acad. Press, Washington, DC.

Olfati. A.; Mojtahedin. A.; Sadeghi. T.; Akbari. M. and Martínez-Pastor. F. 2018. Comparison of growth performance and immune responses of broiler chicks reared under heat stress, cold stress and thermoneutral conditions. Span. J. Agric. Res. 16 (2), e0505, 7 pages eISSN: 2171-9292.

Olmos J, Acosta M, Mendoza G, Pitones V.2020. Bacillus subtilis, an ideal probiotic bacterium to shrimp and fsh aquaculture that increase feed digestibility, prevent microbial diseases, and avoid water pollution. Arch Microbiol. 2020;202:427–35.

Perederiy, D.B., 2023. The influence of heat stress on the antioxidant protection

glutathione link and the content of lipid peroxidation products in chicken liver. The Animal Biology, 25, no. 4. https://doi.org/10.15407/animbiol25.04.051. UDC 591.128/616-001.16:612.176:636.52/.58:616.36.

Rahimnejad, S.; Yuan, Y.Y.; Liu, W.;Jiang, G.Z.; Cao, X.F.; Dai, Y.I..; Wang, C.C. and Desouky, H.E.,2020. Evaluation of antioxidant capacity and immunomodulatory effects of yeast hydrolysates for hepatocytes of blunt snout bream (Megalobrama amblycephala). Fish & Shellfish Immunology.106:142-148.

Ramirez-Olea, H.; Reyes-Ballesteros, B.; Chavez-Santoscoy, R.A.2002. Potential Application of the Probiotic Bacillus Licheniformis as an Adjuvant in the Treatment of Diseases in Humans and Animals: A Systematic Review. Front. Microbiol. 2022, 13, 993451. [CrossRef]

Reitman, S. and Frankle, S.A., 1957. Colorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvic transaminase. Am. J. Clinic. Pathol., 28:56-63.

Renaudeau, D.; Collin, A.; Yahav, S. ; Basilio, V.; Gourdine, J.L.;Collier, R.J. 2011. . Adaptation to ho cli,mate and strategies to alleviate heat stress in livestock production. Animal;6:707–728

Ricard, M.J., Portal, B., Meo, J., Coudray, C., Hadjian, A. and Favier, A., 1992. Malondialdehyde kit evaluated for determining plasma and lipoprotein fractions that react with Thiobarbituric acid. Clinical Chemistry, 38:704-709.

Saeed, M.; Xu, Y.T.; Zhang, T.T.; Ren, Q.; Sun, C. 2018b.. ribosomal RNA sequencing reveals a modulation of intestinal microbiome and immune response by dietary L-theanine supplementation in broiler chickens. Poultry Science;98(2):842-854.

Saeed, M.; Xu, Y.T.;Hassan, F.U. ; Arain, M.; Elhack. M.A.; Ahamed. N.2018a .. Influence of graded levels of l-theanine dietary supplementation on growth performance, carcass traits, meat quality, organs histomorphometry, blood chemistry and immune response of broiler chickens. International Journal of Molecular Sciences;19(2):462.

Sahin K, Orhan C, Tuzcu M, Ali S, Sahin N, Hayirli A.2010. Epigallocatechin-3-gallate prevents lipid peroxidation and enhances antioxidant defense system via modulating hepatic nuclear transcription factors in heat-stressed quails. Poult. Sci. 2010; 89 (10): 2251–2258. DOI: 10.3382/ps.2010-00749.

SAS Inistitute ,2009. SAS User's Guide:statistics Version 5th ed ., SAS Inst., Inc., Cary, NC,USA.

Sefcova, M., Larrea-Alvarez, M., Larrea-Alvarez, C., Karaffova, V., Revajova, V., Gancarcikova, S., et al. 2020a. Lactobacillus fermentum Administration Modulates Cytokine Expression and Lymphocyte Subpopulation Levels in Broiler Chickens Challenged with Campylobacter coli. Foodborne Pathog. Dis. 17, 485–493. doi: 10.1089/fpd.2019.2739 .

Shleeva, M.O.; Kondratieva, D.A.; Kaprelyants, A.S., 2023) Bacillus licheniformis: A Producer of Antimicrobial Substances, including Antimycobacterials, Which Are Feasible for Medical Applications. Pharmaceutics. 15, 1893. https://doi.org/10.3390/ pharmaceutics15071893

Sohail et al., 2012 Sohail, M. U.; Hume, M. E.; Byrd, J. A.; Nisbet, D. J.; Ijaz, A.; Sohail, A.; Shabbir, M. Z. and Rehman, H. 2012. Effect of supplementation of prebiotic mannan-oligosaccharides and probiotic mixture on growth performance of broilers subjected to chronic heat stress. Poult. Sci. 91: 2235–2240.

Sohail, M. U.; Ijaz, A.; Yousaf, M. S.; Ashraf, K.; Zaneb, H.; Aleem, M. and Rehman, H. 2010. Alleviation of cyclic heat stress in broilers by dietary supplementation of mannan-oligosaccharide and Lactobacillus-based probiotic: Dynamics of cortisol, thyroid hormones, cholesterol, C-reactive protein, and humoral immunity. Poult. Sci., 89, 1934–1938.

Stein, E.A., 1986) Textbook of clinical chemistry, NW Tietz, ed. W.B. Saunders, Philadelphia, pp: 879-886.

Stoica, R.-M.; Moscovici, M.; Tomulescu, C.; Casarica, A.; Babeanu, N.; Popa, O.; Kahraman, H.A.2019. Antimicrobial

Compounds of the Genus Bacillus: A Review. Rom. Biotechnol. Lett. 2019, 24, 1111–1119. [CrossRef].

Su, Y.; Liu, C.; Fang, H., and Zhang, D., 2020. REVIEW- Bacillus subtilis: a universal cell factory for industry, agriculture, biomaterials and medicine. Microb Cell Fact. 19:173 https://doi.org/10.1186/s12934-020-01436-8.

Taha-Abdelaziz, K., Astill, J., Kulkarni, R. R., Read, L. R., Najarian, A., Farber, J. M., et al. 2019. In vitro assessment of immunomodulatory and anti-Campylobacter activities of probiotic lactobacilli. Sci. Rep. 9:17903. doi: 10.1038/s41598-019-54494-3.

Tamzil, M. H.; Noor, R. R.; Hardjosworo, P. S.; Manalu, W. and Sumantri, C. 2014. Hematological response of chickens with different hsp70 genotypes to acute heat stress. Inter. J. Poult. Sci. 13 (1): 14-20.

Tan, G. Y., L. Yang, Y. Q. Fu, J. H. Feng, and M. H. Zhang. 2010. Effects of different acute high ambient temperatures on function of hepatic mitochondrial respiration, antioxidative enzymes, and oxidative injury in broiler chickens. Poult. Sci. 89:115–122.

Temim, S., A. M Chagneau, R. Peresson, and S. Tesseraud. 2000b. Chronic heat exposure alters protein turnover of three different skeletal muscles in finishing broiler chickens fed 20 or 25% protein diets. J. Nutr. 130:813–819.

Temim, S., A. M. Chagneau, S. Guillaumin, J. Mitchel, R. Peresson, and S. Tesseraud. 2000a. Does excess dietary protein improve growth performance and carcass characteristics in heat exposed chickens? Poult. Sci. 79:312–317.

Thomas, M. J.2000. The role of free radicals and antioxidants. Nutrition 16:716–718.

Verma et al., 2019. Disease activity index, reducing the length of the mice's colon, significantly lowering the microbiota, reducing the infiltration of neutrophils and macrophages into the colonic tissue, and avoiding physical mucosal damage in mice, salicin (one of BF's components) significantly decreased intestinal inflammation (Verma et al., 2019).

Wan, X.; Jiang, L.; Zhong, H.; Lu. Y.; Zhang, L. and Wang, T. 2017. Effects of enzymatically treated Artemisia annua L. on growth performance and some blood parameters of broilers exposed to heat stress. Anim. Sci. J. 88, 1239–1246.

Wolde, S.; Negesse, T. and Melesse, A. 2011. Effect of dietary protein concentration on feed intake, body mass gain and carcass traits of Rhode Island Red chicken. J. Sci. Dev., 1:53–64.

Yahav S.2015. Regulation of body temperature: strategies and mechanisms. In: Scanes CG, editor. Sturkie's Avian Physiology. 6th ed. London: Academic Press (2015). p. 869–905. doi: 10.1016/B978-0-12-407160-5.00037-3.

Yang, Y. S., Li, J. C., & Zou, Y. 2014. Resveratrol induces antioxidant and heat shock protein mRNA expression in response to heat stress in black-boned chickens. Poultry Science, 93, 54.

Zollner, N. and Krisch, K., 1962. Colorimetric method for determination of total lipids. J, of Exp. Medicine, 135:545-550.

Zulkifli, I.; M.T.Che-Norma.; D.A. Israf and A.R. Omar 2002. The effect of early age food restriction on heat shock protein 70 response in heat stressed female broiler chickens. Br. Poult. Sci., 43: 141-145.

الملخص العربي

تأثير إضافة البيوفاكتور على الأداء الإنتاجي والفسيولوجي للسمان الياباني تحت ظروف الإجهاد الحراري

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تهدف هذه الدراسة إلى دراسة تأثير مادة البيوفاكتور كمضاد أكسدة مضاف إلى مياه الشرب لتجنب التأثيرات الضارة للإجهاد الحراري على الأداء الإنتاجي، وتحسين الحالة المناعية وجودة اللحوم لدى السمان الياباني. تم توزيع 350 طائر سمان ياباني بعمر يوم واحد بشكل عشوائي على خمس مجموعات تجريبية (كل مجموعة تضم 7 مكررات و10 طيور/مكرر). استمرت التجربة لمدة 6 أسابيع. تم تربية المجموعة الأولى في غرفة منفصلة بدرجة حرارة 22-24 درجة مئوية ورطوبة نسبية 45-55% واستخدمت كضابطة سلبية (NC) أما المجموعات الأخرى فقد تعرضت للإجهاد الحراري (39 ± 1 درجة مئوية؛ رطوبة نسبية 55-65%) لمدة ثلاثة أيام متتالية أسبوعيا من الساعة 11:00 صباحا حتى 15:00 مساء.

المجموعة الثانية استخدمت كضابطة إيجابية (PC) تم تزويدها بمياه شرب دون أي إضافات ، بينما تم تزويد المجموعات الثالثة والرابعة والخامسة بمياه شرب تحتوي على 25 و50 و75 مل من البيوفاكتور لكل لتر من الماء ، على التوالي. أشارت النتائج إلى أن التعرض للإجهاد الحراري أدى إلى انخفاض كبير في وزن الجسم (BW) ومعدل الزيادة في وزن الجسم (BWG) ومعدل استهلاك العلف (FI) بنسبة 17.1%، 19.5%، و10.6% على التوالي لمجموعة PC ، كما تدهور معامل التحويل الغذائي (FCR) بنسبة 7.22% مقارنة بمجموعة NC في نهاية التجربة (6 أسابيع).

ومع ذلك، أدى استخدام 75 مل من البيوفاكتور إلى زيادة وزن الجسم وزيادة الوزن بنسبة 31.8% و37.9% على التوالي مقارنة بمجموعة PC، كما أدى إلى تعويض كامل للنقص في معدل استهلاك العلف بحيث أصبح مساويا إحصائيا لمجموعة PC، مع تحسين معامل التحويل الغذائي بنسبة 17.02% مقارنة بمجموعة PC..

كما أدى التعرض للإجهاد الحراري إلى انخفاض كبير في وزن الذبيحة، الدهون البطنية، البنكرياس، ووزن وطول الأمعاء لدى مجموعة PC بنسبة 2.11%، 1.72%، 12.5%، 2.36%، و6.05% على التوالي مقارنة بمجموعة NC. بينما أدى استخدام مستويات مختلفة من البيوفاكتور إلى تحسين وتعويض وزن الذبيحة بالكامل، وزيادة كبيرة في وزن وطول الأمعاء مقارنة بمجموعة PC.

وانخفض محتوى اللحم من البروتين الخام (CP) في مجموعة HS من 22.43% إلى 21.84% بنسبة 3.1% مقارنة بمجموعة NC، في حين أن استخدام البيوفاكتور (25، 50، و75 مل/لتر من مياه الشرب) أدى إلى زيادة محتوى البروتين الخام بنسبة 4.72%، 12.41%، و14.65% على التوالي مقارنة بمحتوى البروتين الخام في لحم مجموعة PC.

كما أدى زيادة مستويات البيوفاكتور إلى زيادة محتوى اللحم من الأحماض الأمينية الأساسية وغير الأساسية. وأظهرت النتائج أن مجموعة PC المعرضة للإجهاد الحراري شهدت زيادة كبيرة في الدهون الكلية والكوليسترول الكلي ومستويات الدهون الثلاثية في البلازما، بالإضافة إلى زيادة في العدد الكلي للكوليفورم والبكتيريا اللاهوائية والهوائية، بينما انخفض نشاط إنزيمات GPx، TAC، LP، AST، وALP، وكذلك مستويات HDL، 3T، و4T مقارنة بالمجموعات الأخرى.

ومع ذلك، أدى زيادة مستويات البيوفاكتور إلى استعادة نشاط إنزيمات GPx، TAC، LP، AST، وALP في المجموعات تحت الإجهاد الحراري، وتحسين جميع ميكروبات الأمعاء مقارنة بمجموعتي NC وPC.

الاستنتاج: البيوفاكتور منتج آمن ويمكن استخدامه كمضاد للإجهاد الحراري، كما أن الإضافة الفموية للبيوفاكتور بمقدار 50 و75 مل/لتر من الماء حسنت الأداء النموذجي، والمعايير البيوكيميائية، والصحة العامة للسمان الياباني النامي.

الكلمات المفتاحية: السمان الياباني، البيوفاكتور، الأداء، البيوكيميائية، المناعة.