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Effects of Organic Zinc and Probiotic on Carcass Characteristics of Broiler Chickens Under Heat Stress Conditions

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Abstract:
This study aimed to evaluate the impact of heat stress (HS) on carcass characteristics of broiler chickens fed with organic zinc and probiotics. A total of 250-day-old (Ross 308) chicks were randomly divided into five groups (50 chicks per group), with two replicates for each group. The negative control treatment (T1) received a basal diet without HS. The second treatment received a basal diet under HS as a positive control (T2). The third treatment (T3) was fed a basal diet with added zinc (1 g/kg) under the influence of heat stress. The fourth treatment (T4) was fed a basal diet with added probiotics (1 g/kg) under the influence of heat stress. The fifth treatment (T5) was fed a basal diet with zinc + probiotics (1 g zinc + 1 g probiotics/kg). The carcass and edible offal characteristics of groups T5, then, T4, and T3 showed a significant improvement ($P \leq 0.05$) as compared to the control groups .In conclusion, adding zinc plus probiotics to the diet under heat stress might improve carcass characteristics.

Keywords:
Broilers, Organic Zinc, Probiotic, Heat Stress, and carcass characteristics.

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Introduction

Zinc (Zn) is an essential trace element for animals. In human proteins, there are 2,800 kinds of Zn-binding sites, accounting for about 10% of the human proteome; zn-binding proteins can play an important role in life activities as metalloenzymes, growth factors, receptors, and transcription factors. In the majority of tropical countries, heat stress is one of the most important stressors negatively affecting the poultry industry, leading to a great economic loss each year. Higher ambient temperature is detrimental to live weight gain, feed intake (FI), feed efficiency, nutrient utilization, protein digestibility, total mineral retention and immune response of chicken broilers,[1] heat stress can potentially promote formation of excess quantities of reactive oxygen species (ROS), which damages cell phospholipid membranes and other vital macromolecules causing lipid peroxidation, that consequently associated with disorders, such as apoptosis, various diseases and impairing muscle membrane integrity,[2] Dietary zinc (Zn) supplementation has also been reported to have a positive effect on the growth rate and feed efficiency of growing poultry under stress conditions , Zinc is a fundamental element required for normal growth performance, bone development, feathering, skin quality, immunity, appetite regulation and structure and function of more than 300 enzymes associated with carbohydrate and energy metabolism, protein degradation and synthesis, nucleic acid synthesis, carbon dioxide transport and many other reactions[3] Heat stress (**HS**), one of the most serious climate problems of tropical and subtropical regions of world, negatively affects the production performance of poultry and livestock. Concisely, HS is characterized by endocrine disorders, reduced metabolic rate, lipid peroxidation, decreased feed consumption, decreased BW gain, higher feed conversion ratio (**FCR**), immunosuppression, and intestinal microbial dysbiosis [4]. Probiotic supplementation was proven beneficial for improving chicken performance and immunity under HS conditions [5]. Probiotics have been used as feed additives in poultry to promote a healthy gut environment and improve growth performance [6]. It has been reported that probiotic bacteria may acquire and transfer antibiotic resistance genes between organisms [7]. The presence of antimicrobial metabolites, such as organic acids and bacteriocins, in postbiotics can reduce the gut pH and inhibit the proliferation of opportunistic pathogens in the feed and gut of animals [8]. Heat stress remains a major problem in poultry production systems having adverse effects on animal health and productivity [9].

Study Aim

This study aims to determine the efficacy effect of organic zinc and probiotics on carcass characteristics of broiler chickens under Heat Stress Conditions.

Materials and Methods

Experiment design and dietary treatment

This experiment was carried out in a developed private poultry house. Hatchlings were obtained from a commercial hatchery. Two hundred and fifty-one-day-old Ross 308 broiler chicks were randomly divided into five groups, 50 chicks per group. The birds in each group were randomly divided into 2 replicates of 25 birds each.

The T1 group served as the negative control and was fed a corn-soybean diet after weaning without being exposed to heat stress (HS). The T2 group, acting as the positive control, was fed the same corn-soybean diet but under heat stress conditions. The T3 treatment group received a corn and soybean meal diet supplemented with 1 g/kg of zinc during the starter and grower phases while under heat stress. The T4 group was given a corn and soybean meal diet with 1 g/kg of probiotics during the same phases under heat stress. Lastly, the T5 group received a combination of both supplements—1 g/kg of zinc and 1 g/kg of probiotics—in their corn and soybean meal diet during the starter and grower phases, also under heat stress conditions.

Table 1. Ingredients and nutrient composition of broiler starter diets from 1-15 days and grower from 16-35 days.

Ingredient (%)	Starter diet 1-15day	grower diet 16-35 day
Yellow corn	30.0	30.0
Wheat	27.5	35.5
Soybean meal (45%)	38.0	30.0
Vegetable oil	3.0	3.0
Limestone	1.0	1.0
Vitamin premix1	2.5	2.5
Sodium chloride	0.25	0.25
Total	100	100
Metabolizable energy (Kcal /Kg)	3032	3157
Crude protein (%)	22	21
Calorie: protein ratio	137.8	137.2
Ether extract (%)	5.9	6.17
Crude fiber (%)	3.68	3.33
Calcium (%)	1.1	1.1
Phosphorus available (%)	0.48	0.51
Lysine (%)	1.22	1.1
Methionine (%)	0.42	0.38

Each kilogram of broiler starter diet (Provimi 3088 Jordan Co., Amman, Jordan) contained the following: iron, 44 mg; copper, 5 mg; zinc, 75mg; manganese, 6 mg; iodine, 1.306 mg; selenium, 0.225 mg; folic acid, 0.6 mg; biotin, 100 g; pantothenic acid, 10 mg; niacin, 39.994 mg; vitamin A (retinyl acetate), 12,500 IU; vitamin D3, 2,500 IU; vitamin E, 50 IU; vitamin K3, 3.5 g; vitaminB1, 1 g; vitamin B2, 5.5 g; vitamin B6, 2.5 g; vitamin B12, 20.0 g.

Results

The research results showed that broiler chicken live body weight and carcass weight without feathers and viscera and with edible parts and gizzard and liver and heart values all significantly increased in treatment T5 ($P \leq 0.05$) with 2238.00, 2072.38, 1642.69, 1761.26, 46.00, 57.30, and 15.27, respectively. The control groups T1 and T2 showed lower values than treatments T3 and T4. The research findings confirm that zinc and probiotics boost carcass characteristics. The best carcass features were achieved through Zn at 1 g/kg and probiotic at 1 g/kg combination in heat stress-supplemented diets which was most effective in treatment T5 and then T3 and T4.

Table 3. Effect zinc and probiotic on carcass characteristic (g) (mean ±SD)

GROUP g	T1	T2	T3	T4	T5
Live body weight	1955.00±6.36D	1939.00±1.22E	2183.00±0.70B	2155.00±6.48C	2238.00±2.5A
Carcass Without feathers	1810.33±5.89D	1795.51±1.13E	2021.45±0.65B	1995.53±6.00C	2072.38±2.36A
Carcass without viscera	1434.97±4.67D	1423.22±0.89E	1602.32±0.51B	1581.77±4.75C	1642.69±1.87A
Carcass with edible	1517.17±9.57D	1512.62±5.12E	1692.94±1.32B	1681.86±11.92C	1761.26±5.42A
gizzard	34.85±1.31C	34.35±0.93C	37.82±1.31B	40.02±0.98B	46.00±3.53A
liver	37.00±5.04C	43.40±6.13BC	39.35±1.47C	47.64±9.25B	57.30±3.60A
heart	10.35±0.55D	11.65±0.94CD	13.45±0.84B	12.42±0.67BC	15.27±1.91A

Different letters among groups showed a significant difference at ($p \leq 0.05$). The control positive group (T1) control negative group fed basal diet without any additives, (T2) control positive group fed basal diet without any additives,

under heat stress (T3) contained 1 g/kg Zn under heat stress, (T4) contain 1g/kg probiotic under heat stress, (T5) contain a combination of Zn 1 g/kg + probiotic 1 g/kg under heat stress.

Discussion

This suggests that the inclusion of probiotics and Zn supplementation is advantageous in alleviating the negative effects of heat stress on broilers, as well as enhancing feed utilization and growth. Broiler supplementation with probiotics resulted in significantly greater live body weight gain and carcass yield (10). Previous studies indicate that the supplementation of probiotics in feed can enhance feed intake, weight gain, and feed efficiency in broilers (11).

To enhance growth rates, maintain intestinal integrity, and improve the overall health status of birds in intensive production conditions, the use of probiotic preparations as a supplement is a common practice in poultry production (12).

Probiotics may enhance feed intake and digestion efficiency or efficacy by elevating the activity of digestive enzymes, maintaining bacterial balance in the gastrointestinal (GI) tract, promoting gut integrity, and consequently improving growth performance and health in birds (13).

The gut of animals serves as a crucial site for nutrient absorption, and enhanced development of the intestinal system may improve nutrient absorption, thereby benefiting animal growth performance and health (14). The enhancement of protein ration efficiency and nitrogen utilization through probiotic bacteria contributes to improved growth performance in broilers, resulting in greater feed conversion efficiency and enhanced physiological activities in animals (15).

Zinc can enhance animal gut health and facilitate the digestion, absorption, and utilization of nutrients from feed (16).

An increase in body weight typically correlates with an increase in volume, muscle mass, and adipose tissue, necessitating an enhancement in the heart's strength and efficiency to pump blood to these additional regions (17).

Conclusion

Using a combination of zinc and probiotics is much better than using the compounds alone; the highest performance in live body weight, carcass characteristics, and edible viscera weight in broiler chickens in the treatment groups (T5) and (T3) relative to the control group.

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