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Comparative Study Impact of Heat Stress and Oxidative Stress in Broiler Welfare

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Abstract
The current study was conducted at "Al-Anwar Poultry Company" farm twice, the first for the heat stress (HS) group for the period and the second for the period for the oxidative stress (OS) group, to study the effect of rearing conditions with heat and (OS) stress on the welfare of broilers. In this study, 460 Ross 308 broiler chicks were used, divided into 60 chicks raised in natural conditions (C), 200 chicks raised in (HS) conditions (CH) and 200 chicks raised in (OS) conditions (adding 0.5 ml/liter of drinking water of hydrogen peroxide) (CO). As a result of the study, a significant increase in *E. coli* bacteria and the total account of bacteria in the (OS) group, whereas, the litter moisture increased in the (HS) treatments, especially in the last three weeks of the experiment. The weight of the droppings and the pH also increased and the percentage of clean spray decreased in both the heat and (OS) groups, the percentage of plantar fasciitis increased significantly in the (HS) group.

Keywords: HS, OS, broiler, welfare and sustainable green management.

1. Introduction
Mostly, one of the efficient branches of animal production is the production of the poultry, in providing food surety for a substantial proportion of the world's population (Al-Jebory *et al*., 2024 a) [3], this industry suffers from many problems, especially heat and (OS), which calls for the promotion of sustainable green farming (Al-Jebory *et al*., 2023 b,c: Al-Jebory *et al*., 2024 b) [3, 2], the use of intensive rearing techniques has led to a continuous increase in global production of poultry products (Grzinic *et al*., 2023) [23]. This industry faces numerous challenges in various countries around the world, including (HS), as is well known, (HS) can affect various tissues in the bird's body, affecting intestinal integrity and digestive tract health (Dokladny *et al*., 2016) [17], causing disruptions in nutrient digestion, absorption and imbalance in the microbial balance in the intestinal tubule. This, in turn, leads to a drop in bird productivity, as well as an imbalance in the bird's physiological balance, since the hormone corticosterone rises under stress, affecting the degradation of energy supplies and lowering bird immunity (Wasti *et al*., 2020) [29]. (OS) can be defined as an imbalance between the oxidative and antioxidant systems in the body, which in turn causes lipid peroxidation, protein oxidation and disruption of the regulation of neuronal signaling, as well as DNA damage within cells (Surai *et al*., 2019) [28], therefore, (OS) -mainly- is one of the factors which negatively defect the productive performance (Oke *et al*., 2024) [25], oxidative damage to poultry disrupts the normal metabolism of birds due to intracellular damage (Estevez, 2015; Carvalho *et al*., 2016) [21, 13], furthermore, (OS) generates free radicals that negatively affect the health of the gastrointestinal tract due to damage to cell membranes and the intestinal epithelium. High levels of free radicals also affect the balance of the gut microbial community, which in turn leads to disruption of digestion and

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absorption of nutrients (Gonzales-Rivas *et al*., 2020) [22], the imbalance between the antioxidant system within the body and the increase of free radicals may lead to increased stress, causing metabolic dysfunction in cells, programmed cell death, increased levels of inflammation and deterioration of the birds' immunity (Iqbal *et al*., 2024) [24]. The disruption of the digestive tract due to (HS) and (OS) leads to a disruption in the digestion of nutrients and an increase in water intake by birds, which increases the moisture of the droppings and bedding, causing an imbalance in the welfare of the broilers. This is not compatible with raising broilers within the conditions of sustainable development (Al-Jebory *et al*., 2024: AL-Saeedi *et al*., 2021, 2023) [3, 11, 6]. Thus, the present research aimed to examine the effect of (HS) and (OS) on some welfare traits of broiler.

2. Materials

At Al-Anwar Poultry Company farm The experiment was carried out in two periods, the first for the (HS) group for the period and the second for the period for the (OS) group, to study the effect of rearing conditions with heat and (OS) on the welfare of broilers. In this study, 460 Ross 308 broiler chicks were used, divided into 60 chicks raised in natural conditions (C), 200 chicks raised in (HS) conditions (temperatures were according to the table below) (CH) and 200 chicks raised in (OS) conditions (adding 0.5 ml/liter of drinking water of hydrogen peroxide) (CO). The characteristics of microbial contamination of the litter were studied according to (Elsagheer *ET AL*., 2024) [19], the traits of the litter moisture, the pH of the litter, the weight of the droppings and the foot pad dermatitis and feather hygiene percentage according to (Elsagheer *et al*., 2024) [19].

SAS program (2012) was used to analyze the data statistically and Duncan test (1955) [18] to determine the significant differences between the treatments.

Table 1: The temperatures used during the study weeks for the (HS) group.

Week/ period	6 am	12 am	6 pm	12 pm
1st week	35.16	36.27	35.31	34.36
2nd week	35.21	35.26	35.89	35.41
3rd week	35.21	34.65	34.98	34.51
4th week	34.56	33.98	34.14	34.25
5th week	33.21	33.45	33.26	33.74

3. Results and Discussion

1) Litter Contamination Count

Figure 1 presents an improvement in the beneficial and harmful bacteria in the litter of chicks in normal breeding compared to the thermal and (OS) groups. The logarithmic number of total accounted bacteria also increased in the litter of the broiler group raised under (OS).

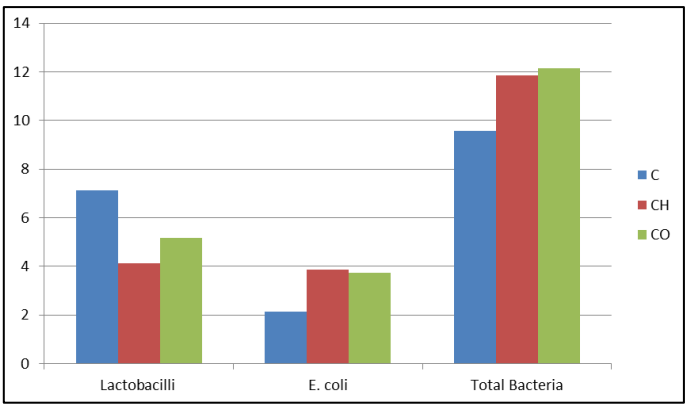

Fig. 1

2) Litter Percent Moisture %

Figure 2 presents, the effect of heat and (OS) on the relative humidity of the litter, it is noted that the humidity was higher in the litter of the stressed broiler. The litter of the (HS) group had the highest humidity, especially during the first, third, fourth and fifth weeks of the study.

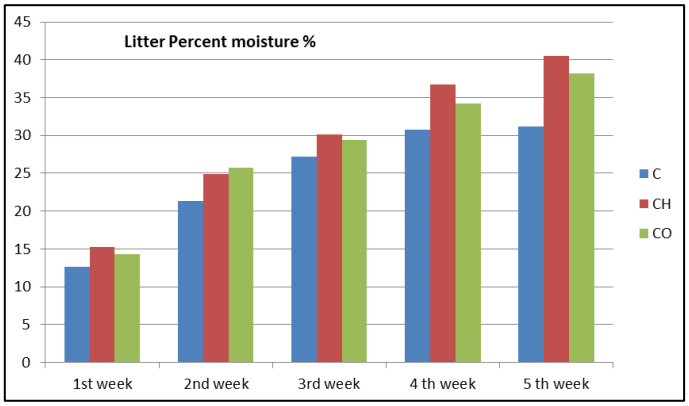

Fig. 2

3) Feces Weight (g)

A non-significant difference of the weight of the droppings during the first, second and fourth weeks, present in Figure 3. In the third week, the weight of the droppings induced in the group of (OS) birds, while in the fifth week, both stress groups increased compared to the group of broilers raised under normal conditions.

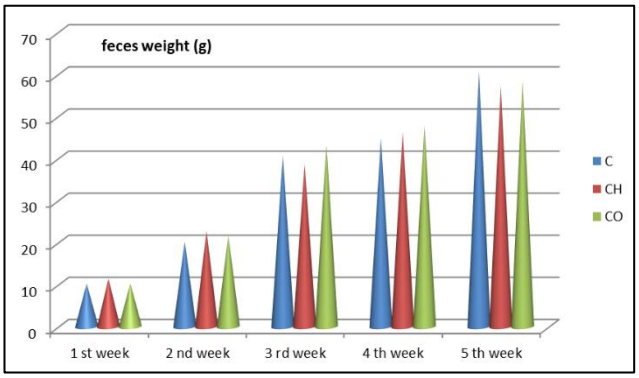

Fig. 3

4) Litter PH

Figure 4 shows no significant differences in the pH of the litter during the first and second weeks. In the third, fourth and fifth weeks, the pH decreased in the (HS) and (OS) broiler group in comparison with the normal breeding chicks group, the (HS) group was the most acidic.

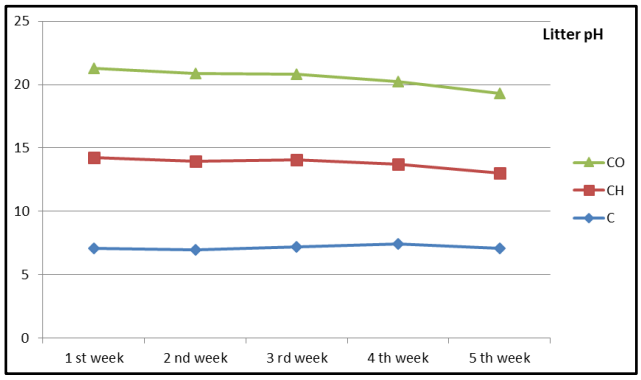

Fig. 4

5) Foot Pad Dermatitis %

Figure 5 shows the effect of two types of stress on Foot pad dermatitis of the broiler's, It is noted that the percentage of inflammation in the soles of the broiler's feet was higher in the (HS) group, followed by the (OS) group on the group of normal breeding.

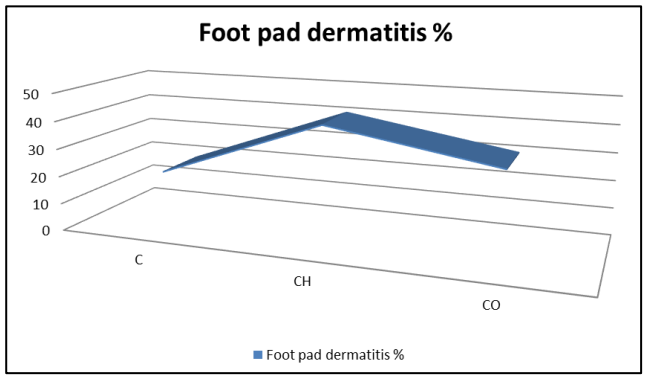

Fig. 5

6) Feather Hygiene Percentage %

Feather hygiene percentage was higher in the (OS)ed broiler group followed by the (HS) broiler group compared to the control treatment.

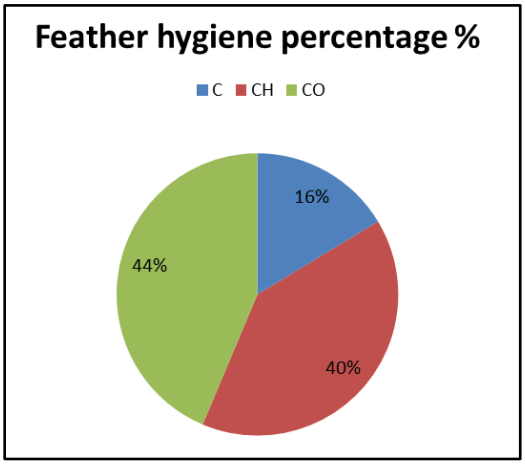

Fig. 6

Poultry production is normally dependent on nutritional and environmental factors. (HS) or high ambient temperature, could be a result of the gradual rise in global mean surface temperature. Other problems that threaten broiler output include poor ventilation and high stocking density. In broiler chickens, the gut microbiota stability directly alters by the high ambient temperature, disrupting gut morphology, the function of intestinal barrier and the enzymatic-activity, compromising the digestion of feed and the assimilation of nutrient. Furthermore, in broiler chickens, (HS) induces (OS) at the levels of cellular and tissue by increasing the fabrication of the reactive oxygen and nitrogen molecules which cause the oxidation of lipids and proteins. In broiler chickens, the limit or the prevent of heat dissipation is the result of the absence of sweat glands adding to the presence of feathers (Al-Jebory *et al*., 2021a,b) [5]. Furthermore, (HS) and the concomitant rise in humidity alter the microenvironment of broiler chickens, resulting in a reduction in litter quality in terms of temperature and humidity . Induced litter humidity resulting plantar fasciitis in broiler chickens (Elsagheer *et al*., 2024) [19], resulting in severe economic losses for the poultry sector worldwide. Plantar fasciitis ,in broiler, is linked to a variety of risk factors, which include nutrition intake insufficiently or excessively, litter type and humidity and environmental circumstances such as high temperature and stocking density (Cengiz *et al*., 2011) [14]. All of these factors have a negative impact on the health and growth of broiler chickens. Plantar fasciitis is a skin ailment that affects broiler hens and turkeys' plantar surfaces. It is not just a rising issue because of the economic relevance and health of broiler chickens, but it is also becoming a major concern for animal welfare (Burkholder *et al*., 2008) [12]. Previous studies have attempted to prevent the development of plantar fasciitis, however, none of them have been successful in completely preventing plantar fasciitis (Abdel-Wahab *et al*., 2013;

Cengiz *et al*., 2011; 2013; 2018; Sevim *et al*., 2021) [13-16]. Considering the role of zinc in wound healing, skin diseases and its antioxidant activity, zinc, selenium, iron and amino acid supplementation are expected to contribute to the prevention of plantar fasciitis in broiler chickens exposed to high environmental temperature or (HS) (Al-Jebory *et al*., 2023) [2]. The deterioration in the welfare of broiler chickens may also be due to the fact that heat and (OS) cause damage to feather follicles, deterioration of feather quality and discoloration. There is also an increased susceptibility to skin diseases due to increased levels of free radicals and changes in hormonal balance resulting from increased levels of corticosterone, which causes an imbalance in protein and amino acid metabolism responsible for the growth and quality of feathers (Al-Jebory *et al*., 2024: Elsagheer *et al*., 2024) [3, 19].

4. Conclusion

We concluded from the results of our study that both types of stress reduce the welfare of broilers and (HS) had the greatest effect, this is because (HS) also generates free radicals and (OS).

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