Plant Archives Vol. 25, No. 1, 2025 pp. 1906-1910 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.1.277

ADDING LUTEIN TO FEED AS AN ANTIOXIDANT IMPROVING THE PERFORMANCE OF BROILER CHICKENS UNDER THE INFLUENCE OF HEAT STRESS

Afrah A.H. Abeeb
Technical institute of Al-Dewaniyah, AL-Furat AL-Awsat Technical University (ATU), Iraq
E-mail: afrah.abdulwaheed@atu.edu.iq
(Date of Receiving : 13-02-2025; Date of Acceptance : 14-04-2025)

ABSTRACT

This research is a study aimed at identifying the addition of lutein as antioxidant to the feed of broiler chicks under the influence of heat stress, 75 birds were raised at the age of one day and up to 42 days and divided into three groups, each group of 25 birds, a control group and a treatment group : lutein was added to the feed (0.1% and 0.2%) and then measure the rate of feed consumption per week, weight rate, nutritional conversion efficiency and measurement of the number of total white blood cells (TWBC), total red blood cells (TRBC), high density lipoprotein (HDL), low density lipoprotein (LDL), antioxidant(GSH) and carcass characteristics. The results shown increase in feed intake, body weight (2577.8 g, 2686.5g) and body weight gain in lutein group after 15 days. There was a significant increase in the number of red and white blood cells, antioxidants (GSH) and HDL in the L1 and L2 group, while the LDL were reduced in lutein groups from the control group, the characteristics of the carcass there was an increase in the lutein group in most of them, such as liver and Carcass yield, spleen and decrease Abdominal fat. So lutein can be given to broilers under heat stress because it causes an increase in body weight and immunity as well as antioxidants**.**
Keyword **:** Lutein, antioxidant, broiler chickens, heat stress.

Introduction

One of the problems that suffers from broilers breeding in summer is the high temperatures and their effect on productive qualities and immunity, which negatively affects this breeding. Moreover, the industry is witnessing rapid growth, especially in developing countries (Pawar *et al.*, 2016). Animal protein consumption rapidly increases annually following the development of the social economy and population growth. Poultry products mainly fulfil this demand (Pertiwi *et al*., 2022). Furthermore, the industry is experiencing rapid growth, particularly in developing nations. Heat stress is one of the most important obstacles to cellular metabolism, which has a negative impact not only on animal health, but also on the negative effects of hindering the productive performance and specifications of meat and eggs produced (Suria *et al*., 2003).

Heat stress is a condition in which the bird is unable to maintain a balance between body heat production and heat loss and heat stress is caused by the interaction of several factors such as high environmental temperature, humidity, radiant heat and air velocity. The normal body temperature of chickens ranges from 41-42 °C and moderate ambient temperature for growth (18-21 °C). Studies have shown that the temperature of the environment above 25 °C leads to heat stress *(*Alhenaky, 2017).

Antioxidants: substances that fight free radicals in the body, preventing or slowing down cell damage caused by free radicals and unstable molecules in the body. It also has an important role in enhancing the body's immunity (Salim *et al*., 2013).

Lutein is an antioxidant that occurs naturally. It protects and improves eye function. It is part of a group of substances called carotenoids (Allison, 2018). Lutein is one of 600 known xanthophyll that occurs naturally as carotenoids. Lutein is only synthesized from plants such as Spinach and yellow carrots. other xanzophiles that are found in high amounts in green

leafy vegetables, such as zeaxanthin, may help prevent or slow macular degeneration (Gary, 2017). Lutein is the most abundant carotenoid in the eyes and brain (Johnson, 2014). Studies show that oral administration reduces the risk of developing decreased levels in the body (*Karadas et al.*, 2016) other Studies show that the use of lutein works to reduce the incidence of cancers such as skin cancer, breast cancer, and esophageal cancer of the intestine and colon (Cynthia *et al*., 2007, Xiao Ge *et al*., 2013). Also Some sources consider Lutein is a type of vitamin known as carotenoid, and it is usually associated with beta-carotene and vitamin A, and it is an antioxidant belonging to the carotene group. This type of vitamin is also usually found in leafy greens, yellowish-orange vegetables, and some different supplements (Buscemi *et al*., 2018).

Materials and Methods

75 one-day-old chicks of sweat rose available in the local markets were bred for period 1/7/2023 to 11/8/2023 and divided into:

1- Control group (C **)**includes (25 birds)

2- The treatment group includes (50 birds) divided into two groups: L1 group and a therapeutic dose of 0.1 and includes 25 birds and L2 group and a therapeutic dose of 0.2 and the duration of breeding was 42 days where the weights of the groups are taken weekly with the measurement of the amount of feed consumed and blood sample was collected from the wing vein using blood tube containing anticoagulant (EDTA)to measure the number of total white blood cells ,red blood cells , GSH By method (Burtis, 1999, Rahman, 2006), HDL, and LDL by method (Azeke and Ekpo, 2008).

Statistical Analysis

The results were analyzed statistically using the statistical program (SPSS) version (2003), which includes the calculation of the arithmetic mean and standard error and comparisons between the averages at the probability level($p<0.05$) (SAS, 2000).

Result

The results of the current study regarding feed consumption during the breeding period showed that there is a significant increase in the level($p<0.05$) of feed consumption for luteinizing treatment groups for the control group despite the presence of the effect of high temperatures and exposure of chicks to heat stress, where the difference in feed consumption appeared from the second week (7-14) days until the end of the breeding period (36-42) days There was also an increase in lutein addition groups, where the 0.2 group was more feed consumption than the 0.1 group as shown in Table (1).

There is also an increase in the body weight of the lutein treatment groups for the control group and the work (7-14) days there was no significant difference between the difference in the concentration of lutein for L1 and L2, but after the age of (15-21) days the difference or increase in feed intake of the L2 group for the L1 group until the end of the experiment period Table (2).

Table (3) an increase in the body weight gain of the lutein treatment groups for the control group and the work (7-14) days there was no significant difference ($p<0.05$) between the difference in the concentration of lutein for L1 and L2, but after the age of (15-21) days the difference or increase in body weight of the L2 group for the L1 group until the end of the experiment period.

As for the effect of lutein addition on the total number of red and white blood cells, there was a significant difference at the level ($p<0.05$) of where there was an increase in the number of white blood cells in the lutein addition groups from the control group as well as the number of red blood cells, but there was no significant difference in the increase in the L1 and L2 group Table (4).

As for the characteristics of the carcass, the results were for the head and carcass yield there was a significant difference between the groups, where the L2 group was the most influential than the control and L1 group, while the gizzard and the leg, there was no significant difference between the treatment groups, but there was a significant difference (increase) between the treatment groups and the control group, decrease Abdominal fat in L1, L2 than control group. Table (5).

Table 1: The effect of Adding Lutein on feed intake (g/bird).

Groups	7-14 day	15-21 day	22-28 day	29- 25 day	36-42 day
Control	272.6± 0.9a	633.2± 1.2a	1198.5± 2.1a	1212.1± 3.8a	1253.4± 6.3a
L 1	288.4± 1.3b	663.4± 2.2b	1153.3± 1.9b	1303.3± 3.6b	1288.7±5.1b
L 2	293.1± 1.4b	685.3 ±1.6c	1098.3± 1.5c	1323.2± 4.2c	1298.4± 5.4c

Table 2: The effect of Adding Lutein on live body weight (g/bird).

Groups	7-14 day	15-21 day	22-28 day	29- 25 day	36-42 day
Control	345.6± 3.9a	756.6± 4.2a	1391.1± 3.2a	1876.3± 2.6a	2345.5± 4.2a
L 1	378.4± 2.3b	830.3± 2.8b	1448.4± 2.8b	1998.8± 4.3b	2577.8±5.4b
L 2	293.3± 1.4b	843.5 ±3.7c	1476.5± 2.6 c	2080.4± 5.1c	2686.5± 4.5c

Table 3: The effect of Adding Lutein on body weight gain (g).

Groups	7-14 day	15-21 day	22-28 day	29- 25 day	36-42 day
Control	165. 3± 2.9 a	334.3± 2.1a	489.4± 3.1a	558.2± 3.4a	635.4± 5.2a
L 1	187.2± 2.1b	373.2± 3.4b	535.1± 2.8b	604.4± 4.9b	715.7±4.3b
L 2	188.4± 3.42b	380.5±1.6c	598.6± 5.7c	624.1± 5.7c	748.8± 3.45c

Table 4: The effect of Adding Lutein on TWBC, TRBC, GSH, HDL, and LDL

treatments	TWBC $N\times10^3/ml^3$	TRBC $N\times10^3/ml^3$	GSH Mg/ml	HDL Mg/dl	LDL Mg/dl
Control	20.4± 0. 02a	20.3± 0.02a	23.04±0.1a	12.2±0.3a	140.3±1.4a
L 1	25.2± 0.03b	24.4± 0.03b	26.02±0.2b	15.3±0.2b	131.2±1.3b
L 2	26.1± 0.04b	25.3 ±0.05b	31.11±0.2c	19.6±0.4b	123.4±2.1b

Table 5: The effect of Adding Lutein on carcass characteristics

Carcass Parameter	Control	L 1	L 2
Head	2.3 ± 0.3a	2.9 ± 0.4b	3.4 ± 0.2c
Carcass yield	70.3± 0.9a	85.8± 1.1b	89.5 ±0.8c
gizzard	1.4 ± 0.3a	1.7 ± 0.4 b	1.8 ±0.4b
Leg	3.1 ± 1.1a	3.9 ± 0.8b	4.3 ± 0.7b
Heart	0.5 ± 0.1a	0.7 ± 0.3a	0.8 ± 0.4b
Abdominal fat	1.8 ± 0.3a	1.5 ± 0.2b	1.6 ± 0.4b
Pancreas	0.1 ± 0.04a	0.3 ± 0.03a	0.4 ±0.05b
liver	1.4 ± 0.5a	1.8 ± 0.6b	1.9 ± 0.3b
spleen	0.3± 0.1 a	0.5±0.09b	0.6±0.08c

Discussion

Heat stress in poultry affects growth, vital activities and reproduction susceptibility and also affects the effectiveness of the intestines, digestion and immunity, which may lead to inflammation of the digestive tract (Kadykalo *et al.,* 2018**).** An increase in body temperature above the range, due to exposure to hot environmental conditions in broiler chickens, may lead to a series of irreversible thermoregulation events that can be fatal to birds. In general, broilers try to reduce their heat production by reducing their feed consumption during heat shifts. Heat stress is associated with the inability of animals to metabolize carotenoids, which requires giving carotenoid supplements through diet (Kumari *et al.*, 2018) and provide many fruits and vegetables natural carotenoids for broilers, but in limited quantities so these materials are available as nutritional supplements help broilers maintain health and production (Lara and Rostagno, 2022).

In this study, daily processing of lutein at concentrations of 0.1 and 0.2% led to an increase in the amount of feed consumed and body weight as a result of increasing the efficiency of food conversion**.**

It has been noted that the addition of lutein has mitigated the severity of heat stress exposed to the bird, which was represented by improving the food conversion factor through the consumption of a larger amount of feed and the high rate of weight gain cumulatively and from the second week until the end of the experiment (Table No. 1 and 2) as it is known that feed consumption is positively associated with improving the growth performance and health status of birds. The reason for consuming a larger amount of feed in lutein groups due to the increased demand for stress resistance by providing antioxidants and reducing on the other hand that the high rate of accumulated weight gain has been reflected in the high percentage of (Surai *et al*., 2003) retention rate inside the chest body and liver weight and reduce the percentage of belly fat (Table 3) and also may be due to improving the efficiency of food conversion to provide antioxidants that have led to the protection of the epithelial endothelium, including Digestive tissues from oxidative attack resulting from high temperatures

(heat stress) This is consistent with other studies on (Sahin *et al*., 2006) quail birds Who found that the addition of antioxidants in the diet of thermally stressed quail at a concentration of 50, 100 or 200 mg / kg has led to an increase in feed consumption and this was reflected in the high rate of weight gain and improved conversion efficiency of feed and the percentage of refinement. In another study (Zhi-XinLin *et al*., 2023) it was found that the addition of lutein at a concentration of 40 mg / kg leads to increased growth of jejunal villi, which increases the surface area for the absorption of nutrients. In another study (Gao *et al*., 2016), it was found that lutein stimulates the gene for the production of type B lymphocytes, which leads to an increase in the length of enterocyte epithelial cells. Also, this may explain the increase in the total number of total white blood cells Due to the increased number of lymphocytes. Also one of the effects or changes that result from heat stress is the reduction of immune ability, as it is known that heat stress suppresses immunity in chickens, so the spread of infectious diseases such as Newcastle and gumboro is frequent during the summer, as well as the size of organs associated with immunity such as the spleen, thymus gland and lymphatic organs also decline in thermally stressed birds, as well as reducing the level of antibodies in thermally stressed birds, where the total number of white blood cells is significantly reduced in broiler chickens either In our study, there was an increase in the number of leukocytes and spleen weight, which indicates that the addition of lutein reduced the effect of heat stress and led to improved immunity in meat birds (*Nabi et al.*, 2020)

High temperatures (heat stress) result in several changes, including: physiological changes such as oxidative stress Reactive oxygen species (ROS), as the types of reactive oxygen are free radicals and peroxide, which are usually produced inside cells during regular metabolism and are necessary for many cellular processes such as cytokine transcription, immune modification and ion transfer. The excess ROS produced inside the cells is eliminated by removing physiological toxins present inside the cells during the thermal equation, the activation of the transcription factor (Nrf_2) leads to the additional synthesis of a group of antioxidant molecules that react with the increase (ROS) produced within the cells However due to the imbalance between these systems, either by increasing the production of (ROS) or by decreasing the effectiveness of the antioxidant defense system, the cells are exposed to stress conditions known as oxidative stress in broiler chickens.

The increase in antioxidants in the treatment group for L1 and L2 may be due to the increase in carotenoids, which leads to an increase in the concentration of retinol and beta-carotene is an important source of vitamin A, as each beta-carotene molecule gives two molecules of vitamin A and the excess percentage is stored in the liver within certain limits and vitamin A works to protect the various body systems from the dangers of free radicals and effective oxygen varieties as it works as an antioxidant in cell membranes that causes a high percentage of fat and their content of long-chain unsaturated fatty acids Which is one of the main targets of oxidants and this may be the cause of high glutathione (Englmaierova *et al*., 2019). The presence of glycosides compounds that are complain with cholesterol to form cholesterol complexes that are insoluble in the lumen of the digestive canal hinder the absorption of cholesterol in the intestine and work to excrete it in waste and lead to a reduction in its level in the blood serum (Campbell, 1995).

The high concentration of antioxidant enzymes (GSH) in lutein treatment groups is a good indicator of resistance to heat stress exposed to birds as the enzyme GSH digs an oxidative reaction and reduction that converts the oxygen ion O_2 into H_2O_2 and O_2 to prevents the formation of free radicals and then H_2O_2 or disintegrates into water H_2O and oxygen O_2 (Hus *et al*., 2015).

Conclusions

Lutein as an antioxidant can be given to broiler chickens in the summer at high temperatures (heat stress) as it improves feed consumption, food conversion rate and increases bird immunity

Reference

Alhenaky, A., Abdelqader, A., Abuajamieh, M., Al-Fataftah, Abdur-Rahman (2017). The effect of heat stress on intestinal integrity and Salmonella invasion in broiler birds. *Journal of Thermal Biology*. **70** (Pt B), 9–14.

Allison, W. (2018). "What is Lutein?" ،www.foodinsight.org.

Azeke, M. A., and Ekpo, K. E. (2008). Egg yolk cholesterol lowering effects of garlic and tea. *Journal of Biological Sciences*, **8**(2), 456-460.

Burtis, C.A. and Ashwood, E.R. (1999). Tietz textbook of clinical chemistry. Philadelphia, 1654-1655.

Buscemi, S. *et al*. (2018). The Effect of Lutein on Eye and Extra-Eye Health. Nutrients. Sep 18; **10**(9). pii: E1321.

Compbell, T.W. (1995). Avain hematology and cytology (No.Ed.2).Iowa state university press.

Cynthia, T., Nicole, S.H., Cheryl, R. and others (2007). Plasma and Dietary Carotenoids Are Associated with Reduced Oxidative Stress in Women Previously Treated for Breast Cancer, Cancer Epidemiology, Biomarkers & Prevention, Issue 10, Folder 16, Page 2008-2015. Edited.

Englmaierova, M., Skřivan, M. and Vit, T. (2019). Alfalfa meal as a source of carotenoids in combination with ascorbic acid in the diet of laying hens. *Czech Journal of Animal Science*, **64**(1), 17-25.

Gao, Y.Y., Jin, L., Ji, J., Sun, B.L., Xu, L.H., Wang, Q.X., Wang, C.K. and Bi, Y.Z. (2016). Xanthophyll supplementation reduced inflammatory mediators and apoptosis in hens and chicks. *J. Anim. Sci.*, **94**, 2014–2023.

Gary, H. (2017). "Lutein and zeaxanthin: Eye and vision benefits" ‹www.allaboutvision.com

Hsu, W., Chiang, C., Chao, Y., Chang, C., Lin, L., Yu, B. and Lee, T. (2015). Effects of recombinant lycopene dietary supplement on the egg quality and blood characteristics of laying quails. J. Biosci. Bioeng. http://dx.doi.org/10. 1016/j.jbiosc.2015.03.016.

Johnson, E.J. (2014): Role of lutein and zeaxanthin in visual and cognitive function throughout the lifespan : *Nutrition reviews*, **72**(9): 605–12.

Kadykalo, S., Roberts, T., Thompson, M., Wilson, J., Lang, M., Espeisse, O. (2018). The value of anticoccidials for sustainable global poultry production. *Int. J. Antimicrob*, **51**, 304–310.

Karadas, F., Erdoğan, S., Kor, D., Oto, G., Uluman, M. (2016). The effects of different types of antioxidants (Se, vitamin E and carotenoids) in broiler diets on the growth performance, skin pigmentation and liver and plasma antioxidant concentrations. *Braz. J. Poult. Sci.*, **18**:101–116.

Kumari, K.N.R., Nath, D.N. (2018). Ameliorative measures to counter heat stress in poultry. *World's Poult. Sci.* J., **74**, 117–130.

Lara, L.J. and Rostagno, M.H. (2022). Impact of heat stress on poultry production," *Animals*, 3(2), 356–369.

Nabi, F., Arain, M.A., Rajput, N., Alagawany, M., Soomro, J., Umer, M., Liu, J. (2020). Health benefits of carotenoids and potential application in poultry industry: A review. *J. Anim. Physiol. Anim. Nutr*. **104**: 1809–1818.

Pawar, S.S., Pawar, B., Sajjanar, V.D., Lonkar, K.P., Nitin, A.S., Kadam, A.V., Nirmale, M.P., Brahmane, S.K. Bal (2016). Assessing and mitigating the impact of heat stress in poultry. *Adv. Anim. Vet. Sci*., **4**, 332-341

Pertiwi, H., Nur Mahendra, M.Y. and Kamaludeen, J. (2022). Folic Acid: sources, chemistry, absorption, metabolism, beneficial effects on poultry performance and health, *Veterinary Medicine International*, vol. 2022, Article ID 2163756, 9 ages,

Rahman, I., Kode, A. and Biswas, S.K. (2006). Assay for quantitative determination of glutathione and glutathione disulfide levels using enzymatic recycling method. *Nature protocols*, **1**(6), 3159.

Sahin, K., Ondercib, M., Sahinb, N., Gursuc, M.F., Khachikd, F. and Kucuk, O. (2006). Effects of lycopene supplementation on antioxidant status, oxidative stress, performance and carcass characteristics in heat-stressed Japanese quail. *J. Therm. Biol*. **31**, 307 – 331.

SAS (2000):SAS/STAT User 's Guide, Version, 6.12. Inst. Ine., Cary.NC .

Surai, P.F., Karadas, F. and Sparks, N.H. (2003). The importance of antioxidants in poultry. Annual North Carolina Poultry Nutrition Conference, 38 – 56.

Xiao Ge, Mei Xing, Lan Yu and others (2013), "Carotenoid Intake and Esophageal Cancer Risk: a Meta-analysis", Asian Pacific Journal of Cancer Prevention, Issue 3, Folder 14, Page 1911-1918.Edited.

Zhi-Xin Lin, Min Zhang, Rui Yang, Yao Min, Ping-ing Guo, Jing Zhang, Chang-Kang Wang, Ling Jin, y,1 and Yu-YunGao (2023). Theanti-inflammatory effect of lutein in broilers is mediated by regulating Toll- like receptor 4/myeloid-differentiation-factor 88 signaling pathway. Poultry Science 102:102622.