

How to Cite:

Abass, K. H., Atiyah, W. R., & Mlaghee, M. A. (2022). Assessment of malondialdehyde level in broiler chickens suffering from chronic heat stress and fed on a diet supplemented with bioactive substances. *International Journal of Health Sciences*, 6(S9), 1714–1720.
<https://doi.org/10.53730/ijhs.v6nS9.12739>

Assessment of malondialdehyde level in broiler chickens suffering from chronic heat stress and fed on a diet supplemented with bioactive substances

Kadham Hasan Abass

Department of Public Health, College of Veterinary Medicine, University of Al-Qadisiyah, Iraq.

Wisam Raheem Atiyah

Department of Public Health, College of Veterinary Medicine, University of Al-Qadisiyah, Iraq.

Mohammed Abdulabbas Mlaghee

Department of Public Health, College of Veterinary Medicine, University of Al-Qadisiyah, Iraq.

Abstract---Heat stress is one of the most important health dilemmas that faces poultry industry characterized by high degrees of economic losses. The presented work, here, was carried out to evaluate the effects of grape pomace (GP) on decreasing the levels of oxidative stress induced by heat stress in broilers. For that purpose, 150 chicks were randomly assigned into three groups (50 chicks/group). One group received no treatment, the control group (G1). The second group (G2) was provided with 25 gm (2.5%) of GP/kg of ration. The third group (G3) was given 50 gm (5%) of GP/kg of ration. The results indicated that the levels of MDA in fresh meat samples (G3) were significantly ($p<0.05$) the lowest than those from other meat samples of the G2 and G1. Frozen meat samples (G2 and G3) had significantly ($p<0.05$) lesser levels of MDA than those from G1. In the case of MDA from the plasmas of chickens, their levels were significantly ($p<0.05$) the lowest in the G3 followed by G2 than those from other plasma samples of G1.

Keywords---Broiler chickens, grape pomace, heat stress, malondialdehyde.

Introduction

Global demand for chicken meat and eggs has increased and that has caused the poultry business to expand in number of countries. The main advantage of poultry meat is that it has a lower quantity of saturated fatty acids and is also a great source of protein, vitamins, and minerals. Other sources of animal protein include eggs, which are the most affordable. Although most sources of vitamins, minerals, and proteins include antioxidants, eggs are particularly abundant in lutein and zeaxanthin, which are important for eye health. From these information, it can be deduced that worldwide chicken meat and egg consumption have increased in the last decade and will almost double by 2050 (1,2).

Improved chicken genetics have been necessary to meet the rising expectations. During the 1950s, commercial broiler chickens weighed about 900 grams at 56 days of age, nevertheless, these birds reached a maximum weight of around 4,202 grams by the year 2005. Broiler chickens with the new enhanced systems have better metabolic rates and productive capabilities. Higher metabolic rate puts them at a greater risk for heat stress, since they generate more body temperature. Combined with the very high ambient temperature, high bird stocking density raises the likelihood of heat stress (3–5).

Because of the heat stress in the poultry, poultry is more susceptible to disease and loses their strength and performances. It's estimated that the chicken industry loses \$128 to \$165 million per year because of heat stress, and it's projected that this figure will grow in the future because of global warming. Inability to maintain a proper balance between heat generation and heat loss occurs when hens are subjected to high heat stress. The combination of high surrounding temperature, humidity, radiating heat, and speed of air is important in heat stress (6,7). Chickens have a normal body temperature of 41–42 degrees Celsius, and the optimal growth temperature for maximum growth is between 18–21 degrees Celsius. Heat stress in chickens is exacerbated over 25 °C in the environment. Heat stress is shown to harm chicken health and performance, and many mitigation methods are available (8). The presented work, here, was carried out to evaluate the effects of grape pomace (GP) on decreasing the levels of oxidative stress induced by heat stress in broilers.

Materials and Methods

Chickens and experimental design

For that purpose, 150 chicks (40gm/chick) were randomly assigned into three groups (50 chicks/group). One group received no treatment, the control group (G1). The second group (G2) was provided with 25 gm (2.5%) of GP/kg of ration. The third group (G3) was given 50 gm (5%) of GP/kg of ration. The food additives were continued to be given until the end of the experiment (42 days). The experiment was conducted in the animal farm that belongs to the College of Veterinary Medicine, University of Al-Qadisiyah, Al-Diwaniyah City, Iraq. The chicks were raised in cages on carpenter residual bedding of wood (3-5 cm) in thickness (6 m/cage). The water was provided for free access during the study period. The chicks were given ration ad-libitum, table 1.

Table 1: Food contents of the ration

Ration ingredients	Ratio (%)
Yellow corn	51.4
Soybean (protein 45%)	31
Bran	1
Wheat	14
Premix	1
NaCl	0.3
Methionine	0.2
Lysine	0.1
CaO	1
Calculated chemical content	
Converted energy (KJ/Kg)	3051
Crude protein (%)	21.58

The necessary numbers of lamps, air ventilators, and thermometers were supplied to the room of the chickens. All the required husbandry procedures were followed in the current work, such as vaccinations, table 2.

Table 2: Vaccine program

Age (day)	Vaccines
1	ND-B1+ IB Spray
10	ND-LaSota (drinking water)
14	Gumboro-IBD2 (drinking water)
20	ND-LaSota

Red grape pomace

GP was purchased from the local stores and was dried out using the sunshine. Then, it was supplied to the chicken food after grinding. No ground GP was put into the food at 12 days of age. The GP chemical analysis was conducted in the Studies and Researches Center, University of Baghdad, Baghdad City, Iraq, table 3.

Table 3: Chemical analysis of grape pomace

Contents	Ratios (%)
Dampness	3.16
Ash	2.56
Crude protein	13.22
Lipids	0.60
Carbohydrates	56.31
Total phenols	290

After the end of the experiment, blood samples from the wing vein were collected, and some animals were sacrificed for meat sample collection.

Thiobarbituric acid

The levels of heat stress were tested using the stress marker, malondialdehyde (MDA), from meat (fresh and frozen meat) and blood plasma of the chickens. The thiobarbituric acids (TBA) is calculated by taking minced meat at 10 gm and soaking in 50 ml distilled water (DW) for 2 mins. Then, 5 ml hydrochloric acid solution was added to decrease the pH down to 1.5, and the volume was completed up to 100 ml by DW. Later, the mixture was transferred to a 100-ml distillation flask and 2 ml of paraffin oil and 1 gm dry stone were added to optimize the heat and inhibit boiling. Heating up until 50 ml of distillation is collected, and the blank solution was produced from DW. Optical spectrophotometer at 538 nm was used to evaluate absorption, and then TBA was measured at mononaldehyde mg/100mg meat.

Results

The results indicated that the levels of MDA in fresh meat samples (G3) were significantly ($p<0.05$) the lowest than those from other meat samples of the G2 and G1. Frozen meat samples (G2 and G3) had significantly ($p<0.05$) lesser levels of MDA than those from G1, table 4.

Table 4: Mononaldehyde in meat of broiler

Group	MDA (Mean±SE)	
	Fresh meat	Frozen meat
Control	27.66±0.66 ^{Aa}	42.66±0.88 ^{Ab}
GP (2.5%)	25.66±0.33 ^{Aa}	31.33±0.66 ^{Bb}
GP (5%)	14.66±0.66 ^{Ba}	27.33±0.33 ^{Cb}

- The similar characters indicate that there are no significant ($p>0.05$) differences while the different letters indicate significant ($p<0.05$) differences.
- Lowercase characters refer to statistical reading vertically between groups while uppercase characters indicate statistical reading horizontally between type of meat for the same group.

In the case of MDA from the plasmas of chickens, their levels were significantly ($p<0.05$) the lowest in the G3 followed by G2 than those from other plasma samples of G1, table 5.

Table 5: Mononaldehyde in blood plasma of broiler

Group	MDA	
	21 day	42 day
Control	8.1±0.1 ^{Aa}	9.2±0.2 ^{Ab}
GP (2.5%)	5.3± 0.3 ^{Ba}	6.4±0.2 ^{Bb}
GP (5%)	3.33±0.33 ^{Ca}	3.66±0.33 ^{Ca}

The similar characters indicate that there are no significant ($p>0.05$) differences while the different letters indicate significant ($p<0.05$) differences.

- Lowercase characters refer to statistical reading vertically between groups while uppercase characters indicate statistical reading horizontally between the age of chicks for the same group.

Discussion

Heat stress in poultry is an important and critical problem that affects the health status of chickens and may lead to high levels of economic losses. Therefore, finding new and novel methods for prevention and treatment of heat stress in poultry is highly demanded to level up the poultry industry outcomes. The current work revealed significant improvement in the readings of meat and plasma levels of MDA in the grape pomace treated groups, especially the group treated with the highest concentration in the chicken ration. The present findings agree with those documented by Gungor *et al* (9), in which GP in ration elevated the glutathione peroxidase and superoxide dismutase levels in the serum of broiler chicks. Gungor *et al* (9) did not only use GP, but they also inserted fermented GP in the diets of their chicks, which showed increased in the body weights of these chicks, elevated levels of catalase in the sera of study subjects, and lowered the levels of *Clostridium perfringens* in the ceca of the treated birds. However, our results disagree with those by Gungor *et al* (9) in the case of MDA levels in the meat of slaughtered chickens, in which they did not recognize changes in the levels of this stress marker in either group of grape pomace or the fermented grape pomace.

The antioxidant defenses performed by glutathione peroxidase, superoxide, and catalase are the initial layer of protection and contribute to the safeguarding of cells and tissues against free radicals. Increased concentrations of these enzymes in blood or tissues thus indicates a greater potential for antioxidants. Based on its phenolic and flavonoid components, such as catechin, epicatechin, and procyanidin, grape pomace has high antioxidant action. Boosting overall antioxidant power in the plasma by including GP at 50 gm/kg has enhanced the overall antioxidant activities in the blood (10,11). In an experiment conducted by Hosseini-Vashan *et al.*(12), heat-stressed broilers given rations contained 20, 40, and 60 gm GP per kilogram of feed had a linear rise in plasma antioxidant levels. In light of the current study's findings, adding 25 or 50 grams of GP per kilogram of meal has the same effect on the plasma overall antioxidant capability (13–15).

Phenolic chemicals influence the quality of meat in direct or indirect ways. In a research conducted by Luna *et al.* (16), 150 mg/kg of thymol, or 150 mg/kg of carvacrol, a polyphenol, was applied to lipid oxidation in broiler meat and, after 5 to 10 days of storage, resulted in reduced thiobarbituric acid levels in thigh muscle. The author came to the conclusion that the natural antioxidant thymol or carvacrol may be beneficial for improving the meat grade of broilers. Reduced MDA values in breast muscle were also seen in broilers fed with hesperidin and genistein at 20 mg/kg diets, indicating that hesperidin and genistein have the potential to extend the shelf life of broilers (17).

Conclusion

The current study may provide a significant evidence that grape pomace may apply protection against heat stress in broilers as the current study shows that MDA was the least in the meat and plasma of the chickens provided with highest amount of grape pomace (50 gm grape pomace per kg of diet).

Acknowledgments

The authors thank Professor Jabbar Ahmed Alssady, Dean of College of Veterinary Medicine, University of Al-Qadisiyah, Iraq, for technical assistance.

Conflict of interests

The authors have not received any funding or benefits from industry, agency of financing, or elsewhere to conduct this study.

Reference

1. Zaheer K. An Updated Review on Chicken Eggs: Production, Consumption, Management Aspects and Nutritional Benefits to Human Health. *Food Nutr Sci.* 2015;06(13):1208–20. doi.org/10.4236/fns.2015.613127
2. Marangoni F, Corsello G, Cricelli C, Ferrara N, Ghiselli A, Lucchin L, Poli A. Role of poultry meat in a balanced diet aimed at maintaining health and wellbeing: An Italian consensus document. *Food Nutr Res.* 2015;59(6):1–11. Doi:10.3402/fnr.v59.27606
3. Goo D, Kim JH, Park GH, Reyes JBD, Kil DY. Effect of heat stress and stocking density on growth performance, breast meat quality, and intestinal barrier function in broiler chickens. *Animals.* 2019;9(3):107–16. Doi:10.3390/ani9030107
4. Tallentire CW, Leinonen I, Kyriazakis I. Breeding for efficiency in the broiler chicken: A review. *Agron Sustain Dev.* 2016;36(4):1–16. Doi:10.1007/s13593-016-0398-2
5. Zuidhof MJ, Schneider BL, Carney VL, Korver DR, Robinson FE. Growth, efficiency, and yield of commercial broilers from 1957, 1978, and 2005. *Poult Sci.* 2014;93(12):2970–82. Doi:10.3382/ps.2014-04291
6. Nath NRK, Nath ND. Ameliorative measures to counter heat stress in poultry. *Worlds Poult Sci J.* 2017;74(1):117–30. doi/abs/10.1017/S0043933917001003
7. Lara LJ, Rostagno MH. Impact of heat stress on poultry production. *Animals.* 2013;3(2):356–69. Doi:10.3390/ani3020356
8. Wasti S, Sah N, Mishra B. Impact of heat stress on poultry health and performances, and potential mitigation strategies. *Animals.* 2020;10(8):1–19. Doi:10.3390/ani10081266
9. Gungor E, Altop A, Erener G. Effect of raw and fermented grape pomace on the growth performance, antioxidant status, intestinal morphology, and selected bacterial species in broiler chicks. *Animals.* 2021;11(2):1–14. Doi:10.3390/ani11020364
10. Brenes A, Viveros A, Goñi I, Centeno C, Sáyago-Ayerdy SG, Arijia I, Saura-Calixta F. Effect of grape pomace concentrate and vitamin E on digestibility of polyphenols and antioxidant activity in chickens. *Poult Sci.* 2008;87(2):307–16. Doi:10.3382/ps.2007-00297

11. Ebrahimzadeh SK, Navidshad B, Farhoomand P, Aghjehgheshlagh FM. Effects of grape pomace and vitamin E on performance, antioxidant status, immune response, gut morphology and histopathological responses in broiler chickens. *South African J Anim Sci.* 2018;48(2):324–36. Doi:10.4314/sajas.v48i2.13
12. Hosseini J, Safdari-Rostamabad M, Piray AH, Sarir H. The growth performance, plasma biochemistry indices, immune system, antioxidant status, and intestinal morphology of heat-stressed broiler chickens fed grape (*Vitis vinifera*) pomace. *Anim Feed Sci Technol.* 2020; 259(1):114343–52. Doi:10.1016/j.anifeedsci.2019.114343
13. Chamorro S, Viveros A, Rebolé A, Arija I, Romero C, Alvarez I, Rey AI, Brenes A. Addition of exogenous enzymes to diets containing grape pomace: Effects on intestinal utilization of catechins and antioxidant status of chickens. *Food Res Int.* 2017;96(6):226–34. Doi:10.1016/j.foodres.2017.02.010
14. Pascariu SM, Pop IM, Simeanu D, Pavel G, Solcan C. Effects of wine by-products on growth performance, complete blood count and total antioxidant status in broilers. *Rev Bras Cienc Avic.* 2017;19(2):191–202. doi.org/10.1590/1806-9061-2016-0305
15. Makri S, Kafantaris I, Stagos D, Chamokeridou T, Petrotos K, Gerasopoulos K, Mpesios A, Goutzourelas N, Kokkas S, Goulas P, Komiotis D, Kouretas D. Novel feed including bioactive compounds from winery wastes improved broilers' redox status in blood and tissues of vital organs. *Food Chem Toxicol.* 2017;102(4):24–31. Doi:10.1016/j.fct.2017.01.019
16. Luna A, Lábaque MC, Zygadlo JA, Marin RH. Effects of thymol and carvacrol feed supplementation on lipid oxidation in broiler meat. *Poult Sci.* 2010;89(2):366–70. Doi:10.3382/ps.2009-00130
17. Abu Hafsa SH, Ibrahim SA. Effect of dietary polyphenol-rich grape seed on growth performance, antioxidant capacity and ileal microflora in broiler chicks. *J Anim Physiol Anim Nutr (Berl).* 2018;102(1):268–75. Doi:10.1111/jpn.12688
18. Hassan AA, Asim RA. Effect of vitamin C and acetylsalicylic acid supplementation on some hematological value, heat shock protein 70 concentration and growth hormone level in broiler exposed to heat stress *Iraqi J of Vet Sci.* 2020; 34(2):357-363. Doi:10.33899/ijvs.2019.125950.1195
19. Abdulameer YS. The effects of dietary vitamin C and Citrus Sinensis peel on growth, hematological characteristics, immune competence, and carcass characteristics in broilers exposed to heat stress. *Iraqi J of Vet Sci.* 2018; 32(2):253-260. Doi: 10.33899/ijvs.2019.153859