Egyptian J. Nutrition and Feeds (2022), 25 (3):377-385

IMPACT OF FEEDING BROILER CHICKS ON GINGER, PEPPERMINT AND VITAMIN C UNDER HEAT STRESS CONDITIONS

Fatma, A. Abdel-Salam[1]; F. Abdel-Azeem[2]; Y. El-Hommosany[2] and H.F.A. Mutawe[1]

[1]*Regional Center for Food and Feed, Agricultural Research Center, ARC*

[2]*Poultry Production Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.*

(Received 23/08/2022, accepted 12/10/2022)

SUMMARY

A total of 320 d-old broiler chicks (Cobb-500) with an average body weight of 48.0±2gm were distributed by weight in eight equal groups, each in 5 replicates. The first group (T1) was fed on a basal diet. Ginger root powder was added to be basal diet at 0.25% and 050% (T2 and T3 groups), peppermint leaves powder was added to the basal diet at 0.25% (T4) and 0.50% (T5), both ginger and peppermint at levels of 0.125% (T6) and 0.25% (T7) groups, respectively, and 300 mg/kg diet vitamin C added to was basal diet (T8) group. Results showed that, the highest live body weight and body weight gain were recorded in the T7 group supplemented with ginger 0.25%+peppermint 0.25%, and lowest values were found in the control group. Feed consumption and feed conversion ratio were significantly improved in all treatment groups compared with control group, where the highest values in feed intake was found in T4 (0.25% peppermint powder), but T8 (300 mg vitamin C) had the best improvement in feed conversion ratio of birds among all experimental treatments compared to the control group. Economic efficiency was increased by supplementing broiler diets with peppermint or mixture between ginger and peppermint as well as vitamin C compared with the control group (T1). Hemolytic malondialdehyde was significantly decreased, while catalase activities were significantly increased in all experimental groups. Amylase or protease significantly increased in chicks fed diets supplemented with different fed additives compared to chicks of control. Fatty acid profile of broilers breast meat results showed that feeding broilers on different types of feed additives were high in unsaturated (monounsaturated and polyunsaturated) fatty acids compared with control group (T1). It is concluded that, dietary supplementation with dry leaves at 0.5% or a high mixture of ginger and peppermint (0.25%+0.25%) may be used for enhancing productive performance, fatty acid profile, antioxidant status and economic efficiency of broilers reared under heat stress conditions.

Key words: *Ginger, peppermint, vitamin C, Broilers, Heat Stress.*

INTRODUCTION

Heat stress is one of the most important factors harmfully affecting overall poultry production (Khan *et al.,* 2011, 2014). High temperature and humidity exert severe stress on birds leading to reduced performance (Khan et al., 2012; Chand et al., 2014). Broiler performs well within a fairly wide range of temperatures (18 and 22°C). However, this wide range thermoneutral temperature is not ideal for the ideal feed efficiency. Charles (2002) on the other hand, reported a lower range of temperature for optimum performance in broilers (18-22°C). Heat stress is additionally mirrored in numerous physiological traits and leads to large economic harms (Kapetanov *et al.,* 2015). Heat stress refers to the high ambient temperature and the heat resulting from metabolism, which increases body temperature (Aengwanich and Chinrasri, 2002). Poultry diets are generally based on maize and soya bean meal and these ingredients are poor in antioxidants. Therefore, inclusion of antioxidants in broiler diets could help alleviate the associated negative effects of oxidative stress. Many synthetic antioxidant compounds have shown, however, to have toxic and/or mutagenic effects in poultry, so there is growing interest in sources of natural antioxidants (Nagulendran *et al.,* 2007). Feed additives are added to broiler diets to improve its productive performance by increasing the growth rate, better feed conversion efficiency and greater livability in poultry birds. Spices as an additive in the diet of chickens is very common. Active principles of the plant or chemical compounds present in certain parts of the plant or the effect of therapeutic activity that companies them (Zhang *et al.,* 2009). Peppermint contains polyphenolic compounds, and hence could possess strong antioxidant properties (Dorman *et al.,* 2003). Birds supplemented with peppermint leaf powder significantly enhanced the body weight and FCR as compared to control group.

The birds supplemented with 0.5% of peppermint leaf powder had the best FCR and was found to be economical. Thus, this can be used in broiler feeds to enhance its growth and make the feed economical (Mohanty *et al.*, 2020). Ginger is the rhizome of the plant Zingiber officinal, the main remarkable components in ginger are gingerdione, gingerdiol and gingerol, which when used in broiler diets have the ability to activate digestive enzymes and affect the microbial activity (Dieumou *et al.,* 2009). The active compounds in ginger have been reported to possess antioxidant, antimicrobial, immuno-modulatory, anti-tumorigenic, anti-inflammatory, anti-apoptotic, anti-hyperglycemic, anti-lipidemic and antiemetic properties (Al-Amin *et al.,* 2006, Ali *et al.,* 2008 Morakinyo *et al.,* 2011). Therefore, the aim of the current study was to detect the effect of dietary peppermint plant, Ginger root supplementation either alone or their combination, and Vitamin C, under heat stress on performance carcass traits, metabolic status, antioxidant capabilities and economic efficiency of broiler chickens.

MATERIALS AND METHODS

A total of 320 one-day-old, unsexed broiler chickens (Cobb-500) were randomly allocated to 8 experimental groups (40 chicks/each), each in 5 replicates. The first experimental group represents the control and fed basal diets (Table 1). The other groups received control diet supplemented with 0.25% ginger powder (T2); 0.5% ginger powder (T3); 0.25% peppermint powder (T4); 0.5% peppermint powder (T5); 0.125% peppermint powder plus 0.125% ginger powder (T6); 0.25% peppermint powder plus 0.25% ginger powder (T7); 0.3 % Vitamin C (T8).

The diets were formulated to meet the nutrient requirements of broiler chicks during starting, growing, and finishing periods according to the National Research Council (NRC, 1994). The basal diets contained 23%, 22% and 21 % protein and 3049, 3175 and 3201 kcal of ME/kg for starter, grower, and finisher diets, respectively. The powders of ginger, peppermint and vitamin C as an antioxidant were added to the diet at 1st day of age.

Initial temperature in the cages was maintained at 32 °C for the first two days, and then reduced linearly by 0.5 °C per day until 14 days of age. From 15 until 40 days of age, temperature-simulated cyclic heat stress (HS) maintained at 31±2 °C for 8h (10 am to 6 pm) and then was slowly reduced until reaching the comfort temperature (22-27°C) that corresponded to bird age according to company recommendations for Cobb 500.

Feed and water were available ad-lib during the experimental period and the broilers were exposed to continuous light (24 h daily) throughout the experiment. All chicks were vaccinated against different diseases according to the vaccination programs adopted in most Egyptian broiler farmers. Feed consumption and individual body weight of birds were measured weekly. The averages of initial body weights of the different groups were nearly equal. Performance index (live body weight (kg)/ feed conversion ratio x 100) was calculated according to North (1984). Weekly individually body weight (BW) and weight gain were measured, weekly feed consumption (FC) (g/d/bird), feed conversion ratio (FCR) (g feed/g gain) were measured for each replicate.

At the end of the experiment, a sample of two randomly selected birds from each replicate within a treatment (10 chicks per treatment) was weighed, slaughtered by severing the carotid artery and jugular veins, carcasses were left for about 3 minutes until all blood has drained. The abdominal cavity was opened and the edible offal's (liver, heart, gizzard), and dressing, abdominal fat, as well as lymphoid organs (bursa of fabrecious and spleen) percentages were then weighed to determine their relative weights. At 40 days of age, two blood samples were taken from 2 chicks per replicates (10 birds per treatment) by puncturing the brachial vein to measure some blood parameters. The first sample was collected in EDTA tube, centrifuged (2000 rpm for 10 minutes) and plasma was then decanted in Eppendorf tubes and stored at -20 ○C for later analysis until antioxidant determination was done. The second sample was collected in non-heparinized tube and the blood was centrifuged within 30 min after sampling to obtain serum and stored at -20 ̊c for later analysis.

The total values of phenolic compounds were measured colorimetrically, using Folin-Ciocalteu method (Singleton et al., 1999). The total antioxidant capacity of the samples is evaluated by the method of (Prieto et al., 1999). Saturated and unsaturated total fatty acids were determined in the breast meat by using methyl esters boron Tri fluoride method (A.O.A.C., 2019). Biomarkers of antioxidant status and lipid peroxidation By Colorimetric Method Activities of blood Serum malondialdehyde (MDA) and plasma catalase (CAT) were measured according to Satoh et al., (1979) and (Aebi, 1984), respectively.

Table (1): Composition and calculated chemical analysis of tested diets during the starter, grower and finisher periods.

Ingredients	Starter	Grower	Finisher
Yellow corn (7.3% CP)	53.500	53.639	55.573
Soybean meal (45.0% CP)	30.764	29.298	28.818
Corn gluten meal (62.5% CP)	8.600	8.074	6.500
Vegetable oil	2.590	4.581	4.922
Dicalcium phosphate	1.734	1.926	1.715
Limestone	1.378	1.111	1.098
Vit. & Min. Mixture (1)	0.400	0.400	0.400
Salt (NaCl)	0.400	0.400	0.400
L-lysine-HCl	0.385	0.365	0.396
DL-Methionine	0.166	0.123	0.095
Choline chloride	0.083	0.083	0.083
Total	100	100	100
Calculated values			
CP	23	22	21
ME (KCal/Kg)	3049	3175	3201
Lysine	1.36	1.30	1.30
Methionine	0.58	0.52	0.47
Methionine + Cystine	0.98	0.94	0.85
Calcium	0.96	0.90	0.85
Available P	0.45	0.48	0.44

[1]*Vitamins - minerals mixture supplied per kg of diet: vit. (A), 12000 I.U., vit. (D_3), 2000 I.U; vit. (E), 10 mg ; vit. (K_3), 2 mg ; vit. (B_1), 1 mg ; vit. (B_2), 5 mg ; vit. (B_6), 1.5 mg ; vit. (B_{12}), 10 µg; Biotin, 50 µg; Pantothenic acid, 10mg; Niacin, 30 mg; Folic acid, 1 mg; Manganese, 60 mg; Zinc, 50 mg; Iron., 30 mg; Copper, 10 mg; Iodine, 1 mg; Selenium, 0.1 mg and Cobalt, 0.1 mg.*

The economic efficiency (%) was calculated from the input-output analysis based upon the differences in both growth rate and feeding cost, (Zeweil, 1996).

Data obtained in this study were analyzed by one-way analysis of variance using the SAS software general linear model (SAS, 2004). Mean values were compared using the Duncan's New Multiple Range test (Duncan, 1955) when significant differences existed. The fixed effects model used in the analysis was as follow: $Y_{ij} = \mu + T_i + e_{ij}$. Where: Y_{ij}: the observation of the jth chick in the ith treatment. µ: the overall mean. T_i: effect of the ith treatment (i = 1, 2….8). e_{ij}: the random error effect. The significance level was set at 5%.

RESULTS AND DISCUSSION

Total phenol and antioxidants:

The determined amounts of total phenols and antioxidants of alcoholic extract of peppermint and Ginger powder are shown in Table 2. Ginger and peppermint powder contain total phenols (mg/kg), which are 6060.83 and 10102.5, respectively, while the corresponding total antioxidants (mg/kg) are 11898.33 and 11250.

Table (2): Total phenols, flavonoids, and antioxidants of alcoholic extract of ginger and peppermint (as dry weights)

Peppermint	Ginger	Compound
10102.5	6060.83	Total phenol (mg/kg)
11250	11898.33	Total antioxidants(mg/kg)

Broilers productive performance:

Live body weight and total body weight gain:

Final live body weight (FLBW) and total body weight gain (TBWG) of broiler chicks as influenced by different treatments are presented in Table (3). All the treatments showed a significant positive effect on FLBW and TBWG among the experimental treatments at 40 days of age. The average body weights at 40 days of age were significantly higher (2295.40) in the group supplemented high levels of ginger and peppermint combination (group 7), intermediate values of final body weights recorded in both peppermint alone (group 5) and ginger plus peppermint (group 6). However, finisher weights were lower in the group with the lowest levels of the peppermint group followed by control one. Data for body weight illustrated that neither ginger supplementation nor vit C; elicit a greater response in final body weight. Similar trend to results on body weights were obtained in body weight gain.

It is well-known that, exposure of animals to high environmental temperature generates behavioral, physiological and immunological responses, which impose detrimental consequences to their productivity. However, the detrimental effects of heat stress in broiler seem to be very harmful. It is important to consider that supplementing diets with feed additives such as natural antioxidants may have an effective role in restoring of these negative effects. When the ginger root powder and peppermint leaves powder used as a feed additive, it could play a role as natural growth promoter for broiler reared under heat stress conditions, due to polyphenolic contents (Warriss *et al.*, 2005). Also, peppermint leaves contain a high concentration of phenolic compounds (flavonoids) which are responsible for the peppermint antioxidant activity (mainly phenolic diterpenes such as carnosol, carnosic acid, rosmanol, epirosmanol and isorosmanol), (Arb Ameri *et al.,* 2016). Herein, using the mixture between ginger powder and peppermint powder may reflect (synergism or antagonism effects) of body weight and body weight gains.

Feed consumption and feed conversion ratio:

The results of the present study showed significantly higher (P < 0.05) improvement in feed conversion ratio of birds among all experimental treatments compared to the control. Results obtained on feed consumption and conversion (Table, 3) showed in general high significant differences in either feed consumption and feed conversion ratio between all experimental treatments followed by those levels of feed consumption recorded by group fed a low of peppermint (group 4) and then by those fed vit C (group 8) and the highest was found in (T7).

Table (3): Growth performance of broiler chicks fed diet supplemented with vitamin C and ginger or peppermint alone or combination under heat stress conditions.

Variable	Treatments								SEM	Sig
	T1	T2	T3	T4	T5	T6	T7	T8		
Final LBW	2102.60^{e}	2132.80^{d}	2139.40^{c}	2092.60^{f}	2237.80^{b}	2234.80^{b}	2295.40^{a}	2139.80^{c}	24.95	***
Total BWG	2054.60^{e}	2084.80^{d}	2091.40^{c}	2044.60^{f}	2189.80^{b}	2186.80^{b}	2247.40^{a}	2091.80^{c}	24.95	***
Total FC	3352.40^{c}	3308.20^{c}	3244.60^{d}	3188.40^{e}	3402.80^{b}	3400.80^{b}	3464.20^{a}	3204.40^{de}	46.14	***
FCR	1.63^{a}	1.58^{b}	1.55^{c}	1.56^{c}	1.55^{c}	1.55^{c}	1.54^{cd}	1.53^{d}	0.01	***
PI	129.00	134.99	138.03	134.14	144.37	144.18	149.05	139.86		
Economic Efficiency	2.05	2.04	2.01	2.08	2.20	2.11	2.15	2.18		
Relative Economic Efficiency	100	98.5	98.05	101.46	107.31	102.92	104.87	106.34		

*a-b… etc. Means, within a row, with different superscripts difference significantly (***=P<.0001). T1 negative control T1:(no antioxidant), T2:(0.25%ginger powder), T3:(0.5% ginger powder), T4:(0.25%peppermint powder), T5:(0.5% peppermint powder), T6: (0.125% peppermint powder+ 0.125% ginger powder), T7 :(0.25% peppermint powder+ 0.25% ginger powder), T8: (300 mg vitamin C) respectively.*

However, the control group was intermediate. In spite of T7 fed (0.25 % ginger plus 0.25% peppermint) exerted highest feed consumption, it recorded the best level conversion after vit C group. Performance index was increased by supplementing broiler diets with ginger or peppermint, or their combination and vitamin C compared with the control group (T1). The addition of either peppermint, mixture of ginger and peppermint or vitamin C into broiler diets increased the economic efficiency (expressed as of net revenue/feed cost, EEf) and relative economic efficiency (REE) than those received un-supplemented control diet and supplemented ginger alone through the whole experimental period. This was due to the improvement in body weight and feed conversion efficiency. The results obtained herein agree with the findings of Mohamed *et al.* (2012) who noticed that use of ginger powder in the broiler diet had a significant positive effect on feed consumption of broiler chicks. Akbari and Torki (2014) showed that the average body weight (LBW) and body weight gain (BWG) and daily FI in female broiler chicks did not significantly affect by dietary supplementation with peppermint oil. Also, Arb Ameri, *et al.* (2016) demonstrated that consumed peppermint powder significantly improved feed conversion ratio and body weight. However, Morshedy *et al.* (2019) reported that supply peppermint oil (400 mg/kg) did not significantly affect the final live body weight and average daily gain compared with control. The absence of the significant differences between their results and our results might be due to that we used peppermint powder, but they used peppermint oil. Results also show that the economic efficiency was increased by supplementing broiler diets with peppermint, or their combination with ginger and vitamin C compared with the control group (T1). The same results obtained with, Abdel-Wareth *et al.* (2019) who found that birds fed diet supplemented with 15 g/kg of peppermint leaves had the highest total benefit compared with the control group. Also, Mohanty *et al.* (2020) found that birds fed basal diets supplemented with 0.5% peppermint powder had a higher profit margin than the control birds.

The fatty acid composition of breast meat:

Data of fatty acid profile of broiler chicken breast meat fed on ginger, peppermint, their mixture, and vitamin C are presented in Table (4). It was observed that meat of chicken fed on diets supplemented with feed additives, was considerably higher in unsaturated fatty acid compared with control group (T1). Broiler chicken meat fed on diets containing T8: (vitamin c), T4: (0.5%) and T2: (0.25% ginger) were the higher content of unsaturated fatty acids compared with other treatments. The polyunsaturated fatty acids of chicken meat fed on diets containing vitamin C T8, T7: (0.25% ginger+0.25% peppermint) and T4: (0.5% ginger) were higher than other treatments. The lowest content of polyunsaturated fatty acids was recorded in T1: (no antioxidant) control group 23.1g/100 of total fatty acid. An observed differences in the most of fatty acid profile were found in the chicken meat among levels of feed additives, used herein. Also, it can be found that UFA/SFA of broiler chicken fed on groups (T1, T4 and T7) was lower compared with those fed on T8: (0.3 % Vitamin C, T2: (0.25% ginger powder), T6: (0.125% peppermint powder+ 0.125% ginger powder), T3: (0.5% ginger powder), while the lowest value of UFA/SFA diet was recorded in the control group T1: (no antioxidant). The Ꞷ -6/ Ꞷ -3 PUFA ratio was highly differentiated, ranging from nearly 30.88% in T8: (0.3 % vitamin C), 30.2% in T3: (0.5% ginger powder), 28% in T6: (0.125% peppermint powder+ 0.125% ginger powder),22.9%in T5: (0.25% peppermint powder)), 21.2% in T2: (0.25% ginger powder), to 14 in T1: (control), 12% in T7: (0.25% Peppermint powder+ 0.25% ginger powder) and the lowest value 6.98% in T4: (0.25% peppermint powder). The consumption of broiler meat enriched with more polyunsaturated fatty acids will represent a better contribution to the human food and is more profitable than other animal products with respect to provision of fatty acids.

Table (4): Effect of dietary antioxidant sources on fatty acid composition of breast meat (g/100 g total fatty acid).

Variable	Treatment							
	T1	T2	T3	T4	T5	T6	T7	T8
Saturated fatty acid	43.83	31.67	32.75	33.21	34.01	38.31	32.45	28.74
Monounsaturated fatty acid	33.6	37.5	36.75	38.1	36.86	31.08	35.4	38.44
Poly Unsaturated fatty acid	23.1	30.59	30.5	31.36	28.8	30.51	32.04	35.65
Unsaturated fatty acid	56.7	68.09	67.25	69.46	65.76	61.59	67.44	74.09
UFA / SFA	1.66	2.37	2.07	1.81	1.93	2.06	1.85	2.34
Omega 3	1.53	1.36	0.97	3.87	1.19	1.04	2.41	0.79
Omega 6	21.5	28.8	29.3	27.0	27.2	29.0	28.9	24.4
Ꞷ 6/ Ꞷ 3	14	21.2	30.2	6.98	22.9	28	12	30.88

T1: (no antioxidant), T2: (0.25% ginger powder), T3: (0.5% ginger powder), T4: (0.25% peppermint powder), T5: (0.25% peppermint powder), T6: (0.125% peppermint powder+ 0.125% ginger powder), T7: (0.25% peppermint powder+ 0.25% ginger powder), T8: (300 mg vitamin C) respectively, SFA = Saturated fatty acids; MUFA = Monounsaturated fatty acids; PUFA = Polyunsaturated fatty acids; Ꞷ 3 = Total omega 3 fatty acid; Ꞷ 6 = Total omega 6 fatty acid.

The inconsistent results could be attributed to the species, strains of broiler in addition to the plant bioactive components, plant fatty acid profile, and dietary supplementation level. Breast meat can be regarded as an important component of a healthy diet as it contains more polyunsaturated fatty acids (PUFA) and less saturated fatty acids (SFA) than meat from other species of animals, e.g., beef and lamb

(Berzaghi *et al.*, 2005). Herbs and herbal products contain antioxidants that can prevent the oxidation of UFA and cholesterol present in animal-origin products such as meat and eggs (Orczewska-Dudek *et al.*, 2020) and increase the antioxidant potential of the animal's body (Skomorucha, and Sosnówka-Czajka., 2021).

Antioxidant status and enzymes activity of ileum intestine:

At 40 d of age, results of serum malondialdehyde (MDA) and catalase (CAT) as affected by experimental feed supplements are presented in Table (5). Malondialdehyde of broilers serum is significantly decreased ($P<0.05$) in all experimental treatments, lowest values had found in T3 and/or T7 compared with the control one. But, on the other hand, catalase activity was significantly increased ($P<0.01$) in all supplemented groups. Greater activity in T3 and T7 treatments which recorded 320.2 and 314.06 U/l s, while the lowest activity was recorded in the control treatment (169.79 U/l). In general, heat stress causes a negative change in antioxidant status of broilers inducing oxidative stress, which causes an increase in MDA and the decrease of catalase activity and endogenous antioxidant enzymes as noticed in the control group (T1). All experimental groups with feed additives used herein exerted high significant increase ($P<0.05$) on amylase and protease contents of the ileum especially for group which T5 recorded the highest ileum enzyme levels, whereas lowest enzyme level obtained from control treatment T1 (66.16 U/ml). The present results are in agreement with Abdelaziz *et al.* (2015) who reported that broiler chicks fed diets supplemented with peppermint leaves significantly showed higher activity of ileum amylase and protease compared with the control group, moreover, Ahmed *et al.* (2016) reported that all peppermint supplemented diets recorded significant highly ileum either amylase or protease.

Table (5): The effect of ginger, peppermint and vitamin C on catalase, malondialdehyde, amylase and protease enzyme level of ileum intestine of broiler chickens.

Variable	Treatments								SEM	Sig
	T1	T2	T3	T4	T5	T6	T7	T8		
CAT (u/l)	169.79^{c}	197.92^{b}	314.06^{a}	199.48^{b}	214.06^{b}	215.1^{b}	230.2^{b}	207.29^{b}	42.37	*
MDA (nmol/ml)	22.21^{a}	12.58^{b}	10.91^{b}	13.29^{b}	12.30^{b}	13.29^{b}	11.00^{b}	14.20^{b}	4.10	*
AMY(u/l)	66.16^{e}	79.77^{d}	123.89^{b}	84.16^{cd}	139.84^{a}	92.17^{c}	124.41^{b}	127.95^{a}	3.161	***
PROT(u/ml)	76.33^{f}	86.00^{d}	81.5^{e}	108.33^{c}	111.66^{a}	109.9^{b}	111.00^{ab}	110.33^{ab}	0.426	***

a, b: means in the same row with different superscript are significantly different (p<0.05) T1: (no antioxidant), T2: (0.25% ginger powder), T3: (0.5% ginger powder), T4: (0.25% peppermint powder), T5: (0. 5% peppermint powder), T6: (0.125% peppermint powder+ 0.125% ginger powder), T7: (0.25% peppermint powder+ 0.25% ginger powder), T8: (0.3 % Vitamin C) respectively. CAT: amylase; MDA: malondialdehyde; AMY: amylase and PROT: protease enzyme

Conclusion

In conclusion, the present study shows that the feeding of either ginger or peppermint and vitamin C showed positive response on growth performance of broiler chickens under heat stress conditions.

REFERENCES

A.O.A.C. (2019). Official Methods of Analysis of the Association of Official Analytical Chemists.17 Ed. 969.3 and 991 .39 Fatty Acid in oils and Fats Preparation of Methyl Esters Boron Tri FLUORIDE-IUPAC Method Codex – Adopted- AOAC Method. Chapter 41, p, .19:20

Abdelaziz, M.A.M.; A.I. El-Faham and N.G.M. Ali, (2015). Using natural feed additives as alternative anti-mycotoxins in broiler diets. Egypt. Poult. Sci., 35: 291-310.

Abdel-Wareth, A. A.; S. Kehraus and K- H. Südekum. (2019). Peppermint and its respective active component in diets of broiler chickens: growth performance, viability, economics, meat physicochemical properties, and carcass characteristics. Poultry science, 96(9):3850-3859

Aebi, H. (1984) Methods Enzymol 105, 121 – 126.

Aengwanich W. and O. Chinrasri (2002). Effect of heat stress on body temperature and hematological parameters in male layers. Thai. J. Physiol. Sci. 15, 27-33.

Ahmed, A.M.; M.H. El-Sanhoury and Mohamed M.M. Mostafa (2016). Effect of Peppermint Extracts Inclusion in Broiler Chick Diet on Chick Performance, Plasma Constituents, Carcass Traits and Some Microbial populations, enzymatic activity and histological aspects of Small Intestine. Asian J. Anim. Vet. Adv, 11: 441-451.

Akbari, M.; and M. Torki (2014). Effects of dietary chromium picolinate and peppermint essential oil on growth performance and blood biochemical parameters of broiler chicks reared under heat stress conditions. Int. J. Biometeorol., 58: 1383-1391.

Al-Amin Z.M, M. Thomson, K.K. Al-Qattan, R. Peltonen Shalaby and M Ali (2006). Anti-diabetic and hypolipidemic properties of ginger (Zingiberofficinale) in streptozo-tocin induced diabetic rats. British Journal of Nutrition, 96: 660-666.

Ali B. H.; G. Blunden; M.O. Tanira.; A. Nemmar (2008). Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber Officinale Roscoe). A review of recent research. Food chemistry and toxicology, 46:409-420.

Arab Ameri. S. S. Samadi.; B. Dastar and S. Zarehdaran (2016) Efficiency of peppermint (Mentha piperita) powder on performance, Body temperature and carcass characteristics of broiler chickens in heat stress condition. Iranian Journal of Applied Animal Science 6 (4), 943-950.

Berzaghi, P.; A. Dalle Zotte; L.M. Jansson and I. Andrighetto. (2005). Near-infrared reflectance spectroscopy as a method to predict chemical composition of breast meat and discriminate between different n-3 feeding sources. Poult. Sci. 2005, 84, 128–136. [Google Scholar] [CrossRef]

Chand, N.; S. Naz; A. Khan; S. Khan and R. U. Khan (2014). Performance traits and immune response of broiler chicks treated with zinc and ascorbic acid supplementation during cyclic heat stress. International Journal of Biometeorology, 58(10): 2153–2157.

Charles, D. R., (2002). Responses to the thermal environment. In D. A. Charles, & A. W. Walker (Eds.), Poultry environment problems, a guide to solutions (pp. 1–16). Nottingham University Press.

Dieumou FE.; A. Teguia; J.R.Kuiate; J. D.Tamokou; N.B Fonge and M.C Dongmo (2009). Effects of ginger (Zingiber Officinale) and garlic (Allium sativum) essential oils on growth performance and gut microbial population of broiler chickens. Livestock Research for Rural Development, 21: 25-34.

Dorman, H.J.D.; M. Kosar, K. Kahlos,; Y. Holm, and R. Hiltunen (2003). Antioxidant properties and composition of aqueous extracts from Mentha species, hybrids, varieties, and cultivars. J Agric Food Chem. 51: 4563-4569.

Duncan, D.B. (1955). The multiple ranges and multiple F-Tests. Biometrics, 11: 1-42.

Kapetanov, M.; M. Pajić; D. Ljubojević and M. Pelić (2015). Heat stress in poultry industry. Arh. Vet. med., 8(2): 87 – 101.

Khan, R., S. Naz; Z. Nikousefat,; V. Tufarelli; M. Javdani; N. Rana & V. Laudadio, (2011). Effect of vitaminE in heat-stressed poultry. World's Poultry Science Journal, 67(03), 469-478.

Khan, R; S. Naz, Z. Nikousefat; M. Selvaggi; V. Laudadio, & V. Tufarelli, (2012). Effect of ascorbic acid in heat-stressed poultry. World's Poultry Science Journal, 68(3), 477-490.

Khan, R., Shabana Nazb, Hammad Ullahc, Qudrat Ullahd, Vito Laudadioe, Qudratullahf, Giancarlo Bozzog, and Vincenzo Tufarell. (2014). Physiological dynamics in broiler chickens under heat stress and possible mitigation strategies. https://doi.org/10.1080/10495398.2021.1972005

Mohamed, A. B.; M. A. M. Al-Rubaee and A. Q. Jalil (2012). Effect of ginger (zingiber officinale) on performance and blood serum parameters of broiler. International Journal of Poultry Science. 11 (2):143-146.

Mohanty. S.; B. Panigrahi.; L. K. Babu.; K. Behera.; S. M. Nanda and G. P. Sabat. (2020) Effect of Supplementing Different Levels of Peppermint powder on production performance of broilers. Int. J. Curr. Microbial. App.Sci.9 (02): 2948-2955.doi: https://doi.org/ 10.20546/ ijcmas.2020.902.336.

Morakinyo A.O; A.J Akindele and Z. Ahmed (2011). Modulation of antioxidant enzymes and inflammatory cytokines: Possible mechanism of anti-diabetic effect of ginger extracts. African Journal of Biomedical Research, 9: 195-202.

Morshedy S. A.l; H. S. Zweil; S. M. Zahran; M. H. Ahmed and B. M. El-Mabrok (2019). Growth performance, carcass traits, immune response and antioxidant status of growing rabbits supplemented with peppermint and basil essential oils. Egyptian Poultry Science Journal, 39 (1), pp. 61-79.

Nagulendran, K.R., S. Velavan; R. Mahesh and V.H. begum (2007) In vitro antioxidant activity and total polyphenolic content of Cyperus rotundus rhizomes. E-Journal of Chemistry, 4: 440–449. doi:10.1155/2007/903496.

NRC. (1994) "National Research Council" Nutrient requirements of poultry. 9th. Rev. (Edn.). National Academy Press, Washington, DC; USA.1994.

North, M.O and D.D. Bell (1981). Breeder Management. In: " Commercial chicken production Manual" 4 th Ed. Van Nostrand emhold York, USA.

Orczewska-Dudek, S.; M. Pietras; M. Puchała; J. Nowak, (2020). Camelina sativa oil and camelina cake as sources of polyunsaturated fatty acids in the diets of laying hens: Effect on hen performance, fatty acid profile of yolk lipids, and egg sensory quality. Ann. Anim. Sci. 2020, 20, 1365–1377. [Google Scholar] [CrossRef]

Prieto, P; M. PINEDA and M. Aguilar (1999). Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphomolybdenum complex: specific application to the determination of vitamin Analytical biochemistry, 269(2), pp.337 -41.

SAS, (2004). SAS User's Guide: Statistics. Version 9.1. SAS Inst. Inc., Cary, NC., USA.

Satoh K., Clinica Chimica Acta (1978), 90, 37.

Singleton, V.L; R. Orthofer and. R. M Lamuela-Raventos. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by mean of Folin-Ciocalteu reagent. M Enzymol. 299, 152-178.

Skomorucha, I and E. Sosnówka-Czajka. (2021). The effect of adding herbal extracts to drinking water on body temperature, level of thyroid hormones and H:L ratio in the blood of broiler chickens exposed to elevated ambient temperature. Ann. Anim. Sci. 2021, 21, 1152–1522. [Google Scholar] [CrossRef]

Warriss, P.D.; A. Pagazaurtundua; S.N. Brown (2005). Relationship between maximum daily temperature and mortality of broiler chickens during transport and lairage. Br. Poult. Sci. 2005, 46, 647–651.

Zeweil H. S. (1996). Evaluation of substituting nigella seed meal for soybean meal on the performance of growing and laying Japanese quails. Egyptian Poultry Science; 16: 451–77.

Zhang, G. F.; Z. B Yang; Y. Wang; W. R. Yang; S. Z. Jiang; and G. S. Gai (2009). Effects of ginger root (Zingiber officinale) processed to different particle sizes on growth performance, antioxidant status, and serum metabolites of broiler chickens. Poult. Sci., 88: 2159-2166.

تأثير تغذية بداري التسمين على الزنجبيل والنعناع وفيتامين ج تحت ظروف الإجهاد الحرارى

فاطمة عبد السلام عبد السلام[1]، فتحي عبد العظيم محمد[2]، يسري الحمصاني[2]، هادئ فتحي عباس مطاوع[1]

[1]*المركز الإقليمي للأغذية والأعلاف، مركز البحوث الزراعية، وزارة الزراعة، الدقى، جيزة، مصر*

[2]*قسم إنتاج الدواجن، كلية الزراعة، جامعة عين شمس، القاهرة، مصر.*

استخدم فى هذه التجربة 320 كتكوت Cobb500 عمر يوم بمتوسط وزن جسم حى 48±2 جرام، تم تقسيم الكتاكيت إلى ثماني مجموعات متساوية. كل مجموعة تكونت من 5 مكررات (8 طيور لكل مكرر).المجموعة الأولى كانت المجموعة الضابطة غذيت على العليقة القاعدية بدون أى إضافة، المجموعة الثانية والثالثة غذيت على العليقة القاعدية مضاف إليها مسحوق جذور الزنجبيل الجافة (0.25% أو 0.50% على التوالي)، المجموعة الرابعة والخامسة غذيت على العليقة القاعدية مضاف إليها مسحوق أوراق النعناع الجافة (0.25% أو 0.50% بالترتيب)، بينما المجموعة السادسة تم تغذيتها على العليقة المقارنة مضافاً إليها مخلوط من جذور الزنجبيل وأوراق النعناع بنسبة(0.125%+0.125%) لكل منهما ،المجموعة السابعة تم تغذيتها على العليقة المقارنة مضافاً إليها مخلوط من جذور الزنجبيل وأوراق النعناع بنسبة (0.25%+0.25%) لكل منهما أما المجموعة الثامنة والأخيرة فتم تغذيتها على عليقة المقارنة مضافا إليها فيتامين سى 300mg. تم الحفاظ على درجة الحرارة الأولية في الأقفاص عند 32 درجة مئوية في اليومين الأولين من عمر الكتاكيت ، ثم انخفضت خطيًا بمقدار 0.5 درجة مئوية يوميًا حتى عمر 14 يومًا. من 15 إلى 40 يومًا من العمر،تم رفع درجة الحرارة لاحداث إجهاد حراري اصطناعي (HS) عند 31 ± 2 درجة مئوية لمدة 8 ساعات (من 10 صباحًا إلى 6 مساءً) ثم تم تقليله ببطء حتى الوصول إلى درجة الحرارة المعتدلة (22-27 درجة مئوية) التي تتوافق مع عمر الطيور وفقًا لتوصيات الشركة لـ Cobb 500. وتم رعاية الكتاكيت بنظام الأضاءة المستمر (24 ساعة أضاءة) طوال فترة الدراسة التي استمرت 40 يومًا. تم استخدام السخانات الكهربائية للتحكم في درجة الحرارة داخل العنبر.

أوضحت النتائج المتحصل عليها:أن جميع الاضافات الغذائية سواء مسحوق الزيجبيل أو مسحوق أوراق النعناع مفردة أو مخلوط مع بعضهما و كذلك إضافة فيتامين c أحدثت تحسن معنوى فى وزن الجسم و الزيادة الوزنية عند مقارنتها بمجموعة الكنترول.أظهرت المعاملات تحسن معنوى أيضا فى معدل استهلاك العلف وكفاءة التحويل الغذائى ، حيث كانت أفضل القيم في (0.25٪) :T4 مسحوق النعناع) يليها (300 mg) T8 ايضا سجلت T8 أعلى تحسن معنوياً في نسبة تحويل الغذائي للطيور بين جميع المعاملات التجريبية مقارنة بالمجموعة الضابطة. سجلت زيادة في الكفاءة الاقتصادية عن طريق إضافة النعناع إلى أعلاف دجاج التسمين أو خليط بين الزنجبيل والنعناع وإضافه فيتامين ج مقارنة مع مجموعة المقارنة (T1). لوحظ انخفاض معنوى فى مستوى MDA فى المجاميع التجريبية المختلفة مقارنة بمجموعة المقارنة لمصل الدجاج و كانت أقل مستويات MDA في الدجاج اللحم المغذى بمسحوق الزنجبيل 0.5٪ (T3) ، خليط من 0.125٪ زنجبيل + 0.125٪ النعناع (T7) ومسحوق أوراق النعناع 0.5٪ ، على التوالي. أوضحت النتائج أيضا زيادة معدل نشاط إنزيم الأميليز وانزيم البروتيز فى الدم للمجاميع التجريبية المختلفة مقارنة بالمجموعة الضابطة. أظهرت نتائج تحليل الأحماض الدهنية في لحم صدور الدجاج أن تغذية دجاج التسمين على أنواع مختلفة من إضافات الأعلاف كانت عالية في الأحماض الدهنية غير المشبعة (الأحادية غير المشبعة والمتعددة غير المشبعة) مقارنة بمجموعة الكنترول (T1).

يستنتج مما سبق أنه يمكن استخدام مسحوق أوراق النعناع الجاف بمستوى 0.5٪ أو خليط من الزنجبيل والنعناع (0.25٪ + 0.25٪) لتحسين الأداء الإنتاجي، وخصائص الأحماض الدهنية، وحالة مضادات الأكسدة، والكفاءة الاقتصادية لدجاج التسمين المربى تحت ظروف الإجهاد الحراري.