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EFFECT OF INCREASING DIETARY VEGETABLE OILS CONCENTRATION ON PERFORMANCE, CARCASS PARAMETERS AND BLOOD CONSTITUENTS OF BROILER CHICKENS EXPOSED TO HIGH AMBIENT TEMPERATURE

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ABSTRACT: One hundred and forty 21-day old Arbor Acres broiler chickens were used in a straight-run experimental design. The broilers were distributed in a completely randomized design among four treatment groups with seven replicates per treatment and five chickens per replicate. During the experiment period (21 to 42 days old), the chickens were fed iso-caloric and iso-nitrogenous diets containing four levels of dietary vegetable oils (DVO) (2.7, 4, 6 and 8%). During the period when chickens were 25–27, 31–33, and 38–40 days old, the chickens were exposed to heat stress for 4 hours a day (from 10.00am–2.00pm) at 34ºC and 70–75% relative humidity, and returned to normal house temperature afterwards. Feeding 8% DVO diet significantly increased body weight gain (BWG) compared to the other levels of DVO. Moreover, feed conversion ratio (FCR), protein conversion ratio (PCR), metabolizable energy conversion ratio (ECR) and European production efficiency factor (EPEF) were significantly enhanced due to feeding 8% DVO diet compared to 6% DVO diet. On the other hand, 6 and 4% DVO did not significantly differ from the control. Feeding 8% DVO diet significantly decreased plasma low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL) and lymphocytes. Feeding 8% DVO diet significantly increased mean corpscular volume (MCV) and mean corpscularhaemoglobin (MCH) compared to the control. Thus, it can be concluded that broiler chickens fed diet containing 8% DVO have showed tolerance to high ambient temperature (34ºC, 70–75% RH) during the period from 21–42 days old, as evidenced by increasing the productive performance, blood haematological and biochemical traits.

Key words: Heat tolerance Vegetable oils - Broilers performance - Physiological response.

INTRODUCTION

Poultry production in hot regions is challenged by a high environmental temperature causing heat stress that adversely impacts the productive and reproductive traits and welfare of chickens (Daghir, 2008; Syafwan et al., 2011). There is emerging evidence suggesting that including dietary fats/oils in broiler diets increases the ME intake and decreases the heat increment while increasing the animal's performance (Aggoor et al., 2000; Attia et al., 2003; Ghazalah et al., 2008). Energy is involved in all biochemical reactions, tissue growth and egg formation. Thus, chickens' growth during a period of high temperature may be restricted by the energy availability (Attia et al., 2006; Lin et al., 2006; Daghir, 2008). The availability of energy under a high temperature is more essential for growth than other dietary nutrients as energy is crucial for dissipating the metabolic heat production (Attia et al., 2011; Attia and Hassan, 2017). In the literature, the effect of energy concentration on broilers exposed to a high temperature is contradictory. In this regard, Veldkamp et al. (2000) (with respect to turkeys), and Attia et al. (2011), and Attia and Hassan (2017) (both with respect to chickens) indicate that increasing dietary methionine, lysine, arginine, and threonine or protein did not improve broiler performance compared to their increasing energy concentration.

Carbohydrates and oils/fats are the principle energy sources; however, fats/oils show a greater boosting effect than carbohydrates due to their high energy value, low heat increment, extra calorific effect, fat soluble vitamins and improving digestibility, and thus better nutrient utilization (Aggoor et al., 2000; Pesti et al., 2015). Elevating the dietary energy level with fats and/or oils additionally boosted the economic traits of chickens' production in hot regions (Mcnaughton and Reece, 1984). In addition, Al-Harthi et al. (2002), Lou et al. (2003), Raju et al. (2004), Ghazalah et al. (2008), Attia et al. (2006; 2011), and Attia and Hassan (2017) concluded that increasing the dietary ME concentration by using fats/oils in broiler diets during periods of high temperature increased their growth performance. Thus, increasing oil levels may be a useful nutritional technique that may help overcome the negative effects of heat stress (Attia et al., 2006; Daghir, 2008; Attia et al., 2011). Nonetheless, fat supplements added to broiler diets under heat-stress conditions did not affect broiler performance (Sinurat and Balnave, 1985). Moreover, decreasing the metabolizable energy concentration during heat exposure is recommended (Baghel and Pradhan, 1990; Hoffmann et al., 1991). There is a lack of study on the effect of increasing oil levels under a constant energy concentration on the performance of broilers exposed to a high ambient temperature. Thus, this research examines the tolerance of broiler chickens fed diet contained increasing dietary vegetable oil concentrations with a constant energy level to high ambient temperature.

MATERIALS AND METHODS

Chickens, experimental design and diets

One hundred and forty, 21-day-old, Arbor Acres unsexed broiler chickens were randomly distributed, keeping their initial body weights similar, in a straight-run, completely randomized experimental design among four treatment groups. Chickens were sexed at 21 and confirmed at 42 days of age using Comb growth. During the experiment period (in which the chickens were 21–42 days old), the chickens were fed iso-caloric and iso-nitrogenous diets containing four levels of vegetable soybean and sunflower oils mixture, 2.7 (basal diet), 4, 6 and 8% (Table 1). Each treatment consisted of 7 replicates and five unsexed chickens per replicate. Each replicate was kept in battery brooders (35×25×30 cm length-width-height). During the period when chickens were 25–27, 31–33, and 38–

40 days old, the chickens were exposed to heat stress for 4 hours a day (from 10.00am – 2.00pm) at 34ºC and 70–75% relative humidity, and returned to normal house temperature afterwards in which the average temperature and relative humidity were 24.9ºC and 66% RH, respectively. The high temperature regimen was similar to those reported by Attia et al. (2009; 2011), and Attia and Hassan (2017). The chosen period (from 10.00am – 2.00pm) experienced the highest environmental temperature. The average outdoor temperature was 29.5ºC with 32% RH. The housing conditions and control for the high environmental temperature was as reported by Attia and Hassan (2017). During the period when they were 1–20 days old, the broilers were reared using common husbandry practices for broilers, according to the broiler management guide, and fed a commercial mash diet containing 22% crude protein (CP), 12.8 MJ, 1% Ca and 0.5% available phosphorus (Table 1). The scientific and ethics committee of the Animal and Poultry Production Department, Faculty of Agriculture, Damanhour University approved the experimental protocol.

Broiler husbandry

During the pre-experimental period, when the chickens were 1–20 days old, the birds were kept under similar managerial and hygienic conditions. The chickens were fed corn-soybean meal feeds in mash form during days 1–20, as shown in Table 1. The husbandry of the broilers was done according to the Arbor Acres broiler husbandry guide. Mash feed and water were provided *ad libitum.* The vaccination regimen was Hitchiner + IB on day 8, avian influenza (AI)(H5N2) on day 9, Gumboro on day 14 and day 24, and Newcastle disease virus via Lasota on days 14, 20 and 30. The chickens were provided with a 23:1 light-dark cycle.

Measurements

At 21 and 42 days of age, the broilers were weighed (g) and their feed intake was recorded for the same period. Subsequently, their body weight gain (BWG), feed conversion ratio (FCR), protein conversion ratio (PCR) and energy conversion ratio (ECR) were calculated using the feed intake data, and the CP and ME values of the experiment by using the intakes of feed, protein and ME divided by bodyweight gain. Survival rate (SR, 100 – mortality rate) during 21-42 d of age were calculated. European production efficiency factor (EPEF) was calculated as following=(Average grams gained/day × % survival rate)/Feed conversion ratio× 10.

At 42 days of age, seven chickens from each treatment, representing all treatment replicates, were slaughtered according to the Islamic method to determine carcass criteria and inner organs, including lymphoid organs, which were expressed as a percentage of the pre-slaughter weight.

Seven blood samples per treatment were collected on day 42, in unheparinised and heparinised tubes, to determine some of the haematological and biochemical constituents. Blood samples were centrifuged at 3000 rpm for 20 minutes, and the plasma and serum were stored at -20°C for further analyses. The blood's haematological characteristics, such as haemoglobin (Hgb) and picked cell volume (PCV), were determined based on Eilers (1967) method; red blood cells (RBCs) were determined as suggested by Hepler (1966); and the blood mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were calculated. The white blood cells (WBCs) and WBCs' fractions were measured as described by Lucas and Jamroz (1961), plasma glucose (Trinder, 1969), serum total protein (Weichselbaum, 1946), serum albumin (Doumas et al., 1977) and serum globulin (Coles, 1974) were determined, plasma total lipid (Chabrol and Charonnat, 1973).

The serum aspartate amino transferase (AST) and alanine amino transferase (ALT)

were gauged according to Reitman and Frankel (1957) method. Renal function, urea and creatinine were assessed in the serum based on the suggestions of Bartles et al. (1972) and Sampson et al. (1980), respectively, and the urea-to-creatinine ratio was calculated. Alkaline phosphatase (ALP) enzyme was measured according to the method of Kind and King (1954). The total plasma triglycerides, cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were assessed according to the methods of Randrup (1960), Watson (1960), Friedwald et al. (1972) and Wieland and Seidel (1983), respectively. Whereas, the very-low-density lipoprotein (VLDL) was determined as plasma triglycerides/5 (https://labtestsonline.org/understanding/analytes/vldl/tab/sample/)

Statistical analyses

Analysis of variance was done using a one-way analysis of variance, as described by SAS® (2009), using the following model:

$Y_{ij}= \mu+F_i+e_{ij}$,

Where Y= the dependent variable, μ= the overall mean; F_i= the effect of DVO treatments and e_{ij}= the random error. The replicate was the experimental unit. All percentages were transformed to log10 to normalise the data distribution before analysis. The mean difference at $p\leq0.05$ was tested using the Student-Newman-Keuls test. The survival rate was analysed using the chi-square test.

RESULTS

The results for body weight gain; feed, protein and energy intake; feed, protein and energy conversion ratio; survival rate; and EPEF are displayed in Table 2. The results indicate that BWG was significantly increased when feed contained 8% DVO during the high temperature period compared to the other groups. In addition, the FCR, PCR, ECR and EPEF were significantly improved when feed was contained 8% DVO during the high temperature period compared to the groups with 6% DVO. The feed, ME, and CP intakes, and the survival rate were not significantly affected by the different oil concentrations.

Table 3 shows the effects of dietary oil supplementation on the dressing percentage, abdominal fat and inner body organs of broiler chickens at 42 days of age. There was a significant effect on most of the traits studied except for the gizzard and pancreas percentage. Broilers fed a 6% DVO diet show a significantly lower dressing percentage than the control and those on the 8% DVO diets, but these groups did not differ from those fed 4% DVO. Abdominal fat percentage was significantly greater for broilers fed 8% DVO diets than the control and 4% DVO, while those fed 6% was intermediate.

It was found that the percentage of proventriculus was significantly higher for the group fed 4% DVO than those fed 6 and 8% DVO, but these groups did not differ from those fed 2.7% DVO (control). The intestine percentage was significantly increased because of feeding 6% DVO diet as compared to the control and 8% DVO diets. In addition, the 4% DVO diet exhibited a significantly larger intestinal percentage than the control group (2.7% DVO). The liver percentage was significantly larger for the group fed 6% DVO than the other groups, but the heart percentage was significantly higher for groups fed 4% DVO than the other DVO groups.

Table 4 displays the influences of different DVO levels on plasma biochemical constituents and excreta nitrogen, and lipids. There was no significant effect on most of the biochemical constituents except for the serum total protein, excreta nitrogen, excreta lipids, plasma total cholesterol, LDL and VLDL. The serum total protein was significantly lower for the groups fed 6% DVO than for the control and 8% DVO groups, while the result for groups fed 4%

DVO was intermediate. In addition, the percentage of excreta nitrogen was significantly higher for the control group compared to those in the groups fed 6 and 8% DVO. The groups fed 4% DVO had significantly decreased excreta lipids compared to the other groups. The plasma cholesterol was similarly and significantly increased due to increasing the DVO levels in broiler diets, but the plasma LDL decreased. In addition, the VLDL significantly decreased in the group fed 8% DVO compared with the other groups.

Table 5 displays the influences of different DVO levels on indices of liver leakage enzymes of 42-day-old broilers. The serum AST was significantly decreased because of feeding 4 and 8% DVO compared to 6% DVO, but the other liver indices were not affected by the different DVO levels.

Table 6 displays the influences of different DVO levels on indices of renal functions of 42-day-old broilers. There was no significant effect on serum creatinine and the urea/creatinine ratio due to different levels of DVO. The serum urea was significantly lower for the groups fed the control (2.7% DVO) and 8% DVO than that of the group fed 6% DVO.

Table 7 shows the effects of different DVO levels on the RBCs parameters of 42-day-old broilers. There was no significant effect on most of the hematological constituents, except for RBCs, PCV, MCV and MCH. It was found that the value of RBCs was similarly and significantly decreased as a result of feeding 4 and 8% DVO compared to the control group, but the PCV was decreased as a result of feeding 4% DVO compared to the other DVO levels. In addition, the MCV and MCH were significantly increased for groups fed 8% DVO compared to the other groups and the control group, respectively.

Table 8 shows the effects of different DVO levels on the WBCs parameters of 42-day-old broilers. There was no significant effect on most of the WBC parameters, except for lymphocytes and the stress index (Heterophile/ lymphocytes ratio; H/L ratio). Lymphocytes were significantly decreased for the 4, 6 and 8% levels of DVO groups compared to the control group. However, feeding 6% DVO significantly increased the H/L compared to the control group.

DISCUSSION

Increasing DVO may be a useful nutritional management tool to help negate the negative effects of a high ambient temperature due to the many beneficial effects of fat/oil supplementation (Attia et al., 2006; Daghir, 2008; Attia et al., 2011). The results indicate that feeding an 8% DVO diet to broilers exposed to a high ambient temperature significantly increased their growth rate; improved utilization of feed, protein and ME; and resulted in an increased EPEF without affecting the intakes of feed, protein and ME, and survival rate. These show the increase in nutrient utilization for growth performance. Further evidence for the improvement in nutrient utilization for growth and the extra caloric effect of oil are provided by the increase in the abdominal fat percentage of broilers fed 6 and 8% DVO diets. In addition, the low intestine percentage of the group fed 8% DVO suggests lower energy expenditure for maintenance and higher utilization for growth (Attia and Hassan, 2017). On the other hand, the decrease in growth performance of broilers fed 6% DVO coincided with decreasing dressed carcass percentage and serum total protein, increasing liver and intestine percentage, serum urea showing elevated energy expenditure for maintenance, and lower protein utilization. Moreover, the increase in the H/L suggested a decrease in animal welfare. This may be due to the interaction between DVO of 6% with the other nutrients of the diets particularly minerals due to formation insoluble complex.

The present results indicate that the effect of DVO on broiler performance is dose dependent as 8% DVO caused beneficial

effects, 6% DVO showed negative effects and 4% DVO had no effects compared to the control containing 2.7% DVO. These results are in line with those reported by Attiaet al. (2006 and 2011) and Suganya et al. (2015). In addition, broilers housed at 29–36°C and fed a diet supplemented with poultry fat at 5–8% had enhanced growth performance (Ghazalah et al., 2008; Attia and Hassan, 2017). Replacing fats/oils for carbohydrates in broiler diets may have a greater boosting effects than carbohydrates due to their high energy value, low heat increment and extra calorific effect (Mateos et al., 1982). Fats/oils are source of fat soluble vitamins and improving digestibility, and thus nutrient utilization is increased because of the decrease in feed-passage time and the increase in the organic matter digestibility (Mateos et al., 1982; Aggoor et al., 2000; Ghazalah et al., 2008; Pesti et al., 2015). In addition, in hot weather conditions, ME that is inadequate to sustain the processes of protein synthesis diverts energy and protein away from growth (Hurwitz et al., 1980; Veldkamp et al., 2000; Attia et al., 2003), and extra protein can contribute to the dietary heat increment (Brake et al., 1998). However, in literature, the results are contradictory: in some studies, fat/oil additions boosted the economic traits of broiler chickens in hot regions (Mcnaughton and Reece, 1984). In addition, increasing the ME concentration by 10% in broiler diets by fat supplementation during heat stress increased growth performance of broilers exposed to heat stress (Al-Harthi et al., 2002; Lou et al., 2003; Raju et al., 2004; Ghazalah et al., 2008; Attia et al., 2006; 2011; Attia and Hassan, 2017). However, in other studies, fat supplementation of broiler diets under heat-stress conditions did not affect broiler performance (Sinurat and Balnave, 1985). Moreover, decreasing the metabolizable energy concentration during heat exposure is recommended (Baghel and Pradhan, 1990; Hoffmann et al., 1991). It should be mentioned that the C:P ratio in this study was constant (177 kcal:1% protein) to avoid its effects on feed utilization.

Similar to the present findings, Attia and Hassan (2017) find that there were reductions in proventriculus, intestine and liver percentage, while abdominal fat was not affected by increasing energy concentrations. The decreases in the percentages of proventriculus, intestine and liver, for broilers on 8% DVO reveal the reassignment of nutrients towards growth, rather than maintenance (Attia and Hassan, 2017). Further evidence suggests that there is enhanced nutrient utilization for growth because of increasing energy availability for net protein utilization, which is confirmed by increased serum protein, decrease in excreta nitrogen and serum urea (Attia et al., 2006; Ghazalah et al., 2008; Attia et al., 2011).

Blood lipid metabolites are the primary index of lipid metabolism; however, DVO is a good source of polyunsaturated fatty acids as it composed mainly of sunflower and soybean oils. There was an unexpected increase in the plasma cholesterol as a result of increasing DVO levels in broiler diets, but plasma LDL was favorably decreased and VLDL decreased in 8% DVO group. This could be attributed to the polyunsaturated fatty acids of DVO and fat soluble vitamins, such as vitamins A and E (Abaza, 2002; Attia and Hassan, 2017). Further evidence for the improving health status of broilers fed 8% DVO was provided by the increased PCV, MCV and MCH compared to the control group.

In summary, it can be concluded that tolerance of broiler chickens fed a diet containing 8% DVO increased to a high ambient temperature (34ºC, 70–75% RH.) during the period from 21 to 42 days old, as evidenced by increases in the productive performance, blood haematological and biochemical traits.

Table (1): Ingredients and chemical composition of the experimental diets

Ingredients	**Preliminary diets**	**Dietary vegetable oils (g/kg)**			
		27	**40**	**60**	**80**
Yellow corn	514	668.8	629	569	508
Soybean meal 48% CP	394	267	275	287	299
Di-calcium phosphate	20	15	15	15	15
Lime stone,	12	10	10	10	10
NaCl	3	3	3	3	3
Vitamin+ mineral premix[1]	3	3	3	3	3
Dl-Methionine	2.5	3.7	3.6	3.4	3.3
L- Lysine	1.5	2.5	2.5	2.6	2.7
Soybean and sunflower oil[2]	50	27	40	60	80
Sand	0	0	18.9	47	76
Total	1000	1000	1000	1000	1000
Calculated and analyzed values (g/kg)					
ME MJ/kg	12.80	12.97	12.97	12.97	12.97
Calcium	10	8.0	8.0	8.0	8.0
Available phosphorus	5.1	4.0	4.0	4.0	4.0
Methionine	5.7	5.3	5.3	5.3	5.3
Sulphur amino acids	9.2	8.2	8.2	8.2	8.2
Lysine	12.8	11.7	11.7	11.7	11.7
Crude protein	213	176	178	175	174
Ether extra	55.9	55.7	84.4	115.9	133.3
Crude fiber	4.23	5.21	4.91	5.02	5.03
Ash	4.58	4.88	4.75	4.86	4.57
Dry matter	906	897	899	901	910

[1]Vit+Min mixture provides per kg of the diet: vitamin A (retinyl acetate), 24 mg; vitamin E (dl-α-tocopheryl acetate), 20 mg; menadione, 2.3 mg; Vitamin D3 (cholecalciferol), 0.05 mg; riboflavin, 5.5 mg; calcium pantothenate, 12 mg; nicotinic acid, 50 mg; choline chloride, 600 mg; vitamin B12, 10 µg; vitamin B6, 3 mg; thiamine, 3 mg; folic acid, 1 mg; d-biotin, 0.50 mg; Trace mineral (mg per kg of diet): Mn, 80; Zn, 60; Fe, 35; Cu, 8; Se, 0.60.

[2]A mixture of soybean oil and sunflower at 50% of each.

Table (2): Effect of increasing dietary oils inclusion on body weight gain, feed, protein and energy intake and conversion ratio, survival rate and European production efficiency factor during 21-42 days of age[1]

Dietary vegetable oils, g/kg	Body weight gain, g	Feed intake, g	Protein intake, g	ME intake, MJ	FCR, g/g	PCR, g/g	ECR, j/g	Survival rate,%	European production efficiency factor
27	1380^{b}	3145	569.4	40.8	2.28^{ab}	0.414^{ab}	29.6^{ab}	91.4	270^{ab}
40	1343^{b}	2844	514.6	36.9	2.12^{ab}	0.383^{ab}	27.5^{ab}	97.1	297^{ab}
60	1255^{b}	2967	537.0	38.5	2.37^{a}	0.428^{a}	30.7^{a}	85.7	219^{b}
80	1569^{a}	3168	573.4	41.1	2.02^{b}	0.366^{b}	26.2^{b}	97.1	360^{a}
SEM	61.2	120.3	21.7	1.56	0.080	0.014	1.04	4.16	27.9
P-value	0.016	0.222	0.220	0.222	0.036	0.034	0.034	0.202	0.019

[1]= Number of observation were 7 replicates/treatment.

[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$), CP= Crude protein; ME= Metabolizable energy; FCR= Feed conversion ratio; PCR= Protein conversion ratio; ECR= Metabolizable Energy conversion ratio; EPEF= European production efficiency factor.

Table (3): Effect of increasing dietary oils inclusion on carcass characteristics

Dietary vegetable oils, g/kg	Percentage							
	Dressing	Abdominal Fat	Proventriculus	Intestinal	Liver	Heart	Gizzard	Pancreas
27	73.1^{a}	1.23^{b}	0.409^{ab}	3.91^{c}	1.97^{b}	0.461^{b}	1.14	0.209
40	70.9^{ab}	1.20^{b}	0.481^{a}	5.39^{ab}	2.15^{b}	0.654^{a}	1.37	0.253
60	69.0^{b}	1.58^{ab}	0.378^{b}	6.07^{a}	2.64^{a}	0.422^{b}	1.25	0.246
80	72.0^{a}	1.90^{a}	0.366^{b}	4.56^{bc}	2.18^{b}	0.495^{b}	1.28	0.207
SEM	0.307	0.068	0.068	0.116	0.045	0.018	0.033	0.01
P value	0.0001	0.03	0.01	0.0003	0.02	0.006	0.583	0.651

[1]= Number of observation were 7 replicates/treatment.

[a,b,c] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$).

Table (4): Effect of increasing dietary oils inclusion on blood biochemical constituents and excreta nitrogen, and lipids[1]

Dietary vegetable oils, g/kg	Blood biochemistry											
	Total protein, g/dl	Alb., g/dl	Glo., g/dl	Excreta N,%	Glu., mg/dl	Excreta lipids,%	Total Lip, mg/dl	Trig., mg/dl	Cho., mg/dl	HDL, mg/dl	LDL, mg/dl	VLDL, mg/dl
27	6.38 [a]	3.32	3.06	6.42[a]	200.2	3.99[a]	466	185	196[b]	42.8	101[a]	37.0[a]
40	6.08[ab]	3.16	2.92	5.92[ab]	208.2	3.71[b]	470	185	209[a]	42.8	93.2[b]	37.0[a]
60	5.88[b]	3.22	2.66	5.44[b]	210.8	3.97[a]	440	184	209[a]	42.2	94.6[b]	36.9[a]
80	6.36[a]	3.36	3.00	5.38[b]	210.8	4.06[a]	462	180	208[a]	42.0	95.8[b]	36.1[b]
SEM	0.059	0.024	0.064	0.229	2.76	0.076	4.89	1.21	0.603	0.375	0.426	0.242
P value	0.05	0.074	0.251	0.043	0.048	0.038	0.253	0.037	0.0001	0.866	0.002	0.041

[1]= Number of observation were 7 replicates/treatment.

[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$), Alb: Albumin; Glo: Globulin; Glu=Glucose; Lip=Lipid, Trig=triglycerides; Cho=Cholesterol; HDL= High Density Lipoprotein; LDL= Low-density lipoprotein and VLDL= very Low-density lipoprotein.

Table (5): Effect of increasing dietary oils inclusion on serum indices of liver function[1]

Dietary vegetable oils, g/kg	Liver function			
	ALT, U/L	AST, U/L	AST/ALT	Alkaline phosphatase (U/L)
27	63.0	55.2[ab]	0.881	11.2
40	63.2	55.2[b]	0.874	11.0
60	62.0	57.6[a]	0.920	11.0
80	61.6	54.6[b]	0.888	11.6
SEM	0.194	0.293	0.013	0.212
P value	0.082	0.02	0.012	0.785

[1]= Number of observation were 7 replicates/treatment.
[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$),
ALT= Alanine aminotransferase; AST= Aspartate aminotransferase; AST/ALT= Aspartate aminotransferase to Alanine aminotransferase ratio.

Table (6): Effect of increasing dietary oils inclusion on serum indices of renal function[1]

Dietary vegetable oils, g/kg	Renal function		
	Urea, mg/dl	Creatinine, mg/dl	Urea/Creatinine ratio
27	23.8[b]	12.6	1.92
40	25.0[ab]	12.6	2.01
60	26.2[a]	12.6	2.12
80	23.2[b]	13.0	1.81
SEM	0.246	0.232	0.102
P value	0.007	0.929	0.213

[1]= Number of observation were 7 replicates/treatment.
[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$)

Table (7): Effect of increasing dietary oils inclusion on red blood cells parameters[1]

Dietary vegetable oils, g/kg	Red blood parameters					
	RBCS,10^6 cell/mm^3	Hgb, g/dL	PCV,%	MCV, fl/cell	MCH, pg	MCHC,%
27	1.96[a]	11.2	34.4[a]	179[b]	58.3[b]	32.6
40	1.58[b]	10.2	31.0[b]	197[b]	65.1[ab]	32.9
60	1.78[ab]	11.2	34.0[a]	193[b]	63.4[ab]	32.9
80	1.46[b]	11.2	33.8[a]	232[a]	77.0[a]	33.1
SEM	0.039	0.167	0.316	4.59	1.84	0.347
P value	0.005	0.19	0.01	0.01	0.03	0.974

[1]= Number of observation were 7 replicates/treatment.

[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$); RBC= Red blood cells; PCV= packed cell volume; MCV= Mean Corpuscular volume; MCH= Mean Corpuscular Hemoglobin; MCHC= Mean Corpuscular Hemoglobin concentration.

Table(8): Effect of increasing dietary oils inclusion on white blood cells parameters[1]

Dietary vegetable oils, g/kg	White blood parameters						
	WBCs,x10^3 cell/mm^3	Lym.,%	Mon.,%	Bas.,%	Eos.,%	Het.,%	Het/Lymratio
27	21.8	46.6[a]	14.2	0.6	10.8	27.8	0.597[b]
40	23.0	42.6[b]	15.8	0.8	12.0	28.8	0.681[ab]
60	22.8	42.2[b]	14.8	0.4	11.2	31.4	0.746[a]
80	21.0	42.4[b]	15.2	1.0	12.2	29.2	0.689[ab]
SEM	0.232	0.317	0.23	0.089	0.214	1.13	0.0348
P value	0.05	0.001	0.205	0.214	0.17	0.185	0.057

[1]= Number of observation were 7 replicates/treatment.

[a,b] Means within a column with different letter superscripts are significantly different based on statistical analysis ($p \leq 0.05$); WBC= White blood cells; Lym.= Lymphocyte; Mon.= Monocyte; Bas.= Basophile; Eos.= Eosinophile; Het.= Heterophile.

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الملخص العربي

تأثير زيادة مستوى الزيوت النباتية في علائق دجاج اللحم المعرض لدرجة حرارة مرتفعة على الصفات الإنتاجية وصفات الذبيحة ومكونات الدم

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وزع 140 كتكوت من دجاج اللحم عمر21 يوماً من سلالة الأربورايكرز على أربعة معاملات غذائية بكل معاملة سبعة مكررات وبكل مكررة خمسة طيور، وتم تغذية الطيور على أربعة مستويات من الزيوت النباتية 2,7، 4، 6، 8% خلال فترة التجربة من 21- 42 يوم . وعند الفترات (25 - 27 و 31 - 33 و 38 - 40 يوم من العمر)، عرضت الأربع مجموعات لمدة 4 ساعات/ يومياً من 10:00 صباحاً حتي 2:00 مساءً إلى درجة حرارة 34 درجة مئوية ونسبة رطوبة 70-75% وعادت إلى ظروف المسكن الطبيعية بعد ذلك، وأدت التغذية على 8% زيوت نباتية إلى زيادة معنوية في الزيادة في وزن الجسم مقارنة بباقي المعاملات، وتحسن كل من معدل التحويل الغذائي للبروتين والطاقة التمثيلية وعامل كفاءة الإنتاج الأوروبي مقارنة بالمعاملة التي غذيت على 6% زيوت نباتية، وعلى الجانب الأخر لم تؤثر التغذية على 6 أو 4% زيوت نباتية عن الكنترول. وأدت التغذية على 8% إلى إنخفاض معنوي في ليبوبروتين البلازما منخفض الكثافة والليبوبروتين منخفض الكثافة جداً والأعضاء الليمفاوية. وأدت التغذية على 8% زيوت نباتية إلى زيادة حجم خلايا الدم وهيموجلوبين الدم مقارنة بالكنترول. وبالتالي، يمكن إستنتاج أن التغذية على عليقة تحتوي على 8% زيوت نباتية حسنت من مقدرة دجاج اللحم على مقاومة درجة الحرارة العالية (34 درجة مئوية، 70-75% رطوبة نسبية) خلال الفترة من 21 - 42 يوماً من العمر، كما يتضح من زيادة مؤشرات الأداء الإنتاجي، هيموجلوبين الدم والصفات الكيموحيوية للدم.