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EFFECT OF DIETARY BROWN ALGAE SUPPLEMENTATION ON THE PERFORMANCE OF BROILER CHICKS

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ABSTRACT: *An experiment was conducted to investigate the effect of dietary brown supplementation diet on growth performance, some blood parameters and carcass characteristics of broiler chocks. A total of 150 unsexed Ross 308 one-day old broiler chicks were individually weighed and randomly divided into five groups, and each treatment replicated three times of 10 chicks. Each group was fed one of five diets during the experimental period from 1 to 42 days of age. Dietary treatments were as follow: control (without supplementation), brown algae at levels of 0.5, 2, 3.5 and 5%, respectively.*

The results indicated that body weight, body weight gain and performance index were significantly ($P \leq 0.05$) increased by brown algae supplementation in comparison with birds of the control group. Feeding diet supplemented with 3.5% brown algae significantly improved feed conversion ratio (FCR). Brown algae supplementation significantly ($P \leq 0.05$) increased plasma total protein, albumin, globulin and liver enzymes (ALT and AST), while total cholesterol concentration was significantly ($P \leq 0.05$) decreased. Results showed significant increase of dressing and giblets percentage by brown algae supplementation, while abdominal fat was significantly ($P \leq 0.05$) decreased. In conclusion, using brown algae at a level of 3.5% in broiler diets improved performance and had positive effect on carcass characteristics of broiler chicks.

Key words: *Brown algae, performance, abdominal fat, Broiler chicks*

INTRODUCTION

Algae can be divided into two groups, micro and macro algae. Seaweeds are macro algae, which generally reside in the littoral zone and can be of many different shapes, sizes, colors and composition. They include brown algae, red algae and green algae. Macro algae and microalgae are sold as feed additives in feeding farm animals, poultry and fish. About 30% of the current productions of algae in the world are used in animal feed. Algae can serve as source of many nutrients.

Algae are considered a vast source of biologically active substances, especially rich in essential nutrients and trace elements for human and animal nutrition (Jiménez-Escring *et al.,* 2011 and Liu *et al.,* 2012). Under *in vitro* conditions, relevant antimicrobial, anti-viral activities and antioxidant capacity are shown (Leonard *et al.,* 2011, Wijesinghe and Jeon, 2012 and Narasimhan *et al.,* 2013). Bioactive components in seaweeds include polyphenols, peptides, and polysaccharides (Jiménez-Escring *et al.,* 2011). Many of these active compounds have useful functional ingredients with numerous health benefits (Kim and Joo, 2008). Functional polysaccharides such as fucans and alginic acid, derivatives produced by seaweeds, are known to exhibit biologically beneficial properties including anticoagulant, anti-inflammatory, antiviral and antitumoral activities (Wijesinghe and Jeon, 2012).

Brown algae are of lesser nutritional value than red and green algae, due to their lower protein and higher mineral content. However, brown algae contain a number of bioactive compounds. Brown algae contain alginates, sulphated fucose-containing polymers and laminarin; red algae contain agars, carrageenans, xylans, sulphated galactans and porphyrans; and green algae contain xylans and sulphated galactans. In monogastrics, those polysaccharides may impact the nutritional value but the addition of enzyme cocktails might help.

In vivo studies on pigs, poultry and rabbits revealed that some seaweed have the potential to contribute to the protein and energy requirements of livestock, while others contain a number of bioactive compounds, which could be used as prebiotic for enhancing production and health status of poultry. Brown algae are considered a good source of dietary fiber (Devillé *et al.*, 2004).

In poultry, algae can be used safely at a level of 5% to 10%, while the use of algae with high concentrations for long periods gives adverse effects (Spolaore *et al.,* 2006). Nimruzi (2000) showed that the broiler chicks fed diets contained 4.0% algae powder improved feed efficiency of broiler chicks. Gu *et al.* (1988) concluded that 2% of marine algae meal improved broiler performance and dressing percentage. Algae have been credited with improving the immune system, lipid metabolism, gut function, stress resistance, as well as increasing of appetite, weight, number of eggs, reproductive performance or reducing cholesterol levels (Svircev, 2005).

The incorporation of algae into poultry diets offers the most promising prospect for their commercial use in animal feeding (Becker, 2007). Also, according to Gouveia *et al.* (2008), they may serve as almost the sole protein source in laying hens, and in several countries, they are officially approved as chicken feed. Research results indicate the possibility of new farming methods in order to improve the quality of meat and eggs, and it may also be considered in order to lower the cholesterol level in blood. The main objective is to study the effect of different dietary levels of brown algae on performance, some blood plasma parameters and some carcass characteristics of broiler chicks.

MATERIALS AND METHODS

One hundred and fifty, unsexed one – day old broiler chicks (Ross 308) with an initial average body weight (BW, 39g) were used in this experiment. Chicks were distributed at random into five treatment groups and each group was divided into 3 replicates of 10 chicks each in a completely randomized design. Chicks were reared in pens with litter (wheat straw) from 1 day to 42 days of age under similar managerial and hygienic conditions.

Feed and water were provided *ad libitum* during the experimental period. Artificial light was used to provide 24 – hour photo period. Dietary treatments were (T_1, basal diet (control, un supplemented), T_2, T_3, T_4 and T_5 fed basal diet supplemented with 0.5, 2, 3.5 and 5% brown algae, respectively. The composition and chemical analysis of brown algae are shown in Table 2. Brown algae (*Taonia atomaria*) was obtained from Edifina Company. It was collected from Alexandria water (Mediterranean Sea) in July, 2015. Algae was identified by specialized researchers in the National Research Center. Algae was firstly washed in water to remove all mechanical impurities. The algae was spread in the sun several days to dry, then was cut into small pieces. Algae bran was finely powdered. The powdered algae was packaged in polyethylene bags and maintained at room temperature till used. All diets were formulated to meet the nutrient requirements of the chicks according the strain catalog recommendations.

Growth performance: body weight and feed consumption were recorded weekly from the beginning to end of the experimental periods. Accordingly, feed conversion ratio was easily calculated. Performance index (PI) was calculated according to North (1984) as follows: PI = Live body weight gain (Kg) ×100 / feed conversion.

Slaughter and plasma parameters: At the end of the experiment (42 days of age), 6 birds / treatment were randomly chosen, fasted for about 12 hours, weighed and slaughtered to complete bleeding, followed by plucking the feathers. Dressing, giblets (liver, heart and gizzard) and abdominal fat weights were expressed relative to live body weight. Blood samples were taken at slaughter time from each bird into heparinized tubes and plasma was separated by centrifugation at 3500 rpm for 15 min and frozen at -20 °C for the determination of total protein, albumin, total lipids, total cholesterol, glucose and transaminases (ALT and AST) which were colorimetrically determined using commercial kits. The globulin values were obtained by subtracting the values of albumin from the corresponding values of total protein (Coles, 1974); also albumin / globulin ratio (A/G ratio) was calculated.

The proximate analysis of feed (Tables 1 and 2) was determined according to the methods of (AOAC, 2011). Data were statistically analyzed by the completely randomized design using the statistical software of SPSS 11.0 (2011) program and the differences among means were determined using Duncan's multiple range test (Duncan, 1955). Percentages were transformed to the corresponding arcsine values before performing statistical analysis.

The following statistical model was applied:

$Y_{ij}=\mu + T_i + E_{ij}$, Where:

Y_{ij} = an observation μ = Overall mean.

T_i = effect of treatment (i = control, 2, 3, 4, 5) and

E_{ij} = Experimental random error.

RESULTS AND DISCUSSION

Chemical analysis:

The chemical analysis of brown algae is shown in Table (2); it contains 2.89.64% DM; 17.48% CP; 11.62% CF; 2.55% EE; 29.11% Ash and 28.88% NFE. Results of Sim *et al.* (2004) indicated that brown algae (*Ecklonia acva Kjellman*) dried aerobically contains 10.49% protein, 0.73% fat, 36.41% fiber, 27.23% mineral salts and 10.6% sodium chloride, and a value of the 1849 Kcal/kg DM. Average value of 13 amino acid is about 32%. These differences may be due to differences in species of algae, drying procedure and the time of harvesting. How ever algae is considered as an important source of vitamins, minerals, proteins, polyunsaturated fatty acids, antioxidants, etc. (Gouveia *et al.,* 2008).

El-Deek, *et al.* (2011) found that raw or treated brown algae contained 47.15, 48.31 and 47.65% ash that may be due to the existence of these algae in the Red Sea environment which is characterized by high salts and this is consequently reflected on the components and the concentration of mineral salts particularly sodium. In this respect, seaweeds are generally poor in energy and fat content, while having high content of mineral elements, especially Mg, Ca, P, K, and I, and vitamins (Jimenez-Escring and Goni, 1999). Rizvi and Shameel (2004) reported that brown algae often contains many minerals such as Ca, Cd, Cr, Cu, K, Fe, Mg, Na and Zn. These differences could be due to differences in species of seaweed and/or differences in season of harvesting the seaweed.

El-Deek and Mervat (2009) reported that value of crude protein in the seaweed was 32.0% and was higher than that reported by El-Deek *et al.* (1987) who found a value of 19.2% CP and the ME value of seaweed was 2129 kcal/kg, while, ash content was lower.In this respect, Al-Harthi and El-Deek (2012) reported that brown marine algae contained protein 7.54-7.77%, crude fat 0.41-0.47%, crude fiber 7.77- 7.90%, ash 47.15-48.31%, nitrogen free extract 29.95-31.38% and soluble sugars 1.666-1.880%, whereas the metabolizable energy (ME) value was 1523-1543 kcal/kg. These differences in composition may be due to differences in different species and sources of algae, geographical location, season, environmental factors and physiological conditions as well as harvesting and processing methods. (Abd El-Baky *et al.,* 2008).

Table (1). Composition and calculated analysis of the experimental broiler diets fed during starter period (1 – 21) days and finishing periods (22 – 42) days of age.

Ingredients	Starter diets					Finisher diets				
	T_1 (control)	T_2	T_3	T_4	T_5	T_1 (control)	T_2	T_3	T_4	T_5
Ground yellow corn (8.5%)	50.64	50.00	48.55	47.50	46.07	56.90	56.26	55.40	54.14	52.69
Soybean meal (44%)	39.86	39.78	39.48	38.60	38.76	33.00	32.97	32.47	32.47	31.84
Plant oil (8800 Kcal)	5.83	6.05	6.26	6.30	6.50	6.43	6.60	6.46	6.46	6.8
Brown algae	—	0.5	2	3.5	5	—	0.5	2	3.5	5
Di-calcium phosphate	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Limestone , ground	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Vitamins & minerals mixture [1]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-methionine[2]	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Sodium chloride (salt)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100	100	100	100	100
Calculated values[3]:										
Crude protein ,%	21.84	21.84	21.84	21.84	21.84	19.35	19.35	19.35	19.35	19.35
ME, Kcal/kg diet	3100	3100	3100	3100	3100	3200	3200	3200	3200	3200
C/Pratio	142	142	142	142	142	165	165	165	165	165
Lysine,%	1.20	1.20	1.20	1.20	1.20	1.14	1.14	1.14	1.14	1.14
Methionine,%	0.53	0.53	0.53	0.53	0.53	0.34	0.34	0.34	0.34	0.34
Calcium,%	0.97	0.97	0.97	0.97	0.97	0.91	0.91	0.91	0.91	0.95
Available phosphours ,%	0.45	0.45	0.45	0.45	0.45	0.39	0.39	0.39	0.39	0.39

[1] Vitamin and Mineral mixture at 0.30%of the diet supplies the following per kilogram of the diet : Vit.A,1200 IU; Vit.D3, 2500 IU; Vit. E, 10 mg; Vit .K3, 3mg; Vit.B1, 1mg; Vit.B2, 4mg; pant othenic acid, 10 mg; Nicotinic acid, 20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin , 40 mg; Vit.B6, 3 mg, Vit. B12, 20 mcg; Chaline Chloride, 400 mg; Mn, 62 mg; Fe,44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01mg.
[2]Dl-Methionine: 98% feed grade (contains 98% methionine).
[3]Calculated according to NRC (1994).

Table (2). The chemical analysis of dried brown algae used in experimental diets.

Constituents	%
Dry matter (DM)	89.64
Crude Protein (CP)	17.48
Crude Fiber (CF)	11.62
Ether Extract (EE)	2.55
Ash	29.11
Nitrogen free extract (NFE)	28.88
ME (Kcal / Kg DM)[1]	1767

[1]ME, calculated according to El-Deek *et al.,* 2011.

Performance:

Results of the effect of brown algae supplementation on broiler performance at 14, 28 and 42 day are shown in Tables 3 and 4. Body weight, body weight gain and performance index were significantly increased ($P \leq 0.05$) by brown algae supplementation in broiler diets for all experimental periods. Chicks fed 3.5% brown algae had the highest body weight gain (T_4; 2099.03) in composition with control (T_1; 1875.98) and other treatments T_2; 1923.86, T_3; 1978.87 and T_5; 2065.89), respectively. The lowest amount of feed consumption was recorded for chicks fed the control diet with 3.5% brown algae supplementation group, (T4, 142.81g.) at 42 day of age. Feed conversion ratio was significantly improved ($P \leq 0.05$) by brown algae supplementation from (0 – 42) d of age (2.19, 2.07, 1.93, 1.79 and 1.80) for T_1, T_2, T_3, T_4 and T_5, respectively. The obtained results confirmed the previous findings of several researches; Nimruzi (2000) and Choi, *et al.,* (2014) who noted that 4% of seaweed resulted in the best value of the chick live weight, body weight gain and feed conversion, efficiency.

El-Deek *et al.* (2011) reported that using different levels (2, 4 and 6%) of algae significantly affected final BW of 39 days old broilers. The total FI and FCR were significantly affected by different levels of algae. Armin *et al.* (2015) recorded that feed intake was lower in diets supplemented with 5% and 10% (*Sargassum sp*) and addition of marine alga led to an improve of FCR. On the other hand, El-Deek *et al.* (1985 and1987) reported that feed conversion ratio did not significantly differ for layers fed on seaweed levels and found substantial improvement in body weight of chicks by using seaweed up to 10%. How ever, seaweeds contain chelating minerals that caused anion-cation imbalance and depression in growth. Therefore, high content of alginate in marine algae can decrease daily feed consumption (Gardiner *et al.,* 2008). This reduction in feed consumption can be related to the high content of fiber (polysaccharide) in the algal biomass (Carrillo *et al.,* 2008). Moreover, alga contains high concentrations of phenolic compounds, which reduce feed intake, N retention, N utilisation and digestion (De Lange, 2000).

Blood plasma constituents:

Results presented in Table 5 showed that there was a significant improve in plasma total protein, albumin, globulin and A/G ratio and liver enzymes (ALT and AST), but lower plasma cholesterol and total lipids for broiler chicks fed the diet containing 3.5 % brown algae, compared to the control group. In addition, adding algae meal to human and animal diets significantly improves the lipid profile (Schiavone *et al.,* 2007).

Table (3). Effect of brown algae on body weight and body weight gain of broilers during the experimental periods (Means ± SE)[2]

Dietary treatments[1]	Body weight (g)				Body weight gain (g)			
	Initial body weight	14 day	28 day	42 day	0 – 14 days	14– 28 days	28 – 42 days	0 – 42 days
T_1 (Control)	39.28 ± 0.22	326.92^{d} ± 1.30	1041.83^{d} ± 11.3	1915.28^{d} ± 16.23	287.64^{c} ± 3.2	714.91^{d} ± 11.25	873.45^{d} ± 16.22	1875.98^{d} ± 22.35
T_2	39.30 ± 0.20	330.84^{c} ± 1.36	1087.59^{c} ± 9.36	1963.16^{c} ± 12.00	291.54^{c} ± 4.5	756.75^{c} ± 11.3	875.57^{c} ± 16.3	1923.86^{bc}± 19.80
T_3	39.22 ± 0.22	356.79^{ab} ± 1.46	1116.97^{ab} ± 11.6	2018.09^{b} ± 13.10	317.57^{b} ± 4.2	760.18^{c} ± 11.3	901.12^{ab} ± 15.6	1978.87^{c} ± 23.14
T_4	39.33± 0.22	402.18^{a} ± 1.33	1204.08^{a} ± 10.41	2138.36^{a} ± 18.45	362.85^{a} ± 4.5	801.90^{a} ± 13.56	934.28^{a} ± 19.8	2099.03^{a} ± 18.88
T_5	39.28±0.22	396.25^{b} ± 0.16	1194.22^{b} ± 10.5	2105.17^{a} ± 10.11	356.97^{a} ± 4.4	797.97^{b} ± 11.5	910.95^{b} ± 18.7	2065.89^{b} ± 22.10

[1] T_1; control; without supplementation, T_2; control + 0.5% brown algae, T_3, control + 2% brown algae ; T_4, control + 3.5% brown algae, T_5, control + 5% brown algae.
[2] means ± SE of 3 replicates / treatment.
[3]a, b, c and ….etc: means within each column with different superscripts are significantly different ($P \leq 0.05$).

Table (4). Effect of brown algae on feed intake, feed conversion and performance index of broilers during the experimental periods (Means ± SE)[2]

Periods	Dietary treatments[1]				
	T1 Control	T2	T3	T4	T5
	---------------------feed intake, FI (g/bird) ---------------------------				
0-14 days	$529.20^{a}±0.22$	$521.92^{a}±0.28$	$518.00^{b}±1.30$	$515.20^{b}±0.16$	$515.48^{b}±0.45$
14– 28 days	$1379.84^{a}±0.70$	$1354.64^{b}±0.53$	$1239.14^{c}±0.13$	$1242.92^{c}±0.32$	$1268.82^{3\ bc}±0.70$
28 – 42 days	$2192.40^{a}±0.40$	$2101.4^{b}±0.19$	$2063.60^{c}±0.63$	$1999.34^{d}±0.56$	$2022.30^{bc}±0.90$
0 – 42 days	$4101.3^{a}±0.62$	$3977.82^{b}±0.31$	$3820.74^{a}b±0.32$	$3757.32^{d}±0.66$	$3806.46^{c}±0.56$
---------------feed Conversion, FC (g feed/g gain) --------------------					
0-14 days	$1.84^{a}±0.05$	$1.79^{b}±0.08$	$1.63^{c}±0.04$	1.42d±0.02	$1.44^{d}±0.02$
14– 28 days	$1.93^{a}±0.05$	$1.89^{b}±0.08$	$1.74^{c}±0.02$	$1.71^{c}±0.07$	$1.72^{c}±0.05$
28 – 42 days	$2.51^{a}±0.06$	$2.40^{b}±0.06$	$2.29^{c}±0.04$	$2.14^{d}±0.04$	$2.22^{c}±0.02$
0 – 42 days	$2.19^{a}±0.02$	$2.07^{b}±0.02$	$1.93^{c}±0.07$	$1.79^{d}±0.04$	1.80^{bc} ±0.01
------------------------- Performance index(PI), % --------------------------					
14 day	$24.87^{c}±0.36$	$25.88^{bc}±0.38$	$30.64^{b}±0.61$	$39.65^{a}±0.36$	$38.52^{a}±0.31$
28 day	$74.41^{e}±1.43$	$80.56^{d}±0.84$	$89.87^{c}±1.33$	$98.57^{a}±0.87$	$97.20^{b}±0.89$
42 day	$106.83^{e}±0.08$	$114.52^{d}±1.66$	$123.38^{c}±1.38$	$139.89^{a}±0.05$	$132.76^{b}±1.33$

[1] T_1; control; without supplementation, T_2; control + 0.5% brown algae, T_3, control + 2% brown algae ; T_4, control + 3.5% brown algae, T_5, control + 5% brown algae.
[2] means ± SE of 3 replicates / treatment.
(P ≤ 0.05).
[3]a, b, c and ….etc: means within each row with different superscripts are significantly different

Table (5). Effect of brown algae on some blood plasma constituents of broilers at 42 days of age (Mean ± SE)[2]

Items	Dietary treatments[1]				
	T1 Control	T2	T3	T4	T5
Total protein (g/dl)	$4.00^{c}±0.06$	$4.32^{ab}±0.06$	$4.41^{b}±0.02$	$4.51^{a}±0.06$	$4.55^{a}±0.08$
Albumin (A) (g/dl)	$2.14^{d}±0.01$	$2.38^{c}±0.02$	$2.45^{b}±0.01$	$2.53^{a}±0.02$	$2.58^{a}±0.02$
Globulin (g) (G/dl)	$1.86^{b}±0.01$	$1.94^{a}±0.04$	$1.96^{a}±0.02$	$1.98^{a}±0.01$	$1.97^{a}±0.01$
A / G ratio	$1.15^{d}±0.01$	$1.23^{c}±0.01$	$1.25^{c}±0.01$	$1.28^{b}±0.02$	$1.31^{a}±0.01$
Total lipids (mg/dl)	$532.00^{a}±0.02$	$488.66^{b}±0.03$	$456.00^{c}±0.02$	$439.5^{e}±.0.01$	$444.6^{d}±0.04$
Total cholesterol (mg/dl)	$156.8^{a}±0.06$	$151.33^{b}±0.02$	$144.2^{c}±0.03$	$132.6^{d}±1.85$	$137.4^{d}±0.03$
ALT (U/L)	146.48±0.02	146.86±0.44	148.10±1.10	149.44±0.04	148.98±0.02
AST (U/L)	39.710.05	40.13±0.03	40.36±0.01	40.51±0.03	40.56±0.04

[1] T_1; control; without supplementation, T_2; control + 0.5% brown algae, T_3, control + 2% brown algae ; T_4, control + 3.5% brown algae, T_5, control + 5% brown algae.
[2] means ± SE of 3 replicates / treatment.
[3]a, b, c and ….etc: means within each row with different superscripts are significantly different (P ≤ 0.05).

In this connection, Al-Harthi and El-Deek (2012) and Armin *et al.,* (2015) reported that brown algae supplementation significantly decreased cholesterol plasma of broiler diets. Also, Ginzberg *et al*., (2000) reported that brown algae has the ability to reduce fatty acid profiles and cholesterol, in addition to its antioxidant properties and pigmentation profiles. Reports in the literature found that algae was a valuable ingredient in human and animal nutrition because of its protein, amino acid, dietary fibre, mineral, fatty acid and bioactive content (Serviere-Zaragoza *et al.,* 2002; Rimber, 2007 and El-Deek *et al.,* 2011). This might be due to its sterols and polysaccharides content (alginic acid, fucoidan, cellulose, xylose, glucouronic acid) (Jimenez-Escrig and Cambrodon, 1999).

Phenolic acids also play an important role in liver cholesterol catabolism (Yugarani *et al.* 1992), because it inhibits intestinal absorption of fat (Ikeda *et al.* 1992). Algae supplementation to human and animal diets has been reported to significantly improve lipid profile (Schiavone *et al.,* 2007). The effect of algae on lipid profile in blood plasma could be due to different species and sources of algae, geographical location, season, environmental factors, growth media and physiological conditions (Abd El-Baky *et al.,* 2008). In this respect, Schaivone *et al.* (2007) and

El – Deek, *et al*., 2011 reported that Plasma total lipidS concentrations were significantly increased by increasing level of algae in broiler diets from 2% to 4% and 6% (268.5 and 297.3 and 301.3 mg / dl, respectively) comparing to the control (225.3 mg / dl), however, no significant differences were observed between those fed the high levels (4% and 6%) of algae. On the other hands, Lokaewmanee *et al*., 2012 and Choi, *et al.,* 2014 indicated that supplementation of brown algae to broilers diets did not affect on blood composition.

Carcass characteristics:

The results recorded of carcass characteristics of broiler chicks of experimental treatments at 6 weeks of age are presented in Table 6. The results showed significant increase of dressing percentage and giblets% by brown algae supplementation. Feeding broilers chick diets containing 3.5% brown algae have significantly higher dressing (75.20%) and lower abdominal fat, (1.22%) compared to other dietary treatments. The present finding was in agreement with previous findings of Schaivone *et al.* (2007) who found that using 5 g algae / kg feed insignificantly affected the slaughter characteristics, chemical structure, color, stability of oxidation properties and sensory of the Muscovy ducks.

In this respect, El- Deeek, *et al.,* 2011 showed that using different levels of algae in broiler finisher diets had insignificant effect on dressing percentages (ranged between 73.1 to 73.8%) and gizzard and spleen percentages (ranged between 2.12 to 2.35% and 0.12 to 0.15%, respectively) at 39 days of age. Kovac, *et al.,* (2013) noted that small amounts of algae used in feeding of different animals, have been credited to improve the immune system, increasing of weight, increasing the number of eggs, improving reproductive performance, or reducing cholesterol levels, indicating the possibility of new farming methods in order to improve the quality of meat and eggs. Also, the importance of applying algae in aquaculture is not surprising since they are natural food for these organisms.

Table 6. Effect of brown algae on some carcass characteristics of growing broilers at 42 days of age (Means ± SE)[2]

Items	Dietary treatments[1]				
	T_1 Control	T_2	T_3	T_4	T_5
Pre slaughter weight (g)	1916^{e}±2.04	1942^{d}±1.99	1989^{c}±2.10	2033^{a}±2.20	2000^{b}±2.01
Carcass weight (g)	1409^{e}±2.01	1436^{d}±2.03	1482^{c}±1.66	1529^{a}±2.0	1501^{b}±1.25
Dressing (%)	73.54^{c}±0.85	73.94^{c}±0.32	74.51^{b}±1.82	75.20^{a}±0.65	75.01^{a}±0.52
Liver (%)	2.97^{d}±0.23	3.42^{c}±0.17	3.66^{b}±0.21	3.75^{a}±0.22	3.70^{a}±0.27
Heart (%)	0.44^{b}±0.03	0.51^{a}±0.05	0.53^{a}±0.05	0.57^{a}±0.05	0.55^{a}±0.05
Gizzard (%)	3.32^{d}±0.19	3.65^{c}±0.23	3.74^{b}±0.18	3.98^{a}±0.19	3.96^{a}±0.18
Giblets (%)	6.73^{d}±0.42	7.58^{c}±0.42	7.93^{ab}±0.48	8.30^{a}±0.52	8.21^{b}±0.41
Spleen (%)	0.07±0.01	0.09±0.01	0.10±0.01	0.13±0.01	0.12±0.01
Abdominal fat (%)	1.38^{a} ±0.02	1.33^{b}±0.01	1.30^{ab} ±0.01	1.22^{d}±0.02	1.27^{c}±0.04

[1] T_1; control; without supplementation, T_2; control + 0.5% brown algae, T_3, control + 2% brown algae ; T_4, control + 3.5% brown algae, T_5, control + 5% brown algae.
[2] means ± SE of 3 replicates / treatment.
[3]a, b, c and ….etc: means within each row with different superscripts are significantly different (P ≤ 0.05).

Conclusion:

Based on the results of this study, using brown algae in broiler diets tend to improve performance, some blood plasma parameters and carcass characteristics especially at the level of 3.5%, without any adverse effects. Accordingly, brown algae could be safely used in the nutrition broiler chicks.

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تأثير اضافة الطحالب البنية على أداء كتاكيت اللحم

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الملخص العربى

يهدف هذا البحث إلى دراسة تأثير إضافة مستويات مختلفة من الطحالب البنية على الأداء الإنتاجي وبعض قياسات الدم وصفات جودة الذبيحة لكتاكيت اللحم . أُجريت التجربة لمدة 42 يوم بإستخدام عدد 150 كتكوت تسمين روص (Ross 308) غير مجنس عمر يوم . قسمت الطيور عشوائياً إلى 5 معاملات بكل معاملة 3 مكررات بكل منها 10 طيور .غُذيت المعاملة الأولى (الكنترول) على العليقة الأساسية (بدون إضافات) ، وغُذيت المعاملات الثانية – الثالثة – الرابعة والخامسة على العليقة الأساسية مضاف لها (0.5 – 2 – 3.5 – 5% من مسحوق الطحالب البنية) على التوالى . أوضحت النتائج المتحصل عليها أن الطيور المغذاة على العلائق المضاف لها مسحوق الطحالب البنية وخاصةً العليقة المضاف لها 3,5% من مسحوق الطحالب البنية زاد معنوياً كلاً من وزن الجسم ووزن الجسم المكتسب بالمقارنة بالعليقة الكنترول (الغير مضاف لها اى إضافات) . كما تحسن معنوياً معدل تحويل الغذاء للطيور المغذاة على عليقة مضاف لها 3,5% من مسحوق الطحالب البنية .كما لوحظ أن إضافة مسحوق الطحالب البنية إلى العليقة الأساسية أدى الى زيادة تركيزات كلاً من البروتين الكلى , والألبيومين والجلوبيولين وكذلك إنزيمات الكبد (ALT, AST) معنوياً بينما إنخفض مستوى الدهون الكلية والكوليسترول فى بلازما الدم. كما تحسنت صفات الذبيحة فى الطيور التى تغذت على العليقة الأساسية مضافاً إليها الطحالب البنية وإنخفضت معنوياً نسبة دهون البطن. عموماً أدى اضافة الطحالب البنية الى علائق دجاج اللحم (Ross 308) بمستوى 3,5% إلى تحسن الأداء الإنتاجي و بعض صفات الدم وصفات الذبيحة .

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