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EFFECT OF DIETARY SUPPLEMENTATION OF ALGAE MEAL (SPIRULINA PLATENSIS) AS GROWTH PROMOTER ON PERFORMANCE OF BROILER CHICKENS

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ABSTRACT: The experimental work was carried out during the period from February to April 2016 to determine the effects of inclusion Spirulina platensis over the broiler diets on productive performance and some physiological responses. The total number of birds (200 Cobb broiler chickens at seven d of age) were distributed randomly into five treatments (40 chicks each), and each treatment contained four replicates of ten chicks being, a commercial basal diet (control group), while the other groups were supplemented with Spirulina platensis (0.3, 0.5, 0.7, and 0.9 g /kg). The obtained results of the experiment showed that chicks fed with 0.9 and 0.7g/kg of feed Spirulina platensis had significant better valus of LBW, BWG, GR, PI, immune organs, improved FCR, blood parameters, and microbial load. Moreover, chicks fed with 0.7g/kg of Spirulina platensis had the best economic efficiency.

Generally, it could be concluded that, dietary with 0.7and 0.9 g/kg of feed Spirulina platensis could improve the growth performance, blood parameters, biochemical changes in serum and microbial load. From an economical point of view, supplementation of 0.7g/kg of Spirulina platensis is recommended of cobb chicks.

Keywords:feed additives-Spirulina platensis-growth performance-broilers.

INTRODUCTION

The use of antibiotics was completely banned by the European Union (European Commission, 2001) as growth promoters due to increase in the microbial resistance to types of antibiotics and the residues in meat products which might be risky to consumers. Presently, feed additives such as prebiotics or probiotics are being tested to mitigate the problems associated with the withdrawal of antibiotics from feed. During the last ten years, the beneficial nutritional aspects of microalgae have been advertised extensively worldwide, and therefore the algae enterprises started to gain a clear interest among producers. The researchers, in turn, have conducted many studies recently focusing on investigating the potential contribution of Spirulina in poultry feeding (Świątkiewicz et al., 2015 and Kanagaraju and Omprakash, 2016).

Spirulina platensis, blue-green algae, is rich in protein, essential amino acids, essential fatty acids, minerals and vitamins (Cheong et al, 2010 and Jafari et al., 2014). Regarding its availability, Spirulina platensis is more broadly disseminated and found largely used in Asia, South America and Africa as main sources of food. The blue-green algae have been used as a food source for animals and humans for hundreds of years due to the high carotenoid content and excellent nutritional value. Also, it has been stated that Spirulina was useful in cases such as arthritis and diabetes mellitus (Parikh et al., 2001 and Rasool et al., 2006). In addition, Nikodémusz et al. (2010) illustarted that hens fed diets containing Spirulina achieved greater productive performance than the control hens. Spirulina improves minerals absorption and nutrient digestion processes and protect from diarrhea (Gružauskas et al., 2004). Also, it has been used in broiler diets as a feed component throughout the world (Yoshida and Hoshii, 1980). Kharde et al. (2012) indicated that feed conversion (FC), body weight gain (BWG), percentage of carcass yield improved by the dietary Spirulina platensis inclusion as compared the control. Kaoud (2015) reported that FC was improved for birds fed Spirulina platensis than the control birds. Moreover, it was revealed that Spirulina enhances immune response and reproduction (Qureshi et al., 1994 and Khan et al., 2005). Addition of less than 1% Spirulina in chicken diets significantly enhanced the defense systems for antigen processing, greater T-cell activity and increased microbial killing (Qureshi et al., 1994).

The aim of this study was investigate the role of dietary Spirulina platensis as a feed additive on growth performance, carcass parameters, bacteria enumeration, intestinal pH, blood parameters, immune parameters and economic efficiency of broiler chicks.

MATERIALS AND METHODS

The experimental work was carried out at El-Azab Poultry Research Station, Fayoum, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Egypt, during the period from February to April 2016. Chemical analyses were performed in laboratories of Animal Production Research Institute, Agricultural Research Center**.**

In total, 200 Cobb broiler chickens at seven d of age were distributed randomly into five treatments (40 chicks each), and each treatment contained four replicates of ten chicks, being a commercial basal diet (control group), while the other groups were supplemented with Spirulina

(0.3, 0.5, 0.7, and 0.9 g/kg). Birds were raised in batteries with wire mesh floors and had a free access to the fresh water from nipple drinkers (2nipples/cage) and feed throughout the experiment. Batteries were sited into a room provided with fans for ventilation and light 23 hours daily. The chicks were fed starter diet from 7 to 14-d, grower diet from 15 to 21 d and finisher diet from 22 to 38 d of age (end of the experiment).

The experimental diets were supplemented with vitamins and minerals mixture and L-lysine HCl and DL-methionine to cover the recommended requirements according to the strain catalog recommendations. The composition and calculated analysis of the control diets are presented in Table 1.

The birds were weighed and feed intake was recorded to calculate feed conversion ratio using the following formula FC = FI (g)/bird during a certain period

Weight gain (g)/bird during the same period

and body weight gain using the following formula: $LBWG_{7-38}=LBW_{38}-LBW_{7}$.

Growth rate and performance index were calculated as follows:

GR7-38= (LBW38–LBW7)/0.5(LBW38+LBW7), PI = (LBW, Kg/FC) x100.

At end of the experiment, slaughter test were performed using 20 chicks around the average LBW. Total giblet, abdominal fat, half breast and half rear % were recorded.

At time of slaughter test, 4 samples of ileum content for each treatment were taken. Total microflora of ileum content was enumerated. The pH of intestinal contents was directly determined by pH-meter.

At 38 d, individual blood samples from 4 birds of each treatment were taken. The blood samples for hematological analysis were expelled gradually into tubes containing EDTA; the sample for biochemical analysis was collected in tubes without anticoagulant. The blood samples were centrifuged at 3000 rpm for 20 minutes to obtain serum, and stored at–20°Ċ until the time of chemical determinations by colorimetrically methods using commercial kits.

To determine the economic efficiency (EEf) for meat production during the experimental period, the amount of feed intake was obtained and multiplied by the price of one kilogram of each experimental diet which was estimated, in addition to the price of one kilogram live weight based upon local market prices at the experimental period. Statistical analysis of results was submitted using the GLM procedure of the SPSS software (SPSS, 2008), according to the following general model:

$Y_{ij}= \mu+ T_i+ e_{ij}$

Where:

Y_{ij}: an observed value

μ: overall mean

T_i: treatment effect (i: 1 to 5).

e_{ij}: experimental random error

Means indicating significant differences ($P\leq0.05$) were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth Performance:

Impact of Spirulina platensis supplementation on growth performance of Cobb strain broiler chicks during the period from 7 to 38 days of age are listed in Table 2.

Data presented in Table 2 indicate that live body weight (LBW), body weight gain (BWG), feed conversion (FC), performance index (PI), growth rate (GR) and feed intake (FI) were significant ($P \leq 0.01$ and $P \leq 0.05$) for LBW at 38 days and BWG, FC, FI, PI, and GR during the period from 7 to 38 days. Chicks fed diet containing 0.9g/Kg diet Spirulina platensis had higher LBW (2078.25, g) and higher BWG, GR and PI and better FC (1931.65 g, 1.37, 38.67 and 1.71, respectively) during the previous period, the deference between groups fed diet containing 0.9, 0.7 and 0.5 g/kg diet Spirulina platensis were not significant for LBW at 38 days and BWG, FC and PI during the period from 7 to 38 d, while, those fed control diet had lower value. Chicks fed diet containing 0.9g/Kg diet Spirulina platensis had higher value of FI (3308.25 g), Table 2.

The obtained results approved the earlier findings of Day (1997), Shanmugapriya and Saravana Babu (2014). Dordevic et al. (2010) and Mariey et al. (2012) clarified that birds fed diets containing Spirulina had useful impacts on productive performance. Spirulina platensis at 0.9 g/ kg showed good body weight gain on 38th day of age. These results are in line with the findings of Kharde et al. (2012), who stated that different levels of Spirulina platensis improve the mean LBW of broilers. Also, dietary Spirulina significantly improved weight gain of chickens compared to the control group (Kharde et al., 2012 and Shanmugapriya and Saravana Babu, S., 2014). The improved in LBW may be due to the absorption of minerals and vitamins (Tsuchihashi, 1987; Gružauskas et al., 2004 and Mariey et al., 2012). In the same line, Kaoud (2015) found that LBW and BWG were significantly ($P<0.05$) augmented by the dietary Spirulina platensis supplementation, this significant effect may be due to improving the efficiency of feed utilization. Also, these results agreed with the findings by Kharde et al. (2012) and Kaoud (2015) who illustrated that, FC significantly ($P<0.05$) improved by inclusion of Spirulina platensis in broiler diets as compared to the control diet. Raach-Moujahed et al. (2011) proved that, FC improved significantly ($P<0.05$) when broilers fed with 2.5% of Spirulina platensis compare with other treatments, this improvement may be related with the balanced microbial population in the gastrointestinal tract enhance the absorbability of dietary vitamins and minerals, which has significant role in the performance and health of broilers (Mariey et al., 2012).

Slaughter parameters:

The results of impact of dietary levels of Spirulina platensis (0.3,0.5,0.7, and 0.9g)/kg diet on some slaughter parameters as a percentage of LBW at 38 d of age are as presented in Table 3.

The results showed that supplementation of Spirulina platensis had significant ($P \leq 0.01$) effect on some slaughter parameters at 38 d of age except total giblets (liver, heart and gizzerd) which had insignificantly affected. Chicks fed diet without supplementation were significantly higher abdominal fat%, half breast% and half rear% (1.11, 19.12, and 16.47, respectively) than the other treated groups.

The results are in harmony with those obtained by Shanmugapriya and Saravana Babu (2014) who reported that, abdominal fat was decreased with inclusion of feed containing 1% of Spirulina platensis compared with the control group and other supplemented group. Furthermore, Bellof and Alarcon (2013) concluded that, dietary Spirulina supplementation significantly improved carcass parameters of broilers. Toyomizu et al. (2001) stated that, feeding birds on Spirulina shows significant difference (P<0.01) on meat color in muscle of chicks when Spirulina was added at the levels of 40 and 80 g/kg in broiler diets.

Immune organs:

Effect of Spirulina platensis supplementation on immune organs of Cobb strain broiler chicks during the period from 7 to 38 d of age are summarized in Table 3. The results showed that significant differences (P≤0.05) were noticed in bursa%, thymus% and spleen% as affected by the treated groups in comparison with the control. The deference between groups fed diet containing 0.7 and 0.9 g Spirulina platensis/kg were not significant for bursa% and spleen%. Birds fed diets supplemented with 0.9 g Spirulina platensis diet had the higher value of bursa (0.18%), thymus (0.59%), and spleen (0.16%).

It can be concluded that addition of Spirulina platensis to broiler diets improved significantly bursa%, thymus% and spleen% compared with the control. In accordance with the present results, Kaoud (2015) showed that the relative and absolute weights of thymus and bursa were induced for the groups fed diet containing Spirulina compared to the control group. These results may be considered as good indicator of healthy status of chicks fed dietary Spirulina. In this respect, Bennett and Stephens (2006) reported that the bursa functions are half of the immune system and its size reflects overall health status of bird. They added that stressed or sick birds have small size of bursa but, healthy or productive birds have large size. Bursa size is a biological indicator of how flocks are well-managed and preserved from disease. Also, Addition of less than 1% Spirulina in chicken diets significantly enhanced the defense systems for antigen processing, greater T-cell activity and increased microbial killing (Qureshi et al., 1996). In addition, Increased content of Zn concentration in Spirulina is play a role to induce the cellular immunity of birds (Mohamed, 1998).

Blood parameters:

Tables (4 and 5) show the effect of dietary levels of Spirulina platensis (0.3, 0.5,0.7,0.9g)/ kg diet, and their impact on some blood parameters. Concerning the treatment effect on blood constituents, the results indicated no significant differences due to supplementation of Spirulina platensis, except, white blood cells (WBCs), heterophils, lymphocyte and H/L ratio, which were significantly affected. Chicks fed diets supplemented with Spirulina platensis (at levels of 0.7 and 0.9g)/kg diet had higher values of WBCs, lymphocyte and lower values of H/L ratio and heterophils, but those fed the control diet had lower values of WBCs and lymphocyte, higher values of heterophils. Also, the results indicated significant differences (P≤0.05) were noticed in globulin, ALT, AST, triglycerides and total cholesterol as affected by the treated groups in comparison with the control (Table 5). Chicks fed diets supplemented with Spirulina platensis at levels of 0.9, 0.7 and 0.5g/kg diet had higher significantly (P≤0.05) values of globulin (2.4, 2.2 and 2,0 respectively) compared with the control diet (1.63). Also, the level of serum ALT, AST, triglycerides and total cholesterol had decreased significantly (P≤0.05) in chicks fed diets supplemented with Spirulina platensis at levels of 0.7, 0.9 compared with the control diets. These results are in line with the findings of Kannan et al. (2005), Abdel-Daim et

al. (2013) and AbouGabal et al. (2015). Also, Spirulina platensis supplementation at level of 1% significantly improved the blood parameters (Shanmugapriya and Saravana Babu, 2014). Furthermore, Jamil et al. (2015) concluded that, ALT and AST decreased significantly (P<0.05) when fed with Spirulina platensis compared with the control group. The results of Kanagaraju and Omprakash (2016) and Swee Weng et al. (2016), found that the addition of 1% Spirulina had
significantly lower serum cholesterol level than that of the control group in quails.

Intestinal microflora:

The microbial load (total count, E. coli as gram negative and Lactobacillus for its beneficial effect) in broilers fed different levels of Spirulina platensis is given in Table 6. No significant differences were noticed in intestinal PH, total count, Avian Influenza (AI) and Newcastle disease virus (ND) between chicks fed diets supplemented with Spirulina platensis and the control group. E. coli count was significantly decreased in birds fed 0.9,0.7g Spirulina platensis (4.42 and 4.52, respectively) than the control birds (4.65). Lactobacillus count was significantly (P≤0.01) increased in birds fed 0.9,0.7,0.5g Spirulina platensis compared with the control diet, (Table 6).

These results are in accordance with the earlier findings of Wakwak et al. (2003), Kabir et al. (2004) and Kulshreshtha et al. (2008). In addition, the current results confirmed those of Baojiang (1994) who found that Spirulina is useful for the beneficial intestinal flora. The count of E. coli was lowest with the usage of 0.9 and 0.7g Spirulina platensis, this observation is in agreement with the results of Tokai (1987) and Mariey et al. (2012) who stated that the feeding of diets containing Spirulina may boost the Lactobacillus population and increase the dietary vitamins absorbability.

Economic efficiency (EEf):

Results in Table 7 exhibited that values of EEf during the period from 7 to 38 d of age improved in groups fed diets containing Spirulina plantensis as compared with those fed the control diet. Birds fed with 0.7 g/kg of Spirulina platensis had the highest economic and relative efficiency values being (1.577and 110.242%), followed by 0.9g Spirulina platensis /kg (1.569 and 109.688%), followed by 0.5g Spirulina platensis /kg (1.550 and 108.353%), followed by 0.3g Spirulina platensis /kg (1.470 and 102.759 %) respectively, but the lowest one was noticed in the birds fed the control diet, without Spirulina platensis (1.431 and 100 %).

The obtained results promoted the previous conclusions of Mariey et al. (2012) who reported that, Sinai laying hens fed 0.2% Spirulina had the highest EEf. Likewise, Mariey et al. (2014) proved that Spirulina supplement in broiler diet had higher economic efficiency than the control group. Spirulina can be considered a feed supplement for poultry having economic benefits (Kaoud, 2015).

It could be concluded that, dietary supplementation of broiler diet with 0.9 or 0.7g/kg Spirulina platensis enhanced productive performance, physiological response and immune system. From economical point of view, dietary supplementation of bird’s diets with 0.7g/kg Spirulina platensis is recommended for Cobb chicks.

Table (1): Composition and calculated analyses of the control starter, grower and finisher diets.

Items%	Starter (7-14 days)	Grower (15-21days)	Finisher (22-38 days)
Yellow corn, ground(8.5%CP)	64.37	70.40	74.22
Soybean meal (44%CP)	23.08	16.78	12.30
Corn gluten meal (60%CP)	8.56	9.00	10.00
Dicalcium phosphate	1.80	1.70	1.50
Calcium carbonate	0.90	0.85	0.80
Vit. and Min. premix*	0.30	0.30	0.30
Salts (NaCl)	0.30	0.30	0.30
DL–Methionine	0.24	0.20	0.15
L-Lysine HCl	0.45	0.47	0.43
Total	100.0	100.0	100.0
Calculated analysis%:**			
Crude protein (CP)	21.50	19.5	18.5
Crude fat	2.84	3.03	3.17
Crude fiber	3.00	3.00	3.00
Calcium	0.90	0.84	0.76
Available phosphorus	0.45	0.42	0.38
Methionine	0.50	0.48	0.50
Methionine+Cystine	0.98	0.89	0.82
Lysine	1.32	1.19	1.05
ME, kCal./Kg	3008.00	3086.00	3167.00

* Each 3.0 kg of premix supplies one ton of the diet with: Vit. A, 12000000 I.U; Vit. D3, 2000000 I.U.; Vit. E, 40g; Vit. K3, 4g; Vit. B1, 3g; Vit. B2, 6g; Vit.B6, 4g; Vit.B12, 30mg; Niacin, 30gm; Biotin, 80mg; Folic acid, 1.5g; Pantothenic acid, 12g; Zn, 70g; Mn, 70g; Fe, 40g; Cu, 10g; I, 1.5g; Co, 250mg; Se, 200mg; Choline chloride, 350g and complete to 3.0 Kg by calcium carbonate. **According to NRC, 1994 and AOAC,1990.

Table (2): Effects of supplementation of Spirulina platensis to broiler diets on growth performance.

Item	Control	Spirulina 0.3g	Spirulina 0.5g	Spirulina 0.7g	Spirulina 0.9g	Overall Mean±SEM[1]	P value
Body weight (g) at: 7 d	146.60	145.87	146.40	146.30	146.60	146.32±0.27	0.937
Body weight (g) at: 38 d	1911.72[c]	1966.45[bc]	2014.60[ab]	2016.80[ab]	2078.25[a]	1997.56±9.89	0.001
Body weight gain (g)7-38 d	1765.00[c]	1820.57[bc]	1868.20[ab]	1870.00[ab]	1931.65[a]	1851.2±9.9	0.001
Feed intake7-38 d (g)	3302.45[a]	3315.62[a]	3270.37[ab]	3215.67[b]	3308.25[a]	3282.4±10.4	0.048
Feed conversion	1.87[a]	1.82[a]	1.75[b]	1.71[b]	1.71[b]	1.77±0.009	0.000
Growth rate	1.71[c]	1.72[bc]	1.72[ab]	1.73[ab]	1.73[a]	1.72±0.001	0.006
Performance index	33.58[b]	34.7[b]	37.34[a]	37.92[a]	38.67[a]	36.45±0.26	0.000

a,b and c means in the same row within different letters, different significantly (at $P \leq 0.05$) [1] Pooled SEM

Growth rate = $(LBW_{38} – LBW_{7})/0.5(LBW_{38} + LBW_{7})$, Performance index = (LBW, Kg/FC) x100

Table (3): Effects of supplementation of Spirulina platensis to broiler diets on some slaughter parameters% and immune organs%.

Item%	Control	Spirulina 0.3g	Spirulina 0.5g	Spirulina 0.7g	Spirulina 0.9g	Overall Mean±SEM[1]	P value
Live body weight (g)	2063.3^{b}	2093.30^{b}	2243.30^{a}	2328.30^{a}	2357.00^{a}	2217.6±16	0.001
Total giblet	4.13	4.05	3.88	3.90	4.02	4± 0.068	0.78
Abdominal fat	1.11^{a}	1.02^{ab}	0.86^{c}	0.89^{bc}	0.83^{c}	0.95±0.02	0.007
Half breast	19.12^{a}	16.50^{b}	15.75^{b}	16.12^{b}	16.52^{b}	16.8±0.21	0.004
Half rear	16.47^{a}	14.69^{b}	14.75^{b}	14.92^{b}	14.66^{b}	15.1±0.14	0.012
Immune organs							
Bursa	0.12^{b}	0.14^{b}	0.15^{ab}	0.15^{ab}	0.18^{a}	0.15±0.005	0.028
Thymus	0.41^{c}	0.46^{bc}	0.47^{bc}	0.48^{b}	0.59^{a}	0.48±0.011	0.002
Spleen	0.13^{c}	0.14^{c}	0.14^{c}	0.15^{ab}	0.16^{a}	0.14±0.002	0.035

a,b and c means in the same row within different letters, different significantly (at $P \leq 0.05$) [1] Pooled SEM

Table (4): Effects of supplementation of Spirulina platensis to broiler diets on blood parameters.

Item	Control	Spirulina 0.3g	Spirulina 0.5g	Spirulina 0.7g	Spirulina 0.9g	Overall Mean±SEM[1]	P value
Hemoglobin (g/dL)	11.93	12.23	11.53	11.83	11.67	11.84 ±0.2	0.84
RBC(10^6/mm^3)	3.01	2.88	3.06	3.05	2.97	2.99 ±0.3	0.56
Hematocrit %	27.82	27.25	27.23	27.74	27.66	27.54±0.11	0.34
MCV (μ^2)	92.34	94.51	88.94	91.13	93.10	91.9±0.99	0.52
MCH (µµg)	39.67	42.39	37.67	39.05	39.19	39.6±0.99	0.66
(MCHC)%	42.91	44.87	42.36	42.71	42.18	43.01±0.82	0.83
WBC(10^3/mm^3)	28.00[b]	28.40[b]	29.94[b]	33.34[a]	33.19[a]	30.57±0.4	0.003
Heterophils	18.67[a]	17.33[b]	17.67[ab]	17.00[b]	16.67[b]	17.47±0.17	0.04
Lymphocyte	70.00[c]	72.33[bc]	72.33[bc]	75.33[a]	75.00[ab]	73±0.38	0.007
Monocytes %	5.00	4.67	5.00	4.33	4.67	4.7±0.12	0.38
Eosinophiles %	6.33	5.67	5.00	3.33	3.67	4.8±0.35	0.097
H/L ratio	0.26[a]	0.24[ab]	0.24[ab]	0.21[c]	0.22[bc]	0.23±0.003	0.007

a,b and c means in the same row within different letters, different significantly (at $P \leq 0.05$) [1] Pooled SEM
RBC= Red blood cells count; MCV= Mean corpuscular volume; MCH= Mean corpuscular hemoglobin;
MCHC= Mean corpuscular hemoglobin concentration; WBC= White blood cells count.

Table (5): Effects of supplementation of Spirulina platensis to broiler diets on serum parameters.

Item	Control	Spirulina 0.3g	Spirulina 0.5g	Spirulina 0.7g	Spirulina 0.9g	Overall Mean±SEM[1]	P value
Total protein g/dL	2.93	3.23	3.43	3.56	3.73	3.38±0.08	0.11
Albumin(A)g/dL	1.30	1.23	1.33	1.36	1.33	1.31±0.051	0.93
Globulin(G)g/Dl	1.63[b]	2.00[ab]	2.10[a]	2.20[a]	2.40[a]	2±0.056	0.01
A/G	0.79	0.61	0.62	0.62	0.55	0.6±0.023	0.06
ALT (U/L)	27.33[a]	27.00[ab]	24.66[bc]	24.33[c]	23.66[c]	25.4±0.35	0.02
AST (U/L)	158.66[a]	158.00[a]	147.66[ab]	141.00[b]	136.33[b]	148.3±1.9	0.01
Triglycerides mg/dl	91.00[a]	88.00[ab]	78.66[bc]	75.33[c]	76.00[c]	81.8±1.4	0.01
Total cholesterol, mg/dl	179.00[a]	176.33[a]	162.00[b]	159.33[b]	159.00[b]	167.1±1.7	0.01

a,b and c means in the same row within different letters, different significantly (at P≤0.05) [1] Pooled SEM
ALT= Alanine aminotransferase AST= Aspartate aminotransferase

Table (6): Effects of supplementation of Spirulina platensis to broiler diets on bacterial count and immune response to Influenza (AI) and Newcastle (ND)

Item	Control	Spirulina 0.3g	Spirulina 0.5g	Spirulina 0.7g	Spirulina 0.9g	Overall Mean±SEM[1]	P value
Intestinal pH	6.54	6.56	6.49	6.42	6.36	6.47±0.03	0.26
Total Count	10.66	10.73	10.61	10.58	10.65	10.65±0.028	0.55
E. coli 10*^{4}	4.65[a]	4.55[ab]	4.56[ab]	4.52[bc]	4.42[c]	4.53±0.02	0.01
lactobacillus	5.03[b]	5.10[b]	5.22[a]	5.26[a]	5.29[a]	5.18±0.02	0.002
Newcastle	7.33	7.67	7.67	8.33	8.33	7.86±0.149	0.20
Influenza	7.00	7.00	7.67	7.67	8.00	7.46±0.18	0.39

a,b and c means in the same row within different letters, different significantly (at P≤0.05) [1] Pooled SEM

Table (7): Effects of supplementation of Spirulina platensis to broiler diets on economic efficiency (EEf).

Treatments Items	Control	Spirulina 0.3 g	Spirulina 0.5 g	Spirulina 0.7 g	Spirulina 0.9 g
average feed intake (a_1)	0.389	0.394	0.389	0.381	0.384
price / Kg feed (b_1)	389.200	393.400	396.200	399.000	401.800
feed cost (c_1)	151.496	155.098	154.466	151.987	154.492
average feed intake (a_2)	0.558	0.527	0.549	0.541	0.553
price / Kg feed (b_2)	381.200	385.400	388.200	391.000	393.800
a_2 x b_2=c_2	213.003	203.055	213.413	211.433	217.968
average feed intake (a_3)	2.354	2.394	2.330	2.294	2.370
price / Kg feed (b_3)	369.500	373.700	376.500	379.300	382.100
a_3 x b_3=c_3	869.803	894.638	877.245	870.114	905.577
(c_1+c_2+c_3) =c_{total}	1234.457	1252.978	1245.407	1233.535	1278.133
d	1.765	1.821	1.868	1.870	1.932
e	1700.000	1700.000	1700.000	1700.000	1700.000
Total revenue (f)	3000.500	3094.969	3175.940	3179.000	3283.805
Net revenue (g)	1766.043	1841.991	1930.533	1945.465	2005.672
Economic efficiency	1.431	1.470	1.550	1.577	1.569
Relative efficiency (r)	100.000	102.759	108.353	110.242	109.688

a_1, a_2, and a_3….average feed intake (Kg/bird) during the periods of starter, grower and finisher, respectively.

b_1, b_2, and b_3 …… price / Kg feed (P.T.) during the periods of starter, grower and finisher, respectively (based on average local market price of diets during the experimental time).

c_1, c_2, and c_3 ……. feed cost (P.T.) = a_1 x b_1=c_1 during the periods of starter, grower and finisher, respectively.

Total feed cost (P.T.) = c_{total} = (c_1+c_2+c_3)

Average LBWG (Kg/ bird) d

Price / Kg live weight (P.T.) e… (according to the local market price at the experimental time).

Total revenue (P.T.) = d x e = f

Net revenue (P.T.) = f - c_{total} =g

Economic efficiency = (g / c_{total}) ….(net revenue per unit feed cost).

Relative efficiency r….(assuming that economic efficiency of the control group (1) equals 100.

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الملخص العربي

تأثير إضافة طحلب الاسبيرولينا بلاتينسيس كمحفز نمو علي أداء بداري التسمين

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تم إجراء هذه الدراسة خلال الفترة من فبراير الى ابريل 2016 بهدف تقدير تأثير أضافة طحلب الاسبيرولينا بلاتينسيس في علائق كتاكيت التسمين علي الأداء الانتاجي وبعض الصفات الفسيولوجية .استخدمت في هذه الدراسة 200 كتكوت غير مجنس من سلالة كب عمر سبعة ايام وزعت عشوائيا الى خمسة معاملات (كل معامله 40 طائر مقسمة الى اربعة مكررات) وموزعة كالاتي: المعاملة الأولي تحتوي على العليقة الأساسية (مجموعة الكنترول)، والمعاملات الاخري تحتوي في علائقها علي اضافة الاسبيرولينا بنسب 0.3، 0.5، 0.7 ، 0.9 جم/ كجم.

وقد أظهرت نتائج التجربة أن الكتاكيت المغذاه علي علائق تحتوي علي الاسبيرولينا بنسبة 0.7 و 0.9 جرام لكل كيلو جرام عليقة تحسنت معنويا في وزن الجسم، ومعدل الزيادة في وزن الجسم، ومعدل التحويل الغذائي، ومعدل النمو، والاداء الانتاجي، وبعض صفات مقاييس الدم والمناعة وميكروفلورا الأمعاء، بينما كانت اعلي أفضل كفاءة اقتصادية وكفاءة اقتصادية نسبية للعلائق التي تحتوي على سبيرولينا بنسب 0.7 جم لكل كيلو جرام عليقة.

ويستخلص من نتائج الدراسة أن: اضافة الاسبيرولينا بنسبة 0.9 و0.7 جرام لكل كيلو جرام عليقة أدت الى تحسين الأداء الأنتاجي والفسيولوجي للكتاكيت، بينما من الوجهة الاقتصادية فأن اضافة الاسبيرولينا لعلائق كتاكيت التسمين بمعدل 0.7 جم لكل كيلو جرام عليقة هي الافضل كفاءة اقتصادية وكفاءة اقتصادية نسبية.

الكلمات الداله: اضافات غذائية، سيبيرولينا بلاتينسيس، الأداء الانتاجى ، كتاكيت التسمين