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USING NATURAL AND SYNTHETIC ANTIOXIDANTS IN LOW-PROTEIN DIETS TO IMPROVE THE PERFORMANCE OF BROILER AND REDUCE LOST NITROGEN IN FECES

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ABSTRACT: The objective of this study was to investigate the effects of using natural and synthetic antioxidants for improving growth performance, some blood parameters, manure characteristics and economical efficiency. A total number of 360 Ross breed chicks, two day old, were weighted and randomly distributed into six groups each of sixty birds; each group has three replicates each replicates has 20 birds which were allocated in individual pin. The experiment was approved at the same time following similar design. Feed and water were provided ad libitum. The experimental groups were arranged as the following: T_1: (positive control),commercial diet, received a 23% crude protein (CP), starter, and 20% CP (grower), according to the breed requirements, without additives; T_2: (negative control) received a 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g butylated hydroxyl toluene (BHT)/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet. Results showed that: increasing feed intake, body weight and body weight gain at group T_4 at 36 days. Also, group T_4 at 36 days old was significantly ($P < 0.05$) the best feed conversion ratio (FCR) compared to T_2 group. Group T4 at 36 days old was significantly ($P < 0.05$) the best values of total protein (TP), albumen (A), globulin (G), A/G ratio, total antioxidant capacity (TAC),glucose (Glu) and triglyceride TG. Also, T_4 significantly ($P < 0.05$) achieved the best values of % nitrogen (N) reducing compared to positive control. From economical point of view, it can be concluded that negative control + 3g pulicaria undulata powder/ kg diet (T_4) value for chicks could be recommended for releasing best results of performance.

Keywords: broiler - performance - antioxidant - blood - manure characteristics.

INTRODUCTION

Most of the developing countries are located in tropical areas, and there is lack of the necessary funds to import the ingredients for livestock feeding and human. Feed additives have been widely used to increase the performance of animals, and are now used in poultry feeding practices extensively (Khan et al., 2007) not only to stimulate feed efficiency and the growth but to improve the performance and health of birds (Fadlalla et al., 2010 and Abouelfetouh and Moussa, 2012). Poultry feedstuffs are expensive, so limiting the growth of poultry industry in the tropics.

The current intense little supply of animal protein in developing countries explains the research into the abilities of some new local produced feed resources for productive animals such as leaf meals, which could be included into the poultry diets in order to tolerate the poultry enterprises and to improve the profit margin through reducing the use of the conventional protein sources (Atawodi et al., 2008). Feed additives have been generally used to increase the performance of animals, and are now used in poultry feeding practices widely (Khan et al., 2007) not only to stimulate the growth and feed efficiency but to improve the health and performance of birds (Fadlalla et al., 2010 and Abouelfetouh and Moussa, 2012).

The EOs are mix of aromatic and volatile compounds, which are usually created from plant, and are entitled with the aromatic characteristics considering the source of plant (Oyen and Dung, 1999). Natural antioxidant such as pulicaria undulat (Rabol). The chemical components of essential oils are phenyl propanoids, terpenoids, and their oxidation products which are all identified to qualitatively and quantitatively differ in plants depending on genetic and environmental factors as well as extraction methodologies used. Essential oil of pulicaria undulata aerial parts revealed activity against Gram-positive and Gram negative bacteria (EL-Kamali et al., 1998).

Synthetic antioxidants such as butylated hydroxyl toluene (BHT) is found in most of the tropics and has economic status and is used for many functions. Effect of organic acids in animal diets can be attended to be controlling pathogenic growth, mucosal immunity, improving digestion, absorption (Zdzislaw, 2005). Therefore, the present investigation was intended to revise using of natural and synthetic antioxidants as broilers feed additives for improving growth performance and economical efficiency, and decreasing the loss of nitrogen in broiler feces.

MATERIALS AND METHODS

The trial of the present study was carried out at El-Rahma Poultry company farms, Kom Osheem, Fayoum Governorate, Egypt during the period from 08/ 12/ 2017 to 06/ 2/ 2018. Chemical analysis was performed in Animal and Poultry Nutrition Laboratories, Environmental Studies and Research Institute (ESRI) and Faculty of Veterinary Laboratories University of Sadat City, Menufyia Governorate, Egypt to determine the effect of using natural or synthetic antioxidants for improving growth performance, some blood constituents and economical efficiency, and decreasing the loss of nitrogen in broiler feces. Performance parameters, hematological parameters, biochemical parameters, nitrogen feces and economic efficiency (EEf) are determined. A total number of 360 Ross breed chicks, two day old, were weighted and randomly distributed into six groups each of sixty birds; each group has three replicates each replicates has 20 birds which were allocated in individual pin. Butylated hydroxyl toluene (BHT) and pulicaria undulata powder were added at the levels of 0, 0.15g or 0, 3g/ Kg diets to the low crud protein diet (20 and 17%), respectively compared to the normal crud protein (23 and 20%), respectively at the starter (1- 21 d) and at the finisher (22- 36 d) period. Birds received their diets to save the nutrient according to the NRC (1994).

Experimental design:

The experimental groups were arranged as the following:

Group 1: T_1, (positive control): (commercial) diet received a 23% CP starter and
20% CP grower (according to the breed requirements) without additives.

Group 2: T_2, (negative control): (basal diet) received a basal diet 20% CP starter and 17% CP grower without additives

Group 3: T_3, basal diet + 0.15g BHT/ kg diet.

Group 4: T_4, basal diet + 3g pulicaria undulata powder/ kg diet.

Preparation of pulicaria undulata powder:

The pulicaria undulata used for this study were collected from local farm Desert in Wadi Elnatron, Elbehera, Egypt. Pulicaria undulata fresh plants were harvested under the control conditions. The plants were collected from June to August, as described by **Shelton and Brewbaker (1994),** were separated from branches, spread out and dried under shade at room temperature for one week, so they can be hard for easy grinding. The full plants were then ground into a meal using a hammer mill of mesh size 3mm to make the pulicaria undulata powder, which were combined to the experimental diets.

Butylated hydroxyl toluene (BHT):

The BHT is an antioxidant that is added to feeds to prevent fats in feeds from becoming rancid. It is also used to slow down the autoxidation rate of ingredients in a product that can cause loss of protein and energy or deterioration of feed taste and quality. It is used at a level of 150g per ton of feed. It was purchased from Multi Vita Animal Nutrition, 6 October Governorate, Egypt.

Mineral determination of pulicaria undulata:

Minerals were determined in P. inuloides from the ash which was prepared and dissolved in 6 M hydrochloric acid and made up to 10 mL according the methods described by Al-Hajj et al, (2014). Calcium content was estimated by the titrimetric method of and iron content was estimated by UV-Visible spectrophotometer (Shimadzu, UV-160A model) at 480 nm (Clark and Collip, 1925). Phosphorus was analyzed by method described by AOAC (1995). The blue color developed was read at 650 nm in UV-Visible spectrophotometer and expressed as phosphorus (mg/100 g meal). Other minerals were estimated by atomic absorption spectroscopy (Shimadzu AA 6701F, Atomic absorption flame emission spectrophotometer) equipped with hollow cathode lamp.

Measurements and methods of interpreting results:

For the feeding trial, the following criteria were measured and/ or calculated as follows:

Feed intake (FI), feed conversion ratio (FCR), body weight gain (BWG) and growth rate (GR). Performance index (PI) was calculated according to North (1984).

Where: PI = live body weight, kg × 100/ feed conversion.

The economic efficiency (EEf) was calculated according to the methods described by Lemme et al., (2006) as follows:

Economic efficiency (EEf) = Net revenue/ Feed cost.

At the end of 36 days of age, blood samples were immediately taken during slaughtering into collecting heparinized tubes. Plasma constituents were determined calorimetrically, on individual bases, by using Spectrophotometer , following the same steps as described by manufactures in terms of glucose (Glu, mg/dl), total protein (TP, g/dl), albumin (Alb, g/dl), triglyceride (TG, mg/dl) and total lipid (TL, mg/dl) .Globulin (Gl, g/dl) was calculated by the difference between TP and Alb and the Alb/ Glo ratio was also calculated. The feedstuffs were analyzed for proximate analysis according to the official methods of AOAC (1995).

All chemical analyses for feedstuffs and excreta samples were carried out at Central Laboratory for Feed and Food. Manure management and manure pH determination, sub samples were taken from all areas of one replicate at full depth of the litter after survey sampling of poultry litter. Thoroughly we are mixing the subsamples to make a composite sample.

Statistical analysis.

The statistical analysis for the feeding trials were performed by using the general linear model (GLM) procedures according to SAS (2010) and significant mean differences between treatment means were distinguished by Duncan's Multiple Range Test (Duncan, 1955). All statements of significance were based on $P \leq 0.05$. The statistical model used in the experiment was as following:

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

Where:

Y_{ij} = the individual observation.

μ = the overall mean.

T_i = treatment effect

E_{ij} = the experimental error.

RESULTS AND DISCUSSION

Growth performance:

Results of LBW of broiler chicks as affected by impact natural and synthetic antioxidants using different experimental diets T_1, T_2, T_3 and T_4 at 2 and 36 days of age are cleared in Table 2. Data indicated that a significant ($P \leq 0.05$) difference between chicks that fed natural or synthetic antioxidants in broiler chickens at age of 36 days. Chicks T_4 had significantly ($P \leq 0.05$) the best LBW value. Meanwhile, T_2 group recorded the worst LBW value. Larsen et al. (1985) observed the inhibition of weight gain in chicks given BHT for six weeks.

Takahashi and Hiraga (1981) described a reduction in body weight gain in rats dosed with a lower level of 918 mg BHT/ kg/ day for a week better weight gain observed in the group III fed BHT at 130 mg/ kg level might have been due to hepatic microsomal enzyme induction at lower doses. The improvement in LBW are in accord with results of Saki et al. (2011), Wickramasinghe et al. (2014) and Mohamed et al. (2016). Body weight gain of broiler chicks for T4 was significantly ($P \leq 0.05$) increased as compared to that of the T_1, T_2 and T_3 during total period (2-36 days) and this is may be due to the more essential oil (EO) of pulicaria undulata aerial parts exhibited activity against Gram-positive and Gram negative bacteria (EL-Kamali et al., 1998).

Superior growth performance during the starter and grower stage could be attributed to the attendance of EO in diet, which encourages secretions of endogenous digestive enzymes, which then improve nutrient digestion and gut passage rate in chickens (Lee et al., 2003 and 2004). Similar results were registered by Amad et al. (2011) who stated that phytogenic feed additives improved apparent ileal digestibility of nutrients at 21, 35, and 42 d of age. Synergistic effects on growth rates of feeding oil combinations have also been reported (Alcicek et al., 2003 and Denli et al., 2004). However, in contrast, there are findings where the effects on animal performance were no significant (Botsoglou et al., 2002). The related factors affecting these differences described in other studies could be attributed to the differences in the inclusion levels of EO, sources of herbs used to form blend of EO, basal diet composition, or the microbial environment in which the birds were reared.

Results of GR % as affected by using natural or synthetic antioxidants in different experimental diets are offered in Table 2. Data exposed that GR was increased ($P < 0.05$) for T4 compared to T1, T2 and T3. Fowls advanced greater intestinal villi, follow-on faster growth rates. Numerous findings shown that put in essential oil to broiler diets improved production performances traits such as body weight, FCR and ADG (Abou-elkhair et al., 2014 and Habibi et al., 2014).

Feed intake and feed conversion:

Data of FI and FCR are revealed in Table 2. There were significant ($P < 0.05$) differences between chicks that fed natural or synthetic antioxidants in broiler chickens at age of 36 days. Feed consumption increased in group T_4 more than T_1, T_2 and T_3 with respect to total feed intake. Fellenberg in (2006) reported that disorders like encephalomalacia or nutritional muscular dystrophy are related to per oxidative dysfunction produced by vitamin E deficiency or free radical increase respectively. Moure et al., in (2001) reported that free radicals can be bound with antioxidants like BHA, BHT or organic acids, which are commercially available and being used in poultry feeds.

Improvements in FCR values of group T_4 recorded significantly ($P \leq 0.05$) the best FCR value for total period (2-36 days) compared to other groups. Insignificant difference was detected among T_1, T_3 but T_2 recorded the worst FCR value. This result may be due to adding the dietary EO would excite the growth performance of broilers (Bampidis et al., 2005). Broilers supplemented with a mixture of oregano, citrus, laurel, sage and anis EO, or a mixture of EO significantly get better FCR (Cabuk et al., 2006). The results revealed nutrition interference in the grower phase improved feed conversion ratio of broiler chickens at market age.

Livability rate and performance index:

Livability % for a total experimental period (36 days) and performance Index as affected by using natural or synthetic antioxidants in broiler chickens are offered in Table 2. Data denoted that T_4 group recorded the best livability rate. Livability rate was highly significantly affected by the feed type. Feed with organic acids and essentials oils supplementation reduced the mortality rate (2.04 %). Similar observation was reported by Kopecky et al. (2012) for the diet added with organic acids. Therefore, Krishan and Narang (2014) found useful effects of essential oils contain improvement of enzyme secretion related to food digestion, desire stimulation and immune response activation.

Results of performance Index (PI) % as affected by using natural or synthetic antioxidants in broiler chickens are presented in Table 2. Data exposed that PI was increased ($P \leq 0.05$) in chicks group T4, at 36 days old. With this regards, (Saki, et al., 2011) reported that the results of broilers index productions were significantly declined by fasting treatments rather than others at 21 and 42 days of age ($P \leq 0.05$).

Blood constituents:

Results of blood constituents at 36-d of age for a total experimental period (36 days) as affected by using natural or synthetic antioxidants in broiler chickens are presented in Table 3. With the same trend, there is significant ($P \leq 0.05$) difference between chicks that fed natural or synthetic antioxidants in broiler chickens at age of 36 days. Group T_4 at 36 days old was significantly ($P \leq 0.05$) the best values of TP, Al, GL, A/G, TL, TAC and Glu. While, the worst values showed on group T_2. This would be expected founded on the fast metabolic exchange and excretion of EO from the body. It has been advised that birds fed EO have decreased concentrations of serum cholesterol and that the hypo-cholesterolemic effect of EO is due to compounds in EO that have the ability to prevent hepatic 3-hydroxy-3-methylglutaryl coenzyme A reeducates activity, a key regulatory enzyme in cholesterol synthesis (Yu et al., 1994 and Case et al., 1995).

Manure Characteristics:

Results of manure characteristics at 36 days of age as affected by using natural or synthetic antioxidants in broiler chickens are presented in Table 4. Data indicated that T_4 significantly ($P \leq 0.05$) achieved the best values of % N reducing being (1 %) compared to control and other experimental groups. While the worst values of % N reducing are presented on T_3 being (0.81). When commercially-available amino acids are used in diet formulation, nitrogen excretion is reduced approximately 10% for each 1 percentage point reduction in dietary crude protein, Shriver et al (2003). Considerable research has been conducted to understand the precise requirements of pigs and poultry for each individual amino acid.

Feeding diets with high levels of feed-use amino acids results in performance similar to that of animals fed diets with intact protein sources. In addition, diet costs are reduced when feed-use amino acids are added to the diet when compared with intact protein sources. Thus, feed-use amino acids allow producers to achieve similar animal performance, reduce feed cost, and reduce the environmental impact from nitrogen excretion. Reducing excess dietary protein reduces the amount of nitrogen excreted (Hartung and Phillips ,1994). Cromwell and Coffey (1995) determined that reducing crude protein levels in the diet by 2 percentage points through the use of commercially-available lysine decreased nitrogen excretion by 17 to 23%.

Later research indicated that further reductions in dietary protein of 3 to 4 percentage points with the inclusion of feed-use lysine, methionine, threonine, and tryptophan reduced nitrogen excretion by 35 % (Carter et al., 1998). A similar trial with corn-soybean meal based diets demonstrated that lowering crude protein by 3 percentage points decreased nitrogen excretion by 28 %.(Sutton et al., 1996.). Latshaw and Zhao (2011) reported that with laying hens, adding feed-use lysine and methionine to lower dietary protein by 4 percentage points reduced nitrogen in the feces by 30%. Results confirmed earlier research where increased use of commercially-available amino acids reduced nitrogen excretion by 45% in laying hens (Keshavarz and Austic, 2004).

Manure pH values:

Results of manure pH values at 36 days of age as affected by using natural or synthetic antioxidants in broiler chickens are presented in Table (5). Data indicated that T_4 significantly ($P \leq 0.05$) achieved the best values of manure pH compared to control and other experimental groups. While the worst values of Manure pH are presented on T_1. These results were in agreement with those obtained by Shriver et al. (2003) who detected that reducing CP with amino acid supplementation clearly decreased N excretion without inducing growth performance. The antimicrobial activity of any organic acid is related to the decrease of pH, as well as their ability to separate because they are lipid soluble in the un dissociated form, in which they are able to enter the microbial cell.

The pH level in specific areas of the gastro intestinal tract (GIT) is a factor which acts a specific microbial population, and also affects the digestibility and absorptive value of most nutrients. Numerous researchers revised on this matter (Jozefiak and Rutkowski, 2005). They also informed that fiber addition to a LPAA (reduced protein) diet had little effect on overall N balance or growth performance, but tended to further reduce slurry ammonium N concentration, PH value and increase volatile fatty acid concentrations. Also Hankins et al. (2001) showed that the adding of SBH (soybean Hulls) or DBP (dried beet pulp) to an LPAA (reduced protein) diet resulted in minor decreases in pH and whole ammonium N concentrations.

Economical Efficiency (EFf):

Results of EFF as affected by using natural or synthetic antioxidants in broiler chickens are shown in Table (6). The economic efficiency values were calculated according to prevailing local market (selling) prices at the experimental time (2018). Results showed an improvement in the average values of net revenue, economic efficiency, and relative economic efficiency due to using natural or synthetic antioxidants in broiler chickens feed compared to control group, which recorded the lowest values of net revenue and economic efficiency.

Also, chicks that fed with diet 20% CP starter and 17% CP Grower + 3g pulicaria undulata powder/ kg diet (T_4) recorded the highest value of economic efficiency (1.67) and relative economic efficiency (108.4%). While, the lowest value of economic efficiency (1.54) and relative economic efficiency (100%) was obtained by broilers in positive control group (T_1). These findings indicated that pulicaria undulata powder 3g/ kg diet (low protein) tends to increase the net revenue.

Table (1): Composition and calculated analysis of the experimental diets fed during starting (1 - 21) and growing periods (22 - 36) days of age.

Ingredients	Starter diets		Grower diets	
	Positive	**Negative**	**Positive**	**Negative**
Ground yellow corn (8.5%).	48.43	63.97	57.54	56.15
Soybean meal (44%).	43.1	22	34.42	16.8
Vegetable oil.	5	2.0	4.60	5.07
Corn Gluten meal (60%CP).	-	1.5	-	5.00
Wheat bran	-	8.8	-	15.65
mono calcium phosphate.	0.25	0.5	0.25	0.5
Sodium chloride.	0.30	0.30	0.30	0.30
Vitamins and minerals mixture[1].	0.30	0.30	0.30	0.30
DL-Methionine[2].	0.22	0.23	0.22	0.03
Limestone.	2.0	0.4	2.37	0.2
Total	100	100	100	100
Calculated analysis (air dry basis)[3]:				
Crude protein, %.	23.07	20.2	20.03	17.08
ME, k cal/ kg diet.	3067	3070	3100	3111
C/ P ratio.	133	152	155	182
Available phosphorous, %.	0.41	0.43	0.40	0.39

[1]Vitamins and minerals mixture at 0.30 % of the diet supplies the following/ kg of the diet: Vit. A, 12000 IU; Vit. D_3 , 2500 IU; Vit. E, 10 mg; Vit. K_3, 3 mg; Vit B_1, 1 mg; Vit. B_2, 4 mg; Pantothenic acid, 10 mg ;Nicotinic acid, 20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin, 40 mg; Vit.B_6, 3 mg; Vit B_{12}, 0.02 mg; Choline chloride, 400 mg; Mn, 62 mg; Fe, 44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01 mg.

[2]DL – Methionine: 98% feed grade (98 % Methionine).

[3]Calculated according to NRC (1994).

broiler - performance - antioxidant - blood - manure characteristics.

Table (2): Growth performance as affected by using natural and synthetic antioxidants in broiler chickens (means ± SE).

Items	Treatments[1]				S. E.	Sig.
	T1	T2	T3	T4		
Initial body weight at 2 days (g).	69.1	68.9	69.4	69.2	0.47	NS
Final body weight at 36 days (g).	2200^{b}	2131^{c}	2205^{b}	2290^{a}	22.59	*
BWG from 2 - 36 days (g).	2131^{c}	2062^{d}	2136^{b}	2221^{a}	30.22	*
Feed Intake from 2 - 36 days (g).	3590^{b}	3550^{b}	3542^{b}	3631^{a}	32.16	*
FCR from 2 - 36 days (g feed/ g	1.68^{b}	1.72^{a}	1.65^{b}	1.63^{c}	0.02	*
Growth rate (%).	187.8^{b}	187.4^{c}	187.7^{b}	188.2^{a}	0.18	*
Livability rate (%).	84.96^{c}	92.20^{a}	94.60^{a}	95.50^{a}	0.30	*
Performance Index (%).	130.9^{b}	123.8^{c}	133.6^{b}	140.4^{a}	4.40	*

[1]T_1: (positive control) 23% CP, starter, and 20% CP (grower) without additives; T_2: (negative control) 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g BHT/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet.
NS: Not Significant.
a, b, c……etc: Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table (3): Blood constituents as affected by using natural and synthetic antioxidants in broiler chickens (means ± S.E).

Items[2]	Treatments[1]				S. E.	Sig.
	T_1	T_2	T_3	T_4		
T P. (g/ dl).	5.23^{b}	4.51^{b}	5.69^{ab}	5.78^{a}	0.59	*
Al. (g/ dl).	3.33^{c}	2.88^{a}	3.72^{b}	3.85^{a}	0.74	*
GL. (g/ dl).	1.79^{b}	1.52^{b}	1.77^{b}	1.88^{ab}	0.79	*
A/ G ratio.	2.77^{b}	2.17^{b}	2.77^{b}	2.88^{a}	0.32	*
TL. (mg/dl).	548.28^{a}	352.05^{b}	491.14^{b}	352.03^{c}	34.57	*
TAC (ml/ l).	0.73^{b}	0.53^{b}	0.96^{a}	1.02^{a}	0.12	*
Glu. (mg/ dl).	254.14^{b}	248.80^{c}	258.03^{b}	263.23^{a}	3.82	*

[1]T_1: (positive control) 23% CP, starter, and 20% CP (grower) without additives; T_2: (negative control) 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g BHT/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet.
[2]TP g/ dl: Blood serum total protein; Al. g/ dl: Blood albumin; Gl. g/ dl: Blood globulin; TL. mg/dl: Total lipids; TAC ml/l: Total antioxidant capacity; Glu.: Blood glucose mg/dl
a, b, c……etc: Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table (4): Manure characteristics as affected by using natural or synthetic antioxidants in broiler chickens (means ± S. E.).

Items	Treatments[1]				S. E.	Sig.
	T_1	T_2	T_3	T_4		
Ash (%).	23.14^{c}	22.1^{c}	27.4^{a}	25.6^{b}	0.65	*
Nitrogen (%).	3.95^{a}	2.93^{c}	3.14^{b}	2.95^{b}	0.09	*
Phosphors (mg/dl).	66.14^{a}	63.1^{ab}	59.9^{bc}	55.6^{d}	1.65	*
% N reducing.	0	1.02	0.81	1.0		
P reducing (mg/dl).	0	3.04	6.24	10.54		

[1]T_1: (positive control) 23% CP, starter, and 20% CP (grower) without additives; T_2: (negative control) 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g BHT/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet.
a, b, c……etc: Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table (5): Manure pH values as affected by using natural or synthetic antioxidants in broiler chickens (means ± S. E.).

Items	Treatments[1]				S. E.	Sig.
	T_1	T_2	T_3	T4		
PH value	8.7^{a}	6.9^{b}	6.47^{b}	5.9^{c}	0.12	*

[1]T_1: (positive control) 23% CP, starter, and 20% CP (grower) without additives; T_2: (negative control) 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g BHT/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet.
a, b, c…etc: Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table (6): The economic efficiency of the experimental diets.

	Treatments[1]			
Items	T1	T2	T3	T4
Total feed intake,(g/ bird).	3590	3550	3541	3630
Price/kg feed (L.E)[2].	7	6.8	6.85	6.85
Total feed cost (L.E.).	25.13	24.14	24.26	24.87
Final live body weight (kg).	2.200	2.130	2.205	2.290
Price/ kg LBW (L.E)[3].	29	29	29	29
Total revenue. (L.E.).	63.80	61.77	63.95	66.41
Net revenue (L.E)[4].	38.67	37.63	39.69	41.54
Economic efficiency[5].	1.54	1.56	1.64	1.67
Relative economic efficiency.	100	101.3	106.5	108.4

[1]T_1: (positive control) 23% CP, starter, and 20% CP (grower) without additives; T_2: (negative control) 20% CP (starter) and 17% CP (grower) without additives; T_3: negative control + 0.15g BHT/ kg diet; T_4: negative control + 3g pulicaria undulata powder/ kg diet.
[2]According to the price of different ingredients available in the market (May 2018).
[3]According to the local market price (May 2018).
[4]Net revenue= Total revenue – Total feed cost.
[5]Economic efficiency = Net revenue/ Feed cost.

broiler - performance - antioxidant - blood - manure characteristics.

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الملخص العربي

استخدام مضادات الأكسدة الطبيعية والصناعية في العلائق المنخفضة البروتين لتحسين أداء دجاج التسمين وتقليل النتروجين المفقود في الزرق

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أجريت هذه التجربة بهدف دراسة تأثير استخدام مضادات الأكسدة الطبيعية والصناعية كإضافات للأعلاف منخفضة البروتين على كل من: أداء النمو، بعض مكونات الدم، صفات الزرق، والكفاءة الاقتصادية لدجاج التسمين. استخدم 360 كتكوت تسمين من سلالة روص عمر يوم – قسمت عشوائياً إلى 6 مجموعات - كل مجموعة قسمت إلي ثلاث مكررات بكل مكررة 20 طائر. المجموعة الأولى: (كنترول موجب) عليقة تجارية نسبة البروتين بها 23٪ (البادئ)، 20٪ (النامي) بدون إضافات - تبعا لاحتياجات السلالة، المجموعة الثانية: (كنترول سالب) عليقة نسبة البروتين بها 20٪ (البادئ)، 17٪ (النامي) بدون إضافات، المجموعة الثالثة: كنترول سالب مضاف إليها BHT بمعدل 0.15جم/ كيلوجرام عليقة، المجموعة الرابعة: كنترول سالب مضاف إليها مسحوق شاي الجبل (روبل pulicaria undulata powder) بمعدل 3جم/ كيلوجرام عليقة.
ويمكن تلخيص أهم النتائج التي تم التوصل إليها فيما يلي:
1- لوحظ تحسن معنوي في كل من: وزن الجسم، الزيادة في وزن الجسم، كمية العلف المأكول، معدل التحويل الغذائي، معدل النمو، ودليل النمو لطيور المجموعتين الثالثة والرابعة مقارنة بطيور مجموعتي المقارنة (المجموعة الأولى والثانية) خلال فترة التجربة.
2- سجلت طيور المعاملة الرابعة أعلى قيم للبروتين الكلى، الألبيومين والجلوبيولين فى الدم. كما حققت المجموعة التجريبية T_4 أعلى القيم للسعة الكلية لمضادات الأكسدة TAC وجلوكوز الدم. بينما لم تتأثر معنويا كرات الدم الحمراء والهيموجلوبين باستخدام مضادات الأكسدة الطبيعية أو الصناعية.
3- حققت طيور المجموعة الرابعة T_4 أفضل القيم معنويا لنسبة النيتروجين الموجود فى الفضلات وقيم درجة حموضة الزرق مقارنة بمجموعة المقارنة T_1 والمجموعات التجريبية الأخرى.
4- سجلت المعاملة T4 أعلى قيمة للكفاءة الاقتصادية والكفاءة الاقتصادية النسبية.
5- بشكل عام وبناء على النتائج المتحصل عليها من هذه الدراسة - يمكن التوصية بإضافة مسحوق Pulicaria undulata L بمعدل 3جم/ كيلوجرام من علائق دجاج اللحم منخفضة البروتين لتحسين كل من: أداء النمو، مقاييس الدم، الكفاءة الاقتصادية وخفض نيتروجين الفضلات (الزرق) وخاصة التي تربى تحت ظروف المناطق الصحراوية والأراضي المستصلحة الجديدة.