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The effect of feed additive supplementation in broiler diet on performance and α–tocopherol

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Abstract

The broilers represent the most important source of meat for Iraqi consumers, therefore, it is very imperative to study the effect of some Feed additive supplementation on some productive performance for these broilers. This study was carried out to explain the effect of different levels of Grape pomace, Rosemary and Thyme supplementation in broiler diet on some productive parameters and α – tocopherol concentration in serum and meat. Two hundred and forty one day old (Ross-308) broiler chicks, have been distributed randomly into four treatments each one consist of three replicates and each replicate contained (20) chicks. All treatments fed a basal diet. The first treatment as a control – free from addition (T1), the second treatment (T2) contained 6% Grape pomace, the third treatment (T3) contained 6% Grape pomace and 1% Rosemary, and the fourth treatment (4) contained grape pomace 6% and 1% Thyme**.** The results of this study illustrated significant differences (P≤0.01) in the second, third and fourth groupas compared with control group concerning some productive traits (live body weight, weight gain, feed intake, feed conversion ratio). The result of α-tocopherol showed significant differences (P≤0.01) in the second, third and fourth treatments compared with control while the third treatment recorded significant increment(P≤0.01) compared with other treatments in both serum and meat. In conclusion: the treatment contained grape pomace 6% and 1% Thyme showed the best results as compared with other treatments.

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Introduction

It is common information that diet is a major factor in animal production, since it does not only distress the health and yield of farm animals, but also the cost of livestock products. In recent years, natural bioactive compounds are combined to animal feed in order to improve bio functional products which would enhance the efficiency, production and welfare of livestock (Pinotti *et al*., 2014). The two main aims in poultry production are the elevated growth rate and feed efficiency. In this sense, the gut is a essential organ which mediates nutrient uptake and use by the animals hence, a well-functioning and healthy gut is the basis of the best performances of the birds (Kabir, 2009).

Feed additives are significant ingredients that can progress the effectiveness of feed consumption and animal performance (Gudev *et al*., 2008). Some plants, including several essential oils, have been consumed as natural alternative preparations by some researchers (Ceylon *et al*., 2003). Some reports have shown that many plant extracts can improve feed conversion ratio, increase carcass quality, decrease the market age of broiler and reduce their rearing cost (Javed *et al*., 2009). Additionally, numerous studies have described a decline in feed intake as the effect of the great inclusion level (>1500 mg/kg) of phytochemical feed additives and the essential properties of some complexes, such as a strong odor and flavor (Yan *et al*., 2011).

The presence of α-tocopherol in the organism of chickens is important for maintaining optimal health conditions (Bou, *et al.,* 2004). Its level in blood is an important indicator, especially with regard to prophylaxis (exudative diathesis, oedema disease, malabsorption syndrome, necrotic dermatitis). Moreover, α-tocopherol is a highly effective natural antioxidant and its presence within muscle cell membranes reduces lipid oxidation. A raised α-tocopherol concentration in the feeding mixture also enhances feed conversion efficiency and weight gain, and decreases feed consumption (Coetzee and Hoffman, 2001). Because of this reason, experts in animal nutrition are trying to find ways on how to produce as natural and qualitative food products as possible (Vaöko *et al*.,2005). The use of extracts from herbs and spices is a very important step in animal feeding (Hernandez *et al*.,2 004). These extracts have strong ant oxidative, antibacterial, and digestive effects. They help animals to overcome stress conditions, influence the microorganisms in the alimentary tract, and improve feed utilization (Botsoglou *et al*., 2002). The aim of this study was to investigate the effect of supplementation of the broilers' diet with several extracts as feed additive on performance and α–tocopherol in serum and meat.

Material and methods

The experiment

An experiment was carried out at the poultry farm of Veterinary College, Baghdad University. The experiment lasted for 35 days from 13/11/2017 to 18/12/2017 days. Two hundred and forty day old chicks (Rose 308) were divided randomly into 4 treatments groups of (60) bird each with 3 replicate.

The treatments were allocated to receive the following diets: First treatment (T1) diet were fed normal basal diet free from addition kept as control, Second treatment (T2) diet was fed with addition of (6% Grape pomace), Third treatment (T3) diet was fed with addition of (1% Grape pomae and 1% Rosemary), Fourth treatment (T4) diet was fed with addition of (6% Grape pomace and 1% Thyme). Chicks were reared in (1.5 m × 1.5 m) floor pens with a thick wooden shaving litter system of (7 cm).

Feeding program

Feeding program were induced a couple of diets (Starter and finisher) which lasted long for 2 periods (21,35)days respectively . Diets of each period included the same ingredients and composition for all diets throughout the experiments, diets were formulated to meet or exceed chicks requirements according to National Research Council (NRC, 1994) for that chicks ages. Feed and water was provided ad-libitum during the experiment. The composition of the experimental basal diets is given in Table 1.

Vaccination

Chicks were vaccinated against Newcastle Disease (ND), Infectious Bronchitis (IB) and Infectious Bursal Disease (IBD).

Performance traits

Body weight was determined throughout the experimental diets periods. Feed intake was recorded for the corresponding periods. At the end of the experiment, three chicks out of each replicate were randomly selected and weighted to obtain live body weight. Blood samples were taken from the wing vein by using disposable syringe. Then added in the glasses test tubes without anticoagulan, serum was immediately separated and kept overnight at 4°C (in the refrigerator), after that put it in centrifuge at (2300 rpm) for 5 minutes as recommended (Hrubec *et al.,* 2004) to separate serum from the cellular part of blood, that serum was frozen at (- 20°C) and

Carcasses from 3 birds per each treatment were immediately trimmed for breast Meat sample and each sample packed separately in sterile polyethylene bag then frozen and stored at –20°C until required for analysis the content of α-tocopherol by HBLC.

The Statistical Analysis System- SAS (2012) program was used to effect of difference factors in study parameters. Duncan (1955) multiple range test (ANOVA) was used to significant compare between means. in this study.

Results

Live body weight(gm)

There were significant (P<0.01) increases through the third week of experimental in T2 and T4 groups as compared with control group, while the group T3 showed significant difference as compared with control group.

Table 1. Composition of the experimental diets.

Ingredients (%)	Starter (1-21) day of age	Finisher (21-35) day of age
Yellow corn	36.86	39.93
Soybean meal	28	25
Wheat	24	24
*Protein concentrat	5	5
Lime stone	0.9	0.6
Dicalcium phosphate	1.0	0.9
Salt (Nacl)	0.1	0.1
Methionine (%)	0.19	0.07
Lysine (%)	0.05	-
Oil	3.9	4.4
Total	100	100
Calculated chemical analysis		
Metabolizable energy (kcal/kg)	2953	3123
Crude protein (%)	24.5	20.77
Methionine + Cyctine	1.07	0.85
Lysine	1.43	1.13
phosphours	0.45	0.45
Calcium	1.08	0.85
*NRC (1994)		

*Animal protein concentrate contain (CP) 40% , (ME) 2100 kcal/kg , Lysine 3.85 , Metheonine + Cyctein 4% ,Calcium 6.5 , Phosphours 2.6.

The treatments T2, T3 and T4 recorded significant (P<0.01) increase in the live body weight as compared with control group during Fourth and Fifth weeks. The treatment T4 recorded the highest significant (P<0.01) increase as compared with T2 and T3 groups (Table2).

Weekly Feed Intake (gm)

The results showed that there were significant (P≤0.05) differences was noted in treatment T4 as compared with control group through the Third week of experiment. On the other hand the results displayed through Fourth and Fifth weeks showed significant (P≤0.05) differences in treatments T2,T3 and T4 groups compared with control group (Table 3).

Feed Conversion Ratio (FCR)

The results recorded significant (P≤0.05)and (p<0.01) improved in Feed Conversion Ratio in treated groups compared with control group.

Table 2. The effect of different treatments on live body weight (gm) of broiler(Mean ± SE).

Age Treatments	First Week	Second Week	Third Week	Fourth week	Fifth week
T1 Basal diet	142.70 ± 1.17 c	401.20 ± 4.18 a	833.30 ± 9.71 b	1350.00 ± 20.33 c	1889.50 ± 21.1 c
T2 Pomace 6%	161.80 ± 2.17 a	414.40 ± 5.94 a	890.90 ± 10.98 a	1440.00 ± 10.69 b	2200.00 ± 37.58 ab
T3 Pomace 6% Rosemary 1%	156.00 ± 2.38 b	408.40 ± 6.08 a	800.00 ± 8.25 c	1465.00 ± 23.36 b	2100.00 ± 37.18 b
T4 Pomace 6% Thyme 1%	157.00 ± 1.84 ab	413.00 ± 6.12 a	865.00 ± 9.04 a	1550.00 ± 17.51 a	2250.00 ± 46.48 a
Level of Sig.	**	NS	**	**	**

Means having with the different letters in same column differed significantly. ** (P≤0.01), NS: Non-Significant.

The First and Second weeks showed that there were higher recorded significant (P≤0.05) and (P≤0.01) improved in Feed conversion ratio in treatment T2,T3 and T4 as compared with control group.

The results revealed significant (P≤0.05) regression in group T2 and T4 in Feed conversion ratio as compared to control group through the Third week. There were significant improvement between T2,T3 and T4 compared with control. while the treatments T3 and T4 recorded highest significant (P≤0.01) differences compared with T2 throughout Fourth week. While the Fifth week of experiment the results registered significant decrement of Feed conversion ratio in treatments T2 , T3 and T4 compared with control group (Table 4).

Table 3. The effect of different treatments on weekly feed intake (gm) of broiler (Mean ± SE).

Age Treatments	First Week	Second Week	Third Week	Fourth week	Fifth week
T1 Basal diet	213.3 ± 7.24 a	368.3 ± 8.41 a	751.6 ± 11.06 a	884.0 ± 9.63 a	1085.0 ± 16.35 a
T2 Pomace 6%	208.3 ± 6.96 a	305.02 ± 7.86 b	695.8 ± 7.54 ab	769.1 ± 7.90 b	951.6 ± 12.66 b
T3 Pomace 6% Rosemary 1%	208.3 ± 6.77 a	326.6 ± 7.91 b	696.6 ± 9.15 ab	759.6 ± 9.02 b	975.4 ± 15.46 b
T4 Pomace 6% Thyme 1%	203.3 ± 8.69 a	270.0 ± 8.35 c	678.3 ± 9.50 b	758.3 ± 10.33 b	983.5 ± 15.72 b
Level of Sig.	NS	*	*	*	*

Means having with the different letters in same column differed significantly. ** (P≤0.01), NS: Non-Significant.

α-tocopherol determination

The results recorded highly significant (P≤0.01) raises in α-tocopherol of serum in all treatments T2,T3 and T4 (11.93 ±0.72, 24.53 ±1.27, 10.83 ±0.65) respectively compared with control group (3.40 ±0.11). while the treatment T3 applied significant (P≤0.01) increase in α-tocopherol of serum than the treatments T2 and T4.The results of α-tocopherol in breast muscles recorded significant (P≤0.01) increase in all treatments T2,T3 and T4 (4.06 ±0.38, 11.63 ±0.70, 6.30 ±0.52) respectively compared with control group (1.95 ±0.21).). While the treatment T3 applied significant (P≤0.01) increase in α-tocopherol of muscles than the treatments T2 and T4 (Table 5).

Table 4. The effect of different treatments on weekly feed conversion ratio of broiler (Mean ± SE).

Age Treatments	First Week	Second Week	Third Week	Fourth week	Fifth week
T1 Basal diet	1.97 ± 0.12 b	1.78 ± 0.05 b	1.72 ± 0.08 b	1.72 ± 0.07 c	2.01 ± 0.15 b
T2 Pomace 6%	1.64 ± 0.04 a	1.17 ± 0.02 a	1.48 ± 0.05 a	1.40 ± 0.05 b	1.25 ± 0.04 a
T3 Pomace 6% Rosemary 1%	1.72 ± 0.07 a	1.27 ± 0.05 a	1.79 ± 0.11 b	1.14 ± 0.08 a	1.47 ± 0.06 a
T4 Pomace 6% Thyme 1%	1.66 ± 0.05 a	1.05 ± 0.02 a	1.51 ± 0.06 a	1.10 ± 0.04 a	1.40 ± 0.06 a
Level of Sig.	*	**	*	**	**

Means having with the different letters in same column differed significantly. ** (P≤0.01), NS: Non-Significant.

Discussion

Results showed that chicks fed a mixture of grape pomace and thyme had a significant role on growth and health of chick, this positive effect may be due to the improvement in digestion and absorbation in digestive system. Essential oils and related components derived from pomace and thyme have been widely used for the appetizing and stimulating effect on digestion. Such materials have traditionally been used to stimulate the production of endogenous secretions in the small intestine mucosa, pancreas, liver, and thus aid digestion.

These results were in agreement with Mansoub (2011) who found that herbals plants have stimulatory effects on pancreatic secretions such as digestive enzymes which help to digest and absorb more amino acids from digestive tract (Lee *et al.,* 2004). The improvement in body weight of broilers achieved with 5 g thyme could be attributed to its positive effect on nutrient digestibility, as reported by Langhout, (2000). Other factors which could have contributed to the beneficial effects of the herbal products on the growth performance of birds are their probable antioxidant and antibacterial effects in the intestine (Nascimento *et al.*, 2000). Mechanism of action of herbal products which founded by Skandamis and Nychas, (2001)there are suggestions that they alter the permeability of the cell membranes and cause a destruction of the pathogenic bacteria.

A wide range of spices, herbs, and their extracts are exert beneficial actions on them digestive tract, such as laxative and spasmolytic effects and prevention from flatulence (Chrubasiket *et al.*, 2005). The inclusion of phytogenic compounds reduce palatability of diet due to pungent adour, which depress the feed intake without changes in body

weight gain, leading to an improved FCR (Windisch *et al.*,2008).

The results of the present study are agreement with Sayago-Ayerdi *et al.*, (2009) they reported that the inclusion over 6% of grape pmace may reduce feed intake and fat digestion. Also, the currant results were in agreement with Rahimi *et al.*, 2011 ; Khan *et al.*, 2012, they reported that the extract Thyme as feed supplements increase the production performance (weight gain, feed conversion, egg production and quality) of broilers and laying hens, also Bolukbasi and Erhan (2007) found that the dietary supplementation of thyme at the level of 0.1-0.5% led to improvements of FCR and egg production associated with a decline of *E. coli* concentration in feces.

Table 5. The effect of different treatments on α-tocopherol in serum and meat of broiler (Mean ± SE).

Samples Treatments	Serum	Meat
T1 Basal diet	3.40 ± 0.11 c	1.95 ± 0.21 c
T2 Pomace 6%	11.93 ± 0.72 b	4.06 ± 0.38 b
T3 Pomace 6% Rosemary 1%	24.53 ± 1.27 a	11.63 ± 0.38 a
T4 Pomace 6% Thyme 1%	10.83 ± 0.65 b	6.30 ± 0.52 b
Level of Sig.	**	**

Means having with the different letters in same column differed significantly. ** (P<0.01), NS: Non-Significant.

The results of the present study are disagreement with previous observations that indicated herbs, plant extracts, essential oil and/or the main components of the essential oil that did not affect body weight gain, feed intake or feed efficiency in broilers (Hernandez *et al.*, 2004). The inclusion of 0.2% thyme leaves in broiler diets had no effects on body weight gain, feed intake or feed conversion ratio(Ocak *et al.*, 2008), also Cross *et al.*, (2007) reported that the performance parameters of male broilers were not improved when their diets were supplemented with 1% thyme.

In broilers, oxidative stress may occur as a consequence of nutrition, including the contamination of feed with fungal toxins (Frankič *et al.*, 2008); high environmental temperatures (Chee *et al.*, 2005; Lin *et al.*, 2006); and several pathological conditions, such as increased activity of the immune system (e.g., infection, vaccination), pulmonary hypertension, ascites, and coccidiosis (Georgieva *et al.*, 2006).

Minimizing oxidative damage through scavenging free radicals mediated oxidative reactions, may be one of the most important approaches to prevent its hazard's effect. The main mode of action of different antioxidants are consists of removal of free radicals(FR) by transfer an H atom which stabilizes FR and becoming themselves low reactivity, thereby stopping the lipoperoxidative chain (Fellenberg and Speisky, 2006).

Recently many studies were conducted to evaluate the antioxidant activities of dietary natural and synthetic antioxidants. Natural antioxidants such as herbs are used as a substitute for synthetic antioxidants (Radwan *et al*., 2008) and are generally believed to be safer, healthier and less subject to hazards for human and animals which make them useful as natural animal feed additives (Faixova and Faix, 2008).

Chamorro *et al.* (2015) also showed that dietary addition of GP (10%) reached similar protective effect observed with the addition of vitamin E. The flavonoids present in grape skin and pomace by-products directly scavenge free radicals and may also regenerate α-T from its radical form.

Studies conducted by Frank *et al.* (2006) showed that dietary supplementation with flavonoids quercetin, catechin and epicatechin resulted in a substantial increase in α-T concentrations in blood plasma and liver tissue of male rats.

These results are in agreement with the reports of Brenes *et al.* (2010) who reported a linear increase in antioxidant activity in grower and finisher diets as well as in excreta of birds fed on grape seed extracts. Goni *et al.* (2007) and Brenes *et al.*, (2008) also reported higher antioxidant activity in chicken fed diets supplemented with grape pomace and grape seed extract, respectively .

The supplementation of feed with rosemary also increased the α-tocopherol level in blood and meat. Rosemary belongs to the substances with high anti-oxidative substances regenerate α-tocopherol and subsequently increase its level in the tissue(Young *et al.*,2003).

Supplementation with tocopherols has some protective role under stressing conditions (Chae *et al*., 2005).

It has also been proved that tocopherols play a role in growth, immunity and in the protection of biological systems against oxidative damage in live animals as well as in meat and meat products (Jacobsen *et al*., 1995).

Conclusion

The adding of Grape pomace, Rosemary and Thyme supplementation in broiler diet led to enhancement of most of productive traits. However, results confirmed the treatment contained grape pomace 6% and 1% Thyme showed the best results as compared with other treatments.

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