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EFFECT OF DIETARY SUGAR BEET PULP ETHANOLIC EXTRACT ON PRODUCTIVE PERFORMANCE, IMMUNIZATION AND MEAT QUAILTY OF BROILER CHICKS

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SUMMARY

A total number of one hundred and twenty, four days broiler chicks, were divided into 4 treatments (30 birds /each), each treatment contained three replicates of ten birds each to evaluate the effect of sugar beet pulp (SBP) ethenolic extract (as a natural antioxidant) compared with butylated hydroxyl toluene (BHT) (as a synthetic antioxidant) on growth performance, carcass characteristics, blood plasma parameters, immunization, sensory evolution of cooked meat, quality of stored meat (TBRS) and European efficiency factor (EEF). The Experimental treatments were as follows: 1-The control diet; 2-The control diet +BHT;3-The control diet +0.5 % E.E.SBP; 4- The control diet + 1%E.E.SBP. Results obtained could be summarized in following: Insignificantly slightly improved performance was detected due to the effect of two types of antioxidants additives .Results observed that birds fed diets with BHT supplementation (T_2) had significantly ($p<0.05$) higher feed intake and less PI%, while, birds fed diets with SBP extract levels (T_3 and T_4) significantly ($p<0.05$) reduced feed intake, improved feed conversion and recorded higher PI% compared with control group. Birds group received 1 % SBP extract (T_4) achieved significantly ($p<0.05$) higher values of albumin, A/G ratio and less globulin (immune cost) than control group. These results means that supplemented ethenolic extract of SBP at level 1% achieved the best immunity and that is may be due to the effect of SBP ethanolic extract at 1% on both negative- gram and positive -gram bacteria and consequently the immune cost will be decreased. Results cleared that SBP ethenolic extract had a good significant effect on sensory evaluation (color, odor, taste and overall acceptance) and the lowest TBA number had been obtained with birds group fed dietary 1% ethanolic extract of SBP. Data indicated that group fed dietary 0.5% SBP ethenolic extract significantly ($P<0.05$) recorded the best EEF values during grower period (251.72) compared with control (215.92) and other experimental groups (180.46 and 208.96 for BHT and 1% SBP extract groups, respectively). In conclusion, it could be recommend that dietary 0.5% and 1% SBP extract supplementation improved performance and significantly ($p<0.05$) decreased feed intake, in addition to the improve in immune response and meat quality.

Keywords: *Antioxidant, Broilers, Sensory evaluation, Performance, Immunization, Stored meat quality.*

INTRODUCTION

Animal health and production depends on dietary contents. Antioxidants have a special place being major players in the battle for animal survival, maintenance of animal health, productive and reproductive performance. The natural antioxidants have many favorable effects on health, such as the inhibition of low-density lipoprotein oxidation, the reduction of heart disease risks, and the prevention of carcinogenesis (Shaker, 2006 and Sultana *et al.,* 2007). This is largely because of the detrimental effects of free radicals and toxic products of their metabolism on various metabolic processes (Surai *et al.*, 2003). Increasing antioxidant supplementation is helpful in improvement for meat quality during storage. Lipid oxidation was reduced with the addition of synthetic antioxidants in broiler diets because antioxidants prevent further damage of ingredients in the diet (Cabel *et al.*, 1988; Cabel and Waldroup, 1989; McGeachin *et al.*, 1992 and Lin *et al.* ,2009).

Dietary fibers of Sugar beet pulp were reported as sources of antioxidants (Sakac *et al*. 2009). Sakač *et al*. (2004) reported that the ethanolic extract of sugar beet pulp possesses strong antioxidant activity, which could be borne in mind during the tolerance of mild oxidative stress in bio systems or during decreasing or eliminating of oxidative changes in food lipids and food processing. Also they identified phenolic acids in ethanolic extract from sugar beet pulp and concluded that predominant acids (ferulic, gentisic and p-coumaric acid), which have been previously evidenced as relatively potent antioxidants; contribute to the antioxidant properties of the investigated extract.

Mohdaly *et al*. (2009) and Mohdaly (2010) reported that sugar beet pulp extract could serve as natural antioxidant owing to their significant antioxidant activity. Therefore, it could be used as a preservative ingredient in the food and/or pharmaceutical industries. Moreover, (Mohdaly *et al*., 2010) demonstrated that sugar beet pulp is potent source of natural antioxidants that might be explored to prevent oxidation of vegetable oils. The effect of antioxidants on the oxidative stability of meat has been extensively studied, but, few studies have determined the effect of antioxidants on sensory properties, the number of attributes studied has been rather limited (Ruiz *et al*., 2001 and Thring *et al.*, 2009) and elevate free radicals levels (Eid *et al.,* 2008).

Therefore ,the present study was conducted to assess the effect of (SBP) ethanolic extract (as a natural antioxidant) compared with butylated hydroxyl toluene (BHT) (as a synthetic antioxidant) on growth performance, carcass characteristics, blood plasma parameters, immunization, sensory evolution of cooked meat, quality of stored meat (TBRS) and European efficiency factor (EEF). Some immunological parameters, antioxidant indicators and lipid profile were also investigated.

MATERIALS AND METHODS

One hundred and twenty, 4 days old broiler chicks ,were randomly divided into 4 equal groups of nearly similar means of LBW (119 ± 0.5 g/chick) in equal 3 replicates, so that, the average initial LBW was insignificantly different in all groups.

Experimental diets and treatment:

During each specific feeding phase, an iso-nitrogenous and iso-caloric corn-soybean meal basal diet was formulated. The 1st group of chicks was fed the basal diet without any supplementation as a control group. The 2nd group was fed the basal diet supplemented with 125 g BHT/ton diet (125 ppm). The 3rd and 4th groups were fed the basal diet supplemented with 5000 ml ethanolic extract of SBP/ton diet (0.5%) and 10000 ml ethanolic extract of SBP/ton diet (1.0%), respectively. Therefore, four experimental dietary treatments were studied during each specific feeding phase. The composition and calculated analysis of the experimental starter, grower and finisher basal diets are shown in Table (1).

Preparing of tested materials:

Butylated Hydroxytoluene (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 125 g per ton of feed. It was purchased from Multi Vita Company, Animal Nutrition, 6 October City, Egypt.

Ethanolic extract of SBP:

The ethanolic extract of SBP was prepared by mixing 4 g from SBP with 40 ml of 80% ethanol. Extraction was carried out with shaking at room temperature during 1 hr. The extract was separated by filtering through the filter paper (Whatman, Grade 4 Chr, UK), and this procedure was repeated with 40 ml of ethanol two times. Ethanolic extracts (3 × 40 ml) were combined, and solvent was removed under vacuum at 40°C to obtained 25 ml volume (Sakac *et al.*, 2004).

Data recorded:

Live body weight and body weight gain were recorded so, feed intake and feed conversion were calculated at each feeding period (starter, grower, finisher), besides, percentage of mortality was calculated. At the end of experiment, three birds /each treatment that had body weight closed to replicate mean were chosen to evaluate carcass characteristics.

Heterophils / Lymphocytes ratio:

At the end of the feeding trial, blood samples were obtained from each group for heterophils (H) and Lymphocyte (L) enumeration based on procedures of Gross and Siegel (1983).

Table (1). Composition and calculated analysis of the basal diets used in the feeding trial.

Item	Starter (4 –10 days)	Grower (11 – 24 days)	Finisher (25 – 42 days)
Yellow Corn, ground	56.60	60.44	63.00
Soybean meal (44% CP)	27.00	23.50	24.00
Corn gluten meal (62% CP)	10.00	9.00	5.51
Mono-calcium phosphate	2.00	1.50	1.34
Limestone	1.60	1.60	1.48
Common salt	0.30	0.30	0.30
Vegetable oil	1.50	2.81	3.70
Premix*	0.30	0.30	0.30
DL-Methionine	0.10	0.15	0.15
L-Lysine	0.60	0.40	0.22
Total	100.00	100.00	100.00
Calculated values**			
ME, kcal/kg	3027	3153	3195
CP %	23.06	21.00	19.12
CF %	3.47	3.28	3.30
EE %	2.80	2.84	2.87
Ca %	1.00	0.92	0.85
Avail. P %	0.57	0.45	0.42
Lys. %	1.42	1.17	1.04
Meth. %	0.55	0.57	0.52
Meth. + Cyst. %	0.94	0.92	0.84

**The premix (Vit. & Min.) was added at a rate of 3 kg per ton of diet and supplied the following per kg of diet (as mg or I.U. per kg of diet): Vit. A 12000 I.U., Vit. D3 2000 I.U., Vit. E 40 mg, Vit. K3 4 mg, Vit. B1 3 mg, Vit. B2 6 mg, Vit. B6 4 mg, Vit. B12 0.03 mg, Niacin 30 mg, Biotin 0.08 mg, Pantothenic acid 12 mg, Folic acid 1.5 mg, chloride 700 mg, Mn 80 mg, Cu 10 mg, Se 0.2 mg, I 0.4 mg, Fe 40 mg, Zn 70 mg and Co 0.25mg.*
***According to Feed Composition Tables for animal & poultry feedstuffs used in Egypt (2001).*

Immunization:

High stress levels may result in immune suppression and decrease resistance (Siegel, 1980). Heterophil /lymphocyte (H/L) ratio is recognized as a measure of stress in birds (Maxwell, 1993; AL Murrani *et al.,* 2002). Another valuable tool in stress research is albumin/globulin (A/G) ratio, whereas, stress is known to decrease total serum protein, albumin and globulin (Huff *et al.,* 1999; Nazar *et al.,* 2012 and El-Damrawy, 2013). The Immunization response of broiler chicks to the tested materials was determined as follows:

1- Measuring globulin and A/G ratio.
2- The differences in weights of lymphoid organs including spleen, bursa and thymus.
3- Heterophils/ Lymphocytes ratio.

Lipid oxidation study (TBARS):

At the end of the experiment after carcass analysis, the thigh meat of each bird were removed and sampled for meat lipid oxidation study (TBARS). The extent of lipid oxidation was determined by measuring the Thiobarbituric Acid Reactive Substances (TBARS) at 7 days (after refrigerated storage) and 30 days (after freezer storage) and was expressed as gram of malonaldehyde per kilogram of thigh meat using the procedure described by Strange *et al.* (1977). Twenty grams of meat were blended with 50 ml of cold 20% Trichloroacetic acid (TCA) for 2 minutes. The blender contents were rinsed with 50 ml of water, mixed together, and filtered through a Whatman#1. This filtrate is termed the TCA extract and is used in the TBA assessment. A 5 ml of the TCA extract was mixed with 5 ml of 0.01 M 2-thiobarbituric acid. This solution was kept for 14 h at room temperature. Absorbance at 532 nm is reported as TBARS.

Blood plasma constituents:

At the end of both feeding trials, individual blood samples, of about 5 ml, from randomly 3 birds of each treatment group were immediately taken during slaughtering into collecting heparinized tubes. Plasma were individually separated by centrifugation at 3000 rpm for 15 minutes, transferred into a clean Ependorf vials and stored in a deep freezer at approximately -20 °C for later analysis. Plasma constituents were determined calorimetrically, on individual bases, by using Spectrophotometer (model, GBC906 AA) and suitable commercial diagnostic kits (Stambio, San Antonio, Texas, USA) following the same steps as described by manufactures in terms of total protein (TP, g/dl), albumin (Alb, g/dl), glucose (Glu, mg/dl), total lipid (TL, mg/dl), triglyceride (TG, mg/dl), cholesterol (Cho, mg/dl), HDL cholesterol, LDL cholesterol, aspartate aminotransferase (AST,mg/dl), alanine aminotransferase (ALT) , alkaline phosphatase (ALK.Ph, mg/dl) and total antioxidant Capacity (ɱ/L) .Globulin (Glo, g/dl) was calculated by the difference between TP and Alb and the Alb/Glo ratio was also calculated.

European efficiency factor (EEF):

The EEF was calculated according to the methods described by Lemme *et al*.,(2006) as follows: EEF = (Final LBW, kg × Livability, %)/(Age, days × FCR) × 100

Statistical analysis:

The statistical analysis of data obtained was performed by using analysis of variance (one way analysis) as described in SAS program (SAS® institute, 1999).Significant differences between treatment means were distinguished by using Duncan's Multiple Range Test (Duncan,1955). All statements of significance were based on P≤0.05. The statistical model used in the experiment was: $Y_{ij} = M + T_i + E_{ij}$ where:

Y_{ij} = The individual observation.

M = The overall mean.

T_i = The effect of dietary treatment (i=1,2, ,.,.,.,.,4.,).

E_{ij} = The experimental error.

RESULTS AND DISCUSSION

The effect of SBP extract levels, BHT supplementation on broilers performance at the starter period (from 4 to 10 days) is presented in Table (2). Data of BHT supplementation showed that there were insignificant (P<0.05) difference in LBW, BWG and FCR compared to control group. Group fed diets with 0.5%SBP supplementation recorded the best significant (p<0.05) values of LBW,BWG,FCR,GR and PI% during starter period compared to control diet and other experimental groups.

Table (2). Effect of dietary BHT or ethanolic SBP extracts on growth performance of broiler at starter period(4-10) days of age. (Means ± SE).

Item	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Level of ethanolic extract of SBP		
			%0.5 5 ml/kg diet	1% 10 ml/kg diet	
Initial BW(g/bird)	118.93±1.33	119±0.955	119.06±1.53	119.33±1.55	NS
Final BW (g/bird)	298.6±6.279^{b}	300.86±3.52^{ab}	313.63±3.97^{a}	266.23±5.07^{ab}	*
BWG (g/bird)	179.66±5.659^{b}	181.86±3.053^{b}	194.56±3.56^{a}	189.9±4.33^{a}	*
FI (g/bird)	338.66±0.57	338.45±0.322	338.66±0.57	338.66±0.57	NS
FCR (feed: gain)	1.95±0.072^{a}	1.87±0.03^{ab}	1.75±0.031^{b}	1.78±0.055^{ab}	*
GR	0.85±0.015^{b}	0.86±0.008^{ab}	0.89±0.010^{a}	0.88±0.012^{ab}	*
PI%	16.13±0.79^{b}	16.25±0.45^{b}	18.13±0.55^{a}	17.00±0.63^{b}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

These findings are in agreement with those of Qiao *et al*. (2008) who found that performance was highest at the lowest level of sinipic acid inclusion (0.025%) and declined to near control values at the highest level of sinipic acid inclusion (0.1%). They added that feed intake was similarly affected by dietary sinipic acid.

Comparing between dietary treatments, no significant difference was observed between effect of BHT and SBP ethanolic extract at 1% level. It was cleared that there were insignificant difference between BHT and SBP ethanolic extract groups among performance measurements during starter period (from 4 to 10) days with the only exception was LBW that increase significantly at 0.5% SBP extract level.

Data of the effect of SBP extract levels and BHT supplementation on broilers performance at the Grower period (from 11 to 24 days) are presented in Table (3). Results indicated that BHT supplementation showed significantly higher feed intake and worst FCR compared with control. Birds fed diets supplemented with of SBP ethanolic extracts at 0.5&1% recorded lower FI values (1066.52 and 1066.59g)/bird during grower period compared with BHT groups and control group (1273.15 and 1075.15) .Also, birds fed diets with 0.5 and 1%SBP extract supplementation had significant improved FCR and PI%, compared with birds fed BHT diets or control diets. These results may be due to the positive effect of phenolic acids (ferulic acid and *p*-cuomeric acid) in SBP. In this concern, Jung and Fahey (1983) reported that *p*-Coumaric and ferulic depressed feed intake when included individually in the diets of rats. These findings are in agreement with those obtained by Qiao *et al*. (2008) who reported that performance was highest at the lowest level of sinipic acid inclusion (0.025%) However, feed intake declined at the highest level of sinipic acid inclusion (0.1%) during period from 1to 18 days of age so improved.

Table (3). Effect of dietary BHT or ethanolic SBP extracts on growth performance of broiler chicks at grower period (11- 24) days of age. (Means ± SE).

Item	Treatments				Sig.
	Control	BHT	Level of ethanolic extract of SBP		
	(0)	125 g/1000kg	5 ml/kg diet	10 ml/kg diet	
BW (g/bird)	949.16±22.99	959.83±16.64	965.33±25.30	931.16±18.92	NS
BWG (g/bird)	650.56±21.83	658.96±16.67	651.70±24.96	621.93±16.57	NS
FI (g/bird)	1075.15±8.95^{b}	1273.43±11.70^{a}	1066.52±4.28^{b}	1066.05±10.27^{b}	*
FCR(feed:gain)	1.73±0.09^{b}	1.98±0.07^{a}	1.73±0.07^{b}	1.75±0.05^{b}	*
GR (g)	0.98±0.02	0.97±0.02	1.01±0.03	1.00±0.01	NS
PI%	58.65±2.99^{ab}	50.30±1.97^{b}	60.72±3.66^{a}	55.32±2.60^{ab}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

Data of the effect of SBP extract levels, BHT supplementation on broilers performance at the finisher period from 24 to 42days are presented in Table (4). Results indicated that BHT supplementation decreased FI compared with control group, however, BWG and FCR were not significantly affected. The same trend had been reported by Hayat *et a*l. (2009) who showed that BHT based diets had insignificant ($P \leq 0.05$) effect on FCR mean while, FI was reduced in hens fed the diets with BHT as compared with those fed the control diet.

Table (4). Effect of dietary BHT or ethanolic SBP extracts on growth performance of broiler chicks at finisher period (24-42) days of age. (Means ± SE).

Item	Treatments				Sig.
	Control	BHT	Level of ethanolic extract of SBP		
	(0)	125 g/1000kg	5 ml/kg diet	10 ml/kg diet	
BW (g/bird)	1902.17±36.72	1905.52±43.85	1901.38±66.04	1963.45±52.08	NS
BWG (g/bird)	953.00±27.45	940.51±40.66	940.00 ±49.59	1032.41±46.77	NS
FI (g/bird)	2465.40±6.84^{a}	2351.21±16.77^{b}	2383.63±12.34^{b}	2278.56±12.57^{c}	*
FCR(feed: gain)	2.66±0.09	2.63±0.12	2.86±0.25	2.43±0.22	NS
GR(g)	0.67±0.02	0.65±0.02	0.64±0.02	0.70±0.02	NS
PI%	74.58±3.34^{b}	77.93±4.87^{ab}	78.43±5.95^{ab}	92.03±6.66^{a}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

Concerning the effect of SBP extract levels supplementation ,data cleared that birds fed diets with 0.5 and 1%SBP extract supplementation significantly ($p<0.05$) achieved the lowest FI (2383.63g&2278.56g) and the best PI% (78.4&92.03) compared with birds fed control diet. These results may be due to phenolic acids (ferulic acid and *p*-cuomeric acid) according to Jung and Fahey (1983) who reported that inclusion of phenolic monomers in the diets caused a reduction in FI. Data indicated also that all antioxidants had no effect on performance under normal conditions. Cooper and Washiburn (1998) indicated a lack of association temperature and traits of economic importance in broilers in a normal (21 ^{o}C) environment. However, when exposed to a heat stress environment, there is a strong negative correlation between body temperature and traits of economic importance after 1wk of heat stress exposure. Therefore, Antioxidants are one of the most promising management methods in enhancing the heat resistance of broiler chickens in the short run.

Effect of SBP extracts levels and BHT supplementation on broilers performance during the total period (from 4 to 42 days) is presented in (Table 5).

Table (5). Effect of dietary BHT or ethanolic SBP extracts on growth performance of broiler chicks at the end of overall period. (4-42 day). (Means ± SE).

Item	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Level of ethanolic extract of SBP 5 ml/kg diet	10 ml/kg diet	
BW (g/bird)	1902.17±36.72	1905.52±43.85	1901.38±66.04	1963.45±52.08	NS
BWG (g/bird)	1783.23±36.95	1786.38±43.67	1789.59±66.18	1844.17±51.78	NS
FI (g/bird)	3879.21±15.05^{b}	3965.33±9.84^{a}	3789.48±12.15^{c}	3684.15±2.36^{d}	*
FCR(feed: gain)	2.20±0.05	2.20±0.01	2.10±0.11	2.04±0.06	NS
GR	1.76±0.01	1.76±0.01	1.75±0.01	1.76±0.01	NS
PI%	88.52±3.44	87.19±4.11	92.55±5.98	100.33±5.54	NS

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant

Regarding the effect of SBP extracts level supplementation, results indicated that birds fed diets with 0.5% and 1% SBP extract supplementation insignificantly affected compared with birds fed control diets, although that birds groups fed diets with 0.5% and 1% SBP extract supplementation showed slightly higher value. Feed intake significantly decreased with ethenolic extract of SBP. These findings are in agreement with those reported by Griffiths (1969) who orally administered sinipic acid and ferulic acid (200 mg) to rats (250 g of BW) and did not find any adverse effect of these phenolic compounds on growth performance. On the other hand, kratzer *et al*. (1975) found that phenolic acid depressed growth and feed intake in chickens.

Results observed that birds fed diets with BHT supplementation had significantly ($p<0.05$) higher feed intake and lowest PI%, while, birds fed diets with SBP extract levels significantly ($p<0.05$) reduced feed intake, improved feed conversion and higher PI% .These results agree with those obtained by Hernandez *et al*. (2004) who found that performance slightly improved with Plant Extracts, feed additives.

***Mortality rate*:**

The calculated cumulative mortality % of chicks during the period (from 4 to 42) days of age are presented in Table (6).The results indicated that groups fed diet with supplemented BHT (125g/1000kg) and 0.5% ethanolic extract of SPB recorded 3.3% mortality. Meanwhile, control group and 1% ethanolic extract of SPB recorded no mortality. In general, it appears that mortality rate was within the normal range and not related to treatments studied. These findings are disagree with those obtained by Qiao *et al*. (2008) who showed that mortality occurred by supplementation of sinipic acid at all levels.

Table (6). Effect of dietary BHT or ethanolic SBP extracts on the mortality rate.

Item	Control (0)	BHT 125 g/1000kg	Level of ethenolic extract of SBP	
			5 ml/kg diet	10 ml/kgdiet
Total number of chicks in the beginning.	30	30	30	30
Number of dead chicks	0	1	1	0
Mortality rate %	0.0	3.3	3.3	0.0

Table (7). Effect of dietary BHT or ethanolic SBP extracts on carcass characteristics of broiler chicks at 42 days of age (Means ± SE).

Item	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Level of ethenolic extract of SBP		
			5 ml/kg diet	10 ml/kg diet	
Pre-slaughter weight	2011.67±123.90	1831.67±82.07	2138.33±80.74	1960±20.20	NS
Carcass %	65.04±0.97	62.37±0.55	64.60±1.26	63.80±1.27	NS
Dressing %*	69.81±1.01	68.10±0.59	70.08±0.71	68.84±1.32	NS
Abdominal fat %	1.96±0.18	1.29±0.29	1.60±0.30	1.61±0.22	NS
Liver (% of LBW)	2.44±0.23	2.74±0.106	3.38±0.45	2.95±0.49	NS
Heart (% of LBW)	0.59±0.039	0.71±0.093	0.71±0.115	0.65±0.065	NS
Gizzard (% of LBW)	1.74± 0.21^{ab}	2.28±0.15^{a}	1.69±0.13^{ab}	1.16±0.25^{b}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

Carcass Characteristics:

The carcass characteristics results as affected by SBP extract levels, BHT supplementation are illustrated in (Table 7). Results detected insignificant (p<0.05) effect of the two antioxidants used types on carcass%, dressing %, relative weight of Liver, heart, and abdominal fat. These results are in agreement by those obtained with Herna´ndez *et al*. (2004) who observed that no differences were noticed for gizzard, liver and heart weight at 42 days of age with addition of two types of plant extract to broiler diets. Similarly, Qiao *et al*. (2008) showed that relative weight of gizzard, liver and heart did not affected by different levels of dietary sinipic acid.

Relative lymphoid organs weight:

Results indicated that there was no significant effect of SBP extract levels, BHT supplementation on relative weight of bursa (Table 8). Data recorded that the highest spleen relative weight was in T_4 with birds fed 1% ethanolic extract of SBP. However, the highest thymus relative weight was in T_3 with birds was 0.5% ethanolic extract of SBP. These results indicated that 0.5 and1% ethanolic extract of SBP may improve the immune response and realize better disease resistance. According to Sturkie (1986) and Katanbaf *et al.*(1989) , the increase in the relative organ weight is considered as an indication of the immunological advances.

Table (8): Effect of dietary BHT or ethanolic SBP extracts on Relative lymphoid organs weight. (means ± SE).

Item	Treatments				Sig.
	Control	BHT	0.5%ESBP	1%ESBP	
Bursa%	0.14±0.02	0.17±0.008	0.14±0.037	0.15±0.03	NS
Spleen%	0.14±0.02^{b}	0.14±0.02^{b}	0.15±0. 05^{ab}	0.18±0.065^{a}	*
Thymus%	0.25±0.04^{ab}	0.22±0.01^{b}	0.38±0.08^{a}	0.28±0.05^{ab}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

A potential beneficial effect of dietary SBP extract, as indicated by higher relatives weights of thymus and spleen, may be associated with the antioxidant and antibacterial activity of feriulic acid and related plant phenolic in SBP, ferulic acid has been claimed to lessen the effects of chemo- and radiotherapy of carcinomas by increasing the natural immune defense (Graf, 1992).

The relative weight of bursa did not significantly ($p<0.05$) affected by any of experimental treatments (Table 8). The same result had been reported by Fathi *et al*. (2003) who detected that size of bursa did not affected by the cell mediated immune response. Also, Qiao *et al*. (2008) showed that there were no differences among treatments in the relative weight of the bursa of Fabricus in birds which received sinipic acid.

Blood plasma parameters:

Effect of SBP extract levels and BHT supplementation on some blood parameters presented in Table (9). Data showed that the total protein and A/G ratio were insignificantly affected by BHT as synthetic antioxidant, but albumin significantly ($p<0.05$) increased meanwhile, triglycerides were significantly ($p<0.05$) decreased and total antioxidant capacity was significantly ($p<0.05$) increased.

Table (9). Effect of dietary BHT or ethanolic SBP extracts on some blood parameters of broiler chicks at 42 days of age (means ± SE).

Trait	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Ethanolic extract of SBP level, (0.5%SBP) 5 ml/kg diet	Ethanolic extract of SBP level, (1%SBP) 10 ml/kg diet	
Total protein (g/dl)	4.05±0.18^{ab}	4.36±0.15 ^{a}	3.99±0.37 ^{ab}	3.33±0.11^{b}	*
Albumin (g/dl)	2.30±0.09^{b}	2.54±0.23^{a}	2.23±0.19^{b}	2.42±0.102^{a}	*
Globulin (g/dl)	1.75±0.16^{a}	1.82±0.33^{a}	1.76±0.20^{a}	0.91±0.049^{b}	*
Albumin: globulin ratio	1.34±0.14^{b}	1.53±0.38^{b}	1.29±0.19^{b}	2.69±0.26 ^{a}	*
Total lipid (mg/dl)	620.47±36.33^{a}	540.57±45.37^{ab}	484.39±61.78^{ab}	329.58±21.62^{c}	*
Total cholesterol (mg/dl)	190.93±6.65	187.86±6.44	181.71±9.79	177.67±12.60	NS
Triglyceride (mg/dl)	113.80±3.17^{a}	92.23±11.03^{b}	77.49±4.80^{bc}	63.47±1.38^{c}	*
Creatinine (mg/dl)	0.74±0.092	0.86±0.073	0.883±0.118	0.93±0.06	NS
AST (mg/dl)	84.00±10.00	104.33±10.33	84.00±10.00	84.00±10.00	NS
ALT (mg/dl)	25.0±0.00	21.33±3.67	25.0±0.00	17.67±3.67	NS
ALK.Ph (mg/dl)	161.42±1.25$_{a}$	162.30±1.75$_{a}$	161.78±1.38$_{a}$	151.69±3.69$_{b}$	*
Total antioxidant (ɱ/L)	0.671±0.004^{b}	0.75±0.055^{ab}	0.754±0.0543^{ab}	0.875±0.038^{a}	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant

Regarding the effect of SBP extract, results indicated that birds group received 1% SBP extract achieved significantly ($p<0.05$) higher albumin, A/G ratio and less globulin (Immune cost) than control group. These results means that supplemented ethanolic extract of SBP at level 1% resulted in the best immunity and that is may be due to the effect of SBP ethanolic extract on both negative and positive gram bacteria and consequently the immune cost will be decreased. This may be due to that ethanolic extract of SBP may save the protein by protecting it from free radical and/or decrease protein consumed in immune globulin synthesis (Immune cost) led to decreasing globulin synthesis and consequently saved protein which is directed towards growth. In this connection, Richerds *et al*. (2005) showed that microflora specific immunoglobulin A and immunoglobulin G secretion can save the animal several hundred grams of protein over a life time that is not directly towards growth (Immune cost).

On the other hand, plasma cholesterol insignificantly ($p<0.05$) affected either by BHT or SBP ethanolic extracts, although the experimental groups achieved lower cholesterol level than control group (187.86; 181.71 and 177.67 mg/dl vs 190.93 mg/dl, respectively). Regarding total lipids, results indicated that birds received ethanolic extract of SBP had significantly ($p<0.05$) lower values comparing with BHT and control birds. .These results agree with those obtained by Ardiansyah *et al*. (2008) who reported that single administration of ferulic acid (9.5mg/kg) may lower blood pressure in rat; also total cholesterol and triglycerides level were found lower.

Results of AST and ALT were insignificantly ($p<0.05$) improved liver and heart functions by raising the level of SBP ethanolic extracts (Table 9). Also, data of alkaline phosphatase were significantly ($p<0.05$) improved liver and heart functions by raising the level of SBP ethanolic extracts, the best alkaline phosphatase value obtained with 1% SBP. These results were in agreement with those obtained by Abd El-Moty(1992), who reported that the values of the plasma alkaline phosphatase were significantly ($p<0.05$) reduced by raising the level of SBP ethanolic extract. Martin *et al*., (1981) reported that serum alkaline phosphate levels may increase in congestive heart failure as a result of injury to the liver. Data of Antioxidant capacity were increased with the two types of used antioxidants, the best antioxidant capacity value obtained with 1% SBP.

Heterophils /Lymphocytes Ratio (H/L):

An animal's protection from disease is based, in part, on phagocytic, cell-mediated, and humeral immunity in birds, against invading microorganisms, whereas primary functions of lymph-involve, cell-mediated and humeral immunity. Heterophils increase and lymphocytes decrease when are stressed, so that the ratio between them (H/L) is an index of response to a stressor (Siegel, 1985).

White blood cells differential count for broiler chicks fed different levels of SBP ethanolic extract, BHT are presented in Table (10). It could be noticed that there were insignificantly differences between control and BHT supplementation for both heterophils and lymphocytes count. Conversely, the two levels of SBP ethanolic extract supplementation significantly ($P\leq0.05$) decreased the heterophils count and increased ($P\leq0.05$) the lymphocytes count when compared to the control group.

Table (10): Effect of SBP extracts levels and BHT supplementation on heterophils/Lymphocytes ratio (means ± SE).

Item	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Level of ethanolic extract of SBP		
			5 ml/kg diet	10 ml/kg diet	
Heterophils (number/mg)	24.83± 0.44[a]	24.66±1.45[a]	19.23±0.392[b]	18.56±0.721[b]	*
Lymphocytes (number/mg)	65.00± 0.57[b]	65.66±0.88[ab]	67.00±1.52[ab]	69.66±1.45[a]	*
H/L ratio	0.382±0.009[a]	0.375 ± 0.017[a]	0.287± 0.002[b]	0.267±0.010[b]	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant

Concerning the H/L ratio, results showed that the SBP ethanolic extract supplementation at 0.5 and 1 % of the diet significantly decreased H/L ratio of birds. These results are in agreement with Abd El-Salam (2012) who reported that addition of proplis ethanolic extract to broiler diets significantly decreased the hetrerophils count, increased lymphocytes and significantly decreased H/L ratio. In this connection, Davison *et al* .(1983); Gross and Siegel (1983) and Maxwell (1993) detected that The H/L ratio is a recognized measure of stress in birds and become a valuable tool in stress research especially when combined with the convenience and repeatability of automated blood cell counts. Accordingly, birds fed diets with SBP ethanolic extract supplementation at 0.5and 1 % could be more resistant to stress than other experimental groups. In this concern, Harmon (1998) reported that Heterophils are highly phagocytic and are capable of a broad spectrum of antimicrobial activity. Also, heterophils rely primarily on oxygen-independent mechanisms for antimicrobial activity (Stabler *et al.*, 1994).

Organoleptic characters:

Organoleptic evaluation values of cooked meat in terms of color, odour, taste, texture, flavor and overall acceptance are illustrated in Table (11). Results indicated that dietary BHT did not significantly affected on texture and flavor. However, color, odour, taste and overall acceptance were significantly ($P\leq0.05$) decreased. With respect to SBP ethanolic extract, data showed insignificant effect on texture and flavor. Meanwhile, SBP ethanolic extract appeared significantly a good feed additive for color, odor, taste and overall acceptance (Table 11). Generally, the best value of overall acceptance being (8.17) had been recorded by birds fed diets supplemented with (1%) ethanolic extract. The worst value was being 6.88 achieved by birds fed diets with BHT supplementation. These results contradict with those of Hayat *et al*. (2010) who reported that antioxidant supplementation (vitamin E or BHT) did not enhance the acceptability of eggs by trained panelists.

Table (11): Effect of SBP extracts levels; BHT supplementation on organoleptic character (Sensory evaluation) of cooked chicken meat (means ± SE).

Item	Treatments				Sig.
	Control (0)	BHT 125 g/1000kg	Level of ethanolic extract of SBP		
			5 ml/kg diet	10 ml/kg diet	
Color	8.88±0.11[a]	7.11±0.67[b]	8.00±0.41[ab]	8.33±0.47[ab]	*
Taste	7.77±0.43[ab]	7.22±0.49[b]	8.00±0.28[ab]	8.77±0.22[a]	*
Oder	8.33±0.44[a]	6.55±0.68[b]	7.33±0.28[ab]	8.33±0.28[a]	*
Texture	7.44±0.41	6.77±0.59	7.66±0.28	8.00±0.33	NS
Flavor	7.66±0.28	7.00±0.52	7.55±0.29	7.44±0.17	NS
All over acceptability	8.02±0.23[ab]	6.88±0.45[c]	7.71±0.25[abc]	8.17±0.22[a]	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant.

Lipid oxidation study (TBARS):

The degree of fat oxidation in meat is usually determined by the TBA method, which is a good indicator of meat rancidity (Guille´n-Sans and Guzma´n-Chozas, 1998).TBA-Reactive Substances (TBARS) of thigh muscle (g kg-1 malonaldehyde) of broilers fed experimental diets are illustrated in Table (12). Results indicated that the extent of lipid oxidation (TBA number) in thigh meat after 7 d of refrigerated storage was not differed between all treatments. However, malonaldehyde concentration was different after 90 days of freezing storage. Birds fed diets with supplemented (1or 0.5 %) ethanolic extract of SBP or BHT had less TBA number while birds fed control group showed the highest TBA number. Under all conditions, the lowest TBA number achieved with birds group fed diets supplemented with 1 % ethanolic extract of SBP. The same results were obtained by Naveena *et al.* (2008) who reported that The pomegranate juice (PJ)or rind powder extract(RP) as a natural antioxidants at a level of 10 mg equivalent phenolics/100 g meat would be sufficient to protect chicken patties against oxidative rancidity for periods longer than the most commonly used synthetic antioxidant like BHT. That is may be due to ferulic acid which is a more effective antioxidant against LDL oxidation than the hydrophilic antioxidants such as ascorbic acid. (Cinzia Castelluccio *et al*., 1996). It could be detected that utilization of dietary antioxidants (synthetic and natural) decreased TBA number of thigh meat at 90 days after freezing storage. The same results were obtained by Webb *et al. (*1972) ; Bartov and Bornstein (1977 and 1981) and Sies (1997) who observed that synthetic antioxidants improved stability of poultry meat. Also, Phenolic antioxidants are less well known but improved stability of vegetable oils under storage conditions. (Pinkowski *et al*., 1986; Hawrysh *et al.*, 1992). Moreover, Bartov and Bornstein (1981) used BHT in broiler diets at level 125(mg/kg) during 60 days. They reported the oxidative stability improvement in poultry abdominal fat.

Recently, Mohdaly (2010) reported that sugar beet pulp (ethanolic extract) is a potent source of natural antioxidants containing predominant acids (ferulic, gentisic and p-coumaric acid) that explored to prevent oxidation of storage vegetable oils.

Table (12): TBA-Reactive Substances (TBARS) of thigh muscle of broilers fed dietary treatments.

Item		Treatments				Sig.
		Control	BHT	Level of ethanolic extract of SBP		
		(0)	125 g/1000kg	5 ml/kg diet	10 ml/kg diet	
Days after storage	7	0.445±0.05	0.47±0.141	0.446±0.105	0.546±0.108	NS
	90	0.776±0.051[a]	0.4903±0.141[ab]	0.4927±0.0829[ab]	0.4663±0.105[b]	*

a,b,..etc.: Means in the same row with different letters, differ significantly p<0.05, NS=not significant

European Efficiency Factor (EEF):

The European Efficiency Factor (EEF) as an indicator for economical assessment requires the information of mortality rate, body mass and feed conversion ratio reached at the age of their delivery to slaughter (Novak *et al*., 2004). Effects of SBP extract levels and BHT supplementation on European efficiency factor are illustrated in Table (13).

Table (13): Effect of dietary BHT or ethanolic SBP extracts on European Efficiency Factor (EEF) (Means ± SE).

Item	Control (0)	BHT 125 g/1000kg	Level of ethanolic extract of SBP		Sign.
			5 ml/kg diet	10 ml/kg diet	
Starter EEF	130.068±6.87	131.42±4.081	142.58±5.153	129.036±5.66	NS
Grower EEF	215.92±8.39[b]	180.46±10.90[c]	251.716±12.64[a]	208.96±13.93[bc]	*
Finisher EEF	180.86 ±7.178	200.498±10.73	185.87±10.91	210.70±13.29	NS
Total period EEF	207.18±7.22	212.707±9.015	205.51±8.05	218.51±10.82	NS

Data indicated that group fed dietary 0.5% significantly ($P \leq 0.05$) recorded the best EEF values during grower period (251.72) compared with control (215.92) and other experimental groups (180.46 and 208.96 for BHT and 1% SBP extract groups, respectively). No significant differences were observed for SBP extract levels and BHT on EEF during starter, finisher and total period compared with control. These results may be due to the similarly of performance for all treatments at all periods.

CONCLUSION

Results observed that birds fed diets with BHT supplementation had significantly ($p<0.05$) higher feed intake and less PI%, while, birds fed diets with SBP extract levels significantly ($p<0.05$) reduced feed intake, improved feed conversion and recorded higher PI%. Blood serum of birds group received 1 % SBP extract achieved significantly ($p<0.05$) higher albumin, A/G ratio and less globulin (immune cost) than control group. These results means that supplemented ethanolic extract of SBP at level 1% resulted the best immunity and that is may be due to the effect of SBP ethanolic extract at 1% on both negative and positive gram bacteria and consequently the immune cost will be decreased**.**

In conclusion, it could be recommend that dietary 0.5% and 1% SBP extract supplementation slightly improved performance and significantly ($p<0.05$) decreased feed intake ,in addition to improve in immune response and meat quality.

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تأثير استخدام المستخلص الايثانولى لتفل بنجر السكر فى علائق دجاج التسمين على الاداء الانتاجى والمناعة وجودة اللحوم.

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استخدم فى هذه الدراسةعدد 120 كتكوت تسمين (روص)عمر 4 ايام قسمت عشوائيا على 4 مجموعات بحثية بكل منها 30 طائر (واحتوت كل مجموعة على ثلاثة مكررات بكل منها 10 كتاكيت) وذلك لدراسة تاثير استخدام المستخلص الايثانولى لتفل بنجر السكر (كمضاد اكسدة طبيعى) مقارنة باستخدام مركب البيوتالايت هيدروكسى تولوين (BHT) (كمضاد أكسدة صناعى) على اداء النمو ،وصفات الذبيحة ،وجودة اللحم الناتج ،ومقاييس بلازما الدم، والمناعة ،واختبار التذوق ،وكذلك نوعية اللحوم بعد تجميدها لفترات مختلفة ،ومقياس الكفاءة الاوروبى . تم توزيع المعاملات التجريبية على النحو التالى :1- عليقة المقارنة، 2- عليقة المقارنة + مركب البيوتالايت هيدروكسى تولوين (BHT)، 3- عليقة المقارنة + المستخلص الايثانولى لتفل بنجر السكر بنسبة 0.5%، 4- عليقة المقارنة + المستخلص الايثانولى لتفل بنجر السكر بنسبة 0.1% .

أوضحت النتائج المتحصل عليها ما يلى :

- لوحظ بصفة عامة تغيير ملحوظ فى اداء النمو للمجموعات التجريبية المغذاه على كل من مضادى الاكسدة الطبيعى والصناعى ولكنه بصورة غير معنوية .
- حققت مجموعة الكتاكيت المغذاه على مضاد الاكسدة الصناعى بيوتايل هيدروكسى تولوين (BHT) (المجموعة الثانية) زيادة معنوية فى الغذاء المأكول وانخفاض فى دليل الاداء(PI%)، بينما اظهرت المجموعتان المغذاه على المستخلص الايثانولى لتفل بنجر السكر (المجموعتان الثالثة والرابعة) انخفاضا معنويا فى الغذاء المأكول وتحسنا ملحوظا فى كل من معامل التحويل الغذائى(FCR) ودليل الاداء مقارنة بعليقة المقارنه والعلائق التجريبية الاخرى .
- اظهرت المجموعة الرابعة المغذاه على 1% مستخلص تفل بنجر السكر بصورة معنوية ارتفاعا فى محتوى بلازما الدم من الالبيومين ونسبة الالبيومين الى الجيوبيولين ، وانخفاضا ملحوظا فى الجلوبيولين (تكلفة المناعة) عن مجموعة المقارنه ،مما يعنى ان استخدام المستخلص الايثانولى لتفل بنجر السكر بنسبة 1% حقق اعلى درجة من المناعة والتى ربما ناتجة عن تاثير ذلك المستخلص على كل من البكتريا الموجبة والسالبة لجرام مما خفض من تكاليف المناعة .
- اوضحت النتائج المتحصل عليها ان المستخلص الإيثانولى لتفل بنجر السكر له تاثير جيد على الصفات الحسية للحوم الناتجة وكذلك على تحسين خواص اللحوم المجمدة لفترات طويلة وذلك بصورة معنوية .
- سجلت المجموعة الثالثة المغذاه على 0.5% من المستخلص الايثانولى لتفل بنجر السكر افضل كفاءة إقتصادية مقارنة بالكنترول والمعاملات الاخرى.

وعلى ذلك فانه يمكن التوصية بان مستوى 0.5%،1% من المستخلص الايثانولى لتفل بنجر السكر حسن بصورة معنوية كل من اداء الانتاج وخفض الغذاء الماكول لدجاج اللحم . كما أدى إلى تحسين الاستجابة المناعية لدجاج اللحم.