Egypt. Poult. Sci. Vol (35) (I): (277-289) (2015) (1560)

Egyptian Poultry Science Journal

http://www.epsaegypt.com

ISSN: 1110-5623 (Print) – 2090-0570 (On line)

FULL-FAT SOYBEAN AS AN ENERGY SOURCE IN BROILER CHICKEN DIETS

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Received: 01/02/2015 Accepted: 25/02/2015

ABSTRACT: An experiment was conducted to evaluate growth performance, carcass characteristics, some blood plasma parameters and economic efficiency of broiler chicks fed graded levels of full-fat soybean (FFS) in replacement of vegetable oil in starter and grower diets. Five levels of FFS representing 0.0% (control, T1), 2% (T2), 4% (T3), 8% (T4) and 10% (T5) were used during the starting period. While, during the growing period 0.0% (control, T1), 4% (T2), 6% (T3), 10% (T4) and 12% (T5) were used to replace soybean oil in the five dietary treatments. In the same manner, control diet was formulated to contain 2% and 4% soybean oil in starter and grower diets, respectively. 150 unsexed one day-old Hubbard broiler chicks were distributed equally into 5 dietary treatments in 3 replicates of 10 birds each. The experiment lasted 5 weeks; feed and water were supplied ad-libitum. At the end of the experiment, 3 birds from each treatment were randomly selected and slaughtered for carcass characteristics.

Main results obtained can be summarized as follows:

1. Chicks fed lowest levels of FFS (2% in starter and 4% in grower in replacement of soybean oil, T2) recorded growth performance equal to that of chicks fed the control diet (T1 without FFS). However, these birds recorded lower values of plasma cholesterol and improved the economical efficiency by 14% as compared to the control diet.
2. Significant differences were observed among different experimental groups in productive performance (at starter period only), carcass characteristics except for values of lymphoid organs %, wing % and drum stick % and some blood plasma parameters.
3. Chicks fed highest levels of FFS (10% in starter and 12% in grower, T5 diet) recorded the highest values of growth performance as compared to other treatments and supported the calculated economical efficiency by 33% as compared to the control diet.

Key Words: Full Fat Soybean, Energy and Broiler.

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From results of the present study, it could be stated that adding FFS at inclusion rates of (2% in starter and 4% in grower) or (10% in starter and 12% in grower) diets to practical broiler rations as a replacement of soybean oil, would have a positive effect on production costs and economic efficiency, without any adverse effects on productive performance or carcass characteristics of broilers.

INTRODUCTION

In Egypt and many other developing countries, the profit of raising broilers is somewhat marginal because of the high feed costs, poor growth rate, poor feed conversion, and high mortality rate. The feed cost for broiler production is about 60-70% of the total production cost, and the feed energy alone contributes about 70% of the feed cost (Saleh *et al*., 2004). This suggests that in order to minimize feed cost with rapid growth at best feed conversion and to maximize profit, the producer should use the cheapest form of energy and protein as substitute for fat/oil and soybean meal. For a number of years, there has been considerable interest in the use of whole un-extracted or "full-fat" soybeans (FFS) in broiler diets. Whole soybeans contain not only high quality protein, but also have the potential of providing significant amounts of energy due to their high oil content.

The possibility of using full-fat soybean (FFS) as a replacement for both soybean meal and oil in chicken diets, has been investigated (Lázaro *et al*., 2002; Ruiz *et al*., 2004; MacIsaac *et al*., 2005 and Demeterová, 2009).

Subuh *et al*. (2002) stated that inclusion of FFS could partially or completely replace soybean meal and dietary oil without any adverse effects on body weight, feed conversion, dressing percentage, or abdominal fat content. Full-fat soybean could provide both supplemental protein and supplemental energy in one feed ingredient. Waldroup and Cotton (1974) reported that up to 25% FFS represented the effective upper limit in mash diets for broiler. Also, Papadopoulos and Vandoros (1988) included FFS in broiler diets at a level of 15% and reported that body weight at 6 weeks of age were not adversely affected. On the other hand, Leeson *et al*. (1987) included FFS in broiler starter and finisher diets at a level of 30% of the diet and reported that growth performance was reduced during the starter period. Limited information is available on the value of FFS for broiler chicks as a source of vegetable oil and the question remains; as to the quality of FFS that can be effectively utilized to replace vegetable oil in broiler diets.

The present study was conducted to evaluate the growth performance, carcass characteristics and economic efficiency of broiler chicks fed graded levels of full-fat soybean in replacement of vegetable (soybean) oil in starter and grower diets.

MATERIALS AND METHODS

This experiment was carried out in the Poultry Production Experimental Unit, Agricultural Experiment and Research Station at Shalakan, Faculty of Agriculture, Ain Shams University, Egypt.

The soybean used in the present study was processed through specific processes. It was first passed through a roller mill to aid in fracturing cell wall, then ground in a hammer mill to 3 mm in size without any physical or chemical treatment and then extruded with steam in a commercial extruder. After cooling and drying, the product was placed in bags (50 kg) and transported to the experimental unit ready to use in the mixture of feeding trials. A sample of FFS was analyzed according to procedures described by AOAC (1995), and data of these analyses showed that FFS contained 93.4% dry matter, 34% crude protein, 6% crude fiber, 21% ether extract, 5% ash and 27.4% nitrogen-free extract. Urease activity of FFS was 0.05. This urease level indicates that FFS was processed sufficiently to denature the trypsin inhibitor without overcooling (Waldroup *et al*., 1985). While metabolizable energy estimated according to NRC (1994), was 3750 Kcal/ Kg. Fatty acid composition of FFS used in this trial in comparison with soybean oil (SO), was summarized in Table (1). These data showed that FFS was higher in linoleic acid (56%) when compared to SO (53.21%). Palmitic acid and linolenic acid were relatively higher in SO (9.98% and 7.29%) compared to those found in FFS (8.96% and 2.43%), respectively. Fatty acid composition of FFS indicated a possibility of being used to replace SO as fatty acid source in broiler diets.

During the experimental period, which started from 1-day old and lasted to 5 weeks of age, chicks were fed the experimental starter diets up to 3 weeks of age, and then switched to the experimental grower diets until the end of the experiment. The experimental starter and grower diets were corn-soybean based diets. Five experimental starter diets (Table 2) were formulated in which the first one (T1) was corn-soybean diet and served as a control. In the other four experimental diets, FFS was incorporated at four levels of 2, 4, 8 and 10% (for T2, T3, T4 and T5, respectively). All diets were formulated to be isonitrogenous of about 23.2% CP. In the same manner, 5 experimental grower diets were formulated to be isonitrogenous (21.25% CP). Levels of FFS were relatively higher than levels used during the starter being 4, 6, 10 and 12% (for T2, T3, T4 and T5, respectively). The composition and calculated analysis of the experimental diets, starter and grower (T1: T5) are shown in Table (2).

One hundred fifty day-old unsexed broiler chicks (Hubbard strain), were randomly distributed into five treatment groups in 3 replicates of 10 chicks each. Chicks were reared in separate floor pens (10 birds/ m^2) and pens were provided with wheat straw litter. Feed and water were offered for birds ad-libitum.

Individual live body weight (LBW) of birds and feed consumption (FC) were recorded at the end of both starter and grower phases (at 3 and 5 weeks of age). While body weight gain (BWG) and feed conversion ratio (FCR) (g feed/ g gain) were calculated for each feeding phase (3 or 2 weeks) in relation to the feeding regimes. At the end of the experiment, 3 birds from each treatment were randomly selected and sacrificed for carcass measurements. Weight of giblets (liver, gizzard and heart), lymphoid organs (spleen, thymus and bursa) and carcass were recorded for each bird. Dressed weight and ready to cook parts (carcass and giblets) were then expressed as percentage of LBW.

Individual blood samples were collected in dry clean centrifuge tubes from slaughtered birds and plasma was then separated by centrifugation at 3000 rpm for 15 minutes, and assigned for subsequent determinations. Biochemical analysis of blood plasma included the following: total protein (TP), albumin (ALB), globulin (GLB) (determined by subtraction the value of albumin for the sample from its corresponding value for total protein), total cholesterol (TC), Low-density lipoprotein (LDL) and High-density lipoprotein (HDL). All biochemical parameters of blood were calorimetrically determined using commercial diagnosing kits (produced by Bio-Diagnostics Company, Egypt).

The economic evaluation as presented by economic efficiency (EE) was carried out in an attempt to investigate the effect of FFS inclusion on feeding costs. The economic efficiency traits were calculated according to North (1981) in relation to the price of local market at the time of the experiment. While, production efficiency factor (PEF) was calculated according to Emmert (2000).

Statistical analysis was conducted using the General Linear Model procedure of SAS (2004). Means were compared using Duncan's Multiple Range Test (Duncan, 1955) where the level of significance was set typically at minimum ($P\leq 0.05$). The statistical model was as follows: $Y_{ij} = M + T_i + e_{ij}$

Where:

Y_{ij} = An observation, M = Overall mean, T_i = Effect of treatment, E_{ij} = Random error

RESULTS AND DISCUSSION

Live body weight and daily weight gain**:** The live body weight and daily weight gain of broilers as effected by dietary treatments are presented in Table (3). It is worth to note that the chicks fed FFS diet (T5) during studied periods (0-3, 4-5 and 0-5 weeks) reflected the highest results in both LBW and BWG compared to other treatments (T1- T4). However during the starting period (0-3 weeks), LBW of chicks fed (T5) diet significantly increased by 8.6% (750.00 versus 690.83 g) compared with the control group (T1). On the other hand, chicks fed 10% FFS (T5) recorded significant higher live body weight (750.00 g) compared to those fed diets containing lower level 2, 4 or 8%, being 688.00, 712.83 and 692.67 g respectively. During the whole experimental period (0-5 weeks), chicks fed highest levels of FFA (T5) were higher in live body weight than those of control group (T1) and the relative increment in live body weight was 100 g (7.2%) as shown in Table (3). However, the improvement in growth performance was more pronounced during starting rather than growing period. Responses of chicks fed diets containing FFS (T2: T5) showed that chicks fed diet containing highest levels (T5) supported the highest body weight than those fed the three other levels. The corresponding figures of live body weight were 1375.50, 1352, 1386.33 and 1487.33 g, respectively and the differences failed to be significant among these groups and the control, 1387.25 (T1). These results are in partial agreement with Subuh *et al*. (2002) who reported that (FFS) in oil-free broiler diets, had no adverse effect on LBW at 42 day of age. On the other hand, Al-Sardary (2010) reported that using 30% roasted FFS reduced final LBW and overall body weight gain of broilers.

Feed consumption and feed conversion ratio: Data presented in Table (3) indicated that daily feed consumption (FC) per bird (g/ d) was increased by feeding high levels of FFS (T5) compared with those fed control diet (T1). The increment in feed consumption was more pronounced during growing period (4-5 weeks) being 3.9%, while it was 3% during the starting period (0-3 weeks). These differences were significant during starter period (0-3 weeks) and insignificant during grower period (4-5 weeks). Increased daily feed consumption (g feed/ day) could be related to the fact that broiler chicks require more dietary energy to maximize growth during short rearing periods. While, this fact was not realized with birds fed (T3) diet . Feed conversion ratio (feed/ gain) showed the same trend since chicks fed FFS (T3) or (T5) were more efficient in converting their food into weight gain during starter period compared with those fed control diet (1.54 versus 1.63) and these differences were highly significant. During starting period, the addition of the FFS to experimental diets (T3) led chicks to consume significantly less feed than those of (T5), while values of feed conversion ratio of both groups appeared significantly similar. On the other hand, the effect of FFS at levels of 2% or 8% showed no significant differences on feed consumption and feed conversion ratio. During growing period (4-5 weeks), experimental treatments fed

FFS (T2: T5) had no significant effect on, daily feed consumption with corresponding values ranging (109.06 g and 117.14 g), and feed conversion ratio with corresponding values ranging (2.23 and 2.46) compared with those fed control diet (T1) without any significant differences in between. It was obvious from Table (3) that the effect of FFS on feed consumption and feed conversion ratio during the whole experimental period (0-5 weeks) did no present any significant differences compared to control group (T1), while feed consumption per bird was decreased by feeding (T3) diet, and feed conversion was better by feeding (T5) diet compared to other dietary treatments. Under the condition of the present study all chicks appeared healthy without any clear differences among different treatments. It seems that neither kind of energy source nor inclusion of FFS adversely influenced health conditions and mortality rate. These results are in partial disagreement with Al-Sardary (2010) who reported that using 30% roasted FFS reduced accumulative feed intake and provoke worse overall FCR of broilers. Conversely, overall FCR was better with feeding about 30% (FFS) to broilers until 42 day of age with no or little dietary oil (Subuh *et al*., 2002).

Carcass characteristics: Table (4) shows the effect of FFS on carcass characteristics of chicks at the end of 5 weeks of age. Significant differences were observed by feeding different FFS levels in the diet in all carcass traits (expressed as percentages of LBW) except carcass weight (g). Both abdominal fat and giblets percentages were relatively increased by increasing FFS level, and significantly ($P\leq0.05$) higher values were recorded with (T4) group compared to (T3) group. Abdominal fat increment by (FFS) addition might be attributed to more efficient fat metabolism of soy oil contained in FFS (Table 1).On the other hand, birds of (T3) group gave lower figures of studied parameters compared with all other treatments and in most cases differences among treatments were significant. Generally, experimental diets containing FFS (10% in starter and 12% in grower, (T5) had no significant effect on carcass parameters compared to control (T1) and the corresponding values for dressing percentages (70.44 vs. 70.72%), ready to cook % (74.97 vs. 75.04%), abdominal fat % (1.32 versus 0.88%) and giblets % (4.53 versus 4.32%) without any significant differences. Percentile weight values of lympoid organs (spleen, thymus and bursa) did not present any significant ($P\geq0.05$) among all tested groups. These results were in harmony with those of Al-Sardary (2010) who reported that using 30% roasted FFS had no significant effect on carcass weight and dressing percentage at both stages of 42 and 49 days of age. Also, Subuh *et al*. (2002) found similar results when (FFS) totally replaced soybean meal and dietary oil in boiler feeding without any adverse effect on dressing percentage and abdominal fat.

Concerning percentages of carcass parts, there was significant, increased breast % and decreased in thigh % by feeding (T3) diet compared with those fed control diet (T1), the corresponding figures were (52.31 and 25.20 versus 48.92 and 26.79 %, respectively) with significant differences. While, relative wing and drum stick percentages were not significantly affected by the dietary treatments. Al-Sardary (2010) reported somewhat similar results of using roasted FFS at 30% of oil-free broiler diets with no significant effect on both thigh and breast percentages at both stages of 42 and 49 days of age.

Blood plasma parameters: Table (5) presents effect of using (FFS) on blood plasma parameters. Concerning data of total protein, albumin, globulin and A/ G ratio, albumin and A/ G ratio values did not present significant differences within different treatments. While birds fed (T2) or (T4) diets had recorded lower values of A/ G ratio compared to other treatments. These results mean that using (FFS) had an important role in improving resistance to stress as well as the immune function. These results are supported by values of globulins recorded with birds fed for both (T2) or (T4) diets. Total protein values were increased by using (FFS) specially with (T4) diets. These results were elucidated by values of LBW and FCR for these birds which represents similarity with (T1, control) group (Table 1). Results of plasma albumin are in disagreement with those of Nahavandinejad *et al*. (2014) who reported higher plasma albumin level with feeding broilers on autoclaved soybean meal.

Concerning lipid metabolism, effect of different treatments in lipid profile in broilers (Table 5), indicated that there were significant differences ($P \leq 0.05$) among different treatments and (T1, control) group. Values of plasma cholesterol decreased by feeding birds on (T2) or (T3) diets, but increased by feeding (T4) diet which contained higher level of (FFS) with higher oil content. Plasma low-density lipoprotein (LDL) as affected by (FFS) supplementations showed that values were decreased by feeding birds on (T3) or (T5) diets compared to other treatments including (T1, control) and these corresponding values were 24.50, 26.51 and 31.15 mg/dl, respectively. These results elucidated that (FFS) supplementation decreased LDL which means that (FFS) has improved lipid metabolism and consequently it improved broiler health then human health that consume these chicken meat. In regard to high-density lipoprotein (HDL), no significant differences were observed within values representing different dietary treatments, while birds fed (T5) diet recorded lowest HDL value among all treatment including those fed (T1, control) diet. Studies of feeding broilers on autoclaved soybean meal (Nahavandinejad *et al*., 2014) revealed different results, in which, plasma LDL level was not significantly affected by dietary treatment. While, plasma HDL level was significantly increased with all dietary treatments. In general, values recorded of blood plasma parameters ranged within normal ranges, and this reduction in lipid metabolism could be due to the ability of high content of poly unsaturated fatty acids (PUFA) found in full-fat soybean (Table 1), to reduce the transcription of lipogenesis genes especially fatty acid synthase (Kim *et al*., 2002).

<u>Economic evaluation</u>: Calculations of economic efficiency were listed in Table (6). The average cost/ ton of final experimental diets (starter and grower) are shown in Table (2). It was clear that using FFS (T2: T5) relatively reduced the cost/ ton of final diets compared with the control (T1) diet. The cost reduction in both starter and grower diets was more pronounced by using low levels of FFS compared with high levels. Economic efficiency (EE) values were 27.74, 30.79, 30.40, 28.07 and 35.66 for broiler chicks fed T1, T2, T3, T4 and T5 diets respectively during the whole experimental period (0-5 weeks). Relative economic efficiency (REE) values were improved by 28%, 11% and 9.6% for the groups fed (T5), (T2) and (T3) diets, respectively as compared to the control group. Whereas, it was increased only by 1% for the group feed (T4) diet. The improvement of EE and REE might be due to the improvement of total return and net return of these birds. In regard to net return, Al-Sardary (2010) reported similar results, when roasted FFS was used up to 30% of broiler diets recording higher value of net return when compared to control group. Conversely the same author Al-Sardary (2010) reported that performance index was affected adversely with using (FFS) at 49 days of age.

CONCLUSION

From the present results, it could be stated that adding FFS at inclusion rates (2% in starter and 4% in grower) or (10% in starter and 12% in grower) diets as practical broiler feeding as a replacement of soybean (vegetable) oil, would have a positive effect on production cost and economic efficiency, without any adverse effect on productive performance or carcass characteristics.

ACKNOWLEDGMENTS

Special thanks are due to El-Safwa For developing Animal Feeds Company for providing all Full-fat soybeans required for achieving the present research.

Table (1): Fatty acid composition of dietary fat sources

Fatty Acids		Composition of fat sources %	
		Pure Soybean Oil (SO)	Full-Fat Soybean (FFS)
Palmitic acid	C16:0	9.98	8.96
Stearic acid	C18:0	4.87	3.45
Oleic acid	C18:1 $_{n9}$	21.43	23.64
Vaccenic acid	C18:1 $_{n7}$	1.26	2.08
Linoleic acid	C18:2 $_{n6}$	53.21	56.00
Linolenic acid	C18:3 $_{n3}$	7.29	2.43
Arachidic acid	C20:0	0.44	0.22
Behenic acid	C22:0	0.38	0.31
Saturated fatty acids (SFA)		15.67	12.94
Monounsaturated fatty acids (MUFA)		22.69	25.72
Polyunsaturated fatty acids (PUFA)		61.24	61.20
(MUFA+PUFA) : SFA		5.36	6.72
PUFA : SFA		3.91	4.73

Table (2): Feed ingredients and chemical analyses of experimental diets.

Ingredients	**Dietary treatments - Starter (0-21 days)**				
	1	2	3	4	5
Full-Fat Soybean	**0.00**	**2.00**	**4.00**	**8.00**	**10.00**
Corn (grains)	55.00	57.00	56.00	55.00	54.00
Soybean Meal (44%)	33.00	31.00	30.00	27.00	26.00
Corn Gluten Meal (62%)	6.15	6.15	6.15	6.15	6.15
Soybean Oil	2.00	0.00	0.00	0.00	0.00
MCP	1.80	1.80	1.80	1.80	1.80
Calcium Carbonate	1.15	1.15	1.15	1.15	1.15
HCL Lysine	0.20	0.20	0.20	0.20	0.20
MHA	0.20	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Chemical Analysis (Calculated)					
CP%	23.01	22.94	23.05	22.93	23.04
ME Kcal/Kg diet	3000	2904	2924	2974	2993
Ca%	0.84	0.84	0.85	0.85	0.85
AP%	0.50	0.50	0.51	0.52	0.52
LYS	1.29	1.29	1.31	1.32	1.34
METH & CYS	0.95	0.96	0.96	0.96	0.97
Price/ Ton (L.E.)	3834	3700	3733	3768	3801
Dietary treatments - Grower (21-35 days)					
	1	2	3	4	5
Full-Fat Soybean	**0.00**	**4.00**	**6.00**	**10.00**	**12.00**
Corn (grains)	58.00	62.00	61.00	60.00	59.00
Soybean Meal (44%)	28.00	24.00	23.00	20.00	19.00
Corn Gluten Meal (62%)	6.15	6.15	6.15	6.15	6.15
Soybean Oil	4.00	0.00	0.00	0.00	0.00
MCP	1.80	1.80	1.80	1.80	1.80
Calcium Carbonate	1.15	1.15	1.15	1.15	1.15
HCL Lysine	0.20	0.20	0.20	0.20	0.20
MHA	0.20	0.20	0.20	0.20	0.20
Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Chemical Analysis (Calculated)					
CP%	21.06	20.92	21.04	20.91	21.03
ME Kcal/Kg diet	3183	2991	3010	3060	3079
Ca%	0.83	0.83	0.83	0.84	0.84
AP%	0.49	0.50	0.51	0.52	0.52
LYS	1.17	1.16	1.18	1.20	1.21
METH & CYS	0.90	0.91	0.91	0.91	0.92
Price/ Ton (L.E.)	3815	3547	3580	3615	3648

MCP: mono-calcium phosphate, MHA: methionine hydroxy-analogue, AP: available phosphorus.Each 3 Kg of premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K3: 2000 mg; B1:1000 mg; B2: 5000 mg; B6:1500 mg; B12: 10 mg; Biotin: 50 mg; Coline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg; Se: 100 mg and Co: 100 mg

Table (3): Effect of different dietary treatments on productive performance of broiler chickens, (0 - 5 weeks of age)

Items	Dietary Treatments					
	1	2	3	4	5	Sig.
Live body weight (g)						
3 weeks	690.83[b] ±1.82	688.00[b]±7.50	712.83[b] ±13.76	692.67[b]±11.54	750.00[a]±13.46	**
5 weeks	1387.25±34.49	1375.50 ±43.58	1352.00±21.36	1386.33 ±34.44	1487.33±63.89	NS
Daily weight gain (g)						
0–3 weeks	30.81[b]±0.08	30.68[b]±0.35	31.86[b]±0.65	430.90[b]±0.54	33.63[a]±064	**
4–5 weeks	49..74±2.59	49.10±2.57	45.65±0.54	49.55±3.28	52.66±3.59	NS
0–5 weeks	38.38±0.98	38.05±1.24	37.38±0.61	38.35±0.98	41.24±1.28	NS
Daily feed consumption (g)						
0–3 weeks	50.40[ab]±0.05	50.62[ab]±0.42	49.16[b]±0.46	50.66[ab]±0.80	51.94[a]±0.55	*
4–5 weeks	112.75±1.96	112.52±2.00	109.06±5.49	119.22±11.89	117.14±5.32	NS
0–5 weeks	75.34±0.75	75.38±1.05	73.12±2.47	78.08 ±5.23	78.01±2.46	NS
Feed conversion ratio (g feed/ g gain)						
0–3 weeks	1.63[a]±0.01	1.65[a]±0.01	1.54[b]±0.01	1.64[a]±0.01	1.54[b]±0.01	**
4–5 weeks	2.28±0.15	2.30±0.07	2.39±0.09	2.46±0.40	2.23±0.04	NS
0–5 weeks	1.96±0.07	1.98±0.03	1.95±0.03	2.04±0.19	1.89±0.02	NS

[a, b] Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non significant.

T1: Control; T2: 2% FFS starter, 4% FFS grower; T3: 4% FFS starter, 6% FFS Grower ; T4: 8% FFS starter, 10% FFS Grower and T5: 10% FFS starter, 12% FFS grower.

Table (4): Effect of different dietary treatments on carcass characteristics of broiler chickens, (5 weeks of age)

Items	Dietary Treatments					
Carcass characteristics	**1**	**2**	**3**	**4**	**5**	**Sig.**
Live body weight (g)	1486.67 ±20.48	1493.33 ±36.66	1498.33 ±64.31	1581.67 ±69.30	1478.33 ±33.70	NS
Carcass weight (g)	1051.33 ±12.97	1038.33 ±20.82	1004.33 ±27.96	1095.33 ±59.02	1041.33 ±26.67	NS
Dressing (%)	70.72^{a}±0.62	69.53^{ab}±0.76	67.11^{b}±1.06	69.18^{ab}±0.93	70.44^{a}±0.76	*
Abdominal Fat (%)	0.88^{b}±0.26	1.42^{ab}±0.10	0.90^{b}±0.30	2.00^{a}±0.41	1.32^{ab}±0.18	*
Liver (%)	2.14^{ab}±0.11	2.21^{ab}±0.19	1.95^{b}±0.03	2.44^{a}±0.16	2.50^{a}±0.07	*
Gizzard (%)	1.74^{a}±0.13	1.37^{b}±0.10	1.48^{ab}±0.04	1.64^{ab}±0.11	1.51^{ab}±0.11	*
Heart (%)	0.43^{ab}±0.04	0.44^{ab}±0.01	0.35^{b}±0.03	0.49^{a}±0.04	0.51^{a}±0.01	*
Giblets (%)*	4.32^{ab}±0.21	4.02^{ab}±0.28	3.79^{b}±0.03	4.58^{a}±0.13	4.53^{a}±0.10	*
Ready to Cook (%)#	75.04^{a}±0.63	73.56^{a}±0.55	70.90^{b}±1.06	73.76^{a}±0.83	74.97^{a}±0.67	*
Lymphoid organs						
Spleen (%)	0.12±0.01	0.11±0.01	0.16±0.01	0.15±0.05	0.15±0.04	NS
Thymus (%)	0.23±0.04	0.24±0.04	0.14±0.01	0.22±0.04	0.26±0.06	NS
Bursa (%)	0.13±0.05	0.11±0.02	0.08±0.02	0.14±0.01	0.11±0.01	NS
Carcass parts						
Wing (%)	11.14±0.36	7.30±3.40	11.45±0.52	9.91±0.16	9.63±0.44	NS
Drum Stick (%)	13.10±0.35	12.29±0.91	14.34±0.90	14.02±0.27	12.82±0.14	NS
Thigh (%)	26.79^{ab}±0.39	28.14^{a}±0.19	25.20^{c}±0.42	27.86^{a}±0.16	26.09^{bc}±0.67	**
Breast (%)	48.92^{bc}±0.19	49.07^{bc}±0.63	52.31^{a}±1.86	48.30^{c}±0.22	51.69^{ab}±0.27	*

[a, b, c] Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non significant. * Giblets = Liver + Gizzard + Heart, # Ready to Cook = (Carcass weight + Giblets weight)

T1: Control; T2: 2% FFS starter, 4% FFS grower; T3: 4% FFS starter, 6% FFS Grower ; T4: 8% FFS starter, 10% FFS Grower and T5: 10% FFS starter, 12% FFS grower

Table (5): Effect of different dietary treatments on some blood plasma parameters of broiler chickens, (5 weeks of age)

Items	Dietary Treatments					
Plasma parameters	**1**	**2**	**3**	**4**	**5**	**Sig.**
Total Protein (g/ dl)	$5.84^{ab}\pm0.33$	$6.35^{ab}\pm0.02$	$5.53^{b}\pm0.22$	$7.26^{a}\pm0.79$	$5.89^{ab}\pm0.36$	*
Albumin (g/ dl)	4.30±0.15	4.19±0.16	4.00±0.52	4.50±0.17	4.52±0.47	NS
Globulin (g/ dl)	$1.54^{ab}\pm0.18$	$2.16^{ab}\pm0.19$	$1.52^{ab}\pm0.29$	$2.76^{a}\pm0.62$	$1.37^{b}\pm0.42$	*
A/ G ratio #	2.85±0.24	1.98±0.25	3.00±0.98	1.78±0.36	4.74±2.43	NS
Cholesterol (mg/ dl)	$196.50^{ab}\pm8.94$	$147.50^{c}\pm0.28$	$160.50^{bc}\pm12.99$	$214.50^{a}\pm17.60$	$185.67^{abc}\pm18.01$	*
LDL[1] (mg/ dl)	$31.15^{ab}\pm0.25$	$38.54^{a}\pm2.85$	$24.50^{b}\pm4.01$	$31.90^{ab}\pm0.11$	$26.51^{b}\pm5.12$	*
HDL[2] (mg/ dl)	46.02±0.72	53.35±5.44	43.17±9.48	53.08±3.76	39.64±7.22	NS

[a, b, c] Means within the same row with different superscripts are significantly different. Sig. = Significance ** (P≤0.01), * (P≤0.05). NS = Non significant.# A/ G ratio (Albumin/ Globulin ratio); 1: LDL (Low-density lipoprotein); 2: HDL (High-density lipoprotein)
T1: Control; T2: 2% FFS starter, 4% FFS grower; T3: 4% FFS starter, 6% FFS Grower ; T4: 8% FFS starter, 10% FFS Grower and T5: 10% FFS starter, 12% FFS grower.

Table (6): Effect of different dietary treatments on some economic traits of broiler chickens (5 weeks of age).

Items	Dietary Treatments				
Economic traits	**1**	**2**	**3**	**4**	**5**
Average Feed Intake (Kg)	2.63±0.02	2.63±0.03	2.56±0.08	2.73±0.18	2.73±0.08
Live Body Weight (Kg)	1.39±0.03	1.37±0.04	1.35±0.02	1.39±0.03	1.46±0.06
Feed Cost (LE)	9.66±0.09	9.19±0.12	9.00±0.30	9.70±0.64	9.79±0.30
Total Cost (LE) #	14.66±0.09	14.19±0.12	14.00±0.30	14.70±0.64	14.79±0.30
Total Return (LE)*	18.72±0.46	18.57±0.58	18.25±0.28	18.71±0.46	20.08±0.86
Net Return (LE)	4.06±0.56	4.38±0.46	4.25±0.01	4.01±1.10	5.29±0.55
Economic Efficiency	27.74±4.01	30.79±2.96	30.40±0.74	28.07±8.78	35.66±3.03
Relative Economic Efficiency	100.00±0.00	110.98±10.69	109.55±2.68	101.18±31.66	128.53±10.92
Performance Index [1]	70.85±4.28	69.47±3.49	69.15±0.12	69.28±8.15	78.65±4.37
Production Efficiency Factor [2]	202.44 ±12.23	154.10 ±26.78	191.00 ±4.14	156.22 ±37.18	182.66 ±35.98

Total Cost = (Feed Cost + price of one-day live chicks + incidental costs); * According to the local price of Kg LBW which was 13.50 L.E.; 1: North (1981); 2: Emmert (2000),T1: Control; T2: 2% FFS starter, 4% FFS grower; T3: 4% FFS starter, 6% FFS Grower ; T4: 8% FFS starter, 10% FFS Grower and T5: 10% FFS starter, 12% FFS grower.

REFERENCES

Al-Sardary, S.T. (2010). Performance of broiler chickens fed locally grown full fat soybean based diets in Iraq. Iraqi J. Poult. Sci., 5: 111-125.

AOAC (1995). Association of Official Analytical Chemists. Official methods of analysis 16th Ed. Volume 2, Washington D.C., USA.

Demeterová, M. (2009). performance of chickens fed diets containing full-fat soybean and natural humic compounds. Folia Veterinaria, 53,(3): 151-153.

Duncan, D.B. (1955). Multiple range and Multiple F tests. Biometrics, 11: 1-42.

Emmert, J. (2000). Efficiency of phase feeding in broilers. Proceeding, California Animal Nutrition Conference. Fresno California, USA.

Kim, H.J.; M. Miyazaki and J.M. Ntambi (2002). Dietary cholesterol opposes PUFA-mediated repression of the stearoyl-CoA desaturase-1 gene by SREBP-1 independent mechanism. J. Lipid Res., 43: 1750-1757.

Lázaro, R.; G.G. Mateos; M.A. Latorre and J. Piquer (2002). Whole soybeans in diets for poultry, Am. soybean Assoc., 1-43.

Leeson, S.; J.O. Atteh and J.D. Summers (1987). Effects of increasing dietary levels of commercially heated soybeans on performance, nutrient retention and carcass quality of broiler chickens. Can. J. Anim. Sci., 67: 821-828.

MacIsaac, J.L.; K.L. Burgoyne; D.M. Anderson and B.R. Rathgeber (2005). Roasted full-fat soybeans in starter, grower, and finisher diets for female broiler turkeys. J. Appl. Poult. Res., 14: 116-121.

Nahavandinejad, M.; S. Alireza; A. Leila; P. Rita (2014). Blood biochemical parameters of broilers fed differently thermal processed soybean meal. Rev. MVZ Córdoba, 19: 4301-4315.

North, M.O. (1981). Commercial Chicken Production. Annual. 2nd Ed., AV., Publishing Company I.N.C., West Post Connecticut, USA.

NRC (1994). National Research Council. Nutrient Requirements of Poultry 9th ed. Composition of poultry feedstuffs. National Academy Press, Washington, DC, USA.

Papadopoulos, G. and S. Vandoros (1988). Dietary estimation of full fat soybeans on broiler fattening during the summer. Epith. Zootech. Epist., 7: 17-31.

Ruiz, N.; F., de Belalcázar and G.J. Díaz (2004). Quality control parameters for commercial full-fat soybeans processed by two different methods and fed to broilers. J. Appl. Poult. Res.,13: 443-450.

Saleh, E.A.; S.E. Watkins, A.L. Waldroup and P.W. Waldroup (2004). Effects of dietary nutrient density on performance and carcass quality of male broilers grown for further processing. Int. J. Poult. Sci., 3: 1-10.

SAS Institute, (2004). JMP Statistics and Graphics Guide version 3.1. SAS Institute, Cary, NC. USA.

Subuh, A.M.H.; M.A. Motl; C.A. Fritts and P. W. Waldroup (2002). Use of various ratios of extruded fullfat soybean meal and dehulled solvent extracted soybean meal in broiler diets. Int. J. Poult. Sci., 1: 9-12.

Waldroup, P.W. and T.L. Cotton (1974). Maximum usage levels of cooked full-fat soybeans in all-mash broiler diets. Poult. Sci., 53: 677-680.

Waldroup, P.W.; B.E. Ramsey; H.M. Hellwig and N.K. Smith (1985). Optimum processing for soybean meal used in broiler diets. Poult. Sci., 64: 2314-2320.

الملخص العربى

فول الصويا كامل الدهن كمصدر للطاقة فى علائق بدارى التسمين

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يهدف هذا البحث إلى معرفة مدى إمكانية استعمال فول الصويا كامل الدهن كبديل للزيوت النباتية فى علائق البادئ والنامى لبدارى التسمين وتأثير ذلك على الأداء الإنتاجى، صفات الذبيحة، بعض صفات بلازما الدم والكفاءة الاقتصادية. صممت التجربة فى ٥ معاملات غذائية (٣٠ طائر على ٣ مكررات بكل مكرر ١٠ طيور) عليقة مقارنة (بدون فول صويا كامل الدهن T1)، ٢% (T2)، ٤% (T3)، ٨% (T4) و ١٠% فول صويا كامل الدهن (T5)، لعلائق البادئ بينما علائق النامى احتوت على صفر% (T1)، ٤% (T2)، ٦% (T3)، ١٠% (T4) و ١٢% فول صويا كامل الدهن (T5) . وكانت المعاملات الغذائية متساوية فى محتوى البروتين. عليقة المقارنة احتوت على زيت فول الصويا بمعدل ٢% فى عليقة البادئ، ٤% فى عليقة النامى. أجريت التجربة على ١٥٠ كتكوت عمر يوم سلالة هبرد غير مجنسة حتى عمر ٥ أسابيع بنظام التغذية الحرة. وتم دراسة صفات الذبيحة فى نهاية التجربة بذبح ٣ طيور من كل معاملة غذائية تم إختيارهم عشوائيا.

أشارت النتائج المتحصل عليها إلى الآتى:

١. تغذية الكتاكيت على مستوى ٢% (عليقة بادئ) و٤% (عليقة نامى) فول صويا كامل الدهن أعطت معدلات أداء إنتاجى مساوى لمجموعة المقارنة (٢% [عليقة بادئ]، ٤% [عليقة ناهى] زيت فول الصويا) بينما انخفض مستوى الكوليسترول فى بلازما الدم وتحسنت الكفاءة الاقتصادية بمعدل ١٤% بالنسبة لمجموعة المقارنة.
٢. المعاملات الغذائية المختلفة (T1 إلى T5) أظهرت تأثير معنوى على معدلات الأداء الإنتاجى، صفات الذبيحة فيما عدا الأعضاء الليمفاوية، % للجناح، و% الدبوس وبعض صفات بلازما الدم.
٣. تغذية الكتاكيت على مستوى ١٠% (عليقة بادئ) و١٢% (عليقة نامى) فول صويا كامل الدهن أدى إلى تحسين فى الأداء الإنتاجى (الوزن الحى، الوزن المكتسب، استهلاك العلف ومعامل التحويل الغذائى) بالمقارنة بالمعاملات الغذائية المختلفة وكذلك تحسن الكفاءة الاقتصادية بمعدل ٣٣% بالقياس لمجموعة المقارنة.

الخلاصة:

أظهرت نتائج هذه الدراسة أن استخدام فول الصويا كامل الدهن بمعدلات (٢% عليقة البادئ و٤% عليقة النامى) أو (١٠% عليقة البادئ و١٢% عليقة النامى) فى علائق بدارى التسمين الخالية من زيت الصويا له تأثير إيجابى على تكاليف الإنتاج وكذلك الكفاءة الاقتصادية بدون تأثير سلبى على الأداء الإنتاجى أو صفات الذبيحة حتى عمر ٥ أسابيع