

Extruded Full Fat Soybean in Diets for Male Turkey

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Abstract

The aim of this research was to study the effect of different levels of the extruded full-fat soybean (EFFSB) on growth performance and serum lipids of male turkeys. A trial was carried out using 300 one day male turkey B.U.T (big 6) during 3 feeding periods (starter, grower and finisher, 18 weeks). Poults were selected and divided into four experimental groups with three replicates containing 25 poults each, in a completely randomized design, and were fed experimental diets for 18 weeks. Treatments consisted on: T1 (control, SBM), T2 (10% EFFSB), T3 (15% EFFSB) and T4 (20% EFFSB).

There were negligible changes in mortality. The results showed that the level of feed intake was decreased, while feed efficiency and body weight gain was improved in male turkey fed with different levels of the EFFSB. As a result, the best growth performance was determined for male turkeys fed diets containing 15% and 20% of EFFSB, which was exceeded significantly ($p < 0.05$).

The experiment confirmed that addition of extruded full-fat soybean in male turkey diets had influenced on serum lipids, so that cholesterol and triglyceride were reduced significantly ($p < 0.05$) on serum lipids of male turkey.

Keywords: Extruded; Male turkeys; Performance; Soybean; Serum lipids

Introduction

Growth depression effects due to anti-nutritional factors (ANF's) present in soybeans have been well documented for more than half a century [1,2]. There are few recent works on the influence of the level of use and processing of beans on productivity in turkeys. However, when preparing formulations in practice, the percentages of use have increased recently, frequently discovering diets with inclusion levels of up to 25%. There are two reasons for this; on the one hand the excess linoleic acid is more harmful to the quality and the appearance of the turkey carcass than in the broiler carcass due to its lower fat content [3]. On the other hand diets for turkeys are very concentrated in protein (for newly-born) and in energy (fattening stages) and as a result, in both cases the composition and concentration of these two nutrients in the bean have high values.

In fact, in current Spanish conditions more than 70% of the protein in the starter diets comes from soya. Other additional advantages of the bean in the European Union-15 are its nature as a plant and its high-unsaturated fat content. observed those turkeys between 2 and 3 weeks old digested fats 15% more efficiently than chicks of a similar age [4], which corresponds with the results of Mossab for soybean oil [5].

Turkeys, as with chickens, are sensitive to the presence of trypsin inhibitors, with pancreatic hypersecretion and hypertrophy. Mian et al. [6] have discovered that the maximum level of trypsin inhibitors tolerated by this species was 2.5 mg/g of diet at three weeks and 3 mg/g of diet for animals above that age. Given that a feed for turkeys may

contain up to 50% beans and soybean meal, the use of products that have been deficiently processed is not suitable for newly- born animals.

Moran et al. [7] compare soybean meal and raw or extruded whole soybean as a source of protein in turkeys of between 8 and 23 weeks of age. The diets based on extruded beans produced equivalent results to those obtained with the control diet. As was expected, the animals that received raw beans displayed an important reduction in productivity. Turner et al. [8] obtained similar results in turkeys between 10 and 23 weeks old with diets based on soybean meal or 23% of two different types of whole roasted soybean. Paradis et al. [9] Obtained similar levels of production in turkeys from eight weeks old until sacrifice when the soybean meal was totally or partially replaced by extruded beans.

This research aims to study the possibility of replacing soybean meal with different ratio of extruded full-fat soybean in male turkey diet, and determine the optimum ratios for replacement.

Materials and Methods

Processing of soybean: Whole soybean was gotten locally, the beans were brought to Oils factory in Damascus, for processing. Technological of soybean extruding was included: Soybean→cleaning→Grinding→Softening→Flaking→Then extruded without steam. Extrusion of finely ground beans has performed in laboratory scale single screw extruder (Extruder model E-250, China).

The extrusion processing was performed using a single screw extruder (Extruder model E-250, China) which was powered by a 37 KW motor with an operating range of screw speeds from 0 to 250 rpm, with length/diameter ratio of 25, screw speed up to 250 rpm and outer screw diameter of 25 mm. feed rate 250 kg/hour, 140 g/kg feed

moisture content in the extruder barrel and the extrusion temperature to 140 co (die temperature), were employed.

Extruded full- fat soybean beans has cooled at room temperature, after drying; the product has placed in bags and returned to the University of Damascus for use in the feeding trials.

A sample of the product was analyzed by animal laboratory and found to contain 38.90% crude protein, 18.5% crude fat (Table 1), 0.09 urease rise, and 77% protein solubility in 0.2% KOH, urease level and protein solubility indicate that the FFSB was processed sufficiently to denature the trypsin inhibitor without overcooking [10,11]. A laboratory specializing in protein nutrition conducted protein analysis of the product, and the metabolizable energy content was estimated from equations published by NRC [12].

Ingredient	Starter	Grower	Finisher
Corn	511.7	598.6	726.2
Soybean meal (44%)	383.8	318.2	245.2
Fish meal (61%)	79.4	61.9	-
Dicalcium phosphate	2.0	-	2.0
Limestone	15.0	12.0	15.5
Lysine	-	1.8	1.7
DL- Methionin	0.6	-	0.4
Vitamin premix1	2.5	2.5	2.5
Trace mineral2	2.5	2.5	2.5
Salt	2.5	2.5	4.0
Calculated analysis			
Crude protein (%)	25.98	22.77	16.88
Metabolizable energy (kcal/kg)	2806	2915	3038
C/P ratio (kcal kg/%protein)	108	128	180

Table 1: Composition (g/kg air dry basis) of the basal diet. 1 Provided the following/kg feed irrespective of the chemical form: vitamin A palmitate 4400 IU; cholecalciferol, 900 ICU; DL-tocopherol acetate, 22 IU; menadione, 1.1 mg; thiamine mononitrate, 2.75 mg; riboflavin, 5.5 mg; calcium pantothenate, 154 mg; niacin, 70 mg; pyridoxine HCl, 4.5 mg; biotin, 0.33 mg; choline chloride, 2200 mg; Folacin, 1 mg; vitamin B, 19.8 µg 12. 2 Supplied in mg/kg feed: Cu (as copper sulfate) 8; I (as potassium iodide) 0.4; Fe (as Ferric citrate) 110; Mn (manganous sulfate) 77; Se (as sodium selenite) 0.2; and Zn (as zinc carbonate) 60.

Diets were isocaloric and isonitrogenous with a different content of extruded full-fat soybean (EFFSB). Each diet was formulated for (0 to 4 w) starter, (5 to 12 w) grower and (13 to 18 w) finisher. The basal diet had no extruded full fat soybean (control) (T1), while those for three treatments contained within 10 (T2), 15 (T3), and 20% (T4) of extruded full fat soybean, respectively (Table 2). Soybeans were processed under temperature 140°C during 15 second. Diets met or exceeded the amino acid requirements suggested by the NRC [12] adjusted to the dietary energy content. Complete vitamin and trace mineral mixes obtained from a commercial poultry integrator were used. Diets were pelleted by using a pellet mill (Richard Size Limited

Engineers, Orbit 15, Kingston-upon-Hull, UK) capable of manufacturing 180 kg of feed/h. Diets fed from 0 to 4 w were fed as mash.

Age /day	The vaccine Name	Method of Vaccination
1	Swallen Head Disease (SHD)	Water
7	Newcastle	Water
15	Turkey Rhino Tracheitis (TRT)	Injection chest
22	oil emulsion vaccine	Injection chest
60	smallpox vaccine	Scratching of Wing
Newcastle vaccine will be returned on every 25 day until the end of fattening		

Table 2: Vaccines were used in immunization of birds.

All diets were manufactured and stored for two weeks prior to the start of the trial and then, prior to feeding.

Birds and housing

Three hundred day-old male turkeys of a commercial turkey strain (B.U.T. big 6) were purchased from a commercial hatchery. The birds were randomly assigned to 4 dietary treatments (twenty five birds per pen and three replicate pens per treatment (0.36 m2 per bird) with used wood shavings over concrete floors. Each pen was contained two trough feeder and one water trough. Birds were brooded using whole house brooding, Indoor temperature was 32°C at the beginning of the experiment and step by step reduced 2°C every week to reach a constant temperature of 22 ± 2°C. The lighting was a continuous 24-hour in the first three days, and then were reduced to 22-hour lighting and so until the second week of life, and after the second week until the week (12) was used intermittent lighting as follows program: (16L:2D : 3L:3D). Feed was offered ad libitum and water was freely available throughout the trial. Vaccines were used in immunization of birds (Table 3).

Treatment	Mortality rate (%)			
	Starter	Grower	Finisher	Total
T1	4 NS	2.78 NS	2.84 NS	9.33 NS
T2	2.67	2.72	2.78	8
T3	2.67	5.44	1.45	9.33
T4	2.67	2.72	1.39	6.67

Table 3: Effect of different levels of extruded soybean on mortality rate of male turkey. NS: Not Significant.

Growth performance

Birds and feed were weighed in the 4th, 12th and 18th weeks and individually to determine Body weight gain (BWG), feed intake (FI) and Feed Conversion Ratio (FCR).

Serum lipids

At the end of the period three turkey broilers were selected from each replicate and blood samples were collected from wing veins,

approximately 5 ml of blood were taken from each bird for the analysis.

Serum triacylglycerol, total-and high density lipoprotein (HDL)-cholesterol of the chickens were measured by appropriate methods [8,10,13-21]. Serum low density lipoprotein (LDL) cholesterol was calculated using Friedewald equation [2], $LDL\text{-chol} = \text{total cholesterol} - HDL\text{-chol} - \text{triglyceride}/5$.

Statistical analysis

Data from study were subjected to a statistical analysis by one-way analysis of variance test (ANOVA) using the General Linear Model procedure of Anderson-Haferman et al. [22]. Differences were considered to be significant at $P < 0.05$ and significant differences between means were separated by the Fisher's Least Significant Difference test.

Results and Discussion

Results of the study relating to effects of experimental diets on performance in turkey poults were in Tables 4, 5, 6 and 7.

Treatment	BWG (kg/bird)			
	Starter	Grower	Finisher	Total
T1	1,242 ^b	8,400 ^b	7,506 ^b	17,148 ^b
T2	1,282 ^a	8,451 ^{ab}	7,594 ^a	17,327 ^{ab}
T3	1,269 ^{ab}	8,505 ^a	7,619 ^a	17,393 ^a
T4	1,251 ^{ab}	8,489 ^a	7,658 ^a	17,399 ^a
LSD1	0.034	0.087	0.076	0.195

Table 4: Effect of different levels of extruded full fat soybean on Body weight gain of male turkey. ^{a,b}Values in the same Column not sharing a common superscript differ significantly ($P < 0.05$). ¹Least significant differences of means (5% level). NS: Not Significant.

Treatment	FI (kg/bird)			
	Starter	Grower	Finisher	Total
T1	1,600 NS	15,343 NS	20,957 NS	37,900 NS
T2	1,597	15,337	20,904	37,838
T3	1,592	15,331	20,899	37,821
T4	1,574	15,323	20,840	37,736
LSD1	-	-	-	-

Table 5: Effect of different levels of extruded soybean on feed intake of male turkey. ^{a,b}Values in the same Column not sharing a common superscript differ significantly ($P < 0.05$). ¹Least significant differences of means (5% level). NS: Not Significant.

Treatment	FCR (Feed: Gain)			
	Starter	Grower	Finisher	Total
T1	1.289 NS	1.828 NS	2.792 ^a	2.210 ^a
T2	1.245	1.815	2.753 ^{ab}	2.184 ^{ab}
T3	1.255	1.803	2.743 ^b	2.175 ^b
T4	1.258	1.805	2.721 ^b	2.169 ^b
LSD1	-	-	0.040	0.033

Treatment	Parameters (mg.dL ⁻¹)			
	Cholesterol	Triglyceride	LDL	HDL
T1	146.23 ^a	48.1 ^a	103.18 NS	33.43NS
T2	145.43 ^{ab}	45.67 ^{ab}	101.53	34.77
T3	144.03 ^b	45.8 ^{ab}	101.54	33.33
T4	144.13 ^b	43.33 ^b	101.8	33.67
LSD1	1.4	2.55	-	-

Table 6: Effect of different levels of extruded full fat soybean on feed conversion ratio of male turkey. ^{a,b}Values in the same Column not sharing a common superscript differ significantly ($P < 0.05$). ¹Least significant differences of means (5% level). NS: Not Significant.

Treatment	Parameters (mg.dL ⁻¹)			
	Cholesterol	Triglyceride	LDL	HDL
T1	146.23 ^a	48.1 ^a	103.18 NS	33.43NS
T2	145.43 ^{ab}	45.67 ^{ab}	101.53	34.77
T3	144.03 ^b	45.8 ^{ab}	101.54	33.33
T4	144.13 ^b	43.33 ^b	101.8	33.67
LSD1	1.4	2.55	-	-

Table 7: Effect of different levels of extruded full fat soybean on serum lipid of male turkey. ^{a,b}Values in the same Column not sharing a common superscript differ significantly ($P < 0.05$). ¹Least significant differences of means (5% level). NS: Not Significant.

Mortality

The results in Table 4 showed that mortality rates of birds during the experimental period did not influence by dietary supplementation of EFFSB. Similar results were obtained by Subuh [19]. This implies that EFFSB supplementation had no toxicity with the birds.

Body weight gain

The Body weight gain of poults during periods in the experimental groups fed different levels of extruded full fat soybean were increased than control group in Table 5. Lower BWG of turkeys ($p < 0.05$) was found for the starter period in the control treatment (1,242 Kg) compared to the average BWG of T2 (1,282 Kg). Differences ($p < 0.05$) were also found on BWG for the grower period between the control treatment (8,400 Kg) and the treatments T3 and T4 (8,505 and 8,489 Kg, respectively). The BWG of turkeys for the finisher and total periods was lower ($p < 0.05$) in the control treatment (17,148 Kg) than in the treatments T3 and T4 (17,393, and 19,399 Kg, respectively), without any significant differences among these EFFSB treatments. Heat treatment, in addition to destroying thermolabile antinutritional factors, also opens up the tertiary structure of proteins and improves their digestibility Anderson-Haferman et al. [22]. However, what must be considered is the fact that BWG of turkeys due to fed with the extruded full-fat soybean from 15% to 20% at the finisher period was increased than control diet ($p < 0.05$). This significantly increase probably due to absence of fishmeal in this period. Feeding high-fat diets to young poults (up to 14 days of age) is an important topic that deserves some discussion. Current industry wisdom among nutritionists is to minimize supplemental fat levels in diets for poults

between 14 and 28 days of age. Thereafter, it is generally accepted that fat utilization increases with age. Several researchers have supported this concept from a fat digestibility perspective [14,17,23]. The improvement in fat utilization with age is largely a function of increased bile production and intestinal lipase activity as the poults mature.

The positive impact clearly has been observed to add extruded soybean with the progress of the birds at the age during the last phase of life with the increasing need for energy and the lack of fish meal in the ration, which confirms that the extruded soybean is not only a good source of protein, but also a good source of energy. The results of the present study were in conformity with the results of previous studies [24,25] from viewpoints of body weight gain and increased level of EFFSB. Whereas, these findings were not in conformity with results of some other studies [26] based on the fact that lack of effectiveness of extrusion on broiler body weight gain.

Feed intake

The results showed that there were no significant differences ($p > 0.05$) on FI of turkeys for the starter, grower, finisher and total periods between the control treatment and the others (Table 6). Nevertheless, total period FI was higher ($p > 0.05$) in the control treatment (37,900 Kg) than in the T2, T3 and T4 (37,838, 37,821, and 37,736 Kg, respectively). The findings of the present study are in conformity with the findings of the previous research works [26,27], but at the same time they were not in conformity with the findings of the researchers who witnessed increased intake of EFFSB [16]. This might be due to an underestimation of the energy content of the beans used, and was probably because the energy value available to the bird because of rolling and extrusion, coupled with pelleting of the diets, was underestimated. Wiseman [28] also showed that the ME value of diets containing extruded whole soybean were greatly enhanced by pelleting the diets.

Feed conversion ratio (FCR)

The results relating to effects of experimental diets on feed conversion ratio (FCR) of turkeys in starter, grower showed that there were no significant differences ($p > 0.05$) between the control treatment and the others (Table 7).

Differences were found ($p < 0.05$) on FCR for the finisher and total periods between the control (2.792 and 2.210) and T3 (2.743, 2.175), T4 (2.721, 2.169) respectively. However, no differences were found between the three EFFSB treatments on FCR of turkeys for the starter, grower, finisher and total periods. This finding was in line with the results of the research works done on broilers fed on EFFSB, which found out that the FCR decreased significantly [25]. Furthermore, FCR in experimental groups, which received regular level of the full fat soybean seed, was significantly compared to the control group. Nevertheless, it was not significant among the groups fed with different levels of the EFFSB. The reason for such discrepancy could be due to the apparent increase in indigestibility of protein, starch, and non-starch polysaccharides in ileum. Processing improves the availability of the lipid and protein fractions of the bean and increases its nutritional value. Furthermore, the inclusion of fats in the feed may improve the digestibility of other fractions in the diet such as protein and carbohydrates [29,30].

These results were in line with the results obtained in previous research works, which reflect the positive effect of extruded feed on increased FCR and as a result, performance of poultry [16,26].

Results showed, it can also be claimed that the 15% and 20% EFFSB is suitable due to higher weight gain and decreased FCR. Therefore, it is suggested that future research studies with over 20% EFFSB diet are undertaken to see if a better result can be achieved. Moreover, Sirtori et al. [17] indicated that whole extruded will enhance nutrient release and denature the trypsin inhibitor, was a highly effective feed ingredient for broiler diets.

Serum lipids

Cholesterol is the precursor of all steroid hormones and bile salts. Cholesterol levels may vary depending on the climatic conditions of the environment, nutrition, fitness of broilers and sexual activity [31]. Data in Table 7 showed that utilization of the extruded full-fat soybean had a significant effect on serum lipids of the turkeys. The serum cholesterol was a function of a sinusoidal curve of the extruded soybean in a way that with increased level of soybean, the cholesterol serum significantly decreased with birds fed the extruded full-fat soybean from 15% (144.03 mg.dL⁻¹) to 20% (144.13 mg.dL⁻¹) compared to the level of cholesterol serum of control (146.23 mg.dL⁻¹) ($p < 0.05$). Plant-derived protein especially extruded full-fat soybean has been shown to decrease cholesterol.

The effect of extruded soybean on triglyceride was significant as the level of extruded soybean increased resulting in lower concentration of triglyceride significantly with birds fed the extruded full-fat soybean 20% (43.33 mg.dL⁻¹) compared to the level of triglyceride serum of control (48.1 mg.dL⁻¹) ($p < 0.05$). But LDL levels decreased insignificantly with birds fed the extruded full-fat soybean ($p > 0.05$). Anderson [32] reported that serum lipoprotein concentrations could be changed by dietary fat in broilers. Ham et al. [33] reported that EFFSB was effective in lowering the levels of serum triglycerides and cholesterol in humans and animals. However, the mechanism of EFFSB on blood cholesterol is unknown, although several theories have been proposed. One hypothesis suggests that the amino acid composition of EFFSB protein causes some changes in cholesterol metabolism. In other studies, some authors proposed that non-protein components (such as fiber and isoflavones) associated with EFFSB protein affect cholesterol metabolism either directly or indirectly [34].

Soybean contains isoflavonoids (genistein and daidzein) that have estrogenic effects [35]. Yousef [36] showed a positive effect of isoflavonoids on biochemical parameters of blood in male rabbits. Isoflavonoids led to the lowering of cholesterol and triglycerides. Oligosaccharides may have a significant impact on reducing levels of cholesterol and triglycerides in rats fed with high fat content [37]. And thus lipoproteins of low density may be reduced due to the presence of soybean oil in the diet, which contains a high proportion of unsaturated fatty acid, and the liver converts unsaturated fatty acid preferentially to bodies of ketone instead of lipoproteins LDL or triglycerides, and are transferred to the tissues of the oxidation without the impact of lipoproteins of low density [38]. The most popular theory suggests that EFFSB protein reduces cholesterol metabolism in the liver by increasing the removal of LDL 'bad' cholesterol [17].

HDL levels were not influenced by the inclusion rate of EFFSB ($p > 0.05$). Serum HDL carries about 75% of total cholesterol in broiler [39], it is

more likely that this lipoprotein may be more influence by the type of dietary fat.

Conclusion

In conclusion, the results of this experiment point to that use of extruded full-fat soybean in male turkey diets did not has any negative effect on performance of male Turkeys during the whole period. Inclusion dietary different levels of from 10 to 20% on diet is decreased FI and BWG increased of turkey. Therefore, utilization of the EFFSB at the 20% level led to decrease FCR of turkeys. The experiment confirmed that add extruded full-fat soybean in male turkey diets has influenced on serum lipids, so that it reduced cholesterol, triglyceride and LDL on serum lipid of male turkey. In the end, we recommend to used up to 20% extruded soybeans in male turkeys diet.

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