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EFFECT OF USING HIGH LEVELS OF SOYBEAN MEAL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKS.

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ABSTRACT

An experiment was conducted to study the effect of using high levels of soybean meal in broiler starter diets on growth performance and carcass characteristics at 7 weeks of age. A number of 72 day-old broiler chicks were individually allocated among four treatment groups. The different experimental starter diets (from 1-21 days of age) were formulated to be of iso-nutritive value and contained 23% crude protein and 3100 kcal ME/Kg feed. The inclusion rate of soybean meal was 30, 35, 40 or 45%. All treatment groups were fed the same grower and finisher diets from 22 to 37 days and 38 to 49 days of age, respectively.

At the end of the starter period (21 days of age), weight gain, feed intake, feed conversion and performance index values of chicks fed diets containing different levels of soybean meal were approximately similar. At the end of growing period (37 days of age) and at the end of experiment (49 days of age), the values of performance parameters and carcass characteristics of birds fed the different treatments had no significant differences.

It could be concluded that, under this experimental conditions, using high level of good quality SBM up to 45% of starter diet had no negative impact on growth performance , carcass characteristics of broiler chicks or economic efficiency.

INTRODUCTION

The rapid growth of poultry industry and it's increased sophistication greatly affected the acceptance of soybean meal (SBM) by the feed industry. The use of computers to arrive at high efficiency, low-cost diets encouraged reliance on soybean meal as the main source of protein in all poultry diets. Using nutritive needs as the restraints in computer (rather than stipulated minimum amounts of certain ingredients) results in diets based largely on corn and SBM supplemented with methionine, vitamins and minerals. Therefore, feeding chicks on diets containing no related animal ingredients such as SBM, sunflower seed meal (SFM) and or corn gluten meal (CGM) now is common practice in many countries and broilers grown on this feed called "vegetarian broilers". Meat of these chicks is more tender, juicy and preferable to consumer (Sexena, 1996).

Raw soybean can not be used successfully in poultry feed or human food, because it contains many antinutritional factors. Therefore, all studies coincide in the need of processing the beans in such way that all antinutritional factors are eliminated (Herkelman *et al.*, 1989 and Zhang *et al.*, 1991). It has been recognized for many years that heating (processing) soybeans is needed to increase the protein nutritive value (Balloun, 1980) mainly by destroying the antinutritional factors. Soybeans contain a number of natural toxins for poultry, the most problematic being trypsin inhibitor. Trypsin inhibitor (TI) disrupt protein digestion, which results in decreased release of free amino acids. Fortunately, the heat treatment employed during

processing is usually adequate to destroy trypsin inhibitor and other toxins such as lectins.

Trypsin inhibitor and lectins are the major antinutrients in raw soybeans due to their high concentration and the severity of the growth-depressing effects they cause in animals (Grant, 1989 and liener , 1994). A high quality (highly digestible) SBM requires low residual activities of trypsin inhibitor and urease. The raw soybean seeds are deffated and processed by desolventizing–toasting to produce the high – protein cooked meal used in commercial poultry diets (Mustakas *et al.*, 1981). Although the desolventizing–toasting process reduces antinutrients in raw beans to low levels, processed meals still contain residual antinutritional factors levels (Maenz *et al.*, 1999). The SBM may be included at levels of 25 to 50% in poultry diets (Fasina *et al.*, 2004). They mentioned that at such high dietary inclusion levels, the antinutritional content of the diet could be enough to cause antinutrients effects. Although the traditional corn – soybean meal broiler starter diets are considered highly digestible , they may contain a variety of complex proteins that may not be easily digested by the young chick due to the lack of the necessary intake enzymes at early stage of life (Uni *et al.*,1999) Thus, the objective of this study was to evaluate effect of the including high levels of SBM in broiler diets during the starter period (0 – 21 days of age) on growth performance and carcass characteristics at 7 weeks of age.

MATREIALS AND METHODS

This experiment was carried out at poultry research farm, Poultry Production Dept., Fac. of Agriculture, Ain-Shams University, Cairo,Egypt.

A number of 72 unsexed one-day old broiler chicks (Arbor Acres) were obtained from a commercial hatchery. Chicks were individually weighed, wing banded and randomly distributed into four equal treatments each of 18 birds representing the four respective experimental diets. The average initial live body weight of assigned groups was nearly similar (44 gm). Chicks were brooded and reared individually in separate wire cages (as an each bird represent one replicate) in an open system house. Water and feed were offered *ad-libitum* and artificial light was provided 24 hours daily allover the experimental period, which lasted for 7 weeks. Chicks of all experimental treatments were kept under similar hygienic and environmental conditions and vaccinated against common disease.

During the experimental period, which lasted from 1 day old to 49 days of age, chicks were fed the experimental starter diets containing 23 % CP and 3100 Kcal ME/Kg feed, up to 21 days of age, then switched to a grower diet containing 20% CP and 3200 Kcal ME/Kg from 22 to 37 days of age. A finisher diet containing 18.5 % CP and 3200 Kcal ME/Kg feed was fed to all the birds during the finishing period (38 – 49 days of age). Four experiment

al starter diets were formulated in which the first one (T_1) was corn soybean meal diet containing 30% SBM and served as a control. In the other starter diets, the levels of SBM were 35, 40 or 45% for (T_2), (T_3) or (T_4) , respectively. All starter diets were adjusted to be iso-nitrogenous of about 23 % CP and iso-caloric of about 3100 Kcal ME/Kg feed. The composition and

calculated analysis of the four experimental starter diets, a grower diet and a finisher diet are shown in Table (1). All diets were formulated to satisfy nutrient requirements of broiler chicks according to the strain catalog recommendation. The chemical composition of samples from soybean meal which were used in the present study was determined according to A.O.A.C (1990). The method described by Caskey and Knapp (1944) was used to determine the activity of urease. Data on body weight, feed intake and calculated feed conversion ratio were recorded at the end of each period, while performance index (PI) was calculated according to North (1981) as follows: PI = (Live body weight (kg) / feed conversion) x 100.

At the end of the experimental period, all the birds were starved for 12 hours then individually weighed prior to slaughter. Six random samples of experimental birds were taken from each treatment and slaughtered to determine the carcass characteristics. Legs and heads were separated, the birds were then eviscerated and small intestine, gizzard, lungs, spleen, liver, heart, kidney and reproductive organs were removed The carcass with neck and giblets (liver, empty gizzard and heart) were separately weighed. Abdominal fat was weighed and expressed as percent of live body weight. The commercial carcass cuts (breast and thigh muscles) were estimated as a percentage of live body weight.

Blood samples were collected at the same time of slaughtering birds and centrifuged at 6000 rpm for 15 minutes. Serum was separated for determination of cholesterol, transaminases (GOT and GPT), total protein, albumin and globulin, which were colorimetrically determined using commercial kits, following the same steps as described by manufactures.

The total feed cost (L.E / bird) at the end of the experiment for each treatment, was calculated depending upon the local market prices of the ingredients used in formulating the experimental diets. Also, the total income (L.E / bird) was calculated depending upon the local market prices of 1 kg live body weight. Economic efficiency was determined by comparing the net revenue (L.E / bird) and the total feed cost, for each experimental treatment. It was calculated as follows:

$$\text{Economic efficiency} = \frac{\text{Net revenue (LE / bird)}}{\text{Total feed cost (LE / bird)}}$$

Data were statistically analyzed using the linear model (SX, 1992). A simple one-way classification analysis followed by least significant difference test (LSD) was used for testing the significance between means.

RESULTS AND DISCUSSION

The results of chemical analysis of SBM recorded values of 10.43% moisture, 44.15% crude protein, 1.51% ether extract, 6.97% crude fibers, 6.75% ash and 30.19% nitrogen free extract, these values of nutrients content were approximately the same as recorded by NRC (1994) while determination of the urease activity in SBM as an indicator to their contents of antinutritional factors revealed value of 0.037 pH units. In this connection, Al-Shanti (2003) found similar results for urease activity "UA" (0.04 pH).

Table (1) : Composition and calculated analysis of the experimental diets.

Ingredients	Treatments					
	Starter (0-21days)				Grower (22-37 days)	Finisher (38-49 days)
	1 Control	2	3	4		
Yellow corn	53.47	50.47	47.50	44.03	60.16	59.98
Soybean meal (44%)	30.00	35.00	40.00	45.00	24.25	28.84
Corn gluten meal (60%)	8.92	5.85	2.73	--	7.36	1.84
Mono Ca. phosphate	1.33	1.31	1.29	1.26	1.38	1.37
Lime stone	1.87	1.85	1.82	1.80	1.75	1.73
Vegetable oil	3.41	4.61	5.81	7.00	4.13	5.40
Na Cl	0.42	0.42	0.42	0.46	0.42	0.42
DL-methionine	0.07	0.10	0.13	0.15	0.09	0.12
L. lysine HCl	0.21	0.09	--	--	0.16	--
Vit. & Min Mixture*	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100
Calculated analysis **	23.00	23.00	23.00	23.28	20.00	18.50
Crude protein %	3100	3100	3100	3100	3200	3200
ME (k cal/kg diet)	1.00	1.00	1.00	1.00	0.95	0.95
Calcium %	0.45	0.45	0.45	0.45	0.45	0.45
Available phosphorus %	0.52	0.52	0.53	0.53	0.49	0.46
Methionine %	0.91	0.91	0.91	0.91	0.83	0.77
Methionine + cystine %	1.20	1.20	1.23	1.33	1.01	0.95
Lysine %	0.18	0.18	0.18	0.19	0.18	0.18
Na %	6.09	7.18	8.27	9.35	6.94	8.15
EE %	3.60	3.83	4.07	4.30	3.30	3.52
CF %						

***Each 3Kg contains: Vit.A 12 mIU ; Vit D_3 2.2 mIU ; Vit.E 10g ; Vit K 2g ; Vit B_1 1g ; Vit.B_2 5g ; Vit B_6 1.5 g ; Vit B_{12} 10mg ; Niacin 30g ; pantothenic acid 10g ; Folic acid 1g ; Biotin 50mg ; Choline 300g ; Iron 30g ; Iodine 1g ; Zinc 50g ; Manganese 60g ; Copper 4g ; Selenium 100 mg ; Cobalt 100 mg .**

****According to NRC (1994)**

These results show that SBM, used in this experiment, is in a good quality, since the circumstances during desolventizing-toasting process are ideal to destroy most of the antinutritional factors which involved in raw soybean seeds. Main and Garlich (1995) concluded that SBM with UA between 0.02 and 0.2 pH could be used in broiler diets without any adverse effect on growth performance. In addition, Fasina *et al.* (2003) reported that UA can be used to monitor lectin levels during SBM processing because both protein inhibitors (TI and lectin) exhibit similar sensitivities to heat treatment. The UA of 0.031 to 0.088 units of pH change are indicative of adequately processed meals that contain very low lectin levels.

Data presented in Table (2) show values of average live body weight, feed consumption and feed conversion ratio for the experimental treatments at different intravel periods and all over the experimental period.

Table (2): The effect of soybean meal levels on the performance of broiler chicks.

Items	Treatments (soybean meal levels)				
	30% Control	35%	40%	45%	Significance
At 21 days of age:					
Live body weight (g/bird)	626.0	626.8	622.2	622.0	N.S
Feed consumption (g/bird)	903.0	898.0	900.0	897.0	N.S
Feed conversion ratio	1.442	1.433	1.446	1.443	N.S
Performance index (PI) %	43.41	43.74	43.03	43.10	N.S
At 37 days of age:					
Live body weight (g/bird)	1692.9	1697.6	1689.8	1716.9	N.S
Feed consumption (g/bird)	3269.0	3272	3259	3315	N.S
Feed conversion ratio	1.931	1.928	1.929	1.931	N.S
Performance index (PI) %	87.67	88.05	87.60	88.91	N.S
At 49 days of age:					
Live body weight (g/bird)	2677.1	2665.9	2648.7	2667.2	N.S
Feed consumption (g/bird)	5486.0	5446	5419	5454	N.S
Feed conversion ratio	2.049	2.043	2.046	2.045	N.S
Performance index (PI) %	130.65	130.49	129.46	130.43	N.S

The results at the end of the starter period (21 days of age) revealed no significant differences among dietary treatments in growth performance. The explanation of that could be related to the fact that, all experimental starter diets were formulated to meet the optimum nutrient requirements for the chicks and the SBM used in these diets was of high quality (highly digestible) and contained negligible amount of antinutrients . These results are in agreement with the results of EL-Deek *et al.* (2002) who examined three levels of SBM in broiler starter diets (21.7, 32.5 or 43.4%). They found no negative effect of SBM level on live body weight, feed intake and feed conversion ratio. Similar results were reported by Fasina *et al.* (2004) when they compared corn starch-casein diet and corn-soy diet containing 52% SBM with starting turkey poults which grow equally well. Also, many investigators used corn-soy diets at starter period for broiler chicks containing high levels of SBM as 38.03% (Shelton *et al.*, 2003); 38.09% (Kilburn and Edwards, 2004); 40.59% (Abou El-Wafa *et al.*, 2000), 40.85% (Al-Shanti, 2003) and 47.7% (Batal and Parsons, 2003) without negative effects.

Inspection of data listed in Table (2) revealed that, at 37 and 49 days of age, the experimental treatments with high SBM levels in starter period had no significant effect on all performance parameters compared with control group. These results are logic since all birds were fed the same diets during the growing and finishing periods. These results are in agreement with those obtained by Abou El-Wafa *et al.* (2001) who used four levels of SBM in broilers starter diets (34, 35.5, 42.8, and 43.56%) and concluded that no significant effect was observed on productive performance neither at 21 nor

at 42 days of age. Also, Arafa *et al.* (2001) compared the effect of feeding diets containing all-vegetable protein diets versus mixture of vegetable and animal protein sources on the performance and carcass characteristics of broiler chicks. They found that live body weight, feed consumption and feed conversion ratio of chicks fed on vegetable protein diets such as soybean meal (containing 38.65% SBM), corn gluten meal and/or sunflower seed meal were not significantly different from those of the control fish meal diet. Similarly, Ali *et al.* (2000) studied the effect of feeding low-protein diets (20 or 22% CP) supplemented with amino acid or high-protein diets (24 or 26% CP) on the performance of Japanese quail. These diets contained 33.06, 38.98, 44.88 or 50.78% of SBM, respectively. The authors concluded that the performance of Japanese quail fed low-protein diets supplemented with amino acids (containing 33.6 or 38.98% SBM) were similar to that achieved with the high – protein diets (containing 44.88 or 50.78 % SBM).

Data in Table (3) shows the effect of SBM levels on carcass characteristics, expressed as percentage of body weight, for chicks slaughtered at 7 weeks of age. Statistical analysis revealed no significant effect of the experimental treatments on percentages of dressing, liver, gizzard, heart, abdominal fat, kidney and total edible parts. These results are in agreement with those reported by El-Deek *et al.* (2002) who found no significant difference in carcass characteristics due to SBM levels in the diets. Abou El-Wafa *et al.*, (2001) found that dressing and total edible parts percentage was not affected by different dietary treatments. On the other hand, Arafa *et al.* (2001) found that carcass characteristics were not significantly affected by feeding chicks either on animal or vegetable protein sources.

Table (3): Relative carcass characteristics of broiler chicks at 7 weeks of age as affected by experimental diets.

Item	Treatments (soybean meal levels)				Significance
	30% Control	35%	40%	45%	
Carcass %	79.40	79.76	79.22	79.15	N.S
Abdominal Fat %	2.42	2.40	2.49	2.45	N.S
Liver %	1.73	1.74	1.72	1.76	N.S
Gizzard %	1.38	1.35	1.41	1.34	N.S
Heart %	0.47	0.48	0.47	0.49	N.S
Giblets %	3.58	3.57	3.60	3.59	N.S
Total edible parts %	82.98	83.33	82.82	82.74	N.S
Kidney %	0.48	0.51	0.50	0.47	N.S
Breast muscles %	18.23	18.13	18.19	18.11	N.S
Thighs muscles %	15.78	15.60	15.53	15.74	N.S
Breast+Thighs muscles %	34.01	33.73	33.72	33.85	N.S

The effect of dietary SBM levels on some blood serum constituents of broiler chicks are shown in Table (4). Results showed insignificant effect of treatments on total protein, albumin (A), globulin (G), A/G ratio or cholesterol. Also, serum GOT and GPT activity values are similar in all experimental groups which mean no detrimental effect of high levels of SBM on the liver functions. Pescatore *et al.* (1990) reported that the numerical variations in some blood parameters could be interpreted due to many factors such as genetics, age, sex, physiological state, environmental conditions, nutrition factors as well as pathological factors. Generally, the present values of tested blood protein fractions in broiler chicks which received different dietary treatments were within the normal range published by Meluzzi *et al.* (1992) who reported that reference values of total protein ranged from 2.58 to 5.22 gm/100 ml, albumin ranged from 1.17 to 2.74 gm/100 ml and those of cholesterol ranged from 87 to 192 gm/100 ml for broiler chicks.

Table (4): Mean values of serum blood constituents of broiler chicks fed different levels of SBM.

Item	Treatments (soybean meal levels)				
	30% Control	35%	40%	45%	Significance
Total protein g/100 ml	3.43	3.39	3.54	3.47	N.S
Albumin (A) g/100 ml	1.55	1.49	1.62	1.53	N.S
Globulin g/100 ml	1.88	1.90	1.92	1.94	N.S
A / G ratio	0.82	0.78	0.84	0.79	N.S
Cholesterol mg/100 ml	114.7	113	116	118.5	N.S
GOT units/ml	179	190.7	181	177	N.S
GPT units/ml	15.25	16.31	15.41	15.01	N.S

Economics (total feed cost and total revenue as well as the economic efficiency of meat production) of using different levels of SBM in broiler diets are shown in Table (5). The data showed that although increasing level of SBM in broiler starter diets lowered the total feed cost /bird, the different experimental treatments recorded approximately similar net revenue/bird and economic efficiency values. These results indicated that good quality SBM can be used in broiler starter diets up to 45% without adverse effect on economic efficiency. However, the price of protein unit will dictate what to be used as a source of protein in broiler diets .

Table (5): Effect of experimental treatments on the economical efficiency of broiler production.

Items	Soy meal levels			
	30%	35%	40%	45%
Average feed intake (g/bird)				
Starter	903.0	898.0	900.0	897.0
Grower	3269.0	3272.0	3259.0	3315.0
Finisher	1314.0	1276.0	1260.0	1242.0
Feed Price:				
Starter (LE/bird)	1.36	1.36	1.37	1.39
Grower (LE/bird)	4.70	4.71	4.69	4.77
Finisher (LE/bird)	1.83	1.78	1.76	1.73
Total feed cost (LE/bird)	7.89	7.85	7.82	7.89
Average live weight (g/bird)	2677	2666	2649	2667
Price of 1Kg live weight (LE)	6.00	6.00	6.00	6.00
Total revenue (LE/bird)	16.06	16.01	15.90	16.00
Net revenue (LE/bird)	8.17	8.16	8.08	8.11
Economical efficiency	103.6	104	103.4	102.7
Relative economical efficiency	100.0	100.4	99.8	99.1

It could be concluded that, under this experimental conditions, using high level of good quality SBM up to 45% of starter diet had no negative impact on growth performance ,carcass characteristics of broiler chicks or economic efficiency.

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تأثير استخدام مستويات مرتفعة من كسب فول الصويا على الأداء الإنتاجي وصفات الذبيحة لكتاكيت اللحم

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قسم الإنتاج الحيواني - المركز القومي للبحوث - الدقي- القاهرة

أجـريت تجربة لدراسة تأثير استخدام مستويات مرتفعة من كسب فول الصويا في علائق بـادئ التـسمين وذلك على أدائها الإنتاجي وكذا صفات الذبيحة. استخدم ٧٢ كتكوت عمر يوم في أقفـاص فـردية موزعين على أربعة مجموعات كل منها تحتوى على ١٨ طائر تم تركيب علائق البادئ (حتي عمر ٢١يوما) بحيث تكون متساوية في محتواها من المركبات الغذائية وتحتوي على ٢٣% بروتين، ٣١٠٠ كيلو كالوري طاقة ممثلة / كجم غذاء. استخدم كسب فول الصويا في تكوين هـذه العلائـق بنسب ٣٠، ٣٥، ٤٠ أو ٤٥%. تم تغذية كل المعاملات التجريبية على نفس عليقة النامي (٢٢ ــ ٣٧يوما) وعليقة الناهي (٣٨ ــ ٤٩ يوما)

لـم يلاحـظ عند عمر ٢١ يوما أي فروق معنوية في وزن الجسم وكمية الغذاء المستهلك ومعامل التحويل الغذائي بين المعاملات المحتوية على نسب مختلفة من كسب فول الصويا. وفي نهاية فترة النامـي (٣٧يوما) وكذا في نهاية التجربة (٤٩يوما) كانت معدلات الأداء الإنتاجي متشابهة في كل المعـاملات. أيـضا لـم يلاحظ أي تأثير للمعاملات الغذائية المختلفة على كل من صفات الذبيحة وبعض القياسات على دم دجاج التسمين في عمر ٤٩يوما.

يستنتج من هذه التجربة أنه يمكن إضافة كسب فول الصويا جيد النوعية في تغذية كتاكيت اللحم حتى مستوي ٤٥% من العليقة في مرحلة البادئ دون أي تأثيرات ضارة على الأداء الإنتاجي وصفات الذبيحة وكذا الكفاءة الإقتصادية.