REPLACEMENT OF SOYBEAN MEAL BY RAW OR TREATED LINSEED MEAL IN BROILER DIETS

ABDALLA, A. A[1], M. A. ASAR[2], F. N. K. SOLIMAN[2] AND G. E. HASSAN[2]

1 Animal Production Research Institute, Agricultural Resereach center, Ministry of Agriculture, Dokki- Giza- Egypt.
2 Faculty of Agriculture, Alexandria University.

(Manuscript received 29 August 2004)

Abstract

Seventy-five Lohman, two weeks of age broiler chicks were used to examine the effects of substitution of raw and treated linseed meal instead of soybean meal protein on broiler performance during starter and finisher periods. Raw linseed meal was treated by boiling in acid solution (HCl 0.1 N), then, soaking over night in copper sulphate solution to minimize the level of some toxic or antinutrional factors. The results indicated that boiling treatment was effective in reducing phytic acid, tannic acid and cyanide ion contents of linseed meal. Treated linseed meal could be replaced effectively and economically up to 25% instead of soybean meal protein in starter and finisher diets without adverse effect on broiler performance carcass traits. This level realized the most relative economic efficiency.

INTRODUCTION

Linseed is one of major oilseed crops and the deoiled meal is a by-product of the oil-milling industry, containg 25 to 35 % protein and deficient in lysine. Madhusudhan *et al.* (1986) reported that raw linseed meal and water boiled meal contain 28.3 and 30.2 % crude protein, 6.6 and 2.0 % crude fat, 12.1 and 1.1 % mucilage, 6.4 and 8.6 % ash, 8.6 and 13.2 % crude fiber and 0.015 and 0.000 % HCN (Hydro Cyanic Acid), respectively. Barbour and Sim (1991) showed that flaxseed and meal had 93 and 91 % dry matter, 25 and 39 % crude protein, 6.211 and 4.541 K cal / g gross energy. Wet-autoclaving linseed meal could replace half of the vegetable protein without adverse effects on broiler chicks (Mandokhot and Singh, 1983). Mahmoud and Malik (1986) concluded that linseed meal should not be given in chickens diet at more than 2.5 %.

The aim of the present study was to examinine the effect of boiling treatment on the nutritional value of linseed meal as source of plant protein in broiler diets. Also, the effect of using different levels of raw and treated linseed meal on broiler performance and carcass traits was tried

تقييم فاعلية مركبات مختلفة للسيطرة على فراشة درنات البطاطس التى تصيب نباتات البطاطس والطماطم

محمد حلمي بلال[١] ، أميمة كمال مصطفى[٢] ، نيروز رزق الله جرجس[٢]

١. *كلية الزراعة جامعة القاهرة.*

٢. *مركز البحوث الزراعية – الدقي – جيزة – مصر.*

اختبارات الصوبة الزجاجية : –

* بدراسة طوال فترة تأثير المركبات المختبرة على نباتي البطاطس والطماطم داخل الصوبة بحساب فترة نصف عمر المتبقيات أمكن ترتيب المركبات تنازلياً كما يلي : الزنتاري – الفيرتيمك – بروفينوفوس – بريمفوس ميثايل ـــ الأجرين ـــ إم في بي تو ـــ دايبل ٢إكس ـــ إيكوتيك ـــ ثم الفيروتيكتو... عند معاملتها على نبات البطاطس.

بينما أمكن ترتيبها تنازليا عند معاملتها على نبات الطماطم كما يلي :– الفيرتيمك– السيليكرون ـــ الزنتاري ـــ الأكتيلك ـــ إم في بي تو ـــ أجرين ـــ دايبل ٢إكس ـــ إيكوتيك ـــ فيروتيكتو.

الاختبارات الحقلية : –

أوضحت النتائج الحقلية ما يلي :–

١– استخدام المركبات المختبرة لمكافحة فراشة درنات البطاطس على محصول البطاطس أمكن ترتيبها تنازليا كما يلي :– فيرتيمك ـــ سيليكرون ـــ زنتاري ـــ أكتيلك ـــ أجرين ـــ إم في بي تو ـــ دايبل ٢إكس ـــ إيكوتيك ـــ فيروتيكتو ـــ بقيم فترة نصف عمر ٢٤,٢٨ ، ٢٣,٩٦ ، ٢٢,٥٣ ، ١٩,٤٥ ، ١٥,٥٦ ، ١٣,٥٣ ، ١٠,٦٦ ، ٩,٥٣ ، ٧,٤٥ يوم على الترتيب .

٢– عند معاملة نبات الطماطم حقليا بالمركبات المختبرة لمكافحة فراشة درنات البطاطس كان الترتيب تنازليا كما يلي :– فيرتيمك ـــ سيليكرون ـــ أكتيلك ـــ زنتاري ـــ أجرين ـــ إم في بي تو ـــ فيروتيكتو ـــ دايبل ٢إكس ـــ إيكوتيك ـــ حيث كانت قيم فترة نصف عمر كما يلي :– ٢٥,٩٤ ، ٢٣,٩٢ ، ٢١,٦٥ ، ٢٠,٧١ ، ١٦,٨٢ ، ١٤,٣٩ ، ٩,١٦ ، ٨,٣٩ ، ٧,٨٢ يوماً على الترتيب .

Analytical Methods

Standard methods (A.O.A.C., 1984) were used for the determination of crude protein, moisture, fat, fiber, ash and calcium in the samples and diets. Phosphorus was determined colorimetrically by the molybdenum yellow method (A.O.A.C., 1984). The total and free amino acids, except tryptophan, were evaluated by the method described by Moore (1958) using a Beckman 119 C amino acid analyzer. The colorimetric method of Spies and Chambers (1949) was used for tryptophan estimation, cyanoides by Boyd and Truog (1955), phytic acid by Wheeker and Ferrell (1971) and tannic acid by Folin Ciocolten colorimetric method (Mc Grath *et al.*, 1982). The amount of the essential amino acids (EAAs) in greatest deficient in raw seeds and raw or treated meals were considered, the first, second and third limiting amino acids as compared with the chicks requirement present in the NRC(NRC,1994). Accordingly, essential amino acid index (EAAI) and chemical score (CS) were calculated (Abdalla *et al.*, 1997).

Economical Efficiency (E.E)

Economic evaluation for all experimental diets was made. Economical efficiency is defined as the net revenue per unit feed cost calculated from input-output analysis.

Statistical Analysis

The data obtained from each experiment were analyzed, separately, by one-way analysis of variance (Snedecor and Cochran, 1981). Duncan's multiple range test (Duncan, 1955) was used to test the significance among mean differences.

RESULTS AND DISCUSSION

Approximate Analysis of Raw and Treated Samples

The percentages in crude protein were 22.82, 28.67 and 29.79% for raw linseed, raw linseed meal and treated linseed meal, respectively (Table 3). These results of crude protein for linseed are almost equal with the results of Barbour and Sim (1991) who found that crude proteins for linseed were 25.0 and 22.41%, respectively. The percentage of crude protein for linseed meal found in the present study is in agreement with the findings of Madhusudhan *et al.* (1986). They reported that it was 28.3. However, the present results were lower than the finding (39.0 %) of Barbour and Sim (1991). Moreover, Madhusudhan *et al.* (1986) found that boiling linseed meal had 30.2 % crude protein, which is in line with the result of the present study.

The Amino Acid Contents of Raw and Treated Samples

The results in Table 4 show that raw linseed and raw or treated linseed meals were lower than the findings of Madhusudhan *et al.* (1986), Barbour and Sim (1991). In general, raw seeds and raw or treated meals were lower in their content of amino acid than soybean meal. These findings are in line with the corresponding results of Barbour and Sim (1991).

The CS values of raw linseed meal (RLSM) and treated linseed meal (LSMT) were 64.71 and 28.50 %, also the EAAI was 86.13 and 74.21%, respectively Table 3. It is clear that Leucine was the first limiting amino acid in RLSM and it was the third limiting amino acid for LSMT. Methionine was the first limiting amino acid for LSMT, while it was the third limiting amino acid for RLSM. Tyrosine was the second limiting amino acid in both RLSM and LSMT.

Metabolizable energy and digestibility values

The results in Table 5 show that boiling treatment for raw linseed meal reduced their ME value from 2214 to 1671 kcal/kg. The ME values of raw linseed meal
mean nightly male moth catch and percentage of infestation in potato plants was determined. The program I included the sex pheromone water traps as mentioned, and two biocides. The two selected biocides were chosen because they had been the most efficient in the field tests Belal *et al* (2004). The first application on the 7th of May 2001, was the bio – compound , Abamectin 1.8% EC at the rate of 60 ml per feddan. The 2nd treatment, applied 10 days following the 1st, was Xantari 10.3% (water dispersible granule) based on *Bacillus thuringiensis* subsp. aizawai at the rate of 240 g per fed. El – Santa canal water was used for the dilution of the tested bio – compounds , Xentari and Abamectin . The program II consisted of the sex pheromone traps only .

At harvest time potato tuber were picked, at random, from the yield of each program area (2 ton / fed.) to be stored in traditional Nawwallas. The potato crop was divided into four piles (replicates) and dusted with Verotecto or Agerin. Piles were covered with dry *Lantana camara* plants in a layer 2.5cm deep and rice straw in a layer 50cm thick. One sex pheromone water trap was put outside of the Nowwalla. Four piles were used as control without any treatment. The infested tubers were recorded after 15 days. Reductions in PTM infestation were estimated according to Henderson and Telton (1955) .

should not be given in chickens diets at more than 2.5%. However, the reduction of growth reported herein disagreed with finding of Mandokhot and Singh (1983) who showed that wet autoclaved meal could replace half of the vegetable protein without adverse effect. Madhusudhan *et al.* (1986) observed that the addition of water boiled linseed meal to the diet at 50 or 75% protein replacement was similar or superior to the control diet based on expeller pressed groundnut cake.

Feed intake and feed conversion

The results of feed intake and fed conversion indicated that both traits (Table 7) were significantly affected by level of replacement and/or processing technique applied with RLSM throughout all experimental period, except the FI at finisher period (35-49 days of age). The FI results showed that the chicks fed control diet (T1) consumed higher amount of ration and had the better value of the FC throughout all experimental periods, while, the lowest FI and FC was recorded for chicks fed TLSM at level 50% replacement (T5). The highly significant differences showed for this trait among different experimental diets may be attributed to the taste or viscosity of RLSM. El-Boushy *et al.* (1989) stated that broiler and layer have an acute sense of taste (gustration), and they have the ability to differentiate between sweet, salt, sour and bitter tasting. El-Boushy *et al.* (1989) reported that selection or rejection of feed is based on feed shape, colur, texture, viscosity, osmotic pressure, nutritive value and toxicity.

Total cyanide intake and total tannic acid intake

The results of cyanide intake showed significant differences among the treatments through the experimental periods (Table 8). These ions are indicators to the amounts of the glucosinolates present in these samples. At the end of the experimental period the cyanide amounts consumed by chicks fed 25 % RLSM (T3) increased significantly compared with other treatments. These results were compatible with the corresponding body weight and gain results, which may explain the reduction in broiler performance.

The results of tannic acid intake reported in Table 8 showed significant differences among the treatments in their tannic intake at the end of experiment. Chicks fed 50 % TLSM (T5) consumed the lowest amount of tannic acid, while, the highest amount was consumed by chicks fed 25 % RLSM (T3), followed by control group (T1). These results were in agreement with the finding of Vahra *et al.* (1966) that the border toxic line was under 0.5 % tannic acid in the diets; since the levels of tannic acid in the experimental diet were (0.186%) lower than the toxic line (Table 2).

Viability:

The viability results showed insignificant differences among treatments, however, it ranged between 86.0 % and 100 %.

Carcass traits

The results of slaughter traits are presented in Tables 9 and 10. Carcass weight of control chicks (T1) had the higher weight than the other treatments, and the lowest weight was observed with chicks fed 50 % TLSM. There were insignificant differences among treatments for proventricules, abdominal fat, heart, liver, spleen, pancreas and gizzard weights. After feeding chickens with linseed meal up to 10 % level for six weeks of age, Mahmoud and Malik (1986) found that dressing percentage was the lowest for 10 % level. Madhusudhan *et al.* (1986) showed that chicks fed raw linseed meal at 20 % protein replacement had significantly higher weight of the heart, lungs, pancreas, liver, kidney and brain.

Economical efficiency

According to the input-output analysis, the diets containing 25 % TLSM (T4) proved to be the most economical diets where the relative economic efficiency (REE) was 104.3 %, while, the other treatments gave less than 100 % REE of the control treatment Table 11.

Conclusion

It could be concluded that Lohman broiler chicks could be fed up to 25 % treated linseed meal, instead of soybean meal protein (about 10 % 0f starter and finisher diet), without adverse effects, and realizing the most relative economic efficiency. However, more investigations are required to increase the nutritional value of linseed meal as an ingredient for poultry.

Table 1. The plan of the experimental diets.

Diet No.	Treatment (T) No.	Period	Plant protein ingredient In the diets	Sample (S)	% Of replacement Soybean protein
1	1	Starter	SBM[1] (control diet)	-	-
2	2		SBM + RLSM[2]	1	12.5
3	3		SBM + RLSM	1	25.0
4	4		SBM +TLSM[3]	2	25.0
5	5		SBM +TLSM	2	50.0
6	1	Finisher	SBM (control diet)	-	-
7	2		SBM + RLSM	1	12.5
8	3		SBM + RLSM	1	25.0
9	4		SBM +TLSM	2	25.0
10	5		SBM +TLSM	2	50.0

1- Soybean meal. 2- Raw linseed meal. 3-Treated linseed meal.

Table 2. Composition of starter and finisher diets.

	Starter diets (kg / ton).					Finisher diets (kg / ton).				
Feed stuffs	1	2	3	4	5	6	7	8	9	10
Yellow corn	450.0	450.0	450.0	450.0	450.0	500.0	500.0	500.0	500.0	500.0
Soybean meal (44%)	280.0	245.0	210.0	210.0	140.0	260.0	227.5	195.0	195.0	130.0
Lin seed meal	-	53.7	107.5	103.6	207.2	-	49.9	99.8	96.2	192.4
Meat&bonemeal(58%)	110.0	110.0	110.0	110.0	110.0	93.0	93.0	93.0	93.0	93.0
Limestone	4.7	4.7	4.7	4.7	5.5	4.8	4.8	4.9	4.8	3.0
Bone meal	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.5	5.0
Premix*	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Salt	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.1
Vegetable oil	10.0	10.0	10.0	20.9	37.0	10.0	10.0	10.0	20.0	33.0
Starch	110.0	99.0	90.0	82.0	37.9	98.4	90.0	79.4	72.4	36.7
D. L.Methionine	1.5	1.3	1.2	1.2	1.4	1.2	1.1	1.0	1.0	0.8
L. Lysine	-	-	-	-	1.0	-	-	-	-	1.0
Sand	23.8	16.3	6.6	7.6	1.0	22.6	13.7	6.9	8.1	0.1
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Calculated values										
Crude protein (CP) %	22.84	22.84	22.84	22.84	22.84	21.18	21.18	21.18	21.18	21.18
ME *k cal / kg*	2855	2855	2855	2855	2855	2902	2902	2902	2902	2902
C/P *ratio*	125.00	125.00	125.00	125.00	125.00	137.00	137.00	137.00	137.00	137.00
Crude fat *%*	2.89	3.53	4.17	3.01	3.13	2.90	3.53	4.12	3.04	3.16
Crude fiber *%*	2.80	3.16	3.52	3.31	3.82	2.75	3.08	3.41	3.22	3.69
Calcium *%*	1.26	1.28	1.28	1.28	1.33	1.13	1.14	1.15	1.14	1.20
P.(availabl *%*	0.63	0.64	0.64	0.64	0.65	0.56	0.57	0.57	0.57	0.56
Arginine *% of CP*	6.89	6.92	6.96	6.88	6.85	6.91	6.94	6.98	6.90	6.92
Lysine *% of CP*	5.73	5.16	4.94	4.88	4.85	5.32	5.11	4.90	4.85	4.83
Methionine *% of CP*	2.16	2.16	2.21	2.20	2.26	2.11	2.11	2.20	2.19	2.26
Cystine *% of CP*	1.53	1.49	1.45	1.45	1.36	1.57	1.53	1.49	1.49	1.40
Tryptophan *% of CP*	1.07	1.24	1.41	1.52	1.97	1.30	1.27	1.43	1.55	2.00
Tannic acid %	0.171	0.172	0.186	0.160	0.162	0.156	0.169	0.182	0.148	0.162
Cyaniod Ion %	-	0.050	0.100	0.041	0.083	-	0.046	0.093	0.038	0.077

***Premix:** : V.A: 8000000 IU; V.D3:160000 IU;V.E:3000 mg;V.K3: 1500 mg; V.B1: 750 mg; V.B2: 2250 mg ; V. B6: 750 mg; V.B12:5000 mg; D. calcium pantothenate: 500 mg; Choline chloride: 6000 mg; Folic acid:100 mg; Biotine:5 mg;Manganese:1000 mg; Iodine:240 mg; Cobalt: 60 mg; Zinc:10000 mg; Copper:1000 mg; Iron: 6500 mg; Selenium:40 mg; Ethoxyquine:5000 mg; Ascorbic acid: 500 mg; Carrier: till 1000 gram.

Table 3. Chemical analysis and Percentage of antinutritional factors of the raw seeds and raw or treated meals

	Mo. %	CP %	ME k cal/ kg	E.E. %	CF %	NFE %	Ash %	Ca %	P.t %	P.v %	Fe %	TA %	PhA %	Cy I. %
RLS	9.82	22.82	ND*	34.20	8.50	17.13	7.53	0.37	0.79	-	0.38	0.47	0.68	1.05
RLSM	9.32	28.67	2214	12.54	10.56	29.75	9.16	0.45	0.75	0.32	0.35	0.50	1.21	0.93
LSMT	10.28	29.79	1621	1.80	8.97	39.71	9.45	0.39	0.70	0.30	0.43	0.27	0.39	0.40

Mo.: Moisture. NFE: Nitrogen Free Extract. CP.: Crude protein
Fe.: Ferrous. Ca : Calsium. TA.: Tannic acid.
ME.: Metabolizabl Energy. P.t.: Phosphorus (total). Ph.: Phytic acid.
P.v. Phosphorus (available). E.E.: Ether Extract Cy I.: Cyanide Ion.
ND*:not detected.

Table 4 . Determined amino acids contents' of the raw seeds and raw or treated meals

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Table 5. Means and standard error ($\bar{x}$ ± S.E.) of ME value and percentage of digestibility (dry matter, protein, fat and carbohydrate).

Plant protein	ME*	% Digestability of			
Ingredient	(k cal / kg)	Dry matter	Protein	Fat	Carbohydrate
RLSM	2214 ± 0.18	72.2 ± 0.04	58.8 ± 0.37	85.9 ± 0.00	90.6 ± 0.06
LSMT	1671 ± 0.09	72.0 ±0.06	49.0 ± 0.00	85.0 ± 0.01	90.0 ± 0.04

* ME (Kcal/kg)air dried

Table 6. Means and standard error ($\bar{x}$ ± S.E.) of body weights and gain (g) of broiler chicks at 14, 35 & 49 days of age.

	Body weight(g)			Body weight gain(g)		
Treatments	Age (days)			Age (days)		
	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.
1	219.3 ± 5.58	878.0 ± 38.77^{a}	1435.0 ± 57.48^{a}	665.3 ± 40.10^{a}	549.5 ± 40.34^{a}	1222.3 ± 55.36^{a}
2	217.0 ± 5.95	734.0 ± 39.48^{bc}	1079.2 ± 57.99^{b}	517.0 ± 37.41^{bc}	343.8 ± 38.44^{b}	860.4 ± 56.94^{bc}
3	218.7 ± 5.68	696.7 ± 35.55^{c}	1166.4 ± 42.69^{b}	478.0 ± 33.92^{c}	464.6 ± 37.35^{a}	947.1 ± 42.82^{b}
4	219.3 ± 5.02	801.4 ± 32.98^{ab}	1321.3 ± 64.09^{a}	581.1 ± 30.44^{ab}	506.8 ± 40.98^{a}	1093.3 ± 67.38^{ab}
5	217.7 ± 4.50	557.9 ± 23.79^{d}	803.8 ± 53.56^{c}	345.4 ± 25.49^{d}	247.9 ± 44.52^{b}	585.0 ± 53.58^{d}
Overall mean	218.5 ± 2.30	735.10 ± 19.70	1167.0 ± 36.00	518.8 ± 19.40	425.7 ± 22.10	948.0 ± 33.60

♘ *Column means with different superscripts are differ significantly (P < 0.05).*

Table 7. Means and standard error ($\bar{x}$ ± S.E.) of feed intake (g / bird) and feed conversion (g feed / g gain) of broiler chicks.

	Feed intake			Feed conversion		
Treatments	Age (days)			Age (days)		
	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.
1	1461.3 ± 55.09^{a}	1723.3 ± 129.44	3148.0 ± 115.49^{a}	2.20 ± 0.01^{c}	3.20 ± 0.61^{ab}	2.63 ± 0.08^{b}
2	1390.0 ± 58.59^{a}	1452.6 ± 112.85	2843.3 ± 85.56^{bc}	2.70 ± 0.08^{bc}	4.25 ± 0.43^{a}	3.28 ± 0.13^{b}
3	1452.7 ± 9.68^{a}	1435.5 ± 125.77	2856.0 ± 56.71^{abc}	3.05 ± 0.09^{ab}	3.19 ± 0.45^{ab}	3.01 ± 0.17^{b}
4	1455.3 ± 40.44^{a}	1482.9 ± 126.86	2904.7 ± 149.55^{ab}	2.55 ± 0.15^{bc}	2.99 ± 0.47^{b}	2.89 ± 0.47^{b}
5	1198.0 ± 37.54^{b}	1225.1 ± 208.72	2524.7 ± 113.17^{c}	3.57 ± 0.35^{a}	4.82 ± 0.70^{a}	4.43 ± 0.31^{a}
Overall mean	1391.5 ± 30.60	1463.9 ± 52.28	2855.3 ± 113.17	2.81 ± 0.14	3.50 ± 0.15	3.26 ± 0.20

♘ *Column means with different superscripts are differ significantly (P < 0.05).*

Table 8. Means and standard error ($\bar{x}$ ± S.E.) of total cyanide ion (g / bird) and total tannic acid intake (g / bird) of broiler chicks.

	Cyanide ion			**Tannic acid**		
Treatments	Age (days)			Age (days)		
	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.	14-35 $\bar{x}$ ± S.E.	35-49 $\bar{x}$ ± S.E.	14-49 $\bar{x}$ ± S.E.
1	-	-	-	23.09 ± 0.88^{b}	16.17 ± 1.79	49.40 ± 1.81^{ab}
2	6.95 ± 0.11^{c}	3.91 ± 2.77	13.63 ± 0.39^{f}	23.91 ± 0.66^{b}	24.88 ± 1.85	48.47 ± 1.44^{ab}
3	14.53 ± 0.10^{a}	19.04 ± 5.84	27.58 ± 0.38^{a}	27.02 ± 0.18^{a}	27.64 ± 3.70	52.56 ± 1.03^{a}
4	5.97 ± 0.17^{d}	1.60 ± 3.84	11.48 ± 0.57^{c}	23.29 ± 0.65^{b}	21.42 ± 1.78	44.74 ± 2.21^{b}
5	9.95 ± 0.31^{b}	10.91 ± 0.93	20.17 ± 0.87^{b}	19.41 ± 0.61^{c}	19.25 ± 3.90	40.90 ± 1.83^{c}
Overall mean	7.48 ± 1.28	8.87 ± 0.93	14.57 ± 2.47	23.34 ± 0.69	23.87 ± 0.85	47.22 ± 1.25

♘ *Column means with different superscripts are differ significantly (P < 0.05).*

Table 9. Means and standard error ($\bar{x}$ ± S.E.) of carcass, proventricules, abdominal fat weights and total intestinal length of broiler chicks at the end of the experiment.

Treatments	Carcass	Proventricules	Abdominal fat	Total intestinal l.
	G $\bar{x}$ ± S.E.	g / kg BW $\bar{x}$ ± S.E.	G / kg BW $\bar{x}$ ± S.E.	Cm / kg BW $\bar{x}$ ± S.E.
1	988.3 ± 22.42[a]	7.3 ± 0.33	8.0 ± 1.53	137.3 ± 7.31[b]
2	740.0 ± 35.12[c]	7.7 ± 1.20	5.0 ± 2.63	134.3 ± 17.82[b]
3	810.0 ± 50.33[bc]	6.7 ± 0.33	10.3 ± 1.73	131.7 ± 24.06[b]
4	876.7 ± 17.64[b]	7.7 ± 0.88	18.7 ± 2.85	160.3 ± 12.03[ab]
5	573.3 ± 33.83[d]	7.3 ± 0.67	10.3 ± 7.54	214.7 ± 13.38[a]
Overall mean	797.7 ± 39.3	7.3 ± 0.30	11.7 ± 2.30	155.7 ± 10.30

Column means with different superscripts are differ significantly (P < 0.05).

Table 10. Means and standard error ($\bar{x}$ ± S.E) of some organs weights of broiler chicks at the end of the experiment.

Treatments	Heart	Liver	Spleen	Pancreas	Gizzard
	g / kg BW $\bar{x}$ ± S.E.	g / kg BW $\bar{x}$ ± S.E.	g / kg BW $\bar{x}$ ± S.E.	g / kg BW $\bar{x}$ ± S.E.	g / kg BW $\bar{x}$ ± S.E.
1	5.0 ± 0.58	25.3 ± 1.76	2.3 ± 0.33	3.0 ± 0.00	14.0 ± 2.08
2	6.0 ± 0.58	31.0 ± 3.06	2.3 ± 0.33	3.3 ± 0.33	19.7 ± 0.88
3	7.0 ± 0.00	24.0 ± 1.53	3.3 ± 0.33	4.3 ± 0.33	19.7 ± 1.33
4	5.7 ± 0.67	25.7 ± 2.60	3.7 ± 0.33	4.7 ± 0.67	19.3 ± 1.20
5	7.7 ± 1.67	22.3 ± 0.67	4.0 ± 0.00	4.7 ± 0.33	21.3 ± 0.88
Overall mean	6.3 ± 0.40	25.7 ± 1.10	3.1 ± 0.20	4.0 ± 0.20	18.8 ± 0.30

Column means with different superscripts are differ significantly (P < 0.05).

Table 11. Economical efficiency (E.E.) and relative economical efficiency (R. E.E.).

Treatments	Av. BW[1]	T. Rev. / Chick [2]	T. F.C. / Chick[3]	Kg F. cost[4]	T. F. cost[5]	Net Rev. / chick[6]	E.E.[7]	R.E.E.[8]
	G	L.E.	G	L.E.	L.E.	L.E.		%
1	1435.0	6.10	3148	0.997	3.14	2.96	0.94	100.0
2	1079.2	4.59	2843	0.974	2.77	1.82	0.66	70.2
3	1166.4	4.96	2856	0.950	2.71	2.25	0.83	88.3
4	1321.3	5.62	2905	0.979	2.84	2.78	0.98	104.3
5	803.8	3.42	2525	0.982	2.48	0.94	0.38	40.4

1 ⇨ average live body weight. 2 ⇨ total revenue / chick assuming 4.25 L.E. / kg live body weight

3 ⇨ kg total feed consumption / chick. 4 ⇨ kg feed cost. 5 ⇨ total feed cost / chick. 6 ⇨ net revenue.

7 ⇨ economical efficiency (E.E. = $\frac{\text{net rev. / chick}}{\text{T. F. cost}}$)

8 ⇨ relative economical efficiency, assuming control treatment = 100 %

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استبدال كسب فول الصويا بكسب الكتان الخام أو المعامل في أعلاف كتاكيت اللحم

احمد عبد العزيز عبد الله[١] ، محمد احمد عصر[٢] ، فريد نصيف كامل[٢] ، جمال الدين حسن[٢]

١. *معهد بحوث الإنتاج الحيواني- مركز البحوث الزراعية- وزارة الزراعة - الدقي- جيزة- مصر*
٢. *كلية الزراعة - جامعة الإسكندرية*

أستخدم في هذه الدراســـة ٧٥ كتكوت لوهمان عمر أسبوعين لدراسة تأثير إحلال كسب الكتان الخام والمعامل لبروتين كسب فول الصويا على أداء كتاكيت اللحم خلال فترتي البادئ والناهي.

عومل كسب الكتان الخام باستخدام الغليان في محلول ملحي (حامض هيدروكلوريك ١و٠ عياري) ثم النقع في الماء لليوم التالي في محلول كبريتات النحاس وذلك لخفض محتواه من المواد السامة أو العوامل المثبطة غذائيا. أوضحت النتائج أن المعاملة لكسب الكتان الخام بالغليان كانت مؤثرة في لخفض محتواه من حامض الفيتك وحامض التانيك وأيون السيانيد . واتضح من النتائج انه يمكن استخدام كسب الكتان المعامل بنسبة استبدال ٢٥ % من بروتين كسب فول الصويا في أعلاف كتاكيت اللحم البادئ والناهي دون أن يؤثر ذلك على أداء و صفات الطيور كما انه يحقق اكبر عائد اقتصادي نسبي.