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DIETARY VEGETABLE PROTEIN IN BROILER FEEDING

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ABSTRACT

The performance of broiler chicks fed plant-protein-diets (starter , grower , finisher) was compared to those fed diets supplemented with 5% meat and bone meal, (67% protein). One hundred and sixty, one day old male Ross broilers, were used. A total number of 80 chicks were allocated for each treatment, divided into four replicates of 20 birds each , and housed in broiler cages .The experimental diets were formulated to cover the chick requirements as recommended by the management guide data (Ross). The protein Efficiency Ratio (PER) of both dietary proteins were almost of the same value . Also the essential amino acid make up (or pattern) of the proteins of both sets of diets contained almost the same concentration and pattern .Body weight gain and efficiency of feed utilization during the three growth periods of chicks fed either plant-protein diets or those fed the animal protein supplemented diets , were almost of similar magnitude with no significant differences . The final body weight of broilers fed plant-protein diets surpassed those of chicks fed the animal protein supplemented diets . While, the over all feed efficiency showed better values with chicks fed the animal protein supplemented diets , with no significant differences compared to those fed plant – protein diets. Abdominal Fat Pads were significantly lower in birds fed plant-protein diets .The cost of feed required to produce 1 kg live weight gain was LE 1.59, for chicks fed plant-protein diets compared to LE 1.56 for those fed animal-protein supplemented diets with a difference of 1.9% on the time of experiment .The results of the present work encouraged CLFF to implement such work on semi commercial production scale. A broiler house of 16000 broiler chicks capacity per run, was used. Four runs were carried out during the period from Jan. up till Nov.2003 and showed that mortality rate was below 5%, average live weight ranged between 1650-1850 g , with an efficiency of feed utilization ranging between 1.70-1.87 kg feed / kg live weight at 37 days of age (slaughter date) . The quality of birds meat fed plant protein diet is better, less abdominal fat pad, more thickness of breast tender and tasty.

Keywords: Plant protein diet, broiler chicks, performance, abdominal fat.

INTRODUCTION

During the last decade, two important alarming incidences, in respect to animal and poultry feeding, took place, i.e.:

i- Bovine Spongiform Encephalopathy (BSE), known as " mad cow disease", break-out in the united kingdom and spread in many European States. It is thought (not yet sure) that the disease may be transferred by a prion to animals and humans through contaminated meat, meat products and other animal parts.

ii- Dioxin concentration mainly in animal products (Fish, meat and dairy products) exceeded safe levels and became alarming in European products.

The Egyptian Authorities took steps to safe-guard the Egyptian people and to avoid the transfer of such hazards to the animal wealth of the country. Accordingly a decision was taken to ban importation of meat, meat products or any part of the animal from European countries.

The Central Laboratory of Food and Feed (CLFF) is the Quality Control Authority of Egypt for animal feeds. Beside that, it has many activities in human food and nutrition, and the production of safe food is one of its interests. Under the prevailing situation of scarcity of animal protein supplements for poultry, CLFF adapted the use of all-plant protein-diets for poultry, specially in broiler production.

In this respect Vogt (1968) found no significant difference among groups of laying hens fed on a diet supplemented with 6% fish meal, and others fed on a diet where soybean meal (SBM) was the main protein source and supplemented with amino acids and vitamins of B group. Also, Labib *et al* (1970) showed that an all-plant-protein – diet for layers (main protein sources were sesame seed meal and peanut meal) supplemented with L-lysine, gave production of 129% of the control diet, whereas the diet supplemented with 2.0% fish meal, 3.0% meat meal (59%) and 0.5% dried skim milk gave only 117% of the control. Using an all plant protein diet containing 35% cotton seed meal and supplemented with lysine to 0.9% level, and sulphur amino acids to a level of 0.71% (NRC,1960), Hassan (1975) found that Dokki 4 chicks gave live weight of 479g at 6 weeks, almost the same as those fed a diet supplemented with casein, fish meal and blood meal.

The present work has been planned to confirm that the protein requirements is controlled essentially by the amino acid pattern in the feed and not by the source of protein. This shall be manifested by feeding broiler chicks (fast growing chicks, with higher nutrient requirements than those prevailed during the 60s and 70s of the last century) on plant-protein -diets with the necessary adjustments of the critical amino-acids (lysine and methionine) compared to broilers fed on feed supplemented with animal protein sources.

MATERIALS AND METHODS

The present work was carried out in the animal experimental house of the Central Lab for Food and Feed (CLFF), attached to the Agricultural Research Center, Egypt.

One hundred and sixty one day old, male Ross broiler chicks were used. Two treatments were involved in the present study, to evaluate the performance of broiler chicks fed on all plant protein diets versus those fed on animal protein supplemented diets. A total number of 80 chicks were allocated for each treatment, divided into four replicates of 20 birds each and housed in broiler cages.

The experiment lasted for 47 days divided into 3 periods i.e : starter 1-13 days, grower 14-28 days and finisher 29-47 days. Diets were formulated to satisfy the requirements of each growth period as recommended by the Ross management guide data shown in Table 1.

Proteins in plant protein diets (starter, grower, and finisher) were supplied by yellow corn, soybean meal (46%), corn gluten meal (62%). In animal protein supplemented diets, proteins were supplied by yellow corn, SBM 46%, corn gluten meal 62%, and meat and bone meal (57%). Diets were supplemented with L-lysine HCL and DL. methionine as recommended

by the management guide data (Ross). Sunflower oil was used to adjust the levels of metabolizable energy content of the diets. Calcium and available phosphorous were adjusted by the use of dicalcium phosphate and limestone. Vitamins and trace minerals were added to cover the requirements. Feed and water were supplied *ad libitum*, and light was supplied 24 hrs daily.

Table 1: Experimental diets.

Ingredients	Plant Protein Diets g/kg			Animal Protein Supplemented Diets g/kg		
	Starter	Grower	Finisher	Starter	Grower	Finisher
Yellow corn	571.0	571.1	631.7	620.0	623.7	674.2
Soy bean meal (46%)	320.5	300.5	260.0	240.0	220.0	180.0
Corn gluten meal (62%)	50.4	50.4	30.0	50.0	50.0	40.0
Meat & Bone meal (57%)	-	-	-	50.0	50.0	50.0
Sunflower Oil	14.7	36.6	39.0	11.0	26.6	32.0
Dicalcium Phosphate	21.4	20.4	27.7	15.0	15.5	10.9
Lime stone	9.9	9.3	0.5	1.0	0.8	1.6
Nacl	3.0	3.0	3.0	3.0	3.0	3.0
Vitamin & Trace Mineral mix.[1]	4.0	4.0	4.0	4.0	4.0	4.0
L-Lysine HCl (98%)	2.9	2.8	2.2	3.7	4.1	2.0
DL-Methionine (99%)	2.2	1.9	1.9	2.3	2.3	2.3
Total	100	100	100	100	100	100
Calculated analysis						
Protein (Nx 6.25%)	23.14	22.18	19.53	22.78	21.92	19.66
M E (Kcal/Kg)	3032	3175	3223	3081	3184	3256
Lysine %	1.37	1.30	1.02	1.32	1.29	1.03
Methionine %	0.61	0.56	0.52	0.62	0.60	0.58
Met.+ Cystine %	1.00	0.94	0.84	1.01	0.97	092

[1] Vitamin – mineral mixture supply per Kg of diet: Vit. A, 12000 I.U., Vit. D3, 2000 I.U; Vit. E, 10mg; Vit. K3, 2mg; Vit. B1, 1mg; Vit. B2, 5mg; Vit. B6, 1.5mg Vit. B12, 10mg; Biotin, 50mg; Choline chloride, 500mg; pantothenic acid, 10mg; Niacin, 30mg; Folic acid, 1mg; Manganese, 60mg; Zinc, 50mg; Iron, 30mg; Copper, 10mg; Iodine, 1mg and Cobalt, 0.1mg.

At the end of each growth period, broilers body weight, feed consumption and mortality were recorded.

Body weight gain and efficiency of feed conversion values were calculated for each growth period and for the whole growth period.

At the end of the experiment, two broilers from each replicate were sacrificed, and the weight of abdominal fat pad was determined. To confirm the results obtained in the present work and its suitability for commercial production, a broiler house situated in Nubaria (ca 160 km North West of Cairo)of 16000 broiler capacity per run was used. Five runs, using all-plant-protein diets were carried out.

Data were statistically analyzed using the general linear model for analysis of variance (SAS Institute, 1990). Significant differences among treatment means were separated by Duncan's new multiple range test (Duncan, 1995).

RESULTS AND DISCUSSION

Performance of broiler chicks fed on the experimental diets shown in Table 1, is summarized in Table2.

Table 2: performance of broiler chicks fed plant-protein diets versus those fed animal-protein supplemented diets

Performance		Plant Protein Diets		Animal-protein SupplementedDiets	
Starter Period (1-13days)					
Live Body weight	g	232	a	227	a
Body weight gain	g	190	a	185	a
Feed intake	g	261	a	246	a
Efficiency of feed utilization	g feed / g gain	1.37	a	1.33	a
Growth Period (14-28 days)					
Live Body weight	g	964	a	942	a
Body weight gain	g	732	a	715	a
Feed intake	g	1278	a	1251	a
Efficiency of feed utilization	g feed / g gain	1.75	a	1.75	a
Finisher Period (29-47 days)					
Live Body weight	g	2159	a	2147	a
Body weight gain	g	1195	a	1205	a
Feed intake	g	2490	a	2307	a
Efficiency of feed utilization	g feed / g gain	2.08	a	1.91	a
Entire Growth Period (1-47 days)					
Live Body weight	g	2159	a	2147	a
Body weight gain	g	2117	a	2105	a
Feed intake	g	4029	a	3804	a
Efficiency of feed utilization	g feed / g gain	1.90	a	1.81	a
Mortality	birds/treatment	2		3	
Abdominal Fat pad	% of live weight weight	1.626		2.512	

a...Means within a column for each statistical analysis with no common superscripts are significantly different (P<0.05).

It is apparent that body weight gain during the three growth periods of broiler chicks fed either plant-protein diets or animal protein supplemented diets were almost of similar magnitude, with no significant differences. Also, no significant differences were noticed in the efficiency of feed utilization between the two treatments. Examining the data obtained for the whole growth period, the final body weight and body weight gain of broilers fed plant-protein diet surpassed those fed on the animal - protein supplemented diets, with no significant difference. The efficiency of feed utilization showed better value with chicks fed the animal-protein supplemented diets than those fed plant protein diets, but the differences were not significant. Birds fed on plant-protein diets showed significantly less abdominal fat pad than chicks fed on meat-meal supplemented diets.

From the foregoing survey of results obtained from the experiment, it is apparent that no marked differences in performance could be traced. If the nutritive value of the dietary proteins is questioned, it could be shown that Protein Efficiency Ratios (PER) of *Osborne et al.* (1919), a measure for protein nutritive quality , were almost similar (Table 3).

Table 3: Protein Efficiency Ratio[1] for plant protein diets versus animal protein supplemented diets

	Plant protein diets	Animal-protein Supplemented diets
Starter Growth period (1 – 13 days)	3.15	3.30
Grower Growth period (14 – 28 days)	2.58	2.61
Finisher Growth period (29 – 47 days)	2.46	2.66
Entire Growth period (1 – 47 days)	2.55	2.68

[1] Osborne et al (1919)

Also the amino acid make up of the protein for both diets may be examined. Data in Table 4 show the percent of essential amino acids in the plant protein diets and those of the animal protein supplemented diets. It is obvious from Table 4 that the two sets of diets contained almost the same concentration and pattern of the essential amino acids. Therefore, it is expected that chicks fed on either of the two sets of diets, would give the same performance. The amino acid patterns also confirmed the results in Table 3 for the PER .

Table 4: Calculated amino acid concentration of experimental diets.

AMINO ACIDS	Starter Feeds		Grower Feeds		Finisher Feeds	
	Plant protein Diets	Animal-protein supplemented Diets	Plant protein Diets	Animal-protein supplemented Diets	Plant protein Diets	Animal-protein supplemented Diets
	A.A% of Feed	A.A% of Feed	A.A% of Feed	A.A% of Feed	A.A% of Feed	A.A% of Feed
LYS	1.37	1.32	1.30	1.29	1.02	1.03
MET	0.61	0.62	0.56	0.60	0.52	0.58
MET+CYS	1.00	1.01	0.94	0.97	0.84	0.92
THR	0.87	0.84	0.83	0.81	0.72	0.73
TRY	0.28	0.26	0.27	0.24	0.24	0.20
ILE	0.95	0.88	0.91	0.84	0.79	0.76
LEU	2.26	2.22	2.19	2.14	1.62	1.96
ARG	1.42	1.34	1.36	1.27	1.19	1.14
GLY	0.93	1.03	0.89	0.99	0.79	0.91
PHE	1.17	1.11	1.11	1.07	0.96	0.96
PHE+TYR	2.12	1.99	2.02	1.91	1.75	1.71
HIS	0.60	0.56	0.57	0.54	0.51	0.50
VAL	1.07	1.03	1.02	0.98	0.90	0.89

In respect to abdominal fat pad, Scaife *et al.* (1994) found that beef tallow gave higher fat pad than soybean oil. Also, Shimamura *et al.* (1990) came to the conclusion , that supplemented vegetable oil reduced body fat deposition. Mendonca and Jensen (1989) found that abdominal fat pad was significantly lower for birds fed on corn-soy diets than those fed on poultry-by product supplemented diet. The significant high values of abdominal fat pad observed with birds fed on meat meal supplemented diets may be due to the presence of animal fat (meat meal contains10-15% fat) rich in saturated fatty acids and poor in polyunsaturated fatty acids (Akiba *et al.*, 1994, and Leveille *et al.*, 1975.

Calculating the cost of feeds used in the present work, table 5 shows that the three plant-protein feeds were cheaper than their respectives animal – protein supplemented feeds.

Table 5 : Feed cost , LE / Ton.

Experimental Feeds	Plant Protein Diets	Animal–protein supplemented Diets
Starter	818.84	855.33
Grower	859.07	893.69
Finisher	827.71	843.66

Also, it is apparent from Table 6 that the production of one kilogram growth during the starter and grower periods required amounts of feeds of plant-protein diets cheaper than those of animal protein supplemented diets, although it was not the case with the finisher period. The overall performance showed that the cost of feed required for the production of 1 kg live weight gain was LE 1.59 for plant protein diets compared to LE 1.56 for those fed on the animal protein supplemented diets with a difference of 1.9% only.

Table 6 : Cost* of Feed for Kg live weight gain.

Growth Periods	Plant Protein Diets	Animal–protein supplemented Diets
Starter Period (1-13days)		
ive weight gain (SLWG) kg	0.19	0.19
eed consumed / period kg	0.26	0.25
ost of Feed Consumed LE	0.22	0.24
ost of Feed / 1kg SLWG LE	1.13	1.14
Grower Period (14-28 days)		
- Live weight gain (GLWG) kg	0.73	0.72
- Feed consumed / period kg	1.28	1.25
- Cost of Feed Consumed LE	1.11	1.12
- Cost of Feed / 1kg GLWG LE	1.50	1.56
Finisher Period (29-47 days)		
-Live weight gain (FLWG) kg	1.20	1.21
- Feed consumed / period kg	2.49	2.31
- Cost of Feed Consumed LE	2.06	1.95
- Cost of Feed / 1kg FLWG LE	1.72	1.62
Entire Growth Period (1-47 days)		
- Live weight gain (ELWG) kg	2.12	2.11
- Feed consumed / period kg	4.03	3.80
- Cost of Feed Consumed LE	3.38	3.27
- Cost of Feed / 1kg ELWG LE	1.59	1.56

*** on the time of experiment**

The present work showed clearly that biologically and economically, it is possible to grow successfully broilers on plant protein diets. This will reduce the hazards that may occur when animal – protein sources are used .

To confirm the results obtained on a research scale, it was decided to carry out such work on commercial production scale . A poultry house , in Nubaria (North west of the Nile Delta), well equipped , with a capacity of 16000 broilers was used. Four batches of broiler chicks were grown on plant-protein feed uptill 37 days (Slaughter date). The performance of the chicks is summenzed in Table 7.

Table 7: Performance of broiler chicks fed on plant-protein diet grown on commercial scale .

Batch No.	Growth period days	Number of chicks received	No. of Broilers received by processing plant(PP.)	Mortality %	Broilers weight received by PP. kg	Average Live Wt g	Feed consumed kg	Feed conversion g feed/g gain
1	37	16000	15295	4.41	26716	1747	47500	1.78
2	37	16000	15353	4.04	26410	1720	47500	1. 80
3	37	16000	15319	4.25	25314	1650	47500	1.87
4	38	16000	15564	2.73	28820	1852	49000	1.70

Mortality rate was below 5%. Efficiency of feed utilization ranged between 1.70-1.87 g feed / g gain, which is better than that obtained under research scale condition, being 1.90 (Table 2) . The feed conversion value obtained on commercial scale is considered to be one of the best values obtained in Egypt .

The work on commercial production scale proved that the use of plant – protein diets can produce commercially sound results that are not different , if not better, than those when animal – protein supplemented feeds are used.

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تغذية كتاكيت اللحم على علائق نباتية

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تهدف هذه الدراسة لتقييم الاداء الانتاجى لكتاكيت اللحم المغذاه على علائق نباتية الاصل (بادىء – نامى – ناهى) مقارنة بأداء كتاكيت اللحم المغذاه على علائق تحتوى على ٥% مسحوق اللحم والعظم الذى يحتوى على ٦٧% بروتين خام.

استخدم فى هذه الدراسة ١٦٠ كتكوت تسمين ذكور من نوع Ross عمر يوم بكل معامله ٨٠ كتكوت قسمت إلى اربعة مكررات بالتساوى (٢٠ كتكوت فى كل مكرر) ووضعت فى بطاريات.تم تركيب العلائق لتحتوى تقريبا على نفس تركيزات العناصر الغذائية فى كل المعاملات اخذا فى الاعتبار الاحتياجات الخاصة بالسلالة المستخدمة .تم ضبط قيم الميثيونين والليسين لتتفق والمستويات المنصوص بها فى دليل السلالة المستخدمة وكانت نسبة كفاءة البروتين متساوية القيمة تقريبا فى كلا المعاملتين هذا بالاضافة الى ان نمط الاحماض الامينية الاساسية فى كلا العليقتين كانتا تحتوى على نفس التركيز أوضحت النتائج ما يلى:

كانت الزياده في وزن الجسم وكفاءه استخدام الغذاء اثناء فترات النمو الثلاثه (بادي – نامي – ناهي) للكتاكيت التي غذيت اما علي علائق بروتين نباتي فقط او علي علائق تحتوي علي بروتين حيواني تقريبا متشابهه بدون اختلافات معنويه بينما اظهرت الاوزان النهائيه للكتاكيت التي غذيت علي بروتين نباتي فقط تفوقها علي تلك الكتاكيت التي غذيت علي علائق تحتوي علي بروتين حيواني.

اظهرت كفاءه الغذاء النهائيه قيما افضل مع الكتاكيت التي غذيت علي علائق تحتوي علي بروتين حيواني ولكن الاختلافات كانت غير معنويه عند مقارنتها بالعلائق المحتوية على بروتين نباتى فقط. كما وجد انخفاض معنوي في نسبه دهن البطن بالنسبه للطيور المغذاه علي علائق تحتوي علي بروتين نباتي فقط مقارنه بالطيور المغذاه علي علائق تحتوي علي بروتين حيواني كما وجد ان تكاليف الغذاء المطلوب لانتاج ١كجم وزن حي هو ١,٥٩ جنيه من كتاكيت غذيت علي علائق بروتين نباتي فقط مقارنه بـ ١,٥٦ جنيه للكيلوجرام من تلك الكتاكيت المغذاه علي علائق تحتوي علي بروتين حيواني (باختلاف يقرب من ١,٩ % بينها) وذلك في وقت إجراء التجربه.

شجعت هذه النتائج المعمل المركزي للاغذيه والاعلاف ان يقوم بعمل انتاجي شبه تجارى لتطبيق نتائج الدراسة السابقة حيث تم انشاء مزرعه تسمين بقدره ١٦٠٠٠ كتكوت لكل دوره تسمين. وقد تم انجاز اربعه دورات تسمين خلال المده من يناير حتي نوفمبر ٢٠٠٣ ، وكانت نسبه النفوق اقل من ٥% وبمعدل وزن حي يتراوح ما بين ١٦٥٠-١٨٥٠ جرام وبكفاءه استخدام غذاء تتراوح بين ١,٧ -١,٨٧ كجم غذاء / كجم وزن حي عند عمر ٣٧ يوما (تاريخ الذبح) ذلك للطيور المغذاه على علائق تحتوى على بروتين نباتى فقط ومتزنة فى محتواها من الأحماض الأمينية وبقية العناصر الغذائية اللازمة للسلالة المستخدمة فضلا عن تميز لحم الطيور بالجودة والطعم الجيد.