Assiut Vet. Med. J. Vol. 37 No. 73, April 1997

Animal Health Research Institute
Assiut Laboratory
Head of Lab.: Prof. Dr. S. Nashed

THE VALUE OF USING DIFFERENT SOURCES AND LEVELS OF FAT IN BROILER DIETS

(With 7 Tables)

By

H.K. SHOEIB

(Receirved at 16/2/1997)

فـــائدة أستخدام مصادر ومستويات مختلفة من الدهـن في علائق بداري التسمين

حســـــين شـــــعيب

أجريت هذه التجربة لدراسة مدي تـاثير اضافـة الدهـون النباتيـة والحيوانيـة علـي اداء بـداري التسمين.وقد تم استخدام مصدريـن للدهـون احدهمـا نبـاتي(زيـت عبـاد الشـمس) والاخـر حيوانـي (شحوم حيوانية) كمصادر شائعة الاستخدام بنسب ٢٪ ,٤٪ لكل منهما بالاضافة الي خليـط منهمـا بنسبة (٢٪ + ٢٪) وقد وجد ان إضافة الدهون بوجه عام الي علائق البداري ادي الي تحسن في وزن الجسم مقارنة بالعليقة الضابطة ,وكان اعلي معدل وزن لبداري المجموعة الرابعة التي تمـت تغذيتها علي خليط من المصدرين (٢٪ زيت عباد الشمس+٢٪ شحوم حيوانية) مـع وجـود زيـادة معنوية في كل من وزن الجسم ومعدل التحويل الغذائي. كذلك أن اعلي معدل تصافي للذبيحـة فـي المجموعات المعاملة وجد في المجموعـة التـي غذيـت علـي خليـط الزيـت والشـحوم واقـل معـدل بالمجموعة التي غذيت علي ٢٪ شحوم حيوانية . وقد أظهرت النتائج ان اعلي محتوي من دهـن الاحشاء وجد في المجموعة التي غذيت علي ٤٪ زيت عباد الشمس واقل محتـوي فـي المجموعـة التي غذيت علي ٢٪ شحوم حيوانية . واستخدام الدهون فـي العلائـق أدى لزيـادة الـوزن النسـبي للكبد بينما ادي الي زيادة معنوية في مستوي الكوليسترول والدهون الكلية في الدم.

SUMMARY

This study was carried out to investigate the effect of inclusion of animal and vegetable fat sources in the broiler diets on their performance. Two sources of fat; vegetable oil (Sunflower oil, SFO) and animal fat (Beef tallow, BT) were tried in two levels (2%, 4%) in four groups of chicks, besides a mixture of both fats (2% for each) was tried in additional group. The diets were

isocaloric and isonitrogenous. Both fat levels (2% &4%) improved growth and feed conversion compared with the control diet but the 4% level was superior in its effect.Birds which had been fed diets containing a mixture from plant and animal fats were significantly higher at 21 & 42 days than those fed either SFO or BT alone.At the same time ,all the three groups recorded heavier weights compared to those fed on the diet supplemented with 2% fat or fed basal diet alone. The same trend was detected for liver weight and abdominal fat percent ,however the group fed on diet supplemented with 4% SFO recorded the highest value of cholesterol. Total lipids were significantly affected by fat supplementation and the animal fat was the highest in its effect.

Key words: *Broiler - Diets - Fat levels.*

INTRODUCTION

There have been remarkable increases in growth rate and efficiency of feed utilization in commercial broilers during the past 25 to 30 years. Concomitant with those increases is a tendency for broiler to accumulate large deposites of fat.Hot environmental temperature prevails in Egypt causes feed intake to decrease and often results in inadequate nutrient intake contributing to poor performance.

Among many recommended practical approaches that proved to offset the effects of hot temperature and to increase energy density of diets to promote more gain and desired finished carcass ,is the usage of different sources of fat (Thomson, 1989).Hamm et.al. (1973) demonstrated that the quantity and type of dietary fats in the finisher diet influence the quantity of fat in the poultry processing.

The beneficial effect of fat addition to poultry diets not only accounts to its high energy content, but also ,fat improves feed palatability and feed intake (Thomson, 1989). However ,the inclusion of high levels of fat (4-

10%) to corn-soybean diets improved weight gain and feed efficiency of broilers (Deaton et al. , 1981; Cantor et al., 1989; Senkoylu, 1990). .Moreover, under high Egyptian environmental temperature, addition of fat animal or plant origin to broiler diets improved the performance, however, vegetable oils at level of 2% (cottonseed oils) showed the best performance (Hady et al. , 1992).

The objective of this study to investigate the effect of inclusion of animal and vegetable fat sources in the broiler diet on their performance throughout 6 weeks experimental period.

MATERIALS and METHODS

A total of 90 one-day old chicks (Arbor acres) obtained from Beni-Mor hatchary were floor reared in an experimental room bedded by a layer of wheat straw and provided with clean feeders and waterers .The chicks were weighed and randomly divided into six groups (15 chicks/group).

Chicks were fed on the starter diets for the first three weeks and grower-finisher diets for the slaughter age (42 days),(tables,1-2). The calorie-protein ratio of the experimental diets was kept constant as possible and to satisfy the requirement stated in the NRC (1984).

Two sources of fat ,vegetable oil (Sunflower oil,SFO) and animal fat (Beef tallow, BT) were used in this experiment with two levels (2% , 4%).

Group 1 was considered as control and fed on the basal diet without fat supplement.Diets with 2% and 4% SFO were fed to groups 2 & 5, while, groups 3 & 6 were fed on the diets containing 2% & 4% BT; respectively. Group 4 was fed on the mixture of SFO & BT (2% + 2%).

The experiment was conducted in Summer months where the temperature in the experimental room was recorded daily with average day-time temp. 36 ±3°C and average night-time temp. 29±3°C. The relative humidity was ranged between 65% and 70%.

The diets were fed ad-libitum and a fresh clean water was continuously available throughout the experimental period (6 weeks). Feed consumption and body weight were recorded on weekly basis.

Weight gain and feed conversion were calculated for 3 ages: (1) up to the time that the starter diet was discontinued (21 days), (2) from 21 to 42 days and (3) from day old to slaughter age.

At the end of the experiment ,5 birds from each group were randomly taken, weighed and slaughtered.Weights of abdominal fat ,liver were expressed as a percentage of body weight.Blood samples were collected from each group and serum samples were separated and used for analysis of total lipids and cholesterol (Loeffer and Mcdougald , 1963) .

Analysis of variance was used to examine the significance of difference between means of different treatments (Snedecor and Cochran , 1980).

RESULTS

The results data are presented in tables (3-7).

DISCUSSION

Growth data presented in table (3) revealed that the addition of fat to the experimental diets improved body weight in comparison with the control diet.The improvement in body weight gains achieved by chicks receiving the high fat diets again confirms the finding of workers cited previously (Donaldson et al.,1956 ; Gazia , 1971 ;and Donaldson, 1985) that the incorporation of fat into a balanced ration without altering the energy nutrient balance enhances chick growth.Similarly ,in accordance with the work of Waldroup et al. (1976), increasing dietary density improved chick

growth (Dale and Fuller, 1979) found that dietary energy would be utilized more efficiently with the high density diets.

Results revealed that the quantity and type of dietary fat influenced significantly the body weights of the chicks.Birds that have been fed diets containing 4% fat of either types or mixture of them were heavier.At the same time ,chicks of group 4 fed on (2%SFO+2%BT) were significantly heavier at 21 & 42 days than those fed either SFO or BT alone and along the experiment ,all the three groups recorded heavier weights compared to those fed diet supplemented with 2% fat or the basal diet alone.

The favourable effect of dietary vegetable oil on broiler weight gain over that of animal fat could be explained on view of Abrams (1961) and Zumbado et al. (1990) studies who found that digestibility of animal fat is not as high as vegetable oil.

The effect of fat on feed intake and feed conversion is shown in table (5) . It is obvious that,the addition of fat to the diets (as different sources and in different levels) during hot season exhibited an improving effect on feed intake compared to the control group. These are in agreement with the results of Dale and Fuller (1980) .However,several suggestions had implicated that such increases may result from improved palatability or increased nutrient density by fat supplementation (Donaldson, 1985). Carew and Hill (1964) found that fat decreases heat increment of the diet would increase the amount of usable energy available to the bird ,first by increasing feed intake and secondly by increasing the net energy in relation to metabolizable energy intake (Dale and Fuller ,1979).Feed conversion ratio was not improved for birds fed on diets containing beef tallow (BT).This came in agreement with the results reported by Scaife et al.(1994). However,feed conversion was improved with the diets containing SFO at the two levels.

Data of this study revealed that when vegetable oil (SFO) was used in combination with animal fat (BT) ,there was a significant increase in final

body weight accompained by improved feed conversion along the experiment.

The significantly better feed conversion by chicks fed the diets containing a mixture of SFO and BT compared to chicks fed on either fat alone suggests that a combination of two fat sources might be more efficiently utilized than when fed alone. This supports the claim by Sibbald and Kramer (1978); Garrett and Young (1975) that there are synergestic effects from combining dietary fats from different sources.

The dressing percentages (table, 6) ranged between 62.7% and 75.6%. Chickens fed on the diet containing the mixture of SFO & BT showed the highest dressing percentage (75.6%) compared to the other treatments. The lowest value was recorded for chicks fed diets having 2% BT.

Abdominal fat percentages (table, 6) were altered by dietary fat supplementation. Highest abdominal fat was found in broilers fed on diet containing 4% SFO (2.45%) and the lowest value in chicks fed on diet containing 2% BT. These result disagreed with those of Teleb et al. (1993) who found that addition of 2% BT gave the highest percentage of abdominal fat and 1% CSO gave the lowest percentage.

The weight of liver expressed as percentage of dressing weight ranged from 2% to 2.60%. The inclusion of 4% fat significantly affected liver weight.The greater effect was clearly evidence with the mixture of SFO & BT.

In regard to serum cholesterol (table,7),the results show highly significant increase in all treatments received fat. The highest level of cholesterol (200 mg%) was found at using 4% BT and the lowest level (145 mg%)at using 2% SFO. Hady et al. (1992) found significant increase in serum cholesterol level in all fat treatments especially with higher level of BT (2%). However ,for total lipids ,there was significant increase with 4% SFO & 4% BT. The highest level of total lipid (11.4 g/L) was found when using

4% BT followed by 4% SFO (10.2 g/L) and the lowest level (8.5mg/L) was recorded when using 2% SFO.The observed increase in the serum cholesterol level of chicks fed diets having the two experimental fat levels (2% & 4%) needs further study,otherwise it may affect human health.

It may be concluded that,inclusion of different fat sources (SFO & BT) at levels of 2% & 4% to broiler diets could improve broiler performance under high environmental temperature but the 4% level was superior in its effect.Moreover,the mixure of SFO & BT may lead to improvements in body weight and feed conversion.

REFERENCES

Abrams , J.I. (1961): Animal Nutrition and Veterinary Dietetics. 4th Ed., Edinburgh, W.Green & Son.Ltd.UK.

Cantor ,A.H. ;Pescatore,A.J.;Johnson,T.H.and Pfaff,W.K.(1989): Effect of extruded full-fat soybeans with various by-products and fat on growth of broiler chicks. Pouit.Sci. 69:25 (Abst.).

Carew ,L.B. and Hill ,F.W.(1964): Effect of corn oil on metabolic efficiency of energy utilization by chicks. J.Nutr.83:293-299.

Dale,N.M.and Fuller,H.L.(1979): Effects of diet composition on feed intake and growth of chicks under heat stress. I.Dietary fat levels. Poult.Sci.59:1529-1534.

Dale,N.M.and Fuller,H.L.(1980): Effects of diet composition on feed intake and growth of chicks under heat stress. II.Constant vs.cycling temperatures. Poult.Sci.59:1434-1441.

Deaton, J.W.; McNaughteon, J.L.; Reece, F.N. and Lott, B.D. (1981): Abdominal fat of broilers as influenced by dietary level of animal fat. Poult. Sci. 60: 1250-1253.

Donaldson,W.E (1985): Lipogenesis and body fat in chicks:Effects of calorie-protein ratio and dietary fat.PoultSci. 64:1199-1204.

Donaldson,W.E.;Combs,G.L.and Romoser,G.L.(1956): Studies on energy levels in poultry rations.I.The effects of calorie/protein ratio of the ration on growth , nutrient utilization and body composition of chicks.Poult.Sci.35:1100-1105.

Garrett ,R.L. and Young,R.J. (1975): Effect of micelle formation on the absorption of neutral fat and fatty acids by the chicken. J. Nut. 105: 827-833.

Gazia,Nabila,A. (1971): Studies on the effect of different fat supplements on growth and egg production of fayomi fowl Thesis to Fac. Vet. Med., Cairo Univ.

Hady ,Maha,M. ;El-Banna R. and Teleb ,H.M.(1992): Practical approach to fat inclusion in broilers diets.Vet.Med.J.,40(3):119-128.

Hamm,D.;Childs,R.E.and Mercuri,A.(1973): Relationships between fats in broiler finisher rations and fats in chiller water from broiler processing. Poult.Sci.52:88-92.

Loeffer,H.H.and Mcdougald,C.H.(1963): Estimation of cholesterol in serum by means of improved techniques.Am.J.Clin.Path.39:311.

NRC (1984): Nutrient requirements of poultry. National Academy of Science,Wash., D.C.

Scaife, J.R.; Moyo, J.; Galbraith, H.; Michie, W. and Campbell, V. (1994): Effects of different dietary supplemental fats and oils on the tissue fatty acid composition and growth of female broilers. Br. Poult. Sci. 35: 107-118.

Senkoylu,N.(1990): The effects of tallow and soapstock upon broiler performance. Poult.Sci.69:120 (Abst.).

Sibbald,I.R.and Kramer,J.K.G.(1978): The effect of the basal diet on the true metabolizable energy value of fat.Poult.Sci.57:685-691.

Snedecor,G.W.and Cochran ,W.G.(1980): Statistical methods.Iowa State Univ.Press Ames,Iowa,USA.

Teleb,H.M.;Maha M.Hady; El-Banna R.and Ibrahim ,A.(1993): Effect of fat supplementation on carcass composition and quality in broilers. 4th Symp. Anim., Poult. and Fish Nutr., El-Fayoum .

Thomson,D.M.(1989): ASA-Poultry nutrition manual for developing poultry industries. American Soybean Association.No.28-9.

Waldroup, P.W.; Mitchell, R.J.; Payne, J.R. and Johnson, Z.B. (1976): Characterization of the response of broiler chickens to diets varying in nutrient density content Poult.Sci.55:130-145.

Zumbado ,M.E.;San Jose ,C.R. and Solis ,J.(1990): Nutritive value of palm oil and palm kernel oil for broilers.69:151(Abst.).

Table (1):Composition of the starter diets.

Ingredients (%)	Diets					
	1	2	3	4	5	6
	Basal diet	2%SFO	2%BT	2%SFO+2%BT	4%SFO	4%BT
Yellow corn,ground	67.70	62.57	63.17	57.81	57.21	58.41
Soybean meal(44%)	21.00	25.57	24.97	30.08	30.68	29.48
Fish meal (72%)	4.00	4.00	4.00	2.00	2.00	2.00
Meat meal (60%)	5.84	4.00	4.00	4.00	4.00	4.00
Added fat**	-----	2.00	2.00	4.00	4.00	4.00
Bone meal	0.08	0.65	0.65	0.66	0.66	0.66
Dicalcium phosphate	0.20	0.06	0.06	0.25	0.25	0.25
Limestone,ground	0.86	0.80	0.80	0.80	0.80	0.80
Salt	0.10	0.12	0.12	0.15	0.15	0.15
Methionine	0.07	0.08	0.08	0.10	0.10	0.10
Premix*	0.15	0.15	0.15	0.15	0.15	0.15
Calculated analysis:						
Crude protein(%)	21.58	22.04	21.82	22.16	22.37	21.95
ME (Kcal/Kg)	3004	3066	3038	3084	3113	3056
C/P ratio	139.20	139.11	139.23	139.17	139.16	139.22
Ether extract(%)	3.61	5.30	5.32	6.96	6.94	6.97
Methionine (%)	0.47	0.48	0.48	0.48	0.48	0.48

*Broiler premix:furnishing the following ingredients per Kg of feed:Vit.A 12000 IU ,vit.D_3 2000 IU ,vit.E 10 mg ,folic acid 1 mg ,niacin 20 mg ,pantothenic acid 10 mg ,vit.K 2 mg ,vit.B_1 1mg ,vit.B_2 4mg ,vit.B_6 1.5 mg ,vit.B_{12} 10µg,biotin 50µg ,iron 30mg ,copper 10mg ,zinc 55mg ,Mn 55mg ,iodine 1mg,Se 0.1mg ,choline chloride 500mg.

**Sunflower oil (SFO) contained 8815 Kcal ME/Kg ;beef tallow (BT) ,7050 ME/Kg ,according to NRC (1984).

Table (2):Composition of the grower-finisher diets.

Ingredients (%)	Diets					
	1	2	3	4	5	6
	Basal diet	2%SFO	2%BT	2%SFO+2%BT	4%SFO	4%BT
Yellow corn,ground	73.14	68.38	68.88	64.85	64.30	65.40
Soybean meal(44%)	18.30	21.79	21.29	23.32	23.97	22.77
Fish meal (72%)	3.00	2.00	2.00	2.00	2.00	2.00
Meat meal (60%)	4.00	4.00	4.00	4.00	4.00	4.00
Added fat**	----	2.00	2.00	4.00	4.00	4.00
Bone meal	0.45	0.46	0.46	0.46	0.46	0.46
Dicalcium phosphate	0.10	0.25	0.25	0.25	0.25	0.25
Limestone,ground	0.76	0.80	0.80	0.80	0.80	0.80
Salt	0.10	0.15	0.15	0.15	0.15	0.15
Methionine	----	0.02	0.02	0.02	0.02	0.02
Premix*	0.15	0.15	0.15	0.15	0.15	0.15
Calculated analysis:						
Crude protein(%)	19.05	19.44	19.27	19.81	20.00	19.61
ME (Kcal/Kg)	3050	3113	3083	3170	3200	3140
C/P ratio	160	160	160	160	160	160
Ether extract(%)	3.54	5.29	5.31	7.17	7.15	7.19
Methionine (%)	0.36	0.37	0.37	0.37	0.38	0.38

Table (3):Body weight development (g/chick)of the experimental groups of chicks.

Age (in days)	Group					
	1*	2	3	4	5	6
	Basal diet	2%SFO	2%BT	2%SFO+2%BT	4%SFO	4%BT
0	$39.5^{a}\pm1$	$40^{a}\pm1.3$	$39.4^{a}\pm1.1$	$39.8^{a}\pm1.25$	$40.2^{a}\pm1.2$	$39.7^{a}\pm1.4$
21	$410^{c}\pm16$	$441^{abc}\pm14$	$425^{bc}\pm12$	$474^{a}\pm14$	$463^{ab}\pm13$	$452^{ab}\pm12$
42	$1224^{c}\pm37$	$1353^{bc}\pm50$	$1311^{bc}\pm59$	$1545^{a}\pm69$	$1425^{ab}\pm52$	$1361^{bc}\pm50$

*Group 1 was considered as control.

^{a,b,c} means with the same row with the same letter are not significantly different ($P<0.05$).

Table(4):Analysis of varianceof body weight at 21 and 42 days of age

Source of variation	d.f	MS	
		21 days	42 days
Between treat.	5	8591.11**	153131.28**
Error	84	2779.64	37826.98

** Differences between treatments are highly significant ($P<0.05$).

Table (5):Feed intake,weight gain (g/chick) and feed conversion of the experimental groups of chicks.

Age (in days)	Group					
	1	2	3	4	5	6
Feed intake:						
0-21	780	800	820	900	860	850
22-42	1700	1786	1815	1900	1840	1937
0-42	2480	2586	2635	2800	2700	2787
Weight gain:						
0-21	370	401	386	434	423	412
22-42	814	912	886	1071	962	909
0-42	1184	1313	1272	1505	1385	1321
Feed conversion:						
0-21	1.90	1.81	1.93	1.90	1.86	1.88
22-42	2.09	1.96	2.05	1.77	1.91	2.13
0-42	2.03	1.91	2.01	1.81	1.89	2.05

Table (6):Dressing weight ,liver weight and abdominal fat % of the experimental groups of chicks.

Items	Group					
	1	2	3	4	5	6
Dressed carcass ,% (without giblets).	62.7	67.8	64.0	75.6	70.6	66.5
Liver weight as % of body weight.	2.03	2.20	2.00	2.60	2.38	2.57
Abdominal fat ,%	1.80	1.76	1.60	2.00	2.45	2.17

Table (7):Cholesterol and total lipids of the experimental groups of chicks.

Items	Group					
	1	2	3	4	5	6
Cholestrol ,mg%	131±1.6	145**±1.8	155**±1.8	192**±3.8	179**±2.6	200**±3.2
Total lipid ,g/L	7.5±0.4	8.5±0.3	8.9±0.4	9.5±0.7	10.2*±0.5	11.4*±0.7

*Significant at P<0.05. **Significant at P<0.01.