Vet.Med.J.,Vol.40,No.3(1992).119:128

PRACTICAL APPROACH TO FAT INCLUSION IN BROILERS DIETS

BY

MAHA M. HADY, R.EL-BANNA AND H.M. TELEB
Dept. Nutrition and clinical Nutrition, Fac. Vet. Med., Cairo University.

(Recived:28.11.1992)

INTRODUCTION

The growth in population and disposable income for the Middle East and Africa is rapidly increasing the demand for animals proteins. To meet this demand, there has been remarkable expansion in commercial broilers production. A key factor in efficient weight gains and/or egg production of poultry is optimum nutrient intake. Hot environmental temperatures cause feed intake to decrease and often resulting in less than adequate nutrient intake contributing to poor performance. As ambient temperature increases by one degree F above the zone of comfort, feed consumption reduces by about 0.75 to 1% **(Keshavarz, 1991)**. Proper dietary manipulations are effective in reducing the adverse effects of high summer temperature on production performance. Among many recommended practical approachs that proved to offset the effects of hot temperature involve the usage of available sources of fat **(Thomson, 1985)**. The beneficial effect of fat addition to poultry diets during hot weather not only accounts to its high energy content but also, fat improves feed palatability and feed intake **(Thomason, 1985)**, improves weight gain **(Cantor et al., 1989)**. Although there are numerous reports present the possible effect of fat utilization in poultry diets **(Gazia, 1971; Horani and Sell, 1977; Hulan et al., 1984)**, most of these concerned with the use of fats fore poultry stock and layers rather than commercial type broilers. **Dale and Fuller (1979 & 1980)** found that inclusion of high poultry fat level (8-10%) in broilers diets could elevate the adverse effect of heat stress induced by constact (32 ± 1 c) or dirunally cycled (22 to 33 C) temperatures. The inclusion of high levels of animal fat (4 to 10%) to corn soybean meal diets had improved weight gain and feed efficiency of broilers **(Deaton et al., 1981; Cantor et al., 1989; Senkoylu, 1990)**. At the same time, **Zumbado and solis (1990)** found that feeding of beef tallow at level of 3 and 6% in broilers diet for 32 days had pro-

CamScanner الممسوحة ضوئيا بـ

a given C/P ratio when dietary fat increased.

Regarding fat sources, CSO supplemented at level of 2% maintained significantly ($P < 0.05$) the best body weight throughout the whole exprimental period compared with other treated groups. These results come inagreement with the work of **Donaldson (1985)**. The favorable effect of dietary vegetable oil on broilers weight gain over that of animal fat could be explained on view of **Abrams (1961) and Zumbado and Solis (1990)** studies which documented that digestibility of animal fat is not as high as vegetable oil. Unlike our results which postulated that BT at both levels was not entitled to compete with CSO, come the work of **Deaton et al., (1981) and Cantor et al., (1989)** which showed that animal fat exerted a positive effect especially at higher rates of inclusion.

Regarding feed intake, it is obvious that the addition of fat during hot season regardless to its source or level exhibited an improving effect on feed intake compared to the control groups. The values in starting period were 1405, 1415, 1450 and 1430 for groups 1, 2, 3 and 4 compared to 1372 and 1395 for control groups (5 and 6). Such improving effect of fat addition on feed intake of broilers subjected to heat stress was also recorded by **Dale and Fuller (1980)**. How added fat exerts its action to increase nutrient intake is contradictory. However, several suggestions had implicated that such increase may esult from improved palatability or increased nutrient denisty as fat added **(Donaldson, 1985)**. Furthermore, there has been sufficient evidence with chicks **(Carew and Hill, 1964)** that fat decreases the heat increament of the diet. It is logical to assume that the beneficial effect of high fat diet on heat stressed chicks resulted largely from the associative dynamic action of such diets Dale **(Dale and Fuller, 1980)**.

The addition of fat sources at the level of 2% improved the efficency of feed utilization of both starting and growing periods (table 2 and 3). However, this effect was more pronounced during starting period as 2% BT and CSO achieved 2.04 and 1.97 vs 2.16 and 2.2 for the control groups. The same results was also recoded by **Donaldson (1985). In contrary, Biely and March (1955); Gazia (1971)** observed better feed efficiency in growing chicks with the addition of animal fat but at higher levels (4 to 6%). The magnitude of difference in feed efficiency for fat fed groups and the control group reduced to be minimal during growing period (table 3). These results suggest that if higher levels of fat were incorporated in diets a better feed efficiency values could have been attained.

الممسوحة ضوئيا بـ CamScanner

The efficiency of energy utilization was improved by supplemental fat irrespective to level and source. CSO as a source exerted more noticable effect during starting period, whereas the chicks in the control groups consumed 6.48 and 6.59 Kcal the 1 and 2% CSO groups consumed 6.16 and 6.09 Kcal per gram gain (table 2). The better energy utilization by broiler fed CSO may be attritutable to the difference in composition and balance of unsaturated and saturated fatty acids in the source of fat. BT had higher saturate to unsaturate ratio than do CSO(**Hulan et al., 1984**). Moreover, true metabolizabel energy values presented by **Sibbald and Kramer (1978)** suggest that the higher metaboilzable energy values of vegetable oils as compared with animal fats is due to the higher degree of absorpability of oils which contain high amounts of oleic and other unsaturated fatty acids.

CSO supplemented at level of 2% during growing period could not induce an overall improvement effect on performance, which suggest that CSO supplementation at level of 2% could not outweigh the adverse effect occurred due to heat stress.

The effect of fat supplementation on serum cholesterol, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT) and serum protein levels of broilers throughout the whole experimental period is presented in table 4. Serum cholesterol levels were significantly ($P < 0.05$) increased due to fat supplementation irrespective to source or level. The 2% level of inclusion of fat sources (BT and CSO) had significantly ($P < 0.05$) increased the cholesterol levels (group 2 and 4) than did the 1%. However at 2% level of inclusion, BT as a source had exerted higher serum cholesterol levels compared with CSO. Moreover, addition of 2% CSO during last 2 weeks (group 5) had increased insignificantly the serum cholesterol level compared with control. The above result come inagreement with the finding of **Sim and Bragg (1978)** who observed that serum cholesterol levels were gradually increased with all added fat sources except for safflower oil. In the current study, similar effect was observed with CSO as it maintained lower serum cholesterol levels throughout the 6 weeks feeding period compared with BT fed groups. The previous results could be attributed to the hypolipogenic effect of n-6 fatty acids (vegetable oils) which is greater than that of saturated fatty acids (animal fats) (**Wiegand et al., 1973; Harris et al., 1983; Hood, 1991**). Another suggestion that emphasise the previous results, stated that feedback inhibition of fatty acid synthesis is greater during ingestion of unsaturated fatty acids than saturated

Table 1 . Ingredients and Composition of experimental diets.

Group number	Starter diets (0 - 4w)						Grower diets (4 - 6w)					
	1	2	3	4	5	6	1	2	3	4	5	6
Added fat	1% BT	2% BT	1% CSO	2% CSO	0% BD	0% BD	1% BT	2% BT	1% CSO	2% CSO	2% CSO	0% BD
Ground yellow corn	64	62	64	62	66	66	71	70	71	70	70	74
Soybean meal (44 %)	25	26	25	26	24	24	18	18	18	18	18	16
Added fat [1,2,3]	1	2	1	2	—	—	1	2	1	2	2	—
Concentrate [4]	10	10	10	10	10	10	10	10	10	10	10	10
Calculated analysis												
CP %	21.8	22.1	21.8	22.1	21.6	21.6	19.4	19.3	19.4	19.3	19.3	18.8
ME Kcal / kg	3028.7	3054.3	3046.3	3089.5	3003.2	3003.2	3107.6	3144.4	3125.1	3179.6	3179.6	3093.2
Ether extract %	4.25	5.2	4.25	5.2	3.3	3.3	4.5	5.5	4.5	5.5	5.5	3.6
Methionine %	0.42	0.43	0.42	0.43	0.42	0.42	0.39	0.39	0.39	0.39	0.39	0.37
C/P ratio	138.9	138.2	139.1	139.8	139.0	139.0	160.2	162.8	161.1	164.7	164.7	164.6

1- Concentrate mixtrne supplied 51.6% CP; ME kcal / kg 2440 ; EE 8.9%, Ca 7.5%, Methionine 1.5% ; Methionine + Cystine 1.8%.

2- Mineral and vitamin added to each kg concentrate provided : Vit A 120.000 IU; Vit D3. 25.000 IU; Vit E, 100 mg ; Vit k_3, 30 mg; Vit B2, 50 mg; Niacin, 300mg ; Pantothenic acid, 90mg ; Vit B_1, 15 mg ; Folic acid , 10mg ; Biotin, 750 mg ; choline, 60 mg; Vit B_{12},100 µg - Zn 500 mg ; I 5 mg ; Se 1mg ; Mg 30mg; Cu 50 mg , Fe 600 mg.

3- Antioxident present in Concentratce was BHT 1.2 µg / kg.

4- Based upon feedstuff ingredients analysis tables (1984) presented by feedstuffs yearbook issue.

Table 2 . Performance of broiler chicks fed diets variously supplemented with beef tallow (BT) and vegetable oil (CSO) during starting period (0-4w).

Parameter	Group number					
	1	2	3	4	5	6
Body weight (g) at 0.day.	37.7 ^{a}	37.9 ^{a}	37.6 ^{a}	37.8 ^{a}	37.8 ^{a}	37.8 ^{a}
Body weight (g) at 4 weeks.	700.5 ^{b}	730.0 ^{b}	734.0 ^{ab}	765.0 ^{a}	672.0 ^{c}	658.0 ^{c}
Gain, g / 4 weeks	662.8	692.1	696.4	727.2	634.2	620.2
Gain, g / bird / day	23.7	24.7	24.9	25.9	22.7	22.2
Feed intake, g / 4 weeks	1405.0	1415.0	1410.0	1430.0	1372.0	1365.0
Feed / Gain 0 – 4 weeks	2.12	2.04	2.02	1.97	2.16	2.2
energy intake, 0 – 4 weeks (kcal ME / bird / day)	152.0	154.4	153.4	157.8	147.2	146.4
energy efficiency (kcal intake / g gain)	6.41	6.25	6.16	6.09	6.48	6.59
Energy and nutrient density / kg (relative)	100.9	101.7	101.4	102.9	100.0	100.0

^{a,b,c} means in the sam raw with the same superscript are insignificantly differed ($P < 0.05$).

الممسوحة ضوئيا بـ CamScanner

Table 3 . Performance of broiler chicks fed diets variously supplemented with beef tallow (BT) and vegetable oil (CSO) during growing period (4-6w).

Parameter	Group number					
	1	2	3	4	5	6
Body weight (g) at 4.weeks	700.5 ^{b}	730.0 ^{b}	734.0 ^{ab}	765.0 ^{a}	672.0 ^{c}	658.0 ^{c}
Body weight (g) at 6 weeks	1413.0 ^{c}	1471.0 ^{b}	1493.0 ^{b}	1546.0 ^{d}	1388.0 ^{c}	1332.0 ^{d}
Gain, g / 2 weeks (4-6w)	712.0	741.0	759.0	781.0	716.0	674.0
Gain, g / bird / day	50.9	52.9	54.2	55.8	51.1	48.1
Feed intake g / 2 weeks (4-6w)	1438.0	1460.0	1485.0	1512.0	1490.0	1425.0
Feed / Gain (4-6w)	2.02	2.0	1.96	1.94	2.08	2.11
Energy intake, (4-6w) kcal ME / bird / day	319.2	327.9	331.5	343.4	338.4	314.8
Energy efficiency (kcal intake / g gain)	6.27	6.19	6.12	6.15	6.62	.6.55
Energy and nutrient density / kg (relative)	100.5	101.7	101.03	104.6	104.6	100.0

a, b, c and d means in the same raw with the same superscript are insignificanltly differed (P< 0.05) .

Table 4 . Effect of variously supplemented fat sources on some blood parameters of broiler chickens .

Parameter	Age in weeks	Group number					
		1	2	3	4	5	6
Cholesterol (mg %)	2	110.2 ^{b}	121.2 ^{a}	107.6 ^{c}	113.4 ^{b}	103.1 ^{d}	99.5 ^{d}
	4	119.1 ^{c}	130.3 ^{a}	118.6 ^{c}	125.1 ^{b}	110.2 ^{d}	112.3 ^{d}
	6	134.2 ^{c}	141.1 ^{a}	129.1 ^{c}	138.5 ^{b}	123.1 ^{d}	120.4 ^{d}
SGOT (FU / ml)	2	100.3 ^{a}	103.5 ^{a}	105.0 ^{a}	106.0 ^{a}	99.5 ^{a}	98.1 ^{a}
	4	109.1 ^{a}	107.2 ^{ab}	110.0 ^{a}	111.1 ^{a}	106.0 ^{b}	105.8 ^{b}
	6	122.1 ^{a}	125.1 ^{a}	123.1 ^{a}	124.1 ^{a}	119.0 ^{a}	118.6 ^{a}
SGPT (FU / ml)	2	18.4 ^{a}	20.5 ^{a}	20.1 ^{a}	19.8 ^{a}	17.9 ^{a}	18.7 ^{a}
	4	18.7 ^{a}	20.1 ^{a}	21.2 ^{a}	21.6 ^{a}	19.8 ^{a}	20.1 ^{a}
	6	19.6 ^{a}	20.1 ^{a}	22.3 ^{a}	22.5 ^{a}	21.4 ^{a}	21.1 ^{a}
Total serum protein (mg %)	2	4.6 ^{a}	4.7 ^{a}	4.5 ^{a}	4.3 ^{a}	4.3 ^{a}	4.4 ^{a}
	4	4.9 ^{a}	5.2 ^{a}	4.8 ^{a}	4.7 ^{a}	4.9 ^{a}	4.8 ^{a}
	6	5.1 ^{a}	5.2 ^{a}	5.0 ^{a}	5.1 ^{a}	4.8 ^{a}	5.0 ^{a}

a, b, c and d means in the same raw with the same superscript are insignificanltly differed (P< 0.05) .

الممسوحة ضوئيا بـ CamScanner

ones which are more dominant in animal fats (**Reiser et al., 1963; Chung et al., 1970**).

Results of SGOT and SGPT for different groups were within the normal recorded ranges (**Farahat, 1975 and El-Banna, 1987**), However, the fat supplemented groups had showed little insignificant elevation in these parameters compared to control. The former result indicat that liver was not affected due to such dietary treatments.

Results of total serum protein showed no significant change due to fat supplementation regardless to source and level. All the recorded levels in the different groups were within the normal values (**Farahat, 1975**).

It is to be concluded that inclusion of fat sources (BT and CSO) at levels of 1 or 2% to broiler diets could improve broiler performance under high environmental temperature. In regard to fat source, CSO as vegetable oil seemed to achieve a better performance than did BT when supplemented during 6 weeks experimental period. Meanwhile, the higher level of CSO (2%) acheived better performance than its lower level (1%). However, the usage of 2% CSO at growing period (4 to 6 weeks) was not able to overcome the adverse effect of heat stress commonly occures during our summer season. Total serum protein, SGOT and SGPT showed insignificant variation due to such treatments. Serum cholesterol level showed significant increase with all fat treatments, especially with higher level of BT inclusion. From the practical stand point of view, our results suggested that inclusion of vegetable oils at level of 2% will help to protect broilers from lower feed intake and gain induced by heat stress.

SUMMARY

This work was planned to threw a light on a practical approach currently used by poultry growers in Egypt to include different sources of fat in broilers diets to promote more gain and better finished carcass. One hundred and fifty day old commercial broiler chicks were equally allocated into six groups and fed on basal diet to which either animal fat (beef tallow) or vegettable oil (cottonseed oil + sunflower oil) was added at level of 1 or 2% for 6 weeks experimental period. It is concluded that the inclusion of fat (animal and vegetable) at level of 1 or 2% to broiler diets could improve broiler performance under high environmental temperature. In regard to fat source, CSO as a vegetable oil seemed to achieve better performance than did beef tallow. meanwhile, the higher level of CSO achieved better performance than its lower level. However, the usage of 2% CSO in growing period was not able to overcome the adverse effect of heat stress commonly occures during our summer season. Concerning blood parameters, no significant difference could be detected for SGOT , SGPT and total serum protein which indicated that no determintal influence for such treatments. Serum cholesterol level was increased due to fat supplementation

الممسوحة ضوئيا بـ CamScanner

but beef tallow addition induced the highest values.

REFERENCES

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

Bielly, J. and March, B. (1955): Fat studies in poultry. 2 Fat supplements in chick and poult rations. Poult. Sci 34: 1220-1227.

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. Poult. Sci. 69:25 (Abst.).

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

Chung, R.A., Tsai, P.H., Lai, C.N. and Lu, J.Y. (1970): Effect of dietary lipids and cholesterol on the levels and synthesis of some hepatic lipid comonents of young chickens. Poult. Sci. 49: 729-733.

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. 58: 1529-1534.

Dale, N.M. and Fuller, H.L. (1980): Effect 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 ration and dietary fat. Poult. Sci. 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 ration of the ration of the ration on growth, nutrient utilization and body composition of chicks. Poult. Sci. 35: 1100-1105.

El-Banna, R. (1987): The role of nutrition in the problem of ascites in broiler chicken. Thesis presented to Fac. Vet. Med. Cairo University.

Farahat, A.A. (1975): Morphological and biochemical constituents of the blood in the farm and experimental animals. Alkilany press, Cairo, Egypt.

Fritsche, K.L., Cassity, N.A. and Huang, S.C. (1991): Effect of dietary fat source on antibody production and lymphocyte proliferation in chickens. Poult. Sci. 70: 611-617.

Gazia, N.A.H. (1971): Studies on the effect of different fat supplements on growth and egg production of Fayomi fowl. Thesis presented to Fac. Vet. Med., Cairo University.

Harris, W.S., Cannor, W.E. and McMurray, M.P. (1983): The comparative reductions of the plasma lipid and lipoproteins by dietary polyunsaturated fats: Salmon oil vs vegetable oils. Metabolism. 32: 179-184.

Hood, R.L. (1990): Effect of diet and substrate on the invitro measurement of cholesterol and fatty acid synthesis in hepatic tissue of Japanese quail. Poult. Sci. 69: 647-651.

Hood, R.L. (1991): Effects of dietary fats on hepatic cholesterol synthesis in Japanese quail. Poult. Sci. 70: 1848-1850.

Horani, F. and Sell, J.L. (1977): The modifying effect of calorie: protein ratio on laying hen performance and on "extrat metabolic effect" of added fat. Poult. Sci. 56: 1981-1988.

Hulan, H.W., Proudfoot, F.G. and Nash, D.M. (1984): The effects of different dietary fat sources on general performance and acid composition of broiler chickens. Poutl. Sci. 63: 324-332.

Keshavarz, K. (1991): Managing in hot weather. Practical approach for reducin the adverse effects of temperature. ASA-Animal Nutrition High-lights. No. 1, page 2-4.

Loeffer, H.H. and Mcdougald, C.H. (1963):

الممسوحة ضوئيا بـ CamScanner

Estimation of cholesterol in serum by means of improved techniques. Am. J. Clin. Path. 39-311.

National Research Council (NRC) (1977): Nutrient Requirement of Poultry. Washington DC., National Acad. Sci., USA.

Reiser, R., Williams, M.C., Sorrels, M.F. and Murty, N.L. (1963): Biosynthesis of fatty acids and cholesterol as related to diet fat. Arch. Biochem. Biophys. 102:276-285.

Reitman, S. and Frankel, S. (1957): Transaminases in serum. Am. J. Clin. Path. 28 (28):56.

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 metabolisable energy value of fat. Poult. Sci. 57: 685-691.

Sim, J.S. and Bragg, D.B. (1978): Effect of dietary oil, cholesterol and soysterols on the lipid concentration and fatty acid composition of egg yolk, liver and serum of laying hens. Poult. Sci. 57: 466-472.

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

Thomson, D.M. (1985): ASA-Poultry Nutrition Manual For Developing Poultry Industries. American Soybean Association. No. 2 8-9.

Weichselbaum, P.E. (1946): Total proteins. Am. J. Clin. Path. 16:40.

Wiegand, R.D., Rao, G.A. and Reiser, R. (1973): Dietary regulation of fatty acid synthetase and microsomal glycerophosphate acyltransferase activities in rat liver. J. Nutr. 103:1414-1424.

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.).

الممسوحة ضوئيا بـ CamScanner