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Fatty Acid Effect on Carcass
The Influence of Various Blends of Dietary Fats Added to Corn-Soybean Meal Based Diets on the Fatty Acid Composition of Broilers[1]

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Abstract: Studies were conducted to determine the influence of the fatty acid composition of the dietary fat supplement on the fatty acid composition of the adipose tissue of broilers. Samples of lard, tallow, poultry oil, and soybean oil, representative of the major source of fats and oils in poultry diets in the United States, were blended in various combinations and fed at 6.34% of the diet in corn-soybean meal broiler finisher diets fed 35 to 56 d of age. Samples of adipose tissue were subjected to fatty acid analysis and regression analysis was used to develop equations for predicting carcass fatty acid composition from the composition of the dietary fat supplement. Highly significant R^2 values were observed, indicating that these equations can be used to predict the influence that a particular blend of dietary fatty acids will have upon changes in the fatty acid composition of the adipose tissue of broilers fed diets supplemented with these fats. If sources with markedly different fatty acid structures such as coconut oil, linseed oil, or fish oil are used in constructing the fat blends, these equations may not be applicable.

Key words: Broilers, adipose tissue, fatty acids, carcass composition

Introduction

Several reports have appeared in the literature that clearly demonstrate that the fatty acid composition of poultry can be markedly altered by the type of dietary fat supplement used (Hilditch *et al*., 1934; Feigenbaum and Fisher, 1959; Marion, 1965; Edwards *et al*., 1971; Prinz and Hartfiel, 1988; Pinchasov and Nir, 1992). In these studies, the researchers have generally compared a highly saturated fat such as beef tallow with highly unsaturated fat sources such as soybean oil, corn oil, or cottonseed oil (Marion and Woodroof, 1966; Yau *et al*., 1991). Edwards *et al*. (1973) included poultry oil among the supplemental fat sources but did not examine blends of fats that might be more characteristic of those used in commercial practice.

An increasing percentage of the fats currently being used in the poultry industry are blends of fats from animal and vegetable origin. Renner and Hill (1961) and Artman (1964) have reported that the absorbability and subsequent utilization of relatively saturated fats or fatty acids such as stearic or palmitic, found to a high percentage in animal fats such as tallow or lard, is markedly increased by mixing them with unsaturated fats or fatty acids such as oleic or linoleic obtained from vegetable oils. Fatty acid soapstocks from vegetable processing are high in nutritional value but because of their high degree of unsaturation are generally blended with fats from animal origin to avoid problems of excessive unsaturated fats in the carcass.

Because of the sporadic occurrence of the so-called "oily bird" syndrome, nutritionists and feed manufacturers are often concerned about the possible influence that the dietary fat source may have upon the fatty acid makeup of the broiler carcass as a possible contributing factor towards the development of this condition, although Garrett (1975) had demonstrated that the amount of saturated fat in the carcass does not appear to be the causative factor. Garrett concluded that the development of the "oily-bird" syndrome in commercial processing operations was not the result of the dietary fat supplement used in the diet.

The response of the chick to changes in dietary fat composition is quite rapid. Yoshida and Morimoto (1970) reported that the carcass fat of young chicks reached an apparent equilibrium following a dietary change within 12 days. Jen *et al*. (1971) beginning with chicks 4 wk of age found that the characteristics of different dietary fats were incorporated into the carcass in less than 2 wk after the chicks were fed the experimental diets.

The objective of the studies reported herein was to determine the influence which different blends of supplemental fats, similar to those used in the poultry industry, when fed at levels typical of modern broiler production have on the makeup of the adipose tissue of the broiler, with an attempt to derive equations which could be used to estimate the effects which might result from feeding different fat supplements.

Materials and Methods

Supplies of beef tallow and lard were obtained from the University of Arkansas Meat Processing laboratory.

Table 1: Fatty acid analysis of fat supplements used in broiler diets (% of total)[1]

Fatty acid[2]	Source[3]				
	Tallow	Lard	Poultry oil	Soybean oil	Basal Diet[4]
10:0	0.14	0.14	0.12	0.07	---
12:0	0.10	0.13	0.11	0.07	0.02
13:0	0.10	0.22	0.21	0.02	---
14:0	3.65	1.85	1.43	0.10	0.09
14:1	1.97	0.23	0.62	0.00	---
15:0	0.28	0.00	0.08	0.00	---
16:0	26.79	23.61	20.08	11.20	17.55
16:1	7.02	4.12	7.31	0.05	0.08
16:2	0.00	0.00	0.12	0.00	---
17:0	0.31	0.43	0.37	0.03	---
18:0	16.49	11.22	6.36	3.85	2.86
18:1	38.59	44.76	40.84	20.98	28.25
18:2	3.33	11.63	20.59	55.10	46.59
18:3	1.26	1.63	1.70	8.44	4.06
20:0	0.00	0.05	0.10	0.12	---
TUFA[5]	52.17	62.37	71.18	84.57	78.98
TPUFA[6]	4.59	13.26	22.41	68.54	50.65

[1]May not total 100% due to rounding or minor peaks. [2]First number shows number of carbon atoms; second shows number of double bonds. [3]Values for tallow, lard, poultry oil and soybean meal values determined by gas chromatography. [4]Derived from NRC (1971) and Edwards (1964). [5]TUFA = Total unsaturated fatty acids. [6]TPUFA = Total polyunsaturated fatty acids.

Table 2: Composition of experimental diet

Ingredient	% of diet
Ground yellow corn	57.90
Dehulled solvent extracted soybean meal	28.25
Dehydrated alfalfa meal	3.78
Dicalcium phosphate	2.06
Ground limestone	0.53
Vitamin premix1	0.50
Iodized salt	0.40
Trace mineral premix[2]	0.10
DL Methionine (98%)	0.14
Test fat source	6.34
Total weight	100.00

[1]Supplies per kg of diet: 6600 IU vitamin A; 2200 IU vitamin D_3; 22 IU vitamin E; 1.1 mg menadione; 6.6 mg riboflavin; 17.6 mg pantothenic acid; 44 mg niacin; 1870 mg choline; 11 mcg vitamin B12; 1.1 mg folic acid; 125 mg ethoxyquin.
[2]Supplies per kg of diet: 100 mg Fe; 100 mg Mn; 100 mg Zn; 10 mg Cu; 1 mg I.

Poultry oil was obtained from a local poultry rendering plant, and crude soybean oil was purchased from a local soybean processing plant. Although soybean oil is not generally used in blended fats for economic reasons, soybean soapstocks are frequently used. The four fat samples were subjected to fatty acid analysis by a commercial laboratory specializing in fat analysis (Table 1). From these analyses, calculations were made of the fatty acid composition of the various blends used to supplement the experimental diets. The amount of individual fatty acids supplied by ingredients in the basal diet were calculated using the ether extract values of the ingredients (NRC, 1971) and the fatty acid values reported by Edwards (1964). It is important to consider the fatty acids in the dietary ingredients as Bartov and Bornstein (1976) demonstrated the influence of lipids from dietary ingredients, especially from yellow corn, on carcass lipid composition of broilers. Since ingredients in the basal diet were calculated to contain 2.65% ether extract and 6.34% of the various fat blends were tested, the fatty acid composition of the entire test diet was calculated as follows:

%Fatty acid = [2.65 (% basal fatty acid) + 6.34 (% fatty acid in supplement)] ÷ 8.99

A high energy (3300 AME kcal/kg) diet served as the vehicle for the feed fat blends. The composition of this diet is shown in Table 2. The test fat sources were fed at a level of 6.34% of the diet. This level approaches the maximum feasible usage level for supplemental fats; higher levels may be used by the chick but result in flow problems in the feed system. Various blends of the different fat sources were used to give a wide range of fatty acid values for supplementing the diets.

Three feeding trials were conducted. In the first study, blends of tallow and soybean oil were used (Table 3). In the second study, the soybean oil was blended with lard (Table 3), while in the third study poultry oil was blended with tallow in one series and with lard in a second series (Table 4). Blends were made to provide a series of supplements with approximately 5% increments in linoleic acid content.

Male broiler chicks of a commercial strain (Cobb 500[3]) which had been previously fed a high energy (3200 ME

Table 3: Calculated fatty acid composition of diets containing blends of tallow, lard, and soybean oil in different combinations

% of fat supplement		Saturated fatty acids					Monunsaturated fatty acids			Polyunsaturated fatty acids		Total Mono Unsat	Total Poly Unsat	Total Unsat
Tallow	Soy oil	12:0	14:0	16:0	18:0	20:0	14:1	16:1	18:1	18:2	18:3			
100.00	0.00	0.08	2.60	24.07	12.47	0.00	1.39	4.98	35.54	16.08	2.09	41.91	18.17	60.08
88.5	11.5	0.07	2.31	22.80	11.44	0.01	1.23	4.40	34.11	20.28	2.66	39.74	22.94	62.68
77.8	22.5	0.07	2.04	21.61	10.49	0.01	1.08	3.88	32.78	24.18	3.21	37.74	27.39	65.13
66.7	33.3	0.07	1.76	20.40	9.50	0.02	0.92	3.33	31.40	28.23	3.77	35.65	32.00	67.65
55.6	44.4	0.06	1.49	19.18	8.50	0.04	0.77	2.79	30.03	32.29	4.33	33.59	36.62	70.21
44.4	55.6	0.06	1.20	17.95	7.51	0.04	0.61	2.24	28.63	36.38	4.90	31.48	41.28	72.76
33.3	66.7	0.06	0.93	16.73	6.52	0.06	0.46	1.69	27.26	40.33	5.46	29.41	45.79	75.20
22.2	77.8	0.06	0.65	15.52	5.53	0.06	0.30	1.14	25.87	44.48	6.02	27.31	50.50	77.81
11.50	88.5	0.06	0.38	14.33	4.58	0.07	0.16	0.62	24.55	48.39	6.56	25.33	54.95	80.28
0.00	100.00	0.06	0.10	13.07	3.55	0.08	0.00	0.06	23.12	52.59	7.15	23.18	59.74	82.92
Lard	Soy oil													
100.00	0.00	0.10	1.33	21.82	8.75	0.04	0.16	2.93	39.89	21.94	2.35	42.98	24.29	67.27
95.00	5.00	0.10	1.27	21.38	8.49	0.04	0.15	2.78	39.05	23.47	2.59	41.93	26.06	67.99
82.50	17.50	0.08	1.11	20.29	7.84	0.04	0.13	2.42	36.95	27.30	3.19	39.50	30.49	69.99
70.00	30.00	0.08	0.96	19.19	7.19	0.05	0.11	2.06	34.86	31.13	3.78	37.03	34.91	71.94
57.50	42.50	0.08	0.80	18.10	6.54	0.05	0.09	1.71	32.76	34.96	4.38	34.56	39.34	73.90
45.00	55.00	0.07	0.65	17.01	5.89	0.06	0.07	1.35	30.67	38.79	4.98	32.09	43.77	75.86
32.50	67.50	0.06	0.49	15.91	5.24	0.06	0.05	0.99	28.57	42.62	5.58	29.61	48.20	77.81
20.00	80.00	0.06	0.34	14.82	4.59	0.07	0.03	0.63	26.47	46.46	6.18	27.13	52.64	79.77
7.50	92.50	0.06	0.19	13.73	3.95	0.08	0.01	0.27	24.38	50.28	6.78	24.66	57.06	81.72
0.00	100.00	0.06	0.10	13.07	3.56	0.08	0.00	0.06	23.12	52.59	7.15	23.72	59.74	83.46

kcal/kg) diet supplemented with tallow were placed on the test diets at 35 d of age and fed the test diets on an *ad libitum* basis to 56 d of age. Each of the diets in all three trials was fed to three pens with six male chicks per pen. At 56 d the surviving birds were killed by CO_2 inhalation (AVMA, 1993) and abdominal fat pad removed for fatty acid analysis.

The fat pads from the six chicks in each pen were pooled and the fat extracted following the procedure of Folch *et al.* (1957). The extracted fats from the first replicate group were analyzed by a commercial poultry company routinely engaged in carcass fatty acid analysis. The fats from the second and third replicate groups were analyzed in the laboratories of two companies that provide feed-grade fats to the poultry industry. Means and standard deviations were calculated on the carcass fatty acid values supplied by the three cooperating laboratories.

At the conclusion of the three trials, all data regarding diet and carcass fatty acids were combined and simple correlations were determined between the fatty acid composition of the experimental diets and the fatty acid composition of the abdominal adipose tissue. In addition, regression analyses were conducted to derive equations for predicting carcass fatty acid composition from diet fatty acid composition. Software from SAS (1991) was used for the statistical analysis.

Table 4: Calculated fatty acid composition of diets containing blends of tallow, lard, and poultry oil in different combinations

% of fat supplement		Saturated fatty acids					Monunsaturated fatty acids			Polyunsaturated fatty acids		Total Mono Unsat	Total Poly Unsat	Total Unsat
Tallow	Soy oil	12:0	14:0	16:0	18:0	20:0	14:1	16:1	18:1	18:2	18:3			
100.00	0.00	0.08	2.60	24.06	12.47	0.00	1.39	4.97	35.54	16.08	2.09	41.90	18.17	60.07
80.00	20.00	0.08	2.28	23.11	11.04	0.01	1.20	5.00	35.85	18.51	2.14	42.05	20.65	62.70
60.00	40.00	0.08	1.97	22.17	9.60	0.03	1.00	5.05	36.18	20.95	2.20	42.23	23.15	65.38
40.00	60.00	0.08	1.65	21.22	8.18	0.04	0.82	5.09	36.49	23.38	2.27	42.40	25.65	68.05
20.00	80.00	0.08	1.35	20.28	6.75	0.05	0.63	5.14	36.81	25.81	2.33	42.58	28.14	70.72
0.00	100.00	0.08	1.04	19.33	5.32	0.07	0.44	5.18	37.13	28.25	2.40	42.75	30.65	73.40
Lard	Poultry													
100.00	0.00	0.10	1.33	21.82	8.75	0.04	0.16	2.93	39.89	21.93	2.35	42.98	24.28	67.26
80.00	20.00	0.09	1.27	21.32	8.06	0.04	0.21	3.37	39.34	23.20	2.35	42.92	25.55	68.47
60.00	40.00	0.09	1.21	20.82	7.38	0.05	0.27	3.82	38.78	24.45	2.36	42.87	26.81	69.68
40.00	60.00	0.09	1.15	20.32	6.70	0.06	0.32	4.28	38.23	25.72	2.37	42.83	28.09	70.92
20.00	80.00	0.08	1.09	19.83	6.01	0.06	0.38	4.72	37.67	26.98	2.38	42.77	29.36	72.13
0.00	100.00	0.08	1.04	19.33	5.32	0.07	0.44	5.18	37.13	28.25	2.40	42.75	30.65	73.40

Results and Discussion

The effects of blends of tallow, lard, and soybean oil in various combinations on the fatty acid composition of adipose tissue of male broilers is shown in Table 5, while the effects of various blends of tallow, lard, and poultry oil are shown in Table 6. It is highly apparent that the percentage of various fatty acids in the adipose tissue is influenced by the dietary fatty acid makeup, in agreement with that of many reports (Couch *et al.*, 1964; Marion, 1965; Edwards *et al.*, 1971; Jen *et al.*, 1971; Edwards and Denman, 1975; Prinz and Hartfiel, 1988; Pinchasov and Nir, 1992; Valencia *et al.*, 1993; Scaife *et al.*, 1994). Correlation between fatty acid composition of the diet and fatty acid content of adipose tissue (Table 7) reveals some interesting relationships. The amount of saturated and monoenoic fatty acids in the diet had a strongly positive influence on the amount of saturated and monoenoic fatty acids in the adipose tissue and a strongly negative influence on the amount of polyunsaturated fatty acids. The amount of polyunsaturated fatty acids in the diet had a strongly positive effect on the amount of polyunsaturated fatty acid in the adipose tissue and a strongly negative effect on the amount of saturated and monoenoic fatty acids. As would be expected, the highest correlations appeared to be between the specific fatty acid in the diet and that in the carcass.

To quantify these responses, linear regression was conducted to relate the amount of fatty acid in the carcass to the fatty acid in the diet, including both supplemental fat as well as that from the basal diet. The results of the regression analysis are shown in Table 8 and shown graphically in Fig. 1 to 9. The R^2 values of the linear regression equations were similar to the correlation coefficients observed for the various carcass fatty acids with their dietary contents. Carcass 18:0 content had the poorest relationship with its dietary content (Table 8, Fig. 4) while the carcass 18:2 fatty acid content had the best relationship with its dietary content (Table 8, Fig. 6). Strong relationships also existed when fatty acids were divided into monounsaturated (Table 8, Fig. 8) and polyunsaturated (Table 8, Fig. 9).

It is interesting to note the similarity of the slope of the response line of carcass polyunsaturated fats to dietary polyunsaturated fatty acids in the chicken in the present study to that obtained by Beynen *et al.* (1980) in a survey of the relationship between fatty acid composition of diet and that of adipose tissue in man. Beynen *et al.*, 1980 reported a linear relationship expressed as

Table 5: Effects of blends of tallow, lard, and soybean oil in various combinations on fatty acid composition of adipose tissue of male broilers (means ± SD of triplicate analyses)

% of added fat		Carcass fatty acid (% of sample)								
Tallow	Soy oil	14:0	16:0	16:1	18:0	18:1	18:2	18:3	TUFA	TPUFA
100.00	0.00	1.9±0.4	21.5±1.3	5.0±0.8	7.2±0.6	39.8±2.3	19.9±1.3	1.8±0.5	67.0±3.5	21.7±0.9
88.5	11.5	1.6±0.1	20.9±1.0	4.4±0.2	8.9±1.9	37.9±1.7	22.0±1.9	7.7±0.2	65.2±1.8	23.8±2.2
77.8	22.5	1.3±0.2	19.1±0.6	4.4±0.3	8.3±1.4	35.6±0.8	26.2±0.3	2.4±0.2	68.8±1.4	28.5±0.2
66.7	33.3	1.3±0.2	19.6±0.9	3.6±0.2	8.1±1.6	34.4±0.8	28.7±4.0	1.8±0.9	68.8±4.1	30.5±4.9
55.6	44.4	1.3±0.3	19.8±1.7	3.4±0.3	7.4±0.3	32.3±0.4	30.4±2.7	3.0±0.3	69.5±2.4	33.4±2.9
44.4	55.6	1.5±0.3	20.2±0.7	4.0±0.7	7.8±1.0	36.1±3.2	26.0±5.4	2.2±0.6	68.6±2.5	28.2±5.9
33.3	66.7	0.9±0.3	19.1±0.4	3.5±1.2	7.6±1.8	33.0±2.8	30.7±1.8	3.0±1.3	70.4±2.0	33.7±3.0
22.2	77.8	0.9±0.1	17.6±0.2	3.2±0.2	7.2±1.0	31.8±0.5	33.8±0.3	3.4±0.6	72.4±0.5	37.2±0.8
11.50	88.5	0.7±0.1	17.1±1.3	2.7±0.3	6.6±0.6	31.0±0.5	37.3±2.1	3.3±0.3	74.3±1.7	40.6±2.3
0.00	100.00	0.5±0.1	18.1±1.8	2.8±0.5	5.9±1.1	30.2±1.7	37.5±3.3	3.5±1.1	74.0±2.8	41.1±4.4
Lard	Soy oil									
100.00	0.00	1.4±0.7	22.0±0.5	4.4±0.3	6.9±0.4	40.3±0.8	21.5±1.4	1.8±0.4	67.9±1.7	23.2±1.1
95.00	5.00	1.2±0.5	21.6±1.4	3.8±0.7	7.2±0.4	38.3±0.6	27.4±4.1	1.9±0.6	68.5±1.9	26.3±1.5
82.50	17.50	0.9±0.1	20.9±1.9	4.2±0.6	5.8±0.4	37.6±0.8	26.9±1.8	2.3±0.3	71.1±0.7	29.3±1.7
70.00	30.00	0.8±0.2	20.4±0.4	4.6±1.4	6.3±0.9	36.5±1.7	26.4±1.2	3.1±0.8	70.6±1.7	29.4±1.9
57.50	42.50	0.8±0.1	20.0±0.4	3.9±0.4	6.5±0.2	35.9±1.3	28.6±0.9	2.6±0.4	71.2±0.2	31.3±1.2
45.00	55.00	0.6±0.1	19.8±0.7	3.2±0.8	6.7±1.6	34.2±1.9	31.6±2.3	2.6±0.3	71.7±1.6	34.2±2.3
32.50	67.50	0.5±0.2	18.7±0.6	3.4±0.7	5.8±0.7	32.8±1.9	33.9±1.0	3.3±1.0	73.4±1.3	37.2±1.6
20.00	80.00	0.5±0.1	17.3±1.2	2.7±0.7	5.2±0.4	29.4±1.3	39.3±2.4	4.2±1.0	75.5±1.9	43.4±3.3
7.50	92.50	0.6±0.2	16.9±1.3	2.9±0.6	5.5±0.7	29.3±2.4	38.9±2.2	4.3±1.4	75.6±2.0	43.3±3.2
0.00	100.00	0.4±0.2	15.7±1.4	2.4±0.5	5.2±0.4	28.2±1.4	41.3±1.7	4.7±0.3	76.7±0.3	46.0±1.7

Y= 3.43 + 0.54 X where Y = relative polyunsaturated fat in adipose tissue and X = relative percentage of dietary polyunsaturated fatty acids. While the intercept of this equation differs somewhat from that found in the present study (3.43 vs.10.33) the slope of the response line is almost identical (0.54 vs. 0.55). It is possible that the use of fats or oils differing from those used in the present studies might result in differing fatty acid profiles. Lipstein *et al.* (1970) reported that the use of acidulated cottonseed soapstock (ACS) resulted in high stearic acid content of the abdominal fat of broilers, even though the stearic acid content of the ACS was less than found in tallow or acidulated soybean soapstock. The phenomenon could not be explained on the basis of dietary fatty acid composition and the authors concluded that there was some interference with the metabolic desaturation of stearic acid by the ACS. Similar results were observed by Bartov *et al.* (1974). However, nutritionists often avoid the use of ACS due to possibility of residual gossypol and the adverse effects that cyclopropenoid fatty acids in ACS have on albumen of eggs.

There has been a great deal of interest in recent years in manipulating the carcass fatty acid profile in attempts to "tailor make" the fatty acid profile of the chicken to obtain profiles that are perceived as more beneficial to the consumer (Yau *et al.*, 1991; Hargis and Van Elswyk, 1993; Scaife, 1994). These efforts generally focus on the n-3 polyunsaturated fatty acids such as

Table 6: Effects of blends of tallow, lard, and poultry oil in various combinations on fatty acid composition of adipose tissue of male broilers (means ± SD of triplicate analyses)

% of added fat		Carcass fatty acid (% of sample)								
Tallow	Poultry	14:0	16:0	16:1	18:0	18:1	18:2	18:3	TUFA	TPUFA
100.00	0.00	1.6±0.1	20.9±0.4	5.4±0.3	8.0±0.4	40.6±0.5	19.1±1.0	1.7±0.4	67.1±1.8	20.8±1.0
80.00	20.00	1.9±0.4	21.5±0.8	6.0±0.9	7.6±0.7	39.1±1.2	19.3±1.5	1.5±0.3	66.4±3.0	20.8±1.3
60.00	40.00	1.4±0.1	21.1±0.5	5.8±0.5	7.4±0.8	39.5±0.6	21.2±1.4	1.6±0.2	68.4±1.2	22.7±1.5
40.00	60.00	1.3±0.1	20.9±1.1	5.7±0.6	6.6±0.5	38.6±0.8	21.5±1.9	1.9±0.3	68.1±0.6	23.4±1.8
20.00	80.00	1.0±0.1	21.5±0.6	6.2±0.2	5.6±0.6	38.0±0.3	24.0±1.0	1.7±0.1	70.1±0.8	25.7±1.0
0.00	100.00	1.0±0.2	19.7±3.9	6.5±0.8	6.8±1.8	35.1±3.0	26.2±3.6	2.3±1.1	70.4±2.7	28.5±4.6
Lard	Poultry									
100.00	0.00	1.0±0.1	22.5±0.3	4.8±0.6	6.8±0.5	40.7±1.4	21.0±1.4	1.5±0.3	68.2±1.4	22.5±1.5
80.00	20.00	1.0±0.2	21.7±0.3	5.2±0.6	6.1±0.5	41.8±1.3	21.4±0.2	1.4±0.2	69.9±2.0	22.8±0.3
60.00	40.00	1.1±0.2	22.2±1.7	5.7±0.3	5.6±0.9	39.3±0.5	22.6±1.7	1.6±0.4	69.3±1.5	24.2±2.1
40.00	60.00	1.0±0.3	20.8±1.4	5.3±1.4	7.3±1.0	38.7±0.9	23.5±0.4	1.7±0.4	69.4±1.9	25.2±0.5
20.00	80.00	1.2±0.4	21.9±2.1	5.9±0.5	5.7±0.7	37.6±1.1	23.8±1.5	2.2±1.4	69.8±2.5	26.0±2.9
0.00	100.00	1.0±0.2	19.7±3.9	6.5±0.8	6.8±1.8	35.1±3.0	26.2±3.6	2.3±1.1	70.4±2.7	28.5±4.6

Table 7: Correlation of fatty acid composition of the diet with fatty acid content of adipose tissue

Fatty acid In diet	Fatty acid in adipose tissue								
	14:0	16:0	16:1	18:0	18:1	18:2	18:3	TUFA	TPUFA
14:0	0.81	0.56	0.56	0.54	0.69	-0.81	-0.65	-0.78	-0.80
16:0	0.75	0.74	0.68	0.41	0.87	-0.92	-0.76	-0.80	-0.92
16:1	0.69	0.65	0.83	0.33	0.75	-0.85	-0.71	-0.71	-0.85
18:0	0.78	0.56	0.44	0.55	0.69	-0.78	-0.62	-0.77	-0.77
18:1	0.48	0.79	0.74	0.13	0.88	-0.86	-0.74	-0.63	-0.86
18:2	-0.72	-0.76	-0.73	-0.37	-0.88	0.93	0.78	0.79	0.93
18:3	-0.64	-0.78	-0.80	-0.27	-0.89	0.93	0.78	0.74	0.92
TUFA	-0.78	-0.67	-0.60	-0.49	-0.80	0.88	0.72	0.80	0.87
TPUFA	-0.71	-0.77	-0.74	-0.36	-0.89	0.94	0.78	0.78	0.93

Table 8: Results of regression analysis of response of fatty acid in adipose tissue to quantity of fatty acid in the basal diet, expressed as percentage of total dietary fat

Fatty acid	Intercept	Slope	R^2
C14:0	0.42	0.54	0.86
C16:0	10.95	0.47	0.75
C16:1	2.49	0.65	0.85
C18:0	4.75	0.27	0.49
C18:1	14.99	0.64	0.83
C18:2	9.99	0.56	0.92
C18:3	0.69	0.46	0.82
Monounsaturates	16.44	0.66	0.90
Polyunsaturates	10.33	0.55	0.94

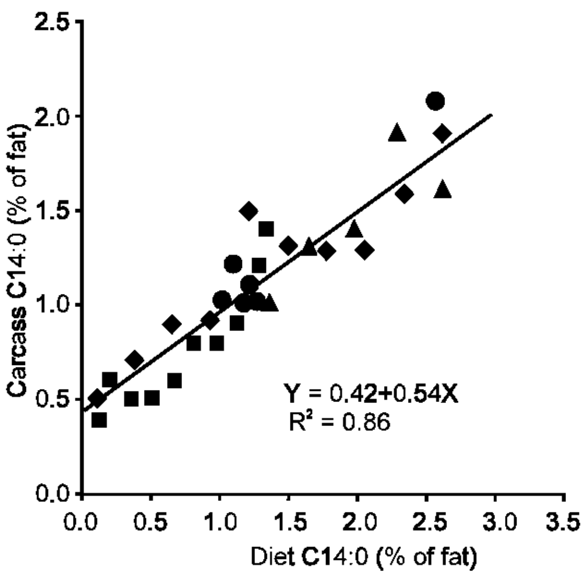

Fig.1: Carcass C14:0 content as influenced by C14:0 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

linolenic (C18:3n-3) and eicosapentanoic (C20:5n-3). Such fatty acids are very limiting in traditional fat supplements such as lard, tallow, poultry oil, and soybean oil soapstocks. The use of linseed oil or whole linseed meal has been shown to be a source of enrichment of carcass n-3 fatty acids (Ajuyah *et al.*, 1991; Olomu and Baracos, 1991; Phetteplace and Watkins, 1989, 1992; Chanmugam *et al.*, 1992), Numerous studies have evaluated the possibility of using marine oils to alter the carcass lipid content of the broiler (Miller *et al.*, 1967; Hulan *et al.*, 1988, 1989; Chanmugam *et al.*, 1992). However, the problems associated with "fishy taste" of meat from broilers fed high levels of fish meal or fish oil) limits the use of this source of n-3

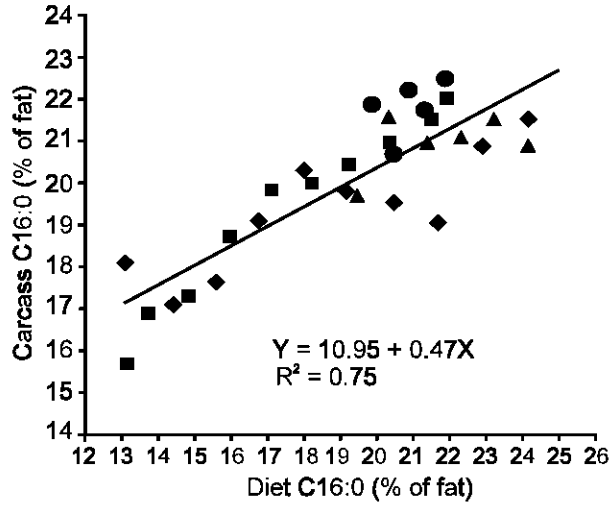

Fig.2: Carcass C16:0 content as influenced by C16:0 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

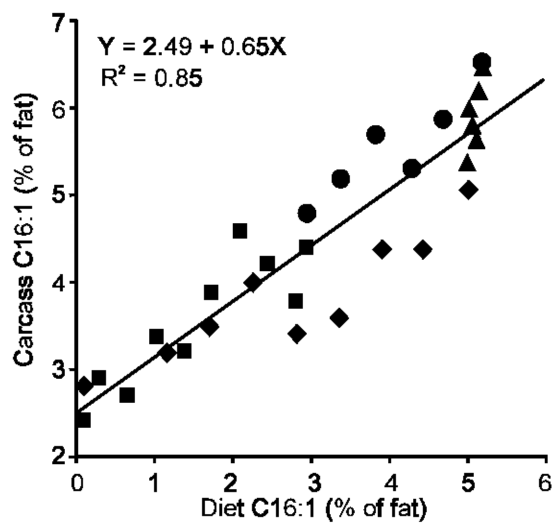

Fig. 3: Carcass C16:1 content as influenced by C16:1 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

polyunsaturated fatty acids (Miller *et al.*, 1967; Hargis and Van Elswyk, 1993). Feeding strategies to enrich poultry fat with n-3 fatty acids will involve the use of fats other than the typical sources used in the poultry industry and in the present trial and the equations presented in this study will not be applicable in such circumstances.

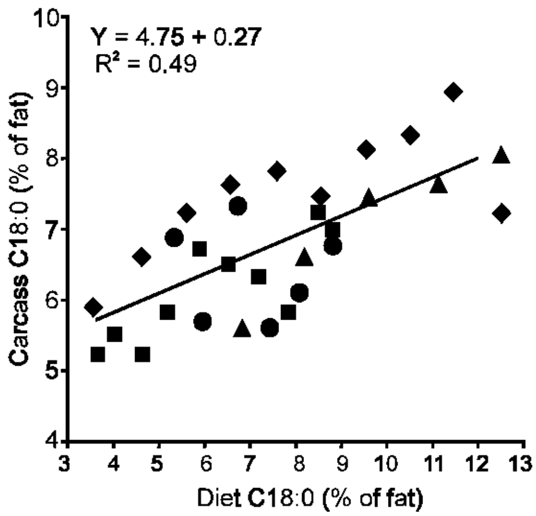

Fig 4: Carcass C18:0 content as influenced by C18:0 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

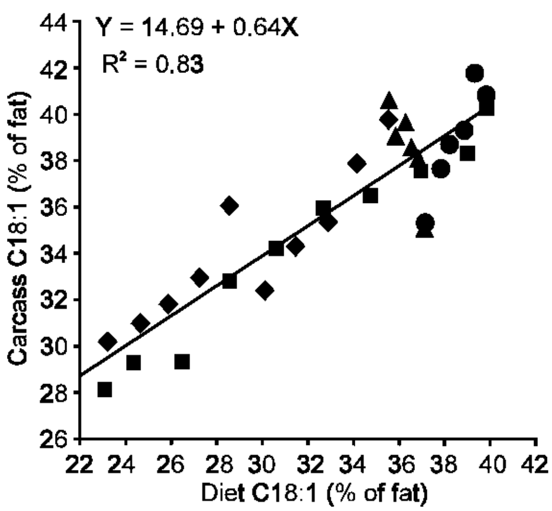

Fig 5: Carcass C18:1 content as influenced by C18:1 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

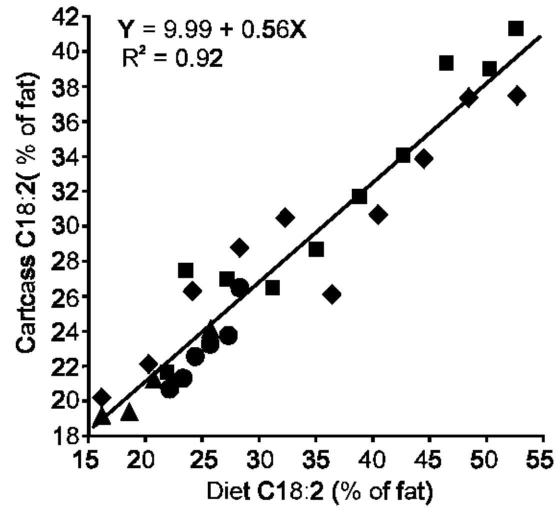

Fig 6: Carcass C18:2 content as influenced by C18:2 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

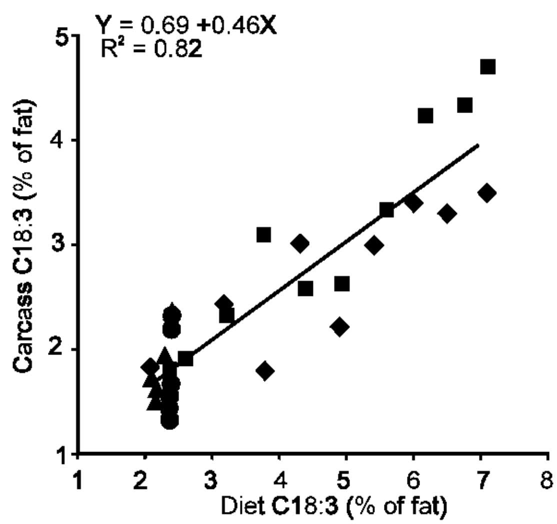

Fig 7: Carcass C18:3 content as influenced by C18:3 content of dietary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

In summary, the results of this study demonstrate that the fatty acid composition of the adipose tissue of the broiler is significantly influenced by the fatty acid composition of the diet, and present equations that can be used to estimate the possible change in composition of the adipose tissue when changes are made in the fatty acid makeup of the fat supplement. Because the amount and composition of the basal dietary ingredients, especially the grain source, comprise a significant portion of the total dietary lipid, it is essential

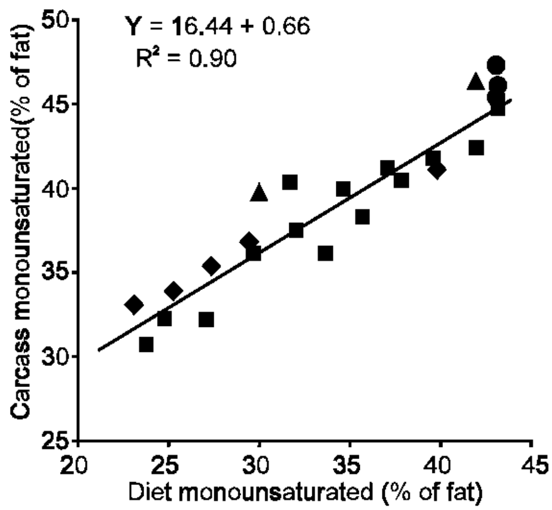

Fig 8: Carcass monounsaturated fatty acid content as influenced by monounsaturated content of dietartary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

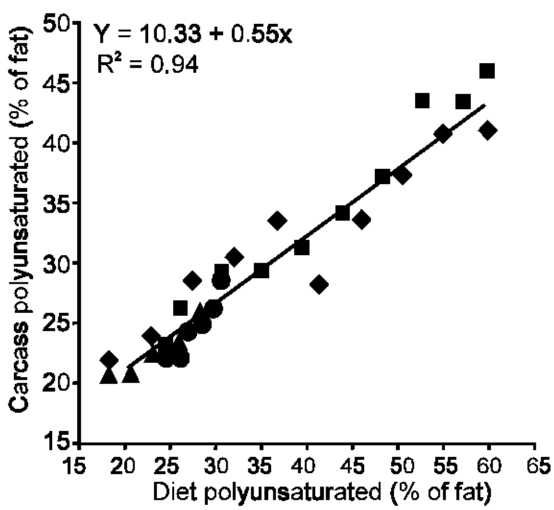

Fig 9: Carcass polyunsaturated fatty acid content as influenced by polyunsaturated content of dietartary fat. Data points represent blends of tallow and soybean oil (◆), lard and soybean oil (■), tallow and poultry oil (▲), and lard and poultry oil (●). Includes fatty acids contributed by basal diet.

that the fatty acids contributed by this segment of the diet be considered in making these estimations. In contrast to many studies in the literature where high levels of individual fats are compared, this study utilized blends of fat sources that are typically used in broiler diets at levels comparable to normal usage.

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