Lipid and Fatty Acid Composition of Turkey Liver, Skin and Depot Tissue[1]

W. W. MARION, S. T. MAXON and R. M. WANGEN, Poultry Science Department, Iowa State University, Ames, Iowa 50010

Abstract

Total lipid and phospholipid contents of liver, skin and depot fat from yearling hen turkeys have been studied. Liver lipid averaged 88.5 mg/g wet tissue; skin, 385.0 and depot fat, 753.5. Phospholipids comprised 32.05% of total lipid of liver, but only 0.81% of skin and 0.46% of depot fat. Fatty acids of liver differed from those of skin or depot fat by larger amounts of 16:0, 18:0, 20:4, 22:0 and 24:0, and smaller amounts of 16:1, 18:1, 18:2, 18:3 and 20:0. Similarity existed between skin and depot fat.

Introduction

Characteristics of animal lipids have been studied successfully for many years. Researchers have shown that variation in tissue lipids may be due to specie (23), muscle class (1,6,20), age and sex (21,22) and fasting (18). One question that is inadequately answered is that of specie variation in susceptibility to oxidative deterioration of muscle lpids (10). Degree of unsaturation undoubtedly is part of the explanation. Work by Hilditch et al. (8), Cruickshank (4), Kummerow et al. (14), Chu and Kummerow (3), and Klose et al. (12,13) showed that turkey lipids, for example, are relatively unsaturated, and, in composition, resemble tht dietary lipids previously consumed. These findings are similar to those reported with chicken broilers by Darrow and Essary (5), and Marion and Woodroof (16,17).

This paper is concerned with the proportion of phospholipid to total lipid, and the fatty acid composition of tissue lipids from mature turkey hens which previously had been used for breeding. They exhibited good finish as evidenced by sub-cutaneous deposition of fat and large depot stores within the body cavity.

Experimental Procedure

Ten yearling hens of the Williams strain were selected from a group previously on a standard breeder ration. Following exsanguination and feather removal, samples of breast skin (near the neck-breast juncture), liver and abdominal depot fat were removed from each turkey. For ease of sampling and weighing, skin was passed once through a food grinder (plate perforations of 4 mm), and liver and depot fat divided with a knife. Ten gram samples of each tissue were added to blender jars containing 200 ml of cold chloroform-methanol (2:1) and blended for 2 min. The supernatant was transferred to a separatory flask and the extraction step repeated. The combined supernata were treated by the method of Folch et al. (7), including overnight washing of the extract with 0.03M $MgCl_2$.

Phosphorus Determination

Phosphorus was determined on lipid extracts by using the method of Chen et al. (2). The optical density of samples was read at 820 mμ, and phosphorus estimated from a standard curve of anhydrous KH_2PO_4. Phospholipid was then calculated as: PL = P (μg) × 25.

Fatty Acid Methyl Ester Determination

Approximately 1 g of lipid was used to prepare methyl esters (19), which were then determined by gas chromatography (F & M Model 810: H_2 flame detector; ¼ in × 6 ft stainless column, 15% diethylene glycol succinate on Chromosorb W, (AW); oven temperature 190–200 C). Fatty acids were identified by comparing them with known standards.

TABLE I

Total Lipid and Phospholipid Content of Turkey Tissues

Tissue	Total lipid (mg/g wet tissue)	Phospholipid[a] (mg/g wet tissue)	% Phospholipid of total lipid
Liver	88.6 ± 16.5[b]	28.4 ± 2.2[b]	32.05
Skin	385.0 ± 32.3	3.1 ± 0.2	0.81
Depot fat	753.5 ± 37.4	3.2 ± 0.3	0.46

[a] Based on 10 observations.
[b] Overall standard deviation.

Results

Table I shows the total lipid and phospholipid content of the tissues studied. Total lipid varied from 88 mg/g of liver to 753 mg/g of depot fat. The phospholipid portion of total lipid varied from about 0.5% for depot fat and skin, to nearly one third in liver. In skin and depot fat, the relatively high content of neutral lipids, especially triglycerides, and a lower metabolic activity (10) account for their low content of phospholipid. In previous work in this laboratory, the phospholipid portion of liver lipids has ranged as high as 80%, which is explained in part by age and sex differences of the experimental animals used. Yearling hen turkeys used in this study were well finished.

Fatty acids varied appreciably among the tissues studied (Table II). In each instance, traces of

TABLE II

Fatty Acids of Turkey Tissues and Ration Lipid

Fatty acid	Liver, %	Skin, %	Depot fat, %	Ration, %
8:0	Trace	Trace	Trace	.....
10:0	Trace	Trace	Trace	Trace
12:0	Trace	0.11 ± 0.01	0.10 ± 0.01	0.05 ± 0.004
14:0	0.61 ± 0.02[b]	0.82 ± 0.03	0.77 ± 0.02	0.33 ± 0.02
U[a]	0.62 ± 0.04	0.66 ± 0.03	0.54 ± 0.02	0.07 ± 0.01
16:0	23.12 ± 0.96	19.98 ± 0.29	20.03 ± 0.49	13.32 ± 0.44
16:1	4.93 ± 1.14	7.97 ± 0.44	6.16 ± 0.47	0.24 ± 0.04
18:0	13.45 ± 1.59	5.25 ± 0.20	6.41 ± 0.33	0.10 ± 0.006
18:1	27.63 ± 2.97	38.86 ± 0.48	38.38 ± 0.59	27.98 ± 0.99
18:2	16.61 ± 0.72	22.62 ± 0.32	23.70 ± 0.40	49.02 ± 1.82
18:3	0.25 ± 0.04	1.63 ± 0.04	1.61 ± 0.04	4.21 ± 0.16
U	0.69 ± 0.04	.....	.....	.....
20:0	0.55 ± 0.03	1.13 ± 0.05	1.32 ± 0.10	0.60 ± 0.12
U	0.35 ± 0.06	0.17 ± 0.01	0.21 ± 0.03	.....
U	0.57 ± 0.11	0.01 ± 0.004	0.01 ± 0.004	.....
20:4	6.00 ± 0.64	0.27 ± 0.03	0.27 ± 0.02	0.14 ± 0.04
U	.....	.....	0.36 ± 0.04	0.17 ± 0.04
22:0	0.13 ± 0.04	0.01 ± 0.009	0.02 ± 0.01	1.10 ± 0.08
U	0.13 ± 0.13	.....	.....	0.16 ± 0.05
U	0.66 ± 0.07	.....	.....	0.05 ± 0.02
24:0	3.12 ± 0.43	.....	.....	0.32 ± 0.02

[a] Denotes an unidentified fatty acid.
[b] Denotes the standard error of the mean.

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caprylic, capric and lauric acids were identified, but were estimated with appreciable error since they were eluted on the descending side of the solvent peak. Fatty acids of liver differed from those of skin or depot fat by larger amounts of 16:0, 18:0, 20:4, 22:0 and 24:0, and smaller amounts of 16:1, 18:1, 18:2, 18:3 and 20:0. Gas chromatography of liver lipid also demonstrated the presence of other fatty acids in trace amounts between 20:4 and 24:0 positions. These longer chain fatty acids in liver are similar to those described by Katz et al. (9), and Marion and Miller (15) for chicken tissues. Our results showed that considerable similarity existed between skin and depot fat.

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