Acids	Oil	
	Mixed Glycerides	Fatty Acids
	Pct.	*Pct.*
Licanic	73.3	70.3
Linoleic	7.6	7.3
Oleic	5.4	5.2
Elaeostearic	1.6	1.5
Saturated	11.6	11.1
Unsaponifiable	0.5	.....
Total	100.0	95.4

The following calculation was made of the iodine number of the oil, using the above percentages of the glycerides present, and the empirical iodine values of licanic and elaeostearic glycerides.

Licanic	73.3%	× 181.9	=	133.3
Linoleic	7.6%	× 173.2	=	13.2
Oleic	5.4%	× 86.0	=	4.6
Elaeostearic	1.6%	× 182.4	=	2.9
				154.0

The calculated iodine value of 154.0 is in satisfactory agreement with the experimental value of 153.0.

In conclusion, it should be mentioned that a sample of *Licania arborea* seed oil was supplied to Dr. Henry A. Gardner of the National Paint, Varnish and Lacquer Association, who prepared varnishes from it. Gardner [9] reported that the drying times of these varnishes were similar to those made with oiticica oil. The results of cold and hot water tests made on the varnish films were found to be satisfactory. He concluded that if made available the oil could be used to advantage by the paint and varnish industry.

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The Chemical Composition of Depot Fats In Chickens and Turkeys*, **

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The scientific literature contains but little data on the chemical composition of the depot fats of chickens and turkeys. In the present investigation the depot fats of several breeds of these two species were analyzed to extend these data and determine whether chicken fat is different from turkey fat in any important respect.

Review of Literature

The chemical and physical characteristics of chicken and turkey fat reported in the literature are summarized in Tables I and II.

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In 1897 Amthor and Zink (1) determined a few of the chemical and physical characteristics of fats from many species of animals and birds. The outstanding feature of their work with chicken fat was the finding of an unusually high acetyl value. In 1911 Ross and Race (2) reported high acetyl values for both turkey and chicken fats. Grossfeld (3) determined a few of the constants of chicken fat and made a rough estimation of component fatty acids, while Pritzker and Jungkunz (4) limited their investigation to a determination of the iodine number. Hilditch, Jones and Rhead (5) estimated quantitatively the component fatty acids of Light Sussex hens. They found no significant differences between fats from the gizzard, abdomen and neck of hens seven

TABLE I

Chemical and Physical Data on Chicken Fat (from Literature)

Investigator	Amthor and Zink (1)		Ross and Race (2)		Grossfeld (3)	Pritzker and Jungkunz (4)	Hilditch, Jones and Rhead (5)	Brown and Sheldon (6)	
Determination	Fat	Fatty acids	Fat	Fatty Acids	Fat	Fat	Fat	Fat	Methyl esters
Sp. Gr. 30/30°C.	0.9241	0.9283	0.9065	0.8866					
M.P. °C.	33-40	38-40	23-27	27-30					
Sol. Point °C.	21-27	32-34							
Ref. Index 40°C.					1.4610-1.4620				
Sap. No.	193.5	200.8	204.6	208.6	195.2-195.3			{ 194.5 / 195.8	{ 194.2 / 195.2
	Hübl	Hübl	Wijs	Wijs	Hanus	Hanus			
Iodine No.	66.7	64.6	71.5	73.6	69.9-78.2	69.0-73.1		76.7-77.2*	73.8-74.8*
SCN No.					62.5-62.8				
Acetyl No.	45.2			25.4					
Reichert-Meissl			1.8						
Polenske			2.1						
Hehner			94.6						
Satd. Acids %							30.35		
Palmitic %					18.4-19.3		24.0-26.7		
Stearic %					8.9- 7.5		4.1- 7.1		
Unsatd. Acids %									
Oleic %					54.7-55.4		36.9-43.0		
Linoleic %					17.9-17.8		18.4-22.8		

* = method not given.

months or two years old when fed controlled diets, and no differences in comparison with the fat from two-year-old hens fed a diet containing low-fat fish meal. Using the polybromide reaction, Brown and Sheldon (6) found evidence of the presence of linolenic acid, and also more highly unsaturated acids, in chicken fat. These findings are not in agreement with those of Hilditch, Jones and Rhead (5) who found in it no evidence of any eighteen-carbon acids more unsaturated than linoleic acid.

Carlin (7) analyzed the fat from one freshly-killed turkey but determined only a few constants. Hepburn and Katz (8) found that visceral fat extracted from one turkey had a higher acid-value than fat extracted from many chickens. Brown and Sheldon (6) also give evidence indicating the presence in turkey fat of eighteen-carbon acids more unsaturated than linoleic acid.

Experimental

A. History of Samples

I. Chicken fat of known origin. Live chickens (1-2 years old) were received in the laboratories direct from commercial farms. They had lived on the feeds indicated in Table III. The depot fats from individual chickens of each breed were pooled, frozen in carbon dioxide ice, and analyzed. New Hampshire Red, White Wyandotte, Rhode Island Red and White Plymouth Rock were the breeds studied.

II. Turkey fat of known origin. Live turkeys (1-2 years old) were received direct from commercial turkey farms. They had lived on the feeds designated in Table IV. The depot fats from individual turkeys from each of four breeds (White Holland, Narragansett, Bronze, Bourbon Red) were pooled, frozen in carbon dioxide ice, and analyzed separately. The depot fats from two turkeys (Bronze) which had been in cold storage for several months were handled similarly and analyzed separately.

III. Pooled chicken fat. A twenty-five pound sample of chicken fat was obtained from the Boston Market. It was pooled from many birds, had been exposed to the air and to temperature changes for an undetermined period of time and represented the type of fat purchased for use in food products.

IV. Pooled turkey fat. A twenty-five pound sample of turkey fat collected in a similar way, and subjected

TABLE II

Chemical and Physical Data on Turkey Fat (from Literature)

Investigator	Amthor and Zink (1)		Ross and Race (2)		Carlin (7)	Hepburn and Katz (8)	Brown and Sheldon (6)	
Determination	Fat	Fatty Acids	Fat	Fatty Acids	Fat	Fat	Fat	Methyl esters
Sp. Gr. 30/30°C.	0.9220	0.9385	0.9090	0.8990	0.91			
M.P. °C.		38-39	31-32	37-38				
Sol. Point °C.		31-32			19			
Ref. Index 40°C.						1.4663		
Sap. No.	200.5	210.7	191.6	195.0	196.5	225.1	195.0	194.9
Iodine No.	Hübl 81.15	Hübl 70.7	Wijs 66.4	Wijs 70.7		Hanus 64.90 Hübl 65.5	83.6*	79.9*
Acetyl No.				18.4				
Reichert-Meissl	2.2	4	3.8					
Polenske			1.6					
Hehner			95.1					
Acid No.					15.3	6.8		

* = method not given.

TABLE III

Chemical and Physical Constants of Chicken Fat

Breed	New Hampshire Red		White Wyandotte		Rhode Island Red		White Plymouth Rock		
Sex	Female		Female		Female		Female		
Feed	Wirthmore Complete Breeder Ration		Wirthmore All Mash Feed		Wirthmore Breeder Mash and Scratch Grain		Eastern States Breeder Mash and hard grain —green grass		
Sample Number	11	12	13	14	15	16	17	18	Limits of Values
Gms. fat in sample	133.5	141.9	16.3	62.7	183.1	284.5	71.6	92.2	
Peroxide*	0.0	0.0	0.98	1.73	0.0	0.0	0.0	0.0	0.0-1.73
F.F.A. (as % oleic)	0.08	0.14	......	0.08	0.06	0.14	0.11	0.12	0.06-0.14
Sap. No.	196.2	195.0	197.0	197.4	196.0	195.6	196.3	197.2	195.0-197.0
Iodine No. (Hanus)	92.0	90.8	84.7	83.9	86.8	83.7	88.3	87.0	83.7-92.0
SCN No.	65.3	65.8	60.2	59.8	65.7	64.7	65.9	66.4	59.8-66.4
Acetyl No.	1.80	1.90	......	2.43	1.33	1.73	1.61	1.53	1.33-2.43
Ref. Index 40°C.	1.4626	1.4624	1.4619	1.4618	1.4622	1.4620	1.4623	1.4621	1.4618-1.4626
Satd. Acids % (**)	27.6 (22.2)	26.9 (21.1)	33.3	33.7	27.1 (24.1)	28.2 (23.7)	26.9 (17.0)	26.3 (24.2)	26.3-33.7 (17.0-24.2)
Unsatd. Acids % (**)	72.4 (77.8)	73.1 (78.9)	66.7	66.3	72.9 (76.0)	71.8 (76.3)	73.1 (82.9)	73.7 (75.8)	66.3-73.7 (75.8-82.9)
Linoleic %	29.5	27.6	27.0	26.6	23.3	21.0	24.7	22.7	21.0-29.5
Oleic %	42.9	45.5	39.7	39.7	49.6	50.8	48.4	51.0	39.7-51.0

* = No. of ml. of 0.002 N thiosulfate required to titrate the iodine liberated by the active oxygen in 1 gm. of fat.
** = values in parentheses are experimental results. Values not in parentheses are calculated from Jamieson formulae (12).

to much the same treatment, was obtained from the Boston Market.

B. Preparation of Samples

Each sample was prepared by melting the depot fat, filtering through non-absorbent cotton into a Mason jar, thoroughly mixing, then storing under nitrogen at 4° C. The sample was melted and thoroughly mixed before a portion was removed for analysis. Since a number of portions of each sample were taken for examination over a period of several weeks, the sample was refrigerated each time, after the same precautions had been observed.

C. Methods of Analysis

The peroxide and free fatty acid content were the first to be measured because instability during storage might affect these values. Peroxide values were measured according to Greenbank and Holm (9) except that the reaction was carried out under nitrogen. The iodine number, saponification number, refractive index, melting point and specific gravity were estimated according to the official or tentative methods of the Association of Official Agricultural Chemists (10). The free fatty acid content was measured according to Lea (11), and the thiocyanogen number by the method of Jamieson (12). The iodine and thiocyanogen numbers were used to calculate the oleic and linoleic acid content (13).

(a) 89.9 × % oleic acid + 181.2 × % linoleic acid = 100 × iodine value

(b) 89.9 × % oleic acid + 90.6 × % linoleic acid = 100 × thiocyanogen value.

The percentage of saturated and unsaturated acids was determined by the official lead salt-ether separation procedure of the AOAC (10). Acetyl values were estimated according to West, Hoagland and Curtis (14) after it had been demonstrated that the results by this method were in complete agreement with those by the official AOAC method which requires approximately six times as much sample.

The analytical results are presented in Tables III and IV, and summarized in Table V.

Discussion

The variations in the analytical results (Table III) among the four breeds of chicken were not great. In most instances, however, the results from paired individuals agreed more closely than did those from the various breeds. The variations found among different breeds may be due either to differences in genetic composition or to differences in the feeds used by the several poultry growers.

Chicken fat melts over a range of temperatures. This may account for the discrepancy between the literature and the present report.

While the saponification number of the fat from freshly killed chickens agreed with the literature, that of the "commercial" sample was somewhat lower.

The iodine values found in this investigation are higher than those reported in the literature. Making use of the data for the saturated and unsaturated fatty acid fraction reported by Grossfeld (3) and applying the formulae of Dean (13), we have calculated that iodine values below 80 may be incorrect and that those reported by Grossfeld are too low.

Also, the acetyl numbers noted in this investigation of chicken fats are one-tenth and one-twentieth as high as the two reports (1, 2) in the literature. As the method was standardized against hydroxyl-containing fats and fatty acids, the acetyl numbers of which were known, we do not believe that our findings are in error.

In general, the remarks made pertaining to chicken fat apply also to turkey fat. The analytical results on turkey fats (Table IV) indicate that there is no great difference in the composition of turkey fats.

TABLE IV

Chemical and Physical Constants of Turkey Fat

Breed	White Holland		Narragansett		Bronze		Bourbon Red		Bronze		
Sex	Female		Female		Female		Male		Male		
Feed	Commercial Mash —5 companies scratch feed		New England Conf. Breeder Ration—, wheat and oats		Commercial feeds		Commercial feeds		Taken from cold storage		
Sample Number	1	2	3	4	5	6	7	8	9	10	Limits of Values (Live Birds)
Gms. fat in sample	117.2	67.9	172.8	151.7	9.0	25.0	156	55.6	174.5	109.2	
Peroxide*	0.0	0.0	0.0	0.0	0.0	1.36	0.0	0.0	3.52	2.22	0.00-1.36
F.F.A. (as % oleic)	0.23	0.19	0.24	0.17	......	......	0.25	0.28	0.95	1.00	.17-.28
Sap. No.	196.3	195.3	195.5	196.0	182.8	192.1	198.6	199.3	196.6	194.3	182.1-199.3
Iodine No. (Hanus)	80.4	84.9	86.6	87.9	78.8	82.1	80.8	85.7	78.6	75.4	78.8-87.9
SCN No.	59.6	62.4	64.8	66.8	60.3	63.2	59.2	59.4	60.2	59.9	59.2-66.8
Acetyl No.	4.27	1.89	2.02	2.79	......	2.93	2.40	1.96	4.14	3.65	1.89-4.27
Ref. Index 40°C.	1.4615	1.4620	1.4625	1.4623	1.4620	1.4618	1.4616	1.4617	1.4610	1.4602	1.4615-1.4625
Satd. Acids %	33.9	30.7	28.1	25.9	33.1	29.8	33.1	32.2	33.2	33.5	25.9-33.9
(**)	(32.1)	(25.3)	(21.6)	(20.7)			(32.4)		(30.6)	(30.2)	(20.7-32.4)
Unsatd. Acids %	66.1	69.3	71.9	74.1	66.9	70.2	66.9	67.8	66.8	66.5	66.1-74.1
(**)	(67.9)	(74.7)	(78.4)	(79.3)			(67.6)		(70.2)	(69.8)	(67.6-79.3)
Linoleic %	23.0	24.8	24.3	23.3	20.4	20.9	23.8	29.0	20.3	17.1	20.4-24.8
Oleic %	43.1	44.5	47.6	50.8	46.5	49.3	43.1	36.8	46.5	49.4	36.8-50.8

* = No. of ml. of 0.002 N thiosulfate required to titrate the iodine liberated by the active oxygen in 1 gm. of fat.
** = values in parentheses are experimental results. Values not in parentheses are calculated from Jamieson formulae (12).

TABLE V

Summary of Chemical and Physical Constants of Chicken and Turkey Fats

	Individual Live Chickens	Pooled Sample of Chicken Fat	Individual Live Turkeys	Pooled Sample of Turkey Fat	Cold Storage Turkeys
F. F. A. (as % oleic)	0.10	0.75	0.23	2.26	0.98
Sap. No.	196.3	182.9	194.7	184.5	195.5
Iodine No. (Hanus)	87.1	79.1	82.1	78.4	76.6
SCN No.	64.2	60.5	61.6	59.6	60.1
Acetyl No.	1.76	3.42	2.81	....	3.90
Ref. Index 40°C.	1.4621	1.4612	1.4617	1.4610	1.4606
Sp. Gr. 30/30°C.	....	0.9107	....	0.9098	....
M. P. °C.	20.1-36.2 (5 chickens)	....	19.5-35.6 (5 turkeys)	....	....
Satd. acids %	28.8	32.8	30.8	33.7	30.4
Unsatd. acids %	71.2	67.2	69.2	66.3	70.0
Linoleic %	25.4	20.6	22.7	20.8	18.7
Oleic	45.8	46.6	46.5	45.5	50.9
Peroxide*	0.34	0.0—initial 0.0—4 mos.	0.17	4.02—initial 7.54—3 wks.	2.87

* = number of ml. of 0.002 N thiosulfate required to titrate the iodine liberated by the active oxygen in 1 gm. of fat.

Calculations indicated that there were no acids more unsaturated than linoleic acid, a result in agreement with Hilditch et al (5) but contrary to Brown and Sheldon (6). There seems to be no characteristic by which turkey fat consistently differs from chicken fat, for the range of the constants of each may overlap that of the other. Thus it would seem impossible to differentiate between these fats by the ordinary forms of chemical analysis.

We have noted, however, that the commercial turkey fat sample had a greater tendency toward rancidification. This is shown by peroxide values determined after varying periods under the same conditions. After four months at 4° C. the value for chicken fat was still zero, while after three weeks the value for turkey fat had increased from 4.02 to 7.54. Consequently, turkey fat tends to have a higher fatty acid value, a higher acetyl value, and lower iodine and thiocyanogen values. Rancidification, in the case of turkey fat, may be due to a lower content of natural antioxidants, such as tocopherols, but this possibility has not yet been checked. The samples of fresh turkey fat, however, showed no such tendency toward rancidification, so it must be concluded that the commercial sample was received in poor condition.

Chicken fat has long been used in the food industry, especially as a soup ingredient. It would seem that turkey fat is chemically similar to chicken fat and might be used in its stead, especially since it is more abundant and less expensive. The stronger flavor and poorer stability of turkey fat may interfere with its widespread use as a substitute for chicken fat.

Summary

Several chemical constants have been determined on the depot fats taken from four strains of chickens and four strains of turkeys. Similar analyses have been run on depot fat from cold storage turkey and on "commercial" samples of chicken and turkey fat obtained from the wholesale market.

There is no significant difference in the constants of fats from various breeds of chicken. The fats from various breeds of turkey are also similar.

Furthermore, there is no outstanding difference between the constants of turkey and chicken fats, though turkey fats tend to have higher fatty acid and acetyl values and lower iodine and thiocyanogen values, and a somewhat greater instability. Thus it is not easily possible to distinguish between turkey and chicken fats by the usual analytical procedures.

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