Chemical composition of pork and mutton in Egypt

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INTRODUCTION

Protein plays an important role in the life of people and nations. Meat is considered the most valuable source of protein. Till 1950 the animal protein was quite enough and more in Egypt, where mutton and mutton products were highly consumed. Because of our Islamic religion pigs are not enormously produced or consumed. Due to high standard of living and outbreak increase in the number of population, the lack of meat took place. Therefore, it was necessary to import different kinds of meat and meat products to cover shortage in animal protein. The present investigation was carried out to study the chemical composition of pork and mutton in Egypt in order to find methods of detection of pork or lard in meat products.

MATERIALS AND METHODS:

Mutton and pork were taken from the hind quater i.e., the hind legs, of male animals about 8 months age, (after 2.5 hours of slaughtering).

Lard was taken from fatty tissues layers under-skin, while in mutton, fatty tissues were taken from the tail.

Analytical methods:

A. Determination of physiochemical properties of fat:

Specific gravity, refractive index, melting point, acid value, peroxide value, saponification no., and iodine value - Hanus method - , were determined using the methods described in A.O.C.S. (1964). The thiobarbituric acid value (T.B.A.) was determined as described by Pearson (1970), using 10 gm of ground sample. Measurements were carried out colourimetrically as O.D. at 538 m.u.

Moisture, protein (N x 6.25), fat, and ash content of the fresh meat were determined using the methods described in the A.O.A.C. (1975).

Preparation of triglycerides:

The triglycerides were separated from monoglycerides, by adopting the method of Dister and Baur (1965).

Preparation of monoglycerides:

Enzymatic preparation of 2-monoglyceride from triglycerides by pancreatic lipase was followed as the method described by Abdel-Fattah (1970).

Thin layer chromatography of the hydrolysate:

was carried out due to (Thomas et al., 1965).

Preparation of the methyl esters of fatty acids by transesterification:

The methyl esters of fatty acids were prepared according to the method described by (Gauglitz and Lehman, 1963).

Purity assessment of the prepared methyl esters by thin layer chromatography:

was conducted according to (Tuna and Mangold, 1965).

Gas liquid chromatography of methyl esters of fatty acids:

The Gas chromatographic analysis was carried out using a (G C V) Gas liquid chromatography app. at the central laboratorie of Faculty of Agriculture Cairo University. The temperature of column was 100°C and 250°C. for the detector. Quantitative analysis was carried out on basis of peak area measurements by multiplying the length of the peak by its width at half the length. The fatty acid composition of the triglycerides and 2-monoglycerides were calculated as mol. %.

The factor of palmitic acid enrichment, the saturation ratio and other ratios based on the fatty acids composition of 2-monoglycerides were calculated by the method used by Abdel-Fattah (1974), and El-Dashlouty (1978). The following equations were used respectively:

(1) Palmitic acid enrichment factor = $\frac{\text{\% of palmitic acid in 2-M.G}}{\text{\% of palmitic acid in T.G.}}$

(2) Unsaturation ratio = $\frac{\text{\% of unsaturated fatty acids in 2-M.G.}}{\text{\% of unsaturated fatty acids in T.G.}}$

(3) a. $\frac{\text{\% of total } C_{16} \text{ fatty acids}}{\text{\% of total } C_{18} \text{ fatty acids}}$

b. $\frac{\text{\% of saturated fatty acids}}{\text{\% of unsaturated fatty acids}}$

Microscopic shape of fat crystals:

Microscopic shape of fat crystals for fresh mutton and pigs tissues, were examined according to the method described by Williams (1966).

RESULTS AND DISCUSSION:

I. Composition of fresh mutton and pork

1. Chemical composition:

Data presented in Table (1) show the chemical composition of meat obtained from the legs of sheep and pig.

It could be noticed from Table (1) that mutton showed higher moisture and protein contents compared to pork, which contained higher content of fat. The variations in fat content were relatively proportional with moisture content. Variation in protein and ash contents were small specially when calculations were on fresh weight basis. Such resuls are in agreement with the findings of Anfimov et al. (1959), Pavlovski and Palmin (1963), and Cattaneo et al. (1979) who reported that pork contained higher fat and lower moisture and protein contents than mutton.

Mutton showed low energy value than pork, due to higher fat content in pork, however, in some cases high energy value is not appreciated.

2: Physical and chemical properties of fat:

The physicochemical properties of sheep and pigs fat were determined. Data obtained are tabulated in Table (2).

It is shown from Table (2) that the specific gravity is slightly higher for lard than sheep fat which may indicate higher fatty acids content in lard.

The same trend was noticed for refractive index, which may refer to higher unsaturated fatty acids content in lard as mentioned by Sokolov, (1965).

The increase of unsaturated fatty acids may be associated with the increase of biological value. Meanwhile the increase of unsaturation reduced the stability of fat upon storage due to more rapid oxidation as reported by Sokolov, (1965).

As shown in Table (2) the melting point of sheep fat was higher than that of lard, while peroxide, T.B.A., acid, iodine and saponification values were higher in lard than sheep fat. This may assure higher content of unsaturated fatty acids in lard which enhances oxidation and accelerates deterioration of fat upon storage. These results are in agreement with those reported by El-Dashlouty (1948) and Sokolov (1965).

3. (a) Fatty acids composition of 2-monoglycerides and triglycerides in sheep fat and lard:

The fatty acids composition of 2-monoglycerides and triglycerides determined by gas liquid chromatography, are presented in Table (3).

Table (3) showed that the fatty acids proportions in triglycerides vary in lard from sheep fat. However, the composition of lard triglycerides may be affected to some extent by the fatty acids of feed.

The fatty acids composition of 2-monoglycerides gave the characteristic pattern to lard triglycerides. Lard on the contrary of other animals and vegetable fats is characterised by the presence of high percentage of saturated fatty acids specially palmitic acid at the 2-monoglycerides. These results are in agreement with those mentioned by (Mattson and Lutton, 1958); Vander Wal, 1960; Coleman, 1963; Mattson et al., 1964; Abdel-Fattah, 1970 and El-Dashlouty, 1978).

(b) Palmitic acid enrichment factor:

The palmitic acid enrichment factor of lard was 2.73, while it was 0.15 in sheep fat, as shown in Table (4). This may be due to the palmitic acid low content in 2-monoglyceride and high content in triglycerides of sheep fat.

(c) The unsaturation ratio:

Results given in Table (5) indicate that the unsaturation ratio was low for lard than sheep fat as it was 0.35 and 1.42, respectively.

(d) Other ratios based on the fatty acids composition of 2-monoglycerides:

Table (6) indicates the total C_{16} fatty acids/total C_{18} fatty acids and the saturated fatty acids/unsaturated fatty acids for sheep fat and lard in 2-monoglycerides.

From Table (6) it could be observed that the ratio of total C_{16}/total C_{18} in 2-monoglycerides was considerably high in case of lard as it was 3.17; while it was 0.09 in sheep fat. Such results are in agreement with the findings of Abdel-Fattah, (1970 and 1974); and El-Dashlouty, (1978).

(e) Glyceride pattern of lard and sheep fat:

Results in Table (7) show the glyceride pattern of lard and sheep fat, calculated by Vander Wal, (1960) method.

The ratio USU/SUS was calculated for lard and sheep fat, and results are given in Table (8).

The USU/SUS ratio was higher in lard than in sheep fat as it was 42.5 and 0.13, respectively.

4. Fractionation of triglycerides:

The fractionation of lard and sheep fat triglycerides was carried out by thin layer chromatography on plates of silica gel G impregnated with 12% (w/v) silver nitrate and the

chromatograms are shown in Fig. (1). Lard gave 10 separable bands, while sheep fat showed 4 highly saturated bands. Lard contained 6 more unsaturated glyceride fractions.

5. Fat crystals:

The photo-micrographs of lard and sheep fat crystals are shown in Fig. (2). Sheep fat crystallized in characteristic fan-like tufts, with more or less pointed ends and they were needle-like. Cristals of lard were chisel-like shaped.

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Table (1): The chemical composition of fresh mutton and pork.

Components	Mutton		Pork	
	fresh weight basis	dry weight basis	fresh weight basis	dry weight basis
Moisture %	73.75	-	71.55	-
Protein (N x 6.25%)	15.75	60.0	15.35	53.96
Fat %	8.21	31.28	10.85	38.14
Ash %	1.04	3.96	1.06	3.73
Carbohydrates %	1.25	4.76	1.19	4.18
Dry matter %	26.25	-	28.45	-
Energy value (Cal./100 gm)	144.41	-	166.55	-

Table (2): The physical and chemical properties of fat.

Indices	Sheep fat	Lard
Physical properties:		
Specific gravity at 15°C (gm/cm^3)	0.8864	0.8904
Refractive index at 40°C.	1.4625	1.4648
Melting point C°.	46	40
Chemical properties:		
Peroxide value	1.484	2.631
Acid value	0.299	0.602
Iodine value	52.405	60.377
Saponification number	206.635	222.062
T.B.A. (O.D. at 538 mu)	0.035	0.050

Table (3): The fatty acids composition of 2-monoglycerides and triglycerides of sheep and lard.

Fatty acids %		Sheep fat		Lard	
		2-MG*	T.G.**	2-MG*	T.G.
Myrisitic	$C_{14:0}$	4.46	8.29	4.89	1.[illegible]
Pentadecanoic	$C_{15:0}$	0.24	1.20	-	28.[illegible]
Palmitic	$C_{16:0}$	3.66	24.40	69.69	2[illegible]
Palmitoleic	$C_{16:1}$	3.67	10.94	2.63	1.[illegible]
Heptadecanoic	$C_{17:0}$	2.88	3.00	-	0.[illegible]
Heptadecenoic	$C_{17:1}$	-	3.22	-	13.[illegible]
Stearic	$C_{18:0}$	1.09	1.58	5.14	39.[illegible]
Oleic	$C_{18:1}$	75.56	43.65	12.83	14.[illegible]
Linoleic	$C_{18:2}$	8.46	3.82	4.83	

* 2-MG = 2-monoglycerides.

** T.G. = Triglycerides.

Table (4): The palmitic acid enrichment factor for sheep and lard.

Sample	Palmitic acid in 2-MG. %	Palmitic acid in T. G. %	Palmitic acid enrichment factor
Lard	69.69	25.51	2.73
Sheep fat	3.66	24.40	0.15

Table (5): The unsaturation ratio of sheep fat and lard.

Source of fat	Sheep fat	Lard
Unsaturated fatty acids in T.G. %	61.62	67.[illegible]
Unsaturated fatty acids in 2-MG %	87.68	[illegible]
Unsaturation ratio	1.42	

Table (6): The ratios of total C_{16} fatty acids/total C_{18} fatty acids and saturated fatty acids/unsaturated fatty acids for sheep fat and lard in 2-monoglycerides.

Source of fat	Lard	Sheep fat
Total C_{16} fatty acids %	72.32	7.33
Total C_{18} fatty acids %	22.80	85.10
Total C_{16} fatty acids/total C_{18} fatty acids ratios	3.17	0.09
Saturated fatty acids %	79.72	12.32
Unsaturated fatty acids %	20.29	87.68
Saturated fatty acids/unsaturated fatty acids ratios	3.93	0.14

Table (7): The glyceride pattern of lard and sheep fat.

Indices	Lard	Sheep fat
Unsaturated T.G. %	57.84	61.62
Unsaturated 2-M.G. %	20.29	87.68
a	42.16	38.38
b	79.72	12.32
SSS	4.36	3.26
USU	46.78	2.91
SSU	28.57	6.15
SUS	1.10	23.17
UUU	11.91	20.71
UUS	7.27	43.81

Table (8): The proposed ratio of USU/SUS as calculated for sheep fat and lard.

Sample	USU/SUS
Sheep fat	0.13
Lard	42.53

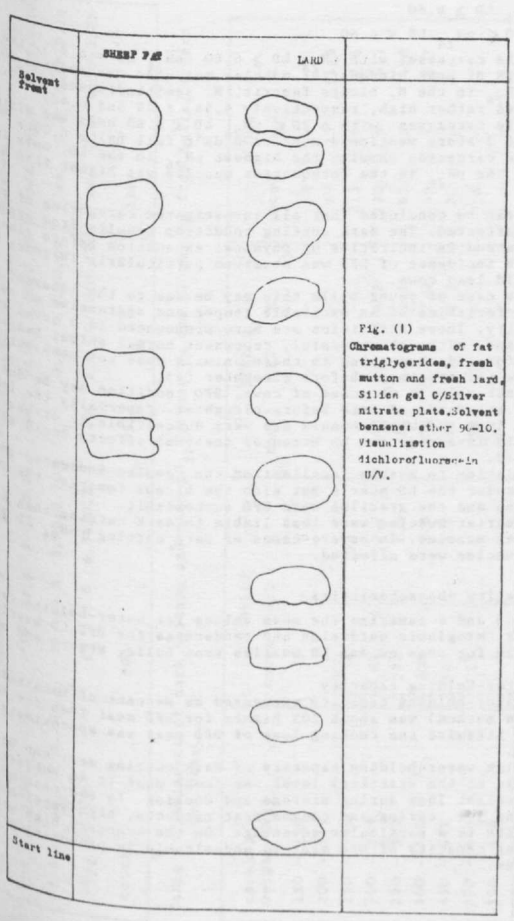

Fig. (1) Chromatograms of fat triglycerides, fresh mutton and fresh lard, Silica gel G/Silver nitrate plate. Solvent benzene: ether 90-10. Visualization dichlorofluorescein U/V.

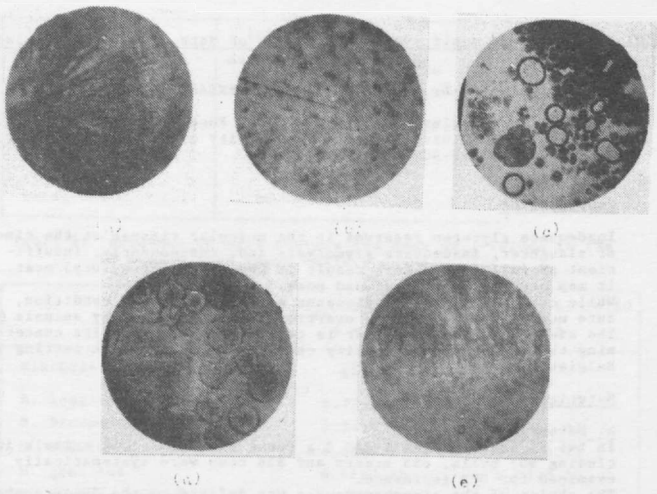

Fig. (2): The crystals of fresh sheep and lard (5X40).

(a). Sheep (fan-like tufts).

(b). Lard (chisel-like shaped).

(c). Sheep, small crystals (round and grouped).

(d). Sheep, larger crystals (rounded and fan-like).

(e). Lard (bunches of plate-like leaf).