APPLICATION OF IR SPECTROPHOTOMETRY AND GLC TECHNIQUE FOR CHARACTERIZATION AND QUALITY ASSESSMENT OF LARD-CAMEL TALLOW MIXTURES.

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ABSTRACT

This investigation was carried out in an attempt to find out reliable characterization and quality assessment parameters for lard-camel tallow mixtures.

Infrared (IR) absorption spectra for pure lard; camel tallow and certain mixtures of lard in camel tallow were determined on a perkin Elmer-580 B infrared spectrophotometer. Fatty acid composition of triglycerides (TG) and B-monoglycerides (B-MG) of lard, camel tallow as well as camel tallow mixtures with 3;6; 9;12 and 15% of added lard was determined by applying GLC technique.

The data showed that the infrared (IR) technique could be recommended as a reliable helpful parameter for lard detection in camel tallow mixtures, by applying the following regression equation: Y= A + BX.

where: Y= percentage of lard in tallow;
A= the intercept of the regression line;
B= regression coefficient
X= ratio of absorbance.

Furthermore, the GLC data revealed that palmitic acid ($C_{16:0}$) identified in lard was mainly incorporated in B-monoglyceride, while oleic acid ($C_{18:1}$) and linoleic acid ($C_{18:2}$) were preferentially esterified in the 1- and 3- positions of the triglycerides.

INTRODUCTION

Fats and oils constitute one of three major classes of food materials. During this century, the proportion of energy in the food supply attributed to fat has increased from 32 to 42%; conversely, the proportion attributed to carbohydrate has decreased from 56 to 46%, (Rizek et al. 1983).

El-Magoli et al. (1979) reported that the evaluation of animal tallows indicated the presence of large amounts of saturated fatty acids. Oleic acid was found to be the only predominant unsaturated acid, especially in camel hump. Likewise, small levels of palmitoleic and myristoleic acid were found in camel hump and buffalo caul.

Lapshev (1976) showed that infrared spectroscopic studies of animal tallows and lard gave absorption peaks characteristic for each fat type.

According to Griffiths (1975) absorptions in the range of 600-500 cm^{-1}, due to the stretching or deformation vibrations of molecules, may be used as a definite parameter to detect or confirm the presence of certain functional groups within an unknown compound.

This investigation was carried out in an attempt to find out reliable characterization and quality assessment parameters for lard-camel tallow mixtures.

MATERIALS AND METHODS

1- Materials

Camel tallow was obtained from Assiut slaughter house immediately after slaughter. Withdrawn lard from pork outer back fat of male pigs was procured from local market. Camel tallow was deliberately adulterated in the laboratory with added lard to give the following adulteration

percentages: 3;6;9;12 and 15% (w/w).

2- Analytical methods:

Fat extraction: Fat was extracted from fatty tissues as described by Folch *et al.* (1957).

Preparation of triglycerides: The triglycerides were separated from total fat by adopting the method of Dister and Baur (1965).

Preparation of B-monoglycerides: Enzymatic preparation of B-monoglycerides from triglycerides by pancreatic lipase was performed as described by Rossell *et al.* (1978).

Preparation of methyl esters of fatty acids: The methyl esters were prepared from total lipids; triglycerides and B-monoglycerides as mentioned by Rossell *et al.* (1983).

Gas liquid chromatography: The methyl esters of fatty acids were separated using a PYE unicam (GCD) gas liquid chromatography apparatus with S 8 auto sampler.

Factors calculation: The following equations were calculated as outlined by Rashwan (1986):

(1) Palmitic acid enrichment factor:

$$\frac{\%\text{ palmitic acid in B-monoglyceride}}{\%\text{ palmitic acid in triglyceride}}$$

(2) Unsaturation ratio:

$$\frac{\%\text{ unsaturated fatty acids in B-monoglyceride}}{\%\text{ unsaturated fatty acids in triglyceride}}$$

(3)a. $$\frac{\%\text{ total } C_{16} \text{ fatty acids in B-monoglyceride}}{\%\text{ total } C_{18} \text{ fatty acids in B-monoglyceride}}$$

b. $$\frac{\%\text{ saturated fatty acids in B-monoglyceride}}{\%\text{ unsaturated fatty acids in B-monoglyceride}}$$

Infrared spectrophotometric analysis: Infrared absorption spectra for pure lard; camel tallow and experimental mixtures of added lard in camel tallow were determined on a perkin Elmer-580 B infrared spectrophotometer. Samples were pressed between two discs from K Br. Spectra were scanned from 3100 cm^{-1} to 2700 cm^{-1}. Absorption values were taken at 3010 cm^{-1} (c=c) and at 2855 cm^{-1} (c-c).

RESULTS AND DISCUSSION

The data of mean values of fatty acid composition of lard and camel tallow are given in Table (1).

The results showed that in general the quantitative fatty acid content markedly varied in lard than that in camel tallow.

It is obvious from the data that generally lard contained more unsaturated fatty acids (57.37%) than camel tallow (46.74%).

An alternative check-up of the adulteration of camel tallow with lard is made from the $C_{18:0}/C_{18:2}$ ratio. This ratio was 1.15 and 5.69 in lard and camel tallow, respectively.

Table (2) revealed that palmitic acid enrichment factor was 2.29 and 0.87 in pure lard and camel tallow, respectively. This may be due to the rather high content of palmitic acid in B-monoglyceride and its low content in triglyceride of lard Furthermore, from such data it might be concluded that as lard percentage increased the palmitic acid enrichment factor values were elevated. This

Table (1): Fatty acid composition of lard and camel tallow (% of the total).

Tallow	% of fatty acid content								
	$C_{14:0}$	$C_{16:0}$	$C_{16:1}$	$C_{17:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{18:0}/C_{18:2}$
Lard	1.92	27.34	4.26	0.79	12.39	41.03	10.76	1.32	1.15
Camel tallow	3.78	26.03	3.61	0.32	22.76	36.63	4.00	2.50	5.69

might be attributed probably to the fact that 90% of the total palmitic acid in lard was in the B-position (Mattson et al. 1964; Amer et al. 1972; and Bracco et al. 1976).

Table (2): Palmitic acid enrichment factor for lard, camel tallow and lard-camel tallow mixtures.

Origin		Palmitic acid in B-MG	Palmitic acid in TG	Factor
Lard		59.82	26.11	2.29
Camel tallow		21.09	24.31	0.87
% Added lard in camel tallow (w/w)	3%	21.51	24.40	0.88
	6%	23.89	24.89	0.96
	9%	27.63	25.32	1.09
	12%	29.09	25.48	1.14
	15%	30.13	25.87	1.16

Table (3) represents the data of unsaturation ratio of lard; camel tallow and lard-camel tallow mixtures. Such data revealed that this ratio was rather low in lard (0.45) than that in camel tallow (1.03). This might be due to the marked high content of unsaturated fatty acids (54.16%) in B-monoglyceride of camel tallow, while lard recorded an opposite trend (25.98%). These data are in close agreement with that previously reported by Abou-Arab (1980), Bayoumy (1982) and Rashwan (1986).

On the other hand the data revealed that the unsaturation ratio for lard-camel tallow mixtures gradually decreased as lard percentage was increased.

Table (3): The unsaturation ratio for lard; camel tallow and lard-camel tallow mixtures.

Origin		saturated fatty acids in TG	unsaturated fatty acids in B-MG	Ratio
Lard		57.30	25.98	0.45
Camel tallow		52.33	54.16	1.03
% Added lard in camel tallow (w/w)	3%	52.71	53.24	1.01
	6%	52.96	52.43	0.99
	9%	53.32	50.12	0.94
	12%	54.40	48.96	0.90
	15%	55.23	48.60	0.88

Table (4) shows the total C_{16} fatty acids/total C_{18} fatty acids and saturated/unsaturated fatty acids for lard, camel tallow and lard-camel tallow mixtures in B-monoglyceride.

The data revealed that the total C_{16}/total C_{18} fatty acids ratio was considerably high in lard (2.29), reaching four fold its value in camel tallow (0.54).

On the other hand, saturated/unsaturated fatty acids ratios were 2.78 and 0.57 in lard and camel tallow, respectively. This might be attributed to the rather high content of saturated fatty acids (72.281) and low content of unsaturated fatty

Table (4): Total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratios in B-monoglycerides for lard; camel tallow and lard-camel tallow mixtures.

Fatty acids	Lard	Camel tallow	Added lard in camel tallow (w/w)				
			3%	6%	9%	12%	15%
% Total C_{16} fatty acids	64.73	28.30	29.16	31.03	34.89	36.76	38.55
% Total C_{18} fatty acids	28.30	52.32	52.07	51.72	50.57	44.83	43.31
C_{16}/C_{18}	2.29	0.54	0.56	0.60	0.69	0.82	0.89
% saturated fatty acids	72.28	31.10	31.78	33.91	35.09	38.68	40.01
% unsaturated fatty acids	25.98	54.16	54.79	53.83	53.17	52.99	51.96
Ratio	2.78	0.57	0.58	0.63	0.66	0.73	0.77

acids (25.98%) in B-monoglyceride of lard, while camel tallow recorded an opposite trend. Such data coincide with those previously reported by Nour El-Din et al. (1984) and Rashwan (1986).

Moreover, the data revealed that the addition of lard to camel tallow resulted in a rather slight increment in the C_{16}/C_{18} fatty acids and saturated/unsaturated fatty acids ratios.

Generally, it could be concluded that applying certain calculation factors can be considered as reliable parameters for the detection of lard in camel tallow.

On the other hand, Fig. (1) illustrates the infrared (IR) absorption spectra, from 3100 cm^{-1} to 2700 cm^{-1}, for lard and camel tallow. Absorption ratio (R) was calculated as follows:

$$R = \frac{\text{Absorbance at } 3010\ cm^{-1}}{\text{Absorbance at } 2855\ cm^{-1}}$$

The data revealed that the absorption ratio (R) was 0.1998 and 0.1268 for lard and camel tallow, respectively. Thus the latter ratio can be used to differentiate between lard and camel tallow.

Plotting this ratio vs. the percentage of added lard in camel tallow is shown in Fig. (2). The method is based upon the direct linear relationship between the percentage of added lard in camel tallow and the absorption ratio (R).

The data represented in Fig. (2) led to the following equation: $Y = A + BX$

where: Y= added lard percentage in camel tallow.
A and B constants.
X= absorption ratio (R)

Such equation may be successfully used in detecting lard in camel tallow, which is in close agreement with Arnold et al. (1971) and Rashwan (1986) findings.

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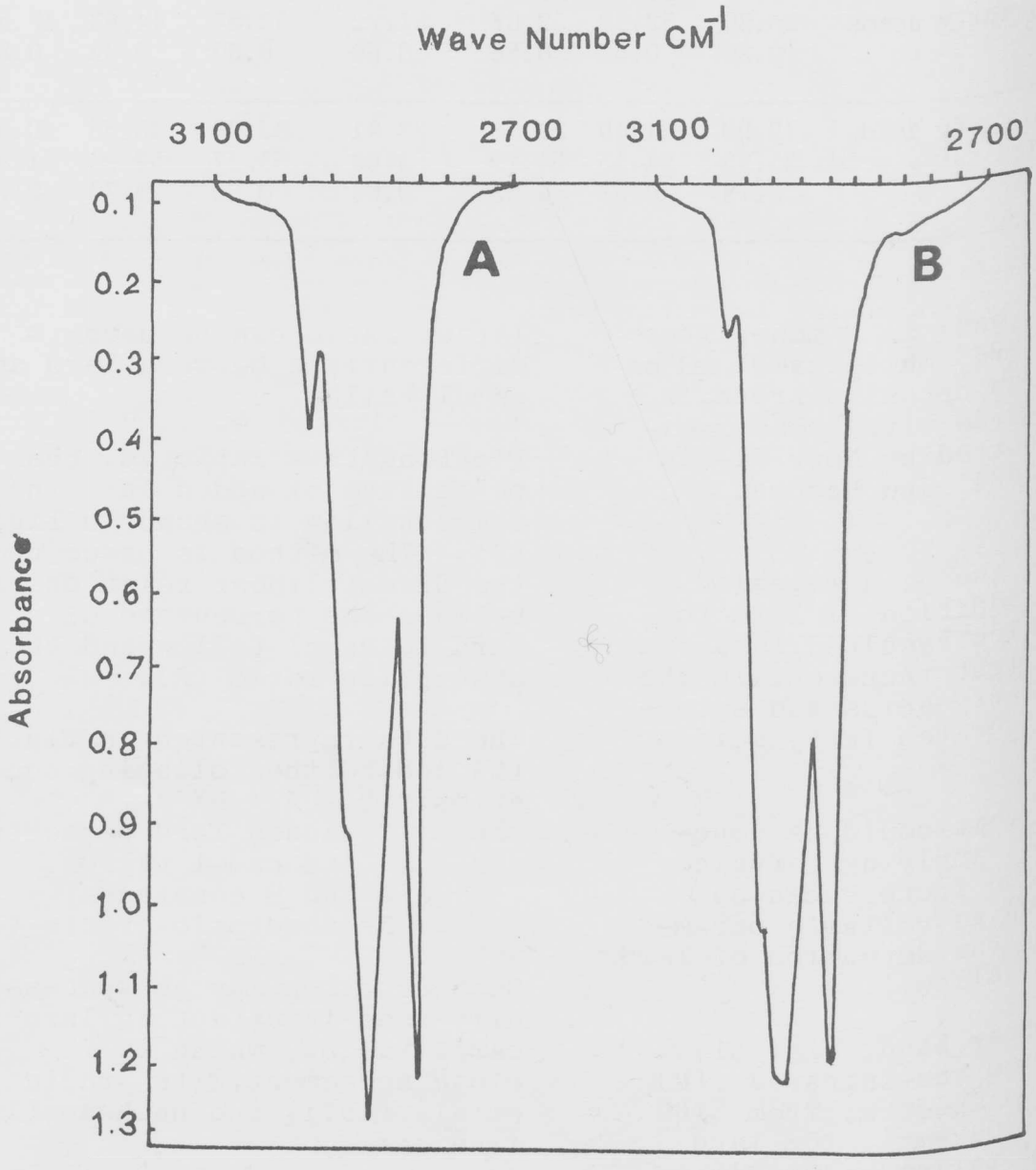
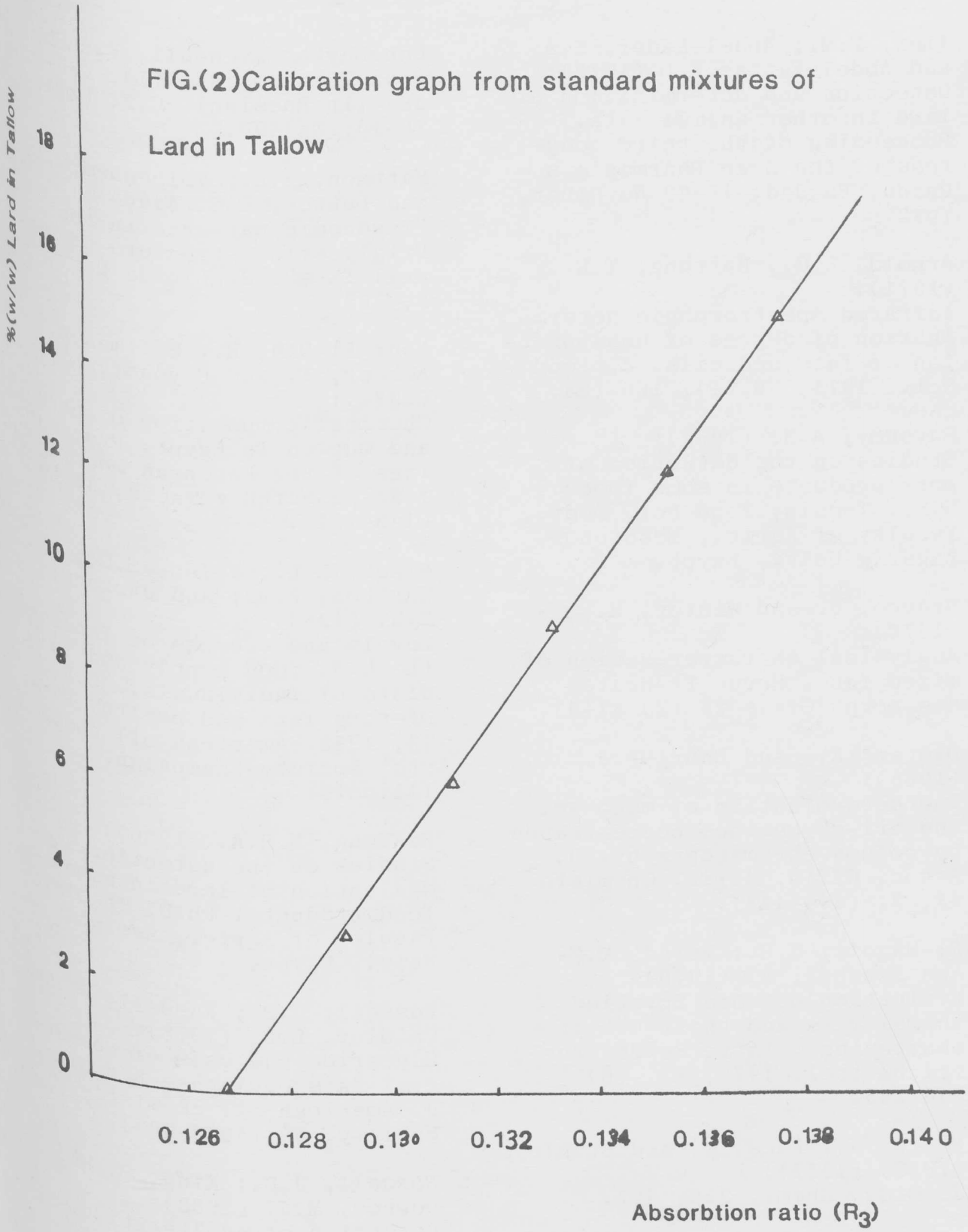


FIG.(1) Infrared absorption patterns of (A) Lard,(B) Tallow

FIG.(2)Calibration graph from standard mixtures of Lard in Tallow



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