GLC DETECTION AND ASSESSMENT OF LARD ADULTERATION IN BUFFALO TALLOW

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ABSTRACT

Studies on samples of pure lard and buffalo tallow, as well as buffalo tallow mixtures including 3; 6; 9; 12 and 15% of added lard were performed. Methods based on GLC determination of fatty acid composition of lard, buffalo tallow and lard-buffalo tallow mixtures, as well as GLC determination of triglyceride (TG) fatty acids and the fatty acid content in B-monoglycerides (B-MG) obtained after fat lipolysis were assessed.

The linoleic acid ($C_{18:2}$) content in lard and buffalo tallow amounted to 10.76% and 4.32%, respectively, while the stearic acid ($C_{18:0}$) content was markedly lower in lard (12.39%) accounting to less than 50% of its content in buffalo tallow (26.51%). An alternative check-up index of buffalo tallow adulteration with lard was derived from the $C_{18:0}/C_{18:2}$ ratio. The latter amounted to 1.15 and 6.14 in lard and buffalo tallow respectively.

A calibration graph was plotted using the percentage of added lard in buffalo tallow against the percentage of linoleic acid content of afore-mentioned mixtures of lard in buffalo tallow.

Feasibility of applying some calculation factors namely, palmitic acid enrichment factor, unsaturation ratio, total C_{16}/total C_{18} fatty acids in B-MG, and saturated/unsaturated fatty acids in B-monoglyceride as a criteria for the detection of lard adulteration were assessed as well.

INTRODUCTION

The specific distribution of palmitic acid in the B-position of the triglycerides of lard offers a new analytical tool for evaluating lard-buffalo tallow mixtures. Based on fatty acids distribution in individual triglycerides of natural fats Abd el-Fattah (1970 and 1974) and Rashwan (1986) successfully detected lard in other animal fats.

Taking in consideration that lard is the only fat which contains high percentage (more than 80%) of saturated fatty acids at B-position, the detection of lard in animal fats was achieved by calculating a proposed value so-called the unsaturation ratio (Amer et al. 1972). This ratio was found to be 1.4 or more in animal and vegetable oils and fats, whereas being 0.5 or less in lard. Farag et al. (1980) found that the fatty acid ratios $C_{18:0}/C_{18:2}$ and total saturated/total unsaturated were rather effective for detecting the adulteration of buffalo and cow ghee with lard. This investigation is dealing with GLC determination of fatty acids of lard, buffalo tallow and lard-buffalo tallow mixtures in an attempt to find out the most reliable methods for detection and assessment of lard adulteration in buffalo tallow.

MATERIALS AND METHODS

1- Materials:

Buffalo tallow was withdrawn and trimmed free from lean meat of male buffaloes immediately after slaughtering in Assiut slaughter house.

Lard was procured from Assiut local market. Lard was withdrawn from pork outer back fat of male pigs.

Buffalo tallow was deliberately adulterated in the laboratory with lard in 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) applying Ways et al. (1964) modifications.

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

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

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

Gas liquid chromatography of methyl esters of fatty acids: 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 palmitic acid enrichment factor, the unsaturation ratio and other ratios based on the fatty acid composition of triglycerides and B-monoglycerides were calculated as outlined by Rashwan (1986). The following equations were used respectively:

(1) Palmitic acid enrichment factor:

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

(2) Unsaturation ratio:

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

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

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

RESULTS AND DISCUSSION

Fatty acid composition of lard and buffalo tallow are given in Table (1). The data showed that the quantitative fatty acid content markedly varied in lard than that in buffalo tallow. The linoleic acid ($C_{18:2}$) content in lard and buffalo tallow ammounted 10.76% and 4.32%, respectively. While, the stearic acid ($C_{18:0}$) content was markedly lower in lard (12.39%) than that in buffalo tallow (26.51%).

An alternative check-up index of the adulteration of buffalo tallow with lard was derived from the $C_{18:0}/C_{18:2}$ ratio. This ratio amounted to 1.15 and 6.14 in lard and buffalo tallow, respectively. These results are in close agreement with that previously reported by El-Magoli et al. (1979), Youssef et al. (1980-a), and Youssef and Rashwan (1987).

A calibration graph as illustrated in Fig. (1) was plotted using the percentage of lard in buffalo tallow against the percent of linoleic acid content of afore-mentioned mixtures of lard in buffalo tallow. Estimation of lard in unknown samples, is made by determining the percentage of linoleic acid content by taking the corresponding percentage of lard from the graph.

The data presented in Table (2) revealed that the palmitic acid enrichment factor was 2.29 and

FIG.(1) Calibration graph from standard mixtures of Lard in Tallow

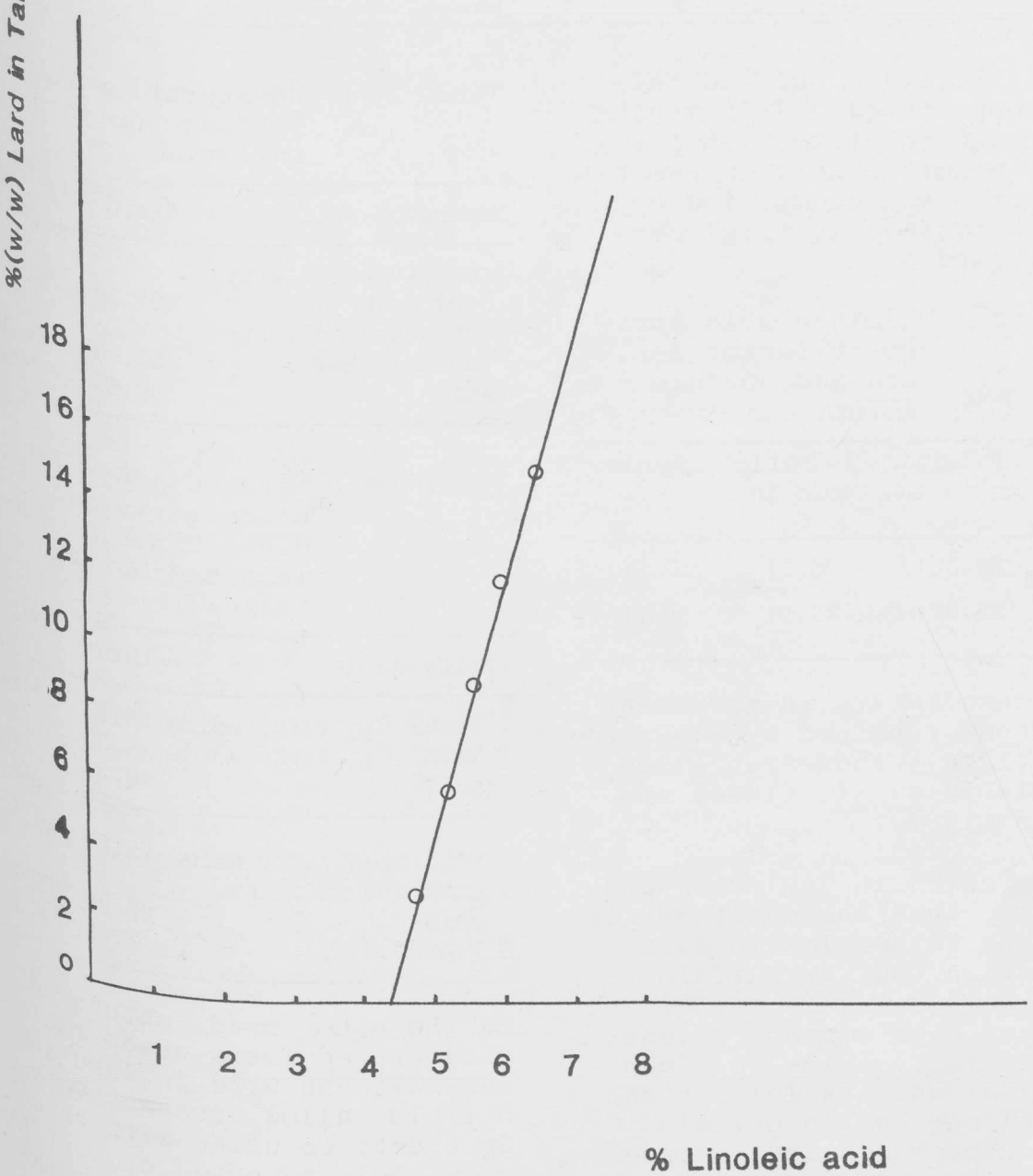

Table (1): Fatty acid composition of lard and buffalo tallow (% of the total).

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
Buffalo tallow	2.12	25.09	2.30	0.97	26.51	37.11	4.32	1.87	6.14

0.92 in lard and buffalo tallow, respectively. This may be due to the relative high content of palmitic acid in B-monoglyceride as accompanied by its low content in triglyceride of lard.

Table (2): Palmitic acid enrichment factor for lard and buffalo tallow.

Sample	Palmitic acid in B-MG.	Palmitic acid in TG.	Factor
Lard	59.82	26.11	2.29
Buffalo tallow	22.07	23.94	0.92

These results are in agreement with those reported by El-Dashlouty (1978); Abou-Arab (1980), Nour El-Din et al. (1984) and Rashwan (1986).

Results given in Tables (3 and 4) showed that the unsaturation ratio was rather low in lard (0.45) than that in buffalo tallow (1.06). This may be due to marked high content of unsaturated fatty acids in B-monoglycerides and its low content in triglycerides in buffalo tallow. However, lard recorded as opposite trend.

The data revealed that the total C_{16}/total C_{18} ratio in B-monoglyceride of lard was considerably high (2.29) reaching almost five fold its value in buffalo tallow (0.51).

Table (3): Unsaturation ratio of lard and buffalo tallow.

Source of fat	Lard	Buffalo tallow
% unsaturated fatty acids in T.G.	57.30	52.06
% unsaturated fatty acid in B-MG.	25.98	55.09
Ratio	0.45	1.06

Table (4): Total C_{16}/C_{18} fatty acids ratio and S.F.A/U.S.F.A. for lard and buffalo tallow.

Fatty acids	Lard	Buffalo tallow
% Total C_{16} fatty acids	64.73	28.24
% Total C_{18} fatty acids	28.30	55.61
C_{16}/C_{18}	2.29	0.51
% saturated fatty acids	72.28	32.46
% unsaturated fatty acids	25.98	55.09
S.F.A./U.S.F.A.	2.78	0.59

On the other hand, saturated/unsaturated fatty acids ratio was 2.78 and 0.59 in lard and buffalo tallow, respectively. Such data coincide with those previously reported by Nour El-Din et al. (1984) and Rashwan (1986).

Furthermore, it is clear from Table (5) that as lard percentage increased a real increase of palmitic acid enrichment factor

Table (5): Palmitic acid enrichment factor for standard mixtures of lard and buffalo tallow.

Fat mixtures (w/w)		Palmitic acid	Palmitic acid	Factor
Lard	buffalo tallow	in B-MG.	in TG.	
3	97	22.42	24.01	0.93
6	94	24.67	24.60	1.00
9	91	29.08	25.14	1.16
12	88	31.43	25.49	1.23
15	85	32.66	25.72	1.27

Table (6): The unsaturation ratio of standard mixtures of lard and buffalo tallow.

Source of fat	3%	6%	9%	12%	15%
% unsaturated FA in TG.	52.87	53.13	53.64	54.78	55.49
% unsaturated FA in B-MG.	54.96	53.68	52.07	50.65	48.43
Ratio	1.04	1.01	0.97	0.92	0.87

Table (7): Total C_{16}/C_{18} fatty acids ratio and saturated/unsaturated fatty acids ratio for standard mixtures of lard and buffalo tallow.

Source of fat	3%	6%	9%	12%	15%
% Total C_{16} fatty acids	29.72	32.60	36.71	39.45	41.88
% Total C_{18} fatty acids	51.24	50.15	47.06	44.83	43.63
C_{16}/C_{18}	0.58	0.65	0.78	0.88	0.96
% saturated fatty acids	34.31	36.01	39.74	41.99	43.65
% unsaturated fatty acids	56.96	53.68	52.07	50.65	48.43
Ratio	0.60	0.67	0.76	0.83	0.90

took place. This may be due to the fact that 90% of the total palmitic acid in lard is prevalent in the B-position (Mattson et al. 1964; Amer et al. 1972; and Bracco et al. 1976). As regards the unsaturation ratio, it could be noticed from Table (6) that there was a gradual decrease in this ratio with the increment of added lard percentage.

Furthermore, the data given in Table (7) revealed that the C_{16}/C_{18} fatty acids and saturated/unsaturated fatty acids ratios could be successfully used as a helpful guide for detecting lard in pure buffalo tallow, as it was elevated as lard percentage was increased. This may be attributed to the rather high and the relative low corresponding ratios in lard and buffalo tallow, respectively (Rashwan, 1986).

In conclusion, the palmitic acid enrichment factor; unsaturation ratio; total C_{16}/total C_{18} fatty acids and saturated/unsaturated fatty acids ratio could be recommended as a reliable criteria for lard detection in buffalo tallow.

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