# Triglyceride Composition of Lard by Differential Thermal Analysis

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## Abstract

The differential thermal analysis of lard is described and an attempt is made to assign the melting peaks to particular triglycerides which are likely to be found in lard.


## Introduction

The triglyceride composition of natural fats has been studied by many different methods, such as counter current distribution (1,2), fractional crystallization (3) and various oxidation techniques (4,5). The overall fatty acid composition and the type of fatty acid at the 2 position of the triglyceride have been determined by the lipase splitting technique (6,7). Separation of triglycerides according to their molecular weight has been achieved by gas liquid chromatography (8,9) which has proved useful in combination with other techniques such as quantitative analysis by thin layer chromatography on silver nitrate impregnated silica (10).

Chapman et al. (11) have shown from cooling curves and x-ray and infrared analysis that the major disaturated glyceride in lard is 2-palmito-1,3-oleostearin. Apart from the above observation, the structure of individual triglycerides that occur in lard has not been reported in the literature.

The present communication describes the differential thermal analysis (DTA) of lard. The observed melting peaks have been correlated with those individual triglycerides which, from the analytical data available, are most likely to be present in the lard.

## Experimental Procedures

Thermal analysis was carried out on a Netzch Differential Thermal Analyzer 404T, loaned by Polaron Equipment Limited, London. The differential thermal analysis measuring head was used in this investigation.

Commercial lard (ca. 0.1 g) and reference material (aluminum oxide) were placed in a steel block with four bored holes; it was then rapidly cooled in a dry ice-acetone bath to about −40 C. The lard was heated, without any tempering procedures, from −40 to 100 C at a rate of 8°/min. The difference in temperature between the lard and reference sample was measured by an iron-constantan thermocouple. Another thermocouple measured the temperature of the reference sample. Differential temperature (ΔT) was plotted against temperature (T) on a compensation recorder and all temperature measurements were calculated to within ±1 C.

## Results

The DTA thermogram (Fig. 1) showed melting peaks due to the component triglycerides in lard at 6 ± 1, 17, 33 ± 0.5, 41 ± 1 and 50 ± 0.5 C. These values are the mean of 12 determinations.

TABLE I

Fatty Acid Composition of Lard

| Acid | Percentage constituents | | |
|---|---|---|---|
| | Ref. 13 | Ref. 16 | Lard used for DTA |
| Myristic | 1.3 | 0.9 | 1.4 |
| Palmitic | 28.3 | 27.6 | 32.0 |
| Palmitoleic | 2.7 | 2.6 | 2.0 |
| Stearic | 11.9 | 8.6 | 17.0 |
| Oleic | 47.5 | 41.7 | 41.0 |
| Linoleic | 6.0 | 12.3 | 5.0 |
| Linolenic | | 1.4 | |
| Others | 2.3 | | 1.6 |

## Discussion

Mares (12) recently developed a method to detect beef tallow in lard using DTA. Characteristic melting areas of unrefined edible lard were identified by three peaks at 32.6 ± 0.6, 38.4 ± 1.0 and 46.6 ± 1.2 C. These peaks, especially the first two, are in reasonable agreement with those obtained in the present investigation.

The triglyceride composition of lard has been thoroughly investigated and the percentage of each triglyceride type in lard is 5% trisaturated, 32–39% disaturated, 46–60% monosaturated and 3–10% triunsaturated glycerides (13). On the basis of x-ray data and cooling curves, several workers (11,14,15) have shown that lard consists mainly of 2-palmityl glycerides. Other workers have saponified lard, converted the free fatty acids into their methyl esters and analyzed the esters by gas chromatography. Typical gas chromatographic results are given in Table I and indicate that lard contains mainly oleyl, palmityl and to a lesser extent stearyl glycerides.

Table II gives the melting point data of the triglycerides (3) which melt at temperatures that correspond to the melting peaks obtained from the DTA of lard.

From the data already presented the DTA melting peaks for lard obtained in the present investigation are assigned to the following triglycerides.

The areas under the curves in Figure 1 indicate that the major components of lard are 1,2-dipalmito-3-olein and 2-palmito-1,3-oleostearin, the former being the predominant triglyceride. According to the gas chromatography analysis (Table I) the lard sample

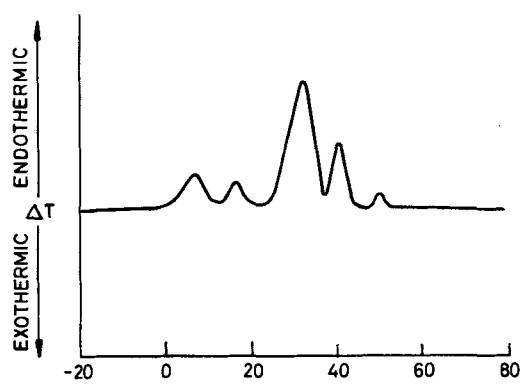


FIG. 1. Differential thermal analysis of lard.

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TABLE II
Melting Points of Triglycerides

| Glyceride | Melting point C |
|---|---|
| 1,3-Dioleo-2-palmitin | 5.0– 6.0 |
| 1,2-Dioleo-3-laurin | 6.5 |
| 1,2-Dilauro-3-olein | 16.0 |
| 1,3-Dilauro-2-olein | 16.5 |
| 1,2-Dioleo-3-palmitin | 19.0 |
| 1,2-Dipalmito-3-olein | 34.5 |
| 1,3-Dipalmito-2-olein | 35.2 |
| 1,2-Dipalmito-3-linolein | 36.0–38.0 |
| 1,2-Distearo-3-linolein | 36.0–38.0 |
| 2-Oleo-1,3-palmitostearin | 37.5–38.0 |
| 2-Palmito-1,3-oleostearin | 40.5–41.0 |
| 2-Stearo-1,3-oleopalmitin | 41.0–41.5 |
| 1,2-Distearo-3-olein | 41.6 |
| 1,3-Dimyristo-2-laurin | 50.0 |
| 1,3-Dilauro-2-myristin | 50.2 |

contains some linoleyl glycerides. Thus the melting peaks at 33 and 41 C may also be due to small amounts of 1,2-dipalmito-3-linolein and 1,2-distearo-3-linolein.

The evidence in favor of the correlations in Table III is as follows: (a) Gas chromatography analyses have shown lard to be a mixture of mainly oleyl and palmityl glycerides (6). (b) Quimby et al. (14) and Hilditch (15) have shown that lard contains mainly 2-palmityl glycerides. Luddy et al. (7) analyzed lard by pancreatic lipase hydrolysis and found that 83% of the palmitic but only 10–12% of the oleic and 10–12% of the stearic acids occurred in the 2 position of the triglycerides. The triglycerides in Table III are mainly 2-palmityl glycerides. (c) Lard contains over 40% dioleopalmitins (13,14). The major melting peak and one of the minor melting peaks are identified as dioleopalmitins. (d) Chapman et al. (11) state that the major disaturated glyceride in lard is 2-palmito-1,3-oleostearin. Other investigators (13,14) have shown that lard contains around 30% of a palmitoleostearin. This evidence supports the correlation of the second largest melting peak at 41 C to 2-palmito-1,3-oleostearin.

TABLE III
Correlation of DTA Melting Peaks for Lard

| DTA melting peak C | Glyceride |
|---|---|
| 6 ± 1 | 1,3-Dioleo-2-palmitin |
| 17 | 1,2-Dioleo-3-palmitin |
| 33 ± 0.5 | 1,2-Dipalmito-3-olein |
| 41 ± 1 | 2-Palmito-1,3-oleostearin |
| 50 ± 0.5 | 1,3-Dimyristo-2-laurin |

ACKNOWLEDGMENTS

The Gas Council for permission to publish this work and N. C. Ross for helpful discussion. Lard used in the present investigation was analyzed by the British Food Manufacturing Industries Research Station, Leatherhead, Surrey, England.

REFERENCES

1. Scholfield, C. R., and M. A. Hicks, JAOCS *34*, 77 (1957).
2. Scholfield, C. R., H. J. Dutton and T. L. Mounts, Ibid. *38*, 96 (1961).
3. Hilditch, T. P., in "The Chemical Constitution of Natural Fats," 3rd ed., Chapman and Hall, London, 1956.
4. Youngs, C. G., JAOCS *38*, 62 (1961).
5. Privett, O. S., and M. L. Blank, Ibid. *40*, 70 (1963).
6. Mattson, F. H., and L. W. Beck, J. Biol. Chem. *219*, 735 (1956).
7. Luddy, F. E., R. A. Barford, S. F. Herb, P. Magidman and R. W. Riemenschneider, JAOCS *41*, 693 (1964).
8. Kuksis, A., and M. J. McCarthy, Can. J. Biochem. Physiol. *40*, 679 (1962).
9. Jurriens, G., and A. C. J. Kroesen, JAOCS *42*, 9 (1965).
10. De Vries, B., and G. Jurriens, J. Chromatog. *14*, 525 (1964).
11. Chapman, D., A. Crossley and A. C. Davies, J. Chem. Soc. *1957*, 1502.
12. Mares, E., Nahrung *9*, 881 (1965).
13. Bailey, A. E., in "Industrial Oil and Fat Products," John Wiley and Sons, New York 1964.
14. Quimby, O. T., R. L. Willie and E. S. Lutton, JAOCS *30*, 186 (1953).
15. Hilditch, T. P., Ibid. *24*, 315 (1947).
16. Mason, M. E., and G. R. Waller, Anal. Chem. *36*, 583 (1964).

[Received November 27, 1968]