Glyceride structure of mango seed (Magnifera indica) oil

M. A. ABD ALLAH, FERIAL M. ABU SALIM and M. A. GOMA

Faculty of Agriculture, Shabin El-Kom, Egypt.

Introduction

Several methods such as oxidation, fractional crystallization, counter-current distribution and hydrolysis by lipase were used for the elucidation of the glyceride structure of fats and oils.

Oxidation, for instance, resulted in the formation of carboxylic acids and the separation of the oxidized glycerides from the trisaturated glycerides was possible. In 1953, *Kartha* was able to isolate the monoglycerides when excess of acetic acid was used for oxidation (1).

With regard to the fractional crystallization method, it does not permit the complete separation of a given fat into the individual triglycerides, but the fractions contain glycerides that could be deduced from their fatty acid content. However, the organic solvent used most trequently for crystallization is acetone and the glyceride of about 10% w/v is the desired concentration. Calculation of the glyceride composition usually follows the random distribution of fatty acids.

The counter-current distribution method is based on the separation of the glyceride mixtures according to their distribution coefficient between two immiscible solvents. Separation is carried out on the basis of the degree of unsaturation of the triglycerides present as reported by *Dutton, and Cannon* (2) and *Scholfield et al.*, (3)

Thin layer chromatography was also used by *Mangold and Malins* (4), who succeeded in separating the lipid glycerides of several vegetable and fish oils. In 1959 *Huenber* reported that the determination of mono- and diglycerides, after acetylation, was possible by gas chromatography, but triglycerides were not included (5). However. in 1961 the same author was able to identify the triglycerides by gas chromatography.

Hydrolysis by lipase as a tool for the identification of fatty acids in natural fats was suggested earlier by *Frayer and Sammons* (6). *Maltson and Beck* (7) mentioned that the pancreatic lipase exhibits a positional specificity in the hydrolysis of triglycerides and they used the pancreatic lipase for studying the distribution of fatty acids in natural fats. The error in enzyme hydrolysis lies in the isomerization of the products that sometime occur after hydrolysis.

Materials and Methods

Materials:

The seeds of mango fruits *(Mangifera indica)* that represented a large amount of wastes after mango juice extraction, were used for extracting their oil by an organic solvent (hexane). Mango seeds were collected from El-Nasr Company for Preserved Foods „Kaha Plant".

Methods:

The lipase hydrolysis method mentioned by *Cason et la.*, (8) and *Quinlin and Weiser* (9) and applied by *Aly* (10) was used.

Gas chromatographic analysis was carried out with a "PYE – Argon GLC" instrument incorporating a strontium-90 detector available at the Analytical Department, General Administration of Soil, Ministry of Agriculture.

Fatty acids were methylated by the method of *Luddy* (11), and the glyceride structure was calculated by the method of *Coleman and Fulton* (12).

Results and Discussion

The oil obtained from mango seeds of "Balady" variety was used for investigating its glyceride structure and to identify the nature of fatty acid distribution.

It appers from Table 1, and Fig. 1 that the free fatty acids identified by gas chromatography of the oil of mango seeds were palmitic, stearic, palmitoleic, oleic, linoleic, and linolenic acids. The corresponding percentages of the mentioned fatty acids were 7.80, 41.23, 1.21, 40.41, 7.05, and 1.34%, respectively. From these results it is clear that stearic and oleic acids were the two main fatty acids of the oil.

Table 1

Percentage of the free fatty acids and the 2—monoglycerides of the mango seed oil

Types of fatty acids	Fatty acid		2-mono-glycerides
	Identified	Percentage	
Saturated	Palmitic	7.80	4.93
	Stearic	41.23	9.76
Unsaturated	Palmitoleic	1.12	0.67
	Oleic	40.41	71.83
	Linoleic	7.05	9.63
	Linolenic	1.34	0.63

The 2-monoglyceride of mango seed oil was investigated and the results showed that it is mainly acylated by unsaturated fatty acids. However, the obtained values were 4.93, 9.76, 0.666, 71.83, 9.63 and 0.63, %, respectively, as given in Table 1 and this may be related to the positional distribution of the fatty acids as pointed out by *Vanderwal* (13), *Gunston* (14) and *Young* (16). *Gonstone* (14) reported the same results. On the contrary, *Aly* in 1968 (10) pointed out that arachidic acid was present in the mango varieties Fonsa, Sennara and Tymoor, in amounts of 1.5, 1.7, and 1.8%, respectively and their contents of the corresponding 2-monoglycerides were 4.0, 0.7, and 2.8%.

The main glyceride categories that were detected in the oil of the "Balady" mango variety were trisaturated, disaturated, mono-unsaturated, monosaturated di-unsaturated, and triunsaturated glycerides.

It can be concluded from Table 2 that trisaturated glycerides represent 7.26%. This value is much lower than that expected since the oil was characteri-

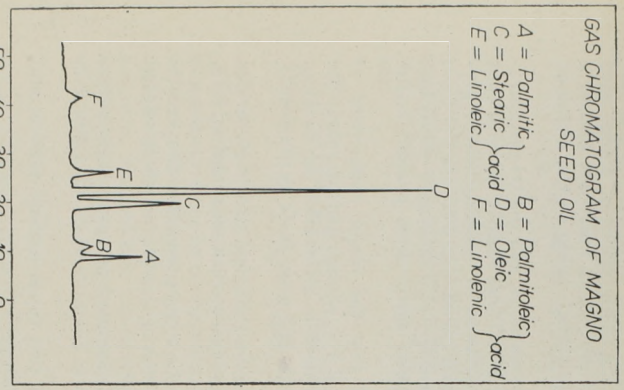

Fig 1.

Table 2

Identfied triglycerides of mango seed oil

Identified glycerides															
Saturated glycerides												Unsaturated glycerides			
Tri	Percentage			Di	Percentage			Mono	Percentage			Tri	Percentage		
	A	B	C		A	B	C		A	B	C		A	B	C
Tristearin	2.90			Distearolein	26.63			Palmitodiolein	3.56			Triolein	6.10		
Palmito di-stearin	2.33			Distearolin-olein	3.73			Stearodiolein	23.56			(Dioleolino (lein	2.10		
				Palmitoolein-stearin	8.80			Stearopalmito-diolein	1.10						
				Palmitolinoleo stearin	1.26			Palmitoleo-linolein	1.20						
								Stearooleo-linolein	7.16						
	5.23	7.26	2.03		40.42	44.03	3.61		36.58	39.23	2.56		8.20	9.46	126

A = identified percentage of glycerides
B = Total percentage of gylcerides
C = Residual percentage of unknown glycerides

zed by a high content of saturated fatty acids. This could be due to the fact that saturated fatty acids are evenly distributed in the triglycerides of mango seed oils. The view that the amount of trisaturated glycerides must not exceed a certain value since racking will occur could be justified owing to the obtained figure.

The average values of the disaturated, monosaturated, and the tri-unsaturated glycerides were 44.03, 39.23, 9.46% respectively. These results indicate that disaturated glycerides came in the first order, followed by monosaturated glycerides, meanwhile the contents of tri-unsaturated glycerides were higher than those of trisaturated glycerides. The high percentage of disaturated glycerides could be related to the high percentage of saturated fatty acids present in the oil sample.

It can be also established from Table 2 that the major component of trisaturated glycerides is stearin with a value of 2.9%, wheras distearo-olein the main glyceride of disaturated glycerides was present in an amount of 26.63%. This may be related to the predominance of stearic and oleic acids as previously proved by gas chromatographic analysis.

The distearolinoleic, palmitodistearin, and palmitolinoleic stearin glycerides were also found as glycerides of the disaturated category, with a content of 3.73, 8.8, and 1.26%, respectively.

On considering the diunsaturated (monosaturated) glycerides the results proved that dioleostearin is the main diunsaturated glyceride which is related to the higher amount of oleic acid in the main oil.

Dioleopalmitin, stearopalmitoolein, linoleicoleopalmitin, and linoleicoleostearin were present as monosaturated glycerides in amounts of 23.56, 1.103, 1.2, and 7.16%, respectively.

The triunsaturated glycerides were only of two types, namely triolein and dioleiolinolein with contents of 6.1, and 2.1%, respectively.

The oil of mango seed contains about 40.41% oleic acid and it is considered to be the main acid forming the glycerides especially mono- and diolein.

The above mentioned results agree with the data given by *Pathak et al.* (1) and *Aly* (10).

The identification of the glycerides of the mango seed oil showed unknown tri-, di-, and monosaturated glycerides present in amounts of 2.03, 3.61 and 2.56% respectively. The amount of unsaturated glycerides was 1.26%.

LITERATURE

(1) *Kartha, A. R. S.:* J. Am. Oil Chemist's Soc. *30*, 1953.
(2) *Dutton, H. J.* and *Cannon, J. A.:* J. Am. Oil Chemist's Soc., *33*, 46, 1956.
(3) *Scholfield, C. R., Nowakowska, J.* and *Dutton, H. J.:* J. Am. Oil Chemist's Soc., *38*, 175, 1961.
(4) *Mangold, H. K.* and *Malins, D. C.:* J. Am. Oil Chemist's Soc. *37*, 383, 1960.
(5) *Huenber, V. R.:* J. Am. Oil Chemist's Soc., *36*, 262, 1959.
(6) *Frayer, A. C.* and *Sammons, H. G.:* J. Biol Chem *93*, 212, 1945.
(7) *Maltson, F. H.* and *Beck, L. W.:* J. Biol. Chem. *219*, 735, 1956.
(8) *Cason, J. Sunnell, G.* and *Mitchell, R. S.:* J. Org. Chem. *15*, 850, 1950.
(9) *Quinlin, Patrica,* and *Weiser, H. J.:* J. Am. Oil Chemist's Soc. *35*, 325, 1958.
(10) *Aly, F. M.:* M.Sc. Faculty of Science, Cairo University. 1968.
(11) *Luddy, F. E.:* J. Am. Oil Chemist's Soc.: *37*, 447, 1960.
(12) *Coleman, M. H.* and *Fulton , W. C.:* Fifth Int. Conf., Biochem. Problems of Lipids; Pergamon press (London). 1961.
(13) *Vanderwal, R. J.:* J. Am. Oil Chemist's Soc., *37*, 18, 1960.
(14) *Gonstone, F. D.:* Chemisty and Industry London, 1962.
(15) *Pathak, S. P., Gunde, B. G.* and *Godble, N. N.:* J. Ind. Chem., Soc. *23*, 207, 1946.
(16) *Young, G. G.:* J. Am. Oil Chemist's Soc. *36*, 665, 1959.

A MANGO (MANGIFERA INDICA) MAG-OLAJÁNAK GLICERID SZERKEZETE

M. A. Abd Allah, M. Abu Salim Ferial és *M. A. Goma*

A mangógyümölcs levének kinyerésekor kapott magból mint hulladékból hexánnal extrahált olajban a telített zsírsavak közül palmitinsavat, stearinsavat, a telítetlen zsírsavak közül pedig palmitolajsavat, olajsavat, linolsavat és linolénsavat mutattak ki. A háromszor telítetlen gliceridek mennyisége 8,20%, a háromszor, kétszer ill. egyszer telített gliceridéké pedig rendre 5,23, 40,42 ill. 36,58% volt.

СТРУКТУРА ГЛИЦЕРИДА МАСЛА КОСТОЧКИ МАНГО

М. А. Абд Аллах, М. Абу Салим Фериал и *М. А. Гома*

При извлечении мангового сока в масле косточек экстрагированном гексаном обнаружили из среди насыщенных жирных кислот пальмитиновую кислоту, стеарионовую кислоту, а из не насыщеных жирных кислот пальмид масляную кислоту, масляную кислоту и линоленувую кислоту, петроселлиновую кислоту. Количество глицеридов тройной не насыщенности 8,20%, а количество глицеридов тройной, двойной и одной насыщенности всегда 5,23 – 40,42 и 36,38%.

DIE GLYCERIDSTRUKTUR DES MANGOKERNÖLS (MANGIFERA INDICA)

A. A. Abd Allah, M. Abu Salim Ferial und M. A. Goma

In dem aus den bei der Gewinnung des Saftes der Mangofrucht als Abfall erhaltenen Kernen mittels Hexans extrahierten Öl wurden aus der Gruppe der gesättigten Fettsäuren Palmitinsäure und Stearinsäure, während aus der Gruppe der ungesättigten Fettsäuren Palmitölsäure, Ölsäure, Linolsäure und Linolensäure nachgewiesen. Die Menge der dreifach ungesättigten Glyceriden betrug 8,20%, die der dreifach, zweifach bzw. einfach gesättigten Glyceriden dagegen der Reihe nach 5,23%, 40,42% bzw. 36,58%.

LA STRUCTURE DES GLYCÉRIDES DE L'HUILE DE MANGUE (MANGIFERA INDICA)

M. A. Abd-Allah, M. Abu Salim Ferial et M. A. Goma

Dans l'huile extraîte à l'héxane des grains obtenus en tant que déchet lors du travail du jus de fruit de la mangue, on a décolé, parmi les acides gras saturés l'acide palmitique et l'acide stéarique, parmi ceux insaturés l'acide palmitoléique etac les ides oléique, linolique et linoléique. La quantité des glycérides trois fois insaturés était 8.20 p. c., tandis que les taux respectifs des glycérides saturés trois, deux et une fois montaient à 5,23, 40,42 et 36,58 p. c.