Processing Mango Stones for Fat

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ABSTRACT AND SUMMARY

Stones of mango fruit (*Mangifera indica*) were processed for recovery of fat and the fat refined. Mango kernel fat is potentially edible and can substitute for tallow and cacao butter. Mango kernel meal can be used as a sizing material and as a feed.

INTRODUCTION

India produces about 7 to 8 million tons of mangoes annually (1). Latest estimates put the figure at 9 million tons. About a million tons of mango stones would be available every season which extends from April to September. Mango stone consists of a tenacious leathery outercoat and an inner kernel. The moisture content of the fresh stones varies from 25 to 40%, and the stone content of the mango fruit ranges from 9 to 23% with an average of 15% for 29 varieties (2). About 0.3 million tons of dry mango kernel would be available annually from which 30,000 tons of mango fat currently valued at 200 million rupees (Indian currency) could be obtained. Apart from data on the fatty acid composition (3), determined by classical methods, no work is available on the processing and utilization of mango kernel fat and meal. The present work is an attempt in that direction.

EXPERIMENTAL PROCEDURES

Materials

Mango stones procured locally comprised 15% of the weight of the ripe fruit. The kernels, 9.5%, contained about 25% water, 11% fat, 5.5% protein, and 2.1% ash on a moisture-free basis.

Equipment

A specially adapted mechanical mango stone decorticator, a mechanical disintegrator, an expeller with stack cooker, and a fixed-bed batch extractor, comprise the equipment used for processing the mango stones.

Methods

The composition of mango kernels and kernel fat was determined by the applicable analytical AOCS methods. The Bellier number was determined according to the method described in reference (4). The fat was alkali-refined and bleached in the laboratory on the AOCS combined refining and bleaching apparatus. The strength of alkali used for refining was 16°Be' 60% maximum. Indigenous brands of bleaching earth (2%) and activated carbon (0.2%) were used. A Lovibond tintometer was used to read the color of the melted fat. Methyl esters of neutralized mango kernel fat were analyzed using a F&M model 720 gas chromatograph with a flame ionization detector, and the composition was arrived at after analyzing on EGSSX (10%) at 200 C and with SE 30 (5%) columns.

RESULTS AND DISCUSSION

Freshly depulped mango stones were collected and washed in a current of water to free them from adhering pulp, fiber, dirt, etc. The washed stones were air-dried. They were then decorticated in dry or wet condition in a mango stone decorticator (5) (Fig. 1 and 2). The kernels were separated from the shells by using screens having round holes big enough to allow the passage of kernels through, leaving wide winglike shells over the screens. The

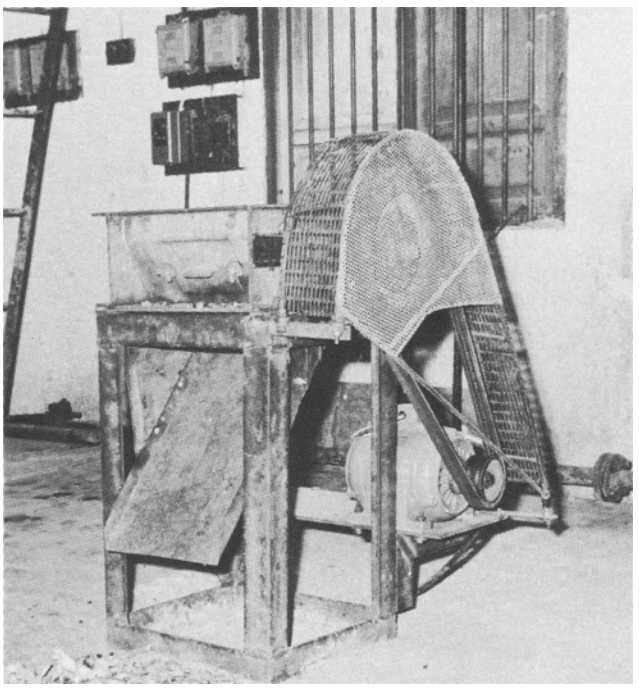

FIG. 1. Mango stone decotricator–front view showing the complete setup.

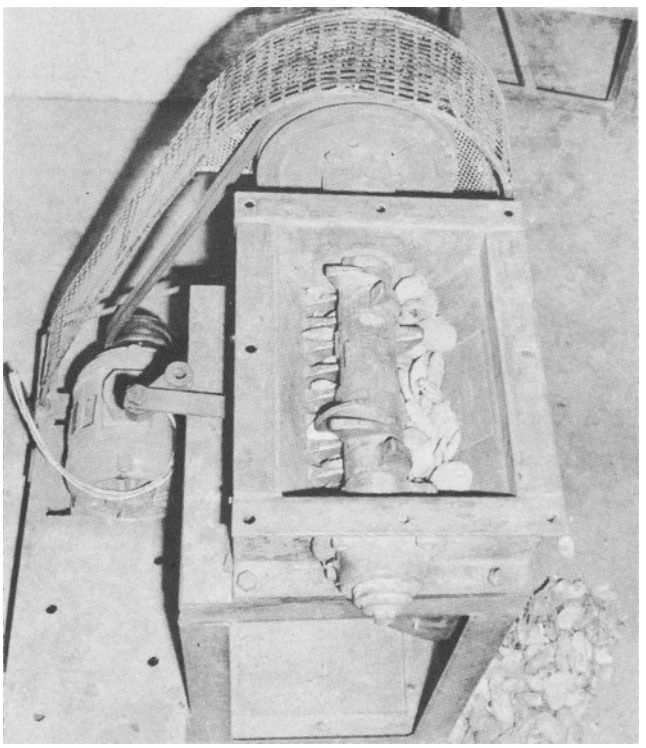

FIG. 2. Mango stone decorticator–top view showing the open chamber with shaft.

TABLE I

Physical and Chemical Characteristics of Mango Kernel Fat

Sl. number	Characteristics	Mango kernel fat	
		Crude	Refined and bleached
	Physical		
1.	Melting point, °C	38	38
2.	Specific gravity 30 C	0.901	--
3.	Refractive index, 40 C	1.4470	1.4570
4.	Titre, °C	51	--
5.	Bellier number, °C	38.5	--
	Chemical		
1.	Moisture, percent	0.08	Nil
2.	Acid value, mg KOH/g fat	6.0	0.3
3.	Saponification value, mg KOH/g fat	191	190
4.	Iodine value (Wijs)	50	50
5.	Nonsaponifiable matter, percent	1.5	0.7

kernels were dried in the sun to a moisture content of ca. 10%. Two approaches were used after decortication. In one, dried kernels were broken into smaller coarse particles in a mechanical disintegrator, and the kernel particles were extracted with normal hexane; in the other approach, the kernels were mildly cooked and passed through an expeller, and the resulting cake-like material was extracted with normal hexane. This latter course has certain advantages. The kernel, when cooked, is sterilized and when pressed in the expeller, is converted into a cake which is easier to extract than is a gritty hard kernel. For extraction, the kernel particles or cake were placed as a fixed bed in a cylindrical vessel, and normal hexane was percolated through the bed until the miscella contained no fat. The extracts were combined, and solvent distilled off. The marc was air-dried and then heated under partial vacuum at 60 C to remove the last traces of solvent. The crude fat was alkali-refined and bleached with bleaching earth and activated carbon. The characteristics of crude, and refined and bleached mango kernel fat are given in Table I. The proximate composition of defatted mango kernel meal is as follows: fat 0.14%, protein 6.2%, ash 3.6%, and crude fiber 4.5%.

Refinability data of mango kernel fat are given in Table II. Gas liquid chromatographic (GLC) data on the fatty acid composition of mango kernel fat are presented in Table III.

Mango kernel fat was obtained in 11% yield on the weight of dry kernel. The fat obtained from fresh kernels was cream-colored (in the solid state). Blandness, plasticity, and absence of toxic substances render it a potential edible fat in sweet meats and in pastries where saturated fats are required. It can also be used as a substitute for tallow in the preparation of quality soaps and as an extender to cacao butter. Potato chips fried in mango kernel fat had a good taste and a shelf life of 7 days. Mango kernel meal can be used in animal feed rations and as a direct sizing agent in textiles.

TABLE II

Refinability of Mango Kernel Fat

Free fatty acid of crude fat, percent (calculated as oleic acid)	5.0
Refining loss, percent	18.0
Free fatty acid of refined and bleached fat, percent (calculated as oleic acid)	0.09
Lovibond color (in 0.635 cm cell)	
Crude	14 Y + 1.4R (Brown)
Refined	4.5 Y + 0.4R (Yellow)
Refined and bleached	0.4 Y + 0.0R (White)

TABLE III

Fatty Acid Composition of Mango Kernel Fat by Gas Liquid Chromatography (GLC)

Methyl ester	Weight percent
Palmitate	8.6
Stearate	42.2
Oleate	45.8
Linoleate	3.4

ACKNOWLEDGMENTS

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