Manufacture of Palm Kernel Oil Using the Traditional Coconut Oil Processing System

E.O.I. BANIGO, A. OGUNLESI, Department of Food Technology, and **O. OFI,** Department of Design and Production Engineering, Faculty of Technology, University of Ibadan, Ibadan, Nigeria

ABSTRACT AND SUMMARY

The traditional processing system of coconut oil, comprising grating of coconut meats, extraction with boiling water, cooling, followed by skimming off the cream, and heating it to dryness to give coconut oil, has been adapted for the manufacture of palm kernel oil. Palm kernels were crushed in a laboratory hammer mill, extracted with several lots of boiling water, cooled, the resulting cream skimmed off, and heated to dryness to yield palm kernel oil. A comparison of existing traditional and new adapted processing systems showed that the yield of palm kernel oil obtained in both cases was about the same. Furthermore, the specific gravity, melting point, refractive index, and saponification number were similar, but the moisture content, acid value, color, and odor were dissimilar.

INTRODUCTION

The oil palm (*Elaeis guineensis* Jacq.) is an important economic crop in Nigeria and yields two distinct types of oils: palm oil extracted from the fleshy pericarp of palm fruits and palm kernel oil from the kernels. Accurate data on the overall production of palm oil and kernels in Nigeria are not readily available, but purchases by the Nigerian Produce Marketing Company are given in Table I. Figures for the period 1969-1973 showed a low of 172,196 metric tons in 1969 and a high of 306,734 metric tons of palm kernels and corresponding figures for palm oil were 2,337 and 31,401 metric tons, respectively.

Palm kernel contains 44-53% oil used mainly in soap and food products such as margarine and confectionery butter (1). It is very similar to coconut (*Cocos nucifera* Linn.) oil with which it is used interchangeably. It has a higher iodine number than coconut oil because of a higher content of unsaturated fatty acids. It has smaller quantities of the shortest chain, lowest melting members of the saturated fatty acid series – namely caproic and caprylic; hence its melting point is slightly higher than coconut oil. The predominant fatty acids of palm kernel and coconut oils are lauric, myristic, and palmitic acids in that decreasing order, whereas those of palm oil are oleic, palmitic, and linoleic acids (1).

The bulk of the palm oil produced in Nigeria is presently used locally and very little is exported. On the other hand, most of the palm kernels produce is processed into oil on a large scale by a mechanical oil extraction system and exported. A small quantity of palm kernels is, however, processed into oil by the traditional method (Fig. 1A) for local consumption. Traditionally prepared palm kernel oil is occasionally used for cooking and soap manucature, more frequently as hair and body cream. It is sometimes use for medicinal purposes (2). Because of its darker color and strong flavor, resulting in part from the very intense heating employed in the traditional preparation (Fig. 1A), utilization of this oil has been rather limited. In order to produce a lighter colored oil with mild flavor, modification of the present small-scale traditional processing system is essential. In the present study, the traditional coconut oil manufacturing process (Fig. 1B), comprising grating, extraction, straining, cooling, skimming, and heating has been adapted for palm kernel oil (Fig. 1C).

TABLE I

Purchases of Palm Kernels and Palm Oil (1969-1973)[a]

Year	Palm kernels (metric tons)	Palm oil (metric tons)
1969	172,196	2,337
1970	264,880	14,834
1971	306,734	31,401
1972	268,758	20,914
1973	230,450	13,863

[a]Source: Nigerian Produce Marketing Company, *Digest of Statistics*, Volume 23, 1974, Federal Office of Statistics, Lagos, Nigeria.

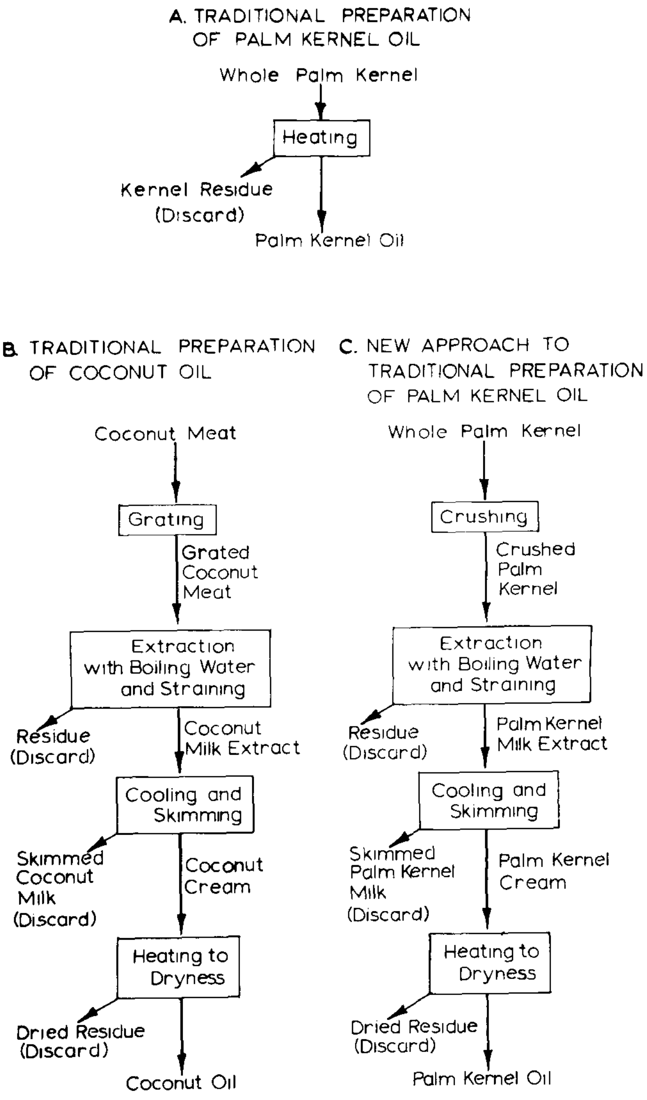

Fig. 1. Flow diagrams (A, B, and C).

TABLE II

Characteristics of Palm Kernel and Coconut Oils

Characteristics	Coconut oil[a]	Palm kernel oil[a]	Palm kernel oil[b]	Palm kernel oil[c]
Moisture content (%)	0.17	0.47 - 0.54	0.11 - 0.18	2.96 - 3.22
Melting point (°C)	26.5 - 29.0	26.0 - 28.5	27.0 - 29.0	25.5 - 27.5
Specific gravity (25 C)	0.9110	0.9200	0.9213	0.9171
Refractive index (25 C)	1.4537	1.4566	1.4554	1.4551
Saponification number	254.9 - 262.3	236.71 - 247.91	235.44 - 250.71	242.58 - 255.26
Iodine value	8.15 - 9.33	17.07 - 18.86	15.67 - 16.94	15.27 - 16.85
Acid number	0.37	2.45 - 2.73	1.68 - 2.01	22.42 - 23.36

[a]Existing traditional process.
[b]Adapted new system.
[c]Commercial mechanical oil extraction process.

EXPERIMENTAL PROCEDURES

Palm kernels and coconut used in this study were obtained from commercial sources in Ibadan, Nigeria. A sample of crude palm kernel oil obtained from Vegetable Oils (Nigeria) Ltd. (V.O.N.), Ikeja, Lagos, Nigeria was produced by the large-scale continuous screw press processing system.

The flow diagram of the traditional preparations of palm kernel oil from whole kernels and coconut oil from fresh coconut meats are given in Figure 1 (A and B). The traditional palm kernel oil extraction system comprises heating whole kernels in iron pots and draining off the resulting oil. In this study, 250 g of whole palm kernels were heated in an aluminum saucepan over a bunsen flame with stirring. The resulting oil was drained off periodically and filtered through Whatman No. 1 filter paper before analysis.

Coconut oil was prepared as outlined in Figure 1B.

In the new approach (Fig. 1C) whole palm kernels were crushed in a laboratory hammer mill. Crushed kernel (250 g) was mixed with water, heated to boiling, and strained through a fine sieve, followed by further extractions with several lots of boiling water and straining. All of the extract was collected in the same vessel and allowed to cool to room temperature. The cream was skimmed off and heated to dryness to yield palm kernel oil which was filtered through Whatman No. 1 filter paper before analysis.

Analyses of the samples for moisture content, specific gravity, refractive index, and melting point were carried out according to AOAC Methods (3). Iodine, saponification, and acid values were determined according to the AOCS Methods (4). Visual assessment of color and olfactory evaluation of odor were carried out on the oil samples. The fat contents of the kernels and residue were also evaluated (3).

RESULTS AND DISCUSSION

The results presented in this report were obtained from eleven separate determinations except that three and two determinations were carried out in the case of coconut oil and commercial (V.O.N.) palm kernel oil samples, respectively.

The moisture content of palm kernels used in this study ranged from 5% to 6%. The fat content of dried palm kernels was 46.0%. The average yields of palm kernel oil obtained were 22.4% by the existing traditional process (Fig. 1A) and 24.1% by the new adapted system (Fig. 1C), respectively. The fat contents of kernel residues after oil extractions were 12.2% (traditional process) and 7.8% (new system). These results indicated about the same recovery of oil by both processes (Fig. 1A and 1B) which was about half of the oil originally present in the kernels. Processing losses appeared to be slightly higher in the new system due to losses occurring in the skimming step of cream separation. Theses losses are more than compensated for by the improved quality of the palm kernel oil obtained.

Some of the physico-chemical properties of the oil samples are given in Table II.

The color of palm kernel oil by new system (Fig. 1C) was pale yellow, whereas that obtained by the existing traditional process (Fig. 1A) was dark dirty brown. Excessive uncontrolled heating employed in the traditional process may lead to slight burning of the resulting oil, hence a darkening of the color. The color of palm kernel oil (new system) was very similar to that of coconut oil (traditional process, Fig. 1B). Olfactory evaluation of the odor indicated that palm kernel oil by the traditional process had a slightly pungent odor unlike that of the new system.

The kernel residue (sieve overtails) of the new extraction system (Fig. 1C) could be utilized as animal feed supplement, whereas that of existing traditional process (Fig. 1A) has no feed value. The new processing system appears superior to the existing traditional process of palm kernel oil manufacture as regards the quality and utilization of the oil and by-product. Further investigation into the effects of these two processing systems (Fig. 1A and 1C) on the fatty acid composition of palm kernel oil is underway and will be reported later.

REFERENCES

1. "Bailey's Industrial Oil and Fat Products," Edited by D. Swern, Interscience, New York, NY, 1964.
2. Oyenuga, V. A., "Nigeria's Foods and feeding Stuffs," Ibadan University Press, Ibadan, Nigeria, 1968.
3. "Official Methods of Analysis of the Association of Official Agricultural Chemists," 10th Edition, AOAC, Washington, DC, 1965.
4. "Official and Tentative Methods of the American Oil Chemists' Society," Vol. I and II, Third Edition, AOCS, Champaign, IL, 1964 (revised to 1972).

[Received July 12, 1977]