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Individual Variation in Nigerian Palm Kernel Oil

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ABSTRACT

Forty-one samples of palm kernel oil from two oil palm estates in Eastern Nigeria were studied, each sample being isolated from an individual tree. No significant differences were found in the fatty acid patterns, melting points or iodine values.

INTRODUCTION

Palm kernel oil is obtained from the West African oil palm (*Elaeis guineenis* Jacq). The palm kernel oil is prepared from the kernel, or endocarp, of the palm fruit after removal of the mesocarp to obtain palm oil. The kernels are dried after the removal of the mesocarp to reduce the risk of their damage by fungi. The oil is obtained by extracting the endocarp once the shell has been removed.

Palm oil and palm kernel oil production in Nigeria fell drastically between 1961 and 1973 (Cornelius, 1977) and, although palm kernel oil is still exported, the export of palm oil is now an offence and Nigeria is now a major importer of palm oil.

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There is little local use of palm kernel oil although peasants may chew the kernels to allay hunger. Much of the product is exported, either as the intact nuts or as the extracted oil. A major commercial use is in the manufacture of confectionery, although some is used in the production of high quality toilet soaps. Some may also be used as a cream base in pharmaceutical preparations and also in the synthesis of lauryl alcohol for the detergent industry (Loncin *et al.*, 1970).

Several authors have analysed palm kernel oil from a variety of localities, and these have been reviewed by Cornelius (1977) who has also studied technical factors influencing the quality of palm kernel oil (Cornelius, 1966). These analyses, however, have been carried out on bulk samples, frequently from undefined areas, and do not distinguish between individual variations that might occur from tree to tree.

Crombie (1956) analysed the fatty acid variation in maturing palm kernels but studied individual nuts from only three trees using reversed phase column chromatography.

The work reported in the present paper was undertaken to study the properties of a number of samples of palm kernel oil isolated from individual trees grown on two oil palm estates in the Cross River State on the eastern border of Nigeria.

METHODS

Palm fruits were obtained from two oil palm estates in the Cross River State of Eastern Nigeria. The Ikom oil palm estate is owned by the Nigerian Institute for Oil Palm Research and is located in the north of the state at approximately 500 m above sea level.

The Ibiae oil palm estate in the south, near Beten, at approximately 150 m above sea level. Both estates are surrounded by equatorial forest.

Samples were taken from trees planted in 1967, each sample being harvested from a separate tree, all trees being of the *tenera* variety. Care was taken to ensure that only ripe fruits from the middle of each bunch were taken.

The fruits were washed and then boiled with water for 20 min. The endocarp was pressed out of the fleshy mesocarp by hand whilst still hot and the kernel was then washed clean by hand and dried. Once dry, the kernels were washed with chloroform, to remove any traces of palm oil, and then cracked.

When the shells had been broken and the broken pieces removed, the endocarp was ground with an electric grinder for 3 min. The resulting powder was extracted in a Soxhlet apparatus for 2 h using petroleum ether (80–100 °C) and the solvent was removed by drying in an oven. The melting point and iodine value of each sample were also obtained as described in British Standard 684 (1958).

The extracted oils were subjected to methanolysis by adding 15 ml of anhydrous methanol and two or three drops of concentrated sulphuric acid. These samples were incubated at 37 °C for 72 h and extracted with an equal volume of hexane. The hexane was reduced in volume to 0·5 ml and used for gas–liquid chromatography.

Samples were run on a Pye 104 gas chromatograph using hydrogen flame detectors. The glass column used was 180 cm × 6 mm internal diameter and packed with 15% diethylene glycol succinate (DEGS) on diatomite. The column was operated isothermally at 165 °C with the detectors at 220 °C. The carrier gas was nitrogen at a flow rate of 60 ml a minute. The detectors were coupled to a Hewlett-Packard 3390 integrator to calculate the amount of each fatty acid present.

RESULTS

The results of the fatty acid analyses are shown in Tables 1 and 2. The results were very similar and therefore only the maximum, minimum,

TABLE 1
The Individual Fatty Acids (%) of Palm Kernel Oil from the Ikom Oil Palm Estate

	C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}	$C_{18:1}$	$C_{18:2}$
Range	2·2–3·7	2·5–3·9	43·6–[a] 53·2[b]	15·4–21·1[b]	7·4–10·8	1·7–3·2	5·8–[b] 19·2[a]	ND–3·3
Mean ± standard deviation	2·9 +0·4	3·1 ±0·37	47·9 ±2·03	17·4 ±1·34	8·9 ±1·02	2·4 ±0·47	15·3 ±2·81	2·1 ±1·8

ND = not detectable.
Number of samples = 20.
[a,b] These represent two aberrant samples and, if these are removed, the ranges alter as follows: C_{12}, 46·1–50·6: C_{14}, 15·4–19·1: $C_{18:1}$, 11·8–17·4. The mean and standard deviations alter as follows: C_{12}, 47·9 ± 1·37: C_{14}, 17·2 ± 1·07, $C_{18:1}$, 15·6 ± 1·58.

TABLE 2
The Individual Fatty Acids (%) of Palm Kernel Oil from the Ibiae Oil Palm Estate

	C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}	$C_{18:1}$	$C_{18:2}$
Range	2·2–3·2	2·9–3·6	46·5–51·8	16·7–19·6	7·5–9·7	1·4–2·8	13·3–17·2	1·2–2·6
Mean ± standard deviation	2·7 ±0·23	3·2 ±0·19	48·8 ±1·36	17·7 ±0·66	8·6 ±0·58	2·1 ±0·36	15·0 ±1·17	2·0 ±0·3

Number of samples = 21.

mean and standard deviation are shown for each group. All melting points were between 25 and 28 °C and iodine values for both sets of samples ranged from 15·8 to 20·7.

The identities of caprylic (octanoic), capric (decanoic), lauric (dodecanoic), myristic (tetradecanoic), palmitic (hexadecanoic), stearic (octadecanoic), oleic (octadecenoic) and linoleic (octadecadienoic) acids were determined by combined gas chromatography–mass spectrometry.

DISCUSSION

The properties of palm kernel oil have been reviewed by Cornelius (1977) who quotes the results of a number of authors. Their results have usually been obtained on bulk samples from areas and sources which are frequently poorly defined.

The results obtained for the fatty acid pattern of individual trees give mean values which are all within the ranges quoted by Cornelius (1977) and Hilditch & Williams (1964). A few individual trees give results slightly outside these ranges, but the most obvious difference is in the wide range of linoleic acid found in the samples from the Ikom estate. Linoleic acid could not be detected in four of these samples and several other samples contained more than the upper limit of the range (0·7–2·5%) quoted by Cornelius (1977) although the mean was very close to the mean value found on the Ibiae estate.

Crombie (1956) has shown that there is a drastic fall in the linoleic acid content of the kernels as the fruits ripen and that the rate of maturation varies between fruits in different positions on the same bunch. However,

considerable care was taken to only harvest ripe fruits from the middle of each bunch.

The results obtained also compare closely with those quoted by Loncin *et al.* (1970) except that we found approximately 4% more lauric acid.

The standard deviations obtained from the Ikom samples are about twice those of the samples obtained from the Ibiae estate, suggesting that the Ikom samples are from a more heterogeneous population, even though strenuous efforts were made to match all the parameters.

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