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Full Length Research Paper

Environmental and fungal contamination of palm oil sold in Anyigba Market, Nigeria

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In this present study, the environmental and fungal contamination of palm oil collected from Anyigba market, Nigeria was investigated. Results revealed the presence of 0.3% moisture, 0.2% impurity and 6.0% free fatty acid. These values were higher than the acceptable values for palm oil as recommended by the Nigerian Agency for Food and Drug Administration (NAFDAC) Research. Microbial content of the palm oil samples showed the following isolates *Phialophora jeanselmei*, *Trichophyton schoeuleinii* and *Microsporum canis*. The presence of these potentially harmful microorganisms in the palm oil samples portrays a relative health hazards to the consumers of the product. The quality of palm oil may thus be affected by environmental and fungal content. Consequently, an improved method of handling, processing and storage is advocated.

Key words: Physicochemical, fungal contamination, palm oil, Nigeria.

INTRODUCTION

Palm oil is an edible vegetable oil obtained from the fruit of the palm oil tree (*Eleais guineensis*). Previously, palm oil was regarded as the second most produced edible oil after soybean oil (Malaysian Oil Palm Statistics (MOPS), 2005), but it has now surpassed soybean oil as the most widely produced vegetable oil in the world (MOPS, 2005). Palm oil itself is reddish because it contains high amount of beta-carotene (MOPS, 2005, Akinola et al., 2010). Oil palm probably originated from Guinea and spread to West and Central Africa. In Africa, the notable growing areas include Nigeria, Cote de'Ivoire, Cameroun, Liberia, Zaire, Ghana, Sierra Leone, Togo, Benin, Congo and Angola (Kheiri, 1987; Ogo, 1997). The main oil palm growing area in Nigeria is the South, especially the South-Eastern and Mid-Western regions (Raw Materials Research and Development Council, Nigeria, 2005).

Chemically, palm oil, like other seeds is a fatty acid ester of glycerol commonly called triglycerides (Akpanabiatu et al., 2001). Palm oil and its products are useful for cooking/frying, in local dishes, soap manufacture, as source of vitamin A, E and K (Hartley, 1988; Oguntibeju et al., 2010).

The value of palm oil depends largely on its quality. This work is aimed at determining the moisture content, impurity content and free fatty acid (FFA.) content of palm oil sold in Anyigba market. Palm oil is also susceptible to microbial attack; it is known to support the growth of fungi, so the presence or absence of microorganisms is a good quality determinant in palm oil mills (Ekpa et al., 2001). Consequently, this work also assessed the microflora associated with the palm oil sold in Anyigba market, Dekina Local Government Area of Kogi State, Nigeria.

MATERIALS AND METHODS

Sample collection

The palm oil samples used for this study were collected from Anyigba market, Kogi State, Nigeria. Samples were collected from

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Table 1. Physical characteristics of palm oil samples.

Parameter/Attributes	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
State	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid
Colour	Red	Red	Red	Red	Red	Red
Odour	Perfumery	Palmitic	Palmitic	Perfumery	Perfumery	Perfumery
Taste	Aromatic	Palmitic	Palmitic	Aromatic	Aromatic	Aromatic

six points, with ten stands apart. The samples were collected into sterile universal bottles. The sample bottles were submerged to a depth of about 20 cm with the mouth directed to the oil, then carefully taken out of the palm oil, immediately capped and labeled. The samples were transferred to the laboratory in a polythene bag for analysis.

Determination of percentage impurity

The degree of impurity in the oil samples was determined by using the British Standard Method (1976). The palm oil was thoroughly mixed and about 5 g of the oil was warmed at 45℃ and weighed as (M_1). The oil was filtered on the filter paper, the beaker and the filter paper rinsed (to ensure total removal of oil) with diethyl ether. The filter paper was then removed and dried in the oven and reweighed again as M_2.

Percentage Impurity = M_2-M_1 × 100/Weight of palm oil.

Determination of free fatty acid

The free fatty acid content of palm oil samples were determined by using the British Standard Method (1976). 50 ml neutralized ethanol was added to 5 g of palm oil sample in a 250 ml conical flask. The mixture was heated and agitated until the oil was dissolved. Six drops of phenolthalein added and the mixture was titrated against 0.1 M KOH to give an orange, red or pink color which persisted for about 15 s. The final titre value was noted as N.

Percentage free fatty acids = ml (KOH × Molarity × 25.6/Weight of palm oil.

Determination of moisture content

The moisture content of the palm oil samples were determined by using the British Standard Method (1976). 5 g of palm oil sample was weighed in a crucible and put in the oven for about 2 h at 110℃. It was allowed to cool in a desiccator and its final weight determined;

Weight of crucible (empty) = W_1g
Weight of crucible + palm oil before drying = W_2g
Weight of oil = (W_2-W_1) g
Weight of crucible + palm oil after drying = W_3g
The moisture content was obtained by mass difference using Equation 1 - (W_2-W_3) g;

Percentage moisture = (W_2-W_3) × 100/W_2-W_1)

Microbiological analysis

Isolation of fungi from palm oil sample

Sabouraud dextrose agar at 45 to 50℃ in 9 ml amounts was used as blank for the palm oil samples. Sterile streptomycin (50 µg/ml) was added to the Sabouraud dextrose agar to suppress bacterial growth. The agar medium was autoclaved at 120℃ for 15 min. Six sterile test tubes were set up in a rack and labelled (10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}). Thereafter, 9 ml of the prepared Sabouraud dextrose agar was dispensed into each of the tubes using a sterile pipette. Serial dilution of the palm oil sample was carried out by pipetting 1 ml of the sample into the 10^{-1} tube. After thorough mixing, 1ml was pipetted from this tube into 10^{-2} tube and the procedure was repeated in that order till 10^{-6}. Aseptic conditions were employed in the procedure. The prepared serial dilutions were poured into sterile Petri dishes, allowed to cool and solidify. The plates were subsequently incubated at room temperature (28℃) for 72 to 120 h. Isolated fungal colonies were subcultured unto freshly prepared Sabouraud dextrose agar medium and incubated at room temperature (28℃) for 72 to 120 h. This was repeated until pure cultures were obtained, which were then kept as stock cultures for identification processes using standard procedures.

Identification of isolates

Standard mycological identification process was strictly followed. The cultural characteristics of the isolates were noted, including the colour of the colonies, the texture, etc. The cultural features observed were compared with those contained in the fungal atlas (Beneke and Rogers, 1980; Al-Doory, 1980). The type of medium used in the colour atlas was carefully noted to make sure that the same characteristics would be obtained under the same conditions. A small portion of the culture was transferred to a drop of ethanol on a clean slide with the aid of a sterile needle and a drop of lactophenol cotton blue was added after the ethanol has evaporated. Slides were covered with a cover slip and viewed under the microscope. The microscopic characteristics of their hyphae were also noted and compared with those in the standard textbooks for proper identification.

RESULTS AND DISCUSSION

The physical characteristics and selected environmental/chemical content of the palm oil are shown in Tables 1 and 2 respectively while the identified fungal isolates from palm oil samples are show in Table 3.

The average selected environmental/chemical content of the samples that is, the average moisture contents, impurity and FFA of the palm oil samples which are 0.3, 0.2 and 6.0% respectively were slightly higher than the 0.2% maximum for moisture content, 0.1% maximum for impurity content and 5.0% maximum for FFA which are permissible levels for palm oil as standard grade in Nigeria (Iwuchukwu, 1985). The result of the free fatty acid obtained in this study is comparable to that of Ekwenye (2005). The slightly higher FFA values obtained

Table 2. Physicochemical properties of palm oil samples.

Parameter/ Attribute (%)	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Average
Moisture content	0.2	0.4	0.4	0.1	0.3	0.1	0.3
Impurity contents	0.3	0.2	0.2	0.1	0.25	0.1	0.2
Free fatty acid content	5.0	6.0	5.5	4.0	5.0	4.0	6.0

Table 3. Mycoflora isolated from palm oil samples.

Isolate	Identified organism
A	*Trichophyton schoenleinii*
B	*Phialophora jeanselmei.*
C	*Microsporium canis*

in our study may be due to the fact that palm oil samples were exposed to light at the market and may also be due to decomposition of the glycerides by fungi and accelerated by exposure to heat. Egan et al. (1981) reported that glycerides in palm oil can be decomposed by lipase or other actions and that decomposition may be accelerated by light and heat.

The slightly higher moisture content may be due to the fact that most of the palm oil sold at the Anyigba market are produced through local processes, so there could have been accidental wetting or careless handling of the oil leading to increase in moisture content or it could have been to the fact in few cases, traditional methods which do not allow palm oil to be subjected to boiling (boiling is known to reduce moisture content) (Orji and Mbata 2008; Okechalu et al., 2011).

Some fungi have been known to survive in palm oil by producing the enzyme lipase and spores and the ability to produce spores has helped fungi to survive the anaerobic nature of palm oil and makes them resistant to heat. The organisms isolated from the palm oil samples include; *Phialopjhora jeasnselmei, Trichphyton schoenleinii* and *Microsporium canis* as shown on Table 3.

According to Okpokwasili and Molokwu (1996), microorganisms are known to cause chemical changes that lead to deterioration in quality of palm oil. Kuku (1976), also stated that the occurrence of fungi in palm oil is undesirable and that they cause the lipolyzation of the oil with the resultant increase in FFA of the oil. Hence, the presence of these organisms have negative impact on the quality of palm oil by contributing to an increased FFA in palm oil coupled with the fact that the fungi and impurities pose potential health hazard to the consumers of the palm oil.

CONCLUSION AND RECOMMENDATION

Consequent to the lower grade of Anyigba palm oil in relation to the standard grade of palm oil permissible in Nigeria as well as the presence of lipolytic fungi in the palm oil, which may be due to the local method of processing, handling of the oil and the mechanism of storage, the following are recommended: mechanized or modern methods of processing of palm oil should be embraced by the local community, which could be through the setting up of mills with modern facilities. Modern storage facilities should also be used to minimize contamination of processed palm oil. With better handling and improved hygienic methods of processing, the palm oil produced in Anyigba could meet the stipulated standard for palm oil in Nigeria.

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