Research Journal of Biological Sciences 1 (1-4): 16-19, 2006

Evaluation of the Quality of Palm Oil Produced by Different Methods of Processing

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Abstract: Five palm oil samples obtained by different methods of processing were evaluated for quality. The palm oil samples evaluated were oils produced by traditional aqueous palm oil extraction method, palm oil press, fibre extract, Adapalm mechanized extraction method and adulterated palm oil extract. The physical quality indices analyzed were moisture content, impurities, density, smoke point, flash point and fire point, while the chemical quality indices analyzed were Free Fatty Acids (FFA), saponification value, peroxide value, iodine value, unsaponifiable matter and potash content. The Adapalm oil (from the standard industrial oil mill) had significantly($p<0.05$) lower values of FFA (0.97%), moisture content (0.23%), peroxide value (07.0 mEq kg^{-1}) and the other quality parameters showed that it is of higher quality than the rest. It was closely followed by palm oil from press extract and traditional aqueous palm oil with FFA of 3.3% and 2.6%, respectively. These were then followed by palm oil from fibre extract with FFA (2.9%), moisture content (9.3%), impurities (1.6%), peroxide value (7.4 mEq kg^{-1}). The adulterated palm oil extract was found to have significantly higher values of moisture content (26.4%), FFA (3.9%), impurities (1.89%), potash content (3.96%) and other quality indices showed that it is of the poorest quality among all the oil samples.

Key words: Palm oil, processing, extraction, quality, characteristics

INTRODUCTION

Palm oil has become one of the leading vegetable oils for edible applications because of its good quality and properties. It is rich in palmitic acid Wiedermann,[1]. Palm oil is also one of the richest sources of carotenes, a precursor of vitamin A Vaugham,[2]. In particular palm oil is a very important vegetable oil in the diets of many Nigerians and other West African nations. It is obtained from the fleshy pericarp (outer pulp) of the fruitlets of oil palm tree botanically known as *Elacis guinensis* Hartley,[3].

According to Bunting *et al.*[4], in processing palm oil users. Methods used are to ensure oil of low acidity containing not more than 3% of free fatty acids. Palm oil requires careful handling if quality deterioration is to be avoided, such deterioration result to increased or even prohibitive refining costs in order to obtain a product suitable for edible use which is of the required bleached colour and taste. It is important to keep oxidation low.

One of the challenging problems facing palm oil users presently in Nigeria is that of quality assurance. There are diverse kinds of palm oil in the market due to adulteration and poor handling. Palm oil adulteration has been a bugging problem in our nation today, owing to several reasons ranging from corruption, economic degradation, to poverty and greed. The protection of the consumers has occupied the attention of civil authorities from the ancient times, yet the problem seems unsolved because it takes various dimensions. Another factor currently undermining quality standard of oil in Nigerian market today is poor processing methods and handling techniques. Some of the traditional methods introduce impurities and expose the oil to rapid spoilage. This is because they are inefficient and tedious.

There is therefore the need to examine palm oil from different sources to compare their quality with the existing standards and also to ascertain the means for detecting adulteration.

PALM OIL PROCESSING

Traditional aqueous palm oil extraction method: In this traditional method of extraction, palm fruit bunches were harvested when fully ripened and heaped on the ground and covered with plantain leaves for 2 days. They were

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then stripped manually and fermented by soaking in water over night. The fermented fruits were later boiled and pounded with wooden mortar while hot after which the nuts were separated from the fibre. Water was later added to the fibre and heated with the pulp or mash in a pot. The oil was eventually extracted by squeezing it manually, from the fibre. The recovered oil was then boiled for sometime (to remove water) and filtered with a woven native filter made from palm fronts. This is the typical traditional method of palm oil extraction as practiced in Okigwe, Nigeria.

Palm oil from press: In this method the harvested palm bunches were stripped and the palm fruits boiled to soften the fruit. The boiled fruits are then taken to a local oil mill (hand-operated) to press out the oil. The recovered oil is then filled into drums and from there sold or consumed.

Palm oil from fibre: In some local settings after oil may have been recovered from the oil press, the fibre from which oil has been recovered are further mashed with hot water and extracted with the oil press. The recovered oil and water are later boiled to remove the water. This type of oil is sold differently as inferior palm oil.

Adapalm oil: The oil sample was obtained from Adapalm Nigeria limited, which is a modern vegetable oil company producing oil in larger industrial scale. A brief account of how they obtain their oil is given below. Fresh fruit bunches are harvested and sterilized by injecting super heated steam to a pressurized chamber containing fresh fruit bunches to soften and loosen the fruits as well as inactivate the enzymes. This is done at 10 bar, for 40-50 min to terminate acidification process. Then sterilized bunches are stripped or threshed to remove the fruits for efficient oil extraction and are cleaned from sand and other impurities. After stripping, the fruits are digested or mashed to break up the oil cells and then hot water (90-95°C) is used to extract the oil. The clear oil is drawn off as it floats while the dirt fall to the bottom. Hot water is added to the sludge to reduce viscosity and aid separation.

In Adapalm which uses a power driven mills, the crude oil extracted by centrifuge has 40-45% water and small quantities of non-oily solids. During clarification, the extraneous matters are separated from the oil using filters. The oil is finally dehydrated by subjecting it to heat (to aid water removal from the oil). The oil is then sent to the storage tank.

Adulterated sample: Palm oil adulteration is normally a deliberate act to defraud people. The simplest adulteration is the addition of water to oil masking it with potash. The sample was obtained following the prescribed method of adulteration by the users. Potash locally called *Akaun* was ground and macerated with oil and water to form water -in- oil emulsion. This enable a lot of water (30 -80%) to be added to the oil unnoticed.

MATERIALS AND METHODS

Physical quality analyses: The moisture content was determined using the standard hot air oven at 104±2°C to dry to a constant weight by heating the oil samples (25 g) according to Pomeranz and Meloan[4].

The density of the oil samples were obtained according to the method described by Pomeranz and Meloan,[4]. Impurities in the oil samples were determined as described below. 20 g of oil samples were weighed into tares of known weight and the oil extracted with hexane in a Soxhlet extractor. After complete extraction of the oil, the tares were dried in the oven to constant weight at 80°C. The final weight of the tares were taken. The impurities are non-oil solids.

$$\% \text{ Impurities} = \frac{\text{weight of impurities}}{\text{oil weight}} \times \frac{100}{1}$$

the smoke, flash and fire points of the oil samples were evaluated according to the methods of Pearson[5].

Chemical quality analyses: The chemical quality analysis of the oil samples were determined. The quality indices analyzed were free fatty acids/acid value, saponification value, peroxide value, Iodine value and unsaponifiable matter. All these quality indices were analyzed according to Pearson[5].

Also Potash was evaluated using flame photometer as described by Wilson,[6].

RESULTS AND DISCUSSION

The physical quality attributes of the palm oil samples obtained by different processing methods are given in Table 1. It can be noted from this result that the adulterated sample had the highest moisture content, followed by palm oil from fibre extraction 26. 34% and 9. 29% respectively. The presence of excess water in the samples could be attributed to deliberate addition of water to the oil or entrance of water during processing. Poor handling methods (insufficient dehydration) and sharp fraudulent practices of some processors to maximize gain account for the high moisture content of oils. It therefore suggests that the adulterated sample belongs to

Table 1: Physical quality attributes of the palm oil samples

Quality attributes	Fibre extract	Local extract	Palm press	Adapalm oil	Adulterated oil
Moisture ontent(%)	9.29^{a}	1.59^{d}	2.90^{c}	0.23^{c}	26.34^{a}
Impurities (%)	1.58^{b}	1.07^{c}	0.95^{d}	0.09^{c}	1.89^{a}
Density(g/cm^{3})	0.87^{a}	0.85^{b}	0.88^{a}	0.87^{a}	0.87^{a}
Smoke point(°C)	175^{c}	185^{b}	186^{d}	195^{a}	127^{d}
Flash point(°C)	294^{d}	338^{a}	297^{d}	331^{b}	304^{c}
Fire point(°C)	340^{d}	346^{b}	344^{c}	357^{a}	324^{c}

$^{...abc}$ Means on the same row with different superscript are significantly different ($p<0.05$)

Table 2: Chemical quality attributes of the palm oil samples

Quality attributes	Fibre extract	Local extract	Palm press	Adapalm oil	Adulterated oil
Free Fatty Acid(%)	2.8^{c}	2.63^{d}	3.30^{b}	0.97^{c}	3.88^{a}
Peroxide value(mEq g^{-1})	7.4^{cd}	8.5^{bc}	8.8^{b}	7.0^{d}	10.4^{a}
Saponification value(mg KOH g^{-1})	235^{b}	107^{c}	251^{a}	192^{c}	168^{d}
Iodine value	40.3^{c}	42.8^{a}	38.4^{a}	38.4^{a}	39.3^{a}
Unsaponifiable matter(g kg^{-1})	17.8^{b}	9.3^{c}	20.8^{a}	7.8^{c}	22.5^{a}
Potash content(%)	2.41^{c}	2.55^{b}	2.30^{d}	2.17^{c}	3.96^{a}

$^{...abc}$ Means on the same row with different superscript are significantly different ($p<0.05$)

the lowest grade of technical palm oil. The press palm oil sample and locally processed palm oil had 2.9 and 1.59 % respectively falling within the limiting range of 0.09-3.1% reported by Denenu and Eze[7] as acceptable standard which will not pose refining and storage problems (Table 1). Most of the oil samples fall within this limiting rage. Adapalm oil sample in particular proved to be most excellent quality oil comparing with the premium grade specification of 0.5% recommended by Landon[8] as standard moisture content for industrial application. Such oil will also be very stable, as it may not easily undergo hydrolytic rancidity.

Adapalm sample was also found to contain significantly lower impurities (0.09%) even though it fell short of the standard 0.01-0.05% impurities recommended for industries utilizing palm oil in food formulations (Landon,[8]). The press palm oil, locally processed palm oil and fibre extraction had 0.95, 1.07 and 1.58% impurities respectively, which are quite high. The high content of the impurities in these samples were due to poor filtration after extraction. A native woven filter is always used for the locally processed palm oil. The adulterated sample has the highest impurities, 1.89 (Table 1) due to poor removal of the sludge and unhygienic handling techniques during processing. All the samples did not vary significantly in density and they all fall within the range of 0.800-0.900 reported by Eka and Osagie[9] Hartley[10], for palm oil, slight variations were also noted amongst the treatment samples as regards their smoke point, flash point and fire point with the adulterated sample maintaining lower values in most of the study followed by the fibre extract sample and then press oil sample (Table 1).

The chemical quality indices of the palm oil samples are given Table 2. It can be seen from this table that Adapalm oil sample contained barely 0.97% free fatty acid which is significantly lower than the rest of the samples and of excellent quality since it compared quite favourably with premium grade specification of 0.5-1.5% FFA. It is significantly better due its modern processing techniques involving sterilization of the fruits immediately after harvest and threshing, avoiding bruising and fermentation of the fruits that lead to high fatty acid formation. The press palm oil, fibre and locally processed palm oil had 3.30, 2.87 and 2.63% respectively, well above the premium grade which requires a maximum FFA content of 2.5 Landon,[8]. The high FFA was due to the bruises on the fruits during stripping and prolonged keeping of the fruits which most of the processing methods involved.

All these lead to lipolytic and hydrolytic break down of fatty acids because of the presence of lipase and moisture as well as microorganisms Iheoronye and Nggody,[11]. The adulterated sample had 3.87%, the highest FFA which was significantly different from others. It fell short of the range 0.5-1.5% FFA reported by Pearson[5] as standard for commercial oil, the presence of excess water impurities and poor heat treatment during processing contributed to the high FFA which is capable of making the oil highly unstable as it causes rancidity to commence.

The Peroxide value (Pv) of the adulterated sample was 10.4 m Eq kg^{-1} which was slightly above the standard 10 mEq kg^{-1} for fresf oils. Pearson[5] noted that fresh oil usually should have peroxide values well below 10 mEq kg^{-1}. The locally processed palm oil and press palm oil had 8.5 and 8.8m Eq/kg respectively and there was no significant difference between then. Whereas the fibre extraction palm oil sample and adapalm oil with 7.4 and 7.0 Eq/kg respectively (Table 2) also had no significant difference with each other. All these samples except the adulterated oil sample fall within the limit of form Eq kg^{-1} recommended for fresh oil. Peroxide value was shown by Ihekoronye and Ngoddy[10] to be a function of processing method, storage environment and

packaging. The adulterated sample was found to be significantly higher in peroxide value due to marked water content in the oil causing formation of peroxide.

The variation of the palm oil samples in terms of sapanification value, unsaponifiable matter and potash content are highlighted in Table 2. In most study, the adulterated oil sample was found to be significantly higher indicative of poorer quality, closely followed by the fibre extract sample. Adapalm on the other hand consistently proved to be of better quality. In fact the adulterated palm oil recorded highly significant unsaponifiable matter and potash content which are true measures of quality performance showing the false hood and sharp practices usually adopted by processors to maximize their gain. The potash is commonly used by them to create water in oil emulsion which permits then to add as much water as possible. It takes really some weeks before the water separates from the oil, before which they must have sold their oil.The poor oil quality makes it unfit for most food applications Wilson,[10] because it poses refining problems and storage problems.It is only employed for technical uses; soaps, candles, polishes, resins and cosmetics.

REFERENCES

1. Wiedermann, C., 1987. Integrity of fats system formulation. Paper presented at the 7th world congress Food Sci. and Tech. Singapore, pp: 28-20.
2. Vaughan, J.G., 1990. The structure and utilization of oil seeds Chapman and Hall Ltd. London pp: 187.
3. Hartley, C.W.S., 1987. The Oil Palm 3rd Edn. Longman Scientific and Technical, New York.
4. Pomeranz, Y., 1994. Food Analysis. Theory and Practice 3rd Ed. Chapman and Hall, USA.
5. Pearson, D., 1976. The Chemical Analysis of Foods. 7th Ed. Church hill Livingstone. Longman Grp Ltd. London, pp: 4-513.
6. Wilson, D.W., 1989. Comprehenive Analytical Chemistry I.B. and I.C. Elservier Publishing Co. Amsterdam, London.
7. Denenu, E.O. and J.N. Eze, 1983. The quality of Locally Processed Palm Oil- a Comparision of Processing Methods. Nig. F.J., pp: 123-127.
8. Landon, J.W., 1975. Palm oil-Some commercial aspects. Chem. and Ind. Ellis Hormwood Publ. Ltd. Chichester U. K. pp: 892-898.
9. Eka, O.U. and A.U. Osagie, 1998. Nutritional quality of plants foods. Post harvest Research Unit. Dept. Biochem. Univ. of Benin, Nigeria pp: 112-113.
10. Hartley, C.W.S., 1977. The Development of Grooves in the Oil Palm 2nd Ed. Longman, London, pp: 71-76.
11. Ihekoronye, A.I. and P.O. Ngoddy, 1985. Intergrated Food Science and Technology for Tropics. MaCMillan Edu. Ltd. London, pp: 78.