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Short Communication

Effect of Storage on the Physicochemical Properties of Palm Oil

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Abstract. The effect of 4-month storage on the physicochemical properties of palm oil stored in earthenware pots, plastic and tin containers is reported. Significant increase was noted in the iodine value (tin, from 48.22 to 57.95; plastic, from 48.22 to 56.68) free fatty acids (tin, from 0.65 to 0.93 %; plastic, from 0.65 to 0.93 %), and peroxide value (tin, from 5 to 8.07 mEq/kg; plastic, from 5 to 7.87 mEq/kg) of the oil during the period of storage. The increase was even more pronounced in the earthenware pot in iodine value (from 48.22 to 60.91), free fatty acids (from 0.65 to 0.95%), and peroxide value (from 5 to 8.40 mEq/kg). The sensory quality characteristics were adversely affected during storage in the earthenware pots after 4th month of storage. The results suggest that plastic was the best storage container for palm oil.

Keywords: oil storage, physicochemical properties, earthenware pot, plastic container, tin container

Palm (*Elaeis guineensis*) is a "wonder tree", being very useful to humans (Abulude and Lawal, 2002). Oil is among its most useful products, which finds application in cooking, manufacturing of paints, cloth, linoleum, printing ink, insecticides, pharmaceuticals, cosmetics, leather making, production of animal feeds, baking products, and confectioneries. The storing of large volumes of oil for long periods under diverse conditions is not an easy task, since many of its characteristics (colour, flavour and clarity), which are necessary to be maintained, deteriorate. In order to maintain stability of palm oil for a long period for consumption and industrial usage, without the loss of quality and quantity, good storage methods need to be developed. This study was, therefore, carried out to determine the effect of storage on the physicochemical properties of palm oil when stored in containers made of different materials.

The palm oil used in this investigation was procured from the Federal College of Agriculture, Akure, Ondo State Processing Unit. The analytical studies were carried out between May and August. The storage containers (earthenware pots, plastic and tin) were purchased from the local market in Akure. These were washed with detergent, rinsed in distilled water and sun-dried for 5 h. Two litres of oil was stored in each of the containers for 4 months prior to analyses. The initial analytical values, determined before the commencement of storage, were used as the reference values. Two determinations on the physicochemical properties were carried out at 1-month intervals. Iodine value, free fatty acids, peroxide value, and colour were determined by the methods described by Pearson (1976). The relative humidity (%) and temperature (˚C) were recorded daily. Dirt and sediments were removed using the filtration method. Sensory evaluations were done by a taste panel of a nine judges, who evaluated the sample in terms of colour, taste, and odour using a nine point hedonic scale (9 = super-good, downwards to 1 = super-bad). All determinations were done in duplicate. Means and standard deviations were calculated according to the methods of Steel and Torrie (1980). Duncan's multiple range test was used to determine the significant differences (Duncan, 1955).

Table 1 records the average ambient temperature (˚C) and relative humidity (%) during the storage period, by month. The temperature ranged between 26.5-29.0 ˚C, whereas humidity ranged between 90.0-95.4% during the storage period. The physicochemical properties of the oil stored in different containers are presented in Table 2. The free fatty acids (%) was low at the commencement as well as in the stored samples. It varied between 0.65 at commencement and 0.95 in August in the earthenware pots. It was, nevertheless, observed that the free fatty acids increased during storage. The reason for this increase may be attributed to the absorption of moisture by the earthenware pots from the surroundings. When this occurs there is a likelihood of microorganisms affecting the oil, which in turn may lead to spoilage. This is in agreement with the earlier reports for milk during storage (Rehman

Table1. Ambient temperature and humidity of palm oil during storage period

Month	Temperature (˚C)	Humidity (%)
Commencement	26.7	91.0
May	27.0	95.4
June	28.0	92.0
July	29.0	90.0
August	26.5	94.0

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et al., 2002; Pearson, 1976). The low free fatty acids values suggest that the sample was good edible oil and that the storage in containers was observed to be effective. With appreciable further increase, the oil may tend to spoil quickly. The peroxide value, which was also low (ranging between 5 to 8.40 mEq/kg), is a measure of the peroxide oxygen present, and is the value used in assessing the extent of oil spoilage.

Table 2. Physicochemical properties of palm oil stored in different kinds of containers

Parameter storage period	Earthenware pots	Plastic containers	Tin containers
Values at commencement			
Free fatty acid (%)	0.65	0.65	0.65
Peroxide value (mEq/kg)	5.00	5.00	5.00
Iodine value	48.22	48.22	48.22
Taste	801±0.2	8±03	8.0±0.3
Odour	81±0.2	8.1±0.2	8.1±0.3
Colour	red	red	red
Dirt/sediments	nil	nil	nil
Values in May (after one month storage)			
Free fatty acid(%)	0.72	0.67	0.71
Peroxide value (mEq/kg)	5.40	5.00	5.00
Iodine value	53.47	49.91	51.18
Taste	5.2±0.25	8.2±0.3	7.6±0.3
Odour	5.1±0.03	8.3±0.4	7.5±0.3
Colour	orange	red	red
Dirt/sediments	2.0±0.01	nil	nil
Values in June (after two month storage)			
Free fatty acid (%)	0.76	0.73	0.75
Peroxide value (mEq/kg)	6.40	6.20	6.20
Iodine value	56.26	50.76	54.15
Taste	5.4±0.30	8.0±0.2	7.5±0.2
Odour	5.3±0.25	8.1±0.3	7.5±0.3
Colour	orange	red	red
Dirt/sediments	4.0±0.01	nil	nil
Values in July (after three month storage)			
Free fatty acid (%)	0.92	0.85	0.89
Peroxide value (mEq/kg)	7.20	6.67	7.10
Iodine value	58.54	53.72	57.28
Taste	5.6±0.20	8.1±0.2	7.4±0.3
Colour	orange	red	red
Dirt/sediments	6.0±0.01	nil	nil
Values in August (after four month storage)			
Free fatty acid (%)	0.95	0.90	0.93
Peroxide value (mEq/kg)	8.40	7.87	8.07
Iodine value	60.91	56.68	57.95
Taste	5.7±0.20	8.4±0.2	7.2±0.3
Odour	5.6±0.30	8.2±0.2	7.0±0.2
Colour	orange	red	red
Dirt/sediments	6.0±0.01	nil	nil

These values were noted increase as the time of storage increased. The oil stored in earthenware pots had the highest peroxide value. However, the obtained values were within the acceptable value of 10 mEq/kg (Pearson, 1976). The low peroxide values indicated that the oil had a low susceptibility to oxidative rancidity and was suitable to be kept for sometime in different storage containers without appreciable deterioration.

During storage in the container with closed lids, increase in iodine value (from 48.22 to 60.91) was noted. To an extent, these changes were more pronounced in earthenware pots. The higher the iodine value, the greater is the liability of the oil to go rancid by oxidation. It then suggests that the oil stored in the earthenware pots may go rancid quickly if there was a further increase in the period of storage.

As shown in Table 3, the analytical observations at the commencement of storage for free fatty acids, peroxide value and iodine value were much different as compared with the results of samples stored in different containers. It was observed, however, that there were no significant differences ($p < 0.05$) in the parameters, when compared with the variations between the replicates throughout the period of storage in the three kinds of containers. After the storage periods of 1st month to 4th month, the taste, colour and odour of samples stored in the earthenware pots were significantly less ($p < 0.05$) than the sample stored in plastic and tin containers. The total amount of dirt and sediments increased during the storage in earthenware pots, whereas there was none in the other containers. The dirt and sediments were, therefore, on account of the structure breakdown of the earthenware pots. The variation in the physicochemical properties may be attributed to oxidation, and rancidity accelerated by exposure to heat, light and the contact with metals of the containers.

Table 3. Analysis of variance of free fatty acids, proxide value and iodine value of palm oil stored for 4 months

Parameter	F-Value	Test of significance ($p < 0.05$)
Free fatty acids	0.69	ns
Peroxide value	0.22	ns
Iodine value	0.13	ns

ns: no significant difference

From the results of this study, it can be inferred that deterioration in the physicochemical parameters in the containers was in the following order:

earthenware pots > tin containers > plastic containers

It can thus be concluded that plastic containers were the most suitable for the storage of palm oil over the period of four month storage.

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