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Comparative Study of the Physicochemical Properties of Some Refined Vegetable Oils Sold in Mile One Market and Some Departmental Stores in Port Harcourt, Rivers State, Nigeria

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Abstract

Physiochemical properties of some brands of edible oils (namely:-Turkey, Grand, Gino, tropical, Power, Mammador, local vegetable oil and kuli-kuli (raw/locally extracted groundnut oil) sold in mile 1 market, Everyday supermarket and Next-time supermarket in Port Harcourt, Rivers state were studied to determine their quality and compare the results with some standards. All the oils were characterized for flash point, cloud point, iodine value, saponification value, unsaponifiable matter, acid value and peroxide value using standard methods of analysis. The results obtained show that the free fatty acid contents of the local and kuli-kuli oils were higher (0.709 and 1.96 respectively) than the maximum recommended value of 0.3 by SON and NIS while other brands were within the range. The measured moisture content values for Turkey, Grand, Gino and Mammador were higher than the standard range of 0.05 in the samples from Mile 1 market and in some supermarkets. Specific gravity, melting point,and cloud point were satisfactory except for Grand that showed a different cloud point of less than 2. Iodine value for the local oil is 20.25 (Wij's) indicating the predominance of lauric acid while that of kuli-kuli (94.6 Wij's) suggests the predominance of Oleic acid. The other brands showed iodine value of 46-50 Wij's which indicates predominance of palmitic acid except the Grand oil that had the highest value of 125-128 (Wij's). Saponification values and unsaponifiable matter were within the standard range of saponification value (245- 255) and unsaponifiable matter (0.1-0.15) for all the brands. Acid and Peroxide values of all the brands showed results within the standard. These results of the measured parameters show that the oils sold in the supermarkets are better protected from light induced oxidation (photoxidation) than those sold in open markets.

Keywords: Flash point, Iodine value, Saponification value, Acid value, Peroxide value, Photoxidation, Hydroperoxide

INTRODUCTION

Vegetable oils constitute a significant part of the human diet as a source of energy, fat-soluble vitamins and essential fatty acids (FAO, 2009).They are extracted from seeds and nuts of various plants and are composed mainly of triacylglycerols.
Despite their importance, one major drawback in their handling and utilization is their ease of oxidative deterioration, which renders them less acceptable to consumers or for industrial use especially as food ingredients.

The quality of any oil is indicated by some physico-chemical properties. The specific value of some of these properties provides an indication of both the nutritive and physical quality of the oil. These properties include iodine value, peroxide value, saponification value, unsaponifiable value, free fatty acid, color appearance etc. For example, oils with low melting point may readily go rancid due to the high level of unsaturation. Recently; palm oil has become the second most consumed oil all over the world as a result of its being rich in natural antioxidants, vitamins and exhibiting high oxidative stability with attendant long shelf life. However, its high melting point lowers the level of acceptance among some consumers (Edem, 2002). The exposure of oils to either a source of heat, light or moisture can alter some of the quality indicators. The extent of alteration (spoilage) depends on the duration of exposure, temperature and condition of storage (Aidos, *et al*., 2002; Fekarurhobo, *et al*., 2009).The stability of oil to oxidation is an important indicator in determining oil quality and shelf-life(Choe and Min, 2006).Two common practices that render vegetable oils in most commercial centres prone to oxidative deterioration are packaging in transparent containers (plastic bottles and sachets) and displaying oils either under direct sunlight or artificial lights. Studies have shown that some vegetable oils available in the market do meet the recommended standards for edible oils (Reyes Hernandez, *et al*., 2007).

Considerable amount of attention has been given in recent years to test for the extent and nature of oil oxidation. Primary oxidation products are measured by peroxide value which is a value of the quantity of hydroperoxides present in the oil (Maduelosi, *et al*., 2012). It is usually expressed in milli-equivalent of oxygen per kg of oil. The secondary oxidation products are assessed by measuring the Para or p-anisidine value. The p-anisidine value measures mainly the amount of alpha-beta unsaturated aldehydes (2-alkanals) and ketones present in the oil. The primary oxidation products (peroxide and hydro peroxides) are unstable and gives very little off-flavour, but the secondary oxidation products (aldehyde and ketones) gives undesirable off-flavour to the oil and cannot be completely removed on refining (Denenu and Eze, 1983).Some of the oxygenated decomposition products are implicated in degenerative diseases such as aging, membrane damage, heart disease and cancer; as a result the study of lipid oxidation has received great attention recently (Angaye, *et al*., 2013).

The sources and characteristics of a good number of edible oils are not known. It is therefore, very important that the quality and oxidative stabilities of commercially available vegetable oils be examined to ascertain their suitability for consumption.

The aim of this study is to compare the quality of some brands of vegetables oils sold in Port Harcourt with known standards and also compare the effect of storage conditions on the oxidative stability of the oils.

Materials and Methods

Nine (9) brands of different vegetable oils were purchased from Mile one Market, Next Time and Everyday Supermarkets in Port Harcourt, River State. The saponification values, peroxide values, unsaponfiable matter, acid values and Iodine values were determined by AOCS (1986) methods, while the moisture(Miv), flash points, smoke points, melting points (mpt), cloud point and specific gravity were determined by AOAC (1990) methods.

Results

The results obtained from the various analyses are displayed in the Tables 1-6.

Table 1. Physical Properties of Vegetables Oils from Mile one Market

Samples	Flash point	% Miv	Mpt	Cloud point	Smoke point	Specific gravity
Mile I Local	223	0.09	25.3	26	190	0.900
Kuli-kuli	171.6	0.07	21	4.6	128.3	0.903
Turkey	272.6	0.10	Nol	10.6	213.3	0.90
Grand	300	0.10	Nol	<2	248.6	0.903
Gino	290	0.18	Nol	6	246.6	0.795
Tropical	293.3	0.02	Nol	4.3	253.3	0.910
Power oil	283.3	0.02	Nol	8	265	0.910
Mammador	285	0.10	Nd	9	235.3	0.907
Kings	302.6	0.03	Nd	7.6	271.6	0.910
NIS standards	300-350	0.05	(Depend on the oil)	8-10	200-250	0.900-0.913

Results are means of triplicate obtained from the analysis

Table 2. Chemical Properties of Vegetables Oils from Mile one market

Samples	% FFA	Peroxide value	Iodine value	Sap. Value	Unsap. matter	Acid value.
Mile I Local	0.709	5.17	20.25	250	0.10	0.506
Kuli-kuli	1.966	12:0	94.6	258	0.05	6.22
Turkey	0.15	1.99	50.18	191.3	0.09	0.36
Grand	0.055	1.97	128	193.5	0.094	0.35
Gino	0.28	0.72	48.83	198.6	0.092	0.39
Tropical	0.15	1.03	50.05	198.3	0.099	0.38
Power oil	0.23	0.96	48.76	198.3	0.10	0.36
Mammador	0.20	2.23	49.63	198.3	0.10	0.34
Kings	0.15	0.93	49.86	191.3	0.093	0.31
NIS standards	0.3 max	10max	’-10 depend on the oil	245-255 depend on the oil	0.1-0.15	0.6 max

Results are means of triplicate obtained from the analysis

Table 3. Physical Properties of Vegetable Oil from Everyday Supermarket

Samples	Flashpoint	Miv %	Mpt	Cloud point	Smoke point	Specific gravity
Turkey	333	0.07	Nd	9.66	216	0.91
Grand	300	0.07	Nd	<2	250	0.911
Gino	290	0.12	Nd	8.3	246	0.852
Tropical	306	0.05	Nd	7.66	246	0.910
Power oil	293	0.06	Nd	8	265	0.910
Mammador	303	0.10	Nd	9.60	246	0.908
Kings	345	0.07	Nd	8.66	268	0.911
NIS Standard	300-350	0.05	Nd	8-10	200-250	0.900-0.913

Table 4. Chemical Properties of Vegetable Oil from Everyday Supermarket

Samples	%FFA	Peroxide value	Iodine value	Sap. value	Unsap. value	Acid value
Turkey	0.13	0.77	49.12	192.3	0.094	0.39
Grand	0.10	0.83	125.9	192	0.096	0.38
Gino	0.24	0.68	48.95	199	0.09	0.39
Tropical	0.16	0.92	49.57	197	0.10	0.43
Power oil	0.21	0.99	48.98	199	0.10	0.39
Mammador	0.20	2.23	49.84	198	0.10	0.34
Kings	0.21	0.87	49.83	194	0.08	6.36
NIS Standard	0.3 max	10 max	7-10 (Depending on the oil)	245-255 (Depending on the oil)	0.1-0.15	0.6max

Results are means of triplicates obtained from the analysis.

Table 5. Physical Properties of Vegetable Oil from Next Time Supermarket

Samples	Flashpoint	%Miv	Mpt	Cloud point	Smoke point	Specific gravity
Turkey	321.6	0.03	14	10	246.6	0.91
Grand	406	0.03	0	-1	270	0.915
Gino	300	0.12	13	7.6	246	0.798
Tropical	306	0.05	9.6	7.6	246	0.910
Power oil	293	0.06	9.6	8	265	0.91
Mamador	303	0.07	12	8.66	268	0.911
Kings	323	0.07	12	8.66	268	0.911
NIS Standard	300-350	0.05	Depends on the oil	8-10	200-250	0.900

Results are means of triplicates obtained from the analysis.

Table 6. Chemical Properties of Vegetable Oil from Next Time Supermarket

Samples	%FFA	Peroxide value	Iodine value	Sap. value	Unsap.Value	Acid value
Turkey	0.09	0.64	48.9	196	0.09	0.42
Grand	0.08	0.88	127	195.3	0.14	0.48
Gino	0.27	0.82	49.4	200	0.09	0.42
Tropical	0.18	2.80	49.5	198.3	0.10	0.45
Power oil	0.20	1.91	49.2	199.3	0.10	0.36
Mamador	0.23	2.26	50.0	198.3	0.10	0.35
Kings	0.22	0.89	49.9	194	0.09	0.36
NIS Standard	0.3 max	10 max	7-10 (depending on the oil)	245-255 (depending on the oil)	0.1-0.15	0.6max

Results are means of triplicates obtained from the analysis.

The physicochemical properties of the oil samples are presented in the tables above. The specific gravity of the different brands of vegetable oils have values that are closely related to the standard range of 0.898-0.912 approved by Standard Organization of Nigeria(SON,2000), except for the Grand vegetable oil which has 0.917. The physical analysis also revealed that the smoke and flash points of the different brands are high. These high values are indicative of the suitability of the oils for frying. The local oil and kuli-kuli oil showed higher melting points. This is an indication of high stearin which renders the oil to cloud at room temperature. Grand oil exhibited the extra-ordinary characteristics of cloud point 0^0C.Moisture, impurity and volatile matter (%Miv) of the various oils were within the standard range stipulated by SON (1992) for refined, bleached and deodorized (RBD) vegetable oils.

Saponification values obtained for all brands of oil purchased from the various sources are within the range for any particular oil as specified by SON (2000) and NIS (1992). The local oil showed characteristics of palm kernel oil, having saponification value of 245mgKOH/g which is within palm kernel oil range of 245-255mgKOH/g. The high saponification value is an indication that the oils will be most suitable for industrial use.

The values obtained for the unsaponifiable matters in all the samples were less than the maximum value of l0g/kgmax recommended by SON(2000) and NIS(1992) for edible oils. This is because the unsaponifiable matter in edible oils is usually small, as high value will indicate contamination or adulterations(lhekoronye and Ngoddy, 1985).

The free fatty acid (%FFA) values for the local oil and kuli-kuli were high. Their values ranged from 0.8- 1% which is higher than the stipulated 0.3max by SON. This is an indication that the extent of hydrolytic rancidity in these oils is appreciable. The values in the other brands are within the range specified by SON (max.0.3).

CONCLUSION/RECOMMENDATIONS

The exposure of vegetable oils to light and heat results in their degradation affecting their physicochemical properties. This is of interest to scientists because the products of such degradation reactions are linked to some cardiovascular

diseases. The effect is more on the oils sold in the open markets than those sold in supermarkets. This may be attributed to the harsh storage/display conditions of the products in the open markets. The findings from this research show that some of the vegetable oils sold in the markets are substandard. It also reveals that oils with low free fatty acids tend to have high smoke point, high flash point and low peroxide value which are good quality attributes of ideal vegetable oils.

Recommendations. Vegetable oils should be stored in lacquered cans or sachets and not clear glass jars or plastic bottles often used which allows ultraviolet radiation to damage the oil.

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