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Assessment of the Quality Parameters of Edible Refined and Cold Pressed Vegetable Oil Sold at Katako Market in Jos, Plateau State

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ABSTRACT

The quality parameters of edible refined and cold pressed vegetable oil sold at Katako market in Jos were assessed. Two samples of refined made from soya and two samples of cold pressed made from groundnut were purchase. The analysis adopted the standard analytical methods from the 16th edition of Association of Official Analytical Chemist (AOAC, 2016). Physicochemical parameters tested was colour, odour, density, smoke point, moisture content, acid value, iodine value, peroxide value and saponification value. Toxic elements like cadmium, lead, arsenic and chromium were determine using Atomic Absorption Spectroscopy, digested with a mixture of nitric acid/hydrogen peroxide in a ratio of 5:1 Results indicates that, density 0.84±0.02-0.88±0.03 g/cm^3, 0.86 g/cm^3, moisture content 0.21-0.52,0.21±0.03-0.32±0.01%, smoke point 220±0.01-234±0.02, 224±0.05-234±0.02^{o}C, acid value 0.81±0.20-0.87±0.09, 0.91±0.30-1.03±0.13 mgKOH/g ,iodine value 5.71±0.89- 30.14±2.24, 1.59±0.457.74±0.13 I_2/100g, peroxide value 1.40±0.28-2.30±0.14, 3.15±0.21-4.30±0.28 meqO_2/kg, saponification value 180±1.41-189±1.41, 190±2.83-194±1.41mgKOH/g, cadmium 0.19±0.00, 0.38±0.00-0.57±0.01 mg/kg lead 0.29±0.01, 0.29±0.01 mg/kg, arsenic BDL-1.10±0.00 , 1.85±0.00-3.34±0.00 mg/kg, for the refined and cold pressed oils respectively. Chromium was below detectable limit of the instrument. Moisture content of the oils was higher than the recommended value of 0.20 %, acid value was higher than 0.6 mg, cadmium, lead as well as arsenic were all higher than the permissible limit set by FAO/WHO (CODEX Alimentarius) values. These oils are probably affected by unfavourable storage conditions, though they are of good quality and suitable for consumption, but the cold pressed vegetable oil had better quality parameters compared to the refined oil using the FAO/WHO (CODEX Alimentarius) standard values.

KEYWORDS: Quality parameters, Edible oil, Cold pressed, Refined, Katako Market.

1. INTRODUCTION

Oil (Oleum in latin) can be defined as a wide range of flammable substances which are either be a liquid or solid (fat) at room temperature or 25^{o}C [1]. Oils produced by plants are known as vegetable oil. Vegetable oils are important to man as a source of nutrient (fat in the human diet) and industrial raw materials[1]. Cooking oils and oils that are part of other foods can be oxidized in a more standing and a higher temperature[2]. The quality of oil is determined by several parameters such as peroxide number, acid number, iodine number[3]. Cold pressed oils are unrefined, with greater nutritional properties, but oxidizes faster at lower temperatures than refined oils[4]. The methods of extraction make all the difference in the quality and flavour of oil. The process of cold pressed extraction does not involve excess application of heat or chemical solvents, the oils obtained from this method retain their original flavour, taste, aroma, and nutritional value. Meanwhile, regular refined oils are extracted by using high temperatures and treated with chemical solvents which degrades their flavour, taste, and nutritional composition[5].

Edible vegetable oils are a group of fats derived from either seeds, nuts, cereal grains or fruits[6]. Not all these vegetable oils can be edible and also exist as liquid oils at ambient temperatures, but this research work report is centered on edible vegetable oils which are liquid at room temperatures.

If the extraction is done by a solvent, is it called refined oil, because the solvent allows to produce a standardized oil by modifying its fatty acids[4]. The polyunsaturated fatty acids content in cold pressed oil is high and this makes them unsuitable for frying as the temperature degrades its quality, flavor and aroma. Cold pressed oils are relatively nontoxic and has a large safety margin (>5000 mg/kg)[7]. It has become important to assess the quality parameters of edible refined and cold pressed vegetable oil to ascertain their safety levels for consumers especially those sold in Katako Market.

2. MATERIALS AND METHODS

2.1 Sample Collection

One litre each of the vegetable oils were bought randomly at Katako Market, stored at room temperature and transported to the Department of Chemistry laboratory of the University of Jos for analysis.

2.2 Determination of Colour, Odour, Density, Moisture content of Cold pressed and refined edible vegetable oils sold at Katako Market.

The colour was determined according to the methods described by [8]

2.3 Determination of smoke point of cold pressed and refined edible vegetable oils sold at Katako Market.

The oil was heated in a boiling tube clamped to a thermometer. The temperature was read out at the point where smoke was visibly seen rising from the oil in the boiling tube. The temperature was observed for 15 seconds and the range of the temperature within that period was recorded.

2.4 Determination of Physico-chemical properties of cold pressed and refined edible vegetable oils sold at Katako Market.

Acid value was determined by titrimetric method according to [9].

About 1.0 g of each oil was weighed and dissolved with 50 cm^3 of ethanol in a conical flask. Two drops of phenolphthalein indicator were added and titrated to pink end point with 0.1 M potassium hydroxide solution (KOH). Acid value was calculated according to the following Equation

$$\text{Acid value} = \frac{56.1 \times V \times C}{m}$$

Where 56.1 is equivalent weight of KOH, V is the volume in cm^3 of standard volumetric KOH solution used, C is the exact concentration of KOH solution used (0.1 M); m is the mass in grams

2.5 Saponification value (SV)

This was carried out using the method described by[10]. Two grams of the oil sample was added to a flask with 30 cm^3 of ethanolic potassium hydroxide solution, attached to a reflux condenser heated on a water bath for 1 hour.After the sample had cooled, 1cm^3 of phenolphthalein indicator was added and titrated with 0.5M hydrochloric acid until a pink endpoint was reached. A blank determination was also carried out. Saponification value was calculated using equation:

$$\text{Saponification Value} = \frac{(a - b) \times M \times 56.1}{\text{sample wght } (g)}$$

Where: a = sample titrate value M = molarity of the HCl b = blank titrate value 56.1 = molecular weight of KOH

2.6 Determination of the Levels of Heavy Metals in cold pressed and refined edible vegetable oils sold at Katako Market.

Digestion was carried out by adding 10cm^3 of nitric acid to 1 gram of each sample, followed by 2cm^3 of hydrogen peroxide and heated till a clear solution was obtained. The resulting solution was made up to 50cm^3 and transferred into a plastic bottle. The presence of Lead, Chromium, Cadmium and Arsenic were determined using Atomic Absorption Spectroscopy.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1 present the physical properties of cold press and refined vegetable oils sold at Katako market. The refined soya oil has high moisture content and may be susceptible to rancidity.

Table 1: Physical Parameters of cold pressed and refined vegetable oil sold at Katako market.

Physical properties	Samples				
	RA (soya)	RB (soya)	CA (G/nut)	CB (G/nut)	WHO/FAO (CODEX) Standard
Colour	Amber yellow	Amber yellow	Orange red	Orange red	Nil
Odour	Odourless	Odourless	Nut-like aroma	Nut-like aroma	Neutral
Density (g/cm^3)	0.84	0.88	0.86	0.86	0.914 –0.925
Moisture content (%)	0.52	0.44	0.21	0.32	0.20
Smoke Point (ºC)	230 – 232	220 – 225	230 – 234	224 – 228	230 – 240

Key: RA=Refined vegetable oil A, **RB**=Refined vegetable oil B, CA = cold pressed vegetable oil A CB=cold pressed vegetable oil B

Table 2: Chemical parameters of cold pressed and refined edible vegetable oil sold at Katako market.

Samples of oil	**Acid values mgKOH/g**	**Iodine values I_2/100g**	**Peroxide values meqO_2/kg**	**Saponification values mgKOH/g**
RA	0.87±0.09	30.14±2.24	2.30±0.14	180±1.41
RB	0.81±0.20	5.71±0.89	1.40±028	189±1.41
CA	0.91±0.30	1.59±0.45	3.15±0.21	190±2.83
CB	1.03±0.13	7.74±6.88	4.30±0.28	194±1.41
WHO/FAO (CODEX) Standard	a (0.6mg/0.4mg)	b (124 – 139/77 – 107)	10	c (189 – 195/ 187 – 196)

Key: RA=Refined vegetable oil A, **RB**=Refined vegetable oil B, CA = cold pressed vegetable oil A CB=cold pressed vegetable oil B

Table 3: Concentration level of Heavy metals in cold pressed and refined edible vegetable oil sold at Katako market.

Sample	Elements (mg/kg)			
	Cd	Pb	As	Cr
RA	0.19±0.00	0.29±0.00	1.10±0.00	BDL
RB	0.19±0.00	0.29±0.01	BDL	BDL
CA	0.57±0.01	0.29±0.01	1.85±0.00	BDL
CB	0.38±0.00	0.29±0.01	3.34±0.00	BDL
WHO/FAO (CODEX) Standard	0.05	0.10	0.10	0.003

Key:
RA = Refined vegetable oil A, **RB =** Refined vegetable oil B, **CA =** Cold pressed vegetable oil A, **CB =** Cold pressed vegetable oil B, **BDL=** Below detectable limit

3.2 Discussion

The physical properties of cold pressed and refined edible oil such as colour, odour, density, moisture content and smoke point are shown in Table 1. Sample RB had the highest density while RA had the lowest. Sample RA contains the highest moisture content and CA had the lowest. Sample CA had the highest range of smoke point temperature while RB had the lowest. Densities of vegetable oil varies with type and temperature. The densities of samples RA, RB were in the range of 0.84- 0.86 which agrees with the works of [6]. All samples were within the acceptable range of 0.914–0.925 g/cm^3 recommended by by WHO/CODEX.

When moisture content ranges from 0.05 to 0.30 in edible oils, it shows that rancidity likely to occur. The maximum allowed moisture content in edible oils is 0.20%[11]. Lower moisture content indicates a longer shelf life of edible vegetable oil. The moisture content for samples RA, RB, CA, and CB are 0.52%, 0.44%, 0.21%, and 0.32%, respectively. All samples are within an acceptable range, except sample RA (refined soya oil).

Smoke Point is the temperature at which fat begins to breakdown and oxidize according to [12]. For optimal taste and to maintain their nutritional value, oil should not be used above its smoke point in frying. The oil with high smoke points is best for cooking, sample CA (cold pressed G/nut oil) had the highest smoke point while sample RB had the lowest smoke point in this research. These are comparable to the results obtained by[12]. All samples are within the standard range according to WHO/CODEX.

Acid value is use as a quality control parameter for oils and fats. Higher acid value and free fatty acid content is an indication of a low-quality oil. Sample CA had the lowest acid value while RA had the highest which are comparable to results obtained by [13]. The WHO/FAO (CODEX) standard is 0.6. All samples studied were within the respective standards set by WHO/CODEX as seen in Table 2. The Iodine value measures the degree of unsaturation of a particular vegetable oil. It measures the amount of iodine absorbed by 100 parts of weight of the sample. Studies have shown that oils with a high degree of unsaturation, the higher will be the iodine value, likewise the greater the possibility of the vegetable oil to become rancid or to get oxidize [14]. Oils with high iodine value have more of the unsaturated fatty acids that are prone to degradation reactions such as auto oxidation or polymerization. Standards value for soya oil are (124–139) and groundnut oil (77–107) as provided by WHO/FAO. Only sample RA is within the range for soya oil, while all others are below the recommended values. Peroxide value is the common indicator of oxidation and rancidity of lipids. Peroxides are formed from the oxidation of triglycerides in the oil with high moisture content. Oil samples having peroxide values less than 10meq/kg is safe for human consumption, but oil samples having peroxide value less than 4meq/kg are considered to be fresh and healthy[12]. The WHO/FAO (CODEX) standard is 10 meqO_2/kg. All samples meet the standard.

Saponification value is the amount of KOH required to saponify one gram of fat. Higher saponification value indicates lower fatty acids average length and this will mean lighter molecular weight of the triglycerides in oils and vice versa. The standards for soya oil (189–195) and groundnut oil (187–196) are provided by WHO/FAO. All samples meet the respective standards.

Heavy metals cannot be degraded or destroyed. As trace elements, some heavy metals like copper, selenium, zinc are essential for the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Sample RB had the least concentration of heavy metals over sample CB. Heavy metals tend to bioaccumulation, causing an increase in their concentration in a biological organism over time. This is in comparison to the substance concentration in the environment. High exposure of heavy metals can cause obstruction in the functions of the lungs, which can lead to lung cancer, cause skin irritation and ulceration. While long-term exposure can lead to kidney and liver damage, circulatory and nerve tissue damage, degenerative, inflammatory and neoplastic damage to the skin, respiratory system, blood, lymphatic system, nervous system as well as the reproductive systems. Heavy metals can accumulate in aquatic animals, which can add to the danger of eating fish. All samples had value within the standard set by WHO/CODEX, with all below the limit like in lead, cadmium while arsenic, chromium was below detectable limit of the instrument as seen in Table 3.

4. CONCLUSION

The quality of edible refined and cold pressed vegetable oil sold at Katako market in terms of physicochemical parameters indicate a consistent trend in density, smoke point, iodine values, peroxides and saponification values with the FAO/WHO standards. The refined soya is likely to go rancid within a short period of storage because it has the highest moisture content. The cold pressed groundnut oil is the best for frying because it has the highest smoke point value, lowest acid and free fatty acid content depicting a high-quality oil. All samples are considered fresh and healthy based on their peroxide values. Both oil samples can be saponified. From the results obtained in this study, it can be concluded that the cold pressed vegetable oil had parameters are statistically significant to the FAO/WHO values compared to the refined vegetable oil. Cold pressed oil is better in quality compared to refined vegetable oil. The consumption of cold pressed vegetable oil recommended in preference to that of refined vegetable oils.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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