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Production of Local Drying Oil from Agricultural Based Biomass for Industrial Usage

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Abstract

This study is aimed at extracting and characterizing local available oils from edible and non-edible seeds, with the view of evaluating their chemical and physical characteristics. With the increasing demand for drying oil by industries added with high import duties from the regulatory agencies, this study is poised in giving detailed descriptions on the significance of these raw-materials that are essential in meeting domestic and industrial demands. These have placed a heavy strain on the foreign exchange position of Nigeria through Foreign Direct Investment (FDI). The demand for domestic sourced alternatives cannot be over described. The availability of local sourced oils will definitely advance local industries and get ride of high costs of import duties thereby increasing the Gross Domestic Product of Nigeria through economic empowerment in the area of job creation. The drying and semi drying properties of: Huracrepitan oil, Soybean, orange seed, luffa seed oil and crude palm kernel oils were analyzed in the study. The iodine values for Huracrepitan, Soybean, orange seed, luffa seed oil and crude palm kernel oils were: 170.1, 130.6.60, 70.10, 35.80 and 22.37 respectively.From experimental results, HuraCrepitan oil has the highest iodine value among the oils evaluated while palm kernel oil gives the least value. Local paint industries and other allied have been solely depending on linseed and tung oils for drying oil This study revealed the possibility of producing drying oils from *Huracrepitan oil*and that can be substituted for the imported linseed oil.

Keywords: Drying Oil,HuraCrepitan.Iodine Value, Semi-Drying Oil,Soya Bean Oil.

1.0 INTRODUCTION

Dry oil are liquid substances that have been subjected to efflorescent due to their unique properties components in converting Oxygen to dry, hard, insoluble and resinous film as opined by National Energy Education [5] report. More so, the oil also have partial or wholly synthetic substances that have a glyceride structure on a wide varieties of' other type of structures energy [4] . An example of partial synthetic drying oil is that from castor seeds 40 [6]. This oil dried from the action of glyceride made by chemical dehydration to form more Olefine as posited by . Unsaturated—hydrocarbon polymers such aspolybutadiene are major instances of total synthetic drying oils of the non—glyceride origin etc [4].

The hydrolyzed oil from castor seed can further be converted to dehydrated fatty Acid by hydrolysis and distillation [6].

The drying oil are majorly vegetable oil that are comprises of glycerol esters in the form of triglycerides of both saturated and unsaturated carboxylic acids that appears in group form. The properties and characteristics of these oil arc based on the individual carboxylic acids distributions oils [11,12].

Plants oil are differentiated by properties such as boiling/freezing points (BP/FP), acid value (AV) ,viscoscity, P^H, specific gravity (S.G), iodine value and saponification value (SV) etc. Mostly they are also classified into drying oil, semi-drying oil and non-drying oil depending on their degree of unsaturation(3).

Drying oils: these are liquid substances that explains the behavior of the oil when in contact with moisture, air and other environmental factors, usually in the presence of photo-energy [4]. These oil thicken materials that lead to the formation of an elastic surface or a hard comparatively firm film if spread in a thin layer over a very smooth surface and exposed to daylight [5]. They oil are very unsaturated substances and their iodine value is greater than 140 [6]. The industrial usage relies on its physiochemical characteristics. Some examples of these oil are.;jatropha oil ,luffa oil, Huracrepitan oil, walnut oil and safflower oil, soya bean oil and argemonemexilans seed oil etc [4].

Semi-drying oils: comparing to the drying oil is unsaturated fatty acid, less viscous at a higher temperature and very stable at room temperature.It thicken but doesn't form firm films at room temperature, the reason is because of it slow oxidation occurring at the unsaturation point of the molecules of oil. It has iodine values of 125—140. Examples are Soybean and corn oils [5].

Non-drying oils: theseoil does not have tendency of becoming thick on exposure to environmental condition such as sunlight and air and do not form firm films at room temperature [6]. It usually contain mono-unsaturated compounds and their iodine values are less than 125[6].

It is significant to know that most vegetable oil applied for food product, cosmetics, dye,bio-lubricants,varnish,soap,plasticizers,detergent and paints are majorly non-drying oil or semi-drying oils [11-16].

Sources of Oil

Vegetable oil can be edible or non-edible; consumed directly or indirectly as food ingredients [8]. About 14% of vegetable oil produced is applied as feedstock in the production industry, 6% as animal feed while the remaining 80%is used domestically for food processing and varieties of man's activities ranging from frying oil, salad oil and cooking oil amongst others[17]. The uses of vegetable oil depend on the source of the feedstock. Vegetable oil is use mainly in food processing, soap and cream production, margarine,medicine, biofuels, especially in biodiesel production, paints for coating and drug production [12].

Vegetable fats and oils are abundantly found in fruits and seeds. While fats and oils do occur in the roots, stalks, branches and leaves of the plant. They are present in these part of the plant in quantities large enough for commercial uses. In some seeds the oil is practically confined to the germ or embryo; this is the fact in most of the cereals. The olive contains a large amount of oil in the pulp surrounding the kennel and only a few amount in the kernel itself, while in the oil palm both the pulp and the kernel contain large amount. The oil from the pulp may have characteristics quite different from those of the oil in the kernel[6-8].

Hura Crepitan oil: HuraCrepitan is manufactured from sand box seeds of sand box tree and is largely cultivated in the southern part of Nigeria. The oil in its content is about65% and contains high percentage of Linolenic acid which is the reason for its unsaturation properties. *Huracrepitan* has a mean of 14 seeds per fruit and are normally planted to provide cover from sunlight. The trunk and branches are thorny[19].

Soybean Oil: Soybean oil is obtained from the seed of the leguminous plant known as glycine max[1]merill. The seeds, which arc spherical and weigh about 0.1-0.2g, are widely grown throughout the globe, especially in United State, China and Brazil[10]. It has an oil content of' about 18-22% and is mainly grown in the northern part of Nigeria.

Cotton Seed Oil: Cotton seed oil is sourced from aanatropotis ovoid seed of the species of plant known as gossypiumarboreum and agriculturally belongs to the family ofMaluaceae**.** It contains small amount (about 0.5-2.0%) of cyclo-propene acids (glycerides), which is among the edible oil of commercial value and are unique in nature. It has an oil content of about 19.5% and in Nigeria, it is mostly cultivated in the Western parts and the middle belt area of the nation[19].

Palm kernel Oil: Palm kernel oil is extracted from the kernel of the oil palm (Elacisguineenisisjacq). Oil palm tree exists in the wild, semi-wild and also cultivated by farmers for commercial purpose and its

is mostly plenty in the coastal Niger Delta region of Nigeria. The kernel contains oil content of about 44-48.5% [8-9].

Luffa Seed Oil:luffa seed oil is obtained from the luffacylinderica seed and contains fatty acids of which linoleic, oleic and palmitic acids are main acids present in it.*LuffaCylinderica* is commonly known as sponge gourd. It is cylindrical in shaped with smooth surface, which climbs on other plants or materials while growing and produces an average of 33 seeds per fruit. LuffaCylinderica is a sub-tropical plant, which requires warm temperature and long frost-free growing season when grown in temperate regions [10].

2.0 AIM

As earlier stated, this study is aimed atProducing Local Drying Oil From Agricultural Based Biomass For Industrial Usage. Specifically, the study achieved the following objectives:

- Extracting and characterizing locally available oils from edible/non edib seeds, with the view of confirming their drying/semi drying properties.
- It is also evaluated sources of obtaining a hundred percent local oil with good drying qualities for industrial applications.
- The industrial usage of the edible and non-edible seed oil was also examined in form of evaluation.

2.1 SIGNIFICANCE OF THE STUDY

Considering the increasing needs for oil from non-edible and edible sources of drying oil by our local industries added with high import duties. These study placed will no doubt play a major in creating awareness on the vital role of these oil in growing the economy of the nation. The study will diversify the over dependent on foreign oil product and promote foreign direct investment. The will advance the need of utilizing local materials for production of varieties of products internationally and locally.

3.0 METHODOLOGY

Material and Method: The materials and methods used in meeting the aim and objectives of this research are oil and seeds of the selected agricultural based biomass, potential hydrogen analyzer, potentiometer for the determination of some physiochemical properties of the selected oils and their blends are described. The analysis using American oil chemists' society official methods were carried out under the laboratory condition at 28°C.

Hura Crepitan Oil

The extractive analysis from Hura Crepitan seed obtained from Akwa-Ibom State, Nigeria. The extraction was carried out at the Chemical/Petrochemical Engineering Department laboratory of River State University.Port-Harcourt.

Soyabean Oil

This was bought from Tombia market in Bayelsa State. Nigeria.

Orange Seed Oil

Orange fruits used for this study was obtained from Mbiama market, Rivers State.

Palm Kernel Oil

This oil was extracted from an oil mill in Calabar, Cross Rivers state and the extraction carried out at Okure Oil Mills Limited, Oruk Anam, Akwa Ibom State.

Luffa Seed Oil

Luffa seed oil were harvested from a subsistent farm in orukanam inAkwaIbom state and processed in Chemical/Petrochemical Engineering laboratory of Rivers state University, Port-Harcourt.

3.2.1 Extraction of the Oil

The oil extraction process was done in the soxlet apparatus using n-hexane as solvent with the current model.

Description of Apparatus

Electric blender, Mantle heater, Filter paper, Conical flasks, Round-Bottom flask, Soxhlet extractor and Condenser

Reagents:

n-hexane

Method:

Solvent extraction of oil was done at the Department of Chemical/Petrochemical Engineering laboratory in Rivers State University, Port-Harcourt.

3.2.1.0 DETERMINATION OF IODINE VALUE-

Procedure: WIJ'S method

The Iodine Value (IV) was calculated from the equation

$$IV = \frac{(B-S)\times N \times 12.69}{w_o} \tag{3.1}$$

Where B = blank titre value
S = sample titre value
N = normality of sodium diosulphate
w_o = weight of oil sample.

3.2.1.1 Saponification Value

The Saponification Value (SV) was calculated using the expression

$$SV = \frac{(B-S)\times N \times M}{w_o} \tag{3.2}$$

Where
B = blank titre value
S = sample titre value
N = normality of KOH (0.5M)
M = molar mass of KOH (56.1)
w_o = weight of oil sample.

3.2.1.2 Acid Value

The Acid Value (AV) was calculated using the expression

$$AV = \frac{TV \times N \times M}{w_o} \tag{3.3}$$

Where TV = titre value
N = normality of KOH (0.1M)
M = molar mass of KOH (56.1)
w_o = weight of oil sample.

3.2.1.3 Peroxide Value

The peroxide value (PV) was calculated from the equation

$$Peroxide\ Value\ (PV) = \frac{(S-B)\times N \times (1000)}{w_o} \tag{3.4}$$

Where B = blank titre value
S = sample titre value
N = normality of sodium thiosulphate

w_o = weight of oil sample

3.2.1.4 Refractive Index

The refractive index was determined using Abbe Refractometer.

3.2.1.5 Flash Point

The flash point of oil was obtained using the Pensky Martens flash point tester.

3.2.1.6 Specific Gravity

The specific gravity of the oil was obtained using the expression

$$Specific\ gravity = \frac{Weight\ of\ Oil}{Weight\ of\ equal\ Volume\ of\ water} \qquad (3.6)$$

3.3.0 IODINE VALUE (IV)

Basic Oils

Table 4.1 shows the iodine values (IV) for basic oils as experimentally determined at 28^{O}C . The iodine values for Huracrepitan, Soybean, orange seed, luffa seed oil and crude palm kernel oils are: 170.1, 130.6.60, 70.10, 35.80 and 22.37 respectively. HuraCrepitan oil has the highest iodine value among the oils compared to palm kernel oil giving the least value. The experimental values where compared to values obtain from literature.

Table 1: IODINE VALUES (WIJs) FOR BASIC OILS (g/100g)

BASIC OILS	IODINE VALUE g/100g–	LITERATURE VALUES
HURA CREPITAN OIL	170.1	176.89
SOYBEAN OIL	130.60	130
ORANGE SEED OIL	70.10	30.20
Luffa SEED OIL	35.80	3133
Palm Kernel Oil	22.37	36.74

Source: Experimental Survey (2020)

The low value of iodine is due to unsaturation in the oil. High value of iodine depict high level of unsaturations. The results shows high lodine value of 170.l for *Huracrepitan* oil compared to the lowest 22.37 for palm kernel oil.Oil with lodine value that is greater than 125 are classified as drying oil, while those with 110-140 are classified as semidrying oil (18-19).

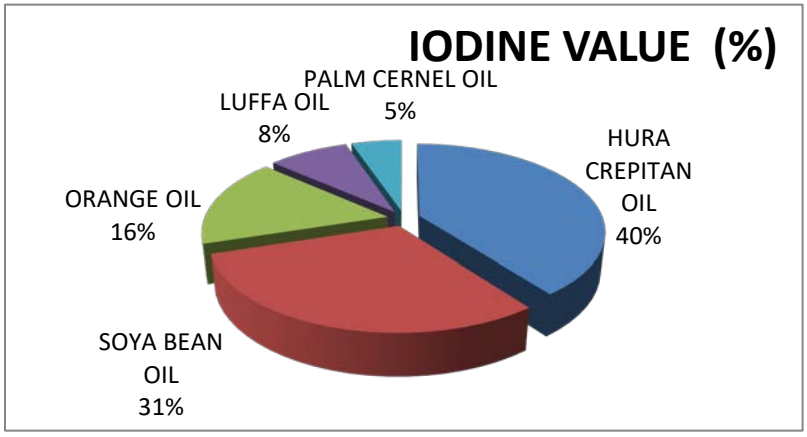

Fig 1: comparison of the basic oils - iodine values (%)

3.3.1 SPECIFIC GRAVITY:

Basic Oils: The specific gravity values obtained from the basic oils from the experiment are detailed in Table 2.

Table 2: SPECIFIC GRAVITY FOR BASIC OILS (-). (16-21)

	SPECIFIC GRAVITY (S.G)	LITERATURE VALUES
HuraCrepitan Oil	0.912	0.94
Soybean Oil	0.923	1.46
Orange Seed Oil	0.914	0.85
Luffa Seed Oil	0.922	0.94
Palm kernel oil	0.914	0.904

(16-21)

The specific gravity of Huracrepitan Oil is 0.912; this was lower than soya been oil (0.923), orange oil (0.914), luffa seed oil (0.922) and palm kernel oil (0.9142).

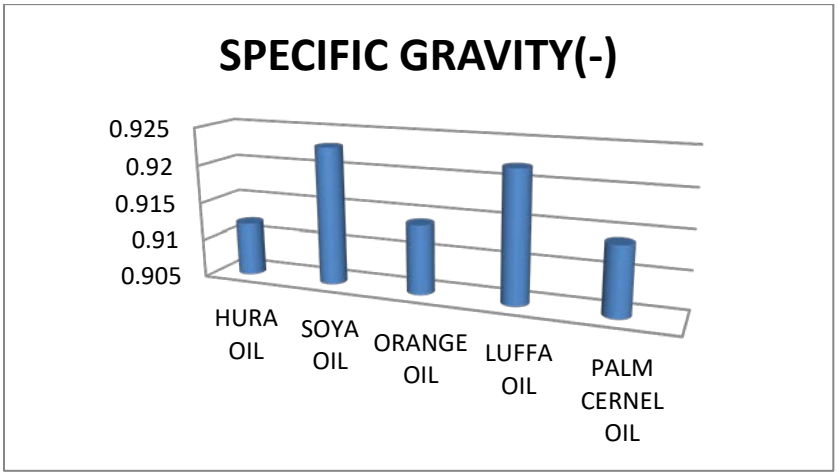

Fig 2: Comparison of Basic Oils -Specific gravity

3.3.2 SAPONIFICATION VALUE: MgKOH/g

Basic Oils: The saponification values obtained from the basic oils from the experiment at are shown below:

Table 4.3 SAPONIFICATION VALUE MgKOH/g.

BASIC OILS	SAPONIFICATION VALUE (Mg KOH/g)	LITERATURE VALUES
HuraCrepitan Oil	235.4	290
Soybean Oil	210.5	228.19
Orange Seed Oil	192.3	194
Luffa Seed Oil	130.25	132.45
Palm kernel Oil	226.3	250.1

(11-21)

Saponification value indicate high percentage of free fatty acids. Luffa seed oil was found to be 130.25 mg koH/g which was the lowest.

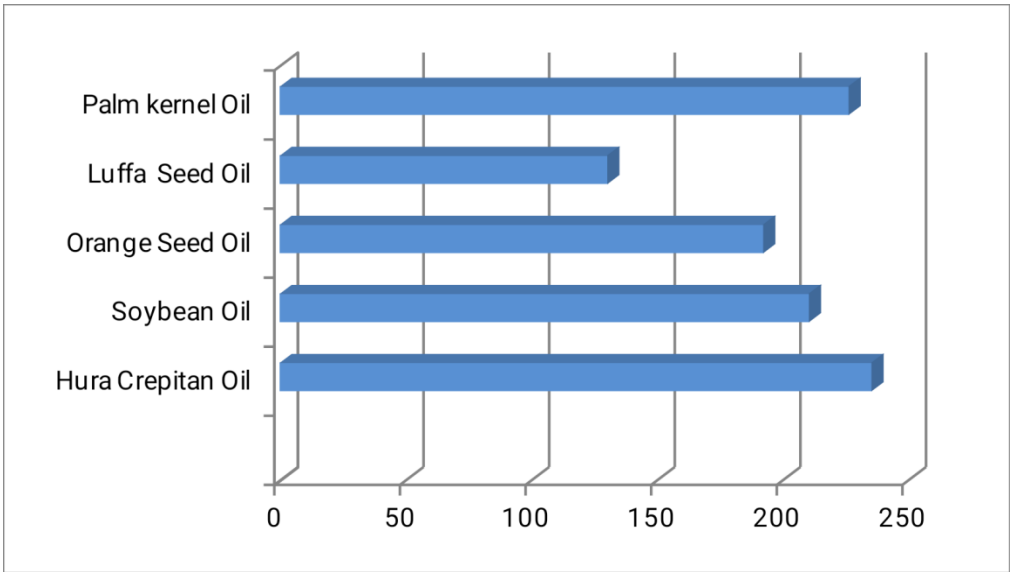

Fig 3: Comparism of saponification values of Basic Oils ((Mg KOH/g)

Table 4.4 PEROXIDE VALUES FOR BASIC OILS (mg eq.kg)

BASIC OILS	PEROXIDE VALUES	LITERATURE VALUES
HuraCrepitan Oil	20.983	3.75
Soybean Oil	21.99	21.38
Orange Seed Oil	15.968	18.20
Luffa Seed Oil	23.43	10.50
Palm kernel oil	7.99	0.30

(25-30)

Peroxide value was used to determine the rate of rancidity of a particular oil sample. Peroxide value of 30-40 MEq/kg are generally associated with rancid taste. The peroxide value for palm oil was 7.99 which was the lowest compared to *luffacylinderica* oil at 23.43 mg eq.kg.

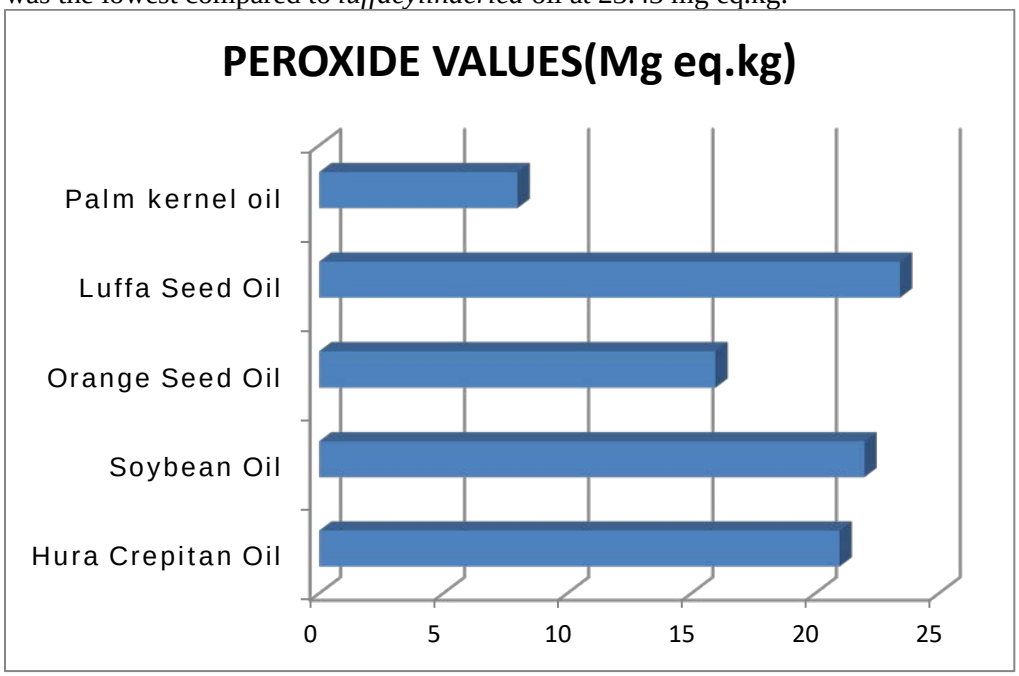

Fig 4:Comparism of Peroxides values of Basic Oils ((Mg KOH/g)

3.3.3 ACID VALUES FOR BASIC OILS (mg/KoH/g): Acid value is used to measure the corrsive free fatty acid and oxidative properties.

Table 4.5 ACID VALUES FOR BASIC OILS (mg/KoH/g)

BASIC OILS	ACID VALUES (mg/KoH/g)	LITERATURE VALUES
HuraCrepitan Oil	28.22	27.21
Soybean Oil	10.61	19.21
Orange Seed Oil	30.51	51.40
Luffa Seed Oil	20.75	27.21
Palm kernel oil	18.79	19.70

(25-30)

Oil extracted from orange seed was found to have the highest acid value of 30.51 mg/KoH/g compared to soya beans oil with 10.61 mg/KOH/g.

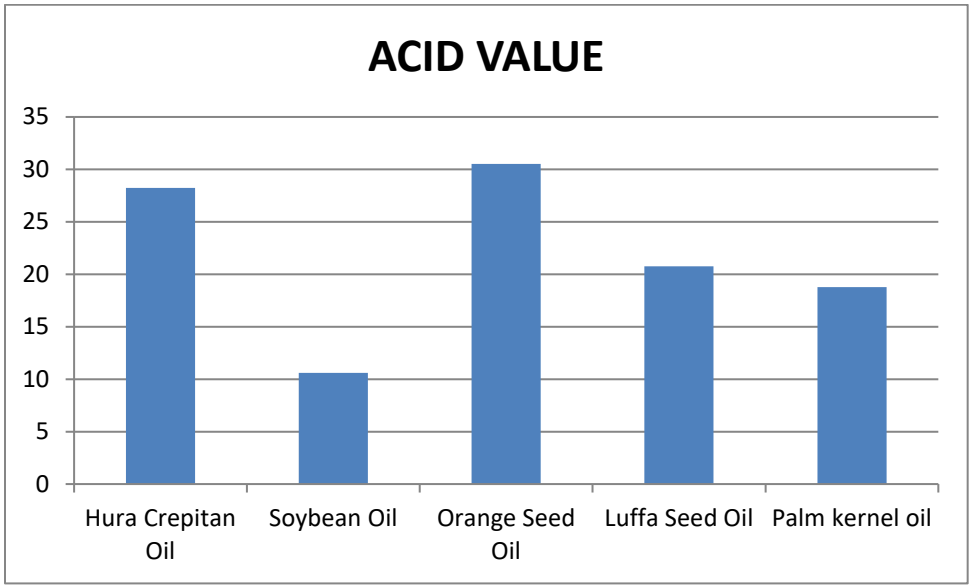

Fig 5: Comparism of Acid values of Basic Oils ((Mg KOH/g)

3.3.4 REFRACTIVE INDEX FOR BASIC OILS (-)

Table 4.6 REFRACTIVE INDEX FOR BASIC OILS (-)

BASIC OILS	REFRACTIVE INDEX(-)	LITERATURE
HuraCrepitan Oil	1.467	1.43
Soybean Oil	1.471	1.46
Orange Seed Oil	1.465	1.47
Luffa Seed Oil	1.468	1.42
Palm kernel oil	1.46	1.45

(25-30)

The refractive index of Hura crepitan was 1.467 compared to what was reported by okureetal (9) 1.43.

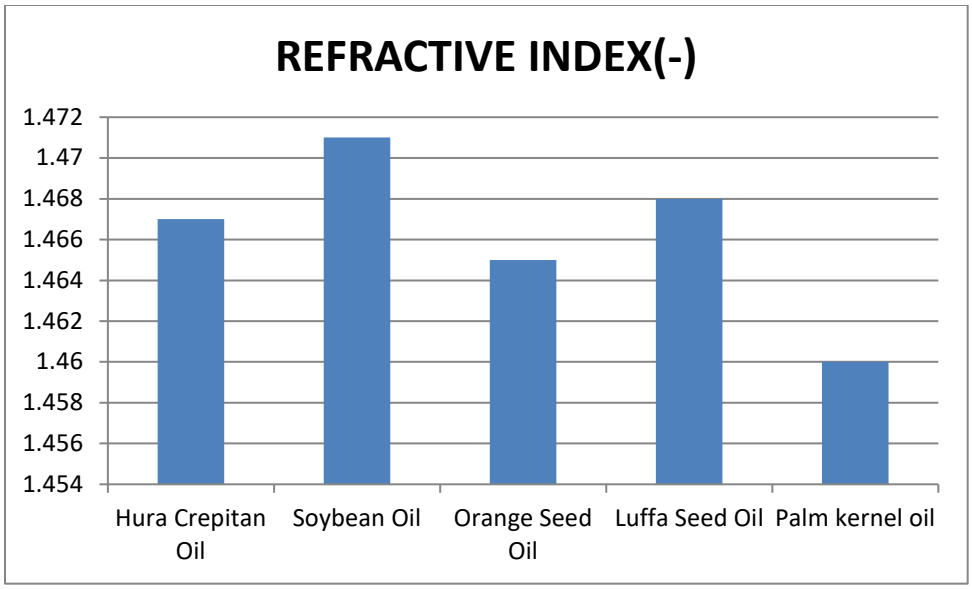

Fig 4.6: REFRACTIVE INDEX FOR BASIC OILS (-)

4.0 CONCLUSION AND RECOMMENDATION

This work has unveiled commercial attractionand possibility of producing drying oils from *Huracrepitan oil* and it can be substituted for the imported linseed oil. Local paint industries and allied partners depends mainly on linseed and tung oils for drying oil. In the conclusion of these research it is recommend that they resort to the use of huracrepitan oil and its blends with other locally sourced oils (example, soybean, orange seed, luffa seed and palm kernel), which will readily yield drying oils. The physiochemical properties of other oils also showed their suitability for Industrial applications in paints, soap,cosmetics and lubricants.

A. Sieving Process

B. *Hura crepitan* seeds

C. Luffa Cylinderica Seeds

D.Pensky Martens,Flash point tester.

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