EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 10
Issue: 12
15-23
Year: 2023

EXTRACTION AND EVALUATION OF OIL FROM THE SEEDS OF *HARUNGANA MADAGASCARIENSIS* AND *CYPERUS ESCULENTUS*

Ordu J. I.* and Okafo S. E.

[1]Department of Pharmaceutics and Pharmaceutical Technology Faculty of Pharmaceutical Sciences, University of Port Harcourt, Nigeria.
[2]Department of Pharmaceutics and Pharmaceutical Technology Faculty of Pharmacy, Delta state University, Abraka, Delta State, Nigeria.

***Corresponding Author: Ordu J. I.**
Department of Pharmaceutics and Pharmaceutical Technology Faculty of Pharmaceutical Sciences, University of Port Harcourt, Nigeria.

Article Received on 03/10/2023 **Article Revised on 23/10/2023** **Article Accepted on 12/11/2023**

ABSTRACTS
The study is aimed at the extraction and evaluation of oil from the seeds of *Harungana madagascariensis* and *Cyperus esculentus.* Soxhlet extraction was adopted using n- hexane, then oil extracts were analyzed for proximate and elemental composition, antimicrobial and physicochemical properties. The antimicrobial screening was carried out on five pathogenic organisms including fungi and bacteria identified as: *C.albicans, K.pneumoniae, S.aureus, Escherichia coli, P.aeruginosa* and aimed at determining the inhibitory activity of the extracts against the organisms. The percentage yield of the oil extracts were 31.72% and 18.91% for *C.esculentus* and *H.madagascariensis* respectively while the proximate principle revealed presence of moisture at 45.23% and 12.5%, CHO 16.0% and 35.05%, protein 6.0% and 5.2% and 1.0% and 2.5% ash content for *C.esculentus* and *H.madagascariensis* respectively. The elemental analysis showed the presence of minerals in the order K>Mg>Ca>Zn for both oil extracts. Chemical characterization of the oils showed acid value of 1.309 and 1.663mgKOH/g, peroxide value as 15.20 and 13.02 meq/KOH, saponification value of 143.10 and 190.74 mg/KOH/g, Iodine value of 80.37 and 83. 05 mg/100g and free fatty acid content of 65.78±3.52mg˙g% and 70.11±1.23 mg˙g% respectively for *C.esculentus* and *H.madagascariensis.* The results obtained indicates the oils extracts to have emollient and antimicrobial activities hence could be useful as potential ingredient in pharmaceutical topical formulations.

KEYWORDS: *C.esculentus, H. madagascariensis,* seeds, extraction, evaluation, oil.

INTRODUCTION
Substances obtained from plants, animals and other natural sources has been of great importance as ingredients of pharmaceutical and cosmetic preparation since they could serve as lead compounds in pharmaceutical formulations judging them, as the oldest means for obtaining drug and drug related compounds. An important consideration in formulations in recent times is the development and incorporation of products that are regarded as "natural" by the populace (consumers, marketers, and regulators).

Natural products are said to be products that occur naturally and are chemical entities produced from living organisms such as plants, mushrooms, animals, and microorganism, hence directly or indirectly, nature in its elegance and vastness has provided varieties of substances that can be harnessed to formulate several products for human benefit.[1]

Plant derived polymers (gums and mucilage's) have pharmaceutical applications such as diluent, solubilizers, binder, disintegrants in tablets, thickeners in oral liquids, protective colloids in suspensions, gelling agents in gels and bases in suppository, viscosity enhancers and stabilizers and they could also be useful in cosmetics, textiles, paints and paper-making industries. Plant triglycerides (fats and oil) have been employed as oleaginous bases, solvents, levigating agent and flavourant.[2] Estimation by WHO states that about 80% (4 billion) of the world's population rely on one or more forms of natural product to meet their healthcare needs; besides this they are also used in beautification and preparation of several cosmetics products, hence the importance of natural products cannot be over emphasized.

OIL
This is one of the products obtained from natural sources including, plants, animal or mineral. Oil has found its

application in diverse sectors of production especially in cooking and in production of locally made cream and soaps. They are used in industries as lubricants, for coating and as biofuel example oils from nuts of *Jatropha circus*, L., *Sapindusmu korossi* and palm oil have all been found to be of domestic, cosmetic and pharmaceutical relevance. In the pharmaceutical industry oil is used in the manufacture of emulsions, suppositories, ointment, creams and so on, while in cosmetic it is used to formulate hair and body cream, lotion and soaps in other to improve appearance of the skin.[3] Oil is one of the oldest form of natural herbal medicine, with majority being sourced from plants. These oils are either used solely or in combination with other forms of medicine example powders, for the treatment of illness and diseases.

Harungana madagascariensis



Figure 1: *H. madagascariensis.*

Scientific classification: This belongs to the kingdom Plantae, Class, Tracheophytes and sub class, angiosperms. *H. madagascariensis* is often called dragon's blood tree, orange-milk tree or haronga, harugana, praying hands, praying hands bush. It is commonly known by Bamileke tribe in Cameroon as Nketto and the Yoruba tribe of Nigeria as Aranje.

Description: The haronga is a small, bushy tree that usually ranges from 4 to 7 m in height, but sometimes it can grow up to 25 meters. The bark appears to be maroon-colored and it is vertically fissured. The scales are vertically arranged and can be flaked off easily. The tree is often identified by its almost fluorescent orange latex obtained from strips that were peeled off from the stem. The orange latex discharges when leaves are snapped off or branches are broken. Majority of tree surface is covered with stellate hairs and when damaged, the bark exudes orange latex.

Its leaves are opposite, simple and ovate. Leaf blades 6-20 by 3–10 cm and leaves appear to be glossy. The flowers are small, approximately 5-6mm, bisexual, white or cream colored, almond scented while sepals are marked by dark red-brownish dots.[4]

In Southern Africa, flowering can be observed from January to April and fruiting season lasts until October while in Sierra Leone, the plant flowering begins in May and reaches its maximum in August and September, then tapers off around December.

The fruits are small about 3mm in diameter, +/-globular and berry-like (drupe). Fruit appear to be greenish-orange and it becomes red when mature. Fruits are marked by glandular dots and streaks. Endocarp surface is hard which makes it difficult to cut. The fruit is not edible and have no apparent use. Its cotyledons are broadly spathulate, margins marked with dark 'oil' glands, petioles relatively long and slender.[4]

Distribution and Habitat

Harungana can be found in medium to low altitudes around 1000-1600m above sea level in evergreen forest, usually around the forest margins and along river banks. It is widely distributed from South Africa to Sudan. It is often the first plant to be found in a forest that has been cleared. It can be found in both forest and savanna regions and it is native to Central African Republic, Congo and other African countries including Nigeria. *Harungana* has now become quite common in undisturbed coastal lowland rainforest and has the capacity to spread widely.

Therapeutic uses

H.madagasacariensis can be used in various ways example as a source of firewood and production of charcoal. The tree is not used commercially because it rarely grows to merchantable size. However, people sometimes use the light wood to make poles for building houses.

The plant has red sap which is used to treat scabies and anthelmintic (tapeworm). It is also used as a material in the treatment of ringworm in Liberia. The leaves are used to control hemorrhages and diarrhea, and as remedy for gonorrhea, sore throat, headaches and fevers. Flower stalks is rumored to ease colic and to check infection after childbirth. Decoction of the bark is used to treat malaria and jaundice while the roots are used to improve breast development in young women.[5]

***Cyperus esculentus* (Tiger nut)**



Figure 2: *Cyperus esculentus* (Tiger nut).

Taxonomy: This belongs to the Kingdom, Plantae – Plants, Subkingdom, Tracheobionta – Vascular plants Superdivision, Spermatophyta – Seed plants, Division, Magnoliophyta – Flowering plants and Class, Liliopsida– Monocotyledons a Specie of *C. esculentus* L (yellow nutsedge). Its common name includes tiger nut, yellow nutsedge, rush nut, nut grass and earth almond and is commonly known in Spanish as Chufa, horchata de chufa, Angola as Olonguesso and aya by the Hausa tribe of Northern Nigeria.[6]

Description: *C. esculentus* is an annual or perennial plant, growing to 90 cm (3 ft) tall, with solitary stems growing from a tuber. The plant is reproduced by seeds, creeping rhizomes, and tubers. Due to its clonal nature, *C. esculentus* can take advantage of soil disturbances caused by anthropogenic or natural forces. The stems are triangular in section and bear slender leaves 3–10 millimeters wide and the plant are distinctive, with a cluster of flat, oval seeds. The color varies from straw-colored to gold-brown and they can produce up to 2420 seeds per plant. The plant foliage is very tough and fibrous and is often mistaken for a grass. The tubers are 0.3–1.9 cm in diameter and the colors vary between yellow, brown, and black. One plant can produce several hundred to thousand tubers during a single growing season. With cool temperatures, the foliage, roots, rhizomes, and basal bulbs die, but the tubers survive and resprout the following spring when soil temperatures remain above 6 °C (43 °F). When the tubers germinate, many rhizomes are initiated and end in a basal bulb near the soil surface. *C. esculentus* is wind pollinated and requires cross pollination as it is self–incompatible.[7]

Invasiveness and cultivation

C. esculentus is a highly invasive specy in Oceania, Mexico, some regions of the United States, and the Caribbean, mainly by seed dispersion and it is adaptable to re-establish in varied climate and soil environments. In Japan, it is an exotic clonal weed favorable to establish in wet habitats.

The seeds can be planted manually on the prepared ridges, which may be approximately 60 cm (2.0 ft) apart. They are planted between April and May and must be irrigated every week until they are harvested in November and December. Tubers develop about 6 - 8 weeks after seedling emergence and grow quickly during July and August while the maturation occur around 90 – 110 days.

Climate requirements

Cyperus esculentus cultivation requires a mild climate, low temperature, shade, and light intensity can inhibit flowering. Tuber initiation is inhibited by high levels of nitrogen, long photo periods, and high levels of gibberellic acid. Flower initiation occurs under photoperiods of 12 to 14 hours per day.[8]

Soil requirements

Tubers can tolerate many adverse soil conditions including periods of drought and flooding and survive soil temperatures around −5 °C (23 °F). They grow best on sandy, moist soils at a pH 5.0 – 7.5. The densiest populations of *C. esculentus* are often found in low-lying wetlands but they do not tolerate salinity.

Harvest and drying process

Harvest usually occurs in November or December and the leaves are scorched during the harvest. With a combined harvester, the tiger nut is pulled out of the ground and immediately after harvesting, the tiger nuts are washed with water in order to remove sand and small stones. The drying occurs usually in the sun and can take up to three months. The temperatures and humidity levels have to be monitored very carefully during this period. The tiger nuts have to be turned every day to ensure uniform drying. The drying process ensures a longer shelf life and prevents rot or other bacterial infections, securing quality and high nutrition levels. Disadvantages in the drying process are shrinkage, skin wrinkles and hard nut texture.[9]

Storage

Tiger nut loses considerable amount of water during drying and storage and the starch content of the tiger nut tubers decreases while the reducing sugar (invert sugar) content increases during storage. Tiger nut can be stored dry and rehydrated by soaking without losing the crisp texture and this can often be done overnight. Dried tiger nuts seeds have a hard texture and soaking is indispensable to render them edible with ease and to ensure acceptable sensory quality. Dried tiger nut has a smooth, tender, sweet, and nutty taste. It can be consumed raw, roasted, dried, baked or made as tiger nut milk or oil. In Spain, the drink now known as horchata de chufa or, in West African countries as Nigeria and Mali, *kunnu aya*) is the original form of horchata and is made from soaked, ground and sweetened tiger nuts.

Flour of roasted tiger nut is sometimes added to biscuits and other bakery products as well as in making oil, soap, and starch extracts. It is also used for the production of nougat, jam, beer, and as a flavoring agent in ice cream and in the preparation of kunnu. The Kunnu a non-alcoholic beverage is prepared mainly from cereals (such as millet or sorghum) by heating and mixing with spices (dandelion, alligator pepper, ginger, licorice) and sugar and it can thus be useful, replacing milk in the diet of people intolerant to lactose to a certain extent.

Tiger nut oil can be used naturally with salads or for deep frying and it is considered to be a high quality oil. The tubers of *C. esculentus* has been found to contain about 20-36% oil, hence it has been suggested as potential oil crop for the production of biodiesel. The oil of the tuber has been found to contain 18% saturated (palmitic acid and stearic acid) and 82% unsaturated (oleic acid and linoleic acid) fatty acids.[10]

Aim of the study

The study is aimed at the extraction, analysis and characterization of the oil from the seeds of *H. madagascariensis* and *C. esculentus*, then evaluation of the antimicrobial activities of the extracted oil for cosmetic/pharmaceutical topical formulations.

Materials

N-hexane, disinfectants, 1% methyl orange solution, 0.5m hydrochloric acid, 0.1diethylether Hydroxide,

carbon tetrachloride, wiji's solution, Standard glucose and boric acid, steric acid, (loba chemie, India), nutrient broth (Titian biotech, India), Sabouraud dextrose sugar, seeds of *Harungana madagascariensis* and *Cyperus esculentus* (University of Port Harcourt Gardens).

Apparatus: Soxhlet apparatus (Borosilicate Glass, England), Heating mantle (PEC medicals, USA), light micro phone, pH Meter (Helmreasinn, PHS 25), Homogenizer (Master chef), Brookfield viscometer (DV2T, Thermostat hot water Bath (HH-6, Techmel and Techmel, USA), oven (scanfrost), milling machine (corona landers), refractometer (ABBE, Germany), conductometer (DDS-22c, Hanna instrument) and UV-vis spectrophotometer (jenway, England), Muffle furnace, Cathode lamp autoclave,incubator, photo colorimeter, centrifuge (PECMedicals, USA).

METHOD

Sample collection

The *H. madagascariensis* seed were sourced from bushes within the university of Port Harcourt environment while the *C. esculentus* seed was purchased from Ozuoba market. The seeds were washed and air dried before milling.

Extraction of oil

The soxhlet extraction method was employed using n-hexane as the solvent. A considerable amount of the milled seed cotyledon was packed in the thimble of soxhlet apparatus with a cotton wool at the top bottom of the thimble. The round bottom flask was filled with about 400 ml of the solvent and then packed to the end of the apparatus with a condenser tightly fixed at the bottom of the extractor. The whole set up was heated up in a heating mantle at temperature of 50°C. The n- hexane extract was concentrated using rotary evaporator. The dried extract yielded a brownish yellow viscous residue and the quality of oil extracted was determined gravimetrically.

The oil obtained was stored appropriately until needed for analysis and further studies

$$\text{Percentage Yield} = \frac{\text{Weight of extracted oil grams}}{\text{Weight of the powdered seed}} \times 100$$

Qualitative Phytochemical Screening

Flavonoids: 2ml of 10% sodium hydroxide was added to 2ml of the extract in a test tube. A yellow colour was formed which turned colourless upon addition of 2ml of dilute hydrochloric acid indicating a positive result.

Test for Phenols: 2ml of the extract was mixed with few drop of 10% ferric chloride solution. The formation of greenish blue or appearance of about 1mm layer of foam indicates a presence of phenol.

Phlobatannins: 2ml of extract was boiled with 1% aqueous hydrochloride. Deposition of a red precipitate indicates a positive result.

Alkaloids: To 2ml of the extract, 2ml of 10% HCl was added. To the acidic medium, 2ml of Meyer's reagent was added. The formation of an orange precipitate indicates presence of alkaloids.

Steroids: 2ml of the extract was dissolved in 10ml of chloroform and then, 10ml of concentrated sulphuric acid was added by the side of the test tube. Formation of a reddish upper layer and yellow sulphuric acid layer with green fluorescence indicates presence of steroids.

Terpenoids: 2ml of the extract was mixed with 2ml of chloroform and 1ml of concentrated sulphuric acid was carefully added to form a layer. Formation of a reddish brown interphase between two clear layers indicates a positive result.

Glycosides: To 2ml of acetic acid, 2ml of the extract was added. The mixture was cooled in cold water bath, and then 2ml of concentrated H_2SO_4 was added. Colour change from blue to bluish green indicates the presence of glycosides.

Anthraquinones: 2ml of the extract was boiled with 5ml of 10% HCl for 3 min. 5ml of chloroform was then added followed by further addition of 5 drops of 10% ammonia. A rose pink coloration indicates a positive result.

Physicochemical properties of the oils

Determination of fatty Acid (FFA Value)

25ml diethyl ether was mixed with alcohol and 1 ml phenolphthalein (1%) and carefully neutralized with 0.1 NaOH. Then about 5.0g of the oil was dissolved and made into a mixture with neutral solvent and titrated with aqueous 0.1 NaOH shaking constantly until pink color which persisted for 15 seconds was obtained.

$$\text{Acid value} = \frac{\text{Titre volume (ml)} \times 5.61}{\text{Weight of sample used}}$$

The FFA value is calculated as oleic acid (1 ml 0.1M sodium hydroxide = 0.0282g oleic acid), in which case the acid value – 2 x FFA

For most oils, acidity begins to be noticeable to the palate when the FFA calculated as oleic acid is about 0.5 -1.5%.

Determination of the iodine value.

10ml of carbon tetrachloride was added to the oil and dissolved in dry glass- stoppered bottle of about 250ml capacity, then about 20ml of prepared wiji's solution was added, the stopper (previously moisten with potassium iodine) was inserted and allowed to stand in the dark for 30 minutes.

Later 15ml of potassium iodide solution (10%) and 100 ml water was mixed with the preparation and titrated with 0.1M thiosulphate solution using starch as indicator just before the end – point (titration = a ml).

A blank titration was carried out at the same time commencing with 10ml of carbon tetrachloride (titration = b ml)

Iodine value = $\frac{(b-a) \times 1.269}{\text{Weight (g) of the sample}}$

if (b-a) is greater than b/2 the test must be repeated using a smaller amount of the sample. It should be noted also that the less unsaturated fats with low iodine values are solid at room temperature, or conversely, oils that are more highly unsaturated are liquid (showing that there is a relationship between melting point and iodine value).[10]

Determination of peroxide value

1.0 g of the sample was weighed into a clean dry boiling tube and 1 g powdered potassium iodide (KI) plus 20 ml of the solvent mixture (2ml glacial acetic acid and 1ml chloroform) was added. The mixture was boiled vigorously for 1minute using boiling water as the heating source. Then the boiled mixture was transferred quickly into a flask containing 20 ml of 5% KI and the tube was washed twice with 25 ml of distilled water into the flask. The content of the flask was titrated with 0.002 M sodium thiosulphate (Na2S2O3) solution using starch as indicator.[10] A blank was determined at the same time and condition. The peroxide value of the sample oil was calculated using equation

Peroxide = $\frac{2(a-b)}{w}$

Where; a = titre value for the sample, b = titre value for the blank and w = weight of sample.

Determination of Saponification Value: Here 2.0g of the oil extract was weighed into a conical flask and added with about 25ml of alcoholic potassium hydroxide and boiled, then added with little drops of phenolphthalein (1%) solution and titrated with 0.5M hydrochloric acid (titration value = a ml). Blank titration was also carried out at the same time (titration value = (b ml)

Saponification value = $\frac{(b-a) \times 28.05}{\text{Weight (g) of sample.}}$

Physicochemical test

Organoleptic properties: The physical characteristics (colors, odors, texture, appearance and rheology of the oils were observed and recorded.

pH: About 5ml of the sample was introduced into a beaker and the pH electrode inserted to detect the pH of the oil when stable and this was conducted in triplicates.

Viscosity Determination: The oil to be evaluated was poured into a 250ml beaker then a temperature probe attached to the spindle guard of the lower viscometer into the beaker until the spindle was fully immersed in the sample. The procedure was repeated at temperatures of $25^{O}C$, $40^{O}C$ and $60^{O}C$. The viscometer was turned on to obtain a stable torque and the result recorded in centipoise, revolutions per minute (rpm) and % torque on the viscosity data sheet.

Specific gravity: An empty specific gravity bottle was weighed with stopper then with 2.0g of the oil. 50ml of water transferred into it and weighed again with stopper. The specific gravity was calculated as.

Specific gravity (SG) = $\frac{\text{Weight of SG of bottle + oil – Weight of SG bottle with stopper}}{\text{Weight of SG of bottle + distilled water – Weight of SG bottle with stopper}}$

Refractive index: Using the refractometer, few drops of the oil to be tested was placed on the polished surface of the lower refracting prism and ensured that the liquid was evenly distributed. The lower adjustment knob was scanned until a light dark image was seen. The dispersion was adjusted using the upper smaller dispersion correction knob until a sharp light/dark boundary was seen. The boundary in the crosshairs of the telescope was centered using the lower large adjustment knob and the refractive index read from the screen scale below the boundary.[11]

Proximate analysis of the oil

Carbohydrate content was determined by the Cleg-Anthrone method, protein content determined by Kjeldahl method applying digestion, distillation and titration technique while the moisture content was verified adopting the air oven method then the ash value determined using the furnace method then the fibre content determined by difference.[12]

Elemental analysis of the oil

The sample was ashed in a muffle furnace at a temperature of $630^{O}C$ for 3 hours. The ashed sample was dissolved in 10 ml concentrated HCl and heated on an electro thermal heater hot plate. The solution of the ash was diluted to 50ml with distilled water and analyzed for metal ion by atomic absorption spectrophotometer at various wavelengths as: magnesium 285.2nm, calcium 422.7nm, potassium 766.00nm, Zinc 213.8nm. Most of the concentration of the elements were extrapolated and recorded in mg/l or ppm.[13]

Antimicrobial property of the oil

Susceptibility Testing: This was carried out by dissolving 100mg of the sample in 9ml of absolute alcohol giving a stock solution of 100mg/ml. About 4ml of distilled water was transferred into five different test tubes. A four- fold serial dilution was carried out by diluting the stock in test tubes containing the distilled water giving concentrations of 50mg/ml, 25mg/ml and 6.25mg/ml. A sterile cotton wool swab was soaked into standardized test micro-organism and used to swab aseptically on the surface of the standardized agar in the petri dish. Sterile cork borer

was used to make agar wells on the media and 2 drops of the oils were introduced into the wells. The plates were allowed to stand for 45 minutes for pre diffusion of the oils to occur and incubated at 37°C for 24 hours and the inhibition zone diameter measured in millimeters (mm).[14]

RESULTS

Percentage yield of oils: Tigernut (*C. esculentus*) = 31.72% and *H. madagascariensis* = 18.91%.

Table 1: Physical characterization of the oils.

Characteristics	*H. madagascariensis* oil	*C. esculentus* oil
Color	Dark brown	Golden brown
odor	Chocolatey	nutty
pH	5.4	5.6
State at room temperature (29.38^{O}C	Semi solid	liquid
Viscosity (Cp)	36.00 at 35.5^{O}C	34.00 at 29.4^{O}C
Density (g/ml)	0.899	0.886
Specific gravity (g/ml)	0.90±0.002	0.92±0.005
Refractive index	1.473	1.452

Table 2: Physico chemical characteristics of the oils.

Parameters	*H. madagascariensis*	*C. esculentus*
Saponification value (mgKOH g^{-1})	190.74	143.10
Iodine value mg 100 g^{-1}	83.05	80.37
Peroxide value (Meq kg^{-1}	15.2	13.2
Acid value (mgKOH g^{-1})	1.663	1.309
Free fatty Acid (mg g^{-1})	70.11±1.23%	65.78±3.52%

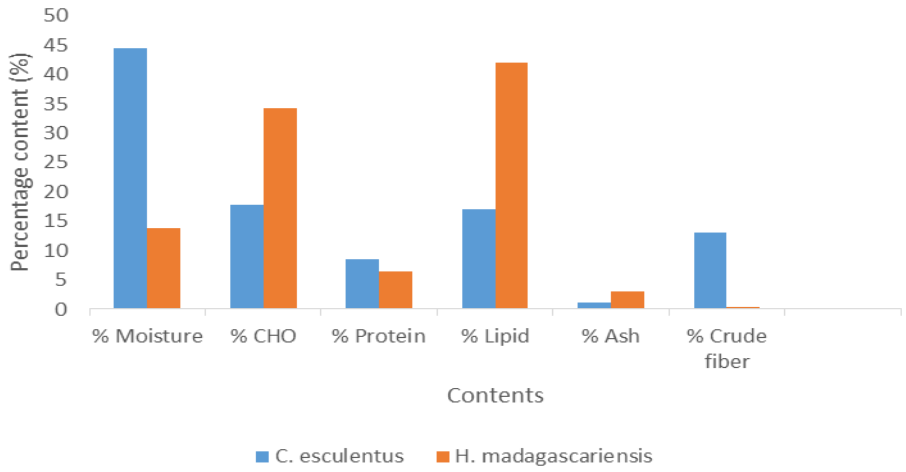

Figure 3: Proximate analysis of C. esculentus and H.madagascariensis seed oil.

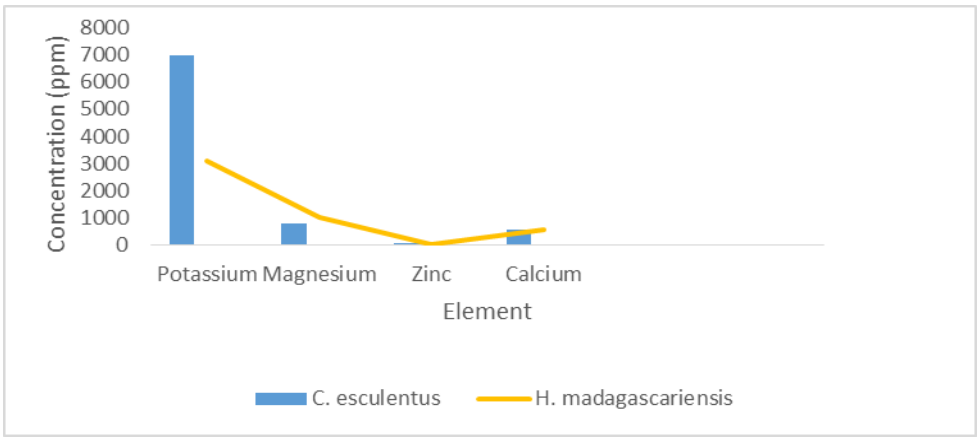

Figure 4: Elemental composition of *C. esculentus* and *H. madagascariensis* oil.

Table 3: Antimicrobial susceptibility.

Extracts	Organism/Zone of inhibition (mm)				
	E. coli	***P. eeruginosa***	***S. aureus***	***K. pneumonia***	***C.albican***
C.esculentus	14	20	22	18	20
H. madagascariensis	13	19	20	13	17
Gentamicin	31	23	25	19	35

Table 4: Phytochemical screening of *C. esculentus and H.madagascariensis* seed oils.

Constituent	C.esculentus oil	H.madagascariensis
Steroids	+++	+
Alkaloids	+++	+
Saponins	++	+
Flavonoids	ND	+
Glycosides	+	+
Phenols	ND	++
Anthraquinones	ND	++
Terpenoids	ND	+
Phlobatans	ND	+
Anthronoids	-	++

+++ = Highly present; ++ = moderately present; + = slightly present; ND = Not detected

DISCUSSION

The percentage oil yield obtained for C.esculentus fruit was 23.94% while from H.madagascariensis was 18.97%.

Phytochemical screening: Phytochemical screening of the extracts using standard methods showed the presence of saponins, terpenoids, alkaloids, flavonoids, reducing sugars, resins, cardiac glycosides and phenols. This therefore signifies that the plant seeds could be suitable for oil production.

The differences in the phytochemical composition can be seen in the result obtained (Table 4), which shows presence of steroid, and alkaloid content in the *C.esculentus* oil but absence of the contents in the *H. madagascariensis* oil. Also the saponin content in the *C.esculentus* oil was higher than that of the *H. madagascariensis* oil. Equal amount was noticed for glycosides in both oils, but phenols, anthraquinones, terpenoids, phlobatannins, tannins and flavonoids were not detected in *C.esculentus* oil but were found present in *H. madagascareiensis* oil though at low amount.

With this screening result, the economic value of *C.esculentus* for example is assumed to be dependent on its oil content and therefore it could also be considered to be useful for bio-diesel.

Organoleptic properties: Colors of the *C.esculentus* and *H. madagascariensis* oil are dark brown and golden brown respectively and these are acceptable, as color is an important consideration in food substances, because the color appearance is generally the first impressions consumers have about a specific product.

Physicochemical properties: The low acid values obtained for *C. esculentus* oil (Table 2) is an indication that the triglycerides present in it have not been hydrolyzed, an indication that the oil is less susceptible to lipase action.

Acid value is a measure of the free fatty acid in oil and it can also be used as an indicator for the age of the oil. Based on the acid values obtained, the oil from *C.esculentus* (acid value; 1.309±0.03) may be more suitable for consumption than that of the *H.madagacariensis* (acid value; 1.669±0.05) due to its lower value.

The iodine values of 80.37±0.05 and 83.05.17±0.08 gl/100g were obtained for the *C. esculentus* and *H. madagascariensis* oil respectively. Iodine value measures the degree of unsaturation in oil sample. The high iodine value obtained in both oils indicates high amount of unsaturated fatty acids in them. The higher the iodine value, the greater the degree of unsaturation and the greater the susceptibility of the oil to oxidative rancidity. The respective iodine values obtained from the oils also implicates a fairly high amount of unsaturated fatty acids, an indication that the oils could be suitable for consumption and appearing as non-drying oils, a quality necessary in the manufacture of soap.[15]

Due to this higher iodine value the *H. madagascariensis* could be more useful in the production of soap than that from the *C. esculentus* oil.

The peroxide values (Table 2) for *H. madagascariensis* and *C.esculentus* oils are moderate (15.20±0.5 and 13.2±0.29) respectively. These are within the values of 0 – 20 range given for most freshly prepared oil. Peroxides are the primary reaction products formed in the initial stages of oxidation of oil and therefore give an indication of the process of lipid peroxidation which depends on the reaction between unsaturated fatty acids and oxygen. The

implication of this is that inherent peroxidation in the oils are low, hence they may be able to withstand long time storage, without undergoing oxidative peroxidation and this could be comparable to the commonly consumed oils which have been shown to have higher peroxide values, example coconut and groundnut oils (10.0 and 18.2 meq/kg) respectively. Thus, the higher the peroxide value of an oil, the lower its storage quality and vice versa.[16]

Free fatty acid (oleic acid) determines the suitability of the oil for consumption or industrial uses. The free fatty acid values obtained are 70.11±1.23% and 65.78±3.52% respectively, for the *H. madagascareiensis* and *the C.esculentus* oil. Evidence from epidemiological studies suggested that the presence of a high proportion of monounsaturated acids especially oleic acid in the diet is linked to a high reduction in the risk of coronary heart disease. Meanwhile Oleic acid has been reported to be useful for building cellular membranes, attracting oxygen to tissues to transform energy into nerve impulses, and as precursors to molecules of cellular communication, such as prostaglandins or eicosanoids. Linoleic and linolenic acids are two essential fatty acids (EFA) that cannot be produced in the body but are important for growth. Absence of these essential fatty acids could lead to scaly skin, necrosis and stunted growth This indicates that *C. esculentus* oil is a good source of edible oil for cooking and frying that may be useful for the fight against cardiovascular diseases. Thus, on the basis of free fatty acid content, *C.esculentus* oil (FFA; 65.78±3.52) could be more suitable as a raw material than the *H. madagascareiensis* oil (FFA; 70.11±1.23%) due to its low free fatty acid value.

Saponification value is an indication of the molecular weights of triglycerides in oil and the fairly high proportion of triglycerides in the both oils suggests that the oils will be a good raw material for soap making industries. As reported[17], oil with higher saponification values contains high proportion of lower fatty acids. Therefore, the values obtained for *H. madagascareiensis* and *C.ecsulentus* oil in this study show that they contains high amounts of long chain fatty acids. Thus, this indicates that both oils could be used for soap production since their saponification values are high. Though the *H. madagascareiensis* oil would be more suitable in soap production due to its slightly higher saponification value than the *C.esculentus* oil. Generally, vegetable oils with high saponification values are important in the manufacture of detergents hence for the *H.madagascariensis*, saturated fatty acids derivatives like the stearates often termed as docosanoates and commonly referred to as behenates were present and have been reported to have hyper cholesterolemic effects therefore oils from the plant may not be suitable for internal use but could be useful externally as surfactants, lubricants and in cosmetology.

Physical properties: The trend in the Physical properties with regard to pH are 5.4 and 5.6 while the viscosities are 36.00 and 34.00 cp for *H. madagascariensis* and *C. esculentum* respectively at atmospheric temperature depicting the oil extracts as mildly acidic and less plastic considering the rheological activity although the plasticity of that from *H.madagascariensis* is more than that observed with the *C. esculentum* oil indicating the later as less viscous.

The Refractive index of oils are 1.473 and 1.452, specific gravity 0.90 and 0.92 g/ml) respectively for *H. madagascariensis* and *C. esculentum* showing that the former is more viscous than the later and this is supported by the result of the state at room temperature where the oil from the seeds of *H. madagascariensis* appeared semi solid and that from *C. esculentus* was liquid at same condition an indication of the characteristic properties of vegetable oils with the *C. esculentus* oil expressing the obvious characteristics.[18]

CONCLUSION

With the adoption of the soxhlet extraction technique using an organic solvent (n Hexane), reasonable yield of oil from the seeds of *C. esculentus* and *H. madagascariensis* plants were obtained and the oils were found to be stable under good storage condition and rich in various analytical determinations involving, proximate, elemental and phytochemical principles.

Test of the oil extracts with some strains of micro-organism showed appreciable zones of inhibition hence the oils could be useful as an antimicrobial agent and coupled with the slightly acidic pH as observed in both oils and the high saponification value obtained especially with the extract from *H.madagascariensis*, the oil extracts could be implicated as possible excipients in pharmaceutical topical formulations.

REFERENCES

1. David J. Newman***** and Gordon M. Cragg, 2020: Natural Products as Sources of New Drugs over the Nearly Four Decades. *J. Nat. Prod*, 83(3): 770–803. https://doi.org/10.1021/acs.jnatprod.9b01285.
2. Atanas G. Atanasov, Sergey B. Zotchev, Verena M. Dirsch, the International Natural Product Sciences Taskforce & Claudiu T. Supuran, 2021: Natural products in drug discovery: advances and opportunities. *Nature Reviews Drug Discovery*, 20: 200–216.
3. Cinzia Cimino,[1] Oriana Maria Maurel,[2] Teresa Musumeci,[1] Angela Bonaccorso,[1] Filippo Drago,[2] Eliana Maria Barbosa Souto,[3,4] Rosario Pignatello,[1] and Claudia Carbone[1,*] Aurica P. Chiriac and Alina Gabriela Rusu, 2021: Essential Oils: Pharmaceutical Applications and Encapsulation Strategies into Lipid-Based Delivery Systems. *Pharmaceutics*, 13(3): 327. doi: 10.3390/ pharmaceutics13030327.

4. BLK Thokozani, D Zulu, CW Sileshi, Z Teklehaimanot, DSB Gondwe, V Sarasan, P Stevenson, 2011: Seed germination and *in vitro* regeneration of the African medicinal and pesticidal plant, *Bobgunnia*. *Madagascariensis*. *African journal of Biotechnology*, 2011; 10(32): ISSN: 1684-5315.
5. Rachel Nimenibo-Uadia and Kanayo Nwachukwu, 2017: biochemical evaluation of *Harungana madagascariensis* lam aqueous leaf extract in diabetic rats. *International Research Journal of Natural Sciences*, 5(2): 1-11. ISSN 2053-4108(Print), ISSN 2053-4116(Online).
6. De Cauwer, B.; De Ryck, S.; Claerhout, S.; Biesemans, N.; Reheul, D, 2017: Differences in growth and herbicide sensitivity among Cyperus esculentus clones found in Belgian maize fields. *Weed Res*, 57: 234–246.
7. Thomas Oladeji Fabunmi, Sunday Ojo Adigbo, Joy N Odedina, Yanmife Iyanu Akinsanya, 2016: Effects of tuber size, soaking hours and sprouting media on sprouting of tiger nut (Cyperus esculentus L. var. sativa) tubers. *Acta agriculturae Slovenica*, 107(2): DOI: 10.14720/aas.2016.107.2.08.
8. Z P Hoffmann[1], K Buzsáki, I Béres, 2006: Spreading and germination of yellow nutsedge (Cyperus esculentus L.) in Hungary. *Commun Agric Appl. Biol Sci*, 71(3 Pt A): 797-801.
9. Moench] Nitish Kumar, Mukesh Kumar*, Arun Kumar, Prabhash Kumar Singh and Vijay Kumar Singh, 2021: Effect of Harvesting Stage and Drying Method on Seed Quality of Okra [Abelmoschus esculentus(L). *Int. J. Curr. Microbiol. App. Sci*, 10(02): 653-661.
10. Putri, A.R., *Rohman, A., Setyaningsih, W. and 1Riyanto, S. 2020: Determination of acid, peroxide, and saponification value in patin fish oil by FTIR spectroscopy combined with chemometrics. *Food Research*, 4(5): 1758–1766. http://www.myfoodresearch.com.
11. Dobromir I Yordanov, Aleksandar N Dimitrov, Zlatotsvet B Tsonev and Petko St Petkov, 2010: Flash point correlation with specific gravity, refractive index, andviscosity of base oil fractions; *Asian Chemistry Letters*, 2010; 14(2): 171-176. https://www.researchgate.net/publication/275338440 .
12. Chinyere Ilodibia, Uchenna Samuel Ugwu, Clement Uwabunkeonye Okeke, Bibian Aziagba, 2014: Determination of Proximate Composition of Various Parts of Two Dracaena Specie. *International Journal of Botany*, 10(1): 37-41 DOI: 10.3923/ijb.2014.37.41.
13. UB Akpabio, JA Ukpong, OU Eka, 2008: Determination of the chemical composition, the physicochemical properties of the oil extract and the amino acid profiles of the seeds of *Telfairia occidentalis* (fluted pumpkin). *Global Journal of Pure and Applied Sciences, 2008; 14(3): 295*-300. eISSN: 1118-0579 DOI: 10.4314/gjpas.v14i3.16811.
14. MounyrBalouiri, Moulay Sadiki Saad and Koraichi Ibnsouda, 2016: Methods for *in vitro* evaluating antimicrobial activity: A review. *Journal of Pharmaceutical analysis*; 6(2): 71-79. https://doi.org/10.1016/j.jpha.2015.11.005
15. William Odoom* and Vida Opoku Edusei. 2015: Evaluation of Saponification value, Iodine value and Insoluble impurities in Coconut Oils from Jomoro District in the Western Region of Ghana. Asian Journal of Agriculture and Food Sciences; Volume 03 – Issue 05: (ISSN: 2321 – 1571) Asian Online Journals (www.ajouronline.com).
16. Gichau AW, Okoth JK, Makokha A, Wanjala GW. 2019: Use of Peroxide Value and Moisture Content as a Measure of Quality for Amaranth-Sorghum Grains Based Complementary Food. Nutr Food Technol Open Access, 5(2): pages 1-5. dx.doi.org/10.16966/2470-6086.162.
17. S. A. Zauro1, M. T. Abdullahi1, A. Aliyu, A. Muhammad, I. Abubakar and Y. M. Sani. 2016: Production and Analysis of Soap using Locally Available Raw-Materials. Elixir Appl. Chem, 96: 41479-41483.
18. Anwesa Sarkar, J. P. Pandey, Anupama Singh, Lakshmi Tiwari and Anil Kumar. 2015: A novel method of using refractive index as a tool for finding the quality of aqueous enzymatic extracted algae oil. Advances in Applied Science Research, 6(4): 50-60.