DETERMINATION OF THE FATTY ACIDS PROFILE IN MECHANICALLY EXTRACTED MELON SEED OIL

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NOVEMBER, 2022.

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A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILMENT FOR THE REQUIREMENTS FOR THE AWARD OF BACHELORS OF SCIENCE DEGREE (B.Sc.) IN SCIENCE LABORATORY TECHNOLOGY (BIOCHEMISTRY TECHNIQUES)

NOVEMBER, 2022.

CERTIFICATION

This is to certify that the Project work titled 'DETERMINATION OF THE FATTY ACIDS PROFILE IN MECHANICALLY EXTRACTED MELON SEED OIL' was presented by Frank Osamede EDIKU with matriculation number LSC1605933 of the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, Benin City.

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DEDICATION

I dedicate this Project to Jehovah God, the God of true wisdom and strength. He has been my guide from the beginning of this Project to the end.

ACKNOWLEDGMENT

My greatest acknowledgment goes to Jehovah, the sustainer of life and the giver of every good gifts for His undeserved kindness and love.

My thanks also goes to my parents and siblings who supported and encouraged me in every way they could. They supported me financially, spiritually and morally and physically. I also appreciate the efforts of my Project supervisor, **MRS. P.O OMOZUWA** for the corrections made while compiling this Project report.

TABLE OF CONTENTS

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ABSTRACT

Melon is a popular soup or stew condiment in Nigeria. Melon soup is usually prepared with or without vegetables. Seeds obtained from melon (*Citrullus vulgaris*) were analysed for their proximate composition. The seeds contained high percentage of unsaturated fatty acids, which totalled to 159.57%. Gas chromatographic analysis of the oil revealed the presence of 8 fatty acids varying from C-16 to C-32 with the of C-18, C-20, C-21, C-22, C-23, C-24, C-26, C-27, C-and C-31. The concentrations of individual fatty acids varied from trace (less than 0.06%) quantities to about 52.74%. Linoleic, oleic, Iso-Oleic, palmitic, and stearic acids were the principal fatty acids contributing to 132.76, 1.36, 8.85, 10.06 and 14.52%, respectively, of the total fatty acids which had a relatively high percentage (159.57%) of unsaturated fatty acids. The P/S index of the mechanically extracted seed oil was found to be 2.30, 3.37, 12.15 respectively. The P/S value greater than 1 indicate that the melon seed oil has good nutritional value; hence *Citrullus vulgaris* is edible for consumption. Mechanically extracted melon seed oil have potential role in lowering the risk of cardiovascular disease, blood cholesterol and LDL cholesterol concentrations, synthesis of steroid hormones, it can also be use as anti-inflammatory agent and antiallergic agent.

CHAPTER ONE

1. INTRODUCTION

Melon popularly called egusi‟ belongs to the family Cucurbitaceae, and its botanical names are Citrulus Lantus, Citrulusco locythis, Citrulus vulgaries and Citrulus edulus. Melon originated from Africa and Asia. It is a creeping annual herb, with hairy stems, forked tendrils and three-lobed hairy leaves. Melon‟s flesh is pale yellow or green, and also tastes bitter unlike the common watermelon, whose flesh is sweet and red. It is widely cultivated in the Caribbean and Indonesia (Ojie *et al.,* 2008). Diversification to other parts of the world has been reported to occur from the Kalahari and Sahara deserts in Africa. Melon is popular in Nigeria because of its edible seeds commonly used in the preparation of local soups or stew prepared with or without vegetables (Oloko *et al.,* 2006; Ogbonna, 2007; Jackson *et al.,* 2013). In Nigeria, melon was cultivated over an area of 361,000 ha with a production figure of 347,000 (Solomon *et al.,* 2010). Melon is called „Egusi‟ by the Yoruba‟s, „Agusi‟ by the Hausas and „Ogil‟ by the Igbo people of Nigeria. Melon is usually grown in mixture with other crops such as cassava, yam and maize where they act as land cover and reduce the growth of weeds in farms (Leona, 2006; Oluwole *et al.,* 2012; Jackson *et al.,* 2013).

Melon is rich in oil and protein, comprising about 50% oil and 35% protein, among major foods only peanut has such high oil content (Ojieh *et al.,* 2008). In northern Ghana it was reported that melon seeds oil ranked second in importance to sheanut as a major cooking oil. (Chike *et al.,* 2011). reported that its fatty-acid make up is 63 percent linoleic and 16 percent oleic. This indicated that it is a highly polyunsaturated lipid. The seed is also reported to contain important amounts of vitamins, especially thiamin and niacin, and is an important source of Vitamin E. It is

high in minerals and the crop thrives where milk is largely unavailable. It is a high-energy, high-protein concentrate which might be ideal to complement Africa‟s prevalent diets based on starch-rich grains (sorghum and maize, for instance) and roots (notably cassava). It can provide the calories and amino acids that stressed, sick, and fast-growing bodies need each day. Melon can also be a vital tool against marasmus, kwashiorkor and other debilitations (Vossen *et al.,* 2004; Leona, 2006). The ground seed is used to prepare various delicacies including cake and soup. Melon seed oil is in high demand in Sudan and Ethiopia (Oluwole *et al.,* 2012). Global production of melon seed is about 586.605 metric tons; while Africa production is about 548.600 metric tons and Nigeria produces about 346.000 metric tons amounting to 56% of the global volume of melon seeds (Solomon *et al.,* 2010). The seed was occasionally exported to Europe for processing into vegetable oil and defatted meal. The solid remaining after the oil has been squeezed out contains 60 per cent protein. This defatted solid can be ground into flour with myriads of dietary uses such as meat substitute (Leona, 2006).

1.1 Significance of the Study

Melon seeds are full of health benefits. The melon seeds are an excellent source of proteins, vitamins (folate, thiamine and niacin, vitamin B6 and pantothenic acid), minerals (magnesium, copper, zinc, iron, potassium, phosphorus, and manganese) fatty acids. The vegetable oil extracted from the seeds is expensive and nutritious; this oil is used for cooking and cosmetics purposes and of interest to pharmaceutical industries (Ayodele and Shittu, 2013).

1.2 Aim and Objective of study

1.2.1 Aim: To determine the fatty acids in mechanically extracted melon seed oil.

1.2.2 Objective:

1. To Produce mechanically extracted melon seed oil.
2. To determine the fatty acids in the oil.

CHAPTER TWO

2. LITERATURE REVIEW

Melon seeds (*Citrullus vulgaris*) are very popular as a condiment in Nigerian local soup. They contain 50% by weight of oil, 28.4% protein (60% in defatted flour), 2-7% fiber, 3-6% ash and 8.2% carbohydrate. 1 As such, they are a valuable source of oil and protein. Traditionally, oil has been expressed from the seeds for edible purposes while the residual cake has been consumed as a snack. The presence of fairly high amounts of the unsaturated fatty acid, linoleic acid, in the oil makes it nutritionally desirable and may suggest a possible hypocholesterolemia effect 1 (i.e., lowering of blood cholesterol). The oil could also be used in the manufacture of margarines, shortenings and cooking oils. The high protein content makes the residual cake a useful source of protein for humans and livestock. Melon Seeds are potential source of edible oil. Oil yield of *Citrullus colocynthis* is slightly higher than that of safflower, cotton, soybean and sunflower (Swern, 1979). Seeds yield considerable amount of oils. Oil yield was 26.6g/100g from whole seeds; its colour was dark yellow, very mild odor and bitter in taste (Sawaya *et al.,* 1983). Seed kernel yielded more than 55% of oil, 56.5h/100g seed kernel (Sadou *et al.,* 2007). In India seeds yielded more than 36% oil (Singh and Yadava, 1978). Melon seed is in high demand in tropical markets, especially in the semi-urban and urban markets. Melon seed is one of the six crops that were reported to be promising in Nigeria with greater than 128% increase in production in 2011 when compared with the year 2000 yield. The land putinto melon seed production in Nigeria by 2011 was about 470,000 hectares (Akinyoade *et al.,* 2013). (Akinyoade *et al.,* 2013) reported that from Food and Agriculture Organization statistics (FAO STAT) the most successful crops in

Nigeria were maize, cassava, rice, melon seed, potatoes and pineapples, out of which melon seed is tagged as the most recently successful crop in Nigeria (Akinyoade *et al.,* 2013).

Citrullus colocynthis

Plate. 1: The Seeds Of ***Citrullus colocynthis.*** SOURCE: (smita, 2021)

Table 1. Classification of *Citrullus Colocynthis* SOURCE: (smita, 2021)

Kingdom	Plantae	Plants
Sub-kingdom	Viridiplanae	Green Plants
Infra-Kingdom	Streptophyta	Land Plants
Super-Division	Embryophyta	Develop from Embryo
Division	Tracheophyta	Vascular Plants
Sub-Division	Spermatophytina	Seed Plants
Class	Magnolipsida	
Super-Order	Rosanae	
Order	Cucurbitales	
Family	Cucurbitaceae	
Genus	Citrullus (Schrad. Ex Eckl. & Zeyh.)	
Species	Colocynthis (L.) Schrad	

2.1 CULTIVATION

Citrullus colocynthis belongs to family Cucurbitaceae. It is a wild herb which is perennial and propagates through vegetative as well as generative means. It grows in sandy soils. Its growing season is summer season especially from April to October.

2.2 Phytochemical Constituents

Numerous studies have been conducted for phytochemical analysis of Citrullus colocynthis. Alkaloids, Flavonoids, Terpenoids, Fatty acids, Essential oils and Glycosides are reported in aqueous extracts of fruit (Wasylikowa and Veen, 2004). Phytochemical studies showed carbohydrates, tannins, proteins and separate amino acids, phenolic compounds, steroids, alkaloids, terpenoids, glycosides and cucurbitacins A, B, C, D, E, J, L are present in plant extracts (Jayaraman and Christina, 2013; Talole *et al.*, 2013).

2.3 MELON SEED AND OIL

Citrullus colocynthis, a member of the Cucurbitaceae family, grows as a wild perennial in desert regions of the world including Saudi Arabia (Khan and Gul, 1975; Sawaya *et al.,* 1983). The fruit of this plant, called gourd, contains 200-300 seeds/gourd. The seeds have been investigated as a possible source of edible oil. Khan and Gul, (1975) reported 13-19% oil in seeds collected from Pakistan, while Singh and Yadava (1978) reported 3&36% oil in seeds obtained from India. Sawaya *et al.,* (1983) showed, from feeding experiment with 1-day-old chicks, that the oil extracted from C. colocynthis seeds was potentially suitable for human and for animal consumption. Apart from their potential as a source of oil, cucurbit seeds, in general, are reported to contain approximately 35% protein by weight of decorticated seeds that have a nutritionally adequate amino acid profile (Jacks *et al.,* 1972). Since large-scale isolation of purified oilseed protein is readily accomplished by current technology (Hensarling *et al.,* 1973), a study of the

nutritional properties of C. colocynthis seed proteins was desirable particularly when reports in the literature are scarce on the protein quality of these seeds.

Seeds of both species are also used to make cooking oils. The use of Egusi and were as cooking oils could prove to be an important economic asset for Ghanaians. Increased production could generate revenue and decrease the need for imported oils, contributing to the independence and prosperity of regional food systems. The traditional oils may also serve as a valuable export, as international demand for new vegetable oil sources has increased (Gohari *et al.,* 2011). The oil sources may be attractive to consumers, as prior studies have described cucurbit-derived oils as having "favorable nutritional status," due to their high levels of unsaturated fats (Sew et al. 2010). Before exploring the potential economic development of the traditional oils, it is important to first study their physical and chemical properties. This information can provide preliminary insight on the oils' fat qualities, resistance to rancidity, and prospective industrial characteristics. Seeds are potential source of edible oil. Oil yield of Citrullus colocynthis is slightly higher than that of safflower, cotton, soybean and sunflower (Swern, 1979). Seeds yield considerable amount of oils. Oil yield was 26.6g/100g from whole seeds; its colour was dark yellow, very mild odor and bitter in taste (Sawaya *et al.*, 1983). Seed kernel yielded more than 55% of oil, 56.5h/100g seed kernel (Sadou *et al.,* 2007). In India seeds yielded more than 36% oil (Singh AK and Yadava KS, 1978).

2.3.1 Nutritional Value of *Citrullus colocynthis*

Palmitic and Stearic acids are the main principle fatty acids found with concentrations ranging from 8.1-17.3% and 6.1-10.5% respectively. High content of essential monounsaturated fat linoleic acid i.e., 50.6–60.1 % in the oil of seed, acts as principle component for the restorative activities. Fat profile of unsaturated fatty acids exposes that the class of linoleicoleic acid bear a close resemblance to few other vegetable oils. So, it is most likely going to have potential uses of

cooking like some other cucurbit seed oils. Seeds contain 13.19 g of protein, 18.59 g of fat, 4.91 g of moisture and 2 mg of ash per 100 g. Mineral present in the seeds contain 569 mg of Ca, 465 mg of K, 210 mg of Mg, 30.0 mg of P, 11.9 mg of Na, 11.6 mg of Fe, 5.1 mg of Cu and 1.1 mg of Zn. (Benariba *et al.*, 2013).

2.3.2 Melon Seed Fat:

Egusi melon oil contains essential fatty acids, with linoleic acid, palmitic acid, stearic acid and oleic acid being the highest as seen in table 1.0 below. Linoleic acid is the most abundant fatty acid in egusi seed; approximately 59% linoleic acid, 16-17.1% w/w oleic acid, palmitic acid 12.4% w/w and stearic acid 8.1% w/w (Akobundu, 1989) and relatively small amounts of linolenic acid (LA) (Bankole *et al.*, 2005). Roasting melon seed at 133.1°C for 20.2 min was reported to produce an optimum yield of high-quality oil from melon seed (Ntui *et al.*, 2009).

Table 2: Fatty acids composition of Egusi oil. Source: Jarret and Levy (2012)

Fatty Acid	% Composition
Lauric acid	0.21
Myristic acid	0.78
Palmitic acid	13.45
Stearic acid	13.71
Oleic acid	14.50
Linoleic acid	56.94
Linolenic acid	0.46
Saturated fatty acid	28.10
Monounsaturated fatty acid	14.50
Polyunsaturated fatty	57.40
Unsaturated fatty acid	71.90

A significant reduction in total cholesterol, as well as reduction in atherosclerosis, was reported in experimental rats fed with egusi oil suggesting that egusi melon can reduce the blood pressure (Ziyada *et al.,* 2008).

Egusi melon has the possibility of preventing heart diseases and help with weight loss by burning adipose tissues in the body also known as brown fat due to the presence of linoleic acid. Linoleic acid is a polyunsaturated omega-6 fatty acid. It is a colourless liquid at room temperature. In physiological literature, it has a carboxylic acid with an 18-carbon chain and two cis double bonds; with the first double bond located at the sixth carbon from the methyl end (Kelly, 2001). Linoleic acid belongs to one of the two families of essential fatty acids, which means that the human body cannot synthesise it but can be found in food components (Kelly, 2001). A recent study by Harvard School of Public Health claims that conjugated linoleic acid (CLA) help reduces internal body fat (Khanal and Dhiman, 2004).

Conjugated linoleic acid raises the body metabolism, allowing the body burn visceral fat. In overweight people adipose tissue is inactive when food high in CLA is consumed, their fatty tissue is made active, and weight loss will be achieved (Kamphuis *et al.,* 2003). Conjugated linoleic acid can also help to suppress appetite if it is incorporated into a weight loss diet (Dhiman *et al.,* 2000). Furthermore, CLA has external benefit for the body. It produces prostaglandin which functions as anti-inflammatory and diuretic, helping the skin to maintain tone and moisturised after weight loss (Bassaganya-Riera et al., 2004). When the fat in the belly and around the heart is removed, coronary heart disease is prevented (Kamphuis *et al.,* 2003). Egusi seed is high in polyunsaturated fatty acid 71.9 g/100 mg, making egusi a nutraceutical food option (Akobundu, 1989).

2.3.3 Essential fatty acids: omega-3 fats

They are an integral part of cell membranes throughout the body and affect the function of the cell receptors in these membranes. They provide the starting point for making hormones that regulate blood clotting, contraction and relaxation of artery walls, and inflammation.

They are essential because your body cannot produce them on its own so they must come from your diet. The two primary EFAs are known as linoleic acid (omega-6) and alpha-linolenic acid (omega-3).

These EFAs are necessary for the following processes:

- Formation of healthy cell membranes
- Proper development and functioning of the brain and nervous system
- Proper thyroid and adrenal activity
- Hormone production
- Regulation of blood pressure, liver function, immune and inflammatory responses
- Regulation of blood clotting: Omega-6 FAs encourage blood clot formation, whereas Omega-3 oil reduces clotting. The ideal is to achieve a balance between omega-6 and omega-3 FAs
- Crucial for the transport and breakdown of cholesterol
- Support healthy skin and hair

Sources of Omega 3's include flax seeds, pumpkin seeds, soybean and its products such as tofu and tempeh. Walnuts, and dark green veggies, such as kale, collards, chard, parsley, and cereal grasses (wheat & barley grasses), are also good sources. This is because all green (chlorophyll-rich) foods contain Omega-3 FA in their chloroplasts.

Sources of Omega-6 fatty acids include nuts, seeds, grains, legumes, and dairy.

Table 3: Fatty acids content of different oil category:

Oil class*	Citron seed oil	Orange seed oil	Mandarin seed oil	Mixed seed Oil
Hydrocarbons	**Tr.****	**Tr.**	**Tr.**	**Tr.**
Triglycerides	**66.8**	**65.4**	**68.4**	**68**
Free fatty acids	**14.5**	**13.4**	**11.7**	**12.8**
Sterols	**2.18**	**3.52**	**3.27**	**3.14**
Diglycerides	**12.1**	**12.0**	**10.5**	**11.3**
Monoglycerides	**2.49**	**1.97**	**2.97**	**2.51**
Alcohols	**Tr.**	**Tr.**	**Tr.**	**Tr.**
Phosphlipids	**1.96**	**3.66**	**2.64**	**2.23**

* Average of three determinations.

** TR. = Traces

2.4 Oil Seed extraction

The vast majority of plants, especially the agricultural stock, contain extractable oil that may be of some commercial value. Since the beginning of human civilization, rural communities from around the globe have used various traditional methods to extract mainly edible oil from materials of plant origin. Many edible vegetable oils such as palm, corn, soybean, peanut, coconut etc. (CODEX-STAN 210-1999) are used as table oils because of their high nutritive value. For instance, fats and oils are the most concentrated form of energy, providing approximately 9 kcal of energy per gram compared to only 4 kcal per gram for proteins and carbohydrates (Ali *et al.*, 2005). This is in addition to their industrial application as raw materials for the synthesis of polyols, polymers, resins, biodiesel, pharmaceuticals etc. Oil is extracted by three general methods: rendering, used with animal products and oleaginous fruits; mechanical pressing, for oil-bearing seeds and nuts; and extracting with volatile solvents, employed in large-scale operations for a more complete extraction than is possible with pressing.

The local method of oil extraction from melon seeds consists of manually shelling the dried seeds, cleaning, cooking and then grinding with pebble or mortar. The oil is extracted by squeezing the ground samples by hand or on a hard-smooth wooden platform inclined gently to the horizontal. This method is slow, inefficient and labour intensive. Recent needs have, however, motivated the production of melon oil on a larger scale with the use of screw and hydraulic presses. This requires the systematic investigation of processes by which good quality oil can be effectively and efficiently extracted from the seeds. The use of an hydraulic press for expression of oil from oilseeds is appropriate for small and medium scale farmers in developing countries because of its lower initial and operating costs compared with the use of screw presses and a solvent extraction process. The small and medium scale farmers form the majority of food producers in these

countries. Efficient expression of oil from oilseeds using the hydraulic press requires size reduction of the oilseeds, followed by heat treatment and application of pressure.

amount of oil expressed is dependent on particle size, moisture content of the seed, heating temperature, heating time, applied pressure and pressing time. Agarwal explained that the inability to extract oil from whole and half soybeans clearly indicated that cell walls must be broken by flaking operations to allow the oil to be removed from the otherwise impervious cells. Singh et al. (Singh *et al.*, 1984) concluded that the moisture content of sunflower seed was the most significant factor affecting the expression of oil from the seed. A moisture content of 6% (wet basis) was found to be optimum for expression of oil from peanut and sunflower seed. (Singh *et al.*, 1984; Bongirwar *et al.*, 1977) Heating of oilseeds increased oil yield due to breakdown of oil cells, coagulation of protein, adjustment of moisture content of the meal to the optimal value for pressing and decrease in oil viscosity which allowed the oil to flow more readily. (Ward, 1976) Temperature and duration of heating have been shown to have significant effects on the yield of oil expressed from oil bearing materials, a-la Sivakumaran et al. a concluded that temperature and period of preheating and moisture content were interactive factors that influenced the yield of oil expressed from peanuts when the pressure of expression was kept at a maximum. Oyenuga and Fetuga, concluded that moisture content after heating, the amount of heat treatment given to samples and applied pressure were the most significant factors affecting the yield of oil expressed mechanically from conophor nut. The oil yield increased with increase in moisture content of samples after heating up to between 7.4 and 9-1% (wet basis) and then decreased with further increase in moisture content. No study is known to have identified the effects of processing factors on oil yield from melon seed. Some properties of oils that can be used to determine quality and their possible uses are refractive index, specific gravity, viscosity and colour. The specific gravity

of oil is of diagnostic value in the consideration of the quality or purity of the oil and is used in assessing the weight of oil in bulk shipments or oil stored in large tanks. (Singh *et al.,* 1984) The refractive index allows the rapid sorting of oils suspected of adulteration because of the ease and rapidity with which the value can be determined, while oil viscosity is used in assessing the lubricating property of oils. (Singh *et al.,* 1984).

2.4.1 Oil seed Pretreatment

Irrespective of the extraction method to be used, oilseed pretreatment is necessary. Basic steps in this process are dehulling, pod or seed coat removal, winnowing, sorting, cleaning, grinding or milling and preheating (Ogunniyi, 2006; Yusuf *et al.,* 2015). Grinding or crushing of oilseeds prior to extraction is to ensure that oil-bearing minute cells embedded in fibrous structures are broken or ruptured to release the oil (Akpan *et al.,* 2006; Tayde *et al.,* 2011). Heat treatment further facilitates the oil release process by reducing moisture content and hardening the interior of the oilseed (Patel *et al.,* 2016). In recent times, preheating of oilseed done conventionally by hot air oven, is being replaced by microwave-assisted heat treatment, the latter offering some advantages (Mgudu *et al.,* 2012). Additionally, grinding or size reduction prior to solvent extraction increases the surface area for solvent penetration to bring out the oil by leaching. Oil yield from an oleaginous seed material is generally dependent on the quality of oilseeds. However, there are certain factors like moisture content of material, particle size and temperature that can be manipulated during pretreatment in order to maximize oil yield. According to Olaniyan (2010), oilseed pretreatment prior to oil extraction normally affects oil yield and quality. Similarly, Faugno *et al.,* (2016) who carried out the analysis of main extraction parameters on yield of

mechanically pressed tobacco (**Nicotiana** tabacum L) seed oil found that the combination of seed preheating and high extraction temperature, among others, had a significant effect on oil yield. Thus, oilseed processing or pretreatment provides an avenue for manipulating key parameters and conditions for enhanced oil yield and quality.

2.4.2 Mechanical Pressing:

Many oil-bearing seeds and nuts are broken up by grinding, flaking, or rolling, then subjected to mechanical pressing to liberate the oil. The modern continuous screw press exerts pressures as high as 30,000 pounds per square inch. In modern press extraction, oilseeds or nuts are cleaned, and the shells or hulls removed; the kernels or meats are ground to a coarse meal that is pressed with or without preliminary heating. Cold-pressed oil, also called cold-drawn, or virgin, oil, is

Plate. 2: Screw Press Mechanical Extractor SOURCE**:** PTI chemical Laboratory, 2021

2.4.2.1 Mechanical Melon Seed Extractor

purer and has a better flavour than oil expressed with the aid of heat. After pressing the meals made from oily seeds or nuts, the remaining cake contains about 5 to 15 percent oil.

Mechanical expression involves the application of pressure (using hydraulic or screw presses) to force oil out of an oil-bearing material (Arisanu, 2013). By this method, oil yield is enhanced by increased mechanical pressure on the oil-bearing material. In a study of the yield characteristics of ground soybean sample at various operating pressures, pressing durations and product bulk temperatures, Mwithiga and Moriasi (2007) found that oil yields increased linearly with compression pressure (40-80 kgf/m2), duration of pressing (6-12 mins) and increase in the bulk

Plate. 3: Mechanical Extraction dry cake after separation

SOURCE**:** PTI chemical Laboratory, 2021

temperature of preheated oilseeds, reaching a peak yield at about 750C. With regard to oil yield, screw presses have an advantage over hydraulic presses for churning out slightly higher yields, in addition to their continuous mode of operation (Arisanu, 2013). Mechanical presses (manual or powered) meant for small (laboratory) scale oil extraction are simple, safer and containing fewer steps compared to solvent extraction of vegetable oils (Oyinlola *et al.,* 2004). However, in developing countries even simpler devices are in use to achieve similar results (Mwithiga and Moriasi, 2007). On the industrial scale, industrial machines or expellers are used for the purpose of extracting vegetable oils mechanically. Mechanical press methods are often used to extract vegetable oil from oilseeds having oil content higher than 20% (Sinha *et al.,* 2015). Generally, these methods have the advantage of low operation cost, and of producing high quality light coloured oil with low concentration of free fatty acids (FFAs) (Carr, 1976; Kirk-othmer, 1979). However, it has a relatively low yield compared to solvent extraction and is therefore comparatively inefficient, often with a large portion of oil left in the cake or meal after extraction (Buenrostro and Lopez-Munguia, 1986; Anderson, 1996). In addition, it is time consuming and labour intensive (Bhuiya *et al.,* 2015). In castor oil extraction for instance, mechanical pressing removes only about 45% of the oil, with remaining oil in meal extractable by solvent extraction method (Ogunniyi, 2006). There are two types of mechanical press methods namely, cold-press and hot-press methods. Cold-press or scarification method is carried out at low temperature (below 500C) and pressure, whereas the hot-press method is carried out at elevated temperature and pressure. Cold-pressed seed oils are safer than hot-pressed seed oils as adverse effects caused by high temperatures are avoided in the former. Some of the likely adverse effects are decreased oxidative stability, degradation of valuable oil components and reduced oil keeping quality. In cold-pressed oils, the purity and natural properties of seed oils are preserved (Azadmard Damirchi

et al., 2011; Bhatol, 2013). This includes the retention of valuable nutraceuticals like phytosterols and tocopherols in the extracted oil (Kittiphoom *et al.,* 2015). Because of these attractive qualities, there is growing global demand for cold-pressed oil. In contrast, hot-press methods give higher oil yield due largely to decreased seed oil viscosity at high temperatures. This enhances oil flow during extraction. Thus, high temperature increases the efficiency of the extraction process and yields of up to 80% of available oil in seed are possible (Patel *et al.,* 2016), but they may also engender oil degradation, with attendant deterioration of oil quality.

2.4.3 Operating Principle of Screw Oil Press in mechanical extraction

Oil-bearing materials are fed from the hopper to pressing chamber when the screw expeller pressing is running. Screw shaft rotates in the cage, which push's the oil material into the machine for pressing. On the one hand, the raw material keeps moving all the time in pressing chamber. Under the high pressure of pressing chamber, there is great friction drag between ra material and the screw shaft, also between feedstock and press chamber. Thus, the friction drag and relative movement emerge. On the other hand, the circle diameter of screw shaft root is gradually thickening and screw shaft distance is reducing little by little. When the screw shaft is rotating, it pushes raw material strongly and rolls over outward at the same time. Thus, there is a relative movement among every raw material particle. The quantity of heat from friction drag satisfies technology in the pressing, which will contribute to thermal denaturation of protein in the material, and improve the oil extracting rate meantime. The screw oil expellers of big scale or small scale have similar theories during the pressing process.

2.5 Gas chromatography mass spectrometry (GC/MS):

Gas chromatography mass spectrometry (GC/MS) is an instrumental technique, comprising a gas chromatograph (GC) coupled to a mass spectrometer (MS), by which complex mixtures of chemicals may be separated, identified and quantified. This makes it ideal for the analysis of the hundreds of relatively low molecular weight compounds found in environmental materials. In order for a compound to be analysed by GC/MS it must be sufficiently volatile and thermally stable (Barding *et al.,* 2013). In addition, functionalised compounds may require chemical modification (derivatization), prior to analysis, to eliminate undesirable adsorption effects that would otherwise affect the quality of the data obtained. Samples are usually analyzed as organic solutions consequently materials of interest (e.g., soils, sediments, tissues etc.) need to be solvent extracted and the extract subjected to various 'wet chemical' techniques before GC/MS analysis is possible.

2.5.1 Principle of Operation:

The sample solution is injected into the GC inlet where it is vaporized and swept onto a chromatographic column by the carrier gas (usually helium). The sample flows through the column and the compounds comprising the mixture of interest are separated by virtue of their relative interaction with the coating of the column (stationary phase) and the carrier gas (mobile phase). The latter part of the column passes through a heated transfer line and ends at the entrance to ion source (Emwas *et al.,* 2015) where compounds eluting from the column are converted to ions.

Two potential methods exist for ion production. The most frequently used method is electron ionisation (EI) and the occasionally used alternative is chemical ionisation (CI). For EI a beam of

electrons ionise the sample molecules resulting in the loss of one electron. A molecule with one electron missing is called the molecular ion and is represented by $M^{+\cdot}$ (a radical cation). When the resulting peak from this ion is seen in a mass spectrum, it gives the molecular weight of the compound (Barding *et al.,* 2013).

Due to the large amount of energy imparted to the molecular ion it usually fragments producing further smaller ions with characteristic relative abundances that provide a 'fingerprint' for that molecular structure. This information may be then used to identify compounds of interest and help elucidate the structure of unknown components of mixtures. CI begins with the ionisation of methane (or another suitable gas), creating a radical which in turn will ionise the sample molecule to produce $[M+H]^+$ molecular ions. CI is a less energetic way of ionising a molecule hence less fragmentation occurs with CI than with EI, hence CI yields less information about the detailed structure of the molecule, but does yield the molecular ion; sometimes the molecular ion cannot be detected using EI, hence the two methods complement one another. Once ionised a small positive is used to repel the ions out of the ionisation chamber. (Emwas *et al.,* 2015).

The next component is a mass analyser (filter), which separates the positively charged ions according to various mass related properties depending upon the analyser used. Several types of analyser exist: quadrupoles, ion traps, magnetic sector, time-of-flight, radio frequency, cyclotron resonance and focusing to name a few. The most common are quadrupoles and ion traps. After the ions are separated they enter a detector the output from which is amplified to boost the signal. The detector sends information to a computer that records all of the data produced, converts the electrical impulses into visual displays and hard copy displays. In addtion, the computer also controls the operation of the mass spectrometer.(Barding *et al.,* 2013).

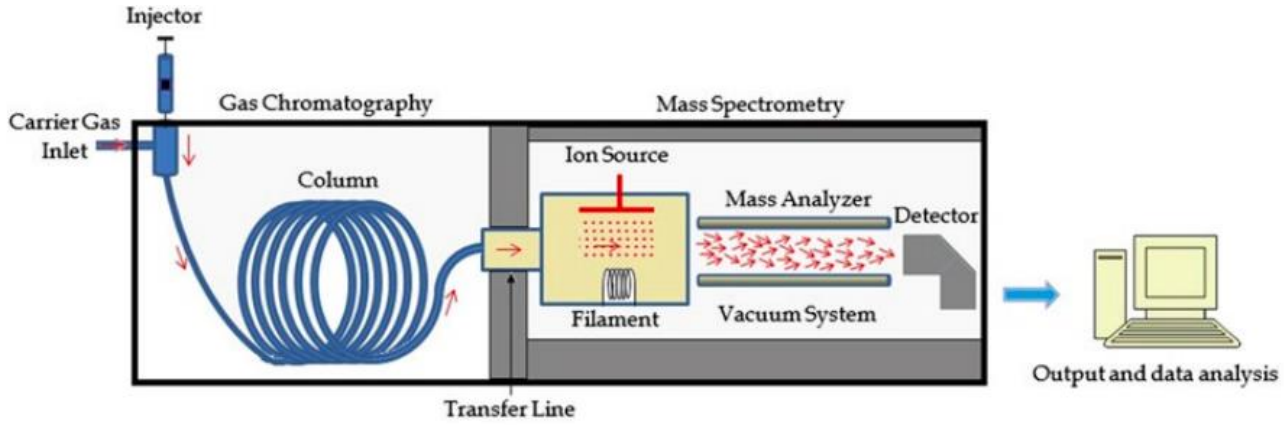

Fig. 1 Operational principal of gas column mass spectroscopy

Source: (Barding *et al.*, 2013).

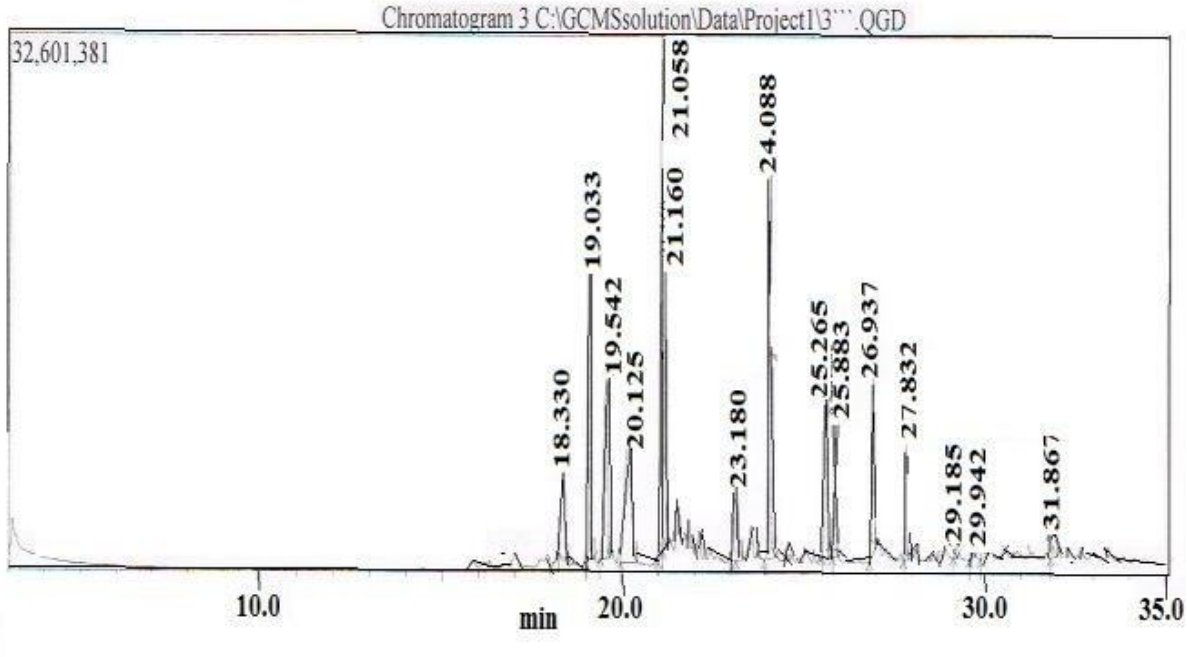

Fig. 2 GC-MS Spectrum

Table 4. GC-MS identification of compounds from derivatised Tomatoes Seed Oil

SOURCE: Botinestean *et al.*, 2012

RT (min)	Area (Abund.min)	Area (%)	Name
6.303	15863	0.147833	Decane
6.908	15743	0.146715	Hexanal dimethyl acetal
12.977	45003	0.419399	Tetralin
23.265	13812	0.128719	Myristic acid, methyl ester
26.685	1450646	13.5191	Palmitic acid, methyl ester
29.705	2022748	18.85073	Oleic acid, methyl ester
29.869	5892298	54.91247	Linoleic acid, methyl ester
30.175	315516	2.940409	Linolenic acid, methyl ester
30.58	116262	1.083488	Oleic acid, ethyl ester
30.733	379397	3.535739	9,12-Octadecadienoic acid, ethyl ester
32.096	145501	1.355977	9,12-Octadecadienoic acid, ethyl ester

Table 5. Fatty acid composition of Tomatoes Seed Oil SOURCE: Botinestean *et al.*, 2012

FAME	Concentration FAME[1] (mg/mL)	Mass ofoil[1] (g)	Volume of oil[1](mL)	Mass of FAME[1] (mg)	Concentration of FAME in TSO[1] (%)
PAME	0.05	0.11	3.80	0.18	17.18
OAME	0.07			0.27	9.20
LAME	1.34			2.96	48.22

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1.1 Sampling and Collection

The Fresh Melon seed samples that were used for the extraction of Melon seed oil during the course of this project were purchased from Uselu market, Benin-city, Edo state.

3.1.2 Materials

3.1.3 Apparatus

- Sample plastic bottles (500ml)
- Beaker (250 ml)
- Syringe
- Glass funnel

3.1.4 Reagents

- Potassium bromide (KBr) powder.
- Nujol ($C_{15}H_{11}ClO_7$) White mineral oil.

3.2 Equipment

1. Screw Press Extractor GGZX-120.

3.2.1 Mechanical Extractor Major Parts

- 1. Seed Hopper
- 2. Press nozzle
- 3. Oil Canals

2. Gas Chromatograph Mass Spectrometer GCMS-QP2010 SE.

3.2.2 Gas Chromatography and Mass Spectroscopy Major Parts

- 1. Injector
- 2. A column
- 3. Ion source
- 4. Mass analyzer
- 5. Detector

4. Analytical balance ISO 9001:2008, OHAUS.

3.2.3 Preparation of Sample for Fourier transform infrared spectroscopy Analysis

0.5g of the oil sample was mixed with 0.5g of Potassium bromide (kbr) after which 1ml of nujor (a solvent for preparation of sample by Buck 530 IR- spectrophotometer) was introduced into the sample with aid of syringe to form a paste before introducing it into the instrument sample Mould and allowed to scan at a wavelength of 600-4000nm to obtain its spectra wavelength.

3.2.4 Extraction process of melon seed oil

Before the operation of the machine, direct steam via a hose was use to clean the extractor, this was done to prevent contamination. The extractor was switched on and allowed to heat, and the temperature was set at the temperature that will not cause the constitute of the melon seed to denature below 100°C. The Melon seed was weighted about 100kg and were fed from the hopper of the mechanical screw press extractor to the pressing chamber, when the screw expeller pressing is running. The Screw shaft rotates in the cage, which push's the Melon seed containing the oil into

the machine for pressing. On one hand, the raw material keeps moving all the time in pressing chamber. The Screw shaft passes the melon seed to the heated zone of the extractor, this pressure and heat created press the melon seed and extract the oil from it. Then the oil come out from the oil plate and it passes through a filter, the filter removes any seed or cake present in the oil. And it is collected into a collection container. At the other end of the mechanical extractor, the cake is removed.

3.2.5 Gas Chromatography and Mass Spectroscopy

- Ion Source Temperature: 230.00°C
- Interface Temperature: 250.00°C
- Solvent Cut Time: 4.50min
- Detector Gain Mode: Relative
- Threshold: 2000

CHAPTER FOUR

4.0 RESULT

4.1 TABLE 6: FATTY ACID COMPOSITION OF MECHANICALLY EXTRACTED MELON SEED OIL MONTH 1

R/T	Area Percent (%)	Molecular Formula	Molecular name of compound	Trivial name	Saturated/Unsaturated
17.524	6.40	$C_{17}H_{34}O_2$	Hexadecanoic acid, methy ester	Palmitic acid	saturated
19.65	36.52	$C_{19}H_{34}O_2$	9, 12 – Octadecadienoic acid	Linoleic acid	unsaturated
19.740	8.85	$C_{19}H_{36}O_2$	10 – octadecenoic acid	isooleic acid	unsaturated
19.800	0.60	$C_{19}H_{36}O_2$	6 – octadecenoic acid	Petroselinic acid	unsaturated
20.060	5.07	$C_{19}H_{38}O_2$	Methyl stearate	Stearic acid	saturated
22.008	5.35	$C_{29}H_{48}O$	Stigmasta – 5-2-3 – dien- 3-β-ol	stigmasterol	unsaturated
23.566	0.63	$C_{19}H_{36}O_3$	9- octadecenoic acid 1,2-hydroxyl methyl ester	Beta-Tocopherol	unsaturated
23.566	0.63	$C_{28}H_{48}O_2$	2H-1-Benzophyran-6-ol, 3,4-dihydro-2,5,8, tri methyl – 2(4, 8, 12 – trimethy tridecyl)	Gamma-sitosterol	unsaturated
24.181	14.07	$C_{28}H_{50}O$	Stigmast-5-en-3-beta-ol	Stigmasterol	unsaturated
24.692	0.27	$C_{28}H_{48}O_2$	Cholest – 8 –ene – 3, 6-diol, 14 – methyl – (3 beta)		unsaturated
25.266	0.35	$C_{32}H_{48}O_6$	2 – (16 – Acetoxy – 11 –hydroxy – 4,8,10,14 – tetramethyl -3-oxohexadecahydrocyclopenta		
25.906	1.73	$C_{30}H_{50}O$	Lup -20 (29) – en -3 beta-ol	Lupeol	unsaturated

26.816	19.77	$C_{30}H_{50}O$	Lup -20 (29) – en -3 beta-ol	Lupeol	unsaturated

4.2 TABLE 7: FATTY ACID COMPOSITION OF MECHANICALLY EXTRACTED MELON SEED OIL MONTH 2.

R/T	Area Percent (%)	Molecular Formula	Molecular name of compound	Trivial name	Saturated/Unsaturated
17.520	10.60	$C_{17}H_{34}O_2$	Hexadecanoic acid	Palmitic acid	saturated
19.653	52.74	$C_{19}H_{34}O_2$	9, 12 – Octadecadienoic acid	Linoleic acid	unsaturated
19.741	16.0	$C_{19}H_{36}O_2$	11 – octadecenoic acid	Vaccenic acid	unsaturated
19.799	1.36	$C_{19}H_{36}O_2$	9 – octadecenoic acid	Oleic acid	unsaturated
19.963	1.04	$C_{20}H_{40}O$	Hexadecen-1-ol,3,7,11,15-tetramethyl	stigmasterol	
20.066	9.45	$C_{19}H_{38}O2$	octadecanoic	Stearic acid	saturated
22.022	0.89	$C_{19}H_{36}O_3$	9 –octadecenoic acid, 1,2- hydroxyl-methyl ester		unsaturated
22.676	0.36	$C_{25}H_{42}O_2$	Cyclopropane butanoic acid		saturated
23.610	7.08		2 H – 1 – benzopyran – 6 – ol, 3,4-dihydro 2,7,8 trimethy -1-2 (4, 8 12 - trimethyltridecyl)		
25.09	0.46		Octadecanal, 2 - bromo		saturated

4.3 TABLE 8: FATTY ACID COMPOSITION OF MECHANICALLY EXTRACTED MELON SEED OIL MONTH 3.

R/T	Area Percent (%)	Molecular Formula	Molecular name of compound	Trivial name	Saturated/Unsaturated
16.973	3.58	$C_{16}H_{32}O_2$	Tetradecanoic acid, 12 – methyl, methyl ester		saturated
19.090	43.50	$C_{19}H_{34}O_2$	9, 12 Octadecadienoic acid	linoleic	unsaturated
19.76	11.84	$C_{19}H_{36}O_2$	9 - Octadecadienoic acid		
19.501	5.92	$C_{19}H_{36}O_2$	octadecenoic acid	Stearic	saturated
27.630	5.97	$C_{19}H_{28}O4$	2 – cyclohexene – 1 –carboxylic acid		
27.674	8.66	$C_{30}H_{50}$	2,66,10,14,18,22, tetracosahexaene, 2, 6,10, 15, 19, 23 – hexamethy, 2,6,10,15,19,23 - hexamethyl	Squalene	unsaturated
27.785	1.25	$C_{29}H_{48}O_3$	Stigmasta – 5,22 – dien -3 –beta - ol	stigmasterol	unsaturated
28.715	16.13	$C_{30}H_{50}$	2,66,10,14,18,22, tetracosahexaene, 2, 6,10, 15, 19, 23 – hexamethy, 2,6,10,15,19,23 - hexamethyl	Squalene	unsaturated
28.715	3.05	$C_{28}H_{46}O$	7, 22 - ergostadienol		

4.4 TABLE 9: MAJOR FATTY ACIDS/ CONTENT OF SFA, MUFA, PUFA AND TUFA IN MECHANICALLY EXTRACTED MELON SEED OIL.

Fatty acids	Composition (%)
Palmitic	10.06
Stearic	14.52
Iso-Oleic	8.85
Oleic	1.36
linoleic	132.76
SFA	
TABLE 1	15.85
TABLE 2	15.67
TABLE 3	3.58
MUFA	
TABLE 1	9.45
TABLE 2	17.36
TABLE 3	-
PUFA	
TABLE 1	36.52
TABLE 2	52.74
TABLE 3	43.50
TUFA	**159.57**

4.5 TABLE 10: ESSENTIAL AND NON- ESSENTIAL FATTY ACIDS OF MECHANICALLY EXTRACTED MELON SEED OIL.

Essential fatty acids	Concentration%	Non-essential fatty acids	Concentration %
Linoleic	132.76	Palmitic	10.06
Linolenic *		Oleic	1.36
		Stearic	14.52
		Iso oleic	8.85
		Vaccenic	19.741
		Methyl 12-methyltetradecanoate	3.58
		Petroselinic acid	0.60
Total essential fatty acid	**132.76**	Total non-essential fatty acid	**58.111**

4.6 TABLE 11: CLASSIFICATION OF MECHANICALLY EXTRACTED MELON SEED OIL BASE ON SATURATED AND UNSATURATED FATTY ACIDS.

Saturated fatty acids (SFA)	**Area percent (%)**		
	Table 1	Table2	Table 3
Palmitic acid	6.40	10.60	-
Stearic acid	9.45	5.07	-
Methyl 12-methyltetradecanoate	-	-	3.58
Monounsaturated fatty acids (MUFA)			
Oleic acid	-	1.36	-
Vaccenic acid	-	16.0	-
Iso-oleic acid	8.85	-	-
Petroselinic acid	0.60	-	-
Polyunsaturated fatty acid			
Linoleic acid	36.52	52.74	43.50

4.7 TABLE 12: POLYUNSATURATED/SATURATED INDEX FOR DETERMINATION OF NUTRITIONAL VALUE OF MECHANICALLY EXTRACTED MELON SEED OIL.

	%SFA	%MUFA	%PUFA	P/Sindex
Table 1	15.85	9.45	36.52	2.30
Table 2	15.67	17.36	52.74	3.37
Table 3	3.58	-	43.50	12.15

CHAPTER FIVE

5. DISCUSSION

The outcome of the melon seed (*Citrullus colocynthis*) oil's fatty acid profile analysis (Table – 1, 2, 3), shows that there are 8 fatty acids in the oil. With the exception of C-18, C-20, C-21, C-22, C-23, C-24, C-26, C-27, C-and C-31, the fatty acids ranged from C-16 to C-32. There were five major fatty acids (Table 4): linoleic acid (52.74-36.52%), which was the most dominant, followed by iso-oleic acid, palmitic acid, stigmasterol, Stearic acid, and oleic acid. The results indicated that melon seed oil had extremely high levels of unsaturated fatty acids, which totalled to 159.57%. Palmitic, oleic, Stearic, and linoleic acids are the main fatty acids present in the oil, constituting more than 90% of the triacylglycerol portion with a predominance of linoleic acid (36.52 %) in (Table 1), which is lower than the values found by (Nolte and Loesecke). (65.61 %).

Linoleic acid levels are higher than those found in cotton seed oil. The values are very similar to those of soy bean, sesame, and corn oils. This implies that melon seed oil could be a good substitute for cooking, table and frying oils. Petroselinic acid, Beta-Tocopherol, Gamma-sitosterol, and Cholesterol, were present in trace amounts in almost all the samples. Acording to the result obtained, linolenic wasn’t detected, this may be due to the amount of linolenic present in the melon seed oil, it may be present in very low quantity that is below the detection level of GCMS. The low levels of linolenic oil will contribute to high stability in the oil as reported by (Gurudeeban and Ramenathan, 2010). Squalene, stigmasterol, and phytol were also found to be present in a handful of the samples. linoleic acid contributed the most to the fatty acid profile, with a value of 36.2, followed by palmitic, oleic, and stearic acids in that order, with values of 8.85, 6.4,

and 8.5.0%, respectively. The overall amount of unsaturated fatty acids was 65.39 percent. The amount of total unsaturated fat obtained was less than the 82.1% found by Mello et al. (2011) and (El-Adawy and Taha). These differences can probably be explained based on the different varieties of the melon seed oil used in the study also the type of extraction employed and the circumstances surrounding the melon seed's growth may be to blame. It was found that the melon seed is extremely high in poly unsaturated fatty acids, which have been said to be beneficial for diabetes patients (Gurudeeban and Rmenathan, 2010).

Due to the presence of large amounts of linoleic and oleic acids, melon seed oil could be suitable for culinary purposes, for the manufacture of margarines.

Stigmasterol was found to have about (24.181). Stigmasterol is used in the synthesis of steroid hormones which are used in the treatment of humans, especially cortisone. However, its presence in soybean oil steroid mixtures makes stigmasterol one of the most abundant sources for the synthesis of steroid hormones (Fieser LF and Fieser M). The differences in fatty acid composition reported in this study could probably be due to variation in method of laboratory analysis and genetic variability. This can be supported by the findings of Karanja, who reported that differences in fatty acid composition of Pumpkin could probably be due to variation in the harvesting season, geographical locations, method of laboratory analysis and genetic variability.

It has been well demonstrated that linoleic acid lowers blood cholesterol and LDL cholesterol concentrations, particularly when it replaces the common saturated fatty acids. (Mensink and Katan 1992; Mensink RP *et al., 2003*). This cholesterol-lowering effect of linoleic acid is not linear across the range of intakes, and the biggest effect is seen going from a low to a moderate intake. Linoleic acid acts through Sterol regulatory element-binding protein, to reduce cholesterol biosynthesis and to upregulate hepatic LDL receptor gene and protein expression, creating a situation that favors hepatic clearance of circulating LDL. palmitic acid (16:0) have specific roles

in acylation of membrane proteins that are important in anchoring those proteins to the plasma membrane (Simons and Gerl 2010). Many cell membrane phospholipids contain significant proportions of palmitic and stearic acids; neural cell membrane phospholipids contain some longer chain saturated fatty acids. Ceramides and sphingolipids can be rich in saturated fatty acids, while gangliosides are often very rich in stearic acid. The high saturated fatty acid content of these structures is related to their membrane location and to their function. Lipid rafts, which are plasma membrane microdomains that serve as cell signaling platforms, are usually rich in saturated fatty acid–containing phospholipids and sphingolipids (Simons and Gerl 2010).

Table 4 indicates that mechanically-extracted melon seed oil contains total saturated fatty acid content of 15.85%, 15.67% and 3.58% respectively, for table 1, 2, and 3. Table 1 and 2 each have monounsaturated fatty acid percentages of 9.45% and 17.36%. It has the corresponding amounts of polyunsaturated fatty acids from tables 1, 2, and 3 36.52%, 52.74% and 43.50% respectively. This suggests that the unsaturated fatty acids found in melon seed oil, which are highly concentrated, may help lower the risk of cardiovascular disease. The result from the GCMS analysis has shown that the oils from the seeds also possess the therapeutic ability, derivatives of hexadecanoic acid (Palmitic acid) have been reported to prevent lipopolysaccharide-induced inflammation by suppressing the production of cytokines and NF-κB.

The anti-inflammatory property of the compound has been linked to their structures, the compound also poses as an active antimicrobial and antidiarrheal agent. (Aparna *et al.*, 2012).

In month 1 (Table 1), the fatty acid composition remained stable for the first month, with little sign if degradation. In Table 2 and Table 3 the results show that; the fatty acid composition of the melon feed oil, degraded, this is represented by the presence of ergostadienol, stigmasterol and Squalene.

The degradation of melon seed may be as a result of the storage method used to store the oil. Degradation can be caused as a result of photo-oxidation of the oil, as a result of exposure to light.

The P/S index of the mechanically extracted seed oil is shown in Table 7 to be 2.30, 3.37, 12.15 respectively, for Table 1, 2, and 3. The P/S index is crucial for determining the nutritional value of certain oils. Oils and fats with P/S indices greater than one (1) are regarded as having nutritional value. *Citrullus vulgaris* is hence edible and has a better nutritional value.

5.1 CONCLUSION

The presented data suggest that Mechanically extracted Melon seed oil, is valuable with excellent nutritional value. According to the nutritional evaluation of the fatty acids, melon seed oil is a good source of fatty acids. It has high amount of unsaturated fatty acids, with oleic (1.36%) and linoleic (36.52 %) acids being the most prevalent ones. Additionally, the oil from melon seeds is a significant source of stearic and oleic acid. These additions may significantly help combat the widespread issue of malnutrition in the nation. Overall, the results of this study indicated that the mechanically extracted melon seed oil have potential role in lowering the risk of cardiovascular disease, blood cholesterol and LDL cholesterol concentrations, synthesis of steroid hormones, and it also play significant role in the manufacture of margarines. It has potential use as anti-inflammatory agent and antiallergic agent.

5.2 RECOMMENDATION

Melon seed oil, is good for consumption, cooking and many health benefits, hence it serve as a good remedy to many diseases, and as major source of essential fatty acids. melon seed oil is recommended to lower the risk for heart disease.

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