



EXTRACTION OF OIL FROM WOOD APPLE SEEDS & TO STUDY THE PROPERTIES OF WOOD APPLE SEED OIL

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Abstract: The present study is carried out on “Extraction of oil from wood apple seeds and to study the properties of wood apple seed oil”. The goal of the current study is to characterize the physical and chemical properties of wood apple (*Limonia acidissima* L.) seed oil, as well as its fatty acid composition, tocopherols content, Vitamin D, Vitamin E, Cholesterol and Thymol content. By using gas chromatography-mass spectrometry (GC-MS), the fatty acids in seed oil are examined, and they contained oleic (23.89%), gamma-linolenic (9.23%), and linoleic acid (16.55%), while the quantity of saturated fatty acids is 32.15%, including palmitic acid (18.52%) and stearic acid (9.02%). The seed is excellent for nutritional and industrial applications since it contains more unsaturated fatty acids (50.19%) than saturated fatty acids (32.15%). Tocopherols, which are regarded as natural antioxidants, are detected in higher concentrations (54.33 mg/100 g). Cholesterol is absent in wood apple seed oil. Thymol is 20.41 mg according to GC-MS analysis. On the basis of the study it is found that the seed oil is an excellent source of organic compounds. It has a lot of health advantages. All the physicochemical properties were qualitatively evaluated in MIT-CARS Center For Analytical Research And Studies which is NABL accredited Laboratory.

Keyword - Wood apple; fatty acid profile; tocopherols; Thymol; GC-MS; HPLC.

I. INTRODUCTION

The wood apple (*Feronia limonia*) is a cheap, highly nutritious and seasonally available fruit. It belongs to the family *Rutaceae*. It is found India, Pakistan, Srilanka. It is also called as Kathbel or Kawat. It is one of the hard fruit crop. It is available from post monsoon periods & continues till winter. The fruit is round, oval & have a hard, woody shell. The fruits are 2 – 5 inches wide with a grayish white, scurfy rind of about 6mm thick. Each fruit weights about 150 – 500 grams. The ripe fruit is sour, aromatic and highly nutritious. It is also a good mixture of vitamins and minerals including calcium, iron, phosphorus, carotene, thiamine, riboflavin and niacin. (Nidhika Thakur, *et al.*2020)

In India, it is mainly found in the dry regions. It is reported from the states of Punjab, Delhi, Rajasthan, Madhya Pradesh, West Bengal, Arunachal Pradesh, Maharashtra, Goa, Karnataka, Tamil Nadu and Andhra Pradesh. This species is globally distributed in Indo-Malaysia. Within India, it is cultivated throughout the plains of India, especially in the drier zones. The pulp of *Limonia Acidissima* L. is sticky, brown, and aromatic. It is odorous, resinous, astringent, acid or sweetish, containing a number of small, white seeds scattered in the wood apple. The utilization of underutilized fruit seed facilitates an extra economic benefit to the local people. (Vishakha Bagul, *et al.*2019)

Medicinal plants are of great interest to the researchers in the field of biotechnology as most of the drug industries depend, in part, on plants for the production of pharmaceutical compounds. *Feronia limonia* L. has economic as well as medicinal value. It contains important medicinal compounds those could be used in the pharmaceuticals industries. The fruit is used in India as a liver and cardiac tonic, and when unripe, as an effective means of halting diarrhoea and dysentery and effective treatment for high cough, sore throat and

diseases of the gums Juice of young leaves is mixed with milk and sugar candy and given as a remedy for biliousness and intestinal troubles of children. Oil derived from the crushed leaves is applied on itch and the least decoction is given to children as an aid to digestion. Leaves, bark, roots and fruit pulp of wood apple tree are used to treat to cure snakebite . Large quantities of citric acid, mucilage and minerals found in its pulp. So the fruits could be good substrates for confectionary products, such as jam, jelly, squash, pickle and so on.

table 1 - limonia acidissima l.'s botanical name.

Kingdom	<i>Plantae</i>
Order	<i>Sapindales</i>
Genus	<i>Limonia L.</i>
Family	<i>Rutaceae</i>
Species	<i>L. acidissima</i>

(Vishakha Bagul, *et al.*2019)

Plant seed are important source of oils & fats having many nutritional properties. In Seed oil tocopherols, carotenoids, phenolics and polyphenolic compounds, and special fatty acids such as α -linolenic acid are present and is rich in unsaturated fatty acids. Oils from citrus seeds to be an important source of essential fatty acids and tocopherols showing good potential for both human consumption and industrial applications. (Malacrida *et al.*2012)

The seed and pulp contain fats and protein. The fats contains palmitic acid, oleic acid, linoleic acid, and linolenic acid, also it contains palmitoleic and stearic acid in very small quantity.

Some fats from both plants and animals are used in the making of food. Oil and fats are essential nutrients that support human health. In addition, oil and fats are better suppliers of energy than protein and carbohydrates. Almost every food contains fats and oils in various quantities. (Yuliana Noor, *et al.*2019)

The early Phytochemical examination revealed the presence of alkaloids, flavonoids, terpenoids, tannins, proteins, carbohydrates, and lipids. (Choudhary, *et al.*2014)

The fruit pulp and seeds of wood apples have outstanding therapeutic potential. Every component of the fruit has a therapeutic benefit. Wood apple fruit pulp has antioxidant, anticancer, antidiabetic, antimicrobial activity. The fruit pulp of wood apple is used for making various products. To increase system efficiency and guarantee food quality and product safety, a variety of antimicrobials (including antibiotics, fungicides, biocides, decontaminants, food preservatives, and disinfectants) are used during the production and manufacturing of food. (Pooja Sharma 2021).

Two methods are used for the oil extraction from seeds. Clevenger apparatus and Soxhlet apparatus are the two methods which are used for the extraction of oil. In Clevenger apparatus water is used as a solvent while in Soxhlet apparatus n – hexane is used as a solvent. The primary benefit of this procedure is complete extraction with a minimal amount of solvent, which is also known as the hot continuous extraction process or Soxhlet extraction. Soxhlet extraction is one of the traditional techniques that has been widely utilized to extract bioactive compounds from a variety of natural sources. This method has continuously worked in a variety of analytical procedures related to the extraction of bioactive chemicals for many years. Compounds with average to low solubility can be extracted using the Soxhlet extraction method, which is one of its key benefits. (Fagbemi, *et al.*2021)

II. MATERIALS & METHODS

2.1 Sample Preparation: - Large fresh wood apple are brought from market The pulp with Seed of wood apple fruit is scooped out from the hard shell. The seed is dried by sun drying at 38°C. The dried pulp seeds are grinded in the mixer. A good quality of dried powder is obtained. The sun dried wood apple seeds powder has higher nutritional properties than oven drying. (Sneha 2018)

2.2 Standards and Chemicals:- n-Hexane, methanol, potassium hydroxide (KOH), hydrochloric acid, 14% methanolic boron trifluoride (w/v), helium, 5% ethanolic pyrogallol (w/v), diethyl ether, ethanol, milli-Q-water, acetone, phenolphthalein, chloroform, Bovine serum albumin, copper sulfate anthrone reagent, sodium carbonate, potassium iodide, sodium thiosulfate, sodium hydroxide, phosphate-buffered saline, and sodium hydroxide are some of the other ingredients.

2.3 Oil Extraction Process:-

1. Oil Extraction by Clevenger Apparatus:-

1000 ml round bottom flask is connected to another two ways round bottom flask which holds wood apple seed dried powder. The top flask is connected with condenser. Take 100 gm of dried sample of wood apple fruit placed into 1 lit round bottom flask. It is connected to another two ways round bottom flask containing distilled water. The water started heating at 100°C. Vapours are formed & Condensed into liquid with use of an external cooling water. The condensate is collected in separate beater. Two layers (Oil & Water) are formed. This trial is taken for about 6 Hrs but oil is not extracted. (A Senthilkumar 2013)

Reason for Failure: - The hydro distillation procedure uses water as a solvent, and since the seed oil concentration is low, the trial may not be successful.

2. Oil Extraction by Soxhlet Apparatus :-

The extraction of dried powder material of the fruit pulp & seed of *Feronia limonia* L. were carried out by soxhlation techniques by using solvent n-hexane. 50 gram Powder is components using condensed vapors of the Solvent. The condensed vapors come in contact with sample powder. Soluble placed in a porous thimble before placing it into the Soxhlet apparatus. 70 ml n-hexane is added in flask. Extraction was carried out for 6 hrs at temperature between 30°C and 60°C. It Extract part in powder gets mixed with solvent. The oil had been fully extracted when the solution in the thimble turned clear. 7 ml yield is obtained after extraction. (Arshed 2019)

The Solvent is evaporated by using rotary evaporator and the oil is collected in a glass vial.

2.4 Determination of Physicochemical Properties of Wood Apple Seed Oil:-

Physico-chemical properties of Wood apple seed oil are analyzed by different standard methods described by AOAC. The acid value (AV), free fatty acid value (FFA), saponification value (SV), and peroxide value of WASO were assayed by the method described by –

- Determination of Acid Value: - For AV determination, 0.1 g of oil was neutralized by ethyl alcohol. Using phenolphthalein indicator mixture is titrated against 0.1 N Potassium hydroxide. 1 ml oil is added and it is heated until oil dissolve. Phenolphthalein indicator is added and titrated against 0.1 N KOH. (AOAC 20th edition, 2016 official method chapter no 33 969.17 Titrimetric method.)
- Determination of Free Fatty Acid: - The percentage of free fatty acid was measured by dissolving 1 g of oil in ethanol and diethyl ether (1:1). It was then mixed thoroughly and neutralized with 0.1N potassium hydroxide, and the mixture was titrated against 0.1N sodium hydroxide using a phenolphthalein indicator.(ISI Handbook of Food Analysis (Part XIII)-1984 Page No 67)
- Determination of Saponification Value: SV was evaluated by adding 5% alcoholic potassium hydroxide to 0.1 g of oil and incubated in a water bath for 1 h to saponify. Using a phenolphthalein indicator, the solution was titrated against 0.1 N hydrochloric acid and defined as mg KOH/g. (AOAC 17th edn, 2000, Official method 920.160 Saponification number of oils and fats / 1984, page 78 of IUPAC 2.202 / ISI Handbook of Food Analysis (Part XIII))
- Determination of Peroxide Value: - Peroxide value is determined by adding 3ml acetic acid chloroform mixture. It is mixed well. Add 1ml saturated potassium iodide and 30ml distilled water. Titrate it against 0.01 N sodium thiosulfate. Then add 0.5 ml 1% starch solution as indicator .Again titrate it against sodium thiosulfate.(AOAC 965.33)
- Determination of Iodine Value: - One gram of the oil sample was weighed into Conical flask and 25ml carbon tetrachloride was added to the oil. 25 ml of Wijs solution (Iodine monochloride + Acetic Acid) was then added and allowed to stand in the dark for 30 min. After 30 minutes, 15 ml of (10%) potassium iodide and 100 ml of water was added and then titrated with 0.1 mol/dm³ thiosulphate solution using starch as indicator just before the end point. Along with the oil samples, a blank was also prepared. The iodine value was obtained using equation.(AOAC 17th edn, 2000, Official method Oils and fats' iodine absorption numbers are listed in section 920.159 of the ISI Handbook of Food Analysis (Part XIII) – 1984 page 76)
- Determination of Specific Gravity: - The specific gravity was estimated using a 10 mL Pycnometer at 28 ± 2 °C temperature. (AOAC 17th edn., 2000, Official method 920.212 Specific gravity (Apparent) of Oils, Pycnometer method / ISI Hand book of Food Analysis (Part XIII) 1984, page 72)

2.5 Fatty Acid Profiling

- Determination of Fatty Acid: - Extraction / Derivatization process:-Procedure: - Accurately weigh 100 mg of sample and place in a test tube. Add 2ml of 2N Sodium hydroxide solution and heat at 80°C for 1 hour. Allow to cool it. Add 2ml of 25% BF₃-Methanol and heat at 80°C for 1 hour. Allow to cool it and then add 5ml water and 5ml n-hexane. Shake the tube vigorously. Allow phases to separate. Pass the organic layer through anhydrous sodium sulphate and collect the 1ml of sample. Inject into Gas Chromatograph.
- Determination of Vitamin D : - Chromatographic condition for Determination of Vitamin D : - column (chromosol onyx ,C18, 4.6mm*150mm, 5μ); Mobile phase is methanol & 10% isopropyl alcohol+0.5% triethyl amine ; Flow rate is 1ml/min; Run time whereas run time is 15min and Wavelength is 265nm;Column temperature is 25°C. Standard preparation: Weigh 10mg of standard vitamin d in 10 ml of volumetric flask make up volume by methanol and sonicate for 10 min. Make further concentration of standard by using the stock standard solution by using mobile phase as dilution (50:50). Sample preparation: - Weigh 10mg of sample in 10 ml of volumetric flask makeup volume upto 10 ml by using mobile phase (50:50) sonicate for 10 min centrifuge the sample for 15 min at 4000 rpm and filter the sample by using 0.45 μm filtrate in the vial.
- Determination of Vitamin E : - Sample Preparation for Vitamin-E :- The separation and quantification of tocopherols were carried out using High-performance liquid chromatography. (1 g) was saponified with 1 mL of potassium hydroxide (100%, w/v), 4 mL of ethanolic Pyrogallol (5%, w/v), and incubated in a water bath for 3 min at 80 °C. As the reaction was suddenly cooled, 30 mL of distilled water was added to neutralize it. Separated diethyl ether fractions were collected in a different tube, and the process was repeated three times. The pooled extract was washed and evaporated to dryness under a vacuum at 40 °C. The residue was evaporated to dryness using nitrogen air after being dissolved in 1 ml of ethanol and 4 ml of benzene. The dried extract was utilized to characterize tocopherols after being dissolved in 1 mL of n-hexane. (Prasad P, et al.2019)
- Determination of Thymol: - Thymol Sample Preparation in WASO: - For thymol extract 1g of sample was weighted and transferred into 100ml conical flask, extraction of thymol content from the extract was done by using two portion of chloroform each 10ml. Extraction of thymol content of the sample was done using two portion of chloroform each 10ml. Vortex the sample for 5 min. allow to settle. Sonicate the sample for 15 min. Centrifuge the sample at 3000 rpm. Take out 0.4 ml in 10 ml centrifuge tube. Evaporate to dryness on Nitrogen Evaporator. Re-constitute with 1 ml of Ethyl Acetate. (A Senthilkumar, et al.2013)

III. RESULT & DISCUSSION

3.1 Extraction of oil from Wood Apple Seed :-

The oil yield of Wood Apple Seed Dried Powder is 14 %.

3.2 Physicochemical properties of WASO:-

Table 1 :- physicochemical properties of WASO:-

S. N.	Nutritional Property	Wood Apple seed dried Powder
1	Acid value	1.96mgKOH/gm
2	Free fatty acid value	0.26mgKOH/gm
3	Saponification value	187mgKOH/gm
4	Peroxide value	7.3 meq/kg
5	Iodine value	102 g I ₂ /100g
6	Specific Gravity	0.83
7	Moisture	2.18g
8	Viscosity	38.83 Cp

*Each Value is average of three determinations

Physicochemical Properties of WASO are given in Table 1. A number of physical and/or chemical parameters are usually monitored such as acid value, Free Fatty Acid value, saponification value, peroxide value, iodine value, Specific Gravity Because of this, oil quality and stability are vital for both consumers and industrial purposes. Vegetable oils of many brands are offered in marketplaces. (Babatunde, et al.2016)

- It is indicated from table 1 that acid Value of WASO is 1.98 mgKOH/gm. Low Acid value represent stability of oil at room temperature & High Acid value leads to unpleasant flavor & odor generation. The Maximum limit of acid value is 4 mgKOH/gm. (ICHU 2019)
Whereas, the acid value of Groundnut is 4.4mgKOH/gm & Palm oil has 5.466 mgKOH/gm (Pandurangan, et al.2014) The Acid value of Soya oil is 2.744 mgKOH/gm & Sunflower oil has 3.6 mgKOH/gm (Fazal Wali, et al.2014) & (Tilahun, et al.2018)
- Free fatty acid Value of WASO is 0.27 mgKOH/gm .Free fatty acids (FFA) are produced by the hydrolysis of oils and fats. As a result of the oils and fats being subjected to a number of applications, including storage, processing, heating, and frying, the degree of FFA varies on time, temperature, and moisture content. Free Fatty Acid should be less than 5%. If it is less than 5% then it is considered as Edible oil. Oil becomes rancid in a short period of time if it is more than 5%. (SA Mahaser, et al.2014) Free fatty acid Value of soybean oil gave the lowest (1.49) FFA value compared to other oil samples. (Tilahun, et al.2018)
- Saponification Value of WASO is 187 mgKOH/gm . Saponification is the process of breaking down or degrading a neutral fat into glycerol and fatty acids by treating the fat with alkali. The milligrams of potassium hydroxide (KOH) needed to saponify 1 g of fat is known as the saponification number (value). It is an index of average molecular weight of the triacylglycerols in the sample. Saponification value is also used in checking adulteration The ability of the oil to produce soap increases with the saponification number. (William Odoom 2015)
The Saponification value of Groundnut id 189 mgKOH/gm & Palm oil has 197 mgKOH/gm (Pandurangan, et al.2014)
The Saponification value of Soya oil is 165.2 mgKOH/gm & Sunflower oil has 198.8 mgKOH/gm (Fazal Wali, et al 2014)& (Tilahun, et al.2018)
- Peroxide value of WASO is 7.4 meq/kg . Peroxide value is define as The measure of degree of primary oxidation that takes place in oils and fats due to certain reactions that include hydroxyl group and oxygen molecule to produce hydro peroxides is known as the peroxide value of oil. (Sarwar, et al.2016).
The oil samples having the peroxide value more than 10meq/kg is considered to be rancid and has various health hazards that includes, Diabetes, Obesity, cardiovascular diseases, infertility, etc. There can be adverse effects on human health due to consumption of fried food cooked in rancid oil. (Seth 2019). (Sana Bustani 2023).
The Peroxide value of Groundnut id 1.9733 meq/kg & Palm oil has 7.48 meq/kg (Pandurangan, et al.2014)
- Iodine value of WASO is 102 g I₂/100g. Iodine value is a measure of the degree of unsaturation of organic compounds and is obtained by measuring the amount of iodine absorbed over a period of time. (Nabaraj Adhikari 2022)
It is an important indicator of the physical and chemical properties of oils and is important for the quality of edible oils and their use in the food and oil chemistry industry. Oils with higher IV are more susceptible to oxidation (Bahruddin Saad, et al.2008).
The Iodine value of Groundnut is 95 g I₂/100g & Palm oil has 55.11 g I₂/100g (Pandurangan, et al.2014) .The Iodine value of Soya oil is 99.6 g I₂/100g & Sunflower oil has 115.5 g I₂/100g (Fazal Wali, et al.2014) & (Tilahun, et al.2018)
- Specific gravity of WASO is 0.83. (Ratnesh Kumar, et al.2018)
The Specific gravity of Groundnut id 0.911 & Palm oil has 0.934.(Pandurangan, et al.2014) The Specific gravity of Soya oil is 0.4 & Sunflower oil has 0.466 (Fazal Wali, et al.2014) & (Tilahun, et al.2018)
- Moisture contents of WASO is 2.18g. Moisture contents are important determinants of oil quality .Low moisture content will extend shelf life by preventing oxidation and rancidity processes, hence it is preferable to maintain it. Higher moisture content in oils leads to rancidity and affects its keeping quality. Hydrolytic rancidity of fats and oils is due to presence of high moisture. (KN Satheeshan, et al.2019)
- Viscosity of oil is measured by (DV-1) visco meter instrument using 634.5 mPa.s with SPL .

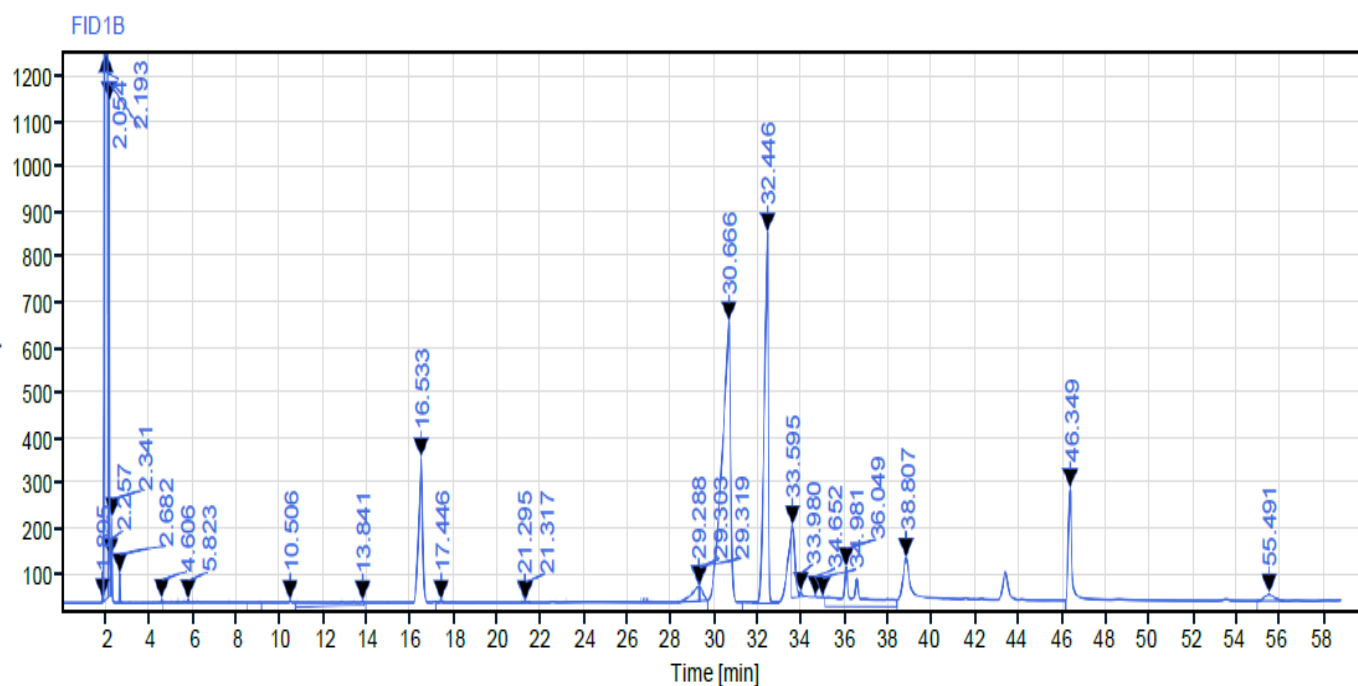
3.3 Fatty Acid composition with Vitamin E & Thymol content

table 2:- fatty acid profiling of waso:-

S.N	Test Parameter	Measurement Unit	Test Method	Test Result
1	Saturated fatty acid			
A	methyl laurate (c12:0)	g/100g	ANtr/7.2/RES/ 09	1.62
B	methyl myristate (c14:0)	g/100g		1.74
C	methyl pentadecanoate (c15:0)	g/100g		0.44
D	methyl palmitate (c16:0)	g/100g		18.52
E	methyl stearate (c18:0)	g/100g		9.02
F	methyl arachidate (c20:0)	g/100g		0.81
2	Mono unsaturated fatty acid (MUFA)			
A	cis-9-oleic acid methyl ester (c18:1)	g/100g	ANtr/7.2/RES/ 09	23.89
B	methyl cis-11 eicosenoate (c20:1)	g/100g		0.52
3	Poly unsaturated fatty acid (PUFA)			
A	gamma-linolenic acid methyl (c18:3)	g/100g	ANtr/7.2/RES/ 09	9.23
B	methyl linolenate (c18:3)	g/100g		16.55
Total Saturated fatty acid (SFA)				32.15
Total Mono unsaturated fatty acid (MUFA)				24.41
Total Poly unsaturated fatty acid (PUFA)				25.78
Total Fat Content				82.34
4	Vitamin D by HPLC	mg/100g	By HPLC	0.03
5	Vitamin E	mg/100g	By HPLC	54.33
6	Thymol	mg/100g	By GCMS/MS	20.41

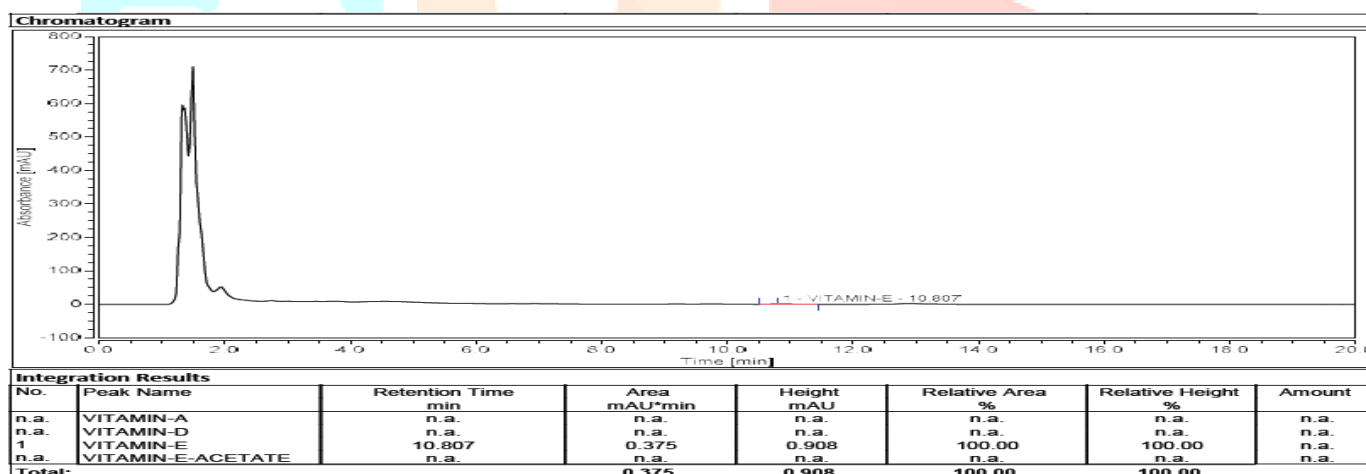
- Vitamin D is an essential nutrient for bone health and has been increasingly recognized as a factor in immune system modulation, musculoskeletal health, cancer, and other aspects of health and disease. The usage of calcium and phosphorus by the body is greatly influenced by vitamin D. It functions by enhancing the absorption of calcium from the small intestine, which aids in the formation and maintenance of bones. By aiding in immunity and regulating cell formation, vitamin D helps the body. Vitamin D is especially important for children because it helps them grow strong bones and pearly whites. (Kathrine, et.al.2018)
- Vitamin E is the most potent lipid-soluble antioxidant in human plasma. I The main natural source of vitamin E in a person's diet is edible vegetable oil, which is typically extracted through the distillation process of refining and deodorizing vegetable oil. Vegetable oil has a unique nutritional profile that includes vitamin E, a micronutrient that influences the nutritional value and oxidative stability of the oil. Additionally, vitamin E has eight isomers, including α , β , γ , and δ , as well as four tocopherols and four tocotrienols. It is a fat-soluble vitamin. (Xuemei, et.al.2021)
Vitamin E (VE) is an essential fat-soluble nutrient in numerous foods such as nuts, seeds and vegetable oils. As a natural antioxidant, VE could stop the production of reactive oxygen species (ROS) formed when fat undergoes oxidation. In addition, VE is of clinical importance for the modulation of immune function, as it affects the susceptibility of the host to infectious diseases. (Yu Zhang, et.al.2022)
Vitamin E value of Soybean Oil is 94.9 mg/100g (Li Xue, et.al.2023)
- Thymol can be used in medicine and has been shown to possess various pharmacological properties including antioxidant, anti-inflammatory, antibacterial, antifungal, antiseptic and antitumor activities. (Mohamed, et.al.2017)
Thymol is included in the list of Generally Regarded As Safe (GRAS) for use as a food additive by the United States Food and Drug Administration (FDA). Thymol is used in the food industry as a natural preservative due to its antimicrobial activity. There are various natural sources of essential oil which contain thymol. Out of these some sources which contain high percentage of thymol are *Thymus vulgaris* which contain 39.5% thymol, *Thymus Algeriensis* contain 48.8% thymol, *Thymus Zygis* contain 19.5% thymol, *Trachysperman ammi* contain 17.4% thymol, *Feronia limonia* contain 20.41% thymol. (Angelica, et al.2020)

3.4 Fatty Acid Profiling:-

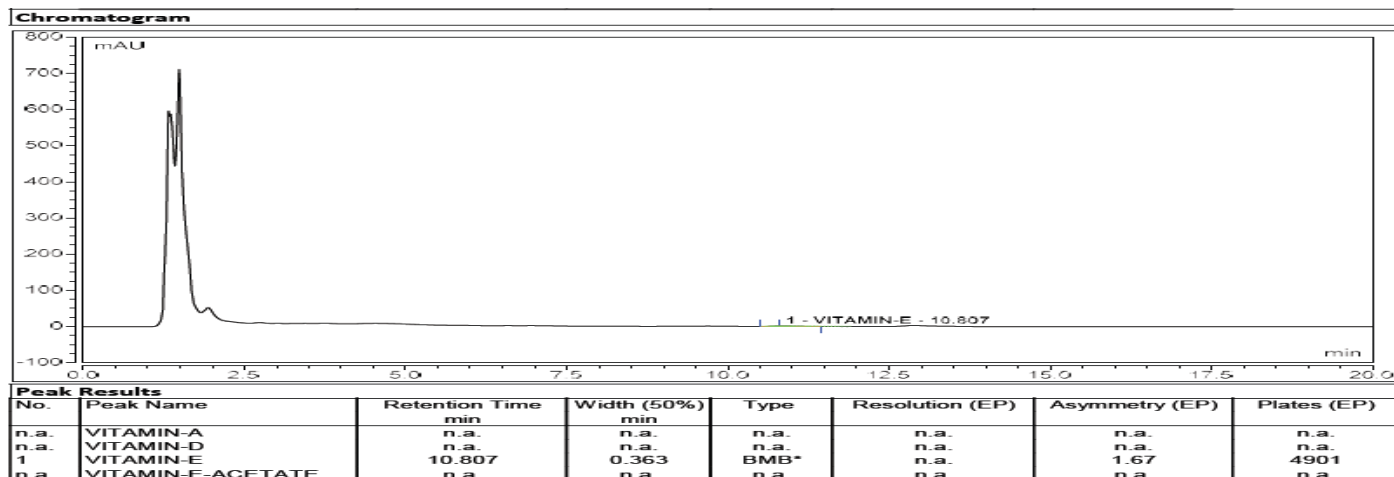


graph 1:-fatty acid profiling

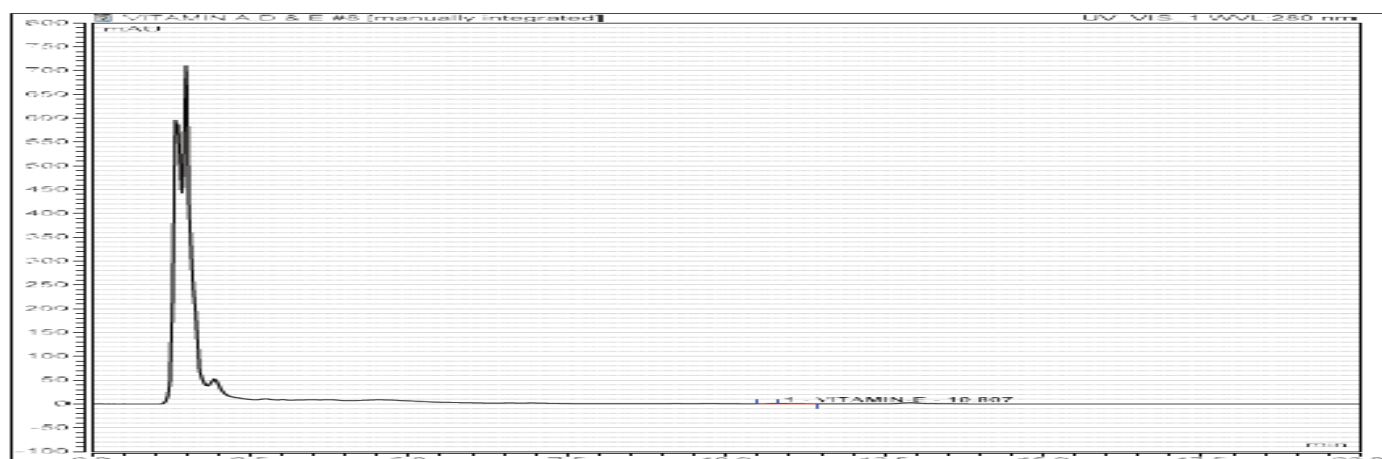
3.5 Vitamin E:-



Graph 2:- Integration Results of Vitamin E (Step-1)



Graph3:-Peak Results of Vitamin E (Step-2)



Graph4:-Chromatogram of Vitamin E (Step-3)

table 3 : the content of sfa, mufa, pufa (%) in different types of vegetable oils.

Type of Oil/Fat	SFA (%)	MUFA (%)	PUFA (%)
WASO	32.15	24.41	25.78
Coconut oil	90.5	8.8	0.5
Soybean oil	13.5	28.5	57.5
Sunflower seed oil	8.8	31.5	59.5
Peanut oil	19.2	58.5	20

(Vesna Kostik, *et al.*2017)

IV CONCLUSION:-

- From the current research work it is found that wood apple seed oil is prepared from wood apple seeds. The quality of the oil depends on the physicochemical properties.
- Acid value of the wood apple seed oil represent stability of oil at room temperature because high Acid value leads to unpleasant flavor & odor generation.
- Free fatty acid value indicates that it is edible oil. IV value is important parameter of oil because oil having higher IV have higher oxidation rate.
- Vitamin E is essential fat soluble nutrient which can be obtained from wood apple seed oil. It is the alternative source for vitamin E.
- Thymol is present in wood apple seed oil therefore this oil can be used as a preservative for different food products.
- The results obtained from GCMS shows that unsaturated fatty acids are more than saturated fatty acids. Cholesterol is absent in WASO. Therefore wood apple seeds are a good source of essential fats. It can be used for cooking.
- Therefore, it is concluded that alternative source for edible oil is obtained and wood apple seed oil is extracted from Soxhlet apparatus.

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