**Original Research Article**

# EXTRACTION AND GC-MS ANALYSIS OF OIL FROM RED POTATO PEELS (*SOLANUM TUBEROSUM*)




## ABSTRACT

Extraction and GC-MS analysis of oil from red potato peel was carried out. The potato used for this research work was gotten from Amassoma market, Southern Ijaw, Bayelsa state. The potatoeswere washed severally with water and peeled. The peels were sun dried for three (3) days and then pulverized to powder with grounding engine to increases the surface area. 250 g of the pulverized sample was weighed into a brown bottle and 900 mL of n-hexane was added and allow to macerate for 72 hours. The solvent was evaporated at room temperature $25^0$C to get the oil. 18 components were detected by the GC. The mass spectrometer identified the structure and names of the compounds. The compounds found are 2-ethyl-1,4-dimethy benzene 1.094 %, bicyclo [4.4.0] decan %, 2-hydroxy-4-methoxybnezaldehyde 10.715 %, 1-hexadecanyl-4-methybenzylsulfonate 5.825 %, 2-heptadecanl 3.0045 %, N-hexadecanoic acid 27.124 %, Z-8 heptadecene 4.090 %, 2-heptadecenal 7.516 %, tricyclo [4.3.1.1(3.8) undecan-3-1ol 2.9962 % , oleic acid 20.199 %, linolenic acid 3.062 %, 2-Methylhexacosane 2.488%, Cholestero acetate 0.863 %, 5-cholestine-3-ol-2methy 1.982% and 4-(2-methylpropxyphenyl)-2-methylpropylpenoate 3.067 %. From the result, It can be said that red potato oil has both pharmaceutical and cosmetic uses.

Keywords: Extraction, characterization, oil, Red potato, Peels

## 1.0 INTRODUCTION

Tubers are underground plant organs that are swollen and enlarged to store nutrients David(2018). Some of the most important tubers that are edible include potato (*Solanum tuberosum*), cassava (*Manihot esculenta*) and yam (*Dioscorea batatas*) from Michael (2018). Potato(*Solanum tuberosum*) is a starchy tuber grown from vegetative leaves; it has its origin from South America, most likely from the central Andes in Peru, Abraham (2022).However potato (*Solanum tuberosum*) is a globally important crop ranking fourth in term of annual production, after maize, rice and wheat. It is also the most economically food crop that is not a grain Fabia, Vanessa,Edvar(2018). Potatoes are great source of fiber, potassium, vitamins and other essentialnutrients and it has many health benefits when consumed such as improving digestion, reducing inflammation, improving insulin sensitivity in diabetes (Food savvy) Megan(2015).

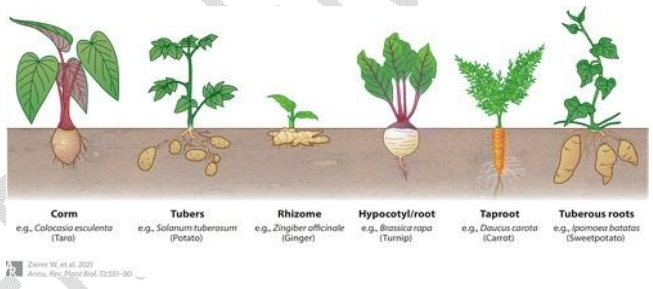


***Fig1.0 picture showing tuber and tuberous plants***

***Fig2 . Image showing potato peels and tubers***

Potatoes are generally consumed in different ways by different people daily therefore the shifting of consumption rate from fresh to more processed food such as potato chips, Crips, puree, French fries has increase in the generation of potato peel waste which account for about 40% of its original weight Niran,khalife, Pankaj, Dhanapati, Utpal and Biraj (2022). Before consumption the potato plants are peeled and if the by-product which are agro industrial waste are not processed carefully they decompose rapidly by bacterial resulting in the release of foul odourand causing air pollution Pranav, Sachin, Mandavgane, Nikhil, Swpnil and Bhaskar. (2017).Instead of accumulating waste product in the environment, these waste peels from potato plants can be processed into various forms which could be used as antioxidant, antimicrobial, pharmaceutical ingredients, and pig feed Haftom, Gebrechristos and Weihua (2018).

The application of essential oils has been given much attention as they are better source of several bioactive compound, they are currently preferred over the synthetic oils Giovanna, Ksenia, Christine and Scampicchio. (2020). Essential oils are aromatic volatile liquid that are obtained from plant material through steam distillation. The name of an essential oil indicates the plant from which it is derived, for example lavender essential oil is obtained from the lavender plant Jose-Luis (2016). The present study is therefore based on the extraction of oil fromred potato peels.The quest for knowledge on how to get oil that is more conducive for consumption, industrial and pharmaceutical utilization has led man into considering what is considered as waste to be raw material for another purpose. Hence this potato (*Solanum tuberosum*) peel seen as waste will be seen as raw material/resource for oil extraction or production.

Extraction of oil from plants has many methods which include pressurized liquid extraction etc. However, to maintain their bioactivity, the use of suitable extraction techniquessuch as hydro distillation, steam distillation and soxhlet extraction requiredprofessionals and skilled operators are required.Availability of the instruments listed above are limited and as well requires financial needs.

Earlier studies revealed that essential oils are of great important and have specific characters Orodu and Ivan (2021). The first evidence of essential oils was recorded from ancient India, Persia and Egypt. Both Greece and Rome carried out extensive trade in odoriferous oils and ointment. The products were gotten by placing flowers, roots, and leaves in fatty oils but with the coming of advance technology the Arab culture developed for distillation of essential oils. From the report, the major constituents of odorous plants are geraniol (a monoterpenoid component of rose oil) and citronellol which is found in citronellol oil; both oils are used as component of many fragrance and food flavoringsMichele (2023).

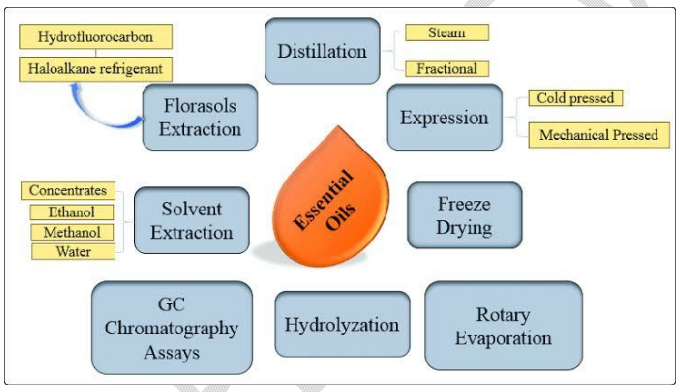


Fig. 3***Several method for extracting essential oil from different plants.***

The processing of fruits in an industrial scale generates significant amount of waste, in the form of peel, seeds, cores, pulp and other discards. This waste material is often fed to livestock or simply disposed, placing a burden on the environment. This has led to efforts to find new uses for fruit processing waste, such as the extraction of valuable compounds or production of biofuels Shweta, Anupama and Prabhat (2022).The conversion of food processing waste into valuable products represents an innovative way to make use of these materials in a more suitable manner (National Library of Medicine) Harsh, Kanchan, Kamil, Daljeet, Eugenie, Ruchi, Rachina, Somesh and Dinesh(2016).According to Mercy, Mub, and Jenifer (2022) who has done research on the application of different fruit peels as a natural fertilizer, fruit peels can

be used as neutral natural fertilizer because they contain vitamins that promote plant growth as well as benefits for both the environmental and human health, (the strength of the fruit peel).Adel, Mohamed, Awad and Moamed (2010) used a spectrophotometer instrument with methanol as reagent reported that extracts from potato peel can be applied as a source of antioxidant and antimicrobial substances in food, also as medium of achieving additional income and a means of minimizing waste disposal issues. Due to the abundance of nutrients and minerals found in banana peels, there is the potential to use them in a variety of food and non-food applications it was reported that banana peel can be used in food, pharmaceutical, and other industries Wafaa, Hussein, Amra, Kirill, Jauad, Miroslava, Mohamed, andAtanassova(2022). Mordi, Fadiaro, Owoeye, Olanrewegu, Uzoamaka and Olorunshola (2016) identify components present in the oil of banana peels extract using GC-MS. Two varieties of banana (musasapientum and musaacuminatacolla) were gotten from Nigeria and identified in the biological science department of Covenant University. The peels of the bananas were cut into small pieces and soaked in methanol for extraction; the extraction process was performed in a soxhelt extractor. The methanolic extract was analyzed for its phytochemical composition, revealing the presence of steroids, saponins terpenoids, anthraquinones and tannins. The chemical constituents of the oil were identified and characterized by GC-MS and the most abundant component was fatty acids.

According to Hevze and Archimede (2016) Banana peels (musasapientum) have been shown to contain a range of nutrients including protein, fats and carbohydrate. The minerals include phosphorus, iron, calcium, magnesium and Amino acid such as leucine, valine, phenylalanine and threonine.Hamid, Abdollaah and Masripan reported that the research performed on three types of banana peels using N-hexane as solvent and morphological studies shows that the presence of follicular gel in the banana peels plays a critical role in the formation of essential oil without the gel it would have been more difficult to extract the oil from the peels. Orodu*et al*(2021) reported that the oil extracted from pineapple peels characterized by GC-MS contains a number of different components including limonene, palmitic acid, n-decimal, 1-

cyclohexane, -1- carboxaldehyde, alpha-farnesenetarus caryophyllene and myrcene. The most abundant component is limonene while the other components are present in smaller amounts.

Melkiyas,Bulcha, Abnet and Ramesh(2022) extracted oil from avocado peels using N-hexane as solvent after the extraction the oil was characterized for its physicochemical properties, the acid content was found to be of higher value while free fatty acid content was lower in value. In another study on the properties of oil extract from avocado peel, itwas reported that the oil is low in level of saturated fat, it can be used in cosmetic industries, and it contain high amount of anti- cholesterol agent by(Tafere2021).According to Shweta *et al*(2022) citrus waste like other types of waste can have negative environmental impacts if not managed properly. Darwin, Favian, Edison and Morayma (2020) in research extracted oil from peels of orange and it was recorded that sodium bicarbonate can be used to enhance the extraction of essential oils from orange peels by simple distillation method. Bli, Smith, and Hossain (2006) determine the phenolic content of citrus peels (citrus Lemon) and in order to optimize the extraction of phenolic compound from citrus peels various factors were studied including the condition of the peel sample, solvent type, solvent concentration and extraction temptation. The report shows that ethanol was found to be the most effective solvent for the extraction of phenolic compoundsfrom citrus peels.Recent studies revealed that lemon peels are rich in oil-producing glands composition of essential oils extracted from lemon peels can vary depending on the type of lemon grown and the specific location where it was grown, these oils are used in perfumery, food and pharmaceutical industries. In the food industry they are used to flavor and scent a variety of products such as sweet beverages and cakes. In the pharmaceutical industry they are used to improve the taste of distasteful medication

## 2.0MATERIALS AND METHODS

2.1 Materials: The material required for this research work are cotton wool, funnel, retort stand, Extraction bottle, Electrical weighing balance, Measuring cylinder, sample bottle andRed potato peels. The reagent required for this research work is N-hexane and is of

analytical grade gotten from Onitsha market Anambra State. The potato used for this research work was gotten from Amassoma market, Southern Ijaw, Bayelsa State.

2.2Method:The method of extraction used for this research work is cooled extraction method

2.3 **Sample preparation**

The potato were washed severally with water and peeled, the peels were sun dried for 2days and then pulverized to powder with grinding engine to increase the surface area. 250g of the pulverized sample was weighed into a brown bottle and 900mLof n-hexane was added and allowto maceratefor 72 hours. The reagent was filtered from the sample into a beaker and allowed to vapourize till the extracted oil was left. The oil extract was then transferred into a small brown bottle for GC-MS analysis.

**2.4 INSTRUMENTATION:**

The technique known as Gas chromatograph –massspectrometry (GC-MS) combines the capabilities of mass spectrometry and gas chromatoraph to identify various compounds present in a test sample.

Fig 4GC-MS Agilent Technologies – 7890A

**2.5 CHEMICAL IDENTIFICATION**

Agilent technologies GC-MS7890A GC. Gas Chromatogram with Agilent technologies 5975C MSD mass spectrometer connected to triple axis detector and capillary column HP5MS(30 m x 025mm ID 0.25u) made of 5% diphenyl 95% dimethyl polysiloxane for Agilent technologies GCSM. A70 eV ionizing energy electron indication system was employed. The carrier gas which was 99.99% helium gas was utilized at a steady flow rate of mL/min. an injection volume of 1 µL was used at split ratio of 50:1 the injection temperature was set at $50^0$C while the ion source temperature was set at $250^0$C. With the software of GCSM mass Hunter the relative percentage amount of each component was determined by comparing its average peak area to the total areas for the examination of chromatograms and spectra

## 3.0RESULTS AND DISCUSSION

### 3.1 RESULTS

The abundance of component present in oil exract of potato was determined analytically as shown in figure 5and table.1 with the use of Agilent technologies 5975C MSD Mass spectrometer connected to triple axis detector.

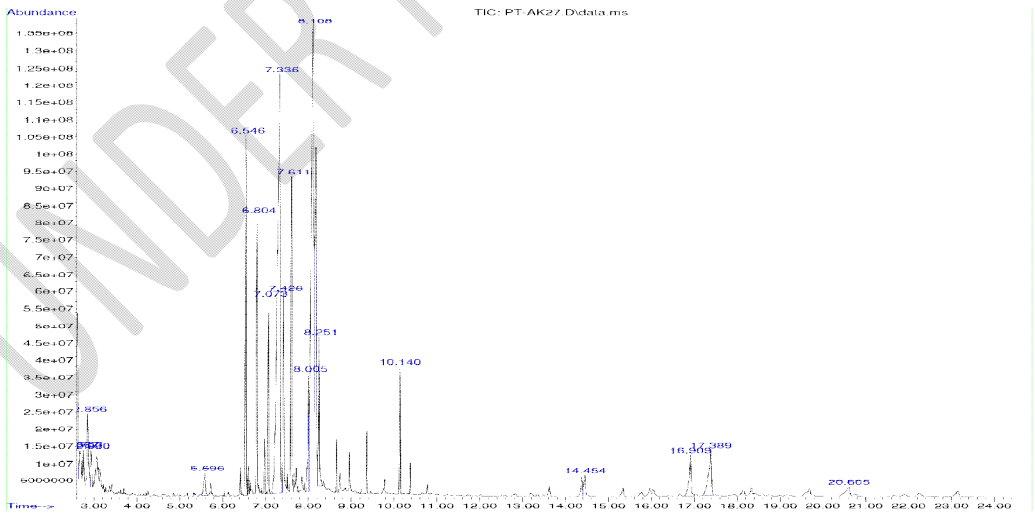


Fig5 CHROMATOGRAM OF MAJOR COMPONENTS OF RED POTATO PEELS

**TABLE 1 SHOWNING COMPONENTS COMPOSITION PRESENT IN OIL EXTRACT**

| PEAK No | COMPONENT NAME | RETENTION TIME (MIN) | % |
|---|---|---|---|
| 1 | 2-ethyl-1,4-dimethy benzene | 2.669 | 1.094 |
| 2 | Bicyclo [4.4.0]decane | 2.753 | 0.896 |
| 3 | 1,2 benzenedimethanol | 2.850 | 2.376 |
| 4 | O-cymene | 2.930 | 0.823 |
| 5 | Dodecanoic acid | 5.596 | 0.910 |
| 6 | 2-hydroxy 4- methyl bnezaldehyde | 6.546 | 10.751 |
| 7 | 1-hexadecanyl 4-methybenzylsulfonate | 4.073 | 5.825 |
| 8 | 2-heptadecanol | 7.073 | 3.045 |
| 9 | N-hexadecanoic acid | 7.336 | 27.124 |
| 10 | Z-8-hexadecene | 7.428 | 4.090 |
| 11 | 2-heptadecenal | 7.611 | 7.516 |
| 12 | Tricyclo [4.3.1.1(3.8) undecan-3-ol | 8.005 | 2.962 |
| 13 | Oleic acid | 8.108 | 20.199 |
| 14 | linolenic acid | 8.251 | 3.062 |
| 15 | 2-methylhexacosane | 10.140 | 2.488 |
| 16 | cholestero acetate | 14.454 | 0.863 |
| 17 | 5-cholestie 3-ol 2methy | 16.909 | 1.982 |
| 18 | 4-(2-methylpropxyphenyl)-2-methylpropylpenoate | 17.389 | 3.067 |



**3.2 DISCUSSION**

2-ETHYL-1,4-DIMETHY BENZENE : Is a colourless non-polar organic solvent with the molecular formula $C_{10}H_{14}$.Its concentration in potato peel oil was found to be 1.094% with a retention time of 2.667. It serves as an inndispensable component in diverse industries including pharmaceutical, food and bereverage testing and wide range of chemical processes with the molecular formula $C_{10}H_{14}$

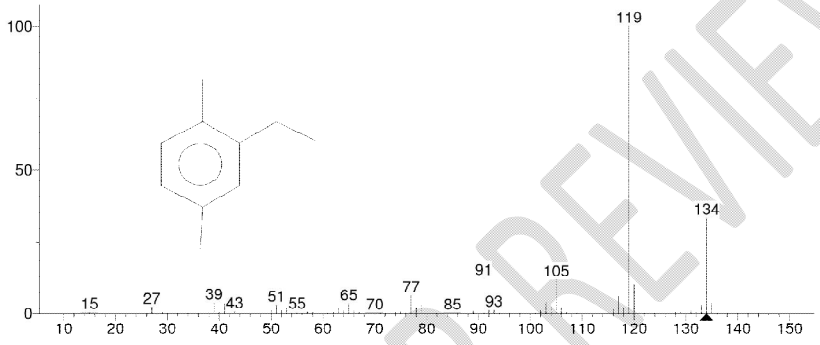


Fig 6SPECTRUM OF 2-ETHYL-1,4-DIMETHYL-B ENZENE

BICYCLO [4.4.0]DECANE: The structure is shown in Fig 7. It is a bicylo organic compound with a molecular formula $C_{10}H_{18}$. The percentage present in the oil is 0.896%with a retention time of 2.753. It is an industrial solvent, a colourless liquid with an aromatic odour it is used as a asolvent for many resins or fuel additives, it is the saturated analog of naphthalene.

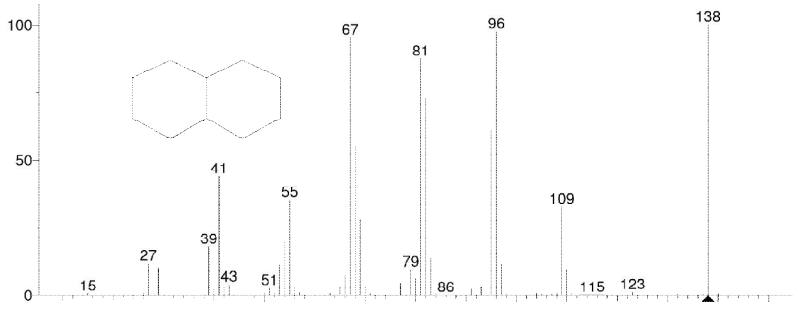

Fig 7SPECTRUM OFBICYCLO [4.4.0]

1,2 BENZENEDIMETHANOL: The structure presented in Fig 8. It has a chemical formular $C_8H_{12}O_3$, The percentage present in the oil is 2.376%, with a retention time of 2.856. It is a substance with a wide range of industrial uses. It is a colourless liquid with hydroxyl and benzene functional groups. It is also known as O-benzenlresorcinol, it is frequently empoyed as precursor in the prodution of polymer dyes and medications, because of its antibacterial qualities. 1,2 benzenedimethanol is frequently used as a preservative in cosmetic and personal hygiene products.

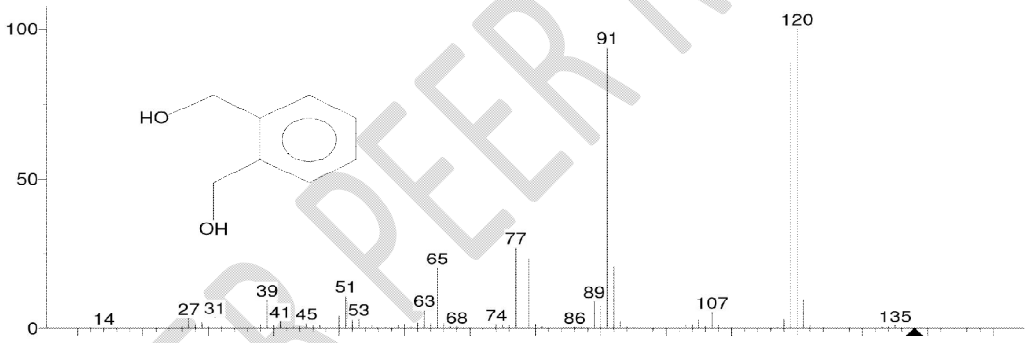


Fig 8SPECTRUM OF1,2 BENZENEDIMETHANOL

O-CYMENE: O-cymene also known as p-isopropytoluene is a naturally occurring aromatic organic compound with a chemical formula of $C_{10}H_{14}$, and its structure is given in Fig 9. Its concentration in potato peel oil was found to be 0.823% with a retention time of 2.930. It is

classified as a hydrocarbon related to a monoterpene; It is sued in flavour and fragrance industry.

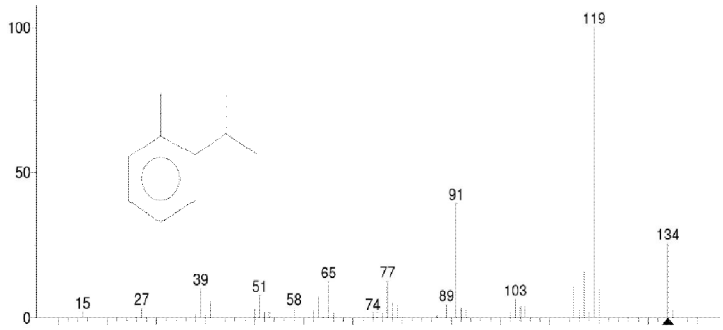


Fig 9SPECTRUM OFO-CYMENE

DODECANOIC ACID: Its structure is shown in Fig 10. Itis a saturated fatty acid used as an intermediary for food grade additives and to create esters for fruit flavours and scents. Saturated fatty acid with carbon intensive chains function as a valuable oil component, algal metabolite, a human metabolite, an antibacterial agent, and ant-inflammatory agent.Its concentration in potato peel oil was found to be 0.910% with a retention time of 5.596.

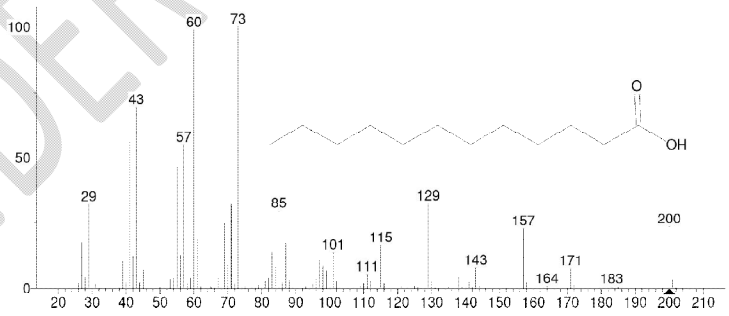


Fig 10SPECTRUM OFDODECANOIC ACID

2-HYDROXY-4-METHOXY BENZALDEHYE: Its structure is presented in Fig 11 Is a flavour compound that is found in roots and rhizomes of medicinal plants. With a chemical formula $C_8H_8O_3$ and its molecular weight is152-147, its concentration in potato peel oil was

found to be 10.715% with a retention time of6.546. It is used in the synthesis of ligand; it functions as a bacterial, metabolite, urine metabolite in humans, and insect repellent.

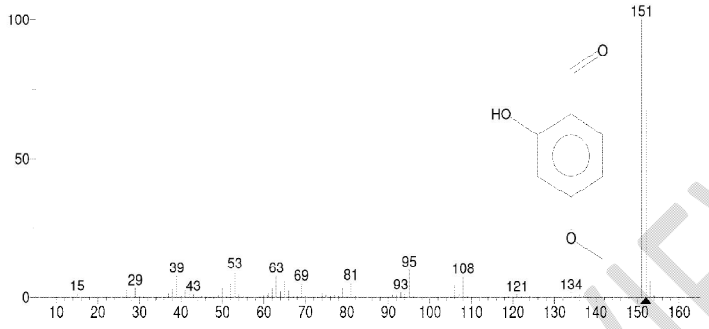


Fig 11SPECTRUM OF2-HYDROXY-4-METHOXY BENZALDEHYDE

1-HEXADECANYL-4-METHYBENZYLSULPHONATE: Its structure is presented in Fig 12. It has a molecular formula of $C_{23}H_{40}O_8S$. Its concentration in potato peel oil was found to be 5.825% with a retention time of 6.804.1-hexadecanyl-4-methylbenzylsulphonate is applied in cosmetic industry as an opacifier in shampoos or as an emollient, emulsifier or thickening agent in manufacture of skin creams and lotions.

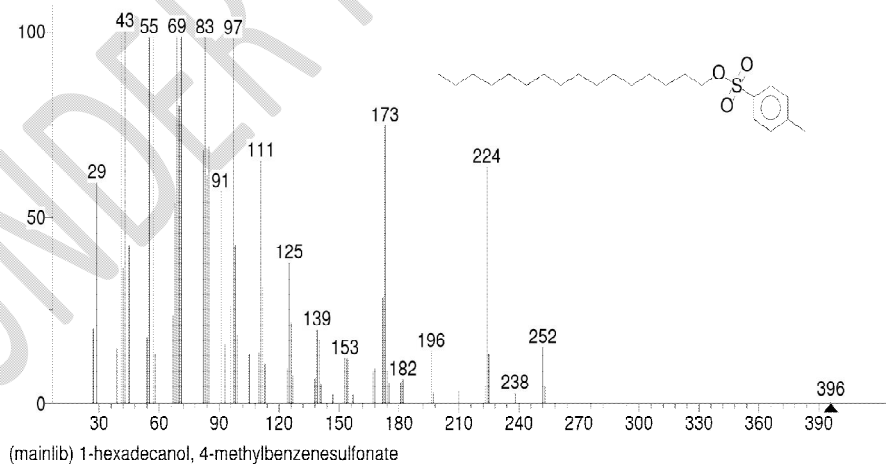


Fig 12 SPECTRUM OF 1-HEXADECANYL-4-METHYBENZYL SULPHONATE

2-HEPTADECAINOL: The structural formula is shownin Fig 13. It is a secondary fatty alcohol with a molecular formula of $C_{17}H_{36}O$ having 3.045% as its percentage concentration present in the oil with a molecular weight 2565g/mo/ and aretention time of 7.073.Itfunctions as an animal metabolite, plant metabolite and a bacterial metabolite.

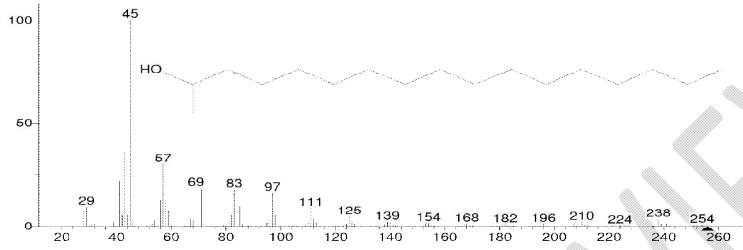


Fig 13SPECTRUM OF2-HEPTADECANOL

N-HEXADEANOIC ACID: Is known a palmitic acid, it is a fatty acid that has 16 carbon chains that is found in animals, plants, and micro-organism. It possesses anti-oxidant antimicrobial and anti-inflammatory activities. Its molecular formula contains $C_{16}H_{32}O_2$with a percentage concentration of27.124% anda retention time of 7.336.

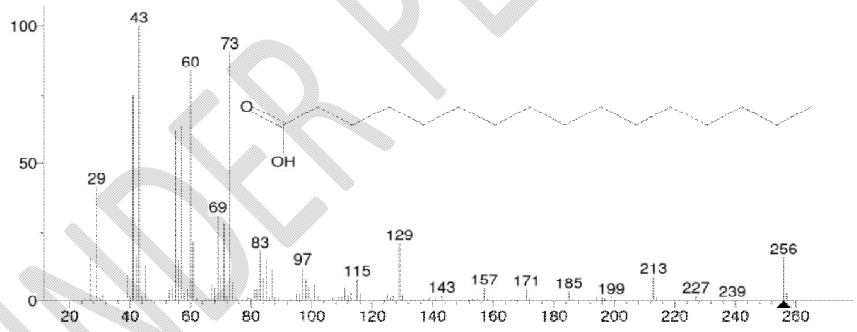


Fig 14 SPECTRUM OF N-HEXADEANOIC ACID

Z-8-HEXADECENE: It is a colorlessliquid with a molecular formula of $C_{16}H_{34}$. It is a non-polar solvent. Z-8-hexadecene has a percentage concentration of 4.090 % with retention time of 7.428 in potato oil. It is an aliphatic alkene that is a component of essential oil; it is used as lubricants, grasses incosmetics.

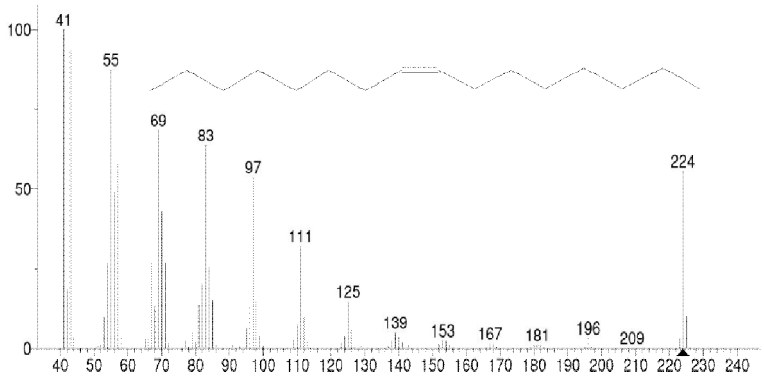


Fig 15SPECTRUM OF Z-8-HEXADECENE

2-HEPTADECENAL: $C_{17}H_{32}O$ it belongs to a group of organic compound called fatty aldehydes. It served as the proper suspending solvent for the concentration and extraction of essential oil. The concentration of 2-heptadecenal in potato oil is7.516% with a retention time of 7.611.

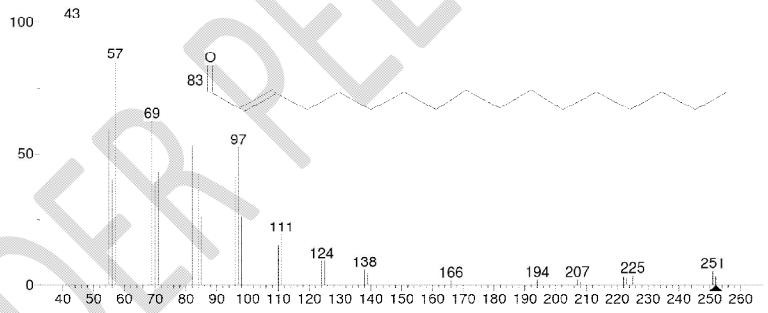


Fig 16 SPECTRUM OF2-HEPTADECENAL

TRICYCLO[4.3.1.1(3,8)]UNDECAN-3-OL:It is used as intermediate or raw materials in some drugs synthesis, it be can be used as an ingredient in perfumes and flavorings. Its concentration in oil extract of potato peel is 2.962% with a retention time of 8.005.

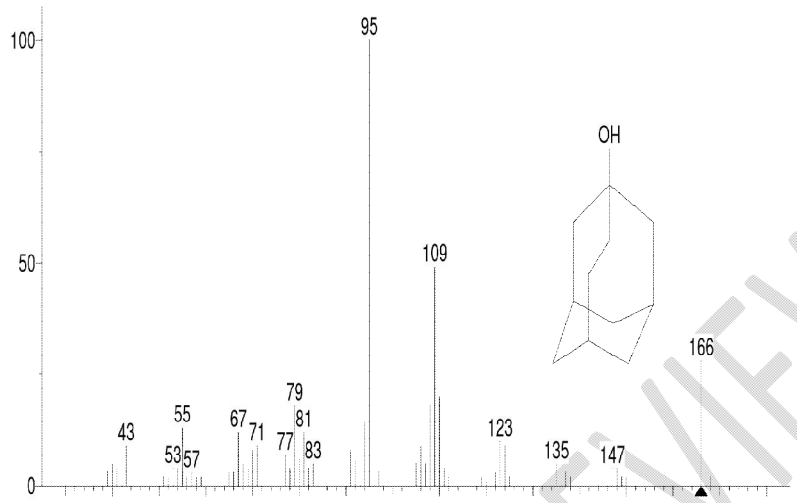

Fig 17SPECTRUM OFTRICYCLO[4.3.1.1(3,8)]UNDECAN-3-O

OLEIC ACID: This is one of the mono-unsaturated omega-9 fatty acid that can be found in both plant and animal. It isodorless, colorless oil; it has a molecular formula of $C_{18}H_{34}O_2$. Oleic acid is used in soap and detergent making, and aerosol products, it lowers inflammation and cholesterol. The concentration of oleic acid in potato oil is 20.199%with a retention time 8.108.

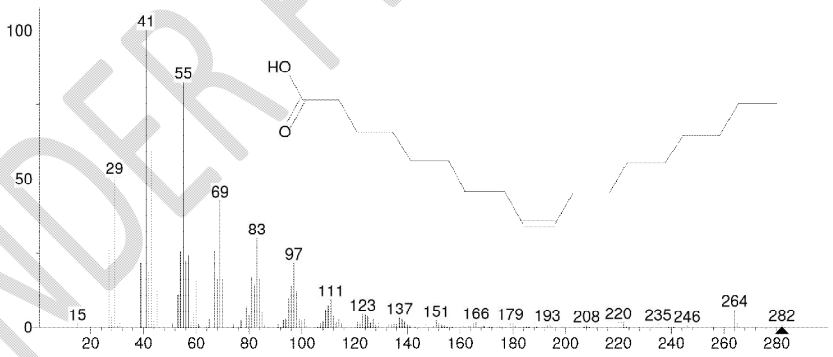

Fig 18SPECTRUM OF OLEIC ACID

9,12,15-OCTADECATRIENOIC ACID, (Z,Z,Z): It is also known as Linolenic acid: Is an omega-3 polyunsaturated fatty acid with a molecular formula $C_{18}H_{30}O_2$. It is essential to human nutrition and a common ingredient in many vegetable oils. Its potential health benefit is antidiabetic and antiobesity. The concentration of 9, 12, 15-octadecatrienoic acid in potato oil is3.062% with a retention time 8.251.

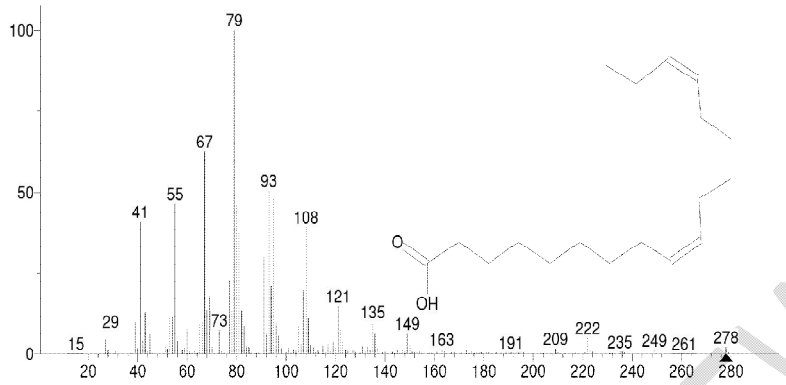


Fig 19SPECTRUM OF9,12,15-OCTADECATRIENOIC ACID, (Z,Z,Z )

2-METHLHEXACOSANE: Is a non-polar saturated hydrocarbon found in (*solanum tuberosum)* with a molecular $C_{27}H_{56,}$ it is an insect pheromone. 2.488 % concentration with a retention value of 10.40 was found I potato oil.

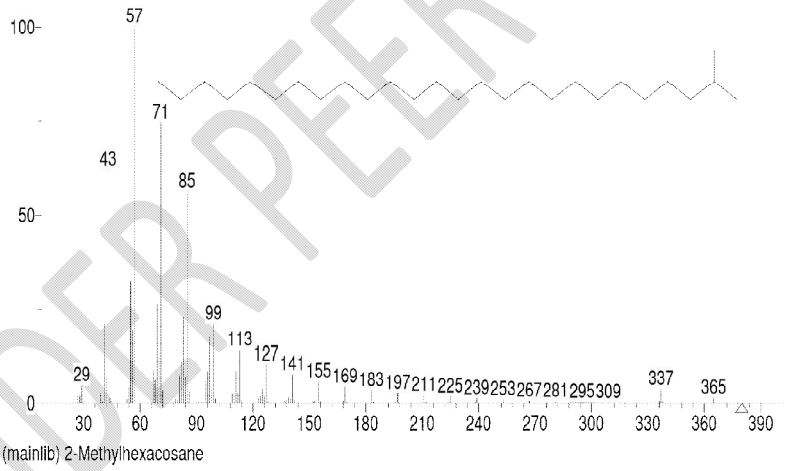


Fig 20SPECTRUM OF2-METHLHEXACOSANE

CHOLESTERO ACETATE: It has molecular formula of $C_{29}H_{48}O_2$, Itis used in cosmetic and pharmaceutical industrials. In cosmetics it functions as a skin-conditioning and viscosity-booster agent. It is used as antimalarial, anticancer, antiviral agent in pharmaceutical

industries.The concentration of cholesterol acetate in potato oil is 0.863% with a retention timeof 14.454.

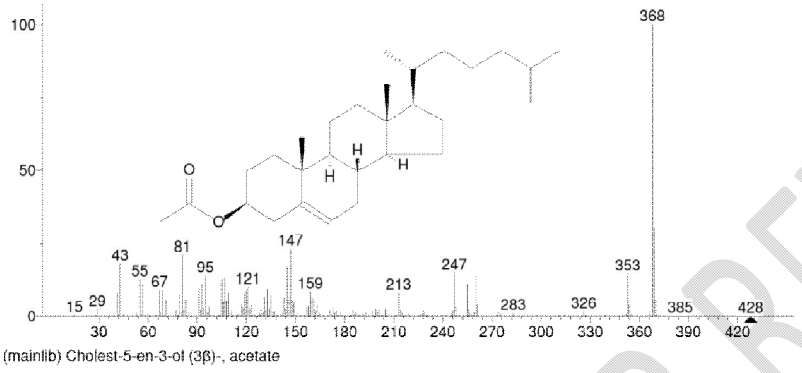


Fig 21SPECTRUM OFCHOLESTERO ACETATE

5-CHOLESTINE 3-OL, 24METHY: Is a phytosterol with a molecular formula of $C_{28}H_{40}O$ that has the ability to inhibit any cancer cells including those from the stomach, ovaries and lungs. The concentration of 5-cholestine 3-ol, 24methy in potato oil is 1.982% with a retention time of 16.909.

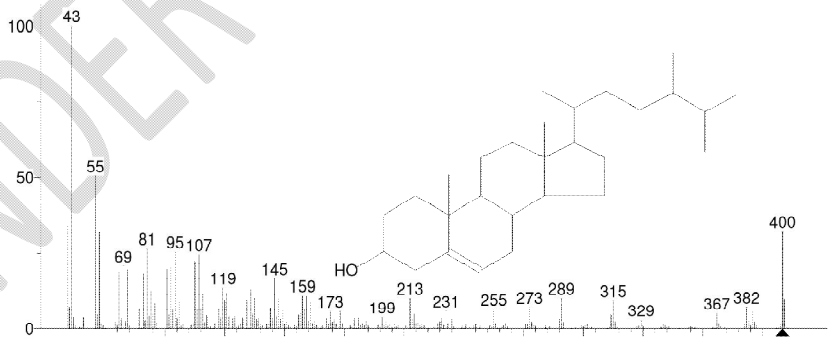


Fig 22 SPECTRUM OF5-CHOLESTINE 3-OL, 24METHY

P-COUMARIC ACID, 2-METHYLPROPYL ETHER, 2-METHYLPROPYL ESTER: It is a natural metabolite found in many edible plants; it has a molecular formula of $C_{17}H_{24}O_3$also refer to as 4-(2-methylpropxyphenyl)-2-methylpropylpenoate. It is used in the cosmetic and personal care product. It is mostly used in the formulation of eye makeup, skin makeup, lipstick it gives the skin a soft and smothering appearance. The concentration of p-coumaric acid, 2-methylpropyl ether, 2-methylpropyl ester in potato oil is 3.067% with a retention time 17.389.

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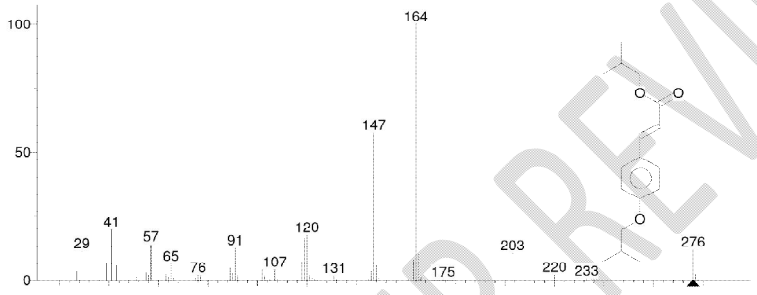


Fig 23 SPECTRUM OF P-COUMARIC ACID, 2-METHYLPROPYL ETHER, 2-METHYLPROPYL ESTER

## 4.0 CONCLUSION AND RECOMMEDATION

### 4.1 CONCLUSION:

In order to highlight the problem statement the background of this study was completed, to gain aadditional knowledge regarding oil extract from plants a large body of literature were reviewed. However the quest for knowledeon how to get oil that is more conducive for consumption, industrial and pharmacectical utilization has led to analysed what is onsidered a waste to be a raw material for other purpose, hence the oil extract from potato peel was analysed.The result obtained from the oil extract using the GC-MS was found to be as followsN-hexadecanoic acid (27.124%), oleic acid(20.19%), 2-hydroxy-4-methoxybenzaldehyde (10.715%), 1-hexadecanyl 4-methybenzylsulphonate(5.825%), linolenic acid(3.062%) and 1,2 benzenedimethanol (2.376%). Based on this result the oil extract from the potato peel is useful both pharmaceuticals and cosmetics induustries.

## 4.2 RECOMMEDATION:

The study have shown that potato peel has useful component which will be beneficial to humanity so we recommed that the government should provide machinery that could readily collect this waste seen to be agro waste to be a raw material for both the pharmaceutical and cosmetics industries.

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