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Chemical Characterization Of Extracted Ginger Oil Using GCMS

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ABSTRACT

Aromatic plants are the species whose leaves, flowers, roots or other parts produce and release pleasant smells. Essential oils are plant extracts which are highly concentrated and are obtained from different parts of plants.Steam Distillation method is used to extract the essential oil of Ginger due to its quicker extraction time ,and simplicity of use. Mainly those compounds are separated from this method which are highly sensitive to the temperature. And component are observed after the analysis of GCMS(Gas Chromatography and Mass Spectrometry). After studying we found the component present in ginger are of mainly phenolic and tarpenoid compound. Eugenol is one of the compound which is found as phenolic and Endo Borneol as tarpenoid compound .While having the analysis we found 10 compounds are observed as major in which Eugenol having a percentage of 78.81.

INTRODUCTION

Aromatic comes from word 'aroma' which means fragnance.[1] Aromatic plants are those compounds that contain aromatic compounds have essential oil that are volatile at room temperature. The term fragrances may also apply to synthetic compound such as those use in cosmetics [2].

Aromatic plants are also known as herbs and spices that have been used in the middle east since approximately 5000BC For their preservatives and medicinal properties, for enhancing the aroma and flavour of foods [3-5]. Aromatic plants synthesis and preserve a variety of biochemical products, many of which are extractable and useful as chemical feed stocks or as a raw material for various scientific investigations. Many secondary metabolites of a plant are commercially important and find used in a number of perfumery and flavouring and pharmaceutical compound. The term essential oil is concomitant fragrance or perfumes because these fragrances are oily nature and they represent the essence or active constituents of plants. They are volatile [6] or essential oils as they evaporate when exposed to air at ordinary temperatures[7].

The oil to be present in the plant depends upon the different plant species [8] as oil to be found in stem, flower, fruit, and many other different parts of the plant. As the essential oil soluble in many polar solvents such as toluene, acetone, ethanol and methanol which having comparatively less dense than water [9]. Essential oil can be used for thousands of year, for their medicinal and therapeutic and aromatic properties in various culture. The most common use of essential oil in Aroma therapy, in which it inhaled by the person for their physical and emotional well being.

Although essential oil is very useful but it is also important to note that these highly concerned substances so we have to take precaution while doing any analytical analysis.

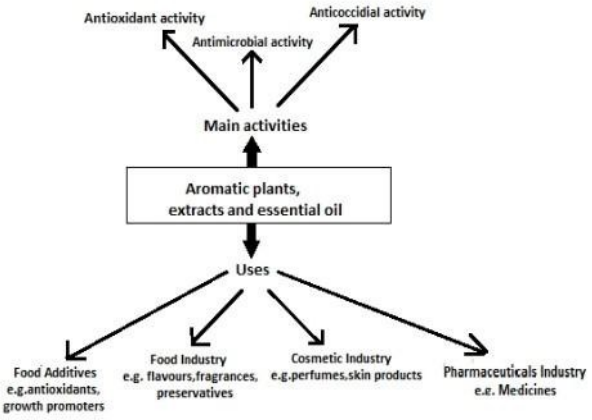


FIG:1 Uses of Aromatic plant and their essential oil

Ginger is also known as Zingiber Officinale Roscoe was given by an English botanist William Roscoe in 1807 . The word genus Zingiber was derived from Sanskrit word singabera which denoting the "horn shaped"[10] the rhizome or perennial tuberous of the ginger. Zingiber belongs to Zingiberaceae's family is planted abundantly and commercially in several parts of the countries like India .This genus, zingiber consist of 85 species of aromatic spices from east Asia and tropical Australia studies have proven that ginger is the most used herbal drug in many countries[11] .

FIG 2: Ginger Plant

Ginger is a flowing plant having rhizome serves as the edible part .Ginger was one of the first spices which export from Asia. Zingiber Officinale Roscoe belong to the family of Zingiber which is firstly found in southern Asia and some tropical region of China, then after it is planted in other part of the countries'[12]. Ginger was firstly used as a used as Chinese herbal medicine in China as it impart the pain and also relief at time of Asthma .It is also consumed as a vegetable and spices. Ginger is the plant having the properties of Anti Tumor and it impart the Gastrointestinal Tumor.

FIG 3: Dry Ginger Rhizome

For many Centuries, ginger called Zingiber has been fertilized in the tropical and subtropical region[13] of the world due to its perennial nature. Zingiber belong to the Zingiberaceae's and it is mostly used as medicinal plant and spices. In Sanskrit this plant is to be called as "Singabera" whereas in Latin "Zingiber" and in Greek "Zingiberi"[14].Ginger having such component that could prevent the heart diseases , blood pressure, ageing and many other diseases of the lungs. The quantity of ginger oil is vary from one's country to different country as like in India ,the essential oil quantity to be found in 46% to 47% whereas in china 29% and Sri Lanka 2% .So in the same organ of the plants , there may be a variation in the essential oil composition[15].

Ginger is composed of many bioactive compounds which is mainly composed of Phenolic and Tarpenoid compounds on major extent so many biological activities could be recognized due to its composition[16]. Shagoal ,paradol are the phenolic group containing compound which is present on major extent, and by some metabolic reaction one form is converted to another .

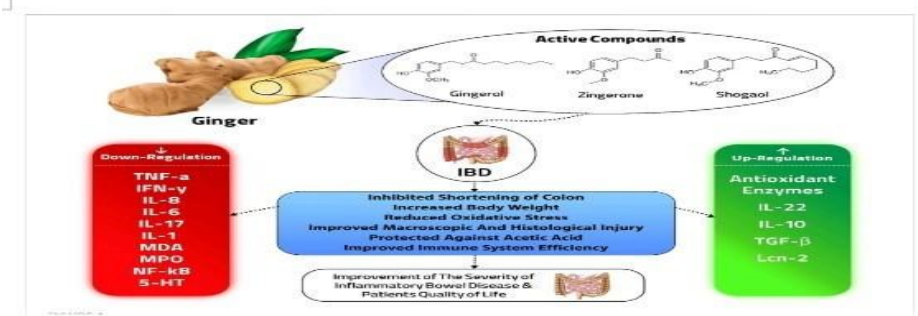


FIG 4: Major component present in ginger

SHAGAOL

Shagaol is the main compound present in the Ginger . It is an alkyl phenol compound which is incarnated by the dehydration of 6-gingerol. 6-shagaol is the major chemical ingredients which can be useful for quality controlling index in ginger. Ginger singnifies its potential as a efficacious agent with anticancer , anti inflammatory, antioxidant and Neuroprotective properties [17-18].

The C3 Carbonyl group and C5 hydroxyl group present on the hydrocarbon chain of Gingerol making the chemical properties of Gingerolunstable. In the certain case of heat and acidic medium, Shagaol is formed only when the active hydrogen present on the Gingerol reacting with hydroxyl group result in dehydration. The conversion of 6- Gingerol to 6-shagaol is pH dependent as 6-gingerol gains stability at the pH of 4 .

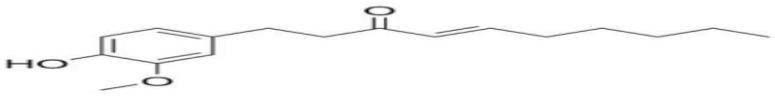


FIG 5: SHAGAOL

Zingerone

Zingerone is a phenolic alkanone and found in ginger from 9 to 9.5% .Gingerol is a compound having a phenolic ring and methoxy group that attaches to the benzene ring which exhibits some pharmacological effects such as antioxidant ,anti inflammatory, anti cancer activities[19]. The content of zingerone is found only in dried ginger and it is absent in the fresh ginger but by cooking and drying may convert the Gingerol to zingerone by the reverse aldol reaction [20]. Zingerone belong to the group of Gingerol which is present in the ginger root .Zingerone has a milder flavour as compare to Gingerol and it is used as a flavouring agent in food and beverages. Zingerone has anti-inflammatory property proves to be efficient and beneficial in the case of arthritis and gastrointestinal issues .Zingerone helps to maintain sugar level ,insulin sensitivity in diabetic patent . So Zingerone is having various health benefits.

FIG:6 ZINGERONE

Paradol

According to the studies, paradol-6 is found generally in the dried ginger and it acts as a primary active compound and it is formed by the biotransformation process from 6 –Shagaol[21]. It has having a large number of pharmacological effect and also proves to be anti cancer and anti proliferative properties [22]. Paradol is a compound which is found in ginger that contribute to spicy taste .It belongs to the group of phenylpropanoid and by drying and heating process of ginger ,Gingerol converts to Paradol .This whole conversion is responsible by the process of heat induced dehydration of Gingerol .It has having a low bioavailability means a very small amount of Paradol is absorbed in the bloodstream . In pregnant women some precaution must be taken while taking ginger extract as it leads to the risk miscarriage. So they should consult to their health provider before taking it.

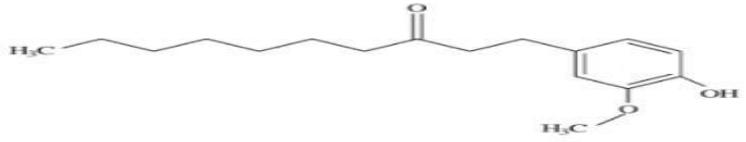


FIG:7PARADOL

In ginger the phenolic and tarpenoid compound is present in major quantity . In addition, the major tarpenoid compound is present in ginger are beta-bisabolene ,curcumene ,sesquiterpene and alpha-pharnesene[23]

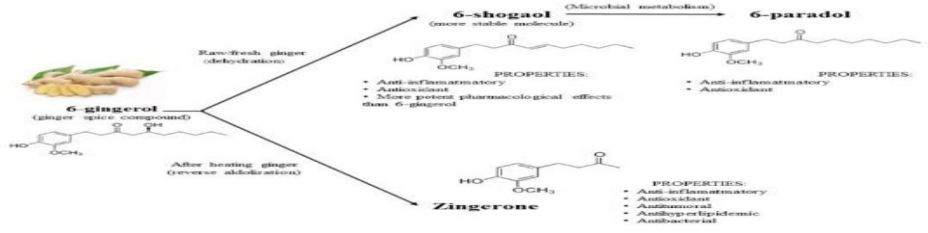


FIG:8 Properties of four main component of ginger

Ginger (zingiber officinale roscoe) is one of the most commonly used dietary elements in the world .Ginger contain many nutrients like carbohydrates, lipids, carbs, amino acid, and some vitamin(Niacin, Retinol) etc also it has essential oil and oleoresin . The oleoresin from the Rhizome of ginger contains many bioactive compounds. From the sources of history, ginger firstly found in the southern part of china from there it spread to the other parts of Asia and Africa .Ginger grows to a height of 1to 8 feet .Its lust green speares sprouts from the underground rhizome [24].

In India, ginger is used as traditional medicine in preparation of Ayurveda and Unani[25] . It contribute a huge beneficial impact to human body to protect diseases. Ginger also can be one of the predominant natural product in nutraceuticals and functional food development. Ginger rhizome is commonly added as spices or

taken as a dietary supplement, and has been widely used in traditional medicine throughout history [26].

FIG 9: USES OF PLANT

Ginger as to be a subtropical plant other than this it could be treated as a medicinal plant due to its impactful uses. Ginger is used as analgesic 27 which reduces pain ,and its oil is also very effective which can be applied on gums during oral cavity by which it to be called as great remedy.
Ginger is generally considered as a safe for most of the people when it consumed in a moderate amount but excessive intake can cause some inflammation and gastrointestinal problem.

(FIG:10 SORREL: A DRINK)

In western countries, ginger is traditionally used in many sweet foods like ginger ale, gingerbread, ginger snaps, parkins etc.

FIG 11: GINGERBREAD

Firstly by pharmacological and epidemiological studies , ginger is associated with abandon health benefits. It is revealed by the pharmacological studies that is to be effective in various diseases and symptoms .Ginger is used as a medicine in various countries such as China India ,such as Respiratory related problem, digestive problem ,cardiac issue and infectious disorder .
These pharmacological effect proved to be beneficial due to the bioactive compound present in the ginger such as Shagaol, Paradol ,Gingerol etc. Secondly, by epidemiological studies ,it is found that ginger extract have a number of pharmacological and physiological effect such as nausea ,vomiting, effect on inflammation .

EFFECT OF GINGER ON NAUSIA AND VOMITING

Ginger extract supplement is beneficial for chemotherapy – induced vomiting according to the meta –analysis of 3studies/301 participants. In this condition the risk of vomiting is quite reduced by 60% after taking the supplement 1g\day for 3 days27.Ginger is found to be beneficial and efficient in controlling chemotheraphy-induced nausea and vomiting in pregnant women in the analysis of 18 studies28.

EFFECT OF GINGER ON CHOLESTEROL AND LIPID METABOLISM

Ginger is found to have a beneficial and favourable effect on tricylglycerol and having low density lipoprotein cholesterol.on taking ginger extract it reduces serum c-reaction protein level and also improves the glycemia indexes and the lipid profile29 .

EFFECTS OF GINGER ON INFLAMMATION

Ginger is very effective in osteoarthritis pain and it act as a anti inflammating agent to cure that pain30 .

In the North America(Caribbean) ,ginger is a popular spice for cooking and making drink like Sorrel ,a drink which is mostly prepared in the Christmas season.
Jamaicans, in their home make ginger beer both as a carbonated beverages.

EXTRACTION OF ESSENTIAL OIL

The extraction of essential oil is done by the steam distillation process through Clevenger apparatus.

Steam distillation

For the separation of temperature sensitive material like oil, resin, hydrocarbon steam distillation process is used. These are the material which are insoluble in water and can be decomposed at their boiling point.
The extraction of ginger oil is done by the following process…….

Collection of the sample

The sample is collected from the northern part of India around 1 kilometre from the Vijay Nagar area .The sample is fresh and wet in condition. The sample is washed with water in order to remove impurity and dirt .Then the sample is allowed to dry at room temperature. This is the most widely used process for the extraction of essential oil and it is practiced since the beginning of 1980s 31. Essential oil have the boiling point upto 200 °C or may be higher but in the presence of steam these essential oil violate even at the water boiling point (100°C) at atmospheric pressure 32 .

PREPARATION OF SAMPLE

In which we require the given crushed and grinded sample of 250 gm in a round bottom flask which fitted with separating funnel. The sample is crushed and grinded in order to increase the surface area of sample. Also this step involve for the ease of release of essential oil.

ADDITION OF WATER

The Clevenger apparatus is consist of round bottom flask, a water cooler condenser, a separating funnel and a collection tube. It assembled in such a way that the sample is suspended in water inside the round bottom flask. The sample present in round bottom flask require 1200ml of water.

HEATING PROCESS

The power source is applied to the heating appliance through which sample is heated. The sample is heated step by step increasing temperature from 0 degree Celsius to 80 degree Celsius. If we increases the temperature at once to 80 degree Celsius, then the round bottom flask will burst out so precaution should be taken while doing extraction .About an hour, the process is going on at the 80 degree Celsius the evaporated water is given out and a very thin layer of oil is also collecting

FIG13 : Actual image of the apparatus used for the extraction of essential

COLLECTION OF ESSENTIAL OIL

Then the oil is collected in the receiving funnel, as the density of oil is lesser then water so we can easily see .the extracted oil. Now the collected sample is having any water molecule, then we pass the anhydrous sodium sulphate and collected the sample .

FIG14: Accumulation of essential oil extracted in the collection tube of the Clevenger apparatus

STORAGE OF SAMPLE

The collected essential oil is stored in a dark, airtight container away from heat and light to preserve its quality. The extracted essential essential oil can be analysed for purity and analysis of major compound using analytical process (GCMS Analysis).

FIG 15: Essential oil

GAS CHROMATOGRAPHY AND MASS SPECTROMETRY

PARAMETER FOR ANALYSIS

The GC-MS analysis is performed by using Agilent 5973 mass selective detector coupled with an Agilent 6890 chromatograph ,equipped with BP*5 capillary column SGE Analytical Science ,Australia (30 m *0.25mm;film thickness) . The oven temperature was programmed 50-300 degree Celsius. Helium was used as the carrier gas at the flow rate of 0.5 ml/min .injector temperature was 290 .retention indices were calculated by the using retention time of n-Alkane (c8-c24)that were injected after the oil at the same condition .Components of the sample were identified by comparison of their retention indices (RI) . After combining both the technique we get the highly sensitive and highly specific analysis of the complex compound .It can require a very small amount of sample for the detection of the compound and for experimentation .In GCMS analysis gas chromatogram is coupled with the mass spectrometer along with the data analysis software .It is used in the various field like chemistry, pharmaceuticals, Forensic etc. The obtained essential oil should be in best condition in order to evaluate chemical composition.

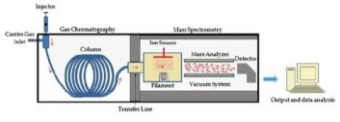


FIG18: Diagramatic representation of GCMS

The obtained essential oil should be in best condition in order to evaluate chemical composition.

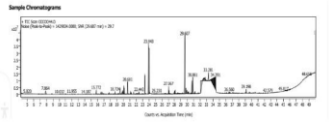
RESULT AND DISCUSSION

The major component present in the compound are listed below ,which obtain through the observable peak, observed and library spectra.

TABLE-1

Serial No.	GC ANALYSIS		MS ANALYSIS		
	AREA	%AREA	NAME	MOLECULAR FORMULA	RT
1	22131726	78.81	Eugenol	$C_{10}H_{12}O_2$	29.607
2	7267614	2.59	2-isopropyl-5-methylcyclohexyl methylphosphonofluoridate ;	$C_{11}H_{22}O_2P$	18.724
3	801473	0.29	Methyl 10,11-tetradecadienoate	$C_{15}H_{26}O_2$	7.377
4	28080979 5	10.0	Benzyl-diseryl phosphate	$C_{15}H_{17}N_2O_6P$	23.933
5	14151231	5.04	Endo Borneol	$C_{10}H_{18}O$	20.149
6	10618592	3.78	1,4-Methanocycloocta[d]pyridazine,1,4,4a,5,6,9,10,10a-octahydro-11,11-dimethyl-,(1.alpha.,4.alpha,4a.alpha.,10a.alpha)	$C_{12}H_{21}N_2$	27.988
7	33564422	12.19	2-Napthalenemethanol,,1,2,3,4,4a,5,6,8a-octahydro-,alpha.,alpha.,4a,8-tetramethyl-,[2R-(2.alpha.,4A.alpha.,8a.beta)]	$C_{15}H_{26}O$	30.700
8	25063580	8.93	Diethyl phthalate	$C_{12}H_{14}O_4$	33.281
9	4850190	1.73	Linalool	$C_{10}H_{18}O$	16.527
10	1193087	0.42	Limonen-6-ol pivalate	$C_{15}H_{24}O_2$	25.980

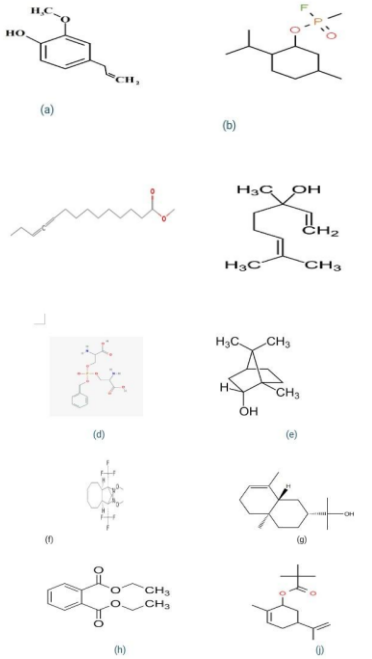
The chromatogram peak we obtained through GCMS analysis for the essential oil sample is given below….



GRAPH:1 GCMS Chromatogram of ginger essential oil

STRUCTURE OF IDENTIFIED COMPOUND

The structures of all the compound find in the ginger essential oil are as follows-



the major component present in the ginger are as follows….a)Eugenol b)2isopropyl-5- methylcyclohexyl methylphosphonofluoridate c)Methyl 11,12-tetradecadienoate d) Benzyl Diseryl Phosphate e)Endoborneol f) 1,4-Methanocycloocta[d]pyridazine,1,4,4a,5,6,9,10,10a- octahydro-11,11-dimethyl-,(1.alpha.,4.alpha,4a.alpha.,10a.alpha g)2-Napthalenemethanol,,1,2,3,4,4a,5,6,8a-octahydro-,alpha.,alpha.,4a,8-tetramethyl-,[2R-(2.alpha.,4A.alpha.,8a.beta)] h) Diethyl phthalate i)Linalool j)Limonen-6- ol pivalate

Physio-chemical properties

It has been observed that major component are present in essential oil of ginger are mainly phenolic and tarpenoid compound .

Chemical composition of essential oil

The Quantitative composition of essential oil is reported in Table-1 ,where component are listed according to the percentage of compound .The composition of essential oil is obtained by steam distillation method and GCMS against RT value. Gas Chromatography and Mass Spectrometry (GCMS) revealed the total 218 compound in which 10 are major and rest are recorded at a very minute percent. By studying we found Eugenol is compound which is found in high percentage which is of 78.81% at the retention time of 29.607.

CONCLUSION

The extraction of essential oil is done by the steam distillation process through clevenger apparatus. Anhydrous sodium sulphate is used in order to separate the oil from water.The collected sample is passed through the GCMS analysis. This is done by the ionizing the volatile compound into fragments. After this it will move to MS analysis.We have to study the data the chromatogram peak and RI values through which we found the compound present in it.The major component present in the compound are Endo

Borneol,citral, Benzyl diseryl phosphate, Eugenol, Diethyl phthalate Ethanethiol, 2-(diethylboryloxy) etc.

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