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GC-MS analysis of bioactive components from banana peel (*Musa sapientum* peel)

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ABSTRACT

Banana belongs to the family of Musaceae and scientifically known as Musa Sapientum. The present study was carried out to determine the possible bioactive components from ethanolic extract of banana peel using gas chromatography-mass spectrometry (GC-MS). Eight compounds were identified which included estragole (11.18%), hexadecanoic acid ethyl ester (9.76%), epicatechin (9.97%), gallocatechin (8.58%), p-coumaric acid ethyl ester(4.2%) , 1,2 benzenedicarboxylic acid mono (2-ethylhexyl) ester (13.47%) , beta-tocopherol (11.37%) and vitamin E (31.35%).

Keywords: Banana peel, GC-Ms, chromatograph, bioactive components, antioxidants,

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INTRODUCTION

Banana is one of the world's most important crops grown by small- and large-scale producers alike, with production occurring in more than 130 countries. The global production of banana is estimated to be around 72.5 million metric tonnes out of which 21.77 million metric tonnes is contributed by India. The peel which protects the banana fruit is discarded as waste after the inner flesh portion is eaten [1] and posses an environmental problem due to it nitrogen and phosphorus quantity.

According to the Authors, the banana fruit helps in preventing anaemia, cure heart burns and many other minor illnesses. Probably, they should be considered as a good source of natural antioxidants and functional foods against cancer and heart diseases [2]. The banana peel like its banana flour counterpart can also offer nutritional products since the peel contains phytochemical compounds and enriched with the minerals like potassium, phosphorus, magnesium and calcium.

The banana peel is rich in phytochemical compounds than its pulp [2, 3, 4 & 5]. The antifungal, antibiotic properties of banana peel can put to be good use. The peel is used for home remedy for treating several skin problems including allergies and skin irritations. Akamine et.al [6] studied the effects of banana peel on androgen induced enlargement of accessory reproductive organs in castrated mice.

The literature survey reveals that information on GC-MS analysis of banana peel is lacking. Hence, the aim of the present study is to identify the bioactive compounds with the aid of GC-MS technique.

MATERIALS AND METHODS

Materials, chemicals and Reagents

The banana peels were obtained from the local markets in Mumbai. The peels were separated from fruit and washed. The peels were dipped in 0.5% citric acid to prevent the enzymatic blackening. The peel was shade dried for 96 hours. Dried peels were ground to make coarse powder and stored.

Preparation of Banana Peel Extract

The banana peel powder was extracted with ethanol as a solvent. The extraction was carried out in the sealed tube in a water bath for 120 min at 25^0C. The extracts were centrifuged. The different extracts obtained were evaporated to dryness in a vacuum evaporator at 40^0 C. The final residue obtained was subjected to GC-MS analysis.

Gas Chromatography-Mass Spectrometry

GC-MS analysis was carried out on a GC 7890 (Agilent) comprising automatic liquid sampler and gas chromatograph interfaced to mass spectrophotometer (GC-MS) at IIT Bombay. Helium was used as a carrier gas and the injector temperature was kept at 350^0C. The oven temperature was programmed from 100^0C held for 5 mins to 375^0C at 20^0C/min. The name, molecular weight and structure of the component were ascertained.

RESULTS AND DISCUSSION

The ethanolic extract of the banana peel powder showed eight peaks from the chromatograph of the extract. The peak indicated the presence of eight compounds in the extract. The maximum peak was shown by Vitamin E (31.3%) followed by 1, 2 Benzenedicarboxylic acid mono (2-ethylhexylester (13.47%), β- tocopherol (11.37%) and estragole (11.18%). Compound 1 was identified as an Estragole and has a molecular formula of $C_{10}H_{12}O$ (M/Z 148) with the retention time of 5.8 min (Figure No.2). It has been reported that estragole has many biological effects including antioxidant and antimicrobial activities. Albuquerque et al [7] have studied the effects of the estragole on skeletal muscle. Compound 2 was identified as hexadecanoic acid ethyl ester and has a molecular formula (M/Z 284) (Figure No.3). The hexadecanoic acid ethyl ester can be antioxidants, hypocholesterolemic, nematicide, pesticide, lubricant activities and haemolytic 5 – alpha is a reducatse inhibitors. The compound 3 was identified as epicatechin and has a molecular formula of $C_{15}H_{14}O_6$ (M/Z-290) (Figure No.4).Catechin, epicatechin are major catechins with the dietary importance for human health. In recent years they have been used as antioxidants in the oils and fats in lipid oxidation and also as an agent in foodstuffs and heath functional ingredients in various foods and dietary supplements. Kim et al [8] have studied the protective effects of epicatechin against the toxic effects of streptozotocin on rat pancreatic islets and concluded that epicatechin appears to be helpful in protective pancreatic islets against exposure to streptozotocin in vitro and in vivo systems. The compound 4 was identified as gallocatechin and has molecular formula of $C_{15}H_{14}O_7$ (M/Z -306) (Figure No.5). Gallocatechin has antimetastatic effects and antidiabetic activity and acts as antiskin cancer agent. Gallocatechin – epigallocatechin showed the best inhibitory activity on alpha-glucosidase. The gallocatechin has anti-uveal melanoma activity, antioxidant and anti-inflammatory activities.

Table 1. Area of percentage and retention time of bioactive compounds obtained from GC – MS

Peak	Retention Time	Area	Area %	Name of the Compound
1	5.9	97327	11.18442751	Estragole
2	17.5	85003	9.768202978	Hexadecanoic acid ethyl ester
3	17.8	86771	9.97137443	Epicatechin
4	18	74739	8.588705368	Gallocatechin
5	19.9	37252	4.280850056	p-coumaric acid methyl ester
6	23.9	117242	13.47297923	1, 2 Benzenedicarboxylic acid mono (2-ethylhexylester)
7	32.8	98975	11.37380904	beta-tocopherol
8	34.3	272892	31.35965139	vitamin E

The compound 5 was identified as p-coumaric acid methyl ester and has a molecular formula $C_{10}H_{10}O_3$ (M/Z 178.1) (Figure No 6). Song et al [9] examined the potential of p-coumaric acid and its hydrophobic derivative methyl –p coumarate as hypopigmenting agents for topical use and found that methyl p-coumarate inhibited the cellular melanin synthesis more effectively than p-coumaric acid suggesting methyl p- coumarate as potential hypopigmenting agent. Daayf et al [10] reported p-coumaric acid methyl ester to be associated with phytoalexin – like behaviour.

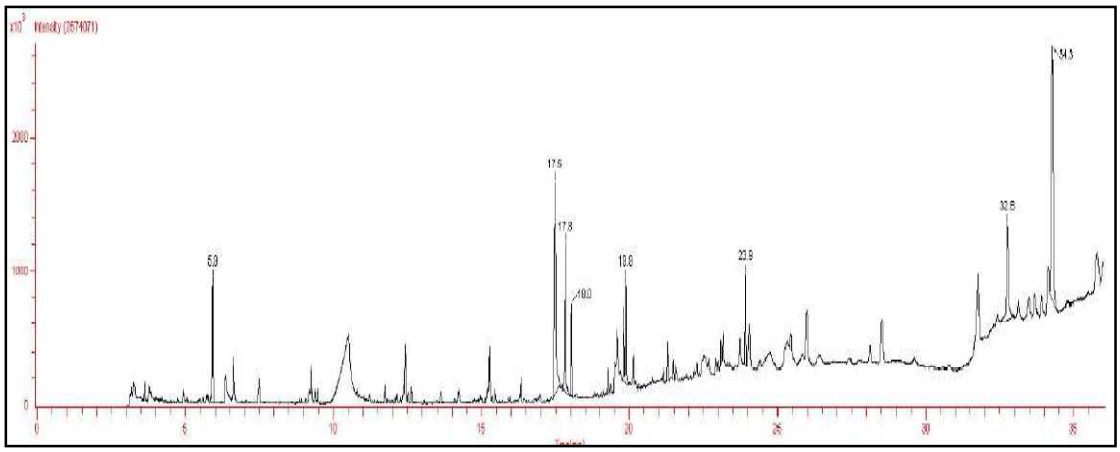

Figure 1: GC-MS chromatogram of the ethanol extract of the banana peel

The compound 6 was identified as 1, 2 Benzenedicarboxylic acid mono (2-ethylhexyl) ester and has a molecular formula $C_{16}H_{22}O_4$ (M/Z 279) (Figure No.7). 1,2- Benzenedicarboxylic acid, mono(2-ethylhexyl) ester its common name are phthalic acid (mono (2-ethylhexyl) phthalate, phthalic acid mono(2-ethylhexyl) ester, 1-benzenecarboxylic acid mono-octyl ester (MOP), MEHP, phthalic acid mono-octyl ester. It is used as a plasticizer for PVC and other resins, as a dielectric fluid. It also finds application in food packaging material. In flexible PVC industry it is widely used for flooring, wire & cables, shoes, cars, pipe, tubes, profiles. Di (2-ethylhexyl) phthalate is widely used as a plasticizer in flexible vinyl products. Plastics may contain from 1 to 40% di (2-ethylhexyl) phthalate by weight and are used in consumer products such as imitation leather, rainwear, footwear, upholstery, flooring, wire and cable, tablecloths, shower curtains, food packaging materials and children's toys.

The compound 7 was identified as β- tocopherol and has a molecular formula $C_{28}H_{48}O_2$ (M/Z 416) (Figure No.8). β-tocopherol is a form of vitamin E. These are the organic compounds required for the normal growth and maintenance of life of animals, including humans and are essential for the transformation of energy and for regulation of metabolism of structural units.

The compound 8 was identified as Vitamin E and has a molecular formula $C_{29}H_{50}O_2$ (M/Z 430) (Figure No.9). The vitamin E acts an Antiageing, Analgesic, Antidiabetic, Anti-inflammatory, Antioxidant, Antidermatitic, Antileukemic, Antitumor, Anticancer, Hepatoprotective, Hypocholesterolemic, Antiulcerogenic, Vasodilator, Antispasmodic, Antibronchitic, Anticoronary . The chain breaking antioxidant property of vitamin E prevents propogation of free radical in membranes and plasma lipoproteins [11].

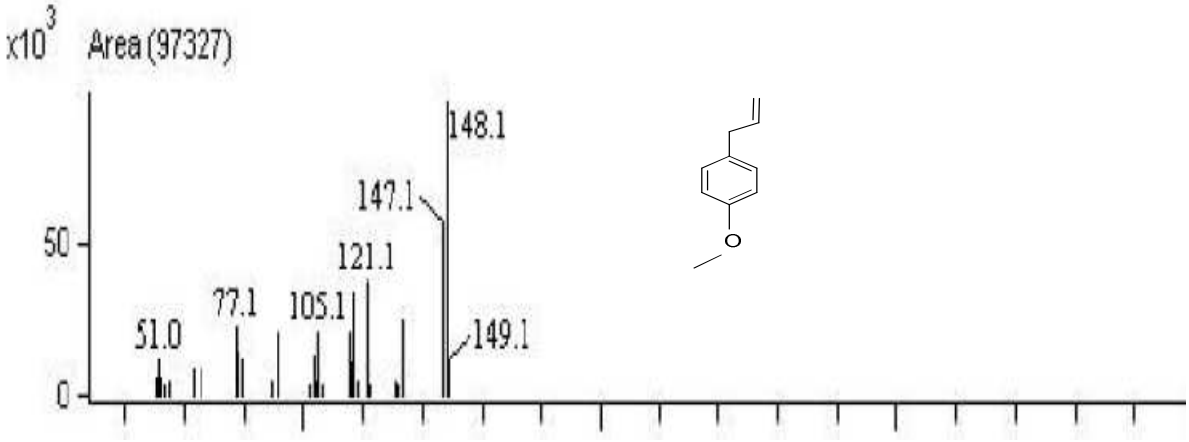

Figure 2: Mass spectrum of Estragole

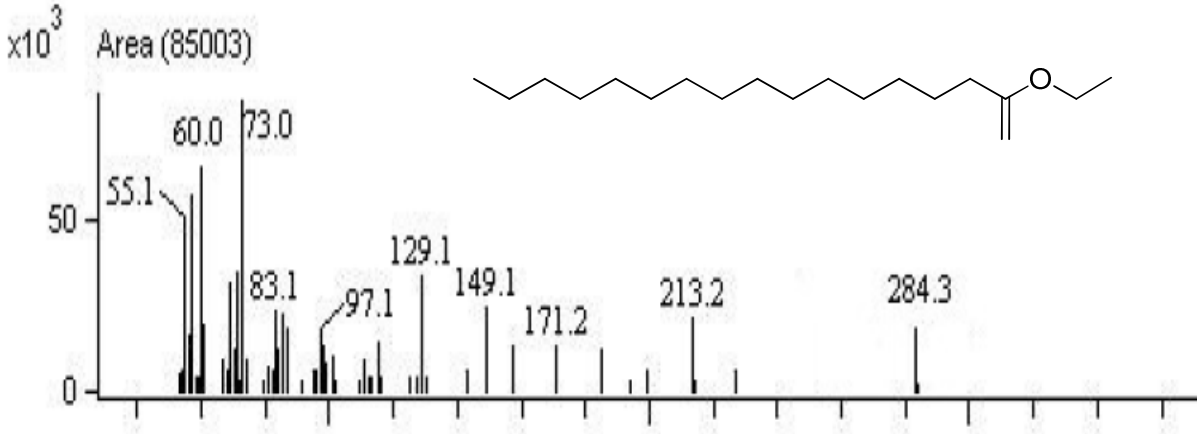

Figure 3: Mass spectrum of Hexadecanoic acid ethyl ester

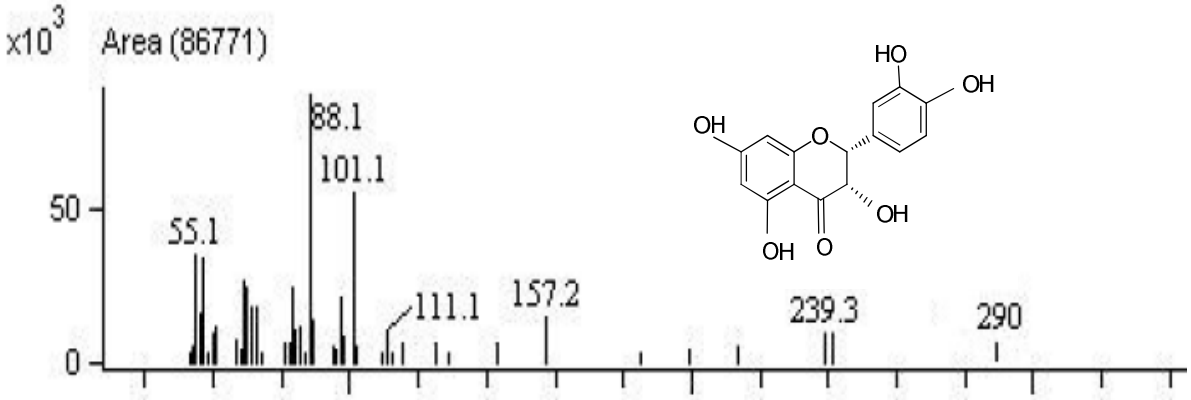

Figure 4: Mass spectrum of Epicatechin

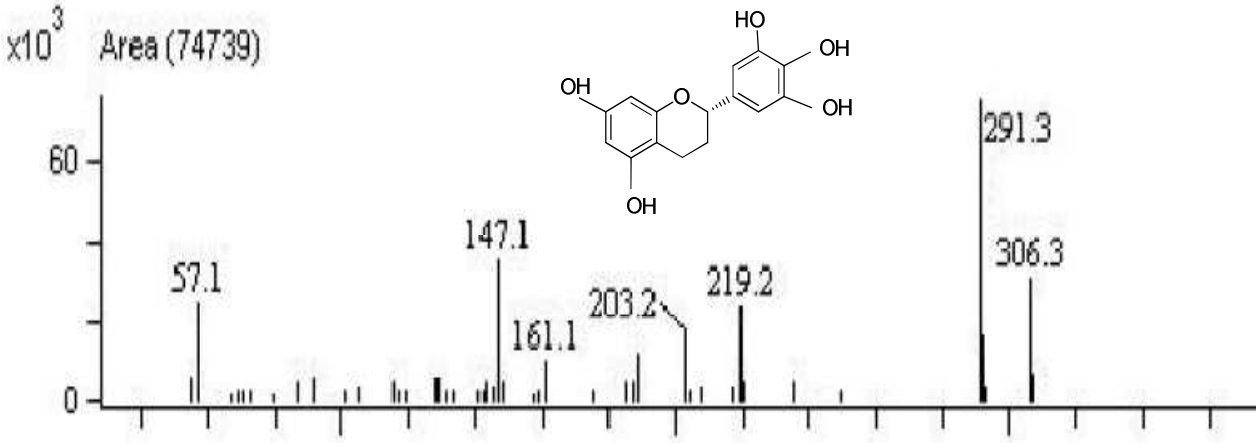

Figure 5: Mass spectrum of gallocatechin

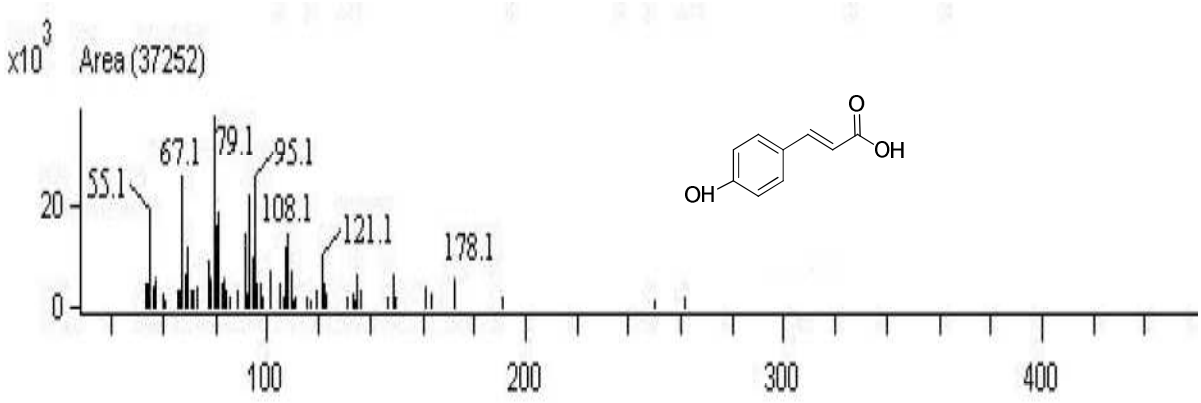

Figure 6: Mass spectrum of coumaric acid methyl ester

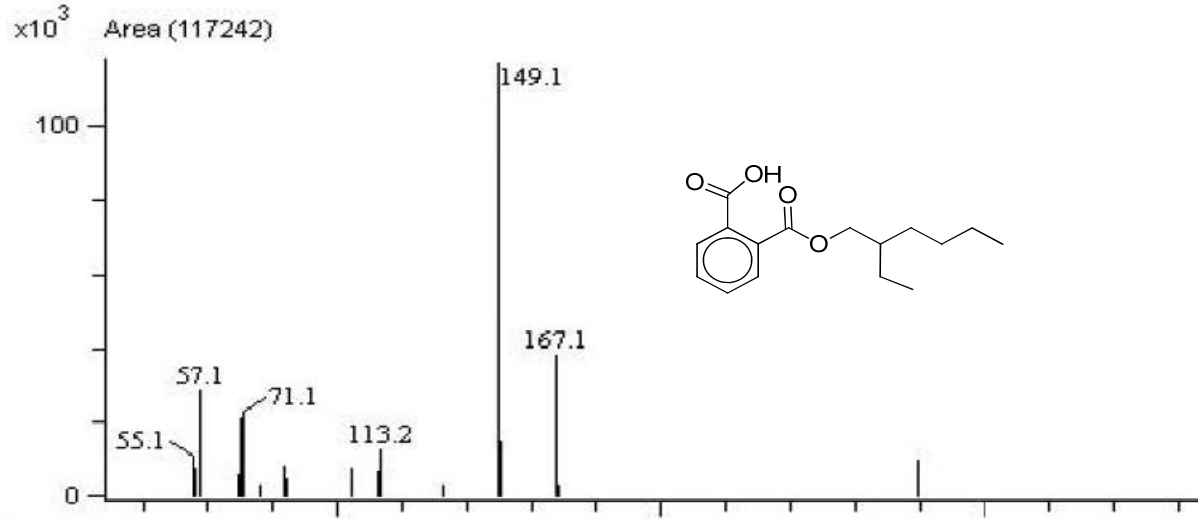

Figure 7: Mass spectrum of 1, 2 Benzenedicarboxylic acid mono (2-ethylhexylester)

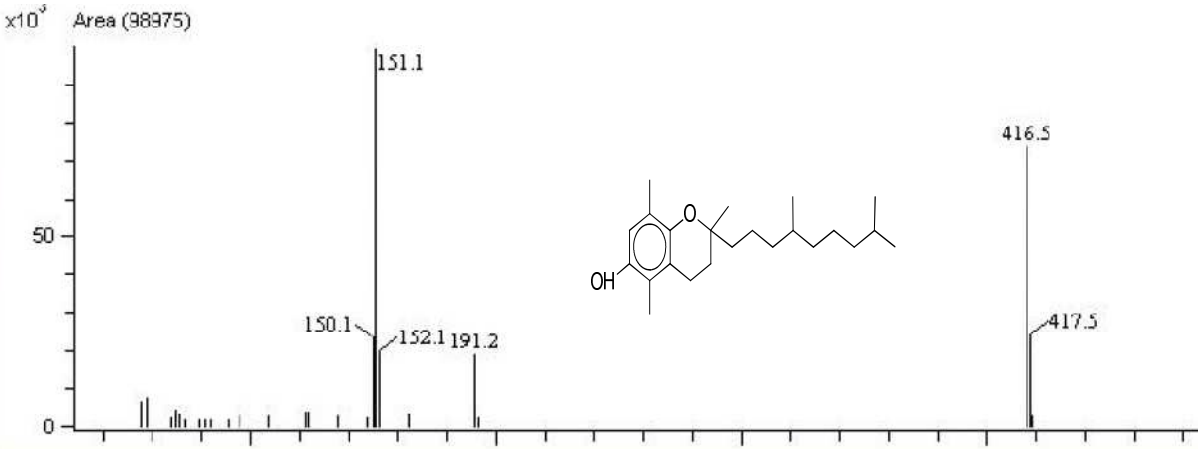

Figure 8: Mass spectrum of Beta tocopherol

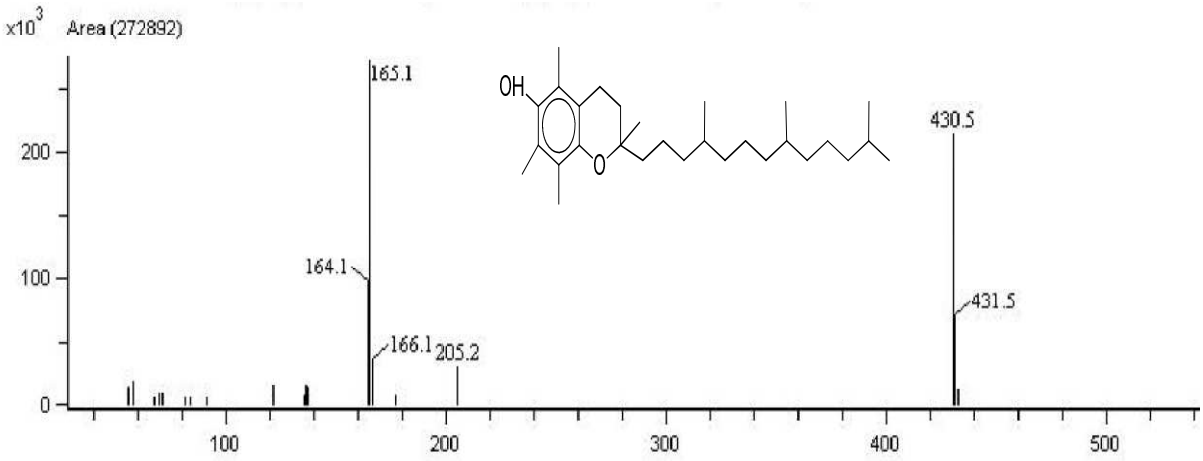

Figure 9: Mass spectrum of Vitamin E

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