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Research Article

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Phytochemical studies of an endemic and critically endangered hill banana, *Musa acuminata* Colla (AA) 'Karivazhai' fruit by GC-MS

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ABSTRACT

Musa acuminata Colla (AA) 'Karivazhai', an interesting hill banana is endemic to Kolli hills of Tamil Nadu and is cultivated for its sacred uses there. The plant is characterized by the black pseudostem and fruits with an excellent flavour and taste. The present study was undertaken to explore the potential bioactive fatty acids and volatile compounds present in the unripe fruit pulp of this critically endangered banana cultivar using Gas Chromatography–Mass Spectrometry analysis. The analysis revealed the existence of 15 important compounds, which will be further considered for pharmacological activities and isolation of individual components would however, help to find new drugs. This also shows the importance as a medicinal plant and the need of conserving it.

Key words: *Musa acuminata* (AA) 'Karivazhai', hill banana, chemical composition, GC-MS, fatty acids, volatile compounds

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INTRODUCTION

India is well known for the use of folklore medicinal plants to cure various diseases and they have been studied for various pharmacological and pharmacognostic activities. They are considered as the potential sources of bioactive compounds and are useful to maintain the normal health of human and animals. Chemical substances derived from the plants – generally considered as secondary metabolites, have been used to cure human diseases since back. Currently, the health care based on natural products is still the mainstay of about 75–80% of the whole world population and majority of traditional therapy and treatment involve the use of plants and plant extracts.

Various parts of banana plant are also used as medicine from the ancient time onwards [1] and some of its medicinal effects were later proved [2-5].

As part of the taxonomic study of the *Musa* cultivars in south India, all of them were collected and conserved in the Calicut University Botanical Garden. An interesting hill banana cultivar, which is restricted to the Kolli Hills of Tamil Nadu, gave much attention due to its sacred nature, rarity and possible medicinal uses. During collection in 2014 only five plants were extant in that locality.

The cultivar is characterized by a slender, black pseudostem of 2.5–2.9 m high with 4–7 suckers. Inflorescence sub-horizontal or oblique with a green and densely pubescent peduncle, 50–53 cm long, 10 cm girth. Fruit bunch lax, 3–5 hands and 7–10 fruits per hand in two rows, fingers pediceled; pedicel very small, 0.5–1 cm long, fused at base. Fruits on mid hand 8–10 cm long, circumference 9–13 cm, straight or slightly curved, pronouncedly ridged in cross section, apex lengthily pointed, without any floral relicts, immature peel colour dark green, become bright yellow with slight greenish tinge at tip on ripening, peel very thick; immature fruit pulp creamy white, becoming cream on ripening, the ripened pulp when pressed at the tip splits in to three longitudinal parts, very sweet with excellent characteristic flavour and taste, seeds completely absent.

This cultivar got high sacred value and the fruit is used for offering to '*Konglaiamman'*, the God of Kolli Hills of Tamil Nadu. The name *Karivazhai* was came from its black pseudostem (*kari*= black) and the plant is also known as *Krishnavazhai*, *Manoranjitham* (the ripened fruit has very sweet and excellent characteristic flavour equivalent to the Manoranjitham flower – *Artabotrys uncinatus* Merr.), etc. The fruits are very small and very easily fall off from the bunch. The fruit has great demand and generally rate more than ten rupees per fruit.

Methanolic extracts of unripe fruit pulp is used for the phytochemical analysis using Gas Chromatography–Mass Spectrometry.

EXPERIMENTAL SECTION

Plant material collection:
The banana plant was collected from the Gundur Nadu of Elangium Patty Village of Kolli Hills of Tamil Nadu, India and identified as *Musa acuminata* Colla (AA) 'Karivazhai'. The rhizomes collected were planted in the Calicut University Botanical Garden (CUBG). The fruit developed in CUBG was used for the Phytochemical Analysis. The voucher specimens (*Sreejith & Kabeer 123257*) were deposited at Calicut University Herbarium (CALI).

Sample extraction:
The fully matured unripe fruits were collected, remove the peel, and shade dried at room temperature after slicing. This dried pulp was powdered using a mixer grinder. 20 grams of the powder was weighed and were subjected to extraction with methanol using Soxhlet apparatus at 65º C; the solvent was recovered under reduced pressure in Rotary evaporator at 54º C and stored in refrigerator. This crude extract was subjected to GC-MS analysis at National Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram.

Gas Chromatography-Mass spectrometry (GC-MS) analysis:
Gas chromatographic analysis was performed using GCMS-TQ8030 SHIMADZU. The samples were injected in to a GC equipped with a MS and a medium polar capillary column Rxi-5Sil MS, (30 m × 0.25 mm I. D., 0.25 µm). The oven program had an initial temperature of 60º C for 2 minute, then increased to 200º C for 2 minute at the rate of 5º C /min which was further increased to 220º C for one minute at the rate of 3º C /min. Finally temperature was increased to 250 at the rate of 6º C /min for 7 minute. Total run time was 50 minutes. The detector temperature and injection temperature were set 250º C. Helium was used as the carrier gas (purity 99.999% at a flow rate of 1mL/ min). The samples were injected in the split less mode. The ion energy used for the electron impact ionization (EI) mode was 70eV. The mass range scanned was 100-1000 *m/z.*

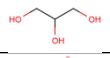
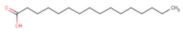
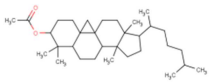
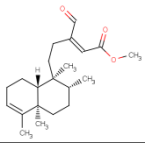
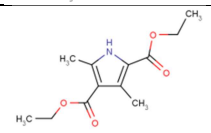
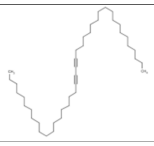
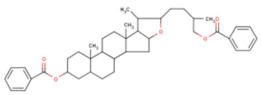
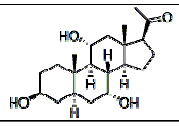
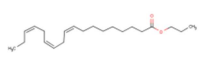
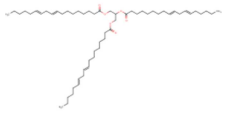
Identification of compounds:
The essential chemical constituents (fatty acids & volatile compounds) were identified by matching mass spectra with spectra of reference compounds in mass spectral library of NIST and WILEY. The relative amounts of individual components were expressed as percent peak areas relative to total peak area.

RESULTS AND DISCUSSION

Medicinal plants play a very significant role in providing the primary health care especially in rural areas. India is well known for its traditional knowledge and folk medicines. In India, many indigenous plants are widely consumed as food and home remedies especially in the treatment of many common diseases. Apart from its use as a valuable food item, banana fruits and the different part of plant find varied uses in various folk practices, customs, religious rituals and medicine among the villagers and tribal communities of the country, which are oral in tradition [6]. It is also considered to signify plenty and fertility and that is why it is placed at the entrance of houses and temples on special religious functions and ceremonies like marriage.

Pushpangathan *et al.* explained some lesser known and traditional and folk uses of banana mainly stressing on Indian culture and practices and most of them are very old and unwritten practices in the villages and tribes [6]. Bananas are rich in nutrients, starch, sugar and vitamins A and C, potassium, calcium, sodium and magnesium [7]. A preliminary study of the chemotaxonomy on the cadenced tannin of the green banana flesh by Santos *et al.* revealed that the total tannin content was highly variable depending on the genotypes and the growing conditions of the plants [8].
The present study was undertaken to explore the potential bioactive fatty acids and volatile compounds present in the unripe fruit pulp of banana cultivar *Karivazhai* using GC-MS analysis (Fig. 01). A total of 15 compounds were identified based on their retention time (RT), Chemical formula, molecular weight (MW), chemical structure and concentration (peak area percentage) (Table 1).

Table 01. Compounds identified in the methanolic extract of unripe fruit pulp of *Musa acuminata* Colla (AA) 'Karivazhai' using GC-MS analysis

Sl. No.	Ret. Time	Compound	Chemical formula	Molecular weight (g/mol)	Structure	Peak area percentage (%)
1.	7.140	1,2,3-Propanetriol	$C_3H_8O_3$	92.09		3.89
2.	13.802	5-(hydroxymethyl)- 2-Furaldehyde	$C_6H_6O_3$	126.11		2.92
3.	30.357	Diphenyl sulfone	$C_{12}H_{10}O_2S$	218.27		8.61
4.	30.488	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270		0.65
5.	31.257	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256		1.49
6.	39.760	1-Heptatriacotanol	$C_{37}H_{76}O$	537		56.48
7.	41.554	9,19-Cyclolanostan-3-ol, acetate, (3.beta.)-	$C_{32}H_{54}O_2$	470.77		2.28
8.	42.725	Methyl 16-oxo-cleroda-3,13(14)-E-dien-15-oate	$C_{21}H_{32}O_3$	332.48		0.23
9.	44.440	1H-Pyrrole-2,4-dicarboxylic acid, 3,5-dimethyl-, diethyl ester	$C_{12}H_{17}NO_4$	239.27		1.69
10.	45.915	19,21-Tetracontadiyne	$C_{40}H_{74}$	555.02		2.50
11.	46.965	Dihydro-neotigogenin dibenzoate	$C_{41}H_{54}O_5$	626.86		1.73
12.	47.105	Allopregnane-3beta.,7alpha.,11alpha.-triol-20-one	$C_{21}H_{34}O_4$	350.49		2.81
13.	47.190	n-Propyl 9,12,15-octadecatrienoate	$C_{21}H_{36}O_2$	320.51		5.32
14.	48.920	Trilinolein	$C_{57}H_{98}O_6$	879.38		2.58
15.	48.980	1,2-Epoxy-5,9-cyclododecadiene	$C_{12}H_{18}O$	178		0.42

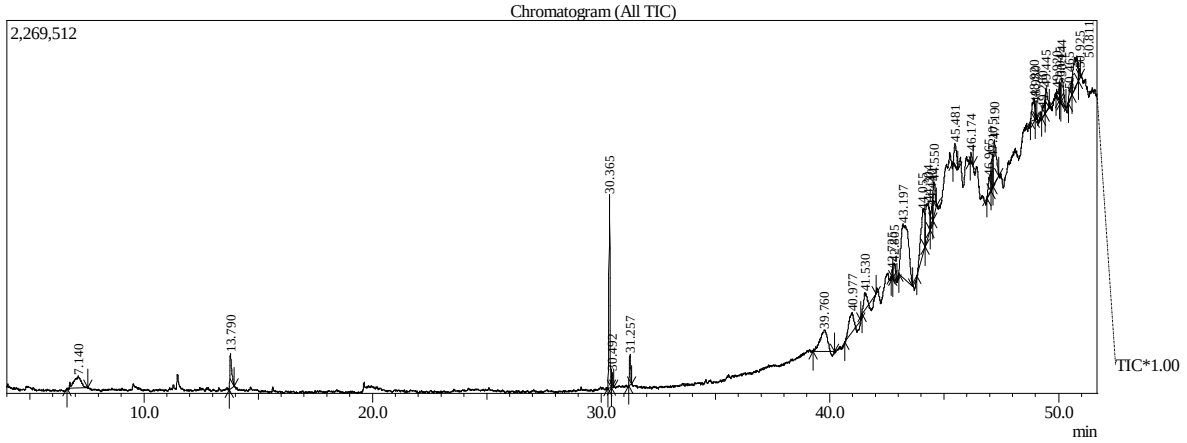


Fig. 01. Chromatogram of methanolic extract of *Musa acuminata* (AA) 'Karivazhai' fruit pulp

1-Heptatriacotanol is the major compound (56.48%) and is an alcoholic compound which showed antimicrobial activity [9]. It also reported in some other plants like *Bulbophyllum kaitense* Reichib [9], *Eclipta alba* (L.) Hassk [10], etc.

Out of this 15 compounds identified, some compounds like n-Hexadecanoic acid have reported bioactive properties *viz.*, Lubricant, antiandrogenic, flavour, hypocholesterolemic, hemolytic, antioxidant, nematicide, pesticide and 5-alpha reductase inhibitor [11, 12]; 5-(hydroxymethyl)- 2-Furaldehyde have hepatoprotective and antioxidant effects [13]. Many other compounds also shows some other properties like anti-inflammatory (n-Hexadecanoic acid), antifungal and antibacterial (Methyl 16-oxo-cleroda-3,13(14)-E-dien-15-oate) properties.

According to the recent concept, the medicinal property of the plants has a positive correlation with the phytochemical compounds present in it [14-16]. Isolation and purification of these compounds may leads to the identification of new drugs against various diseases. Further investigation of the fruits and other parts with various solvents can increase the isolation of the newer molecules which also will be helpful for the study of the pharmacological activities and in discovering drugs, and so this is recommended as a plant of phytopharmaceutical importance.

CONCLUSION

The present study identified 15 major fatty acids/ volatile compounds from the methanolic extract of unripe fruit pulp of *Musa acuminata* (AA) 'Karivazhai' by Gas Chromatography-Mass spectrometry (GC-MS) analysis with a much higher concentration of an antimicrobial compound, 1-Heptatriacotanol (56.48%). Many others also have some other important bioactive properties and can used in future for various industrial applications. And moreover this strengthened the need of conserving this endemic hill banana which faces the threat of extinction.

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REFERENCES

[1] R Amit; S Shailandra, *Ind. J. Pharm. Sci.*, **2006,** 41, 1-13.
[2] JM Oke; CJ Achife; OO Adefisan, *Nigerian J. Nat. Prod. Med.*, **1999,** 3, 68.
[3] SP Dhanabal; M Sureshkumar; M Ramanathan; B Suresh, *J. Herbal Pharmacother*., **2005,** 5, 7-19.
[4] K Managathayaru; G Umeshankar; G Muralitharan; E Cordairayen; J Vasntha, *Ind. J. pharm. Sci.*, **2004**, 66, 123.
[5] KPS Kumar; D Bhowmik; S Duraive; M Umadevi, *J. Pharmacog. Phytochem.* **2012,** 1(3), 51-63.
[6] P Pushpangadan; J Kaur; J Sharma, *Anc. Sci. Life*., **1989,** 9(1), 20-24.
[7] I Doymaz, *Int. J. Food Prop.*, **2010,** 13(3), 486-497.
[8] JRU Santos; F Bakry; JM Brillouet, *Biochem. Syst. Ecol.* 2010, 38, 1010-1017.
[9] A Kalaiarasan; P Kumar; SA John, *New York Sci. J.*, **2011,** 4(10), 29-31.

[10] D Anand; WJ Wyson; P Saravanan; S Rajarajan, *Int. J. Pharmaco. Phytochem. Res.*, **2014,** 6(3), 562-566.
[11] M Sermakkani; V Thangapandian**,** *Asian J. Pharm. Clin. Res.*, **2012,** 5(2), 90-94.
[12] MK Prabhu; P Samydurai; B Subbaiyan; V Thangapandian, *Int. J. Pharmacy Pharmaceut. Sci.*, **2013,** 5(3), 602-605.
[13] Q Xu; YH Li; XY Lu, *J. Zhejiang Univ.*, **2007,** 8, 439-445.
[14] AR Fernie; RN Trethewey; AJ Krotzky; L Willmitzer, *Nat. Rev. Mol. Cell Bio.*, **2004**, 5, 763-769.
[15] LW Sumner; P Mendes; RA Dixon, *Phytochem.*, **2003,** 62(6), 817-836.
[16] DG Robertson, *Toxicological Sci.*, **2005,** 85, 809-822.