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Short Communication

CHEMICAL CHARACTERISATION OF *ALPINIA GALANGA* (L.) WILLD BY GC–MS, XRD, FTIR AND UV-VIS SPECTROSCOPIC METHODS

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ABSTRACT

Objective: Present study was aimed to produce the chemical profile of *Alpinia galanga* (L.) Willd by various analytical methods.

Methods: The sample extracted with methanol were screened for their volatile organic constituents using a Shimadzu QP-2010 PLUS gas chromatograph coupled to a mass spectrometer (GC-MS) instrument (Shimadzu Corporation, Japan). Then the sample was analyzed for the identification of unknown crystalline materials and determination of crystal structure using a PANalytical X'PERT PRO X-ray diffractometer. Finally the extracts were examined under visible and UV light for the proximate analysis. FTIR method performed on IR AFFINITY-1 Spectrophotometer and UV-1700 Spectrophotometer detects characteristic peaks in the visible range.

Results: Forty significant compounds were identified in *A. galanga* by gas chromatography-mass spectrometry method. XRD pattern gave three prominent diffraction peaks at 25 position (15.39 °, 17.42° and 31.32°) results in d-spacing value 5.75, 5.08 and 2.85 Å; confirms the presence of Cu, Si and Pb elements. FTIR analysis confirmed the presence of alkanes, amides, carboxylic acids, epoxides, alcohols, aliphatic amines, aromatics and phenol compounds. UV Vis spectrum profile showed the peaks at 358, 268 and 224 nm with the absorption of 0.590, 1.199 and 2.752.

Conclusion: The information regarding the characterization and quantification may be useful in assessing the genotoxicity of the plant material and can be recommended for implementation in the official pharmacopeias.

Keywords: *Alpinia galanga* (L.)Willd, GC–MS, XRD, FTIR, UV–Vis spectroscopy.

Medicinal plants synthesize and preserve a variety of biochemical products, many of them are extractable and used as chemical feed stocks or as raw material for various scientific investigations. In this regard, new techniques are required suitable for the wide chemical variety and adjusted to the classical pharmacological study of natural compounds. Furthermore, there is also a need for the improvement and establishment of experimental models not yet extensively used in the evaluation of natural products.

Alpinia galanga (L.) Willd known as greater galangal is a perennial aromatic rhizomatous herb. This plant is cultivated for its rhizome in tropical areas of south and East India. The rhizome is generally used as a spice or source of essential oil throughout its distribution area. In Kerala, rhizomes are used for seasoning fish in pickling. Dried rhizomes are used as a food in Thailand [1, 2]. Considering the importance of the rhizome and its essential oil, present study was aimed to describe the chemical nature and principles using various techniques like gas chromatography-Mass spectroscopy (GC-MS), X-ray diffractrometry and Spectrophotometry.

The fresh plant of *A. galanga* was collected from Kavunkal (Alappuzha district) in Kerala, India. The plant material was identified and their authenticity was confirmed at the herbarium of Botanical Survey of India, Southern Regional Centre, Coimbatore, Tamil Nadu (BSI/SRC/5/23/2015/Tech./714). Fresh rhizomes used for extraction were shade dried and powdered using a mechanical grinder. 2 g of the powder was extracted with 50 ml of methanol with gentle stirring and was kept in dark for 72 h with intermittent shaking. After incubation, the solution was filtered through Whatmann No. 1 filter paper and the filtrate was collected (crude extracts). It was then transferred to glass vials and kept at 4 °C for further use.

The GC-MS analysis was performed on a Shimadzu QP-2010 PLUS gas chromatograph coupled to a mass spectrometer (GC-MS) instrument (Shimadzu Corporation, Japan). An Rtxi-5MS column was employed for the following conditions: Initial temperature was 50 °C increased to 150 °C at a rate of 10 °C/min, then to 250 °C at a rate of 8 °C/min, and finally to 280 °C at a rate of 10 °C/min and held for 5 min. The individual components were identified by computerized matching of their mass spectra of peaks with those gathered in the NIST 08 and WILEY 8-Mass spectral library of the GC-MS data software system.

The X-Ray diffraction pattern of the powder samples was recorded on a PAN alytical X'PERT PRO X-ray diffractometer using Cu K∝ radiation (5= 1.54060 Å). The particle characterization was done by measuring the crystalline size of the sample from the line broadening analyses using Debey–Schherer formula after accounting for instrumental broadening. The crystalline size in nm is expressed as D XRD = 0.89 5 /β cos 5

For FTIR measurements powdered sample of plant specimen was loaded in FTIR spectroscope (Shimadzu, IR AFFINITY-1, Japan), with a scan range from 400 to 4000 cm-1 and with a resolution of 4 cm-1. UV-VIS spectrum profile of the extracts was detected with a Shimadzu, UV-1700 Spectrophotometer at wavelength ranging between 200 and 800 nm.

Total forty significant compounds were identified in *A. galanga* by GC-MS method. The most important compounds identified were 2-Butanone, 3-phenyl (23.20%), 1H-Imidazole, 4,5-dihydro-2-phenyl (16.84%), Benzene propanal (11.68%), 2-Methyl-3,5-dinitrophenyl beta-phenyl propionate (11.34%), 3-heptanone, 5-hydroxy-1,7-Diphenyl (9.05%) and 1-(4-hydroxyphenyl)-1-methoxy-4-phenyl butane (5.03%) (table 1).

As per the previous reports, *A. galanga*, growing in the arboretum of CIMAP Field Station Pant Nagar, Uttaranchal constitute a total of 59 compounds from the rhizome and the major constituents were 1,8-cineole (39.4%), β-pinene (11.9%), α-terpineol (6.6%), α-pinene (5.6%), camphene (5.4%) and camphor (3.8%) [3]. On the other hand fresh rhizomes harvested from Menghai, Yunnan Province, China showed somewhat similar compounds but their amount varies significantly [4]. On comparing our results, the differences observed in the constituents were attributed to the variety, soil, climate, drying conditions and harvesting methods.

Table 1: Major components identified in the methanol extract of *A. galanga* (L.) Willd

S. No.	Retention time	Compound name	Area %
1	12.294	2-Butanone, 3-phenyl	23.20
2	33.682	1H-Imidazole, 4,5-dihydro-2-phenyl	16.84
3	11.054	Benzene propanal	11.68
4	34.329	3-heptanone, 5-hydroxy-1,7-Diphenyl	9.05
5	41.025	1-(4-hydroxyphenyl)-1-methoxy-4 phenylbutane	5.03
6	40.979	Nortrachelogenin	3.36
7	39.740	2-Methyl-3-nitrophenyl. beta-phenyl propionate	2.55
8	11.497	3-cyclohexene-1-methanol,alpha	2.27
9	17.510	Naphthalene	1.65
10	17.121	Alpha-Farnescene	0.78
11	28.508	Hexadecanoic acid, methyl ester	0.59
12	15.273	Caryophyllene	0.55
13	31.001	9,12–Octadecanoic acid	0.48
14	21.090	Cubenol	0.34
15	8.816	Eucalyptol	0.25

World Health Organization (WHO) recommended that analytical control of metal elements in medicinal plants is a part of quality control, which should establish their purity, safety and efficacy in a number of resolutions [10]. XRD is commonly used for determination of crystal structure and identification of unknown crystalline materials (eg. minerals, inorganic compounds) present in a material [11]. Detecting the presence of particles in plant tissue can be achieved by examining the diffraction peaks of the plant.

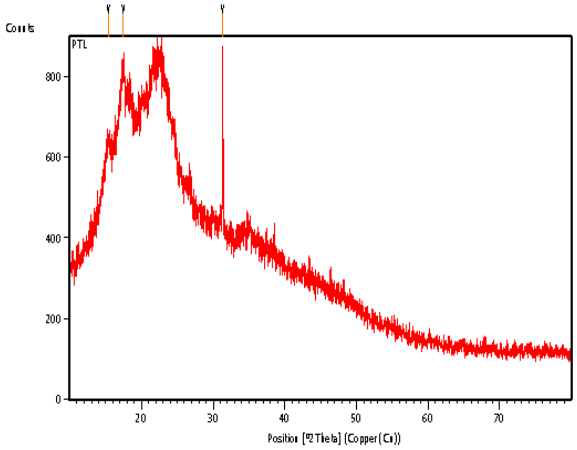

Fig. 1: XRD patteren of methanol extract of *A. galanga* (L.) Willd

Three prominent diffraction peaks were observed at 2 5 positions such as15.39 °, 17.42° and 31.32° (fig. 1) results in d-spacing value 5.75, 5.08 and 2.85 Å; which confirms the presence of Cu, Si and Pb elements respectively.

Fourier Transform Infrared Spectroscopy (FTIR) is a high-resolution analytical technique to identify the chemical constituents/functional groups and elucidate the structural compounds [12]. The methanol extracts of *A. galanga* was passed into the FTIR and the functional groups of the components were separated based on its peak ratio. The results of the analysis confirmed the presence of alkanes, amides, carboxylic acids, epoxides, alcohols, phosphorous compounds, halogen compounds and phenols which shows major peaks at 2931.80, 1612.49, 1442.75, 1257.59, 1064.71, 1018.41, 702.09 and 3348.42 respectively (fig. 2).

The characteristic vibration mode of identified compounds was as follows: C-H stretching, C-N stretching, C-H deformation, Ar-O-Ar asymmetric, C-O stretching, P-O stretching, C-Cl stretching and O-H stretching. These results are in accordance with the reports on selected Indian medicinal plants, which showed similar characteristic vibration modes in the same transmittance range [15].

The qualitative UWis spectrum profile of methanol extracts of *A. galanga* was chosen at a wavelength of 200 nm to 800 nm due to the sharpness of the peaks and the proper baseline. The profile showed the peaks at 358, 268 and 224 nm with the absorption 0.590 and 1.199 and 2.752 respectively (fig. 3). The absorption band at 358, 268 and 224 nm are characteristic for flavonoids and its derivatives and also indicates the presence of aromatic compounds such as acridine, cinnamic acid and benzonitrile.

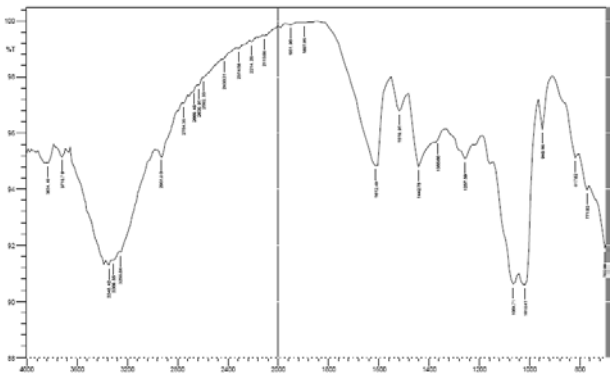

Fig. 2: FTIR spectrum of methanol extract of *A. galanga* (L.) Willd

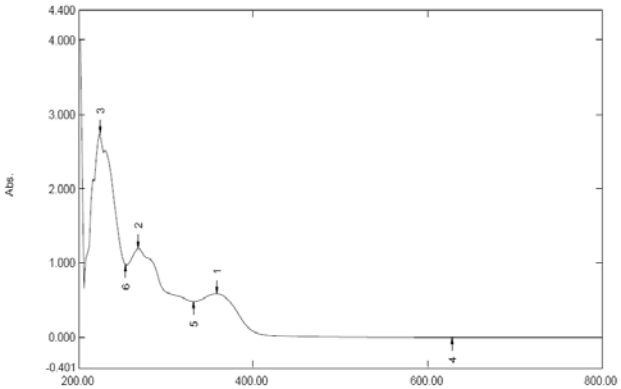

Fig. 3: UV-Visible spectrum of methanol extract of *A. galanga* (L.) Willd

The data on chemical profile of *A. galanga* exhibited some important phytochemical markers as the useful analytical tool to check the quality of the sample. This would help in the assessment of genotoxicity of the plant and can be recommended for implementing in official pharmacopeias.

CONFLICT OF INTERESTS

Declared None

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