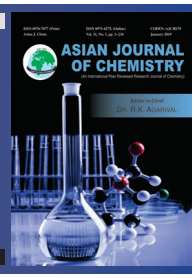
Asian Journal of Chemistry; Vol. 31, No. 7 (2019), 1546-1548

ASIAN JOURNAL OF CHEMISTRY

https://doi.org/10.14233/ajchem.2019.22032



Study on Phytochemicals, Functional Groups and Minerals in *Asparagus racemosus* Root

CHANDAN KRISHNAMOORTHY and RAMALINGAM CHIDAMBARAM*

Instrumental and Food Analysis Laboratory, Industrial Biotechnology Division, School of BioSciences and Technology, Vellore Institute of Technology, Vellore-632014, India

*Corresponding author: E-mail: cramalingam@vit.ac.in

Received: 26 February 2019; *Accepted*: 20 March 2019; *Published online*: 21 May 2019; AJC-19411

Asparagus racemosus root is a rich source of phytochemicals and minerals. The phytochemicals present in the ethanolic extract was studied by gas chromatography/mass spectroscopy (GC/MS). Identification of functional group, quantitive determination of major, and trace minerals was carried out by FT-IR and AAS. GC/MS result shows the presence of five phytocompounds namely 2-ethyl-2-(hydroxymethyl)-1,3-propanediol, (r)-5-(1,5-dimethyl-4-hexenyl)-2-methyl phenol, *n*-hexadecanoic acid, (*z*)-2-(9-octadecenyloxy)ethanol, 4,4-dimethyl-3β,5α-cholest-8(14)-en-3-ol, which has health and other industrial applications. FT-IR spectra highlights the presence of various functional groups. AAS result shows the high level of calcium, magnesium, phosphorous and iron where as sodium, manganese, zinc, and copper were low. All these phytochemical and minerals present in *Asparagus racemosus* can be used in treating various diseases and mineral deficiencies.

Keywords: ***Asparagus racemosus,*** **Phytochemicals, Trace minerals.**

INTRODUCTION

Asparagus racemosus (Shatavari) belongs to the family Asparagaceae and widely distributed in Africa, Australia, China, Sri Lanka and highly cultivated in India [1]. In Ayurveda, *Asparagus racemosus* was known as "Queen of herbs", "Shatavari" and "Ayurvedic rasayana" [2,3]. *A. racemosus* was a female reproductive tonic which helps in treating women′s health disorders such as mensuration and abortions, *etc*. [4-8]. The root of *Asparagus racemosus* was rich in phytochemical and pharmacological properties as compared to other parts of the plant. Antisecretory, antiulcer, antitussive, antibacterial, antiprotozoal, antihepatotoxic, antineoplastic, antioxidant, antilithiatic, antidepressant, anti-inflammatory, antistress and female tonic were some of the important pharmacological activities of *Asparagus racemosus* root. The root was rich in calcium, magnesium, potassium along with some trace elements such as copper, manganese, zinc, selenium, *etc*. [8-10]. It provides a high supplement of carbohydrates, proteins and potassium [11]. Fresh asparagus contains a high concentration of both the major and trace elements [12,13]. Even though canned vegetables contain a moderate level of minerals canned white asparagus were rich in sodium, iron and potassium [14].

In human health, sodium, phosphorous, calcium, magnesium, potassium (major minerals) and iron, copper, manganese, zinc, selenium (trace minerals) play an important role in physiological processes. Calcium is highly important for the electric impulse in the brain, muscle growth, building, and maintaining bones. Iron plays an important role in haemoglobin, maintaining a healthy immune system, menstrual cycle. Apart the role of magnesium with respect to bones and muscles they also involve in preventing high blood pressure and some heart disorders. It also helps in wound healing process. Potassium and sodium are important in maintaining osmotic balance inside and outside the cell. Thus, keeping the cell in proper shape [15].

The objective of this study is to analyze the phytochemicals present in the ethanolic extract by GC/MS, functional groups by FT-IR, major and trace minerals by AAS present in *Asparagus racemosus*.

EXPERIMENTAL

Asparagus racemosus root was obtained from Vellore district, India and milled to obtain fine powder and stored for further analysis. Other chemicals of analytical grade were used.

Asparagus racemosus **extract preparation for GC/MS analysis:** *Asparagus racemosus* root powder (2 g) was weighed

and taken in a beaker to which 100 mL of 95 % ethanol was added and homogenized for 30 min. This mixture was covered with aluminum foil and incubated overnight at room temperature. Later, filtered and centrifuged at 1000 rpm for 10 min. The supernatant was collected and dried. The dried sample was dissolved in ethanol and subjected to GC/MS analysis. The sample (2 µL) were injected into GC/MS. Carrier gas: helium, flow rate: 1 mL/min, oven temperature raises to 300 ºC from 60 ºC at 10 ºC/min, run time: 31 min, GC trace ultra version 5, MS-thermo DSQ II, column-db35 MS capillary. National Institute Standard and Technology database was used for interpretation.

FTIR analysis: Potassium bromide (KBr) of 200 mg and *A. racemosus* root powder of 1 mg were mixed well. The KBr and powder mixture was pressed after transferring to KBr press assembly. FT-IR spectra were recorded between 4000-500 cm^{-1} after placing the sample pellet into the sample holder.

Atomic absorption spectroscopy (AAS): Microwave digester was used for the sample digestion. 1 g of each powdered sample was accurately weighed and taken in digestion vessels to which 6 mL of nitric acid was added. These vessels were placed in a microwave digester and temperature program was set. The digestion vessels were removed after complete digestion, cooled to the room temperature and the cap was removed carefully. The digested samples were filtered using Whatman filter paper No.1 and collected in 100 mL volumetric flask which was made up to the mark using double distilled water. These diluted samples were used for mineral determination by Atomic Absorption Spectroscopy model AAS Pin AAcle 900 T (Perkin Elmer). All the samples were analyzed in triplicates and the values were represented in mean ± standard deviation.

RESULTS AND DISCUSSION

Fig. 1 shows the GC/MS chromatogram of an ethanolic extract of *Asparagus racemosus* root. Compound name, retention time (RT), molecular weight and formula, its activity and application are mentioned in Table-1. Five phyto-compounds are identified namely 2-ethyl-2-(hydroxymethyl)-1,3-propanediol at RT 14.96; (r)-5-(1,5-dimethyl-4-hexenyl)-2-methyl phenol at RT 16.36, *n*-hexadecanoic acid at RT 18.41; (*z*)-2-(9-octadecenyloxy)ethanol at RT 19.79; and 4,4-dimethyl-3β,5α-cholest-8(14)-en-3-ol at RT 28.80.

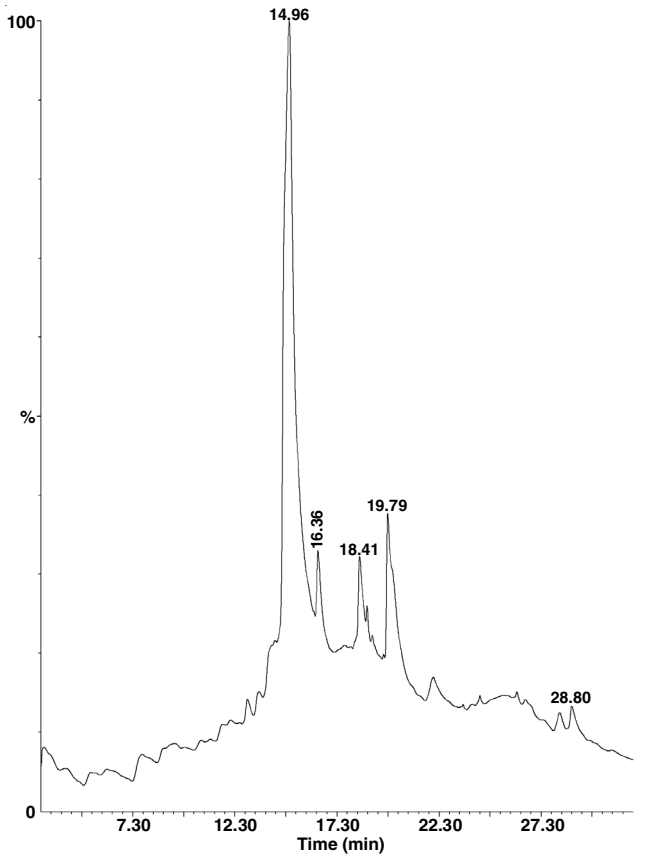


Fig. 1. GC/MS chromatogram of ethanolic extract of *A. racemosus* root

2-Ethyl-2-(hydroxymethyl)-1,3-propanediol is also known as trimethylolpropane which has its application in milling aid and dispersant for pigments and (r)-5-(1,5-dimethyl-4-hexenyl)-

TABLE-1
PHYTOCHEMICAL COMPOUNDS IDENTIFIED IN ETHANOLIC EXTRACT OF *A. racemosus* ROOT

RT	Name of the compound	m.f.	m.w.	Nature	Activity	Application
14.96	2-Ethyl-2-(hydroxymethyl)-1,3-propanediol [Trimethylolpropane]	$C_6H_{14}O_3$	134	Organic compound with three hydroxy functional groups	–	As a milling aid and dispersant for pigments used as components of food-contact polymers except for use in contact with infant formula and human milk.
16.36	5-(1,5-Dimethyl-4-hexenyl)-2-methyl-, phenol (r)- [Xanthorrhizol]	$C_{15}H_{22}O$	218	Bisabolane-type sesquiterpenoid compound	Anticancer, antimicrobial, anti-inflammatory, antioxidant, antihyperglycemic, antihypertensive, antiplatelet, nephroprotective, hepatoprotective, estrogenic and anti-estrogenic effects	Mouthwash or toothpaste
18.41	*n*-Hexadecanoic acid [palmitic acid]	$C_{16}H_{32}O_2$	256	Saturated fatty acid	Antioxidant	Flavoring agent
19.79	Ethanol, 2-(9-octadecenyloxy)-, (z)-	$C_{20}H_{40}O_2$	312	–	–	–
28.80	Cholest-8(14)-en-3-ol, 4,4-dimethyl-, (3β,5α)-	$C_{29}H_{50}O$	414	–	–	–

TABLE-3
CONCENTRATION OF MAJOR AND TRACE MINERALS IN *A. racemosus* ROOT BY AAS

Major minerals					Trace minerals				
Sodium	Phosphorous	Calcium	Magnesium	Potassium	Iron	Copper	Manganese	Zinc	Selenium
356.5 ± 31.82	1545 ± 29.70	3366.5 ± 23.33	2082.5 ± 14.85	BLQ	417 ± 17.68	5.35 ± 0.04	20.65 ± 0.21	14.65 ± 0.50	BLQ

Values are represented as a mean ± standard deviation in mg kg^{-1}. BLQ = Below limit of quantification.

2-methyl phenol is commonly known as xanthorrhizol which is known for its antimicrobial, antioxidant, anti-inflammatory activities, *etc*. so it is widely used in toothpaste and mouth-washes. *n*-Hexadecanoic acid, also known as palmitic acid, is commonly used as a flavouring agent and known for its anti-oxidant property.

Fig. 2 shows the FT-IR spectrum of *Asparagus racemosus* root powder. The broad peak 3267.41 cm^{-1} corresponds to the O-H stretch carboxylic acid group. Two small peaks 2926.01 and 2877.79 cm^{-1} which are observed next to the broad peak corresponds to the same O-H stretch carboxylic acid group. N-H bend amines group is observed at the 1627.92 cm^{-1} and the C-O stretch alcohol group peak is observed at 1247.94 cm^{-1}. The long and narrow peak at 1020.34 cm^{-1} is due to =C-O-C symmetric stretch ethers. A very small and negligible peak 817.82 cm^{-1} is due to C-H bend aromatic compound and the last peak at 514.99 cm^{-1} is attributed to C-Cl stretch alkyl halides. The other key bands of IR are given in Table-2.

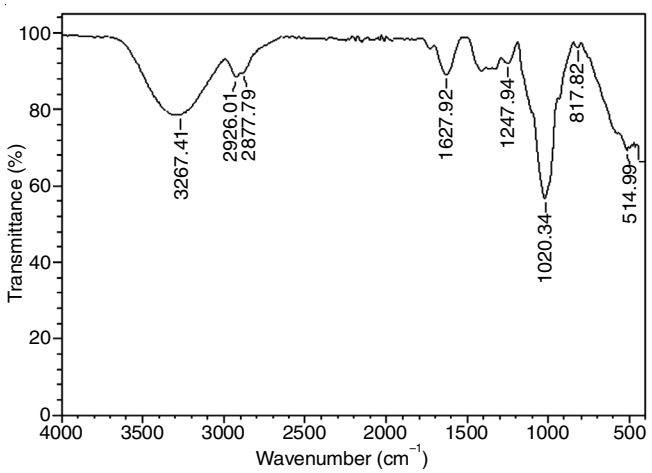


Fig. 2. FT-IR spectrum of *A. racemosus* root

TABLE-2
FUNCTIONAL GROUPS PRESENT IN *A. racemosus* ROOT

Absorption peak (cm^{-1})	Bond and functional group
3267.41	O-H stretch carboxylic acid
2926.01	O-H stretch carboxylic acid
2877.79	O-H stretch carboxylic acid
1627.92	N-H bend amines
1247.94	C-O stretch alcohol
1020.34	=C-O-C symmetric stretch ethers
817.82	C-H bend aromatic compound
514.99	C-Cl stretch alkyl halides

Table-3 shows the major and trace mineral concentration. *Asparagus racemosus* root powder contains a high level of major minerals, namely calcium (3366.5 ± 23.33 mg kg^{-1}), magnesium (2082.5 ± 14.85 mg kg^{-1}), phosphorous (1545 ± 29.70 mg kg^{-1}) whereas sodium at low level 356.5 ± 31.82 mg kg^{-1}. Considering trace minerals, iron is present in high level 417 ± 17.68 mg kg^{-1}, whereas other minerals namely manganese (20.65 ± 0.21 mg kg^{-1}), zinc (14.65 ± 0.50 mg kg^{-1}) and copper (5.35 ± 0.04 mg kg^{-1}) are low. Potassium and selenium are not determined as their levels were below the limit of quantification *i.e*., below 20 and 0.9 mg kg^{-1}, respectively. The dietary intake of *Asparagus racemosus* root will reduce various mineral deficiencies and improve human health system.

ACKNOWLEDGEMENTS

The authors thank the Vellore Institute of Technology (VIT), Vellore, India for providing the necessary research facilities to carry out this research work.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

REFERENCES

1. R. Singla and V. Jaitak, *Int. J. Pharm. Sci. Res.*, **5**, 742 (2014); https://doi.org/10.13040/IJPSR.0975-8232.5(3).742-57.
2. V.M. Gogte, Ayurvedic Pharmacology and Therapeutic uses of Medicinal Plants-Dravyagunavignyan, SPARC: Mumbai (2000).
3. D. Frawley, Ayurvedic Healing-A Comprehensive Guide, Motilal Banarsidass Publishers Private Limited: Delhi (1997).
4. R.K. Sharma and B. Dash, Charaka Samhita-Text with English Translation and Critical Exposition Based on Chakrapani Datta's Ayurveda Dipika, Chowkhamba, Varanasi: India (2003).
5. G.K Garde, Sarth Vagbhat (Marathia Translation of Vagbhat's Astanga-hridya), Uttarstana, Aryabhushana Mudranalaya, p. 40 (1970).
6. Atreya, Ayurvedic Healing for Women, Samuel Weiser, Inc.: York (1999).
7. M. Srikantha and K.R Vagbhata's Astanga Hrdayam-Text, English Translation, Notes, Appendix and Indices, Krishnadas Academy, Varanasi: India (1997).
8. S. Alok, S.K. Jain, A. Verma, M. Kumar, A. Mahor and M. Sabharwal, *Asian Pac. J. Trop. Dis.*, **3**, 242 (2013); https://doi.org/10.1016/S2222-1808(13)60049-3.
9. B.K. Choudhary and A. Kar, *Indian Drugs*, **29**, 623 (1992).
10. B. Mohanta, A. Chakraborty, M. Sudarshan, R.K. Dutta and M. Baruah, *J. Rad. Anal. Nucl. Chem.*, **258**, 175 (2003); https://doi.org/10.1023/A:1026291000167.
11. A. Aberoumand, *Iran. J. Energy Environ.*, **1**, 196 (2010).
12. R. Moreno-Rojas, M.A. Amaro-Lopez and G. Zurera-Cosano, *J. Food Compos. Anal.*, **5**, 168 (1992); https://doi.org/10.1016/0889-1575(92)90033-G.
13. M.A. Amaro-Lopez, G. Zurera-Cosano, R. Moreno-Rojas and R.M. Garcia-Gimeno, *Plant Foods Hum. Nutr.*, **47**, 349 (1995); https://doi.org/10.1007/BF01088273.
14. O. Martín-Belloso and E. Llanos-Barriobero, *Eur. Food Res. Technol.*, **212**, 182 (2001); https://doi.org/10.1007/s002170000210.
15. R.K. Bachheti, I. Rai, A. Joshi, D.P. Pandey and A. Sharma, *Int. J. Pharm. Pharm. Sci.*, **4**, 359 (2012).