Explor Anim Med Res.
Vol. 13, Ethnomed. Spl., 2023
DOI : 10.52635/eamr/13(S)67-70

ISSN 2277-470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Research Article

INDUCTIVE COUPLED PLASMA ANALYSIS OF *HERACLEUM NEPALENSE* D. DON (UMBELLIFERAE)

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Received 16 February 2023, revised 26 April 2023

ABSTRACT: *Heracleum nepalense* D.Don, of the family Umbelliferae is well-known as folklore medicine having the same therapeutic values and is used in different parts of the world. Especially, the fruits of the plant is used as flavoring agent, spices, and ethnomedicine in the hilly regions of Sikkim and adjoining Himalayan regions. Concerning these uses, the present study was undertaken to analyze the contents of fruit by using Inductive Coupled Plasma Spectroscopy. All values of Inductive Coupled Plasma Mass Spectrometry (ICP - MS) analysis are presented in part per billion (ppb) where the contents reflected the presence of elements in the different concentrations. The concentration of Group IA elements are like Lithium 1.809 ppb, Sodium 686.153 ppb, Potassium 163031.511 ppb, Rubdium 1906.258 ppb, Caesium 1.898 ppb; the concentration of Group IIA elements are like Beryllium 0.064 ppb, Magnesium 37082.399 ppb, Calcium 229757.026 ppb, Barium 5.489 ppb; the concentration of Group IIIA elements are like Boron 134.140 ppb, Aluminum 429.261 ppb, Galium 2.059 ppb, Thallium 0.317 ppb; the concentration of Group IVA elements are like Carbon 546685 ppb, Silicon 1055.612 ppb, Lead 59.782 ppb; the concentration of Group VA elements is like Phosphorus 22436.678 ppb, Arsenic 2.458 ppb; the concentration of Group VIA elements are like Sulphur 12716.678 ppb; the concentration of Group VIIA elements are like Bromine 306.966 ppb, and Iodine 18.386 ppb, are noted.

Key words: Folkfore medicine, *Heracleum nepalense* D.Don, Presence of elements, Sikkim Himalaya.

INTRODUCTION

Plants are used in healthcare from an ancient stage of human civilization and scientific studies for their effective use are performed in the following different ways (Pattanayak 2021, Patel *et al.* 2022, Paul and Sujatha 2022). Sikkim is a high-altitude state in India and very rich in plant bio-diversity (Pradhan *et al.* 2021).

Heracleum nepalense D. Don (Umbelliferae) is one of the widely used ethnomedicinal plants of Sikkim. It is also locally available in the market due to its high demand to use as a flavoring agent, ethnomedicine, and spice. In Sikkim, the fruits of *H. nepalense* are mostly used for the treatment of intestinal gastritis and stomach aches and also in some cases used as an appetizer, for digestion as well as a food additive. The plant grows well naturally in the sandy loam soil attaining a height of 1m-2m in areas from 2000 m to 3500 m. The trifoliolate (1-2-pinnate) leaf has a long petiole with a broad ovate leaf blade (leaflets). The fruit is obovoid having filiform lateral ribs. The plants flower from May to June and fruits are available from August to September. The plant is distributed in Bhutan, China, India Myanmar, and Nepal.

Several studies have stated that *H. nepalense* has potential therapeutic values and is widely used for the treatment of inflammation, stomach ache, epilepsy, diarrhea, tonic, and digestive (Dash *et al.* 2005, Bahadori *et al.* 2011). Subba *et al.* (2020) reported its effectiveness against the larvae of *Aedes albopictus* and they also reported the presence of active components such as caryophyllene oxide, furanocoumarins, Bergapten, Phhellopterin, etc. Moreover, it is locally known as "Hogwood" and used

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as a food additives, spices, and flavoring agent (Bahadori *et al.* 2011).

Thus it is initiated to study and investigate the presence of different useful elements of *H. nepalese* to emphasize the information for revealing the therapeutic significance.

MATERIALS AND METHODS

The plant materials were collected from the temperate forest of Sikkim and identified referring to the literature (Hooker 1872-1897, Hara 1966, 1971) and type specimens deposited at CAL, E, & K. Voucher specimens are deposited at SSFH for future reference.

Mature fruits of the plant with a weight of 1473 mg were ground into powder. The plant tissues were digested and made a volume of 50 ml to examine in Inductively Coupled Plasma Emission Spectroscopy. The digestion of plant samples performed in CEM Mars One, 240/ 50. The plant sample was kept in the vessel adding 10 ml HNO_3 and kept for fifteen minutes with an open lid for pre-digestion. The digestion unit was set with ramp 15, hold time 15 minutes, temperature 165ºC, and power 600 watts.

After the completion of digestion, the vessel was cooled for 15-20 minutes, and decant and make a volume of 50 ml in a conical flask. Subsequently, filter it to run in ICP. Using Salsa software, the sample was run in ICP igniting Hg lamp, keeping spectrometer temperature 34-35ºC and pump pressure 25-30s uptake. The data obtained from the spectrometer as a result is presented in this paper.

RESULTS AND DISCUSSION

This plant species was also cultivated as trial cultivation at 1615 m at Gangtok [Lower Burtuk] and found that the species was responding similarly to naturally growing healthy plants bearing well-developed fruits in sandy and loam soil under the well-irrigated facility. The trial plot's profile was on the east-facing land. This result depicted that the species has a wide range of adaptability from sub-temperate to sub-alpine climate conditions. Being the fruits as the subject of interest the sun dried fruits were bought to the laboratory and powdered to analyze the elemental contents of different elements.

In the earlier GC-MS analysis of fruits of Heracleum nepalense by Subba *et al.* (2020), there are reports of the presence of Cadina-1(10), 4 dienes (5.44%) and caryophyllene oxide (1.28%) in diethyl ether extract and 5-Caranol, (1S,3R,5S,6R)- (12.8%) and alpha copaenes (2.19%) in methanolic extract. In addition to diethyl ether extract that contained furanocoumarins [(R)-9-(3,3-Dimethyl-2-oxiranyl) methoxy)-4-methoxyfuro (3,2-g) chromen-7-one (18.11%), bergapten (4.77%), phellopterin (2.82%)], etc.

The elemental study of this plant is thinly documented and no such detailed work was carried out on this aspect of elemental analysis. This study is presently undertaken using the ICP instrument at QCL, Forest and Environment Department, Sikkim. Moreover, the present result shows that there are many elements in the fruits of *H. nepalense*, in both low and high concentrations as obtained and presented with the data from three replicas (Table I).

There are altogether seven groups of concentration of elements. The concentration is expressed as part per billion (ppb). The concentration of Group IA elements like Lithium, Sodium, Potassium, Rubidium, Cesium; Group IIA elements like Beryllium, Magnesium, Calcium, Barium; Group IIIA elements like Boron, Aluminum, Gallium, Thallium; Group IVA elements like Carbon, Silicon, Lead; Group VA elements like Phosphorus, Arsenic; Group VIA element like Sulphur; Group VII A elements like Bromine and Iodine are noted.

Transition metals content like Scandium, Titanium, Vanadium, Chromium, Molybdenum, Manganese Iron, Cobalt, Nickel, Copper, Zinc, Germanium, Strontium, Yttrium, Zirconium, Niobium, Palladium, Silver, Cadmium, Tin, Antimony, Hafnium, Tantalum, Tungsten, Osmium, Iridium, Platinum, Gold, Mercury; Lanthanides like Lanthanum, Cerium, Praseodymium, Neodymium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium; Actinides like Thorium and Uranium are analyzed (Table 1).

The result has interesting findings where it contains the analytes, which are from Lanthanides, Actinides, and Transition metals, and all are at extremely low concentrations.

Table 1. Concentration of elements in the fruits of *Heracleum nepalense* D.Don (all with three replicas).

Analyte/s		Concentration (ppb)	Intensity	Analyte/s		Concentration (ppb)	Intensity
Li	[Lithium]	1.809	1.95	Ag	[Silver]	0.985	4.68
Be	[Beryllium]	0.064	4.07	Cd	[Cadmium]	0.769	5.220
B	[Boron]	134.140	0.001	Sn	[Tin]	5.633	2.86
C	[Carbon]	546685	4.026	Sb	[Antimony]	5.169	3.63
Na	[Sodium]	686.153	0.0074	I	[Iodine]	18.386	4.276
Mg	[Magnesium]	37082.399	0.2036	Cs	[Cesium]	1.898	4.412
Al	[Aluminum]	429.261	0.00249	Ba	[Barium]	5.489	0.00367
Si	[Silicon]	1055.612	0.00395	La	[Lanthanum]	5.489	3.509
P	[Phosphorus]	22436.678	0.118	Ce	[Cerium]	10.767	3.937
S	[Sulphur]	12716.678	0.0672	Pr	[Praseodymium]	1.032	4.0054
K	[Potassium]	163031.511	7.361	Nd	[Neodymium]	4.050	0.0131
Ca	[Calcium]	229757.026	1.469	Sm	[Samarium]	0.910	2.851
Sc	[Scandium]	0.516	1.49	Eu	[Europium]	0.211	9.50
Ti	[Titanium]	177.763	0.0021	Gd	[Gadolinium]	1.462	3.80
V	[Vanadium]	7.702	2.69	Tb	[Terbium]	0.268	7.467
Cr	[Chromium]	21.846	0.00023	Dy	[Dysprosium]	1.559	5.02
Mn	[Manganese]	4502.770	0.00299	Ho	[Holmium]	0.348	1.15
Fe	[Iron]	11579.974	0.039	Er	[Erbium]	1.014	3.869
Co	[Cobalt]	10.256	0.0927	Tm	[Thulium]	0.174	6.788
Ni	[Nickel]	295.721	0.00427	Yb	[Ytterbium]	1.092	4.82
Cu	[Copper]	2375.719	0.0037	Lu	[Lutetium]	0.149	5.43
Zn	[Zinc]	2654.4	0.0076	Hf	[Hafnium]	2.861	9.16
Ga	[Gallium]	2.059	1.03	Ta	[Tantalum]	0.415	2.37
Ge	[Germanium]	0.528	8.14	W	[Tungsten]	7.095	4.88
As	[Arsenic]	2.458	1.031	Os	[Osmium]	10.197	4.69
Br	[Bromine]	306.966	0.00178	Ir	[Iridium]	0.067	6.78
Rb	[Rubidium]	1906.258	0.0209	Pt	[Platinum]	0.089	1.629
Sr	[Strontium]	1938.840	0.0086	Au	[Gold]	14.757	0.00019
Y	[Yttrium]	5.825	2.55	Hg	[Mercury]	0.152	1.56
Zr	[Zirconium]	147.438	0.00052	Ti	[Thallium]	0.317	1.94
Nb	[Niobium]	2.551	4.95	Pb	[Lead]	59.782	0.00010
Mo	[Molybdenum]	106.473	0.00058	Th	[Thorium]	2.600	9.64
Pd	[Palladium]	11.854	1.83	U	[Uranium]	1.588	1.20

Fig. 1. *Heracleum nepalense* D.Don.

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*__Cite this article as:__ Pradhan DK (2023) Inductive coupled plasma analysis of *Heracleum nepalense* D.Don (Umbelliferae). Explor Anim Med Res 13(Ethnomed. Spl.): 67-70, DOI: 10.52635/eamr/13(S)67-70.