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RESEARCH ARTICLES

Study on nutritional and phytochemical profile of seven edible food supplements of Uttarakhand (Garhwal Himalaya)

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Abstract

Medicinal plants are the potential sources of different natural molecules having wide pharmacological activities. The fruits and parts of these plants are also the sources of significant antioxidants and nutraceuticals having potent antioxidant potential and significant immuno-modulatory activities. The present study is the first report on wild edible food supplements that are endowed with various medicinal properties and significant antidiabetic, anticancer and anti-nephrolithiasis properties. The study was performed to determine the nutritional, mineral profile and phytochemical analysis of seven (7) medicinal plants viz. *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* for exploring and development of new, safe and potent drugs. The extraction was performed by fractionation with different solvents, while the nutrients and minerals present in all these plants were studied using Association of Official Analytical Chemists (AOAC) method and Inductively coupled plasma-mass-spectrometry (ICP-MS) techniques. The results of the study revealed the presence of significant nutrients and minerals in all the seven (7) plants studied. The present study revealed that, carbohydrates/glycosides were present in *Cajanus indicus, Dolichos biflorus, Glycine soja*, *Benincasa cerifera*, *Setaria italica, Cleome viscosa and Hordeum vulgare* while alkaloids were observed by Mayer's test only in *Cajanus indicus, Dolichos biflorus* and *Glycine soja.* The flavonoids were observed in *Cajanus indicus, Glycine soja, Benincasa cerifera, Cleome viscosa* and *Hordeum vulgare.* The saponins were observed in *Cajanus indicus, Glycine soja*, *Benincasa cerifera, Setaria italica* and *Hordeum vulgare*. The tannins were observed as pyrogallol and catechol in *Cajanus indicus, Glycine soja, Benincasa cerifera* and *Cleome viscosa.* The unsaturated sterol and triterpene were observed by Liebermann Burchard test and Salkowski test in all the seven plants studied. The varied levels of mineral content were observed in *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*. The nutritional value of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare.*

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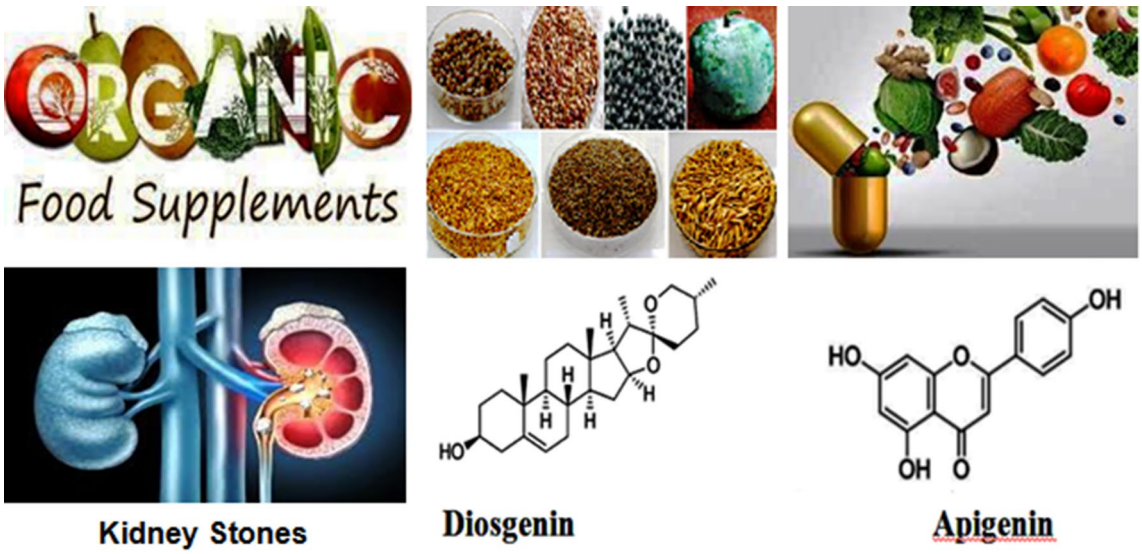
Graphic abstract



Keywords Anticancer activity · Anti-diabetic activity · Anti-nephrolithiasis · Grains · Tor- *C. indicus* · Gahat- *D. biflorus* · Kala bhat- *G. soja* · Bhujaila- *B. cerifera* · Koni- *S. italica* · Jakhya- *C. viscosa* · Jau- *H. vulgare*

Introduction

Uttarakhand region is the area of diversity of different medicinal plants, herbs and shrubs rich in significant phytoconstituents having diverse pharmacological properties. *Cajanus indicus* Linn, (Fabaceae) is known as Tor in north India, especially in Uttarakhand. It's applied as a remedy of various types of infections i.e. sores, hepatitis, jaundice, skin irritation, measles, diabetes, constipation and many other disease, for treatment of bladder stones and regulating the menstrual period. It is rich in sodium, potassium, calcium, iron, phosphorus, protein, fat, fiber and vitamin content and globulins composition viz. cajanin and concajanin (Nene and Sheila 1990; Parrotta 2001). *Dolichos biflorus* L, (Papilionaceae) is commonly called as Gahat, which is rich in vitamins. The vitamins found are thiamine, riboflavin and nicotinic acid. The seeds of *Dolichos biflorus* are mainly used for treatment of nephrolithiasis (kidney, bladder or urethra stones), asthma, cold, cough, astringent, diuretic, diarrhoea, Bowel haemorrahage, leucorrhoea, colic and enlargement of spleen, liver and piles (Gupta and Sharma 2005). *Glycine soja* (Fabaceae) is known as Kala bhatt. It is a small suberect, hairy annual, trifoliate with pods, which is generally 3–4 seeded. The seed of *G. soja* is used in the treatment of fever, cold, insomnia, irritability, headaches and chest problems. *Glycine soja* contains potentially active anticancer substances. Due to the presence of potent and important nutrients in *Glycine soja*, it is more important and beneficial than regular soybeans (Amaaniand and Dwira 2018). *Benincasa cerifera*, (Cucurbitaceae), commonly called Bhujaila in Uttarakhand. Medicinally, it has been used to diagnose various diseases such as diuretic, diabetes, heart problem, gastrointestinal problem, respiratory disease, and urinary diseases. Pharmacological studies have shown that extracts of this plant are helpful in treatment of various health related issues and thus are significant antioxidant, anti-diuretic, anti-inflammatory, antidiabetic, hypolipidemic, analgesic, antiasthmatic, nephroprotective, central nervous effects "anxiolytic, muscle relaxant, antidepressant in the treatment of Alzheimer's disease and possess antimicrobial effects (Al-Snafi et al. 2013). *Setaria italica* (foxtail millet) also known as Koni, It belongs to the Poaceae family. It is traditionally used to treat inflammation, pain, arthralgia and many neurological disorders. The sprouted yellow seeds of this plant are astringent, digestive, emollient, stomachic and carminative. It is mainly used in the following diseases such as fever, cholera, poor digestion, dyspepsia, diuretic and food stagnancy in the abdomen. *Cleome viscosa* Linn. of the family Capparidaceae is commonly called Jakhya in Uttarakhand. The whole (seeds, leaves and roots) plant is a very important medicinal plant, also described in ancient traditional and folklore, it contains the symptoms that prevent and treat various diseases, it removes the following disease like blood diseases, diuretic, skin problems, leprosy, malarial fevers, analgesic, antimicrobial, anti-inflammatory, antidiarrheal, antipyretic, antiseptic, hepatoprotective, stomachic, laxative, uterine complaints and cardiac stimulant (Mali 2010). *Hordeum vulgare* L. (Poaceae) commonly known as

Jau in Uttarakhand. Bread of Jau flour is given to patient to cure diabetes and asthma. It is used in folk remedies for bronchitis, cholera, cough, fever, inflammation, sores, cancer of stomach and uterus, and abdominal tumors. It is also used as diuretic, digestive, nutritive, treating burns and wounds, stomachic and also showed antitumor activity; possessed hypoglycemic effect, lowering blood cholesterol level, preventing bowel cancer, diarrhea. It is utilized as source of folic acid and vitamin B12 and B6. With reference to the plants used for study, the plants are dominant in local areas of Uttarakhand and are utilized by the local people and villagers for medicinal importance. Thus, the study was concentrated on the mentioned plants. The mature pulses/crops of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* are shown in Fig. 1.

Materials and methods

Chemicals

All the chemicals and reagents used in this research work were purchased from Merck, India.

Plant material

Fresh and dry seeds of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* were collected from Dhunglwali village, Distt. Chamoli Uttarakhand, India from April 2018 to August 2018. All these plants were authenticated by the Taxonomy Laboratory Department, HNB Garhwal University, Srinagar Garhwal, Uttarakhand India. The voucher specimens of all seven plants have been deposited in the University herbarium for future records.

Preparation of plant extract

The seeds of all the assorted plants are tedious at room temperature and then finely sliced from all these plants are prepared in powder form, further extracted with ethyl alcohol using Soxhlet apparatus (Chandra et al. 2019). All extracts were dried using rotatory evaporator. The concentrated extracts were stored in airtight glass or plastic containers in a refrigerator for further studies.

Nutritional and mineral assay

Different physico-chemical parameters viz. moisture, crude fiber and ash content were determined by the conventional methods (Iswaran 1980). The total dietary fiber quantification was performed by AOAC methods (AOAC 2000). The total nitrogen content and crude protein content was determined by micro Kjeldhal method. The determination of total carbohydrates was performed (Saklani et al. 2012). The total energy value was obtained. Determination of calcium, sodium, potassium, iron, zinc, phosphorus and magnesium) minerals were done against salt standards by the ICP-MS (PerkinElmer SCIEX ELAN DRCe) method.

Fig. 1 Wild edible food grains/supplements of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*

Phytochemical analysis

The qualitative and quantitative phytochemical properties from dried powder samples were determined using standard methods. The different phytoconstituents were identified by phytochemical screening. For determination of volatile content, 50 gm of air-dried plant samples were taken for hydro-distillation method (Kokate et al. 2005).

Statistical analysis

The data were presented through analysis for variance "ANOVA" in a way in which the analyzed data was expressed as ± SEM and the Tukey's T-test was applied as analysis of research significance. The importance of the P value (< 0.05) was taken as the level of significance.

Results

The results obtained from the seeds of all the plants (*Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*) are shown in Tables 1, 2 and 3. The results of the study revealed the presence of significant nutrients and minerals in all the 07 plants studied.

Nutritional value

The variable levels of mineral content were observed in *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*. The nutritional value of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare.* The results of nutritional values are shown in Table 1.

Table 1 Nutritional value of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*

S. no.	Plant name	Common name	Moisture (%)	Crude fibre (%)	Total protein (%)	Crude fat (%)	Ash (%)	Organic matter (%)	Carbohydrates (%)
1	*Cajanus indicus*	Tor	14.50 ± 0.15	7.50 ± 0.08	14.12 ± 0.01	2.20 ± 0.05	5.30 ± 0.10	94.70 ± 0.25	56.38 ± 0.10
2	*Dolichos biflorus*	Gahat	11.80 ± 0.10	5.30 ± 0.08	16.50 ± 0.05	1.50 ± 0.09	10.70 ± 0.08	89.30 ± 0.08	54.20 ± 0.30
3	*Glycine soja*	Kala bhat	10.80 ± 0.08	8.50 ± 0.05	35.12 ± 0.02	16.2 ± 0.20	5.50 ± 0.15	94.50 ± 0.05	23.88 ± 0.20
4	*Benincasa cerifera*	Bhujaila	62.0 ± 0.25	10.8 ± 0.05	3.87 ± 0.04	0.80 ± 0.20	6.90 ± 0.05	93.1 ± 0.10	15.63 ± 0.25
5	*Setaria italica*	Koni	10.0 ± 0.15	11.5 ± 0.08	3.06 ± 0.25	3.40 ± 0.05	4.50 ± 0.08	95.50 ± 0.10	67.54 ± 0.10
6	*Cleome viscosa*	Jakhya	8.00 ± 0.15	9.20 ± 0.01	25.06 ± 0.03	16.62 ± 0.25	8.00 ± 0.05	92.0 ± 0.10	33.12 ± 0.15
7	*Hordeum vulgare*	Jau	12.00 ± 0.20	5.10 ± 0.10	5.93 ± 0.15	1.00 ± 0.05	3.90 ± 0.10	96.10 ± 0.08	72.07 ± 0.20

Values are given as mean value of three concurrent readings with standard deviation (± SD)

Table 2 Mineral contents of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*

Plant Name	Common Name	Mn (ppm)	Fe (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	Zn (ppm)	Cu (ppm)	Cd (ppm)	Cr (ppm)	Ni (ppm)	Pb (ppm)	Mo (ppm)
Cajanus indicus	Tor	67	398	1900	3875	375	55,750	48	48	1	19	8	20	5
Dolichos biflorus	Gahat	85.5	450	2200	3025	905	20,000	47	32	1	21	10	4	2
Glycine soja	Kala bhat	215	1125	3360	3280	475	28,900	68	66	2	149	7	14	3
Benincasa cerifera	Bhujaila	70	950	3925	2530	985	41,450	195	74	6	37	19	23	1
Setaria italica	Koni	65.5	705	1195	3270	510	8060	81	44	7	20	6	13	1
Cleome viscosa	Jakhya	46.5	462	840	2625	855	4370	66	49	4	15	4	7	< 1
Hordeum vulgare	Jau	90	725	1465	1505	575	7580	78	51	2	47	8	16	1

N.d not determined. Results in ppm (Calculated on the basis of 1 gm in 50 ml)

Table 3 Qualitative phytochemical estimation of *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare*

Test	*Cajanus indicus*	*Dolichos biflorus*	*Glycine soja*	*Benincasa cerifera*	*Setaria italica*	*Cleome viscosa*	*Hordeum vulgare*
Carbohydrates/glycosides							
(1) Molish test	(–)	(+)	(+)	(+)	(+)	(+)	(+)
(2) Fehling test	(+)	(+)	(+)	(+)	(+)	(+)	(+)
(3) Benedict test	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Alkaloid							
(1) Mayer's test	(+)	(+)	(+)	(–)	(–)	(–)	(–)
(2) Dragondroff test	(–)	(–)	(–)	(–)	(–)	(–)	(–)
Flavonoids	(+)	(–)	(+)	(+)	(–)	(+)	(+)
Saponins	(+)	(–)	(+)	(+)	(+)	(–)	(+)
Tannin							
(1) Pyrogoll and catechol	(+)	(–)	(+)	(+)	(–)	(+)	(–)
(2) Gallic acid	(–)	(–)	(–)	(–)	(–)	(–)	(–)
Unsaturated sterol/triterpene							
(1) Liebermann Burchard test	(+)	(+)	(+)	(+)	(+)	(+)	(+)
(2) Salkowaski test	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Resin	(+)	(+)	(–)	(+)	(+)	(+)	(+)

(+) = Present; (–) = Absent

Mineral value

The yields of essential elements viz. calcium, sodium, potassium, iron, magnesium, manganese and zinc are shown in Table 2.

Phytochemical screening

The results of phytochemical screening revealed the presence of glycosides, flavonoids, tannins, carbohydrates, resin, saponins, steroids and terpenoids in *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare,* while alkaloids and resins were found to be absent. The results are shown in Table 3.

Discussion

The optimum and balanced nutrition is an important process for optimal growth and development for children and adults. Healthy food helps in preventing high cholesterol, diabetes, cancer, high blood pressure and stones in our body thus protect us from many chronic diseases like heart disease, cancer, diabetes and reduces their risk of development. A poor diet or non-nutritious diet increases the risk of a number of diseases such as colon, esophageal, colorectal prostate and lung cancers. Consumption of fruits, vegetables and grains are very important for human health because they contain many important elements like vitamins, protein, fat, fiber and minerals, which are necessary for the growth and development of our body. Apart from all these plants have phytochemicals that show many effects such as phytoestrogen, antimicrobial, antioxidant and anti-inflammatory activities. The results of the present study suggest that, *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* are essential for daily intake for nutrition with respect to their nutritional composition viz. proteins, fat, minerals and vitamins (NIN 2009). It was found that a healthy diet taken from these fruits, pulses, vegetables and grains prevents many diseases and also prevents several non-communicable diseases such as cardiovascular problems, Type-2 diabetes & cancers from occurring. The results of the study corelates with the previous findings (Mali 2010; Saklani et al. 2012; Dasgupta and Saikat 2016).

Conclusion

This scientific report is being presented for the first time in which nutrients, mineral content and phytochemical analysis are performed on the seeds of all these wild edible food plants. The results revealed the significant proportion of nutritional contents (as reported in the study) in *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* seeds. The studies thus concluded that, consumption of such

leguminous seeds reduces the risk of several diseases and critical illness.

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Declarations

Conflict of interest The authors declare no conflict of interest, financial or otherwise.

Human and animal right No animals/humans were used for these studies are the basic of this research.

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