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RESEARCH ARTICLE

Comparative nutritional evaluation of pods of *Leptadenia pyrotechnica* from three different regions of Rajasthan

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SUMMARY

Leptadenia pyrotechnica (Khimp) is a small shrub belonging to family Asclepiadaceae found growing in the arid zone of Rajasthan. It has ethnopharmacological importance and known for its stem fibre. Its edible unripe fruits contribute significantly to the food and energy needs of rural populations. These are known as khimpoli and cooked as vegetable. Comparative evaluation of nutritional composition of the pods from different regions of Rajasthan was carried out so as to promote these underutilised fruits. Analysis was carried out using standard AOAC methods. Fruits were found to be rich in ash (5.03 % to 5.57 %), fat (5.35 % to 6.82 %), protein (13.28% to 18.56 %), sugar (5.61 % to 6.54 %), vitamin C (66.62 to 90.1 %) and minerals *viz.,* Cu, Zn, Fe, Mn, Mg, P, K, Ca and Na. Results indicated that khimp pods can be promoted as supplementary food in arid region.

Key Words : Khimp, Pods, Minerals, Underutilized, Supplement, Sugar, Protein

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The shrub *Leptadenia pyrotechnica commonly* known as khimp belongs to family Asclepiadaceae. It occurs in India, Pakistan, Iran, Israel, Arabia and northern and sub Sahalian Africa (Ali, 1983). In India it is widely distributed in western Rajasthan in Jaisalmer, Nagaur, Jalore, Pali and Bikaner districts (Bhandari, 1990). *Leptadenia pyrotechnica* grows commonly on sand-dunes, including coastal dunes and temporary river beds and on well-drained sandy soils. Being highly drought-resistant and a strong soil- binder, *L. pyrotechnica* plays an important role in desert afforestation programmes. The dominant patches of Khimp accumulate sand particles resulting the formation of sand mounds. In many places the dunes and interdunal plains are usually barren except for some *L. pyrotechnica*, alongwith *Aerva* sp. and *Crotolaria burhia* plants. It is a characteristic of *Acacia* grassland, deciduous bush land and grassland in semi-arid areas. It can grow with 100–450 mm rain/year, but can be cultivated in areas with average rainfall 150–350 mm/

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year. It can tolerate high pH and high exchangeable sodium and potassium (Ram, 2016).

Most commonly four species of *Leptadenia* are found to occur. Of these *Leptadenia pyrotechnica* remains leafless for most of the time, whereas the other 3 species, *Leptadenia hastata* (Pers.) Decne., *Leptadenia arborea* (Forssk.) Schweinf. synonym: *Leptadenia heterophylla* (Del.) Decne.) and *Leptadenia reticulata* (Retz.) Wight and Arn. (synonym: *Leptadenia madagascariensis* Decne.) are leafy, twining shrubs. Other species reported are mainly synonyms of these species (Ram, 2016 and WOI, 1950).

Leptadenia pyrotechnica is a much branched often leafless erect shrub with watery sap. Flowering occurs from August to December and fruiting time is from November to March. Fruit is a pair of slender, spindle-shaped follicles with apex long-acuminate, glabrous and many-seeded. Seeds are ovoid, flattened, bearing a coma of long silky hair at one end (Bhandari, 1990). The pods of this shrub, locally known as *khimpoli*, ripe in the month of March. Tender fruit is edible and cooked as vegetable in the arid areas (Goyal and Sharma, 2009).

Leptadenia pyrotechnica has many traditional medicinal uses. Twigs are commonly used as chew sticks for dental care. The bark yields an excellent non-rotting fibre, good for cordage, fishing-lines and snares for catching small animals and birds. In Somalia the twigs are woven into wickerwork containers for milk and water, after which they are being coated with latex. In India, carpets and containers are made from the stems; they are also used as thatch. The plant is a potential commercial fibre plant especially for ropes and textile mixtures with wool. It is also potentially useful in cellulose acetate and paper industries (*http://www.prota4u.org/protav8.asp*). Jamil (1970) and Jamil *et al.* (1971) have accomplished that 'kheep' fibre is better than most of the bast fibres and can be ranked along with flax and ramie in quality. Laghari (1983) reported that Kheep fibre accepts silk dyes, but not dyes suitable for cotton or wool. Presently it is one of the species in arid tract useful as domestic fuel wood in the rainfed region of western Rajasthan due to shortage of quality fuel wood like Phog (*C. polygonoides*), Khejri (*Prosopis cineraria*). However, it is not supposed to be a good fuel wood for cooking due to much smoke. Khimp is also used as strong live hedge around the field boundaries. It checks the soil erosion and also protects from wild animals.

Phytochemical analyses showed the presence of many pharmacological compounds *viz.,* alkaloids and cardiac glycosides (Verma *et al.,* 2014) in *Leptadenia pyrotechnica*. However, not much research has been done to link the medicinal uses to specific phytochemical compounds. The free radical scavenging potential of methanolic extract of *Leptadenia pyrotechnica* (MELP) was studied on in vitro antioxidant models. In all these studies, a significant correlation existed between concentrations of the extract and percentage inhibition of free radicals. These results clearly indicated that MELP could be a potential source of natural antioxidant and effective against free radical mediated diseases (Partap *et al.*, 2014).

Leptadenia pyrotechnica pods have been used for edible purposes from very early by the people of arid zone. Work on nutritional aspects has been reported on its aerial parts and other species but detailed analysis on its nutritional composition is lacking. Hence, comparative study on khimpoli from different regions of Rajasthan was undertaken.

MATERIAL AND METHODS

Collection and processing of material :

Reconaissance survey was conducted for three consecutive years 2012-2014 in three different districts of Rajasthan having dominant population of khimp shrubs *viz.,* Nagaur, Bikaner and Barmer, for collection of its fruits. Immature pods were manually plucked from the plants in field and brought to the laboratory. These were then washed with water to remove dirt and foreign materials, dried in shade stored in refrigerator in polybags. When required they were cut with knife, dried in shade and then powdered in a mixer grinder. The powder was used for chemical analysis.

Nutritional analysis:

All the chemicals used in the study were of analytical grade and procured from Merck. Standards were procured from SIGMA. All the experimental values are mean of three readings.

Proximate analysis:

Moisture, fat, crude protein, total sugar (TSS), ash and dietary fibre (TDF), were determined using standard methods (AOAC, 1984). Moisture was determined by oven drying method. Ash content was determined by incineration of the sample in a muffle furnace at 600ºC for 6 h. Total dietary fibre was determined by assay kit (SIGMA). It is a combination of enzymatic and

gravimetric methods. Samples were gelatinized with heat stable á-amylase and then enzymatically digested with protease and amylo-glucosidase to remove the protein and starch present in the sample. Ethanol is added to precipitate the soluble dietary fibre. Total sugar content was estimated by phenol-sulphuric acid method. Total nitrogen was estimated by the Kjeldahl method. Crude protein was calculated by multiplying the value by 6.25. Fat was determined by petroleum ether extraction in a Soxhlet apparatus. Vitamin C was determined by Indophenol Method (AOAC, 1984).

Mineral analysis:

Mineral elements (Cu, Zn, Fe, Mn, Mg) were determined by wet digestion methods using Atomic Absorption Spectrophotometer (AAS, Perkin Elmer). An acid digestion procedure was used for sample preparation. A weighed amount of plant material were placed in a digestion tube (Kjeldahl flasks) and a mixture of HNO_3 and 70% $HClO_4$ was added to each sample. Mixture was heated slowly at a low temperature. After digestion, the samples were diluted to appropriate volume and the concentration of the elements was determined. Standards for each element were prepared by suitable dilution of the stock standard solutions. Phosphorus was determined by colorimetric method using UV-Vis spectrophotometer (Analytik Jena). K, Ca and Na were estimated by flame photometer (Systronics).

RESULTS AND DISCUSSION

Moisture content in *khimp* pods collected from different regions varied from 77.5 to 80.9 %. Length of pods was more in the samples collected from Bikaner whereas samples from Nagaur were a bit thicker than other places (Table 1).

Nutritional value

Ash content was found to vary from 2.33 % to 8.0 % in samples from Nagaur, 2.26% to 7.6% in samples from Bikaner and 2.38 % to 7.6% in samples from Barmer (Table 2). Fat content varied from 5.36 % to 6.72 % in samples from Nagaur, 6.76 % to 6.9% in samples from Bikaner, 4.7 % to 6.17 % in samples from Barmer (Table 3). Sugar content was found to vary from 4.92 % to 6.55% in samples from Nagaur, 6.12% to 6.8% in samples from Bikaner, 4.7% to 7.2% in samples from Barmer (Table 4). Protein content varied from 18.5% to 18.82 % in samples from Nagaur, 13.33% to 18.8% in samples from Bikaner and 11.52% to 15% in samples from Barmer (Table 5).

Analysis showed that in *L. pyrotechnica* fruits maximum ash (5.57%) and protein (18.56%) was obtained in samples from Nagaur. Maximum fat content (6.82%) and sugar (6.54%) was obtained in samples from Bikaner. Dietary fibre analysed in Nagaur samples showed variation from 33.3% to 50.6% in the three years with average being 44.7 %.

Table 1: Moisture content (%) and morphological parameters of *Pods*

Region	Nagaur	Bikaner	Barmer
Moisture content	77.5	80.9	79.36
l x b	10.93 x 0.48	11.8 x 0.34	10.9 x 0.39

Table 2 : Ash content (%) of *Leptadenia pyrotechnica* pods

Year\Region	Nagaur	Bikaner	Barmer
2012	8.0	7.6	7.6
2013	2.33	2.26	2.38
2014	6.4	5.24	5.26
Mean±SE	5.57±1.68	5.03±1.54	5.08±1.5

Table 3 : Fat content (%) of *Leptadenia pyrotechnica* pods

Year\Region	Nagaur	Bikaner	Barmer
2012	6.72	6.9	6.17
2013	5.81	6.82	5.16
2014	5.36	6.76	4.74
Mean±SE	5.96±0.4	6.82±0.04	5.35±0.42

Table 4 : Sugar content (%) of *Leptadenia pyrotechnica* pods

Year\Region	Nagaur	Bikaner	Barmer
2012	4.92	6.12	6.10
2013	5.36	6.72	4.70
2014	6.55	6.8	7.20
Mean±SE	5.61±0.48	6.54±0.21	6.0±0.72

Table 5 : Protein content (%) of *Leptadenia pyrotechnica* pods

Year\Region	Nagaur	Bikaner	Barmer
2012	18.82	13.33	11.52
2013	18.37	18.8	13.34
2014	18.5	16.75	15.0
Mean±SE	18.56±0.13	16.29±1.59	13.28±1.0

Table 6: Vitamin C content (mg/100g) of *Leptadenia pyrotechnica* pods

Year\Region	Nagaur	Bikaner	Barmer
2012	64.51	60.09	86.02
2013	87.67	68.99	91.99
2014	95	70.8	92.3
Mean±SE	82.39±9.18	66.62±3.3	90.1±2.04

Table 7: Content of micro and macro elements present in *Leptadenia pyrotechnica* pods

	Cu mg/100g	Zn mg/100g	Fe mg/100g	Mn mg/100g	Mg mg/100g	P mg/100g	K g/100g	Ca g/100g	Na g/100g
Nagaur	1.5	3.7	22	4.1	247.0	0.249	5.53	0.65	0.01
Bikaner	2.3	4.2	12.9	2.7	281.0	0.172	4.58	0.55	0.011
Barmer	2.8	3.4	18.8	3.1	279.0	0.120	1.79	0.61	0.001
Mean±SE	2.2±0.37	3.7±0.23	17.6±2.9	3.3±0.41	269±11.0	0.18±0.03	3.9±1.1	0.6±0.03	0.01±0.003

Vitamin C :

Vitamin C content was found to vary from 64.51 to 95 mg/100g in samples from Nagaur, 60.09 to 70.8 mg/100g in samples from Bikaner, 86.02 to 92.3 mg/100g in samples from Barmer. Maximum Vitamin C content was found in samples from Barmer (90.1mg/100g) (Table 6).

Mineral composition:

Among the micronutrients copper was more in samples from Barmer. Zinc was high in Bikaner samples. Nagaur samples were rich in Iron and mangnese. Among the macro elements, phosphorus and calcium were high from Nagaur, whereas Bikaner samples had slightly high sodium and magnesium content (Table 7).

The mineral analysis showed that fruits were rich source of iron, manganese and potassium. As per the recommended dietary allowance for adults the current daily value (DV) for these minerals (ICMR, 2010) can be met by eating about 100g of khimp fruits.

Analysis of aerial parts of *Leptadenia pyrotechnica* from south east Egypt showed lower nutritional values as compared to our samples except ash content. Samples contained 20.85% ash, 9.11% crude protein, 1.6% crude lipid, 22.92% crude fibre and 8.88% carbohydrates (Ahmed and Lofty, 2015). Pods from Rajasthan gave much higher values. Goyal and Sharma, 2009, report 3.32% ash, 3.13% crude protein, 1.84 % crude lipid, 23.18% crude fibre and 9.83% carbohydrates, 39mg/100g vitamin C, 3.48 mg/100g Fe, 156 mg/100g of Calcium and 317 mg/100g phosphorus in khimp pods from Bikaner. We obtained higher amounts of minerals and other nutritional components in our samples.

Conclusion:

Comparison of nutritional value of khimp from different regions shows that the samples from Nagaur are more proteinaceous and also rich in minerals and vitamin C content. Hence, it can be promoted as a mineral and protein rich supplement in diets of rural communities. Collection, preservation and multiplication of this underutilized wild fruit species will lead to nutritional security for the common masses through harnessing its nutritional and medicinal potential. Value addition followed by developing efficient marketing channels of this fruit will result in its promotion and uplifting the tribal economy.

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