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Comparative Nutrient Assessment of Raw Vegetable Crops with Microgreens: A Nutritionally Potential, Self Growing Fresh Food Supplement for Soldiers Deployed at High Altitude

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Abstract

Various studies have been done on the nutritional aspects of microgreens that is trending now days as fresh green salad in urban population. We have worked on the idea to make these microgreens more popular among soldiers posted at high altitude as self growing potential fresh food supplement. In this study we have explored. The nutrition capabilities of fast and easily growing microgreens of five crops at high altitude i.e. Fenugreek, cabbage, garden orche (atriplex), buckwheat, broccoli and their microgreens were selected for the comparative nutrient analysis with their mature part. Nutrient analysis results have shown that protein content and dietary fibre is significantly higher in mature part of these five crops except cabbage (high in cabbage microgreens). Mature cabbage, broccoli and fenugreek possessed significantly higher minerals contents except, Mg, total P, Na, Zn and Fe (significantly higher in fenugreek microgreens). The mean K content (4481.3±1.86 mg/kg) in mature broccoli was highest. The vitamin C and vitamin B3 are found higher in all the three microgreens than counterpart while beta carotene is found higher in cabbage and broccoli microgreens but comparatively less in fenugreek. Vitamin B9 was found significantly higher in cabbage microgreen, almost equal amount in microgreen broccoli and in mature fenugreek. In harsh climatic condition where fresh food availability throughout the year is a major challenge. Microgreens rich with mineral and vitamins can be good option as dietary supplement to the troops and for local residents especially when mature fresh vegetables are not available.

Keywords: Microgreens; High altitude; Vitamins; Counterpart; Harsh climate.

Introduction

According to the global nutrition report-2018, UNICEF, undernourishment is a world-wide issue and difficult to manage individually. According to a report one-third of reproductive-age women are anaemic, while 39% of the world's adults are overweight or obese and each year around 20 million babies are born underweight. Thus the need of fresh

food and nutrition is one of the basic needs for adequate health to overcome all forms of malnutrition. It requires focus on not only ensuring an adequate supply of food but also equally on quality of diets. (Patrick W. et al, 2018). According to the FAO report 2019, to speed up the improvement towards ending hunger and achieving good nutrition and food security, it is important to understand the connections between food insecurity and malnutrition. The countries that have greater levels of social inequality, economic slowdowns and downturns have a disproportionately negative effect on food and nutrition security. Though nutrition security and health are major concern of all population distributed geographically at different part of earth but scarcity of good quality fresh food availability and limited access to more healthy foods (e.g., fruits and vegetables, whole grains, meat) is a major concern for remote areas of world. The relationship between limited healthy food access and chronic disease has been well documented among urban populations and evidence among rural populations is more recently emerging (Bardenhagen et al, 2017). Geographical isolation of the habitat also includes high altitude regions, which beginsat 2,400 meters (8,000 ft) above sea level.

In India, high altitude cold arid regions like Ladakh (cold desert) and some areas in Himachal Pradesh, Uttrakhand, Sikkim and Arunachal Pradesh comprise of uneven land, barren mountains and have extremely harsh climatic conditions. These are the most difficult terrains in the world due to tough life with lack of resources. The local people at high altitudes are still heavily dependent on agriculture and livestock for their food security and livelihoods, The livelihoods and food security of mountain communities are limited due to cold arid agro-climatic conditions, less availability of fertile land, practical difficulties in farming system and low population density. Although specific agro-ecological and livelihood potentials vary considerably according to the region but the people depend largely on local available resources at all elevations, (Merrey, D.J. et. al., 2018)

Nutritious diet is a basic need in the region where it is a challenge to maintain the physical and mental efficacy especially for soldiers from low lands posted in these regions. A paucity of efforts has been expended to determine the effects of cold and altitude on vitamin and mineral requirements even though these elements are absolutely essential in converting the food consumed into the energy that is required for various body functions in these extreme conditions. In context to nutrition, not many efforts have been made to determine energy intake and to determine the preferred mix of energy derived from carbohydrate, fat, and protein. Unfortunately, these micronutrients are no less important than oxygen. It just takes longer to become a nutrient deficient than oxygen.

In such harsh conditions preventing hypothermia is crucial especially to those soldiers who work or spend recreation time in severe cold environments. Thus adequate energy from the correct proportion of carbohydrates, fats and proteins can help. Vitamins and minerals are also necessary to prevent nutrition deficiencies and impaired function, but there is no evidence to suggest an increased requirement for them is attributable to cold exposure alone. High protein diets appear to be the worst choice for cold weather work; compared with diets high in carbohydrates or fats, high protein diets increase metabolic water requirements and reduce cold tolerance. (Askew EW, Hecker AL, 1989)

However, a newly emerging form of fresh food, loaded with extra nutrition without any bio-fortification and genomic changes and has the potential to be produced independently of the climatic conditions is microgreens. Microgreens have been a staple of the culinary world for the last decade, showing up to add dazzling colour and a punch of bright flavour to salads. Microgreens are harvested just before the seedlings begin to grow their first set of true leaves, which follow the original cotyledon (seed) leaves. A single serving of these greens will provide significantly more vitamins and plenty of minerals than an equivalent serving of same vegetable in the mature edible form.The potential nutritional benefits of microgreens combined with their ease of cultivation, has increased consumer interest in cultivating microgreens, especially on remote locations where these are not widely available for retail sale.

Without any disbelief, microgreens are now proven nutrition rich 21st century instant growing food for all group of people throughout the globe. We have worked on the idea to make these microgreens more popular among soldiers deployed at forwarded post of difficult terrains of India as self growing potential fresh food supplement. Such harsh winters of high altitude region makes nothing possible to grow in open field throughout the year. Therefore growing microgreens is a boon for monotonous minds of troops 'deployed at boonies due to its simplicity of growing in a maintained temperature inside their bunkers.

During the study, it was realized that comparison of exact nutrient concentration of successful grown crops as microgreens with their mature edible part as less scientific data for comparing the nutrient content of microgreens and mature plants are

available.Thus, in this study the nutrient contents of cabbage broccoli and fenugreek and mature crops grown at high altitude have been assessed to understand and establish the idea as a fact that microgreens version of plant based food are also appropriate for human health and can act as alternative food for fulfilling daily nutrition when mature fresh vegetables are not consistently available due to harsh climatic conditions.

Here, the major concern to note that microgreens are obtained within 10-15 days without hard core farming practices. It can be grown easily in any season while whole appropriate season and skilled hands are required for cultivation of mature vegetables. Surly, microgreens cannot replace for a feeling of full stomach (as in case of mature vegetables) but in nutrition content per gram quantity, they are either rich or equal to mature. It becomes very special food for the troops who are mostly dependent on tinned/processed food at high altitude and other remote areas of country.

Materials and Methods

2.1 Plant material, growing microgreens and mature crops

The low cost, good quality (non-hybrid and non-pelleted) and well performed variety seeds of cabbage (*Brassica oleraceavar*. Golden Acre) and fenugreek (*Trigonellafoenum-graecum* var. Multi-cut) were procured from Durga Seed Farm (Chandigarh, India) and broccoli (Brassica oleracea var. italica -PUSA KTS-1) and were purchased from regional station of Indian Agriculture Research Institute, (Katrain H.P. India). Garden orche and buckwheat seeds were obtained from the Seed Production Division of the Institutes as these crops are indigenous crops of Ladakh. All crop seeds were sown in well prepared open field at Defence Institute of High Altitude Research, Leh, India campus in May 2018 for obtaining the mature parts of vegetables. All the seeds for microgreens were grown in plastic trays (30 cm Lx, 24 cm W and 7.0 cm D) filled with media mixture (500 g) in ratio of 5:2:1 as cocopeat, vermiculite and perlite respectively. After sowing, trays were kept in microgreens farming unit of size 1.0 meter length, 0.5 meter width and about 1.50 meter height made of stainless steel/aluminium framing and 5 shelves were used to keep the trays in tier system with semi-controlled environment at DIHAR, Leh (Ladakh). Garden orche does not perform well in tray thus it was grown in greenhouse soil for 10 days.

The medium was prepared by hydrating well with drinking water before the sowing. The seeds were sown at proper depth of 0.50 cm in 11-12 rows depending upon the weight and size of seeds. Just after sowing, seeds were covered by a thin layer of wet medium. For growing of tinny plants, 18-25°C temperature; more than 1000 Lux light intensity for 6 hours in a day and 55- 65% humidity was recorded in the growing unit. During the growing period, trays were shifted to different positions within the light field to ensure that seedlings are getting sufficient light and heat. Misting of drinking water was done by sprayer on time intervals when growth media showed dryness.

After 10 days of sowing, microgreens of cabbage, broccoli and fenugreek (may take 12 days) were harvested with ethanol cleaned scissors without roots. harvested microgreens from each of the replicate of all crops were placed into a tared aluminium foil cup and weighed up to 10 gram each on Aicosetfx- 4000 electronic balance, this 10 gram biomass of each replication was dried in hot air oven at 45°C temperature for4-5 hours or untila observe the constant dry mass weight. Crop names, scientific names, mean test weight, dry weight and moisture contents of the three microgreens crops are listed in Table 1.

Table 1: Comparative of Mean fresh weight, dry weight and moisture percentage in five microgreens and their mature crops.

Crop Name	Family	Genes & Species	Seed Test	Microgreens			Mature Counterpart		
			weight	Fresh	Dry	Moisture	Fresh	Dry	Moisture
			(g)	Weight (g)	Weight (g)	%	Weight (g)	Weight (g)	%
Cabbage	Brassicaceae	*Brassica L. Brassica oleracea L.*	3.78± 0.13	10	0.94 ±0.02	90.60 ±0.23	10	1.07±0.06	89.3±0.62
Broccoli	Brassicaceae	*Brassica oleracea var. italica*	4.44± 0.08	10	1.11 ±0.07	88.93±0.66	10	1.21±0.06	87.9±0.56
Fenugreek	Fabaceae	*Trigonella foenum-graecum*	13.14±0.04	10	1.14±0.04	88.6±0.40	10	1.23±0.04	87.67±0.35
Garden orche	Amaranthaceae	*Atriplex hortensis*	4.30 ±0.05	10	1.70 ± 0.15	82.90 ±1.48	10	1.90 ±0.06	80.9± 0.56
Buckwheat	Polygonaceae	*Fagopurum tarticum*	18.83±0.15	10	1.23 ± 0.16	87.73 ±1.60	10	1.44±0.12	85.63±1.17

Values are expressed in Mean ± SD (n=3)

From the each replication 50 g sample was wrapped in aluminium foil and get frozen in liquid nitrogen immediately than kept in separate polybag with proper tagging. These samples were stored in -80°C refrigerator for nutrients' determinations. On next day, these 3nine replications samples were immediately placed in a non-insulated box filled with frozen-ice packs and sealed it properly. These samples were brought from Leh-Ladakh to Chandigarh by one hour air journey and sent immediately toPunjab Biotechnology Incubator, Mohali, India, an authenticated parameters testing laboratory.

Later on, in August, after harvesting the mature crops from the DIHAR, Leh, fenugreek mature, cabbage and broccoli curd was weighed up to 10 gram each and dried in hot air oven until obtaining a constant moisture content.100 g from the edible part of all three replication of cabbage, broccoli and mature leaves of fenugreek were immediately wrapped in aluminium foil and get frozen in liquid nitrogen and packed in polybag with taggingand kept in -80°C for overnight. These samples were also brought to Chandigarh from Leh by air in a non-insulated box full with frozen-ice packets and were immediately sent it to analytical laboratory, Punjab Biotechnology Incubator, Mohali, India for analysis.

2.2 Nutrient analysis

Nutrient analysis of selected parameters was carried out at Punjab Biotechnology Incubator (Mohali, Punjab, India) by using standard methods for different analytical instruments. Mineral content (Zn, Mg, Mn, Fe, Na, K, Ca and Total P) was estimated by standardized method (Lars Jorhem and Joakm Engman, 2000) in which an amount of 0.5 g of fresh samples (microgreens and mature) were accurately weighted into a Teflon digestion vessel on a micro analytical balance and then treated with a mixture of 60 ml of nitric acid and 1 ml of hydrogen peroxide in the microwave digestion system. The extracts thus obtained were re-dissolved in 50 ml of purified water and subsequently analysed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). For the measurements of beta carotene, vitamin B_1, vitamin B_2, Vitamin B_3 vitamin B_5, vitamin B_9, vitamin A, and vitamin C has been estimated by HPLC and vitamin B_6 concentration is evaluated by using LCMS-MS. Other parameters were also estimated as per standard method mentioned in Table1.

2.4 Statistical analysis

All the comparative nutrient analysis results data have been expressed as mean (n=3) ± standard deviation. The descriptive statistics mean, standard deviation and median is obtained for all the parameters. Due to small samples size the nonparametric test Mann Whitney U test is carried out to see the significant difference between two types of crops (matured and microgreens) for all parameters. The effect size was computed for significance results. The statistical significance values (p values) are compared with 0.05 or 0.01 level of significance. The whole statistical analysis is carried out by using SPSS 21 software. The principle component analysis was done for the nutrients which are significantly higher in microgreens.

Result and Discussion

Results have shown that microgreens possess a good content of dietary fibres, vitamins and minerals than their mature counterpart.

3.1 Relative nutrient value of microgreens cabbage, broccoli, fenugreek, garden orche, buckwheat to their mature counterpart

The average test weight of seeds, fresh weight, dry weight and moisture content of microgreens and mature crop are listed in Table 1. The average fresh weight of microgreens and mature crops shows the mean nutrient content in both microgreens and mature counterpart.

3.2 Energy, macromolecules and dietary fibres

An analysis was done to compare the contents of energy, carbohydrate, protein, sugar, fat, cholesterol and dietary fibres in the microgreens of five crops and mature edible version. The values of these parameters are expressed in mean ± standard deviation (n=3) in Table 2-6 for cabbage, broccoli, fenugreek, garden orche and buckwheat, respectively.

Table 2: Comparative of major nutrients in fresh weight of mature cabbage and its microgreens.

Principle		Cabbage	
Nutrients		**Mature**	**Microgreens**
Energy	Kcal/100 g	41.60±0.39	31±1.73
Carbohydrate	%	8.50±0.58	5.67±0.58
Sugar	%	6.17±0.20	0.0
Fat	%	BDL*	BDL*
Protein	g/100g	1.12±0.11	1.33±0.58
Dietary Fibre	%	2.68±0.28	3.00±0.00
Cholesterol	mg/Kg	BDL*	BDL*
Minerals			
Calcium (Ca)	mg/Kg	458.67±0.58	47.67±2.52
Potassium (K)	mg/Kg	2972±1.00	159.33±3.79
Manganese (Mn)	mg/Kg	2.18±0.15	1.00±0.0

Magnesium (Mg)	mg/Kg	168± 1.00	34±0.0
Phosphorous (TP)	mg/Kg	405.67± 0.58	86.00±3
Sodium (Na)	mg/Kg	401.67± 0.58	41.67±0.58
Zinc (Zn)	mg/Kg	1.90±0.09	1.00±0.0
Iron	mg/Kg	6.23±0.20	2.67±0.58
Vitamins			
Beta Carotene	ug/100g	BDL*	523±0.0
Vitamin C	mg/100g	BDL*	5.00±0.0
Vitamin A	ug/100g	BDL*	BDL*
Vitamin B9	ug/100g	28.73±0.46	31.33± 0.58
Vitamin B3	mg/100g	BDL*	4.00 ±0.0
Vitamin B5	mg/100g	BDL*	BDL*
Vitamin B6	mg/100g	0.14±0.12	BDL*
Vitamin B2	mg/100g	BDL*	BDL*
Vitamin B1	mg/100g	BDL*	BDL*

Values are expressed in Means ± SD, n=3.

*Fat, cholesterol vitamin A, B_5 B_2 and B_1 found Below Detection Level (BDL) in both form of cabbage.

Table 3: Comparative of major nutrients in fresh weight of microgreens and mature broccoli.

Principle		Broccoli	
Nutrients		**Mature**	**Microgreens**
Energy	Kcal/100 g	54±0.0	37±2.0
Carbohydrate	%	8.0±0.0	5.67±0.58
Sugar	%	BDL*	BDL*
Fat	%	BDL*	BDL*
Protein	g/100g	5.0±0.0	3.0±0.0
Dietary Fibre	%	5.0±0.0	4.00±0.00
Cholesterol	mg/Kg	BDL*	BDL*
Minerals			
Calcium (Ca)	mg/Kg	805.33±3.06	47±2.65
Potassium (K)	mg/Kg	4481.33±3.21	231±2.0
Manganese (Mn)	mg/Kg	1.0±0.0	3.00±0.0
Magnesium (Mg)	mg/Kg	300.67± 4.16	41.33±0.58
Phosphorous (TP)	mg/Kg	104.33± 2.08	779.67±5.51
Sodium (Na)	mg/Kg	190±3.0	69.33±0.58
Zinc (Zn)	mg/Kg	4.0±0.09	1.00±0.0
Iron	mg/Kg	8.0±1.0	2.0±0.0
Vitamins			
Beta Carotene	ug/100g	58.67±0.58	1763.33±3.51
Vitamin C	mg/100g	BDL*	5.00±0.0
Vitamin A	ug/100g	BDL*	BDL*
Vitamin B9	ug/100g	82.0±0.46	78.33± 0.58
Vitamin B3	mg/100g	BDL*	3.00 ±0.0
Vitamin B5	mg/100g	BDL*	BDL*
Vitamin B6	mg/100g	BDL*	BDL*
Vitamin B2	mg/100g	BDL*	BDL*
Vitamin B1	mg/100g	BDL*	BDL*

Values are expressed in Means ± SD, n=3.

Sugar, fat, cholesterol, vitamin A and B_5, B_6, B_2 and B1 found Below Detection Level (BDL) in broccoli.

Table 4: Comparative of major nutrients in fresh weight of mature fenugreek and its microgreens.

Principle		Fenugreek	
Nutrients		**Mature**	**Microgreens**
Energy	Kcal/100 g	57.67±0.58	5.0±0.0
Carbohydrate	%	10.0±0.0	BDL*
Sugar	%	BDL*	BDL*
Fat	%	BDL*	BDL*
Protein	g/100g	4.0±0.0	2.0±0.0
Dietary Fibre	%	5.0±0.0	3.00±0.00
Cholesterol	mg/Kg	BDL*	BDL*
Minerals			
Calcium (Ca)	mg/Kg	67.67±1.53	35.67±3.51
Potassium (K)	mg/Kg	207.67±2.52	188.33±2.08
Manganese (Mn)	mg/Kg	BDL*	BDL*
Magnesium (Mg)	mg/Kg	22± 0.0	32.33±2.08
Phosphorous (TP)	mg/Kg	60±2.0	70.33± 1.52
Sodium (Na)	mg/Kg	14.67± 0.58	58.33±2.08
Zinc (Zn)	mg/Kg	BDL*	1.00±0.0
Iron	mg/Kg	6.0±0.0	6.0±0.0
Vitamins			
Beta Carotene	ug/100g	2962±1.0	1410.67±0.57
Vitamin C	mg/100g	3.0±0.0	5.00±0.0
Vitamin A	ug/100g	BDL*	BDL*
Vitamin B9	ug/100g	83.67±0.58	43± 1.0
Vitamin B3	mg/100g	BDL*	1.0±0.0
Vitamin B5	mg/100g	BDL*	BDL*
Vitamin B6	mg/100g	BDL*	BDL*
Vitamin B2	mg/100g	BDL*	BDL*
Vitamin B1	mg/100g	BDL*	BDL*

Values are expressed in Means ± SD, n=3.

*Sugar, fat, cholesterol, vitamin A and, B_3 B_5, B_6, B_2 and B_1 found Below Detection Level (BDL) in fenugreek.

Table 5: Comparative of major vitamin contents in fresh weight of Garden orche (Ladakh indigenous) and its microgreens.

Principle		Farden Arche	
Nutrients		**Mature**	**Microgreens**
Energy	Kcal/100 g	44.33±1.15	24.33±0.58
Carbohydrate	%	7.0±0.0	3.0±0.0
Sugar	%	BDL*	BDL*
Fat	%	BDL*	BDL*
Protein	g/100g	4.0±0.0	2.0±0.0
Dietary Fibre	%	6.0±0.0	3.0±0.00
Cholesterol	mg/Kg	BDL*	BDL*
Minerals			
Calcium (Ca)	mg/Kg	1612.67±2.52	131.33±3.06
Potassium (K)	mg/Kg	8747±3.61	8748±2.0
Manganese (Mn)	mg/Kg	2.33±0.58	BDL*
Magnesium (Mg)	mg/Kg	2018.33±2.08	107±2.65
Phosphorous (TP)	mg/Kg	544± 2.65	92.67±2.52
Sodium (Na)	mg/Kg	1405.67±2.08	9.00±1.0

Zinc (Zn)	mg/Kg	3.0±0.0	1.67±0.58
Iron	mg/Kg	28.67. ±1.15	8.0±0.0
Vitamins			
Beta Carotene	ug/100g	4618.33±0.58	1535.33±7.51
Vitamin C	mg/100g	7.0±0.0	2.00±0.0
Vitamin A	ug/100g	307.33±4.04	BDL*
Vitamin B9	ug/100g	25.33±0.58	90.33± 0.58
Vitamin B3	mg/100g	1.0 ±0.0	2.0 ±0.0
Vitamin B5	mg/100g	1.0 ±0.0	BDL*
Vitamin B6	mg/100g	BDL*	BDL*
Vitamin B2	mg/100g	BDL*	BDL*
Vitamin B1	mg/100g	BDL*	BDL*

Values are expressed in Means ± SD, n=3.

Sugar, fat, cholesterol, vitamin, B_6, B_2 and B_1 found Below Detection Level (BDL) in garden orche.

Table 6: Comparative of major nutrients in fresh weight of Buckwheat and its microgreens.

Principle		**Buckwheat**	
Nutrients		**Mature**	**Microgreens**
Energy	Kcal/100 g	50.67±0.58	924.33±1554.23
Carbohydrate	%	9.0±0.0	4.0±0.0
Sugar	%	BDL*	BDL*
Fat	%	BDL*	BDL*
Protein	g/100g	3.0±0.0	2.0±0.0
Dietary Fibre	%	5.67±0.58	3.67±0.58
Cholesterol	mg/Kg	BDL*	BDL*
Minerals			
Calcium (Ca)	mg/Kg	125±3.61	70.0±2.0
Potassium (K)	mg/Kg	143.33±2.52	311.33±2.52
Manganese (Mn)	mg/Kg	1.0±0.0	1.0±0.0
Magnesium (Mg)	mg/Kg	83.33±0.58	65.67±0.58
Phosphorous (TP)	mg/Kg	187± 2.65	112.67±2.52
Sodium (Na)	mg/Kg	1.00±0.0	23.67±0.58
Zinc (Zn)	mg/Kg	1.0±0.0	2.0±0.0
Iron	mg/Kg	8.33. ±0.58	2.67±0.58
Vitamins			
Beta Carotene	ug/100g	3125.67±0.58	2032.67±0.58
Vitamin C	mg/100g	2.0±0.0	3.0±0.0
Vitamin A	ug/100g	208±2.0	BDL*
Vitamin B9	ug/100g	82.0±0.0	29± 0.0
Vitamin B3	mg/100g	8.0 ±0.0	1.0 ±0.0
Vitamin B5	mg/100g	BDL*	BDL*
Vitamin B6	mg/100g	BDL*	BDL*
Vitamin B2	mg/100g	BDL*	BDL*
Vitamin B1	mg/100g	BDL*	BDL*

Values are expressed in Means ± SD, n=3.

Sugar, fat, cholesterol, vitamin B_5, B_6, B_2 and B_1 found Below Detection Level (BDL) in buckwheat.

As applied nonparametric Mann Whitney U test indicated, energy and carbohydrate found significantly higher in per 100 g of mature than microgreens except energy in buckwheat. Fat, cholesterol and sugar content is observed below detection level (BDL) of instrumental (ICP-MS) capability in all forms except sugar in mature cabbage. Protein content and dietary fibre is significantly higher in mature part of these five crops except cabbage microgreens. These data support the vegetables microgreens as a perfect food for some dietary approaches e.g. low carbohydrate diets in daily diet which recommends restricting the intake of fruits, whole grains, and legumes because of their high sugar or starch content, especially in diabetes (Forouhi N. et. al. 2018). As per the analysis, vegetables microgreens can be sanctified as healthy food for old age people and diabetic patients due to their negligible cholesterol, fat, and carbohydrate but rich in micronutrient, phytochemical and fibre content.

3.3 Mineral contents

The comparative values of minerals between the mature and microgreens of five crops are depicted in Table 2-6. Statistical analysis showed that mature cabbage, broccoli, garden orche, and fenugreek possessed significantly higher minerals contents except buckwheat and fenugreek microgreens. In fenugreek microgreens magnesium (Mg), total phosphorous (P), sodium (Na), and zinc (Zn) are found significantly higher. The mean potassium (K) content (4481.3±1.86 mg/kg) in mature broccoli was highest. In buckwheat microgreens, potassium (K), phosphorous (P), sodium (Na), and zinc (Zn) are found significantly higher than mature buckwheat plant.

3.4 Essential Vitamins contents

The essential vitamins *i.e.* beta carotene, vitamin C, vitamin A, vitamin B_1, vitamin B_2, vitamin B_3, vitamin B_5, vitamin B_6 and vitamin B_9 concentrations of cabbage, broccoli, buckwheat, garden orche, fenugreek microgreens and their mature part grown at high altitude have been determined. In research literature, it has been reported earlier that microgreens contain considerably higher content of vitamins than their mature plant counterparts, (Xio *et. al*. 2012) although crop varieties wise variations are found among the different vegetables microgreens. All the estimated vitamins for cabbage, broccoli and fenugreek mature vs microgreens are depicted in Table 2-6. The vitamin C and vitamin B_3 are found significantly higher, (based on effect size) in the microgreens form of stated crops (except buckwheat) than their counterpart while beta

carotene is found higher in cabbage and broccoli microgreens. Vitamin B_9 was found significantly higher in garden orche microgreens, Vitamin B_2, B_5 B_6 and B_1 was found below detection level (BDL) in both form of five crops except B_5 in Garden orche mature and B_6 in cabbage mature.

Here overall significance is microgreens being rapid growing plants could provide a sufficient daily intake of most minerals compared with mature crop which is hard to grow in snow falling winter season of high altitude conditions specifically at forwarded post of soldiers. These microgreens if consumed 100 g as one or two meals daily can provide appropriate nutrition to the people or troops that are living or deployed in unfavourable climate of remote location and are mostly dependent on tinned food.

This nutritional information is a breakthrough in the field of human nutrition. The consumption of microgreens can ensure nutritional security economically to meet daily requirements in a very short span of time (10 days).

Conclusion

This is the first study that compared the detailed nutrient content of cabbage, broccoli, fenugreek, buckwheat, garden orche microgreens and their mature counterpart grown at high altitude. The data produced in the study likely provide a comparison basis scientific evaluation of the nutritional quality of microgreen cotyledon leaves. It can also be used as a possible reference in estimating the dietary intake and capabilities of microgreens. However, recent years research has stated that climatic conditions, growing methods, lighting system, harvesting, and postharvest handling conditions have a considerable impact on the synthesis and degradation of phytocompounds, including minerals and vitamins, further studies may be needed to evaluate the different agricultural practices on phytonutrient preservation for long.

The need of the microgreens and their nutrient study was realized from aspect that it can be obtained within ten to twelve days of sowing but vegetables crops take a quarter (75-90 days) of year to get mature edible parts. Fenugreek cabbage and broccoli garden orche and buckwheat are the most prominent microgreens produced as fresh food for troops in the conditions like high altitude where temperature goes more than -20o C in winter season and it is not possible to grow such vegetables under harsh climate in open field. The situations becomes more critical for obtaining the fresh food based diet at forward snowing posts of borders regions of the country where troops remain dependant mostly on tinned food.

Therefore indoor growing of microgreens at such conditions may fulfil the daily need of nutrition to stay healthy and maintaining operational efficiency. Most of the nutrients and their higher concentration in a particular microgreens reported in this study can be obtained only in 10-12 days of sowing while other additional nutrients (which are higher in mature) can also be obtained up to some level when it is unavailable to the troops and residents during winters of high altitude conditions with the help of fixed and less resources. The yield, texture and taste performance is also been recorded good in high altitude.Therefore this study indicates that microgreens can be considered a good source of nutrition especially for the harsh climatic remote locations.

Declarations of interest: None

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The Under Utilized Indigenous Grain Little Millet: A Mini Review

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Abstract

Little millet is a minor cereal which is known for several health benefits due to the presence of bioactive compounds such as phenolic compounds, gamma-amino butyric acid (GABA), carotenoids, and tocopherols. In this paper, the literature on the nutraceuticals of the little millet and also the influence of processing on their stability has been reviewed. The greatest impact on the nutrient and nutraceutical content of the millet occurs on the milling process, when the physical separation of different morphological parts takes place. These nutraceuticals offer protection to the consumer against various diseases. This information will be useful for utilization of processed little millet as an ingredient in functional foods with health promoting functions. It has a significant role in providing significant amounts of antioxidants and phytochemicals in the diet. However, there is a need to restore the lost interest in millets due to its potential nutritional qualities and health benefits.

Keywords: Little millet; Nutraceuticals; Processing; Phytochemicals etc.

Introduction

India is the leading producer of small millets namely little millet (kutki), kodo millet (kodo), foxtail millet (kangni), barnyard millet (sawan) finger millet (ragi) and proso millet (cheena). Minor millets not only have nutritional value but also tremendous therapeutic uses. They are used in the treatment of different diseases like Cancer, Leprosy and Pneumonia etc. (Bachar et al., 2013). Millets are being used as nutraceuticals as they are rich in antioxidants and much higher than the major cereal crops. Millets are rich in, sulphur containing amino acids and phytochemicals, vitamins, minerals and hence are termed as "nutri- cereals".

Minor millet were high protein, dietary fibre, mineral and antioxidant content. Finger millet (ragi) is the rich in calcium content, about 10 times that of rice or wheat. Millets are also high in fiber and low on calorie. There is an urgent need to reintroduce many of the cereals, millets in our daily diets. In the

food industry, cereal grains and plant nutrients are largely used as a major source of dietary nutrients worldwide. In some M.P. region there is cultivating the two minor millets Kodo (Paspalum scrobiculatum) and Kutki (Panicum sumatrense). Dindori is traditionally a kodo- kutki growing belt.

As, in Villages price of this grain were very low so as a results farmer began converting even upland areas into paddy fields. At a recent rally in Mandla, Chief Minister Shivraj Singh Chouhan spoke about his government wanting to increase the incomes of farmers by promoting kodo-kutki cultivation through self-help groups (SHG). We also need to promote scientific cultivation of these millets for instance, improving yields through line-sowing. Little millet is one of the small millets commonly known as 'kutki' in Hindi, 'samai' in Tamil and 'samalu' in Telugu.

Little millet is mostly consumed as rice. Any recipe made with staple rice can be prepared using little millets with similar taste. As these millets are cook faster than rice because of its smaller in size. Little millets could be milled into flour for making roti, baked and fried items. The whole grains of kutki can be sprouted and used in salads too. Dosa, upma, kichidi, tomato rice, lemon rice, curd rice, porridge, chakli, payasam, halwa and kesari are few traditional recipes prepared in different millet growing states in India.

Nomenclature of Kutki

Kutki is grown on a limited scale as poor man's crop capable of withstanding both drought and water logging. In India the people have begun to look beyond the basic nutritional benefits of food to prevent diseases and enhance health. Cereals especially small millets provide an opportunity to improve the health of people, reduce health care costs and support economic development in rural, tribal and hilly communities.

Scientific Name : *Panicum sumatrense*

Common Name: Kutki (Hindi), Saame (Kannada), Saave (Kannada), Chama (Malayalam), Saamai (Tamil), Samalu (Telugu), Sava (Marati), Halvi (Marati), Suan (Oriya)

Table 1.1: Nomenclature of Kutki

Kingdom	Plantea
Order	Poales
Family	Poaceae
Genus	Panicum
Species	P. sumatrense

(https://en.wikipedia.org/wiki/Panicum_sumatrens)

Structure of Plant

Little millet is generally grown on hills under shifting cultivation. Like other millets it is grown in kharif season. It is and erect, tufted, branched, glabrous, annual grass up to 90 cm high. Leaves 15-20 cm long, narrow, linear margin smooth or obscurely scabrid, flat, acuminate, base rounded and contracted; sheath loose, ciliate or with few bulbous-based hairs, ligule short, truncate ciliate. Spike lets solitary or in pairs, sub-turgid, ellipsoid or ovate-acute, glabrous, green or purple.

Figure: 1.1

(a) Plant structure (b) Whole Kutki

(c) Dehulled kutki

Nutritional composition

The kutki millets contains 69% carbohydrates, 8.2% protein, 6.94% fibre, 3.37% fat, 2.89% minerals, at 12.6% moisture and just 335 calories/100g and per 100g 3.3g ash, 35 mg Calcium, 1.7 mg iron, 0.15 mg thiamin, 0.09 g riboflavin and 2 mg Niacin at 12% moisture content (Hulse et al, 1980). Kutki contained phosphorous (130 mg/100g), zinc (1.82 mg/100g), magnesium (91.41 mg/100g), niacin (1.29 mg/100g) and polyphenols which making it a vital option for nutritional security. Rajput et al.2018 investigated the proximate analysis of Kutki of Dindori variety and founds kutki contains ash - 1.01to 2.70%,, fat- 3.47to 4.84%, fibre- , 6.32-7.88%,, protein - 7.15-8.68%, carbohydrate - 63.23- 65.00%, phosphorus -189-225mg and iron8.2- 9.5 mg/100gm respectively. Besides they were rich in dietary fiber, iron, calcium and B vitamins and also low in phytic acid. Moreover, these millets also diminish the glucose absorption and releases sugar slowly in the blood. These properties

of the minor millets made the present consumers attracted to the consumption of millet.

Kutki as a Functional Food

Little millets provide significant amount of bioactive nutraceutical components such as phenols, tannins, phytates, gamma-aminobutyric acid (GABA), carotenoids and tocopherols which play important role in health, aging and metabolic disease. Little millets with low carbohydrate content, slow digestibility, low glyciemic index and water-soluble gum content improve glucose metabolism. Millet polyphenols inhibit the activity of digestive enzymes like amylase, glucosidase, pepsin, trypsin and lipases in the body. The dietary fiber and resistant starch in minor millets exhibit hypoglycaemic and hypolipidemic effects by inducing carbohydrate tolerance, satiety, weight loss and prolonged gastric emptying. Hence little millets are recommended for people with lifestyle diseases like obesity, diabetes and cardiovascular conditions.

Chandrasekara A, Shahidi F had reported that bound polyphenols (1% HCl extractable) were highest in kodo millet (81.64), followed by foxtail (11.59), little millet (9.64), pearl millet (9.14), finger millet (3.83), and proso millet (2.21). Pietta PG reported polyphenolic compounds such as flavonoids, phenolic acids, and proanthocyanidins are of great interest for the radical scavenging and effective in the prevention of many diseases and morbid states. The bioactive properties of polyphenols include anticarcinogenic, anti-inflammatory, antiviral and neuroprotective activities. The bioactive properties of polyphenols include anticarcinogenic, anti-inflammatory, antiviral and neuroprotective activities.

Value Addition of Kutki

Little millet based value added products could enhance the income, empowers millet farmers and nutrition in rural India. More than 50 per cent of the millet production is now finding its way to alternative uses as opposed to its consumption only as a staple grain. The modern trend for the development of new food products aspires for complementary foods to fulfill the widening gap of nutritional security and food availability. Malnutrition is a serious matter of concern among world population due to modern lifestyle specifically consumption of rapidly processed fast food and evolving dietary habits. The present situation where hidden hunger is on the rise demands development of food products that are rich in nutrients, readily acceptable, meet requirement of growth and development cost effectively. The utilization of little millets for development of various value added, therapeutic and functional products apart from traditional food preparations can increase the demand for this grain in terms of production as it is currently declining due to less utilization.

Conclusions

The majority of tribal farmers were found to prepare various products of kutki for their home consumption only. Very few of them sold the value added products in weekly (haat) bazar. The products were prepared from organically produced small millets by the tribal community, the value addition in small millets needed to be up scaled by establishing micro/small level industries with capacity building in preparation of a variety of products having wider acceptance at national and international markets. The marketing channels should be developed to increase the sales of the value added products and expanded to other areas. In this way, geographical indicator based small millets products may be prepared to match the international norms/standards by supporting tribal with end to end approach thereby inculcating the entrepreneurial skill among them and creating a brand image of these value added products at the global level.

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Nutrimental and Ethnomedicinal Potential Plants of the Qur'an: An Overview -VII Evaluation

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Abstract

Our ancient literatures of Hindus', Muslims as well as of Cristian's are full of plants described about their nutrimental and medicinal potential. A significant number of plants described in their texts are still unidentified because of least or no interest in plant taxonomy among neither grate scientists in well-developed different organisations nor respected teachers of Universities or Colleges of repute. We can say with confidence that there are no teachers who can teach Plant Taxonomy in significant numbers of academic institutions. A man of Biotechnology can do nothing if he/she cannot identify the plant on which the work has to be worked out. As a result, due to non-identification of plants we cannot use our wealth of knowledge which has been provided by our ancestors present in form of scripts.

We were presented a book written by Dr. M.I.H. Farooqi entitled "QuruaniPoudhe-VagayanicDhristi Se" while in Seminar organised by UP Biodiversity Board, Lucknow. We found that there are seventy-one plants being reported in Holy Qur'an and Bible. We have consulted the literatures available as well as the tribal of Bahraich about the uses of the plants available. The perusal of the alphabetical list of plants of Holy Qur'an reveals that there are 71 plant species representing 48 genera of 30 families. Brassicaceae, Cucurbitaceae and Moraceae family were found to be the biggest family represented by 6 plant species each whereas Caesalpiniaceae, Papilionoideae and Poaceae with 5 plant species each; Rosaceae and Rhamnaceae with 4 plant apecies; Mimosaceae, Liliaceae, Pinaceae, Euphorbiaceae, Oleaceae, Lytharaceae, Lamiaceae and Arecaceae with 2 plant species and rest fourteen species viz., Malvaceae, Asclepidiaceae, Lauraceae, Bixaceae, Dipterocarpaceae, Juglandaceae, Cuprassaceae, Lecnoraceae, Loranthaceae, Anacardiaceae, Sterculiaceae, Ericaceae, Salvadoraceae, and Vitaceae is being represented by single plant species each.

Keywords: Ethnobotanical; Ethnomedicinal; Potential; Plants; Qur'an.

Introduction

Herbal Medicine is the oldest form of medicine known to mankind. It was the mainstay of many early civilizations and still the most widely practiced form of medicine in the world today, Ethnobotany is one of the most interesting themes of economic botany which might have first of all came into the existence probably when earliest man of "stone age" observed the animals mostly the apes and monkeys eating certain plants or plant parts ex. Fruits, leaves and even inflorescences to satisfy their hunger. Therefore, on the basis of plants usage first of all by animals and later on by the human beings the concepts of Ethnobotany and Ethnozoology were evolved, which merged into a common term known as Ethnobiology. However, the term Ethnobotany was first of all used in the last of 19th century by J. W. Harsh Berger (1895) to indicate the interrelationship of plants with aboriginal people or tribal societies [Trivedi and Sharma, 2011]. In many parts of the world, wild plants are obtained from forests or wild areas designated for extractive resources and managed by local communities [Jadhav et al., 2011]. Wild edible plants provide food quantity as well as medicines [Patale et al., 2015].

India is one of the twelve mega-biodiversity countries of the World having rich vegetation with a wide variety of plants. As per the 2001 census, the tribal population of India is 8.43 crore, constituting 8.2% of total population of the country [Annual Report, 2005-2006]. With enormously diversified ethnic groups and rich biological resources, India represents one of the great emporia of ethnobotanical wealth [Pal, 2000]. Even today, trial's and certain local communities in India still collecting and preserving locally available wild and cultivated plant species for their day today life [Mahishi et al., 2005 and Ayyanar et al., 2010].

We were presented a book written by Dr. M.I.H. Farooqi entitled "QuruaniPoudhe-VagayanicDhristi Se" while in Seminar organised by UP Biodiversity Board, Lucknow. We found that there are seventy-one plants being reported in Holy Qur'an and Bible. We have consulted the literatures available as well as the tribal of Bahraich about the uses of the plants available. The perusal of the alphabetical list of plants of Holy Qur'an reveals that there are 71 plant species representing 48 genera of 30 families. Brassicaceae, Cucurbitaceae and Moraceae family were found to be the biggest family represented by 6 plant species each whereas Caesalpiniaceae, Papilionoideae and Poaceae with 5 plant species each; Rosaceae and Rhamnaceae with 4 plant apecies; Mimosaceae, Liliaceae, Pinaceae, Euphorbiaceae, Oleaceae, Lytharaceae, Lamiaceae and Arecaceae with 2 plant species and rest fourteen species viz., Malvaceae, Asclepidiaceae, Lauraceae, Bixaceae, Dipterocarpaceae, Juglandaceae, Cuprassaceae, Lecnoraceae, Loranthaceae, Anacardiaceae, Sterculiaceae, Ericaceae, Salvadoraceae, and Vitaceae is being represented by single plant species each.We have enumerated five plants viz., Acacia nilotica, Acacia senegal, Acacia seyal, Alhgimaurorum and Allium cepa in first part and eight plants viz., Allium sativum, Astragaluhadscendens, Bombax ceiba, Brassica arabica, Brassica juncea, Brassica nigra, Brassica rapa and Brassica schimperi in second part, in third part seven plants viz., Butea monosperma, Calotropis gigantean, Cedruslibani, Cedrusdeodara, Ceratonia siliqua, Cinnamomumcamphora and Citrullus colocunthis, in the fourth part eight plants viz., Cochlospermumreligiosum, Cucumis melo, Cucumis utilisimus, Cucurbita pepo, Cydonia vulgaris, Dryobalamopsaromaticum, Euphorbia resinifera and Ficusbenghalensis. and in fifth part nine plants viz., Ficuscarica, Ficuselastica, Ficus racemose, Ficus religiose, Ficusrumphi, Fraxinus ornus, Hordeum vulgare, Juglans regia, Juniperusoxycedrus. In the sixth part we have enumerated fourteen plants viz., Lagenariasiceraria, Lagenaria vulgaris, Lawsoniainermis, Lacanoraaffinis, Lens culinars, Lens esculenta, Loranthus acacia, Ocimumbasilicum, Ocimum sanctum, Olea europaea, Panicum miliaceum, Phoenix dactylifera, Phoenix Sylvestris and Pistacia vera. In the present seventh part we are enumerating nine plants viz.,Prunus armeniaca, Pterocarpus acerifolium, Punicagranatum, Rhododendron arboretum, Ricinus communis, Rosa phoenicia, Rosa damascene, SalvadorapersicaandSeteria italica. The present review is an attempt to compile most of the information available regarding the distribution, ethnobotanical, ethnomedicinal and non-medicinal uses of the plants. The manuscript contains information's obtained fromauthentic and highly regarded sources. Reasonable efforts have been made to provide reliable data and information, but the author cannot assume responsibility for the validity of all materials or the consequences of their use.

Enumerations:

Prunus armeniaca Linn. Apricot (Rosaceae):

Synonyms

Armeniaca vulgaris

Prunus armeniaca is a deciduous Tree growing to 9 m by 6 m at a medium rate. It is not frost tender. It is in flower from March to April, and the seeds ripen from July to September. The species is hermaphrodite

and is pollinated by Insects. The plant is self-fertile. Suitable for: light (sandy) and medium (loamy) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers moist soil.

This species produces hydrogen cyanide, a poison that gives almonds their characteristic flavour. This toxin is found mainly in the leaves and seed and is readily detected by its bitter taste. Usually present in too small a quantity to do any harm, any very bitter seed or fruit should not be eaten. In small quantities, hydrogen cyanide has been shown to stimulate respiration and improve digestion, it is also claimed to be of benefit in the treatment of cancer. In excess, however, it can cause respiratory failure and even death. Oral doses of 50g of hydrogen cyanide can be fatal [Karalliedde and Gawaremmana, 2008].

Most trees growing apparently wild have escaped from cultivation but there are pure stands of the trees in Tibet on mountain slopes in sparse forests at elevations of 700 - 3000 metres[Flora of China, 1994].

The range of its occurrence is East Asia - North China, Mongolia.

Ethnobotanical Potential

Fruits are consumed raw, cooked or dried for later use [Chittendon, 1956;Hedrick, 1972; Simmons, 1972; Harrison et al., 1975].

The best forms are soft and juicy with a delicious rich flavour [Fern, K].

Wild trees in the Himalayas yield about 47.5kg of fruit per year [Parmar and Kaushal, 1982]. The fruit of the wild form contains about 6.3% sugars, 0.7% protein, 2.5% ash, 2.5% pectin. There is about 10mg vitamin C per 100g of pulp[Parmar and Kaushal, 1982].

The fruit is about 5cm in diameter and contains one large seed [Huxley, 1992]. Seed - raw or cooked [Facciola, 1990].

Bitter seeds should be eaten in strict moderation, but sweet ones can be eaten freely [Bianchiniet al.,]. The bitter seeds can be used as a substitute for bitter almonds in making marzipan etc [Grieve, 1984].

An edible gum is obtained from the trunk [Howes]. The seed contains up to 50% of an edible semi-drying oil[Grieve, 1984; Schery, Plant for Man; Usher, 1974; Facciola, 1990].

An edible semi-drying oil is obtained from the seed [Schery, Plant for Man]. Used for lighting [Parmar and Kaushal, 1982].

The oil has a softening effect on the skin and so it is used in perfumery and cosmetics, and also in pharmaceuticals [Grieve, 1984; Usher, 1974].

A green dye can be obtained from the leaves [Grae, 1974].

A dark grey to green dye can be obtained from the fruit [Grae, 1974].

Wood-handsome, hard, durable. Agricultural implements etc [Gamble, 1972; Parmar and Kaushal, 1982].

Ethnomedicinal Potential

Apricot fruits contain citric and tartaric acid, carotenoids and flavonoids [Dan and Doan, 1989]. They are nutritious, cleansing and mildly laxative [Chevallier, 1996]. They are a valuable addition to the diet working gently to improve overall health.

The salted fruit is anti-inflammatory and antiseptic [Dan and Doan, 1989].

It is used medicinally in Vietnam in the treatment of respiratory and digestive diseases [Dan and Doan, 1989]. Antipyretic, antiseptic, emetic, ophthalmic [Parmar and Kaushal, 1982].

The flowers are tonic, promoting fecundity in women[Duke and Ayensu, 1985].

The bark is astringent [Chevallier, 1996].

The inner bark and/or the root are used for treating poisoning caused by eating bitter almond and apricot seeds (which contain hydrogen cyanide) [Duke and Ayensu, 1985]. Another report says that a decoction of the outer bark is used to neutralize the effects of hydrogen cyanide [Bown, 1995].

The decoction is also used to soothe inflamed and irritated skin conditions [Chevallier, 1996].

The seed is analgesic, anthelmintic, antiasthmatic, antispasmodic, antitussive, demulcent, emollient, expectorant, pectoral, sedative and vulnerary [Yeung, 1985; Duke and Ayensu, 1985]. It is used in the treatment of asthma, coughs, acute or chronic bronchitis and constipation [Yeung, 1985; Med. Pl of Korea, 1998].

The seed contains 'laetrile', a substance that has also been called vitamin B17 [Duke and Ayensu, 1985].

This has been claimed to have a positive effect in the treatment of cancer, but there does not at present seem to be much evidence to support this [Fern, K].

The pure substance is almost harmless, but on hydrolysis it yields hydrocyanic acid, a very rapidly acting poison-it should thus be treated with caution [Duke and Ayensu, 1985].

In small amounts this exceedingly poisonous

compound stimulates respiration, improves digestion and gives a sense of well-being [Bown, 1995].

53. Pterocarpus acerifolium Hathipaila, Kanak champa (Fabaceae-Papilionoideae):

Synonyms

Pterocarpus angolensis DC. (Kajaet), Pterocarpus dalbergioides DC. (Padauk), Pterocarpus michelii Britton, Pterocarpus santalionoidesL'Her ex DC., Pterocarpus soyauxii Taub, (Padouk) [Wagstaff, 1935].

Pterocarpus acerifolium and all its synonyms are included in the Checklist of International Poisonous Plants-An evidence Based Reference [Wagstaff, 1935; Pinto and Baruzzi, 1991].

Found in deciduous and semi-moist deciduous forests, usually on or near riverbanks, at elevations up to 100 metres.

It is a semi-deciduous tropical tree growing about 25-40 m in height and 180 cm in diameter. It is buttressed with usually straight and cylindrical bole. It is endemic to India and valued for wood, medicine, food, and other uses. Plant parts such as flowers and young leaves are edible while the bark is used medicinally and as source of tannins. The wood is of high quality and resistant to termite attack. It is used for constructions, furniture, panelling, cabinet making, agriculture implements, bridges, piles, etc. It can fix Nitrogen.

Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils and can grow in very acid soils.It cannot grow in the shade. It prefers moist soil.

Ethnobotanical Potential

The flowers and very young leaves can be eaten [Ecocrop].

The bark is a source of tannins [Ecocrop]. The heartwood is variable, mainly a rich crimson hue or shades of red to brown, often with darker red or blackish streaks, it is sometimes pale red or yellowish; the narrow band of sapwood is greyish. The texture is rather coarse; the grain generally interlocked; dull to lustrous; without characteristic odour or taste. The heartwood is rated as very durable and also resistant to termite attack. The wood is moderately hard; it is not difficult to saw and machine but because of interlocked grain does not dress to a smooth finish; it turns well; takes a good polish [Gamble, 1972]. It is used for light to heavy construction, joists, rafters, beams and interior finish. It is also used to make high quality furniture, panelling, musical instruments, high-grade cabinet work, interior joinery, billiard tables, decorative flooring, agricultural implements, veneer, etc[Ecocrop].Because it withstands weathering, wearing and insect attacks, it is used for bridges, piles, posts, railway sleepers and mine timbers [Ecocrop].

Ethnomedicinal Potential

The bark contains tannins and is astringent. It is used medicinally [Ecocrop].

Punicagranatum Linn. Pomegranate, Dwarf Pomegranate, Anar.

Synonyms

Punicaflorida, Punica grandiflora, Punica nana. Punica spinosa.

Punicagranatum is a deciduous Tree growing to 5 m by 8 m at a medium rate.

It is frost tender. It is in flower from June to September. The species is hermaphrodite.

It is suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers dry or moist soil.Dry limestone soils to 2700 metres in the Himalayas [Polunin and Stainton, 1984].

Range of occurrence is South East Europe to East Asia - Himalayas.

Ethnobotanical Potential

The leaves, fruits and seeds are consumed in one way or the other.

Fruit are consumed raw [Chittendon, 1956; Hedrick, 1972; Simmons, 1972; Grieve, 1984]. Juicy and refreshing with a sub-acid flavour [Facciola, 1990], they are considered delicious by many people though others do not like the large number of seeds with relatively little fruit pulp [Fern]. The fruit juice can be used in soups, sauces, jellies, ice cream, cakes etc [Facciola, 1990]. The fruit contains about 1.5% protein, 1.6% fat, 16.8% carbohydrate, 0.6% ash [Vines, 1987; Reid, 1977]. Annual yields from wild trees in the Himalayas averaged 32kg per tree [Parmar and Kaushal, 1982]. The fruit is about 12cm in diameter [Huxley, 1992].

The fresh seed is soft and can be eaten raw [Vines, 1982]. When dried it is used as a seasoning in dal, fried samosa, stuffing's and chutneys [Facciola, 1990]. The boiled leaves are said to be eaten [Facciola, 1990].

Recommended doses should be taken. Overdose symptoms include: gastric irritation, vomiting, dizziness, chills, vision disorders, collapse and death [Karalliedde and Gawaremmana, 2008].

A red dye is obtained from the flowers and also from the rind ofunripened fruits[Polunin and Huxley, 1987; Polunin, 1969; Gupta, 1945; Grae, 1974]. The dye can be red or black and it is also used as an ink [149]. It is coppery-brown in colour [Grae, 1974]. No mordant is required [Grae, 1974].

A fast-yellow dye is obtained from the dried rind[Parmar and Kaushal, 1982]. The dried peel of the fruit contains about 26% tannin [Uphof, 1959; Rottsieper, 1946].

The bark can also be used as a source of tannin [Gamble, 172].

The root bark contains about 22% tannin, a jet-black ink can be made from it [Parmar and Kaushal, 1982].

Plants are grown as hedges in Mediterranean climates [Huxley, 1992].

Wood - very hard, compact, close grained, durable, yellow. Used for making agricultural implements. A possible substitute for box, Buxus spp [Gamble, 1972; Vines, 1987; Gupta, 1945; Parmar and Kaushal, 1982].

Ethnomedicinal Potential

The pomegranate has a long history of herbal use dating back more than 3,000 years [Bown, 1995]. All parts of the plant contain unusual alkaloids, known as 'pelletierines', which paralyse tapeworms so that they are easily expelled from the body by using a laxative [Bown, 1995]. The plant is also rich in tannin, which makes it an effective astringent. It is used externally in the treatment of vaginal discharges, mouth sores and throat infections [Bown, 1995]. The whole plant, but in particular the bark, is antibacterial, antiviral and astringent [Lust, 1983;Uphof, 1959; Schry, Pl for Man; Polunin and Huxley, 1987; Yeung, 1985; Parmar and Kaushal, 1982]. This remedy should be used with caution, overdoses can be toxic [Lust, 1983; Duke and Ayensu, 1985]. The flowers are used in the treatment of dysentery, stomach ache and cough [Duke and Ayensu, 1985]. Along with the leaves and seeds, they have been used to remove worms [Grieve, 1984]. The seeds are demulcent and stomachic [Grieve, 1984; Choparaet al., 1986]. The fruit is a mild astringent and refrigerant in some fevers and especially in biliousness [Grieve, 1984]. It is also cardiac and stomachic [Choparaet al., 1986]. The dried rind of the fruit is used in the treatment of amoebic dysentery, diarrhoea etc [Grieve, 1984; Bown, 1995]. It is a specific remedy for tapeworm infestation [Chevallier, 1996]. The stem bark is emmenagogue [Duke and Ayensu, 1985]. Both the stem and the root barks are used to expel tapeworms [Grieve, 1984]. Use this with caution, the root bark can cause serious poisoning [Chief, 1984]. The bark is harvested in the autumn and dried for later use [Bown, 1995]. The dried pericarp is decocted with other herbs and used in the treatment of colic, dysentery, leucorrhoea etc [Duke and Ayensu, 1985].

Rhododendron arboreum Sm.rose tree, rhododendron, laligurans, challan (Ericaceae):

Rhododendron arboreum is one of the most stately and impressiverhododendron species. It is extremely variable in stature, hardiness, flowercolour and leaf characteristics. Originally discovered in north-central India, the plant known locally as LaliGuras is the tallest of Nepal'srhododendrons, reaching heights of more than 20m. It has the largesttrunk and flowers, blossoming earlier and longer than the others. In its native land, huge trees of Rhododendron arboreumgrow to a height of 25m ormore.

Trunk often much branched, crooked or gnarled. Bark reddish brown, softand rough, exfoliating in thin flakes.

The foliage of Rhododendron arboreum is extremely handsome. Its thick, stiff, leatherydark green leaves are covered on the under surface with a thin layer ofindumentum ranging in colour from silver to fawn to deep cinnamon,elegant in foliage. Leaves glossy green, oblong-lanceolate, 10-20 cm longand 3.6 cm wide. Crowded towards the ends of branches, petiole coveredwith white scales when young.The flowers of R. arboreum range in colour from a deep scarlet, to red withwhite markings, to pink to white. Bearing up to twenty blossoms in a singletruss this rhododendron is a spectacular sight when in full bloom. It isreported that the bright red forms of this rhododendron are generally foundat the lower elevations.

Fruit a capsule, oblong, curved, longitudinally ribbed, up to 3.8 cm longand 1.25 cm wide.

Seeds minute, dark brown, compressed, oblong.

Three varieties are recognized, var. cinnamomic is a small tree withsmaller leaves and white, pale rose or purple spotted flowers and occursin Nepal and northern Bengal.

The hermaphrodite flowers are insect-pollinated. Seed capsules ripenfrom August through March depending on altitude. The first hybridrhododendrons were created during the early 1830s by Anthony Waterer, at Knapp Hill in Surry, England. He crossed the rather tender Rhododendron arboreum with the much hardier Rhododendron caucasicum. The result were plants which were hardier than Rhododendron arboreum and which had the advantage of repeatblooming. These hybrids are still among the earliest blooming rhododendrons; they bloom when there is a strong possibility of frost. Repeat blooming

means that unlike most rhododendrons, all of the flowersdon't open at once; instead they open in succession. If the first blooms getdamaged by frost, there are still flower buds which aren't damaged. Waterer named this hybid family the 'Nobleanum' grex. A grex is a familyof hybrids which result from the crossing of two species rhododendrons, iteven includes crosses of the same species done by different breeders. This term became very confusing and it is no longer used by rhododendron breeders, it is only used to describe antique hybrids. R. arboreum in the world's most famous rhododendron. This spectacularplant was designated the national flower of Nepal, the legendary home of Mount Everest and other mountain gods. It's even depicted on the nationalcoat of arms.

Rhododendrona rboreum is found in many vegetation types, and sometimes forms almost pure forest in restricted areas. It iscommon in the western Himalayas in association with Quercus species and Pinus roxburghii. It thrives best on moistloam although it is also found on moist rocky ground. The tree can withstand shading although it develops better in theopen [Agroforestry Database 4.0; Orwaet al., 2009].

Ethnobotanical Potential

Flowers are sour-sweet and are eaten as pickles, although excess may cause intoxication.

A sub-acidic jelly or preserve is made from the petals. The flower petals are eaten raw as a famine food in India.

The wood is used as fuel and for making charcoal.

Sapwood reddish to brownish white; heartwood reddish brown, moderately hard, 640 kg/cu. m. It is easy to work, finishing to a smooth surface. It is used for tool handles, boxes and posts and is suitable for plywood [Agroforestry Database 4.0; Orwaet al. 2009].

The leaves are poisonous [Polunin and Stainton, 1984; Choparaet al., 1986]. The flowers can cause intoxication in large quantities [Facciola, 1990].

The tender leaves are used as a cooked vegetable [Tanaka, 1976; Gupta, 1945; Facciola, 1990]. Caution is advised, due to toxicity. Flowers - raw or cooked [Manandhar, 2002]. A sweet-sour taste, they are said to make a good sub-acid jelly [Facciola, 1990].

The flowers are sometimes simply pickled by adding salt and chili [Manandhar, 2002]. Caution is advised, large quantities can cause intoxication [Hedrick, 1972; Facciola, 1990].

The juice of the leaves is spread over cots and beds to get rid of bed lice [Manandhar, 2002].

Wood - soft, even grained, seasons badly.

Used in turnery, it can also be used to make charcoal and for fuel [Polunin and Stainmton, 1984; Gupta, 1945]. Th wood is much employed in Nepal where it is used for making household implements, building small houses and fences [Manandhar, 2002]. Planks of the wood are carved to make boxes, cupboards and other furniture [Manandhar, 2002]. It is a very good fuel, burning well with a long-lasting heat - overcollection of the wood for fuel, and also for making charcoal, has become a cause for conservation concern [Manandhar, 2002].

Services of Rhododendron arboreum

Rhododendron arboreumreadily colonizes newly disturbed ground such as road cuttings and landslides and in thecrevices of bare rocks.

Rhododendron arboreum (Lali Guras in Nepal) is distributed throughout the length of Nepal at a variety of altitudes. Itis known for its variably coloured blossoms, which come in shades of red, pink and white. The blossoming plants are aspectacular sight, with up to twenty blossoms in a single truss.

The foliage adds to the plant's beauty. The under surface of the thick, stiff, leathery dark green leavesis covered with a thin layer of indumentum ranging in colour from silver to fawn to deep cinnamon. Certain areas areknown for their beautiful rhododendrons of various colours. Trekkerstourists who make extensive hikingtripssometimes plan their trips to pass through good rhododendron viewing areas.

Ethnomedicinal Potential

The young leaves are astringent and poultice [Gupta, 1945]. They are made into a pasteand then applied to the forehead in the treatment of headaches [Choparaet al., 1986; Manandhar, 2002].

The juice of the bark is used in the treatment of coughs, diarrhoea and dysentery [Manandhar, 2002].

A decoction of the flowers is used to check a tendency to vomit, especially if there is also a loss of appetite [Manandhar, 2002].

The juice of the flowers is used in the treatment of menstrual disorders[Manandhar, 2002].

The petals are eaten to assist the removal of any animal bones that have become stuck in the throat [Vanderplank, 1991].

Ricinus communisLinn. Castor-Oil Plant, Castor bean (Euphorbiaceae):

Synonyms

Cataputia majorLudw., Cataputia minorLudw., Croton spinosus L., Ricinus africanus Mill., Ricinus

angulatusThunb., Ricinus armatusAndr., Ricinus atropurpureus Pax & K. Hoffm., Ricinus badius Rchb., Ricinus borboniensis Pax & K. Hoffm., Ricinus cambodgensis Benary, Ricinus compactus Huber, Ricinus digitatus Noronha, Ricinus europaeus T.Nees, Ricinusgibsoniiauct., Ricinus giganteus Pax &K.Hoffm., Ricinus glaucus Hoffmanns., Ricinushybridus Besser, Ricinus inermis Mill., Ricinus japonicas Thunb., Ricinus krappa Steud., Ricinus laevis DC., Ricinus leucocarpus Bertol., Ricinus lividus Jacq., Ricinus macrocarpus Popova, Ricinus macrophyllus Bertol., Ricinus medicus Forssk., Ricinus medius J.F. Gmel., Ricinus megalosperma Delile, Ricinus messeniacus Heldr., Ricinus metallicus Pax & K.Hoffm., Ricinus microcarpus Popova, Ricinus minor Mill., Ricinus nanus Bald., Ricinus obermannii Groenl., Ricinus peltatus Noronha, Ricinus perennisSteud., Ricinus persicus Popova, Ricinus purpurascens Bertol., Ricinus ruber Miq., Ricinus rugosus Mill., Ricinus rutilansMüll. Arg., Ricinus sanguineus Groenl., Ricinus scaber Bertol. ex Moris, Ricinusspeciosus Burm.f., Ricinus spectabilis Blume, Ricinus tunisensis Desf., Ricinus undulates Besser, Ricinus urens Mill., Ricinus viridis Willd., Ricinus vulgaris Garsault, Ricinus vulgaris Mill., Ricinus zanzibarensisauct., Ricinus zanzibarinus Popova.

Castor-oil plant, (Ricinus communis), also called castor bean, large plant of the spurge family (Euphorbiaceae), grown commercially for the pharmaceutical and industrial uses of its oil and for use in landscaping. Probably native to tropical Africa, the castor-oil plant has become naturalized throughout warm areas of the world. The plants are chiefly cultivated in India, China, and Brazil, largely as the source of castor oil. Although the plant is the only species in its genus, there are hundreds of natural forms and many horticultural varieties. The oil-rich seeds contain the poison ricin, one of the most toxic substances known, and consumption of chewed seeds can be lethal.

In the tropics the plants reach about 10 to 13 metres in height. In temperate climates they are raised as annuals and grow 1.5 to 2.5 metres in a single season. The plants bear handsome giant 12-lobed palmate (fanlike) leaves. The bristly spine bronze-to-red clusters of fruits are attractive but often are removed before they mature, because of the ricin concentrated in their mottled beanlike seeds

Ethnobotanical Potential

Castor oil, also called Ricinus Oil, is a non-volatile fatty oil obtained from the seeds of the castor bean, Ricinus communis. It is used in the production of synthetic resins, plastics, fibres, paints, varnishes, and various chemicals including drying oils and plasticizers. Castor oil is viscous, has a clear and colourless to amber or greenish appearance, a faint characteristic odour, and a bland but slightly acrid taste, with a usually nauseating aftertaste.

Castor oil is obtained from castor beans either by pressing or by solvent extraction. Both beans and oil are produced principally by India and Brazil and consumed primarily in the United States, largely in industry.

In addition to the uses mentioned previously, castor oil and its derivatives are used in cosmetics, hair oils, fungistatic (fungus-growth-inhibiting) compounds, embalming fluid, printing inks, soap, lubricants, greases and hydraulic fluids, dyeing aids, and textile finishing materials. Turkey-red oil, long used as a dyeing aid, is produced by the reaction of castor oil with sulfuric acid.

Castor oil consists almost entirely of the triglyceride's ricin oleic acid; and although castor oil has been taken internally as a cathartic, its use can be harmful [Encyclopaedia Britannica].

Oil has been obtained from plants since the beginning of recorded history for oil-burning lamps and for anointing and cooking. Castor oil was used as a lubricant for wheels of carts and wagons before the petroleum era.

The whole plant is very poisonous [Altman, 1980; Stary, 1983; Riotte, 1978], even one seed has been known to be lethal to children [Frohne and Dfander, 1984; Cooper and Johnson, 1984; Huxley, 1992]. There is no specific antidote [Ecocrop].

The seedcoat contains an extremely lethal poison that was once used by the KGB to dispose of their enemies [Phillips and Rix, 1998].

The leaves are only mildly poisonous [Cooper and Johnson, 1984].

The toxic principle is water-soluble so is not found in the oil [Cooper and Johnson, 1984].

The seed contains 35 - 55% of an edible oil, used in cooking [Hedrick, 1972; Hill, 1952].

It is used by the food industry to add butter and nut flavours to various foods [Facciola, 1998].

The seed is a rich source of phosphorus, 90% of which is in the phytic form [Duke and Ayensu, 1985].

Some caution should be observed, due to the toxicity as described above.

The growing plant is said to repel flies and mosquitoes [Chief, 1984; Holton and Hylton, 1979; Philbrick and Gregg, 1079; Riotte, 1978; Hill, 1952; Allardice, 1993].

When grown in the garden it is said to rid it of moles and nibbling insects [Holton and Hylton, 1979; Riotte, 1978; Allardice, 1993].

The plant is traditionally grown in living fences in the Northwestern Himalayas, where it helps to exclude livestock and other animals; mark out land boundaries; whilst also providing a range of medicinal and other uses [Sharma and Devi, 2013].

The seed contains 35 - 55% of a drying oil. As well as being used in cooking, it is an ingredient in a wide range of commodities including imitation leather, soaps, polishes, flypapers, paints and varnishes [Hedrick, 1972; 4; Chief, 1984; Holtom and Hylton, 1979; Grieve, 1984; Uphof, 1959; Schery, Pl for Man].

It is also used as a lubricant and for lighting and as an ingredient in fuels for precision engines [Chief, 1984; Clapham et al., 1962; Polunin, 1969].

The oil is used in coating fabrics and other protective coverings, in the manufacture of high-grade lubricants, transparent typewriter and printing inks, in textile dyeing (when converted into sulphonated Castor Oil or Turkey-Red Oil, for dyeing cotton fabrics with alizarine) and in the production of 'Rilson', a polyamide nylon-type fibre [Duke, 1983]. The dehydrated oil is an excellent drying agent which compares favourably with tung oil and is used in paints and varnishes [Duke, 1983]. The hydrogenated oil is utilized in the manufacture of waxes, polishes, carbon paper, candles and crayons [Duke, 1983].

A fibre for making ropes is obtained from the stems [Chief, 1984].

The leaves have insecticidal properties [Hill, 1952].

Cellulose from the stems is used for making cardboard, paper etc [Usher, 1974; Hill, 1952].

Ethnomedicinal Potential

The oil from the seed is a very well-known laxative that has been widely used for over 2,000 years [Foster and Duke, 1990].

It is considered to be fast, safe and gentle, prompting a bowel movement in 3 - 5 hours, and is recommended for both the very young and the aged [Grieve, 1984; Chevallier, 1996].

It is so effective that it is regularly used to clear the digestive tract in cases of poisoning [Chevallier, 1996].

It should not be used in cases of chronic constipation, where it might deal with the symptoms but does not treat the cause [Grieve, 1984].

The flavour is somewhat unpleasant, however, and it can cause nausea in some people [Grieve, 1984]

The oil has a remarkable antidandruff effect [Chief, 1984]

The oil is well-tolerated by the skin and so is sometimes used as a vehicle for medicinal and cosmetic preparations [Chevallier, 1996].

Castor oil congeals to a gel-mass when the alcoholic solution is distilled in the presence of sodium salts of higher fatty acids [Choparaet al., 1986].

This gel is useful in the treatment of non-inflammatory skin diseases and is a good protective in cases of occupational eczema and dermatitis [Choparaet al., 1986].

The seed is anthelmintic, cathartic, emollient, laxative, purgative [Grieve, 1984; Chief, 1984; Lust, 1983].

It is rubbed on the temple to treat headache [Duke and Ayensu, 1985] and is also powdered and applied to abscesses and various skin infections [Duke and Ayensu, 1985].

The seed is used in Tibetan medicine, where it is considered to have an acrid, bitter and sweet taste with a heating potency [Tsarong, 1994].

It is used in the treatment of indigestion and as a purgative [Tsarong, 1994].

A decoction of the leaves and roots is antitussive, discutient and expectorant [Duke and Ayensu, 1985].

The leaves are used as a poultice to relieve headaches and treat boils [Choparaet al., 1986].

Rosaphoenicia Boiss. Rambling Rose, Bare Root Rose, Ward Jouri (Rosaceae):

Synonyms

Rosa arvensis var. trojana Boulenger, Rosa chlorocarpa Fenzl & Heinr. Braun

Height and width range is 6m x 3m, species Climbers & Ramblers, flowers White/Cream,

Bloom size small, bloom type single, suitable for warm climate, flowers with little or no fragrance, flowering in summer, unique to peter bezels- yes

The plant has been shown as a food, medicine and in material including timber, essential oils and another category in Ethnobotanical use categories of Wild Plant Species of Jabal Moussa Bioreserve, Lebanon [Baydounet al., 2017].

Rosa damascene

Rosa x damascena is a deciduous shrub growing to 1.5 m.

It is in flower from June to July. The species is hermaphrodite and is pollinated by Insects. The plant is self-fertile.

Suitable for: light (sandy), medium (loamy) and heavy

(clay) soils, prefers well-drained soil and can grow in heavy clay soil. Suitable pH: acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers moist soil.

Habitat is not known in a truly wild situation, this species is probably a hybrid involving R. centifolia [Bean, 1981; Komarav, 1968]. Range of occurrence is West Asia.

Ethnobotanical Potential

Young shoots - raw or cooked [Tanaka, 1976; Kunkel, 1984]. Best used when they are still red-coloured, they are peeled before being eaten [Facciola, 1990]. Petals - cooked. They are the source of 'attar of roses' and 'rose water', and are used as a flavouring for drinks, sweets, baked goods, ice cream etc [Facciola, 1990]. The petals are also used to make jam [Komarav, 1968]. Fruit - raw or cooked. The fruit is about 25mm in diameter [Huxlay, 1990], but there is only a thin layer of flesh surrounding the many seeds [Fern,K]. Some care has to be taken when eating this fruit, see the notes above on known hazards. The leaves are used as a seasoning. The seed is a good source of vitamin E, it can be ground into a powder and mixed with flour or added to other foods as a supplement [Kavasch, 1979; Facciola, 1990]. Be sure to remove the seed hairs [Kavasch, 1979].

An essential oil obtained from the flowers is much used for perfumery and as a flavouring [Chittenden, 1956; Uphof, 1959; Schery, Pl for Man; Hill, 1952]. 1000g yields 0.5g of oil [Usher, 1974].

There is a layer of hairs around the seeds just beneath the flesh of the fruit. These hairs can cause irritation to the mouth and digestive tract if ingested.

Ethnomedicinal Potential

The petals are applied externally as an astringent [Choparaet al., 1986]. They are also made into a preserve and used as a tonic that helps to put on weight [Choparaet al., 1986]. The buds (the report does not say if it is leaf or flower buds) are aperient, astringent, cardiac and tonic [Choparaet al., 1986]. They are used for removing bile and cold humours [Choparaet al., 1986]. The fruit of many members of this genus is a very rich source of vitamins and minerals, especially in vitamins A, C and E, flavonoids and other bio-active compounds. It is also a fairly good source of essential fatty acids, which is fairly unusual for a fruit. It is being investigated as a food that is capable of reducing the incidence of cancer and also as a means of halting or reversing the growth of cancers [Matthews, 1994].

SalvadorapersicaLinn. Tooth brush tree, Pilu (Salvadoraceae):

Common Names: Ayurvadic name - Pilu, Unani name - Pilu, Miswak, Hindi name KharaJhal, Chota Pilu, Meswak, English name - Mustard Tree, Salt Bush Tree, Trade name-KharaJhal, Tooth Brush Tree.

Salvadorapersica is a large shrub or small tree of Thar Desert. The branches are drooping, terete and glabrous. A typical desert plant grows as a mangrove perennial tree as well as under extreme saline (salt stress) and drought conditions. Thus, the seeds are dispersed by the birds. The plant produces three types of fruits, i.e. pink, purple and white. The purple fruit bearing plants showed better seed traits, viz. seed weight, size, thickness, volume, density and viability and germination percentage as compared to other two types of fruit bearing plant.

The leaves shed twice in a year, i.e. October-November and February-March, but plant never becomes leafless throughout the year. New leaves appear twice in a year, first during April-May and second during September to December and thereafter new leaves develop slowly.

During winter season (cold stress) anthocyanin pigments have been noticed in leaves.

The gall formation has been commonly observed on every plant part except roots. These galls have been reported to possess some growth promoting principles. The plant bear flowers in September-October. The flowers are greenish-yellow borne in axillary and terminal compound panicles. Calyx is glabrous, lobes rounded; corolla is twice as long as calyx; stamens exerted; fruit is a drupe, globose, red when ripe. The plants produce fruits with and without seeds. The fruits are formed in autumn and takes 3 months to increase in size and mature during April-May.

In natural conditions the germination of seeds takes place during rainy season (July and August). It survives under both saline and drought conditions throughout the Indian arid zone. It grows well under arid environment, salt stress conditions and low moisture with high temperature.Soil mixture of 1:2:1 ratio of sand, clay, FYM is best; higher clay content is preferable.

Ethnobotanical Potential

The root contains steam-distillable oil, which has 90% Benzyl isothiocyanate, a compound responsible for decreasing dental caries and used in the preparation of Meswak toothpaste.

The chemical present in the plant can control gingivostomatitis, skin infection and conjunctiva.

The root bark is tonic, stimulant, emmenagogue. The stem bark is good for gastropathy. [Vikaspedia; Agro-techniques of selected medicinal plants].

Fruits have a sweet, agreeable, aromatic, slightly pungent and peppery taste. They can be eaten raw, cooked, ordried and stored. Fruit with or without seeds is said to contain 1.7-1.86% sugars when ripe. Fermented drinks are alsomade from the fThe leaf is somewhat bitter and aromatic, with a taste likened to mustard.

The leaves are alsocooked as a sauce and eaten with couscous or as a green vegetable. Tender shoots, seeds and seed oil are alsoedible. Edible salts are obtained from ashes.

Leaves and young shoots are browsed by all stock, but normally cattle do not occur in the driest part of the S.persica distribution range and hence it tends to be valued more as a camel, sheep and goat forage. Leaves make goodfodder as their water content is high (15-36%). The high salt content of the leaves is said to affect the taste of milk, butthe leaves are said to increase lactation in cows.

S. persica is reported as a good source of nectar.

The wood is sometimes used for firewood and charcoal. However, it is not used for cooking meat, as it leaves afoul taste.

The wood is soft, white, easy to work and is not liable to termite attack. Used for coffins and clubs.

Resin that drips from the tree is supposedly useful for making varnish.

Seeds of S. persica contain 30-40% of a greenish-yellow, non-edible oil that has over 50% lauric and myristicacids. It has a high melting point and a dis-agreeable odour that disappears on purification. The most important aspectof the oil is the presence of a low percentage of C8 and C10 fatty acids that are of great economic significance. The oilis an alternative source of oil for soap and detergent industries.

Crusted leaves placed in cow urine together with leaves of Pergulariatomentosa are used to clear hairfrom tanned hides, allowing the hair to be re-moved with a knife. Roots contain Salvadorian, a urea derivative.

Planted as shelterbelts and windbreaks to protect farm habitation, gardens and orchards.

Planted in sand dune reclamation and also useful for reclaiming saline soils.

Ethnomedicinal Potential

Toothbrushes made from roots and small branches of about 3-5 mm diameter have been used for over 1000 years, especially by Islamic populations in India, Arabia and Africa. Several agents occurring in the bark and wood havebeen suggested as aids in prevention of dental caries, such as antimicrobial agents that suppress bacterial growth andthe formation of plaque. The tooth stick is also said to relieve toothache and gum disease. Roots also are used forcleaning teeth and for relieving toothache. Decoctions of leaves are used as a mouthwash, and masticated leaves fortooth and gum problems.

A decoction of the root is used to treat gonorrhoea, spleen trouble and general stomach-ache.

Roots are also used forchest diseases or pounded and used as a poultice to heal boils.

The bark is scratched and the latex used for treatingsores.

Seeds are used as a tonic, and seed oil is used on the skin for rheumatism [Orwaet al., 2009].

Seteria italica (*L.*) *P.Beauv*. Foxtail Millet, (Poaceae):

Setariaitalicais anannual growing to 0.5 m by 0.1 m. It is hardy to zone (UK) 6. It is in flower from August to October, and the seeds ripen from September to October. The species is hermaphrodite and is pollinated by Wind. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers moist soil and can tolerate drought.

The range of occurrence is Asia. The plant has been derived through cultivation and its origin is obscure.

Ethnobotanical Potential

Seed are consumed after being cooked[Hedrick, 1972; Harrison et al., 1975; Uphof, 1959]. It can be eaten as a sweet or savoury food in all the ways that rice is used, or ground into a flour and made into porridge, cakes, puddings etc [Tanaka, 1976; Facciola, 1990]. The seed can also be sprouted before it is used, when it will become somewhat sweeter[Fern, K]. A nutritional analysis is available [Duke and Ayensu, 1985].

Composition of dry seeds in grams or milligrams per 100g of the food

384 Calories per 100g Protein: 10.7g; Fat: 3.3g; Carbohydrate: 84.2g; Fibre: 1.4g; Ash: 1.8g;

Minerals - Calcium: 37mg; Phosphorus: 275mg; Iron: 6.2mg; Magnesium: 0mg; Sodium: 8mg; Potassium: 281mg; Zinc: 0mg; Vitamins - A: 0mg; Thiamine (B1): 0.48mg; Riboflavin (B2): 0.14mg; Niacin: 2.48mg; B6: 0mg; C: 0mg [Duke and Ayensu, 1985].

Ethnomedicinal Potential

The germinated seed of yellow-seeded cultivars is astringent, digestive, emollient and stomachic [Yeung, 1985; Stuart, 1979; Duke and Ayensu, 1985]. It is used in the treatment of dyspepsia, poor digestion and food stagnancy in the abdomen [Yeung, 1985].

White seeds are refrigerant and used in the treatment of cholera and fever [Duke and Ayensu, 1985]. Green seeds are diuretic and strengthening to virility [Duke and Ayensu, 1985].

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Corporate (collective) author

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