

Introduction

Millets are called so because many thousands of grains are harvested from each seed sown. Besides the two major millets- sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum typhoides*), there are several small millets like finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa colona*), little millet (*Panicum sumatrense*) and Job's tears (*Coix lachryma-jobi*), which are cultivated in India. They are all classified as "coarse cereals". Such labeling has degraded their value, even though millets are the most nutritious of all cereals. Small millets have really small sized grains with 2.1 - 7.1 grams/1000 grains weight and 1.4 - 5.1 ml/1000 grain volume of the well filled grains, whose density ranges from 1.34 - 1.42 grams/ml. They are spherical to oval shaped and possess coloured seed coats (see key to the Indian millets and Table I).

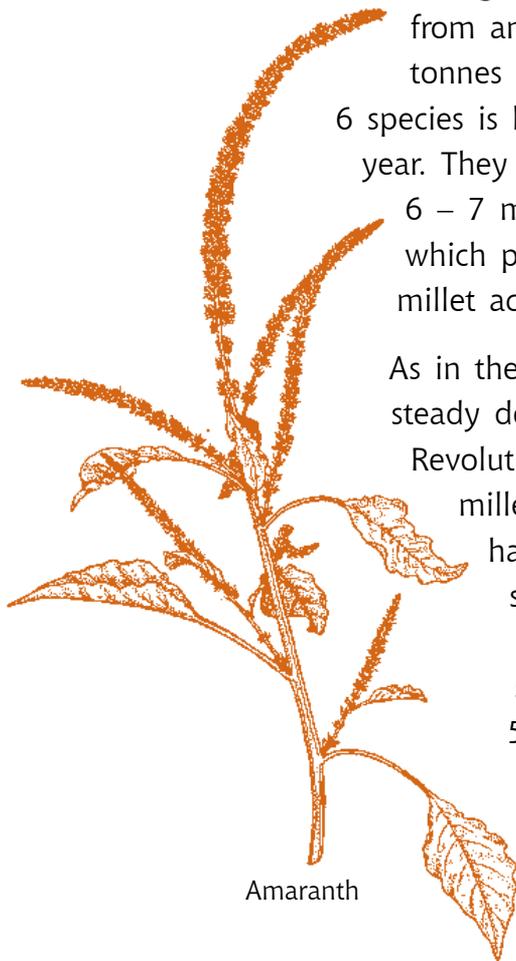
In this book, the two major millets cultivated in India, sorghum and pearl millets are also included along with the small millets mentioned above.



Barnyard
Millet

Millets are grown in arid, semi arid or montane zones as rainfed crops under marginal conditions of soil fertility and moisture, where little else can be grown. Their annual production is less than 2% of the total world grain production. However they are of great local importance as staples and as reserve crops in marginal areas. Thus, they are major source of energy and protein for millions of people and fodder for cattle in vast tracts of Asia and Africa. According to FAO statistics 1990, the world average annual production of small millets was 30.5 million tonnes from an area of 54 million hectares, lower than 34.3 million tonnes 1980. The net production of small millets constituted of 6 species is highest in South Asia, averaging around 4 million tonnes/year. They occupy 4.5 % of the cultivated area in India. Every year, 6 – 7 million hectares of land is sown with small millets in India, which produces about 5 million tonnes of grain. Of this, finger millet accounts for more than 40%.

As in the case of many other traditional crops, there has been a steady decline in the area occupied by millets in the post Green-Revolution era (1965-1990). This holds true for all the small millets. Improvement in productivity during the same period has been conspicuous only for finger millet, but there is significant production decline taking place in the case of other small millets. However, the overall productivity of small millets during this period has increased from 526 kg/ha in 1951-'55 to 662 kg/ha in 1981-'84. This increase is mainly attributed to the improvement in the yield of finger millet.



Amaranth

In the case of finger millet, there is a declining trend in the areas under cultivation in Tamil Nadu and Andhra Pradesh and a considerable increase in Orissa and Karnataka. The national area under finger millet has shrunk from 25.93 lakh hectares in 1980 – '84 to 23.05 lakh hectares in 1985-'89. There is shrinkage observed in the area under the other millets from 5.4 million hectares in 1949-'50 to 3.6 million hectares in 1984-'85. This is mainly due to changes in cropping patterns as a result of the improved irrigation facilities, enabling the cultivation of other cereals like rice, and the entry of cash crops like cotton, sugarcane, soyabean, etc. Therefore, the cultivation of millets is being confined to degraded marginal lands. The subsidised rice and wheat offered through the Public Distribution System also contributes to the reduced consumption of millets. The advent of the Green-Revolution saw the wiping out of many traditional varieties of small millets. Nevertheless, further decline of the area under small millets is unlikely in the coming years, as the area presently occupied by these crops, even if vacated are unsuitable for production of other crops.

As millets are comparatively photo-insensitive, have short growing season and low moisture demand, they fit well into mixed-cropped systems, both under irrigated as well as dry farming condition. During years of scarcity; they can provide nutritious grain as well as valuable fodder in a short span of time. Their long storage life under ordinary conditions makes them suitable candidates for famine reserve foods. This aspect is very important in the Indian situation due to the increasing unpredictability of



Finger Millet

monsoon. Adoption of simple agronomic practice like timely sowing of suitable varieties, manuring, weeding, inter-cultivation with other crops like pulses, oilseeds and other cereals could increase the overall yield level by 200-300%.

The nutritional quality of food items that can be made from the small millets compare well with other cereals. Some of them are even nutritionally superior to rice and wheat (see Table II on page 14).

Except for finger millet, all other small millets have some resemblance to paddy in that they have an outer husk, bran and starch endosperm. The storage tissue in the seed-endosperm-forms the bulk of the seed and the starch in it provides the main food constituent. The outer layer of cells of the endosperm, the aleurone layers, is where much of the protein is present. The embryo, which occupies a small volume of the seed, is rich in fats, proteins and minerals. When milled using certain modern techniques, as the embryo are removed, much of the proteins, fat, minerals and vitamins are lost. Nutritive value and health are thereby sacrificed for the polished and refined grains.

All millets are rich in iron and of all the cereals, finger millets is the richest in calcium and has been part of weaning food in South India. Proso and foxtail millets contain about 4 % fat. The protein content of finger, kodo, little and barnyard millets vary from 6-10%, whereas those of proso and foxtail millets ranges from 9-14 %. Finger millet protein has sulphur-containing amino acids equal to that of milk proteins. The fat from millets contain a higher proportion of unsaturated fatty acids and supply essential fatty acid. The dietary carbohydrate component of



Amaranth

millets and their starch granules are slightly bigger than rice starch granules. They have a relatively higher proportion of “unavailable” carbohydrates, their glycemic index is low and the release of sugars from millet-based diet is slow. These factors could be utilised in developing special foods for diabetics. Millets have a higher percentage of dietary fibre also. It has been observed that the incidence of duodenal ulcers is practically nil among millet eaters.

Millets are normally consumed in the areas of their production and very little finds its way to the market. The improvement of milling and processing techniques and formulation of recipes for snacks, malts, flakes, extruded products of noodles, quick-cooking food items etc. will make small millets attractive to the growing health food market. Processes like par-boiling, co-milling of different species of millets to obtain composite flours, popping, puffing etc. are sure to improve the acceptability of millets to the urban population.

Millets starches have been found to possess superior qualities than rice and wheat starches and therefore can be used to produce industrial starch. The seed coat from milling of finger millet is a by-product and contains pigments. These could be economically exploited for the extraction of food grade colours, as there is a growing demand for natural food colours.

Traditionally, most of the millets are stored in their husks and processed only when needed, because on keeping, the flour becomes rancid due to the high oil content.

Finger millet has high potential for use in malt industry and is suitable base for weaning and supplementary food formulation.

In spite of the fast changing agricultural scenario, substantial shifts in area and production of small millets Navdanya has promoted the potential role of these crops in meeting the needs of farmers and consumers. The fact that these crops have withstood the competition from major cereals in the past forty years and are still cultivated in substantial areas is testimony to their resilience, and their importance in local diets. Besides, several complex social, cultural and economy considerations are instrumental in the farmers' decision to continue growing small millets. And as we popularise these "forgotten foods" among consumers through seed to table linkages, food festivals, innovative recipes, we are witnessing their re-entry in our food culture and gastronomy.

Key to the Indian millets

Inflorescence digitate..... Eleusine

Male and female spikelets in same inflorescence with female below..... Coix

Dioecious with bisexual spikelets. Spikelets paired (or in 3s), with sessile and other (s) pedicelled Sorghum

Inflorescence spicate: involucre of bristles below each spikelet
Spikes dense: grains free from lemma and palea at maturity... Pennisetum



Job's Tear

Inflorescence paniculate.....	awnless
Inflorescence an open panicle.....	Panicum
Inflorescence of racemes of short spikes	
Spikelets without awns.....	Paspalum
Spikelets awned.....	Echinochloa

Table I: Parameters for some of the important quantitative characters of small millets

Crop	Days to 50% flowering	Plant height (cm)	Basal tillers number	Flag leaf length (mm)	Flag leaf width (mm)	Sheath length (mm)	Preduncle length (mm)	Inflorescence length (mm)
Finger Millet	79.10	102.90	6.56	351.00	13.38	105.60	219.80	100.60
Foxtail Millet	52.41	105.80	7.75	286.20	20.56	136.20	299.50	156.40
Proso Millet	33.87	60.74	–	231.40	20.41	82.81	181.80	195.70
Little Millet	54.50	116.10	19.06	256.80	12.33	107.80	144.70	298.20
Barnyard Millet	44.68	74.38	–	191.90	17.91	87.94	165.20	137.20
Kodo Millet	87.75	53.19	23.56	249.60	9.86	153.70	–	58.29

These are mean values adapted from ICRISAT data.

TABLE II: Milling yield, physical characteristics and cooking time of husked small millets

Millets	Colour	Milling yield (%)			1000 kernel		Density (g/ml)	Cooking Time (Minutes)
		Grains	Bran	Husk	Wt (g)	Vol (ml)		
Finger	Brown to brick red	89.0	11.0	–	– (2.9)	– (2.1)	– (1.46)	(6)
Proso	Greenish -grey	78.8	5.0	16.2	5.5 (7.1)	3.8 (5.1)	1.46 (1.39)	4
Foxtail	Yellow	77.2	6.0	16.8	2.0 (2.6)	1.5 (1.9)	1.34 (1.42)	4
Kodo	Deep Brown	63.2	7.5	29.3	4.2 (6.7)	2.8 (4.8)	1.48 (1.38)	3
Little	Brownish-Green	77.0	6.1	17.0	1.9 (2.1)	1.3 (1.4)	1.48 (1.46)	3
Barn-yard	Greyish	77.5	6.0	16.5	2.7 (3.3)	1.5 (2.4)	1.84 (1.34)	4

Figures in parentheses indicate values for whole seeds

TABLE III: Proximate composition of small millets, wheat and rice (per 100 g)

Name	Protein (g)	Fat (g)	Minerals (g)	Fibre (g)	Carbohydrates (g)	Calcium (mg)	Phosphorus (mg)	Thiamin (mg)	Edible matter (g)
Finger Millet	7.3	1.3	2.7	3.6	72.0	344	283	420	100
Proso Millet	12.5	3.1	1.9	7.2	70.4	14	206	400	59
Foxtail Millet	12.3	4.3	3.3	8.0	60.9	31	290	590	79
Little Millet	7.7	4.7	1.5	7.6	67.0	17	220	300	66
Kodo Millet	8.3	1.4	2.6	9.0	65.9	27	188	330	58
Barnyard Millet	6.2	2.2	4.4	9.8	65.5	11	280	300	65
Job's Tears (Milled)	17.5	6.0	1.8	0.5	63.4	23	480	310	100
Rice (Milled)	6.8	0.5	0.6	0.2	78.2	45	160	-	100
Wheat	11.8	1.5	1.5	1.2	71.2	41	306	-	100



Pseudo Cereals

Amaranth (*Amaranthus spp.*)

Hindi: *Chaulai, Marsa, Marcha, Ramdana*; Sanskrit: *Ariki Sira, Balnavada*; Kannada: *Keere, Harave*;

Tamil: *Pung keerai, Rajakeerai*; Malayalam: *Cheera, rajakeera*; Marathi: *Chawli*; Bengali: *Saag*;

Punjabi: *Ganhar, Sil, Bhabri, Savalana, Batu, Daukar, Chaulai*

The amazing Amaranth, in its myriad colours, is one of the world's best sources of nutrition. It is one of the oldest grains in the world, and was first cultivated by the people of South America.

The root word 'amara', in both Greek and Sanskrit, means eternal or deathless.

In India, the amaranth is also known as 'ramdana', or god's own grain.

The Amaranth grows all over India, from the high slopes of the Himalayas, through the plains of north, central and south India, to the coastlines of the east, west and the south. Numerous varieties are found throughout the country. In fact, the Himalayan region is one of the 'centres of diversity' for the amaranth. There are about 60 *Amaranthus* species. Several of them are cultivated as leaf vegetables, cereals, or ornamental plants.

The amaranth, though unrelated to any other cereal grain, forms the mainstay of the diets of many people of the world because of its nutritional value.



As the amaranth is a hardy crop that requires very little water and gives a very high and nutritious yield of both fibre and grain it has traditionally been an important food crop in China and Russia too.

Because it is easy to digest, amaranth is traditionally eaten during fasts, and given to those who are recovering from an illness. It is an excellent substitute for those who are allergic to grains.

The grain is usually popped before use. The popped grain can be made into gruel called sattv, or into laddoos. It can also be ground into flour. The flour is usually mixed with wheat or rice or millet flour to make chapattis and other everyday preparations. Cooking increases the nutritive value of amaranth.

Aesop's Fables compares the Rose to the Amaranth to illustrate the difference in fleeting and everlasting beauty.



*A Rose and an Amaranth blossomed side by side in a garden,
and the Amaranth said to her neighbour,
“How I envy you your beauty and your sweet scent!
No wonder you are such a universal favourite.”
But the Rose replied with a shade of sadness in her voice,
“Ah, my dear friend, I bloom but for a time:
my petals soon wither and fall, and then I die.
But your flowers never fade, even if they are cut;
for they are everlasting.”*

The most nutritious grain in the world

The grain of the amaranth has been called the 'most nutritious grain in the world'. It is probably for this reason that even 3000 years ago, the people of South America cultivated several thousand acres of the crop. Amaranth grain was their staple diet.

The fiber content of amaranth is three times that of wheat and its iron content, five times more than wheat. It contains two times more calcium than milk. Using amaranth in combination with wheat, corn or brown rice results in a complete protein as high in food value as fish, red meat or poultry.

In India, it is consumed both as a vegetable and as a grain all over the country. In the hills people believe that they get their strength from eating amaranth every day. The amaranth is one of the best sources of carbohydrates, protein, minerals, essential micronutrients and fibre.

The FAO (Food and Agriculture Organisation) recommends that equal quantities of amaranth flour and wheat mixed together give adequate nutrition. Furthermore, 12.7% amaranth flour added to maize satisfy the protein lipid need of young children and provide up to 90% of the diet



Protein Value score for Amaranth in comparison with other foods (Score of 100 considered ideal)

Food	Score	Food	Score	Food	Score
Amaranth	75	Barley	62	Cow Milk	72
Wheat	60	Soya Bean	68	Ground Nut	52
Maize	44				

Source : Lehmann (1992)

energy. Supplementation of cereals flour with amaranth can provide up to 70% of the diet energy.

India's most critical health problem: Nutritional anaemia

Nutritional anaemia, or insufficient iron in the diet, affects almost half the Indian population, and more than 70% of children and pregnant women.

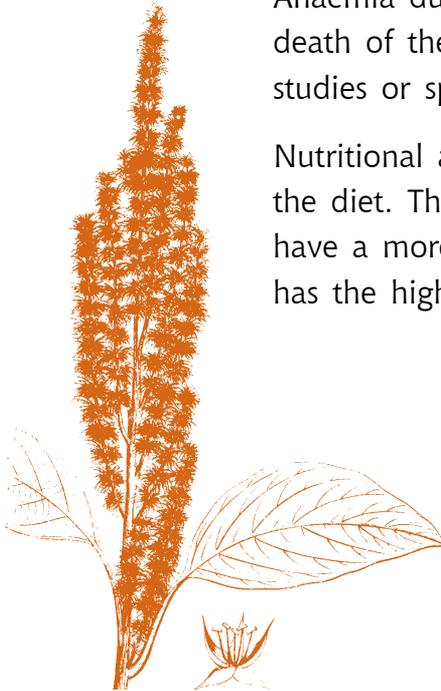
All body cells live and function in the presence of oxygen. Iron is essential for carrying this oxygen to the various cells. People who lack enough iron, are pale, get tired easily, and become extremely vulnerable to infections and other diseases.

Anaemia during pregnancy leads to premature babies, weak babies, and death of the mother. Anaemic children cannot concentrate on either studies or sports as they feel weak, tire easily, and fall ill often.

Nutritional anaemia is best and most cheaply treated by increasing iron in the diet. The leaves of the amaranth contain more iron than spinach, and have a more delicate taste. Besides rice bran, the grain of the amaranth has the highest content of iron amongst cereals.

1kg. of amaranth flour added to 1kg. of refined wheat flour, increases its iron content from 25mg to 245mg.

Thus adding amaranth flour to wheat/rice flour is a cheaper and more healthy way to prevent nutritional anaemia, rather than buying expensive tablets, tonics, health drinks, branded flour and breakfast cereals fortified with iron.





Amaranth: The answer to calcium deficiency

Calcium is essential for the proper growth and maintenance of bones, particularly for infants, children and teenagers, and older people (especially women) for preventing osteoporosis, which makes bones brittle.

The amaranth grain is about the richest source of calcium, other than milk. The amaranth is also an excellent source of phosphorus compared to milled rice.

Name	Protein (g)	Fat (g)	Minerals (g)	Carbohydrates (g)	Calcium (mg)	Iron (mg)
Amaranth	4.0	0.5	2.7	6.1	397	3.49

Source: Nutrition Foundation of India

Adding amaranth flour to regular flour increases not just its calcium content, but the whole mineral content of the flour, making it richer in iron, phosphorus and calcium.

Amaranth: The affordable answer to protein-energy malnutrition

The amaranth is extremely rich in complex carbohydrates and in proteins. It has 12-18% more protein than other cereals, particularly lysine - a critical amino acid. It also differs from other cereals in that 65% is found in the germ and 35% in the endosperm, as compared to an average of 15% in the germ and 85% in the endosperm for other cereals. When amaranth flour is mixed 30:70 with either rice flour or wheat flour, the protein quality rises from 72 to 90 and 32 to 52 respectively. The amaranth starch granules are much finer than those of other cereals, making it extremely suitable for custards, pastes and salad dressings. Ordinary flour mixed with amaranth flour provides



a nutritionally superior source of protein and energy that can satisfy a good portion of the protein requirement of young children, and provide approximately 70% of diet energy.

Amaranth - unparalleled aid to digestion

The oil in the amaranth is unsaturated, and is particularly rich in linoleic acid, which is essential for human nutrition. It also contains tocotrienols - forms of vitamin E, which is good for skin, general health and for lowering cholesterol levels.

Fibre is essential for proper digestion. Both the grain and the leaves of the amaranth have very high fibre content compared to other common cereals and pulses. The high fibre and nutritional content in the amaranth makes it an ideal food for weight watchers.

Adding amaranth to regular flour makes

- Nutritional sense because it adds essential minerals like iron and calcium, as well as increases the protein and energy value of regular flour.
- Economic sense because all this extra nutrition comes at a price far lower than branded flours, which may be fortified with just one of the essential nutrients.
- Health sense because packaged branded flours need to have chemicals added to prevent pest infestations during the long shelf-life.
- Equity sense, because adding amaranth to regular flour can be done very cheaply at chakkis, ensuring that the livelihood of the chakki workers as well as the chain of small traders and middlemen stays intact.



Buckwheat (*Fagopyrum esculentum*)

Punjab: Kala Trumba, Chin, Kathu, Bra, Tsubri, Phapra; Hindi: Kotu, Kuttu, Phaphra; Kumaoni: Gangari

Buckwheat is a psuedocereal used as a food and is grown usually in the Himalayan high altitudes. Eastern Himalayas is one of the centres of diversity of this crop.



This pseudocereal owes its name “buckwheat” to the fact that its grout resembles the beechnut in shape and color; buckwheat actually comes from the anglo saxon “buck” (Beech) and weite “wheat”.

Origin and distribution

It is a native of Central Asia and it was domesticated and cultivated around 6000 BC. From there, it spread to Europe and Russia in the 14th and 15th centuries, and was introduced in the United States by the Dutch during the 17th century.

Buckwheat is widely produced in Russia and Poland, where it plays an important role in their traditional cuisines. Other countries where buckwheat is cultivated commercially include the United States, Canada, and France, the country famous for its buckwheat crepes.

Description

It is a herbaceous plant, with a knotted stem a foot or two in height, round and hollow, generally green, but sometimes tinged with red, lateral branches growing out of the joints, which give off alternately from opposite sides, heart-shaped, or somewhat arrowshaped leaves, and from July to September, spreading panicles of numerous light freshcoloured flowers, which are perfumed. They are dimorphic, i.e. there are two forms of flowers, one with long styles and short stamens, the other with short styles and long stamens and are very attractive to bees. The seeds are pointed, broad at the base, and triangular to nearly round in cross section. They vary in size in different kinds from about 4 mm at maximum width and 6 mm. long to 2 mm. wide and 4 mm. long. The seed consists of an outer layer or hull, an inner layer, the seed coat proper, and within this a starchy endosperm and the germ. The nut (so-called 'seed') has a dark brown, tough rind, enclosing the kernel or seed, and is three-sided in form, with sharp angles.



Varieties

As all Nature's gift, this plant too comes in more than one form. Three species and four varieties of *Fagopyrum* are recorded from Uttaranchal. Of these three are cultivated, whereas one is found wild.

Fagopyrum esculentum, is also known as *Ogal*, in the local language in Uttaranchal and Himachal Pradesh. In Hindi it is called as Kotu. This is cultivated throughout the submontane to montane Himalayan region of



India. Leaves and young branches are made into vegetable, as well as snacks. Flour of the grain is used as a substitute of wheat.

Fagopyrum taticum, which is known as *Phaphar* is considered a little inferior to *Ogal*. Young leaves are consumed as vegetable. Young plants are also used as pot-herb. Decoction of grains with hay is often given for colic pain.

Fagopyrum sp. locally known as *Chabri* is mostly used as a vegetable. Leaves are dried and kept for the dry season. It is also found wild.

Fagopyrum dibotrys known as *Banogal*, *Kanjolya* or *Phaphrya* is a wild variety of *Kotu*, which is used commonly for vegetable. Leaf paste is also applied on insect bites.

The grains can be grey, brown or black. The soft white kernel is enveloped by a dark hard hull high in lysine content, a rich amino acid.

Buckwheat varieties conserved by Navdanya are:

Ogal-1 brown black
Ogal-2 brown red

Lalaangi Ogal-1
Lalaangi Ogal-2

Agronomy

Buckwheat grows quickly, with a 30-day maturity rate. This allows it to kill off most weeds that would compete for its resources. This fast growing characteristic also makes it a good candidate for a catch

crop where other crops fail and helps it fit well into rotations. It is quite economical to produce, as it requires no pesticides and very little fertilizer. It virtually requires no care from sowing until harvest, however preparation of a fine seedbed is very important. Buckwheat is typically seen as a cover crop or rotational crop.

It can grow even in poor soils and since buckwheat naturally eliminates weeds it is often used to prepare the soil for organic crops. Not only will buckwheat suppress weeds, it can also add up to 3,000 pounds of organic material per acre when it is tilled back into the soil.

Buckwheat is a relatively low input crop with relatively high yields even in marginal soil. It adds nutrients to the soil thus making it a good cover crop or rotational crop. The yield varies from place to place depending upon the local agro climatic conditions. In fields, the yields were recorded in between 7-10qtl / acre.

Most of the buckwheat grain utilized as food for humans is marketed in the form of flour. The flour is generally dark colored due to the presence of hull fragments not removed during the milling process. Buckwheat flour is used primarily for making buckwheat griddlecakes, and is more commonly marketed in the form of pancake mixes than as pure buckwheat flour. These prepared mixes may contain buckwheat mixed with wheat, corn, rice, or oat flours and a leavening agent. Buckwheat flour is never produced from tartary buckwheat because of a bitter taste that makes it undesirable as human food.

Some buckwheat grain is utilized in the form of groats (that part of the grain that is left after the hulls are removed from



the kernels). The product may be marketed as whole groats, cracked groats, or as a coarse granular product. These products are used for breakfast food, porridge, and thickening materials for soups, gravies, and dressings.

The cultural importance

The grain is one of the “phalahari” or foods that can be consumed during fasts. It is therefore always in demand at least during the two Navratras, not to speak of the numerous other fasts. It is available in the plains as ‘kuttu’ with indigenous drug stores. Grain traders do not normally stock it. When tender, the plant is used as a green vegetable.

In the plains of India the flour is consumed during fasts. Several preparations are made using ‘kuttu’.

Health benefits and uses



Buckwheat is known as a nutritional powerhouse and has much potential for pharmaceutical and nutraceutical possibilities. Buckwheat has been used and will be better used as an important raw material for functional food production. Buckwheat proteins have unique amino acid (It contains all eight essential amino acids), vitamin E and almost the entire B complex spectrum and composition with special biological activities of cholesterol-lowering effects, anti hypertension effects and improving constipation and obesity by acting similar to dietary fiber and interrupting the *in vivo* metabolism. Buckwheat flour can reduce diabetes, obesity, hypertension, hyper-cholesterolemia and constipation.

Buckwheat flour and groats must be used fresh because their fat content is high and they soon become rancid. This poor keeping quality makes buckwheat products difficult to handle in the summer. Traditionally, most of the millets are stored in their husks and processed only when needed, because of its tendency to become rancid.

Buckwheat hulls have little or no feeding value, but they contain most of the fiber of the seed. They are sometimes combined with middling and sold as buckwheat feed or bran. The table given below shows the percent composition of buckwheat grain and its byproducts

Gastronomically, it is a very versatile ingredient; the grouts make lovely loaves or pilafs or can be added to stews and soups. The gluten free flour can be turned into muffins, breads, waffles, crepes or puddings, such as the Indian halwa. It also makes delicious vegetables fritters. In Italy buckwheat noodles are cooked with cabbage and potatoes. A polenta called polentenera is also made from the flour.

Percent composition of buckwheat grain and buckwheat byproducts						
Grain or byproduct	Moisture	Protein	Fat	Fiber	N-free extract	Ash
			%			
Whole grain	10.0	11.2	2.4	10.7	64.0	1.7
Flour, light	12.1	7.8	1.5	0.7	76.7	1.2
Flour, dark	11.7	15.0	2.8	1.1	67.7	1.7
Groats	10.6	11.2	2.4	0.6	73.7	1.5
Hulls	8.0	4.5	0.9	47.6	36.8	2.2

Source: Coe, M. R. *Buckwheat milling and its by-products*. USDA Circular 190. 1931.

Buckwheat flour is used for making “chillare” unleavened bread fried with ghee and also for crisp “pakora”. People in Himachal Pradesh prefer buckwheat for their own consumption although it is bitter in taste. They are of the opinion that it does not cause stomach ache and also helps in the smooth bowel movement, whereas sweet buckwheat is said to cause little stomach ache and its cultivation is done only for sale in the plains.

In Japan, the flour is used to make noodles called ‘soba’. In Europe and North America buckwheat flour is generally mixed with wheat flour to prepare pancakes, biscuits, noodles, cereals etc. In Russia, they make soups and porridge from buckwheat.

The crop is also used as a source of honey production as it attracts bees.

Given its numerous therapeutic uses and its excellent nutritive value, buckwheat too deserves to be promoted as a food for the future specially since it has several avatars which can adapt to a diversity of food cultures.

The fact that this pseudocereal has withstood the competition from major cereals since five decades and is still cultivated in substantial area is testimony to its resilience, and its importance in local diets. Besides several complex social, cultural and economic considerations, are instrumental in the farmers’ decision to continue growing small and nutrition rich crops.

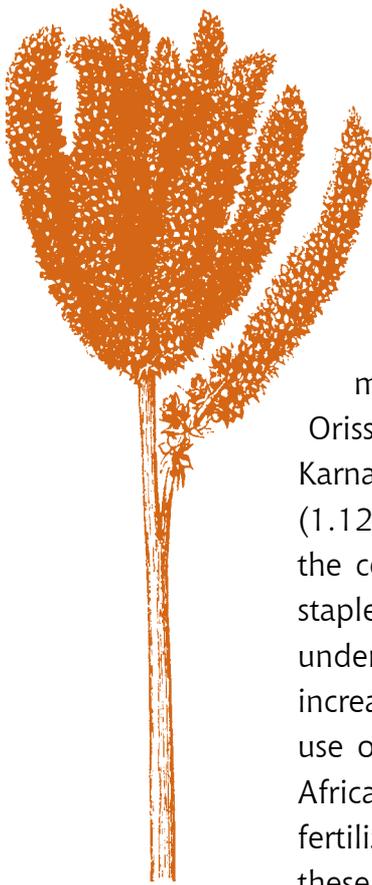




Small Millets

Finger Millet

Hindi: *Mandua, Madua, Maruya, Nagli, Kodu, Koda*; Marathi: *Nachani*; Kannada: *Ragi*; Tamil: *Kelvargu*; Telugu: *Ragulu*; Malayalam: *Koovarugu*; Bengali: *Martia, Modua*; Punjabi: *Mandal, Chalodra*; Sanskrit: *Rajika*



Finger millet was domesticated in Africa from *Eleusine coracane* subspecies *africana*, probably in the Ethiopian highlands. It was introduced to India more than 3,000 years ago. It is a tropical crop, growing from sea level to 3,000 msl. This is the most widely grown small millet in India and Africa.

Among the small millets, finger millet is the only millet in India which has been able to touch an average productivity level of more than 1 tonne per hectare. In India, the important finger millet growing states are Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Maharashtra, Bihar, Jharkhand and Uttar Pradesh, Uttaranchal. Karnataka is the major producer and accounts for 4% of the total area (1.12 million hectares) and 50% of production (1.23 million tonnes) in the country. A survey done in Central Karnataka shows that ragi is the staple food in 93% of the surveyed households. Even though the area under cultivation has decreased in the past decade, there is marked increase in productivity per hectare in the state. This is attributed to the use of certain hybrid ragi varieties developed by crossing Indian and African cultivars (this series of varieties is hence called INDAF), chemical fertilizers and some agronomic practices. Farmers are of the opinion that these varieties yield more but are not tasty and nutritious enough and



don't compare well with the traditional varieties. Besides, these new varieties have to be grown in pure stands and therefore not suitable for mixed cropped fields of the Deccan area. The farmer's views are reflected in the local village market, where the grain of traditional varieties sells at a higher price. The stem of the new ragi varieties is thick and hard and hence has very low fodder value.

Ecological requirements

Ragi is grown as a dry crop in regions where the rainfall ranges from 20-35 inches. In region of higher rainfall like in the Western Ghats of Karnataka, ragi can be grown only in the uplands, where water drains out well. In these regions, seeds are sown or transplanted a little after the full force of S-W monsoon is over. There are varieties which can tolerate heavy rainfall. The yield of ragi under rainfed conditions is positively correlated to the total rainfall during monsoon months. Ragi is the grain crop of the red lateritic and loamy soils. Heavy black cotton soil is not suitable for ragi. It grows well on deep soils free of stones and gravel. The root system of the plant is remarkably extensive, though somewhat shallow. Sometimes ragi is grown on clayey soils also.

Morphology

Ragi is a robust free tillering, tufted, annual grass. It has a laterally flattened stem and round nodes. The plants may be 40-100 cm high, 4-12mm thick, bearing numerous leaves. The leaf blade is acute. Earheads are borne at the end of a stalk on each tiller. The earhead consist of

a whorl of finger-like spikes, 2-8 in number in which the spikelets are arranged closely on both sides of a slender rachis, 2-4 inches in length. Fruits are 4-7 per spikelet, globose, smooth or rough, varying in colour from orange-red, reddish brown, dark brown, to nearly black. Some white-grained varieties are cultivated in the Deccan and Central Himalayan regions. At maturity, the pericarp of the fruit appears as a papery structure surrounding the seed. 400-500 seeds weigh 1 gram. The seeds show prominently from between the glumes in the cultivated varieties, whereas in the wild species *Eleusine indica* and *E. aegyptiaca*, which are often found as weeds in the ragi fields, the grains are smaller and are well enclosed in the glumes.

With regard to the duration of the crop, the varieties are distinguished as early, medium and late maturing, the period ranging from 3-5½ months. The earheads are broadly of two types-those in which the spikes are curved inwards and have a compact appearance and those which are straight and the earheads have an open appearance. There is another type in which the spikes are branched, short and thick, somewhat like a cockscomb. The colour of ears and plants can vary from green, purple or deep violet, depending on the variety.

As regards yield, the open types are as a rule, higher yielding than the compact types, and the long duration varieties are better than the short-duration varieties. The open types with the long spikes are however liable to shed the grains and to be brittle, the spikes breaking during harvesting, carting and stacking. In spite of their smaller yield the compact types are preferred as they don't have the above disadvantages.





Preparation of the field

The land for ragi is prepared as thoroughly as possible. The first ploughing is done immediately after the harvest of the previous crop. Where the soil becomes too hard to plough, at least a shallow stirring up should be given by means of a harrow. This enables the first shower to soak into the soil making the succeeding ploughing easier. Using a toothed harrow, the uprooted weeds are gathered and removed from the field or burnt in the field. Manure is now spread and mixed by ploughing the land two or three times. The seed bed is usually very thoroughly prepared and looks exceedingly clean and in very good tilth. Immediately prior to the sowing, the field is worked with a light wooden-toothed harrow and the surface made quite fine and level.



Manuring

In the Deccan area, especially Karnataka, ragi is the main food crop of the farmer. Ragi fields are manured to the fullest capacity and further supplemented in various ways such as by adding tank silt, fertile red soils as well as by penning sheep in the field. The amount of cattle manure applied may vary from 15-20 cartload/acre which may be supplemented by another 15-20 cartloads of silt or red earth. Additional cattle manure may be applied in the furrows along with the seed while sowing. Oilcakes are also applied after the early maturing intercrops are harvested from the ragi fields. Green manure crops like sunnhemp or one of the pulse crops, if sown early enough and ploughed in when the land is being prepared

for ragi, has been found to improve the fertility of the soil and the crop yield considerably.

Sowing

Ragi is sown broadcast, in rows through seed drills, in shallow furrows, or may be transplanted from nursery beds. There are seed drills which can sow 3, 6 or 12 rows, depending on the number of types. The rows may be 5-10 inches apart depending on the type of drill. The seed drill is attached to the bullocks with a pair of light yoke poles.

Three persons work at the drill—one to drive the bullock, one to sow the grain and one to sow the mixed crops like rice, castor, groundnut, field bean, foxtail millet etc. Sometimes ragi seed is mixed with dry powdery cowdung and sown directly into the furrows or using a seed drill. The seed rate for broadcast-sown ragi is usually 5-6 times the necessary quantity.



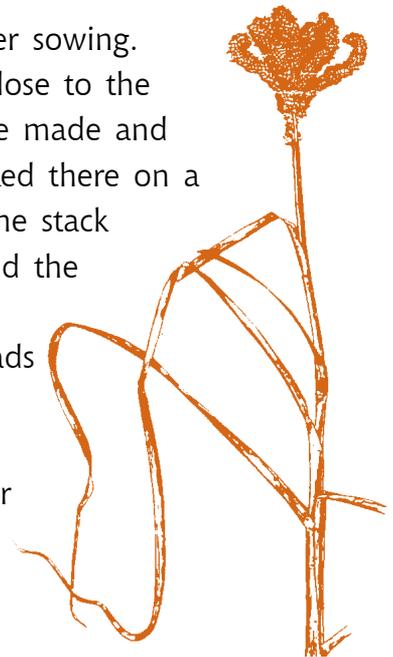
Mixed cropping

In the Deccan area, pigeonpea or field bean and a few rows of fodder sorghum is usually sown in the ragi field. The sorghum is harvested by September. Along with the above-said crops, a few rows, or just a sprinkling of other crops like mustard, cowpea, other millets like small millet (*Panicum sumatrense*) pearl millet (*Pennisetum typhoides*) etc. are sown. Niger, an yellow-flowered oilseed is usually sown on the borders of ragi fields in the Deccan. This is believed to keep away pest from attacking ragi.

In the mid altitudes of the Central Himalayas, the gorgeous, tall grain amaranths are sometimes sown mixed with finger millet. In this area, the millet is sown together with upto twelve crops in the same field. These crops include pulses, condiments and other cereals. These fields are locally known as “baranaja”. The grain has to be sown very shallow, at depths not exceeding 1 to 1½ inches. Ragi seeds sprout readily in 3-4 days. Thinning is done from the fifteenth day after sowing. After thinning twice or thrice at one week interval, weeding is done using hand tools, and this completes the work on the field till harvest. If the crop is growing over luxuriantly, bullocks are let into the field for a light grazing, by which the excessive growth is kept down.

Harvesting and threshing

Ragi is ready for harvesting in about 4-5 months after sowing. Harvesting is done using sickles. The plants are cut close to the ground so as not to waste any straw. Small stacks are made and the harvest is carried to the threshing floor and stacked there on a wooden platform raised on stones. Ragi remains in the stack for a month or two until the dewy season is over and the weather warms up by about the middle of February. In some regions like the hills of U.P., only the earheads are harvested. Threshing is done by beating out the grains with sticks or brick-bat shaped wooden blocks, by treading out the grains under the feet of cattle, or by working a stone roller over the sheaves. The straw from the threshing done by cattle is softer



and is better relished by cattle than the straw from threshing using stone roller.

Yield



The yield of dryland ragi in India on an average in a good season is 600-800 kg/ha, but yields over 5000 kg/ha have been recorded. The irrigated crop yields nearly double that of the rainfed crop. A threshed yield of 1800 kg/ha is regarded as a good average yield. The unthreshed earheads produce 80-85 % grains. The straw of ragi is considered to be highly nutritious fodder and is carefully put up in large well built stacks. About a ton of straw is normally obtained from an acre. The straw from traditional ragi varieties were found to yield considerably larger quantities of fodder, having a higher percentage of digestive organic matter compared to the modern varieties. Another interesting observation is that the digestibility and fibre content decreases with the increasing application of NPK fertilizers.

Storage of grains

Ragi grain is preserved in ordinary earthenware receptacles like other grains, and to a great extent in underground pits excavated suitable areas within the village limits, or in selected fields. Such storage pits should be on dry and high ground with no chance for any water to percolate inside. They are dug in the shape of a huge pot with a narrow neck. The pit may be 7-8 ft deep, sufficient to hold 2-2.5 tons of grains. The size of the pit varies according to the requirement. The walls and floor of the pit are smoothed and plastered with cowdung-mud plaster and lined

with loose straw or twisted straw. The pit is then filled and neck plugged well with a heavy stone slab. The slab is then covered with earth to form an inconspicuous mound. According to the villagers, ragi can be kept for upto 50 years in such pits without damage. But if moisture gets in the seed may undergo fermentation and develop poison. Pit storage used to be widely prevalent in the Deccan area, but is now getting replaced by earthen ware, metal or wicker storage bins.

Given below are some locally popular indigenous varieties of millets.

Finger millet diversity

Finger millets varieties conserved by Navdanya are:

Pankhaliya	Kaddi ragi-2	Karikaddi ragi-7	Karigidda ragi-10
Dunkhiya	Kaddi ragi-3	Karikaddi ragi-8	Karigidda ragi-11
Madua-1	Kaddi ragi-4	Karikaddi ragi-9	Karigidda ragi-12
Madua-2	Kaddi ragi-5	Hullupore ragi-1	Karigidda ragi-13
Madua-3	Beddalu ragi-1	Hullupore ragi-2	Karigidda ragi-14
Madua-4	Beddalu ragi-2	Hullupore ragi-3	Karigidda ragi-15
Madua-5	Beddalu ragi-3	Natti ragi-1	Ananda ragi
Madua white-1	Poorna ragi-1	Natti ragi-2	Udurumallige ragi
Madua white-2	Poorna ragi-2	Doddakaddi ragi-1	Muruthingala ragi
Madua Brown	Poorna ragi-3	Doddakaddi ragi-2	Iyyana ragi-1
Madua Fine Brown	Kalyana ragi-1	Karigidda ragi-1	Iyyana ragi-2
Madua Black Pink	Kalyana ragi-2	Karigidda ragi-2	Pedda ragulu-1
Madua Tirakhiya Pink	Balepatte ragi	Karigidda ragi-3	Pedda ragulu-2
Madua Black White Mixed	Karikaddi ragi-1	Karigidda ragi-4	Gidda ragulu
Madua Bhadail	Karikaddi ragi-2	Karigidda ragi-5	Karimurudga-1
Madua Black	Karikaddi ragi-3	Karigidda ragi-6	Karimurudga-2
Jhaalurya	Karikaddi ragi-4	Karigidda ragi-7	Dodda ragi-1
Madua Fine Grain	Karikaddi ragi-5	Karigidda ragi-8	Dodda ragi-2
Kaddi ragi-1	Karikaddi ragi-6	Karigidda ragi-9	Putta ragi

Hainu ragi-1
Hainu ragi-2
Jenugoodu ragi-1
Jenugoodu ragi-2
Hullu ragi-1
Hullu ragi-2
Hullu ragi-3
Biligidda ragi
Sannakaddi ragi-1
Sannakaddi ragi-2
Sannakaddi ragi-3

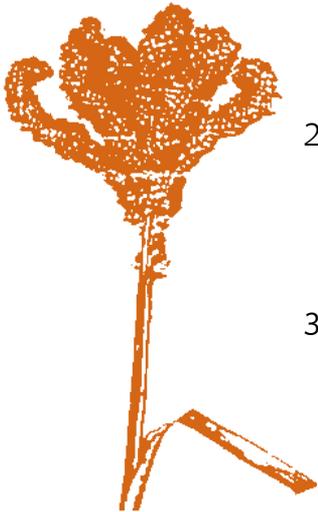
Sannakaddi ragi-4
Sannakaddi ragi-5
Sannakaddi ragi-6
Sannakaddi ragi-7
Sannakaddi ragi-8
Sannakaddi ragi-9
Sannakaddi ragi-10
Sannakaddi ragi-11
Sannakaddi ragi-12
Sannakaddi ragi-13
Sannakaddi ragi-14

Sannakaddi ragi-15
Sannakaddi ragi-16
Hasarugidda ragi-1
Hasarugidda ragi-2
Hasarugidda ragi-3
Hasarugidda ragi-4
Hasarukaddi ragi-1
Hasarukaddi ragi-2
Hasarukaddi ragi-3
Hasarukaddi ragi-4
Hasarukaddi ragi-5

Hasarukaddi ragi-6
Hasarukaddi ragi-7
Hasarukaddi ragi-8
Kari ragi
Majjige ragi
Shakti
Jenumuthige
Bondada ragi

Karnataka

1. Majjige ragi-pest and drought resistant. Duration-100 days. Since the variety matures early, it evades any prolonged drought conditions during monsoon. Colour of grain white, which gives the variety its Kannada name, meaning ragi with the colour of buttermilk. Short plant. Good grain yield. Fodder yield moderate as the plant is short. Can be grown irrigated or rainfed.
2. Kari kaddi ragi-tolerant to drought conditions. Duration-128 days. The leaf and stem joints are dark-coloured. Number of tillers upto 25. No pest problem observed. As the plants height is around 90 cm, this variety is a good fodder. Grain yield comparable to HYVs.
3. Muru thinglau ragi-good resistant to drought and pests. Duration-around 90 days. This variety matures early and hence is suitable for areas receiving erratic rains. Even in years of scanty rains, gives note-worthy yields. Under favourable conditions, yield comparable to HYVs. Good fodder yield.



4. Mitta ragi-drought resistant. Duration-112 days. Need timely rains in the initial stages of growth. Grain and fodder yield good. As the grain colour is light, the variety fetches a higher price.
5. Uduru mallige ragi-drought and pest resistant. Duration-115 days. Suitable for both irrigated and rainfed conditions. Grain and fodder yield good.
6. Kari gidda ragi-drought and pest resistant. Resembles kari kaddi ragi except for the smaller, rounded earheads. Good grain yield.
7. Kari murudga ragi-highly resistant to pests and tolerant to drought. Early maturing. If the rains are good,gives a high yield. Fodder yield moderate.



Garhwal

1. Pankhaldya–duration-150 days. The earheads branches are long, narrow, strap-like, open, often downcurved, resembling wings. Grain colour white or orange-red, depending on the local varieties. Height of the plant 105-110 cm. 4-5 earheads/plant.
2. Maneen-duration-around 130 days. Resembles the above variety except that the earhead branches are pointed up straight. Grain colour-orange-red. Grain yield high.
3. Dundkiya lal-duration-145-150 days. The earhead has the appearance of a closed fist. Grain colour-maroon brown. 5-6 ears/plant.
4. Dundkiya safed-duration-145-150 days. Earhead description as above, but the grain colour white. 5-6 ears/plant.

5. Jhalyuriya-duration-around 130 days. Plant body dark coloured- usually violet-tinged. 4-5 ears/plant.

Besides these, there are many open and closed-eared varieties whose grain colour vary from white, deep orange, brown, reddish-brown, maroon-brown to black. The size of the grain also shows considerable variations. Some of the white-grained, closed-eared dundkiya varieties have large grains and the tip of the earheads branches may be strongly curved in.

Processing and food preparations

Among the small millets, ragi is unique in having a hard seed coat and a soft endosperm. Efforts to debarn have not been successful and hence it is pulverised and used in the form of whole meal for various food preparation. Ragi is still ground into flour using stone grinders in many villages. The meal recovery from the millet is 80% compared to 55% in maize, 65% in sorghum and 75% in pearl millet. The loss of riboflavin and thiamine also was found to be negligible in ragi compared to the 90% loss in the case of maize. The flour contains most of the coloured bran and this enhances its fibre content. Traditionally, this millet is consumed in the form of mudde (thick porridge or dumpling), roti or ambali (a thin porridge)

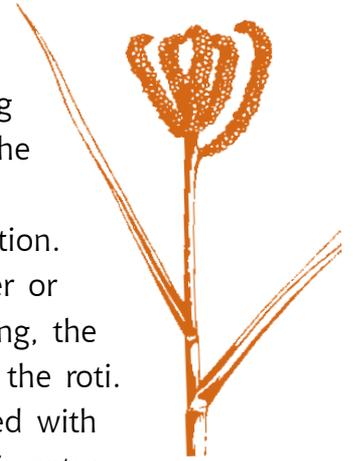


Ambali

This thin porridge is prepared by soaking the flour overnight in water or butter milk and cooking it the next morning. This facilitates mild fermentation and improves its flavour and taste.

Roti

Made from the well-kneaded dough prepared by adding boiled water to the flour. It should be possible to roll the dough into a thin sheet, should swell while baking and retain its soft texture even after a few hours of preparation. Small portions of the dough is rolled using a hand roller or flattened by hand and baked on a hot pan. While baking, the top part is wetted with cold water to avoid cracking of the roti. In the Central Himalayas, the flour of the millet is mixed with wheat or amaranth flour and made into rotis. The roti is eaten with vegetables, legumes or meat.



From the coarse-ground grains, upma is made by boiling and then seasoning. From the fermented batter, the thin pancake, dosa and the steamed cake, idli are made. The wetted flour mixed with rice or wheat flour and coconut scrapings called pitta is very tasty and filling, and is a favourite food in SriLanka.

Ragi develops a highly agreeable flavour on popping. Popped grain flour is now produced and marketed at cottage industry level in some places in the ragi belts. The flour blended with puffed chickpea or roasted green gram flour forms a nutritive food. Popped ragi flour mixed with jaggery and milk is relished in Karnataka. This sweet dish made during festive occasions is called *hurihittu*.

Malting

Malting of ragi is a traditional process followed in India, mostly to make infant foods and milk-thickener formulations. Popularly known as 'ragi malt', several brands are marketed in South and Central India. A weaning food preparation named Malted Weaning Food based on ragi and green gram developed at the Central Food Technology Research Institute, Mysore has been accepted very well and is being manufactured and marketed by small scale entrepreneurs.



Barnyard Millet (*Echinochloa colona*)

Hindi: *Jhangora*; Tamil: *Kuthiravaali*; Bengali: *Shama*

Two species of *Echinochloa* are grown as cereals. The Japanese barnyard millet, *E. frumentacea* is native to temperate Eurasia and archaeological records show that it was domesticated in Japan about 5000 years ago. *Echinochloa* is widely distributed in the tropics and sub-tropics of the Old World. Intestinal contents of mummies excavated in Egypt included among other plant remains, recognizable grains of *E. colona*. It was domesticated in India. *E. colona* differs from *E. crusgalli* in having smaller spikelets with membraneous glumes.

Morphology



Plants are slender to robust, tufted and 50-242 cm tall. Stems are smooth and shining, producing tillers and branches. The internodes are hollow. The leaf blades are linear, gradually tapering to a fine point, 10-42 cm long and about 2-3 cm wide at the base. Towards the tip, the leaves have finely toothed margins. The inflorescence is a panicle slightly bent at maturity, often tinged purple, with ridged, rough stalk bearing upto 15 lateral branches. The branches at the tip of the earhead are often in curved. The flowers have 3 stamens with purple anthers. Mature grains are enclosed in white, shining, hardened, two-lobed husk. Grains are 2-3 mm long and 1-2 mm wide, rounded at the base and pointed to the tip.



Cropping practices

Barnyard millet remains an important cereal only in the tropics and sub-tropics of India. In India, it is cultivated in Uttarkhand, Madhya Pradesh, Maharashtra, and Tamil Nadu. It is an important crop in Uttarkhand, where it occupies around 2,30,000 hectares almost equally divided between the hills and the plains. Barnyard millet is grown as a kharif crop under rainfed conditions. In the terraced fields in the hills of Uttarkhand, the crop is grown during kharif in shallow soils with low moisture-holding capacity. To provide adequate moisture throughout the growth period, sowing is done at the earliest opportunity. Sowing done from March-May is found to give reliable, good yields whereas; when sowing was delayed till the middle of June, there was a reduction in the yield. Studies at Kanke in Bihar revealed that sowing at the onset of monsoon gave the highest yield.



As this millet has high tillering ability, small variations in planting density does not affect the yield considerably. A trial conducted at Almora showed that there was no difference in yield due to variation in row spacing from 10-25 cm. Thus a population range of 1,33,000 – 5,00,000 plants per hectare results in more or less similar yields.

Traditionally, barnyard millet is sown broadcast. Drilling the seeds in row spacing of 25 cm or transplanting was found to yield more than any other method. The seed rate is 7-10 kg per hectare.

It is essential to keep the field free of weeds from the initial stages of crop growth to get a good yield from barnyard millet. Drastic reduction in



yield has been observed when the weeds were left in the field for more than 30 days.

The crop matures in 55-100 days depending on the variety. On an average barnyard millet yields 700-800 kg grain/ha and 1000-1500 straw/ ha.

Rotation

One traditional crop rotation practiced in Northern India is finger millet-fallow-barnyard millet-wheat. Besides rotation like barnyard millet-pea-barnyard-millet-wheat or barnyard millet-chickpea were found to be advantageous for both yields and total returns. In the above said rotation in place of chickpea, lentil or finger millet also can be used. In the Central Himalayas, rainfed rice and foxtail millet are sown together with barnyard millet in the upland terraces. Vivekananda Parvatiya Krishi Anusandhan Kendra at Almora has developed varieties evolved through pure-line selection from local cultivars.

Barnyard millet diversity

Barnyard millet conserved by Navdanya are:

Jhangora-1	Jhangora-7	Syundya Safed-1
Jhangora-2	Jhangora-8	Syundya Laal
Jhangora-3	Jhangora-9	Jhangora safed
Jhangora-4	Jhangora-10	Jhangora Jhalya
Jhangora-5	Muthindya	
Jhangora-6	Muthindya Laal	

Garhwal

1. Jhangora jhalya- duration-150-160 days. Plant height-170-180 cm. The tip of the earhead branches are curved inwards, more so towards the narrow end of the earhead. Depending on the variety, ear colour may be green or purple-red. 7-8 earheads/plants. Straw yields quality fodder.
2. Jhangora syundrya-duration-150-160 days. Plant height-170-180 cm. There are purple-red and green eared varieties.
3. Jhangora muthindya-duration –about 150 days. Plant height-170-180 cm.

Besides these, there are other popular varieties like jhangora jaunsari, jhangora barik etc.

In Tamil Nadu, the millet is known by the name of kuthiravaali.

Food preparation

Dehusked grain of the millet is cooked like rice. Rice with fresh curd or dal is a favourite food in the hills of Uttaranchal. The grain is cooked with milk and jaggery on festival occasions.

Besides the tasty grain, this millet is grown widely for the highly nutritious fodder which is relished by cattle.



Foxtail Millet (*Setaria italica*)

Hindi: *Kauni, kangni*; Kannada: *Navane*; Tamil: *Tenai*; Telugu: *Korala*; Malayalam: *Thina*; Bengali: *Kakun*



Morphology

Foxtail millet is an ancient crop probably domesticated in Eastern Asia. It was known to the Chinese as early as 2700 B.C. It is essentially a crop of subtropical and temperate zones suited to low and moderate rainfall conditions of 500-700 mm. The main production areas are in Japan, China, India, and Eastern Europe. Comparative morphology suggests that the millet had spread to Europe and India soon after its domestication. In India, cultivation of foxtail millet is mainly confined to the lower Deccan Plateau, including the highlands of Andhra Pradesh, Karnataka, and Tamil Nadu, which accounts for about 90% of its area in the country. It is also grown in the Central Himalayan region upto 1830 msl and is an important food grain locally.

The millet is an annual grass attaining a height of 5 ft with a rather thin, leafy stem which bends down a great deal with the weight of the earheads. The leaves are narrow and are about 12-18 inches long ½ inch broad, light green in colour, linear and lanceolate. The flag leaf has long sheath with the leaf blade either shorter or longer than the inflorescence. The stalk of the inflorescence is long and slender. The inflorescence is a spike, which is long and drooping. The earheads may be 6-12 inches long

and ¾-1.5 inches in diameter and may or may not have thin, protruding bristles. The spikelets on the earhead are arranged spirally along the length and they are in clusters of 40-50.

Varieties differ in the height of the plant, in the length and appearance of the earhead and in the colour of the grain. They differ also in the duration of the crop, varying from 3-4 months. The grain are smooth and shiny and show a great variety of colours like yellow, white, cream, orange, red, purple, black, greenish-white, buff and so on. Variety names are generally descriptive of the colour of the grain and appearance of the earhead.

Cropping practices

Foxtail millet is mostly sown mixed with other crops like cotton, castor, pigeon pea, groundnut, finger millet, rice etc. It is also grown as a pure crop particularly in the black cotton soil, where it is followed by a rabi crop like coriander in favourable season, or by safflower or horsegram in years of scanty rainfall. In the foothills of Himalayas, the millet is grown with other kharif crops and matures in about 2 months. In Punjab, Himachal Pradesh, and Uttar Pradesh. It is grown from June-July to September-October either on the border of fields sown with other crops, or as a mixed crop with other kharif crops like barnyard millet.

In the red soils of Deccan, field bean (avare) is sown in rows in foxtail millet fields. Two row of the millet sown with one



sown of cotton was found to produce higher returns compared to pure crops. As this millet is a good soil binder, it is helpful in preventing erosion in the cotton fields.

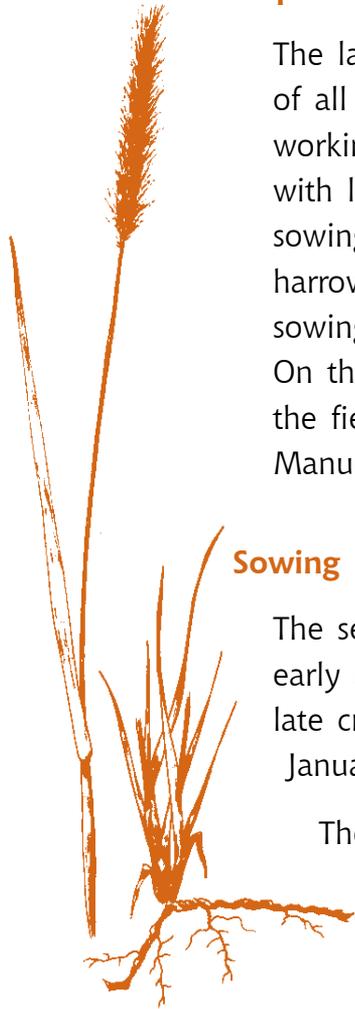
Preparation of the field

The land for sowing foxtail millet is thoroughly prepared. In the case of all soil types except black soils, two or more ploughing followed by working with blade harrows, gathering of weeds, cleaning up and leveling with light harrows or leveling boards are the operations preparatory to sowing. In the black cotton soils, 1 or 2 harrowings with a heavy-bladed harrow is done, followed by working with a light bladed harrow before sowing the seed. On the black cotton soils, manures are seldom applied. On the other soil types and especially where the crop is grown irrigated, the fields are manured with at least 5 cartloads of cattle manure per acre. Manuring is done also by penning sheep in the fields.

Sowing

The seed is sown broadcast or using drills. The sowing season for the early crop is May, for the rainy season crop is June-July and for the late crop, August-September. The irrigated hot weather crop is sown in January-February.

The seed rate per acre is 3.2-4.5 kg; the latter for pure stands and former for mixed sowing with cotton. When sown with finger millet and a mixed crop the seed rate is 0.5-1 kg per acre. If sown as a mixed crop with finger millet (ragi), foxtail millet



is sown in single or double furrows made by the plough at intervals of about 6 feet, after the ragi has been sown.

A fortnight after sowing, the crop is hoed once. Weeding is done once or twice. Depending on the variety sown, the crop is ready to harvest in 3-4 months.



Harvesting and threshing

Harvesting is done by cutting off the earheads alone. Earheads are kept piled up on the threshing floor for a week and then threshed by trampling under the feet of oxen, or by using a stone roller.

Yield

The yield of foxtail millet grown in pure stands is generally between 370-410 kg per acre on an average and may go up to 545 kg per acre under favourable conditions. Grown semi-irrigated, the yield may go up to 730 kg per acre.

Foxtail millet has great yield potential and the Chinese have claimed exceptionally high yields, sometimes exceeding 11,000 kg per hectare.

The straw is thin and delicate, and is relished by cattle. The straw yield may be 1000-2000 kg per hectare.

Early sowing in the monsoon was found to produce higher yield than later sowings. The longer duration varieties were found to give higher fodder yield when sown early.

Foxtail millet diversity

Foxtail millet diversity conserved by Navdanya are:

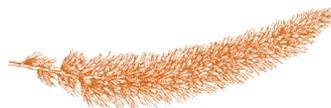
Kauni Safed-1	Hullu Navane-2	Gallada Navane-1	Bili Navane-5	Kempu Navane
Kauni Safed-2	Hullu Navane-3	Gallada Navane-2	Hejjame-1	Javari
Kauni Safed-3	Hullu Navane-4	Bili Navane-1	Hejjame-2	Local
Kauni Kaali	Hullu Navane-5	Bili Navane-2	Koralu-1 (local)	Local
Kauni Laal	Hullu Navane-6	Bili Navane-3	Koralu-2	Local
Hullu Navane-1 (Local)	Hullu Navane-7	Bili Navane-4	Jade Navane	

Garhwal

1. Kauni safed -duration-around 150 days. Plants height – upto 2 m. Seed colour off-white.
2. Kauni kala- duration-around 150 days. Plants height – upto 2 m. As the seed colour is blackish, the earheads have blackish appearance.
3. Kauni lal- duration-around 150 days. Plants height – upto 2 m. Earheads have a burnished orange-red colour when it nears maturity.

Uses

The grain must be husked before cooking to remove the glumes which on pounding detaches easily. The dehusked grain is transluscent yellow. The grain is cooked and eaten like rice either entire or broken. It is also made into sweet puddings and porridges. In Grahwal Himalayas the roasted grain with walnut kernel, Perilla and Sesamum seeds is a favourite food on long journeys. Foxtail millet grain has heating properties. In the Central Himalayan region, the rice of the millet cooked in water is mixed with buttermilk and is used in the treatment of chicken pox.



Kodo Millet (*Paspalum scrobiculatum*)

Hind: Kodra, Kodaka; Kannada: Harka; Tamil: Varaga; Telugu: Arikelu, Allu; Bengali: Koda; Punjabi: Kodra; Gurjari: Menya; Marathi: Kodra, Harik



Kodo millet is the coarsest cereal cultivated in India. The wild form, var, *commersonii* is common in damp places throughout the Old World. The crop was domesticated in India about 3000 years ago. It is grown in India from Kerala and Tamil Nadu in the south, to Rajasthan and U.P. in the North, and West Bengal in the east. Of the total area of about 2.1 million hectares under this crop in India, 1.3 million hectares are in Madhya Pradesh.

Morphology

The cultivated millet is a robust annual grass, upto 90 cm tall, suited to dry, marginal soil conditions. They grow to a larger size than the wild variety. The leaves are erect and stiff, 15-45 cm long and 0.2-0.8 cm wide. Inflorescence consists of two-or-more-stalked, alternate, spike-like racemes, with flattened rachis. Grain is enclosed in hard, horny persistent husks, which are difficult to remove.

Several types of kodo millet are recognized in India differing in crop duration, number or rows of grain on the ear and in grain colour. Light red-grained varieties are said to be sweet-tasting and the dark-grained ones are bitter.

The most common kodo millet variety is characterized by racemes with the spikelets arranged in two rows on one side of a flattened rachis. In most fields of Kodo millet, plants with irregularly arranged spikelets also occur. Two kinds of variants occur commonly. In one, the spikelets are arranged along the rachis in 2-4 irregular rows. In the other kind, the lower part of each ear has irregularly arranged spikelets, while the upper part of the ears are more regular 2-rowed.



Cropping practices

Kodo millet is hardy and drought-resistant, and is often grown on poor, gravelly marginal soils. The crop needs very little attention. Sowing is done in June-July. The seed rate is about 15 kg/ha. Sowing ten days before the onset of monsoon was found to give the highest grain and straw yield, compared to sowing done after the onset of monsoon. The crop responds well to farmyard manure application, showing an increase of 200 kg/grain/5 tons manure. It is a long duration crop (110-130 days), compared to other small millets.

Mixed cropping

The millet is sown mixed with other cereals like ragi and maize and oilseeds like niger, groundnut, sesame or soyabean. It has been found that the grain yield of the millet was higher when grown with green gram. In the Deccan, only one crop is raised in a year, and it is followed in the next year by horse gram or castor.

Harvesting is done in October-November. Threshing is done under the feet of oxen. The grain yield varies from 250-1000 kg/ha depending on whether it is grown mixed cropped, or in pure stands. The experimental trials conducted by the All India Co-ordinated Millets Improvement Programme over the years showed consistently good yields from kodo millets.

The seeds have excellent storage life of upto 100 years. The straw yield is only 1-2 tons/ha, the straw is poor fodder quality.

Food preparation

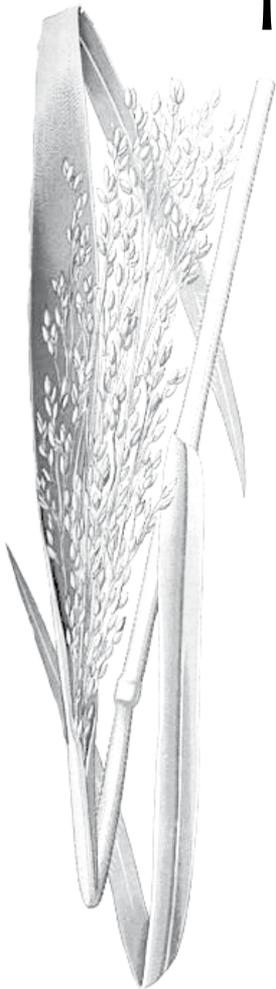
Due to its long storage life, the grain can be used as standby food in famine years. Traditionally, the grain is dehulled using a stone mortar and wooden pestle by which hard, horny seed coat is broken.

Parboiling of the grains has been found to improve its milling quality. The dehusked grain is cooked like rice. It is also parched and ground and the meal is made into a kind of pudding. Like ragi, kodo millet is also recommended as a substitute for rice to patients suffering from diabetes.



Proso Millet (*Panicum miliaceum*)

Hindi: *Barri, Cheena*; Kannada: *Baragu*; Tamil: *Panivaragu, varaga, Karcuny*; Telugu: *Varigalu*;
Bengali: *Cheedah*



The progenitor of proso millet is native to Manchuria. It has been cultivated in China since Neolithic times. It is a quick-growing, short duration cereal with low moisture requirements and has a wide range of adaptation to climates, soils and altitudes. Because of its quick maturity, it was cultivated by nomads. Proso millet has a wide range of cultivation which extends from Japan through China and Central Asia to South Russia, Central and Southern Europe, throughout Africa and parts of the American continent.

In India, the crop is grown in Andhra Pradesh, Maharashtra, Tamil Nadu, U.P. and Bihar. In Bihar, it is cultivated throughout the year, as a catch crop before the main kharif crop or after the rabi crop is harvested. In parts of Bihar, two quick crops may be taken during summer in March-June. Around 75,000 ha in Bihar is estimated to be under this crop. In Deccan, it is grown as an emergency crop when the season is past for sowing the main season food crops like ragi and sorghum.

Morphology

The plant is shallow rooted and erect, 30-100 cm high, usually with many tillers. The stem is hairy or smooth. Internodes are hallow and

cylindrical. Leaf blades are linear, lanceolate, 15-30 cm long and 0.2-2.0 cm wide. Inflorescence is a slender panicle, upto 45 cm long open or compact, sometimes drooping. Grains are enclosed by persistence glumes. The grains are about 3 mm long, white, yellow, orange-red, brown, grey or cream colored and are broadly oval and smooth. Highly evolved cultivars of proso millet have more or less compact inflorescences.



Cropping practices

The crop is usually sown broadcast. Under experimental conditions, line planting with 7.5 cm between plants and 22 cm between rows has been observed to give a good yield. This would need a seed rate of 10-12 kg/ha. For food germination, the seeds should be soaked for 24 hours in water and should not be planted deeper than 4 cm. Sowing dates vary from February-mid April. Studies have observed that optimum sowing time is mid March. In Deccan area, the crop is sown in October. Sowing is done using seed-drill in rows 9 inches apart and seeds are covered with a brush-harrow trailing behind the drill. In Deccan, broadcasting is done when on account of poor season, both preparatory cultivation and sowing have to be hurried through. In this area, the millet is inter cropped with castor, sorghum, green gram, pigeon pea etc.

In Central Himalayas, proso millet is sown immediately after the rabi crop of wheat is harvested. The crop is ready for harvest before rice is transplanted. In the rainfed fields, the millet crop is rotated with potato or some other vegetables, and then, wheat.

In the case of proso millet, shoot fly is a serious pest and grain eating birds can also be troublesome. During the grain maturation phase, it is usual to have children in the fields seated on raised platforms to scare the birds away by making noises, or occasionally catapulting stones.



Threshing

The crop is ready for harvest in 60-90 days depending on the variety. The plants are cut at the base or pulled by the roots and are brought to the threshing ground. As the crop sheds badly, it is not stacked, but threshed soon after harvest. The grain is either beaten out or threshed under the feet of oxen.

Yields

The grain yield ranges from 2.8-605 quintals/ha under rainfed conditions and the straw yield is about 1 tonne/ha. Under irrigation, the grain yield was found to be almost double.

Processing and food preparation

Dehusking can be done using a stone grinder or in modern plate mills. The grain has a nutty flavour. The dehusked grain is cooked like rice and is eaten with curries. The flour from the dehusked grain is used as a substitute for rice flour in various snack foods. It can be used to make chappaties, Mixed with wheat flour, it can be baked into bread.

In terms of protein quality, proso millet is better than the other millets. The level of the essential amino acid lysine in the millet is comparable to that in rice or wheat, and ranges from 9-14% or more protein and 40% fat.

The grain should be ground before use as fodder, except for feeding poultry. It is also good fattening food for cattle, lambs, as well as for egg laying hens.

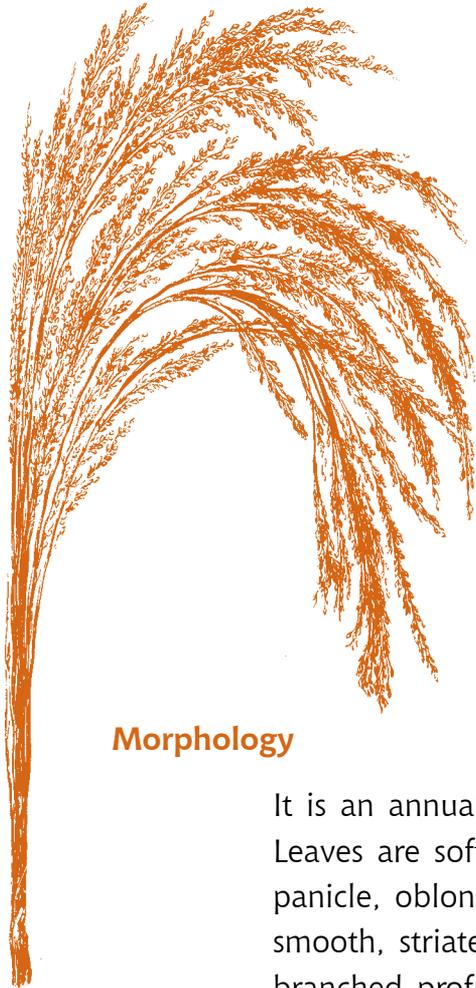
Among the characters indicating grain quality, the brightness of the endosperm denotes the presence of carotenoids. Varieties with bright yellow endosperm have higher amounts of carotenoids. These varieties are preferred in the areas where the crop is grown. The red-coated varieties are preferred in parts of Russia, because they offer protection from degradation of carotenoids under field conditions.

The millet is boiled like rice and eaten with milk and sugar, or with dal or curry, or as *mara*, prepared by slightly boiling the grains, parched in hot sand and then sifted from the husks. The *mara* is then eaten with sour milk. This preparation is a favourite food during marriage feasts. A porridge is also made from the dehusked grains. A *biriyani* is made from the millet in Sri Lanka. Many local sweets also have proso millet flour as an ingredient.



Little Millet (*Panicum sumatrense*)

Hindi: *Kutki, Gundli, Shavan*; Kannada: *Same, Save*; Tamil: *Chamai, Samai*; Telugu: *Samalu, Nella shama*; Malayalam: *Chama*; Punjabi: *Kutki*; Bengali: *Gondula*; Marathi: *Warai*



It is a highly tolerant crop to heat and drought stress as well as water logging. It is a quick growing, short duration cereal. As in the case of many other millets, its cultivation is restricted to tribal areas and marginal lands. It is remarkable for the ability to give a small crop even in years of famine. This millet is frequently grown as a monocrop, but is often mixed with other cereals, millets, pulses, or oilseeds. It is cultivated upto altitudes of 2100msl. It occurs wild in North India and SE Asia. In India, this millet is particularly important in the Eastern Ghats of India. It grown in India on 6,66,000 ha as a dryland crop on both black and red soils in kharif season, where annual rainfall is less than 750 mm.

Morphology

It is an annual, tufted grass with rather slender culms, 30-90cm high. Leaves are soft, upto 60cm long and 2.5 cm wide. Inflorescence is a panicle, oblong, 14-40 cm long, with erect hairy branches. Grains are smooth, striated, usually brown coloured. The inflorescence usually branched profusely.

Cropping practices

The seeds are often broadcast, and sometimes drilled with the onset of monsoon in the month of June. Field trials conducted by the Millets Improvement Programme over the years show that early sowing in June gave higher grain as well as straw yield compared to later sowing. This practice resulted in higher number of effective tillers and reduced the incidence of midge. Farmyard manure at the rate of 10 tons/ha was found to be advantageous. The crop matures in 2 1/2 – 5 months and yields on an average 225-560 kg/ha, which in a good season may go upto 900 kg/ha. The straw is a good source for roughage for cattle. As the straw is soft, thin-stemmed and leafy, it is relished by cattle. The average straw is 8-12q/ha. It is supposed to be poor in nutritional content. The production of little millet in the country is about 79,000 tonnes.

In Tamil Nadu, this millet is rotated with black gram, cowpea or sesame.

The husked grain is cooked like rice, or made into flour and mixed with other cereal flours.

Little millet conserved by Navdanya are

Same-1 local	Same-7 local	Hullu same	Bili same-2
Same-2	Same-8 local	Jade same-1	Bili same-3
local Same-3/Samalu	Same-9 local	Jade same-2	Bele same
Same-4 Local	Same-10 local	Jade same-3	Kari same-1
Same-5 local	Hejjame-1	Jade same-4	Kari same-2 save
Same-6 local	Hejjame-2	Bili same-1	Mungaru same



Job's Tears (*Coix lachryme-Jobi*)

Hindi: *Kauch-gurgur, Saukrau, Lechusa*; Bengali: *Gurgur, Kunch*; Marathi: *Kassaibija*; Nagar: *Re-si*

Job's tears occur wild in SE Asia and tropical Africa. It's likely that it was first domesticated in the region of Indo-China. It occurs as a weed in the plains of Punjab, and on the warm hill sides and valleys of the Himalayas. It ascends to 5000 ft on the Naga Hills in Assam.

It can be grown in tropics and subtropics, provided there is adequate rain and fertile soil. On poor soil in dry weather, hollow fruits may be produced. It can be grown from sea level to 1500msl in the tropics. With relatives of the plant often grow in swampy places.

Morphology

A robust, free tillering erect, glabrous annual, 1-2 m tall. Leaves are large, lingule short and membraneous. Leaf blade lanceolate, 20-45 cm long, 2.5-5.0 cm wide, with rounded base and a prominent midrib. Inflorescence in axils of upper



leaves or stalks, 3-6 cm long, hard, hollow, globular or ovoid, bead-like structure develop at the end of each peduncle from a leaf sheath. False fruit variable in size, shape, colour, and hardness, 8-12 mm long, containing the fruit. The pericarp of the fruit is dark red in hard-shelled forms, pale brown in soft-shelled, edible forms.



Cropping practices

Job's tears is grown under shifting cultivation as a rainfed crop by the hill tribes of tropical Asia from Assam to the Philippines. The crop is usually planted at the beginning of the rainy season at a depth of 10-15 cm/ha. The crop matures in 140-160 days. Normal yields are between 2000-4000 kg/ha of husked grain. The milling percentage is 30-50%.

Uses

The husked grain of this millet contains approximately: water-10.8%, protein-13.6%, fat-6.1%, carbohydrates-58.5%, fibre-8.4% and ash-2.6%. This millet constitutes an important food of the hill tribes in Assam and other Eastern Indian states. Involucres are papery in most cultivars allowing the ready removal of the grain. In Assam, the grain is ground into flour, and used to make bread, or a sweet dish is prepared by frying the grain and adding sugar. The whole grain is also eaten raw as a snack, or fermented to produce beer. In Burma, the grains are eaten parched like sorghum. The plants can be used for forage and fodder, and

the bran can be used as a substitute for wheat bran in feeding poultry. It is also used in folk medicine in Asia. The fruits of wild forms are used as beads and necklaces are made from them.





Major Millets

Sorghum *(Sorghum-bicolor)*

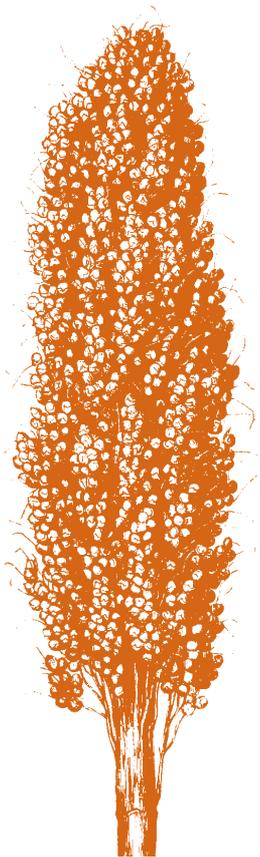
Hindi: *Jowar, Jawari*; Bengali: *Jowari*; Punjabi: *Jawar*; Tamil: *Cholum*; Telugu: *Jonna, Jonnalu*; Kannada: *Jola*; Malayalam: *Cholum*

Sorghum is the most important cereal in the world following wheat, rice and maize. It is a staple food in the drier parts of tropical Africa, India, and China. The greatest variability in both the wild and cultivated sorghums is in North-Eastern Africa. The crop is considered to have been domesticated in Ethiopia about 5000 or more years ago from wild sorghums.

Sorghums was brought to India around 1000 years BC through the old trade routes. From India, the crop traveled to China through the silk route. The crop is most extensively cultivated in the drier savannahs and grass lands of Africa, the plains of India, and the Southern Great plains of the United States.

Ecology

Sorghum is the crop par excellence for dry regions and areas with unreliable rainfall because of its drought-resistant capacities. It can tolerate temporary waterlogging also. Before the introduction of maize in Africa, the crop was grown much more extensively in East and Central Africa. Maize has the following advantages over sorghum-better taste, higher yield, requires less labour to grow, resistance to bird damage, better



storage properties etc. Nevertheless, the substitution can be dangerous in the border line areas for maize as it may result in serious food shortages or famines because these areas face the perpetual threat of drought.

The drought resistance of sorghum is due to the following morphological and physiological peculiarities:

- a) after sprouting, the plant grows slowly until the root system has become well-established.
- b) sorghum produces twice as many secondary roots as maize.
- c) silica deposits in the endodermis of the roots prevent collapse during drought stresses
- d) the leaf area is about half that of maize and hence water loss due to transpiration is half that of maize
- e) the leaves have a waxy coating and they roll inwards in times of drought
- f) sorghum requires only 20% less water than maize to produce the equal amount of dry matter
- g) sorghum can compete well with weed once it has become well established
- h) the plant can remain dormant during periods of drought and resume growth when conditions become favourable. This property is of great importance, permitting the production of grain even under conditions of limited or uncertain rainfall



Sorghum can tolerate a wide range of soil conditions. It grows well on heavy soils, especially the deep-cracking, valley-bottom and black-cotton soils of the tropics, even when subjected to temporary waterlogging. The crop grows equally well on light sandy soils. It can be grown in soils of pH from 5.0-8.5 and tolerates salinity better than maize. It will produce a crop on soils too poor for many other crops. Tropical cultivars may fail to set seed in high latitudes. Locally adapted varieties always flower towards the end of the rains and thus escape damage from moulds and sucking bugs which would have attacked them if they flowered early.



Morphology

The plant is a vigorous annual grass, 0.5-6.0 m in height with a robust, pithy cylindrical stem. Stem solid, usually erect, dry or juicy insipid or sweet, and 0.5-3 cm in diameter at the base. A large number of much branched lateral roots are produced which occupy the soil very extensively, mainly in the top one metre of soil and with lateral spread upto 1.5 m. The stem has a band of roots at the base of the plant which grow out through the leaf sheath to produce prop roots. Number of leaves vary from 7-24, depending on the cultivars. They are erect at first, later curving. The leaf blades 30-135 cm long and 1.5-13 cm broad. Leaf sheath 15-35 cm long, with overlapping margins, encircling stem, often with a waxy bloom. The leaf margins are flat or wavy. Midrib is prominent white or yellow in dry, pithy cultivars and green in juicy cultivars. The young panicle is forced up through the top most leaf sheath. The panicle stalk may be erect or recurved to give a pendant



head to varieties known as “goose-neck”. Central stalk of panicle may be long or short, with primary, secondary and sometimes tertiary branches bearing racemes of spikelets. The length of the main stalk and branches, and their closeness together determines the shape of the inflorescence.

The grain attain maximum dry weight 25-55 days after blooming and at this point contains 25-35% moisture; this is reduced to 15% during the next 10-20 days, after which the crop is harvested, the grain is usually covered partially by the glumes. Grain is rounded at the tip and bluntly pointed at the base, 4-8 mm in diameter and varying in size shape and colour with the cultivars. The seed coat comprises 6% of the total weight of the grain, and varies in colour from pale yellow, through various shades of red and brown to a deep purple brown. Dark coloured grains usually have a bitter taste. The outer endosperm may be hard and corneous, but whiter and more floury inside. One kg of sorghum contains 25,000-70,000 seeds.

Cropping seasons, practices

Sorghum is usually grown as a rainfed crop, but is also grown irrigated in parts of India. It is often grown in mixed cultivation with other crops. It is believed that sorghum sometimes depresses the yield of crops which follow it. This is probably due to nitrate depletion caused by the high sugar content of its roots or reduction in soil moisture. Hence, the crop which follows sorghum is usually heavily manured.

In Mysore area, sowing is done in three seasons. The earliest sowing is done in the first week of April, and the crop is cut by the middle of

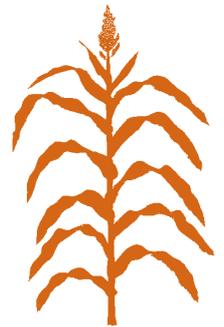
August. The second or main season begins about June and ends about the month of October. The third season begins about October and ends in the month of February. In addition to these is the hot weather crop which is grown irrigated. The season for this crop is from February to May.

Sorghum crop may be rotated with niger and horse gram in the case of early sowing on the red soils of Deccan. Sometimes a ploughed up fallow is followed in the second half of the year, after the sorghum crop. In the next season, ragi is sown in these fields. Groundnuts are also being grown in the above said rotation and in some areas, a sorghum-finger millet-groundnut rotation is being adopted.

In the main season, sorghum is grown mixed with other crops like pigeon pea, cotton, field bean (avare), cowpea, niger, horse gram, black gram, fodder sorghums, pearl millet, and even vegetables crops like brinjal, cucumber, chillies, etc.

After the main crop of sorghum, pearl millet is sown, except in the black cotton soils. In the black cotton soils, the rotation crop is cotton either pure or mixed with grain crop like foxtail millet. Short duration groundnut varieties are also grown at times in the rotation.

In addition to the ordinary cultivable land, many tank beds, which for lack of heavy rains are dry, either only partly over the greater portion of the normal waterspread, are sown with sorghum in this season. This is usually done on a co-operative basis by many households in village. The cultivation work and later on, the produce itself are suitably shared among the villages.



In the case of irrigated sorghum, sowing is done in early February or late January. Many crops enter into the rotation, such as groundnuts, chillies, sugarcane, rice, tobacco etc.

Preparation of the field

In the case of the earliest sorghum crop, the preparation of the field begins with ploughing of the field immediately after the harvest of the previous crop. The land is ploughed several times and is left in a condition almost fit for sowing. Where such ploughing is not possible, the ploughing begins early in April. In order not to miss an early rain when sowing is done, ploughing is even dispensed with altogether, and only plough furrows are drawn a foot apart and the seeds sown therein immediately. The inter-row space maybe worked later, leisurely. In the case of sorghum the preparation of the field is not very thorough and therefore contrasts notably with ragi, which requires very thorough preparation of land.

Cattle manure is applied at the rate of 5 cartloads/acre and mixed with soil by ploughing or harrowing. In the black cotton soils, land preparation is more thorough and carried out over a larger period of time. In these soils, about 7 cartloads of cattle manure/acre is applied. Some cultivars show seed dormancy for the first month after harvesting. The seed remains viable for considerable periods, provided it is properly stored. Under poor storage conditions, it is severely attacked by insects.



Seed rate

In very dry areas, the seed rate is 2-3 kg/ha, 5-7 kg/ha in more favourite areas, and 10-15 kg/ha when irrigated. Forage sorghums are planted close, unlike grain sorghums which are spaced wider. Seed dressing against smut can be done by mixing 5 kg seed with 4 ounces of copper sulphate dissolved in ½ gallon water. A more convenient treatment is by means of mixing sulphur powder with the seed.



Sowing

Before sowing, the ploughed field is leveled with a board. Sowing is done in rows either in the plough furrows or through seed drills. The drills usually have three tynes and sow three row at a time. The tynes are about 13 inches apart. The seedling appear above ground in about 7 days.

Crop protection

The crop begins to head out in 2 ½ months and from then onwards upto the harvest, it has to be watched against the ravages of birds which eat the grain both in the milk stage and the ripe stage. Perches are erected high in the fields, standing on which children set up a din to scare the birds away. Swarms which descent upon distant patches are shot with stones thrown from slings. The varieties of sorghum in which the earheads, are loose, open panicles are attacked less than those with compact earheads as the former does not give a good foothold for the birds descending on them. Varieties in which the earheads curve down

are attacked less. Long before the sorghum matures, the crop grown mixed with it like green gram, black gram, cowpea etc. are ready for harvest.

Harvesting and threshing

Depending on the variety sown, in 4-5½ months, sorghum is ready for harvest. Normally only one earhead is formed per plant. Harvesting is by pulling out the plants or by cutting them at ground level with sickles, or by removing only the earheads. The earheads are cut and carted to the threshing floor. Threshing is done by means of a stone roller after spreading the earheads on the floor, about 6 inches deep and 20 feet in diameter. Exceptionally large and well-filled ears are separated and kept aside for sowing next season. As the grains get separated during threshing, they are swept aside. The work is done through the cool hours of the night, because sorghum threshes well even if it is not dried well.



Storage

Sorghum is often stored in the earhead unthreshed. Grain, whether in the head or threshed, is susceptible to insect attack, which can cause considerable damage, compared to most other cereals. The seed for sowing in the next season is stored unthreshed in the head and hung in the smoke above open wood fires in the houses. The grain should be dried thoroughly before storage to reduce the moisture content to 10–11%. Storage of grain is usually done in earthen vessels or wicker baskets, plastered with cow dung. The grain in the bin is covered over with a two inches layer of sand, which restricts the movement of insects.

Yield

Yield of threshed sorghum per acre vary widely depending on the cultivar and location. The yield vary from 300-2000 kg/ha, with an average of about 650-750 kg/ha for rainfed sorghum. In some parts of India, irrigated sorghum is said to yield about 1800kg/ha.

Variety

Sorghum variety conserved by Navdanya are

Kempu Jola-1	Bili Jola-13	Bili Jola-36	Kaki Jola-3
Kempu Jola-2	Bili Jola-14	Bili Jola-37	Kaki Jola-4
Kempu Jola-3 (Kaki Jola)	Bili Jola-15	Bili Jola-38	Kaki Jola-5
Kempu Jola-4	Bili Jola-16	Mungari Jola-1	Kaki Jola-6
Kempu Jola-5	Bili Jola-17	Mungari Jola-2	Kaki Jola-7
Kempu Jola-6	Bili Jola-18	Kalmuri Jola	Kaki Jola-8
Kempu Jola-7	Bili Jola-19	Hombale Jola-1	Kurmari Jonnalu
Kempu Jola-8	Bili Jola-20	Hombale Jola-2	Makare Jola-1
Kempu Jola-9	Bili Jola-21	Hombale Jola-3	Makare-2 and Kurmari Jola
Kempu Jola-10	Bili Jola-22	Hombale Jola-4	Makari Jola-3
Kempu Jola-11	Bili Jola-23	Hombale Jola-5	Makara Jola-4
Bili Jola-1	Bili Jola-24	Maladandi-1	Pallakki Jola
Bili Jola-2	Bili Jola-25	Maladandi-2	Kempu Makara Jola
Bili Jola-3	Bili Jola-26	Bijapura	Hogaru Jola
Bili Jola-4	Bili Jola-27	Muthyala Jonnalu-1	Bili Jonna
Bili Jola-5	Bili Jola-28	Muthyala Jonnalu-2	Hogaru Ibbani or Bili Jola-39
Bili Jola-6	Bili Jola-29	Muthyala Jonnala-3	Chitte Jola
Bili Jola-7	Bili Jola-30	Bili Mudduga - 1	Kagamari-1
Bili Jola-8	Bili Jola-31	Bili Mudduga - 2	Kagamari-2
Bili Jola-9	Bili Jola-32	Jonnalu-1	Ragadu Jonnalu
Bili Jola-10	Bili Jola-33	Jonnalu-2	Shavige Jola
Bili Jola-11	Bili Jola-34	Kaki Jola-1	Kempu Makari
Bili Jola-12	Bili Jola-35	Kaki Jola-2	Rag Jola

Food preparation and uses

The threshed grain is ground into a whole meal flour; but grinding must be done as and when required as the flour tends to become rancid on keeping. The flour may be made into a thin porridge, a thick paste or dough by boiling in water. The seed coat may be removed by soaking or damping the grain and pounding it gently, with frequent winnowing to remove the bran. But the removal of bran results in a loss of 10-20% and reduction of protein content. After the seed coat is removed, the grain is cooked like rice or ground into flour, which may be made into biscuits or unleavened bread. As the grain contains no gluten, wheat flour or some other cereal flour is mixed for making good bread. White, corneous grain are usually preferred for human consumption, but these varieties are susceptible to bird damage as they contain no bitter principle.

There are some sorghum varieties suitable for popping. They have small grains, with horny endosperm towards the periphery. Some varieties with sugary grains are eaten like sweet corn. Dark-coloured, bitter-grained varieties are used for brewing beer, particularly in Africa. Varieties having large, sweet stems containing upto 10% sucrose are used for chewing and the manufacture of syrup.

The grain and the plant are both used as fodder for cattle. The best stage for harvesting for fodder is when the seed is nearing maturity and for silage at the milk or soft dough stage of the grain. Care is required in letting cattle graze sorghum, as some cultivars produce lethal amounts of the toxic, hydrocyanic acid under certain conditions. This poison is dissipated when the green plant is dried



and made into hay. Application of nitrogenous fertilizers have been found to increase the production of the above said poison.

Cultivars with a waxy endosperm are used for starch production. The starch is used in adhesives for sizing paper and textiles, for gum used in postage stamps and envelopes, and for thickening pie-fillings and gravies. Sorghum oil obtained from the embryos removed during the manufacture of starch is used in cooking and salad oils.

The plant base and stems are used for thatching, for reed walls in houses and for fences. The stem of the wild grass sorghums are used for making baskets and fish traps.

In West Africa, a red dye obtained from sorghum is used for dyeing leather.



Pearl Millet (*Pennisetum typhoides*)

Hindi: *Bajra, Bajri, Lahra*; Tamil: *Kambu*; Telugu: *Gantilu*



About 3,000 years ago pearl millet crossed the Indian Ocean and became a vital contributor to South Asia's food supplies. Today it is India's fourth most important cereal, surpassed only by rice, wheat, and sorghum. Bajra, as it is called, is currently grown on almost 10 percent of India's food-grain area, and it yields about 5 percent of the country's cereal food. Rajasthan, Maharashtra, Gujarat, and Uttar Pradesh account for nearly 80 percent of the 14 million hectares planted and 70 percent of the 5 million tons of pearl millet grain produced each year.

It occupies the drier areas unsuitable for finger millet. Its great merit is that it can be grown on poor, sandy soils in low rainfall areas and its storage life is good.

Morphology

The plant is a tall, erect annual. Stem is solid, slender or stout. Tiller and lateral branching may occur in variable number, depending on the cultivar.

Nodes are prominent, with a ring of silky hairs. Leaves in two vertical rows on either side of the stem; leaf sheath long, open at top, clasping the stem below, leaf blade 30-100 cm long, 0.5-5.0 cm wide, glabrous or hairy. Midrib is well developed, preventing the leaf from drooping.

The inflorescence resembles the ear of bulrush sedge and hence pearl millet is also called bulrush millet. It is a contracted panicle, at the tip of a stalk, 15-140 cm long, 0.5-4.25 cm in diameter, usually greenish yellow, cylindrical throughout its length or tapering at ends. The Indian varieties have hairless spikelets. The seeds are partially exposed and are visible on the earhead. They are usually elliptic or oblong ovoid, about 4mm long. The grain colour is usually white, yellow, grey, or light blue.



Cropping practices

The millet may be grown in pure stands, but is often grown mixed with other crops like sorghum and pulses. The crop may be sown broadcast or drilled. The usual seed rate is 3-9 kg/ha. Sowing is done around the middle of July after the first soaking rains, when the fields are ploughed. The crop may be thinned and weeded during early growth. When the seeds are sown in nurseries, transplanting is done three weeks after sowing. The millet responds well to the application of farmyard manure. The crop matures in 4-5 months depending on the variety sown. Harvesting is done by cutting off the earheads, which are then taken to the threshing floor and threshed by trampling under the feet of oxen or by using stone rollers. The yield range from 770-1100 kg/ha. If the earheads are kept in bales, bound up with straw, the grains will preserve for upto ten years.

Rotation and mixed cropping

The crop is grown in pure stands or with a variety of other crops. When grown pure, it is followed in the same year with horse gram. When the

millet is the sole crop of the year, cotton and sorghum follows it in the next two years. On the rough, coarse, gravels and red soils, castor may follow pearl millet. In the black cotton soil districts of Deccan, the millet is grown mixed together with a variety of other crops like pigeon pea, avare (field bean), green gram, black gram, horse gram, sesame etc.

Bird damage is even more serious in bulrush millet than with sorghum as the grain is smaller and more palatable, and the inflorescence provides a convenient perching place.

Food preparation

Pearl millet is consumed mostly after husking. It is cooked in the same way as rice, or is ground into a flour and made into a thin or thick porridge in the same way as finger millet. The flour can also be made into cakes or unleavened bread. Rotis are made from the flour in winter season as the grain has heating properties. In some parts of India, the grain is parched before eating. It can be used to produce malt and in Africa, the malted seed is an important source of beer.

Fodder

The grain is used to feed poultry and livestock. The green plant provides a useful fodder and this millet is sometimes grown solely for this purpose. The dried straw, which is inferior to that of most other cereals, may be fed to livestock, but it is coarse and hard. The straw and stalk is used for bedding, thatching, fencing, and fuel.





*Recipes of
Forgotten Foods*

Recipes of Millets & Pseudo Cereals

Jowar / Sorghum

1. Jowar Ki Roti
2. Jowar Methi Paratha
3. Jowar Bhakri
4. Jowar Ki Chapati
5. Jowar Bread
6. Jowar Idli

Ragi / Finger Millet

7. Ragi Mathi
8. Ragi Idli
9. Ragi Masala Dosa
10. Ragi Roti
11. Ragi Duddali
12. Ragi Crepe
13. Mandua Roti

Bajra / Pearl Millet

14. Bajra Alu Paratha
15. Bajra Bhakri
16. Bajra and Black Bean
17. Bajra Muffins
18. Bajra Croquettes
19. Bajra Flat Bread
20. Bajra Bread
21. Bajra Stew

Ramdana / Amaranth

22. Amaranth Roti
23. Amaranth Soppu
24. Amaranth Fruitcake
25. Amaranth Apple Bake
26. Toasted Amaranth Rolls
27. Sesame-Amaranth Cake
28. Amaranth Crepes
29. Banana Bread with Amaranth
30. Amaranth Crunch Bar
31. Spicy Ginger Snaps
32. High Protein Breakfast Cereal
33. Atole (Amaranth Drink)
34. Amaranth Shortbread
35. Amaranth Baking Powder Bread
36. Peanut Butter Amaranth Logs
37. Amaranth Cheesecake
38. Cheese & Pineapple Topping
39. Amaranth Doughnuts
40. Besan and Amaranth Dhokla
41. Navdanya's Amaranth Cutlet
42. Amaranth Roll

43. Amaranth-Buttermilk Idlis
44. Paneer & Amaranth Gravy
45. Apple and Amaranth Crumble
46. Amaranth Ladoo
47. Amaranth Bhaji

Kuttu / Buckwheat

48. Kuttu Ka Halwa
49. Kuttu Ka Meetha Cheela
50. Kuttu Dhokla
51. Kuttu Ki Puri
52. Kuttu Flour Pakora
53. Kuttu aur Pahari Alu Ka Paratha
54. Kuttu Crepe

Janghora / Barnyard Millet

55. Jhangora Upma
56. Phaphari Kauni Bhath
57. Jhangora Ki Kheer
58. Jhangora Ka Chencheda
59. Jhangora Tabouleh
60. Jhangora Phirmi
61. Jhangora Sheera

Jawar Ki Roti

Method

Combine all the ingredients in a bowl and knead into soft dough, using warm water as required. Cover and keep aside for 10 minutes. Divide the dough into 4 equal portions. Pat each portion on a dry surface using your palm till it is a circle of 125 mm. (5") diameter. Cook on a tawa (griddle) till both sides are lightly browned. Serve hot with a vegetable of your choice.

Serves 2

Nutritional facts per serving

Energy	349 cal	Calcium	25 mg
Protein	10.4 g	Iron	4.1 mg

Ingredients

1 cup	jowar ka atta / sorghum flour
1 tbsp	oil
1	green chilli
Salt	to taste



Jowar Methi Paratha

Ingredients

½ cup	jowar / sorghum flour
½ cup	wheat flour
1 small bunch	methi / fenugreek leaves
1 tsp	jeera / cumin seeds or ajwain
1 tsp	oil
chilly powder as desired	
salt to taste	
ghee for preparing paratha	

Method

Wash and finely chop the methi leaves and keep aside. Mix jowar flour, wheat flour, chilli powder, salt, 1 tsp of oil and jeera. Mix the chopped methi leaves to the flour mixture. Make a dough adding water to the mixture. Dough should be medium tough. Knead the dough properly until it becomes soft. Keep it aside for 10 minutes. Divide the dough into small balls and roll each ball into a round shape. Use little wheat flour while rolling, if the dough sticks to the roller. Grease a tawa with ghee and place the paratha over it, when done on one side turn on the other side and apply ghee again and cook properly till both sides turn golden coloured. Serve piping hot with a tbsp of butter and a bowl of curd. Note See that corners or the edges of the paratha are not broken. If broken that means, you have not kneaded properly. If it becomes difficult to knead the dough sprinkle very little water while kneading.

Jowar Bhakri

Method

Mix the flour and the salt.

Add water till the flour can be gathered up into a ball of dough.

The amount of water required to do this may vary, so add the water a little at a time. On a floured surface knead gently for a minute or so.

Divide into small balls

Form into a thick circle working with your finger tips with the patty between the palms of your floured hands.

If the flour is not fresh the dough starts cracking at the edges, so freshly ground jowar flour is absolutely necessary.

Turn out onto floured surface and continue to form a circle pressing it out with the finger tips.

Make each roti about 8" in diameter.

Heat a tava or griddle and put the roti on it. After a few minutes the roti starts becoming opaque.

Sprinkle some water on the surface by hand.

After two minutes turn the roti around and cook on the other side for some more time.

Turn over twice more till the roti develops brown spots all over and becomes lighter in colour.

Eat hot with butter. Makes 2 rotis.

Ingredients

1 cup	jowar /sorghum flour
pinch of	salt
3/4 cup	water



Jowar Ki Chapati

Ingredients

125 gms	jowar / sorghum flour
1	onion chopped
2	green chilies chopped
2 tsp	galric paste
2 tsp	ginger paste
1 bunch	dhania / coriander leaves chopped
2 tbsp	ghee / clarified butter
salt to taste	
milk and water to knead dough	

Method

Mix all ingredients in a bowl knead to a stiff dough.

Use milk, ghee and water for kneading.

Make two / three balls.

Roll the balls like thick chapati

Roast on tava till brown

Adding oil on both sides while cooking

Don't turn very often as it may break.

Serve with curd or dal.

Jowar Bread

Method

Sieve the wheat flour and jowar flour into a bowl.
Add the castor sugar and caraway seeds.
Heat the milk, water, butter, sugar and jaggery together.
When the jaggery and butter have melted remove from heat.
While still warm sprinkle the dry yeast over the top of the liquid.
Let it stand for 5 minutes till the yeast bubbles.
Make a well in the centre of the flours and pour the liquid in.
Mix till it forms a ball.
Turn out on to a floured board and knead for 10 minutes till the surface of the dough is smooth. Try not to break the skin of the dough whilst kneading.
Oil a container and let the dough stand covered for 1½ hours to rise till it is almost twice its size. Knead again, form a ring, cover and put it on an oiled baking sheet to rise for another hour. Bake at 400 Degrees for 45 minutes - 1 hour till light brown on top.
The bread turns out very dense and heavy but with a lovely flavour.

Ingredients

2 cups	jowar / sorghum flour
2 cups	wheat flour
1 tsp	castor sugar
1 tsp	shajeera / caraway seeds
¾ cup	milk
¾ cup	water
1½ tbsp	butter
3 tbsp	jaggery / gur / cane sugar
2 tbsp	active dry yeast or 14 gms of fresh yeast



Jowar Idli

Preparation Time	20 min
Cooking Time:	15 min
Serves / Makes:	4 Person

Ingredients

3 cups	jowar / sorghum
1 cup	urad dal / split black
1 tsp	methi / fenugreek seeds
2 tbsp	oil
salt to taste.	

Method

Soak urad dal, jowar & methi seeds in water for 8 to 10 hours.
Then grind it in a mixer.
Cover and keep over night.
Next day stir the batter. Add salt and oil
Stir the batter again.
Apply oil to the idli steamer. Pour batter in the idli steamer.
Cook it for 15 min. Serve hot.

Ragi Mathi

Method

Sieve flour and salt in a bowl, add ajwain to it. Make a well in the centre of the bowl. Pour 4 tbsp oil in it. Slowly draw in flour to mix it with the oil. Add enough milk and knead to make stiff dough. Cover with a moist cloth and leave for half an hour. Divide into balls; roll out each into 3 inch discs. Prick each with a fork. Deep fry over medium heat. Remove when golden brown and crisp. Drain and store in an airtight container. Serve with mango pickle or use for dahi papdi.

Serves 3

Nutritional facts per serving

Energy	1180 cal	Calcium	768 mg
Protein	16.7g	Iron	7.93 mg

Ingredients

600 gms	ragi atta / finger millet flour
4 tbsp	oil
1 tsp	ajwain (carom seed)
salt	to taste
1 cup	warm milk
oil	for deep frying

Ragi Idli

Ingredients

1 cup	ragi flour / finger millet / nachini
1 cup	urad dal / black gram
2 cup	rice
salt	to taste.

Method

Wash and soak the dal and rice separately overnight. Next day grind both of them separately. Mix the ground rice & dal. Add ragi flour to the mixture. Add salt. Set aside for 5-6 hours for fermentation. Steam small portions of the mixture in an idli steamer. Serve hot with sambhar and chutney.



Ragi Masala Dosa

Method

In a pan, put oil and season with cumin seeds, chillies and add onions.

Fry for a couple of minutes, and add potatoes, sauté for few minutes.

Add salt and turmeric powder.

Cook for some time and mix the gram flour with water and add the same to the vegetables and cook well.

In a griddle or a non stick flat pan, with a ladle pour and make it round the bottles shape and pour some oil around it and flip it after bubbling spots appear.

Take a spoonful of masala filling and fill in the centre and fold over the dosa.

Serve hot with sambhar and chutney.

Ingredients

1 cup ragi flour / finger millet / nachini

1 cup urad dal / black gram

2 cup rice

For Masala Filling

3 potatoes boiled, peeled and cubed

1 onion chopped

2 chillies cut into small pieces

2 tsp rai / mustard, channa dal for seasoning

1 tsp jeera / cumin seeds

1 tsp besan / gram flour / chick pea flour

1 tsp haldi / turmeric

salt to taste

Ragi Roti

Ingredients

600g Navdanya ragi flour / finger millet / nachini

200g Navdanya wheat flour

water as required

Method

Mix ragi flour and wheat flour well.

Prepare stiff dough with water.

Divide into even sized balls and roll out into chapattis.

Cook both sides on slow fire.

Ensure that the chapattis have been cooked well.



Ragi Duddali

Method

Soak the ragi in water for 3 hours.

Drain and grind with the coconut gratings

Strain the ground ragi & the coconut through a cloth.

Save the extract.

Repeat the process 2 or 3 times each time adding warm water to the residue in the cloth. Add crushed jaggery in the extract and cook on a medium flame stirring continuously.

The final consistency should be of porridge.

Add the powdered cardamom. Remove from the fire.

This porridge can be served as is.

Or cook the porridge for some more time stirring constantly, till it thickens. To test put a few drops on a banana leaf; these drops when touched will not stick to the fingers.

Brush a plate with ghee. Pour the ragi mixture on the plate. Cut the duddali into diamonds when cool.

Ingredients

½ cup	ragi seeds / finger millet / nachini
3 tbsp	coconut gratings
1 lemon	sized ball of jaggery
2 tsp	ghee / clarified butter
2-3	elaichi / cardamom



Ragi Crepe

Ingredients

1 cup	ragi atta / finger millet flour
150 gms	capsicum chopped
150 gms	tomato chopped
150 gms	onion chopped
2 tbsp	chilli powder

Method

Mix the ragi flour with water and make a batter and add salt and chilli powder and mix well.

Heat the griddle or non stick pan, brush it with some butter, and grasp the pan in one hand. Pour ¼ cup batter onto the pan while rotating it so that a thin layer of batter covers the surface. Return pan to the heat.

Cook for 2 - 3 minutes or until the top dries and the bottom is just lightly browned. Put the chopped vegetables on the top and close the pan with a lid to enable the vegetables to cook well in steam.

Repeat until all batter is used, keeping cooked crepes warm. Serve warm with a filling of your choice.



Mandua Roti – Gahath Ya Bhat Bhari

(Finger millet with horsegram filling)

Method

Knead finger millet and wheat flour together with water to make smooth dough.
Boil the kulath in water to make a paste.
Add coriander, chilly, garlic leaves and salt to the gahath.
Stuff this mixture into the balls of atta, flatten them and roll to make roti. Roast the roti on a pan till done.

Ingredients

600 gms ragi flour / finger millet / nachini
200 gms wheat Flour
100 gms kulath / horsegram / gahath
2 tsp green coriander
2 green chilies
garlic leaves optional
Salt to taste

Bajra Alu Paratha

Ingredients

250 gms wheat flour
150 gms bajra atta / pearl millet flour
1 tsp salt
½ cup water
8 tsp ghee / clarified butter

For the stuffing

2 medium potatoes boiled and peeled
2 green chilies slit
2 tbsp ginger chopped fine
2 tbsp fresh coriander, chopped
1 tsp anar dana / dried pomegranate seeds.
1 tsp red chilli powder

Method

Mix the flours and salt together. Make a well in the centre and add water. Slowly mix the water with the flour. Knead for 5-8 minutes till the dough forms a smooth ball. It has a slightly grayish tinge unlike wheat flour. Cover with a damp cloth and keep aside.

Mash the potatoes; add green chilies, ginger, coriander, pomegranate seeds and chili powder. Mix well. Divide into 8 portions. Divide the dough into 8 portions as well.

Flour a surface and taking one ball of dough, with floured hands press it out into a circle about 3 inches in diameter. Take one portion of filling and place in the center. Gather the edges of the dough together and press firmly till no joints show.

Press down on floured surface again and roll out into a circle of 7 inches diameter. Heat a griddle/tawa and when hot place the paratha on it. Keep heat on medium and cook till the surface of the paratha develops spots and changes colour. Turn over and let it cook on the other side.

Now drizzle ghee around the circumference of the paratha and let it cook for another few minutes. Turn over and do the same on the other side. The layer of dough rises off the filling as it cooks. Press the edges of the paratha with a spatula. Remove. Serve hot with yogurt and pickle.

Bajra Bhakri

Method

Mix bajra flour and wheat flour well.
Prepare stiff dough with water.
Divide into even sized balls and roll out into chapattis.
Cook both sides on slow fire.
Ensure that the chapattis have been cooked well.

Ingredients

600gms Navdanya bajra flour / pearl millet
200gms Navdanya wheat flour
water as required

Bajra and Black Bean Salad

Ingredients

1 cup bajra / pearl millet, uncooked
3 cups water
2 cups black beans, cooked
2 large tomatoes chopped
1 medium onion chopped
1 medium cucumber

Dressing

1/3 cup water
3 tbsp lemon juice
1 tbsp balsamic vinegar
2 tsp garlic, minced
1 tsp sea salt
1/2 tsp allspice
1/4 tsp kali meeri / black pepper
1 tsp jeera / cumin

Method

Cook the bajra in water for about 30 minutes or until the water has been absorbed.
Fluff with fork and allow it to cool.
In a large bowl, combine the bajra, the cooked black beans, tomatoes, and onion.
Peel several strips from the cucumber so that it looks striped.
Cut lengthwise into four pieces.
Remove the seeds and cut into 1/2-inch slices.
Add the cucumber to the salad.
Mix all dressing ingredients until well blended and pour over the salad.
Toss the salad.
Cover and refrigerate until the salad is well chilled.

Bajra Muffins

Makes: 12 muffins.

Method

Combine all dry ingredients in a medium bowl. Separately mix all liquid ingredients together. Add to the dry ingredients. Mix well. Put mixture in well-oiled muffin tins. Bake at 375 for 15-20 minutes or until done.

Ingredients

1 ½ cups	bajra atta / pearl millet flour
½ cup	soy flour
1 tbsp	baking powder (non-aluminum)
½ tsp	salt (optional)
¼ tsp	orange flavoring
1 cup	water or orange juice
¼ cup	vegetable oil
¼ cup	brown rice syrup or honey or stevia

Bajra Croquettes

Ingredients

1 cup	whole wheat flour / gehu atta
½ cup	unbleached white flour / maida
½ cup	corn flour
1 cup	bajra / pearl millet uncooked
1¾ cup	water
a pinch	salt
½ cup	fresh parsley; finely chopped
1 cup	carrots; finely grated
2 tbsp	water
1 tbsp	arrowroot flour
¼ tsp	sea salt
2 cup	carbonated water / soda
1 cup	onions; diced
1 cup	whole wheat flour / gehu atta
2 cup	oil for deep frying (sesame, safflower or canola)
½ cup	soy sauce
½ cup	water
1 tbsp	fresh ginger root; grated

Method

Mix together flours and salt. Gently stir in carbonated water and refrigerate until ready to use.

Wash the bajra in cold water and drain. Bring water and salt to a boil. Stir in bajra, cover and return to a boil. Lower heat and simmer for 25 minutes or until water is absorbed, stirring occasionally. Remove from heat and let cool. Mix in parsley, carrots, onions and wheat flour. Form golf-ball size croquettes, flattening the ends a little.

Coat each croquette with cold batter and roll in bread crumbs. Heat the oil in a heavy skillet. Fry 5 or 6 croquettes at a time for approximately 3 to 5 minutes on both side or until golden. Drain well and keep hot.

To make sauce

Bring soy sauce and 1/2 cup water to a boil. Lower heat and simmer for 5 minutes, stirring constantly. Squeeze juice from ginger root and stir into sauce. Pour hot sauce over croquettes.

Per serving

371 cal; 11 g prot; 231 mg sod; 64 g carb; 11 g fat; 0 mg chol; 70 mg calcium

Bajra Flat Bread

Method

Mix the bajra atta, wheat flour and the buttermilk, to a pouring consistency – like pancakes.

Keep aside for 2 hours.

Water could be used instead of buttermilk.

Add the spices and the vegetables.

On medium heat warm a non stick skillet.

Pout the batter on like pancakes

Cook on both sides for about 3 minutes

The colour should be a light golden on both sides

Ingredients

2 cups	bajra atta / pearl millet flour
½ cup	whole wheat flour.
1 cup	buttermilk
½ tsp	jeera / cumin powder
¼ tsp	haldi / turmeric powder
2 tbsp	til / sesame seeds
¼ tsp	red chili powder
1 tsp	kali meeri / black pepper
1 tsp	salt
1 tsp	baking soda.
½ cup	onions finely chopped
2 cloves	garlic finely mashed.
variation	green peas, carrots, spinach
3-4 tbsp	oil



Bajra Bread

Ingredients

1 cup	bajra atta / pearl millet flour
¾ cup	whole wheat flour
4 tsp	baking powder
1 tsp	salt
1	egg
3 tbsp	oil
1 cup	milk
¼ cup	honey

Method

Sift the dry ingredients together in a large bowl.

Add egg, oil, milk, and honey.

Mix well.

Pour into a greased 8 inch square pan.

Bake in a 400 degree oven for 20 to 25 minutes.

Bajra Stew

Number of Servings: 6

Method

Roast bajra in dry skillet for about 5 minutes.
Stir constantly to prevent burning.
Add all ingredients to a heavy bottomed pot and cook for 4 hours at high or 8 hours at low



Ingredients

1 cup bajra / pearl millet
4 cup water
2 onions - cut in wedges
2 potatoes - cut in large chunks
2 carrots - cut in large slices
1 cup celery - cut in large slices
1 cup mushrooms - chopped
2 tej patta / bay leaves
½ tsp basil
½ tsp thyme

Amaranth Roti

Ingredients

600 gms ramdana atta / amaranth flour
water as required
400 gms wheat flour

Method

Mix amaranth flour and wheat flour together.
Add water and prepare stiff dough.
Divide into even sized balls and roll out into chapattis.
Cook on pre heated tawa on slow fire on both sides.
Ensure that the chapattis are cooked well.

Serves 6

Nutritional facts per serving

Energy	546 cal	Calcium	542 mg
Protein	2.7 g	Iron	14.2 mg

Amaranth Soppu

Method

Wash and finely chop the amaranth leaves.

Cook the tuar dal and channa dal.

When half done, mix in the chopped amaranth, fenugreek, green chillies, onions, garlic, coriander and cumin seeds.

Cook till tender.

Just before removing from the fire add grated coconut and coriander leaves.

Ingredients

2 bunches	amaranth / lal math/ rajgira leaves
½ cup	tuar dal / arhar dal / pigeon pea lentil
½ cup	channa dal / bengal gram dal
¼ tsp	methi / fenugreek
10	green chillies slit
2	onions, chopped and browned
8-10	cloves of garlic, chopped and browned
2 tsp	dhania / coriander, roasted and powdered
1 tsp	jeera / cumin seeds

Amaranth Fruitcake

Ingredients

½ cup	dates, chopped
¼ cup	figs
½ cup	Navdanya amaranth flour
1 cup	boiling water
2	egg whites
¼ cup	butter (margarine can be used instead)
¼ cup	chopped pineapple
2 cups	Navdanya whole wheat flour
2 tsp	baking powder
½ cup	walnuts, chopped
½ cup	almonds, chopped
1 tsp	vanilla extract

Method

Soak dates, figs and amaranth in boiling water.

Beat eggs well, add honey and butter.

Beat well.

Stir in all remaining ingredients and mix well.

Pour into an greased loaf pan.

Bake at 175-180° C for 1 hour and 15 minutes.



Amaranth Apple Bake

Method

Cook apples in water till soft.
Drain, peel and mash, and add honey, cinnamon, flour and arrowroot flour, mix well.
Lightly grease a baking dish, and put the mix into it.
Sprinkle popped amaranth on top.
Bake for 20 minutes at 175-180° C.

Ingredients

8	apples (cut up), unpeeled
1 tbsp	Navdanya organic honey
1 tsp	cinnamon
1/4 cup	Navdanya amaranth flour
1/4 cup	water
1/2 cup	arrowroot flour

Toasted Amaranth Rolls



Ingredients

1½ cup	lukewarm water
1½ tbsp	vegetable oil / butter
3 tbsp	Navdanya honey
1½ tsp	salt (optional)
1½ tbsp	active dry yeast
1 cup	Navdanya amaranth flour
2¼ cups	Navdanya whole wheat flour
½ cup	popped amaranth seeds

For the filling

3 tbsp	raisins
3 tbsp	chopped nuts
1 tsp	cinnamon
2 tsp	dried orange / lime / mosambi peel

Method

Mix first five ingredients together.
Stir in flours. Mix to a smooth dough.
Cover with a damp cloth and keep aside for 1 hour.
Mix all the ingredients for the filling
Roll dough on a lightly floured surface.
Spread with butter and sprinkle the filling.
Roll up dough into small logs.
Cut into 2 inches thick slices
Place on sides, close together in an oiled pan.
Sprinkle with toasted amaranth seeds, and bake at 175-180° C for 30 to 40 minutes.

Sesame-Amaranth Cake

Method

Mix dry ingredients and liquid ingredients in separate bowls, then mix together, and beat well. Put the mixture into an oiled and floured 9" x 13" cake pan. Bake at 175-180° C for 12-15 minutes or until golden brown. Cool slightly before cutting into small wedges.

Ingredients

¾ cup	Navdanya amaranth flour	½ cup	unrefined oil
¾ cup	Navdanya whole wheat flour	½ cup	til / sesame; coarsely ground.
1½ tsp	baking powder	3 tbsp	Navdanya honey
¼ cup	til / sesame seeds (finely ground)	¼ cup	milk or water
¼ cup	til / whole sesame seeds	1 tsp	lime juice
¼ tsp	salt (optional)	1 tsp	vanilla
1	egg; beaten (optional)		

Amaranth Crepes In Lemon Sauce

Ingredients

3	eggs
1 tsp	Navdanya honey
1 tsp	vanilla
2 tbsp	melted butter or vegetable oil
¾ cup	milk or water (milk tastes better)
1/3 cup	Navdanya amaranth flour
1/8 tsp	salt (optional)
4	bananas mashed

Method

Beat eggs well; add other liquids, then flour and salt. Lightly heat a non-stick frying pan. Put 1½ tbsp butter in pan and tip to spread over surface. Add ½ cup batter. Bake. Turn crepe and bake other side. Fill cooked crepe with mashed bananas (with or without cream) or whipped paneer (with or without sugar powder and a little cream); roll up and remove to plate. Arrange rolls side by side in plate, cover with sauce.

CREPE SAUCE

Method

Combine ingredients (except peel) in a saucepan; stir and simmer over medium heat until clear and slightly thick; remove from heat and stir in peel.

Ingredients

1 cup	water
¼ cup	Navdanya honey
¼ cup	lemon juice
1 tbsp	Navdanya amaranth flour
1 tsp	finely grated peel of lime or lemon

Banana Bread with Amaranth

Method

Grind the nuts very fine.

Mix with the flour, arrowroot and baking soda in a large bowl.

Stir in the chopped nuts.

In a separate bowl, mix together the bananas, oil, honey, eggs, lime juice and vanilla.

Then pour the banana mixture into the flour bowl and mix with a few swift strokes.

Do not over mix.

Pour into a greased 9x5" loaf pan or 2 7x3" pans.

Bake large loaf at 175-180° C for 55 to 60 min, or small loaves for 45 min or until a cake tester inserted in the middle comes out clean.

Let stand in the pan for 10 min, then turn the loaf out onto a wire rack to cool.

Ingredients

¼ cup	nuts finely ground
1¾ cup	Navdanya amaranth flour sifted
½ cup	arrowroot powder
2 tsp	baking soda
½ cup	nuts; chopped
1 ½ cup	banana; mashed
¼ cup	vegetable oil
¼ cup	Navdanya honey
2	eggs
1 ½ tbsp	lime juice
1 tsp	vanilla

Amaranth Crunch Bar

Ingredients

2 tbsp	Navdanya honey
1 tbsp	Navdanya jaggery melted
1 tbsp	butter
1 ¼ cups	Navdanya popped amaranth

Method

In saucepan combine honey, jaggery and margarine.

Cook over medium heat for 4-7 minutes.

Stirring constantly, until mixture turns golden brown.

Add amaranth and stir with a wooden spoon until all the amaranth is coated with the syrup.

Lightly grease a plate, pour mixture, and press firmly.

Cut into squares or bars when hot, and allow to cool.



Spicy Ginger Snaps

Method

Heat honey, oil and water or juice till the honey melts. Remove from heat, and set aside. Sift together flour, arrowroot, Eno's fruit salt, ginger, cinnamon, baking soda and cloves. Stir into liquid mixture. Lightly grease a baking sheet. Drop rounded teaspoonful of batter, keeping enough distance between them to allow them to puff a little. Bake at 150° C for 15 to 18 minutes, until cookies are lightly brown. Cool on wire racks. Use within a few days.

Ingredients

¼ cup	Navdanya honey
3 tbsp	oil
3 tbsp	water or unsweetened orange juice
1 cup	Navdanya amaranth flour
1/3 cup	arrowroot
1 tsp	Eno's fruit salt
½ tsp	powdered ginger
½ tsp	ground cinnamon
½ tsp	baking soda
1/8 tsp	ground cloves

High Protein Breakfast Cereal

Ingredients

2 ½ cups	rolled oats
¾ cup	Navdanya amaranth flour
½ cup	chopped walnuts
½ cup	grated coconut
1/3 cup	pumpkin seeds
1/3 cup	peanuts
1 tsp	ground cinnamon
½ cup	oil
½ cup	Navdanya honey
1 tsp	vanilla (optional)
¾ cup	raisins or other dried fruit (optional)

Method

In a large bowl, combine the oats, flour, walnuts, coconut, pumpkin seeds, peanuts and cinnamon. Heat oil and honey till the honey melts. Stir in the vanilla. Pour over the oat mixture. Make sure the dry ingredients are well coated. Mix well. Spread mixture in a thin layer on a cooking sheet or a tray used to make cake rolls.

Bake at 150° C for 20 to 30 minutes, stirring mixture every 10 minutes, till it is golden brown. Allow to cool; stir in raisins or other dried fruit, then store in the refrigerator in tightly capped jars.

Note: 1/2 cup mashed bananas or your favourite pureed fruit can be added to the honey and oil mixture while it is heating.

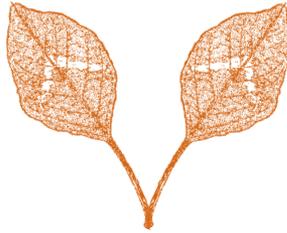
This delicious mix makes a quick, high-energy, high-protein, high calcium and high iron breakfast, especially suitable for school and college goers and for working people. It is also much cheaper than buying fortified breakfast cereals.



Atole (Amaranth Drink)

Method

Mix the amaranth and corn flour with the water until smooth. Pour into a medium-sized saucepan and simmer whilst stirring. Gradually, add honey, then the flavoring stirring all the while. When everything is dissolved serve in cups or mugs. Strain, if needed, to remove lumps. Add water for desired consistency.



Ingredients

½ cup corn flour
½ cup Navdanya amaranth flour
4 - 6 cups hot water,
Navdanya honey to taste.
Flavour with any of the following:
anise / saunf
pineapple
cinnamon
chocolate (this blend is called champurrado)
nuts

Amaranth Shortbread

Ingredients

1/8 cup Navdanya amaranth popped seed
¾ cup Navdanya whole wheat flour
¼ cup Navdanya honey
¾ cup rice flour
¼ cup butter (softened to room temperature)

Method

Mix all ingredients well to make smooth dough. Roll out ¼ to ½ inch thick into an approximate 8" circle. Cut the dough once from the outer edge to the centre with a sharp, greased knife. Bake on an un-greased tray for 17 minutes at 175-180° C. Cool, cut into wedges.

Amaranth Baking Powder Bread

Method

Sift dry ingredients together in a bowl.

Mix the liquid ingredients, and then stir into dry ingredients.

Whip egg whites till they stand in peaks, and fold into mixture.

Pour the batter into well-oiled 8" x 4" pan and bake at 175-180° C for about 45 minutes.

Cool for 10 minutes in the oven before removing bread from pan.

Ingredients

1 cup	Navdanya amaranth flour
1 ½ cup	Navdanya whole wheat flour or rice flour
1 tbsp	baking powder
1 tsp	salt (optional)
1 cup	milk or water
3 tbsp	Navdanya honey
2 tbsp	vegetable oil
2	egg whites beaten (if using rice flour)

Peanut Butter Amaranth Logs

Ingredients

¾ cup	Navdanya popped amaranth seed
¾ cup	grated coconut
1 cup	peanut butter
½ cup	coarsely ground sesame seeds
1/3 cup	Navdanya honey
½ cup	rolled oats or nuts
1/3 cup	pumpkin seeds
1/3 cup	skimmed milk powder

Method

Mix together amaranth seeds and coconut and spread on baking tray Heat at 115-125° C in the oven for 15 minutes.

Meanwhile, mix the remaining ingredients together in a bowl.

Divide amaranth and coconut mixture in half.

Mix one half with other ingredients.

Roll into a cylindrical shape, 1/2 in. wide. Cut into 3" long pieces.

Roll each piece in the remaining amaranth seed and coconut mix to coat it well.

Place in the refrigerator or freezer until ready to serve.



Amaranth Cheesecake

Method

Sift together the flours and baking powder into a bowl.
Mix honey and vanilla together, and add to the flours.
Add walnuts and almonds and stir well.
Pour into a lightly greased and floured baking pan
Bake at 215-220° C for 15 minutes or until lightly browned.
Cool. Cut into wedges and split in half.

Ingredients

¾ cup	Navdanya amaranth flour
¾ cup	wheat flour
1 ½ tsp	baking powder
4 tbsp	Navdanya honey
1 cup	milk or water
1 tsp	vanilla
½ cup	chopped walnuts
½ cup	chopped almonds

Cheese and Pineapple Topping

Ingredients

1	pineapple, peeled, cut into bits and crushed (If using tinned pineapple, drain, wash thoroughly before crushing; do not add any honey)
1 cup	paneer
1 tsp	vanilla
1 tbsp	Navdanya honey
	milk to soften the mix if needed

Method

Blend paneer, honey and vanilla in the mixer to a thick pouring consistency, adding milk if needed.
Pour pineapple on a cake.
Pour cheese mixture over them.



Amaranth Doughnuts

Method

Cook potatoes for 20-25 minutes, until soft.

Drain, peel and mash.

Add butter, cheese, salt, and pepper to mashed potatoes.

Refrigerate until cold.

Preheat oven to 200° C.

Remove potatoes from the refrigerator, and mix with wheat.

Divide into six equal portions.

Roll each portion into a 7 inch long rope.

Roll each rope in toasted amaranth, join ends to form doughnuts. Place on a lightly greased baking tray, and bake 12 minutes.

Ingredients

¾ kg	potatoes, cooked and mashed
1 tbsp	butter or oil
½ cup	grated cheese
½ tsp	salt
1/8 tsp	freshly ground black pepper
¾ cup	Navdanya popped amaranth seed
½ cup	wheat

Besan and Amaranth Dhokla

Ingredients

1 cup	Navdanya besan
1 cup	Navdanya amaranth flour
1 tbsp	eno's fruit salt
1 tsp	baking powder
1 tsp	salt
1 tsp	sugar
1 cup	yoghurt (buttermilk is better)
1 tbsp	ginger/garlic/green chillies paste
	red chilli powder for sprinkling

Method

Sift together the flours, salt, baking powder and Eno's fruit salt. Add sugar.

Beat the yoghurt, add to the flours and mix.

If needed, add water till you get a pouring consistency.

Add the ginger garlic paste and beat well.

Lightly brush oil flat pans or in small bowls.

Fill half of each with the batter.

Sprinkle with chilli powder, and steam till done.

Serve hot with green chutney/coconut chutney/garlic chutney.



Navdanya's Amaranth Cutlet

Method

Boil, peel and mash potato and carrot. Boil the peas and mix. Finely chop coriander and green chilli.

Add popped amaranth, chopped coriander, chilli and all the other spices. Mix well. The dough is now ready.

Make the dough into oval shapes; press them in between your palms to flatten.

Heat the oil in medium frying pan and when oil is hot drop a few of the cutlets and fry on medium heat until they turn golden brown.

Serve the cutlets hot with chutney or sauce.

Nutritional Facts per Serving

Energy	656.5cal;	Protein	6.1g;
Calcium	163mg;	Iron	3.55 mg

Ingredients

75 gms	popped amaranth / ramdana / rajgira
200 gms	potato
15 gms	peas
15 gms	carrot
3 tbsp	garam masala
2 tsp	black pepper
50 gms	peanuts
salt to taste	
1	small bunch coriander leaves
1	green chili

Amaranth Roll

Ingredients

50 Gms	amaranth / ramdana / rajgira flour
1 tsp	salt
2 small	capsicums
30 gms	cabbage
3 small	onions
1 tsp	soy sauce
½ tsp	vinegar
½ tsp	black pepper
1 tsp	mustard Oil
1 tsp	butter

Method

Cut all the vegetables in juliennes and sauté it in oil for 5 minutes. Add salt, pepper, soy sauce and again cook for 2 minutes. Switch off the gas then mix vinegar to the sautéed vegetable. Keep aside.

Make dough with amaranth flour and water

Roll it into chapatti, but little larger in size than the normal chapatti.

Cook it on griddle applying a little butter on both the side. Now spread the vegetable mixture in the middle of the chapatti and roll it into cylindrical shape.

Cut the roll into two equal pieces. Cover one open side of each roll with a paper napkin. Serve hot with green chutney.



Amaranth-Buttermilk Idlis

Method

Clean and soak the urad dal in water for 2-3 hrs. Wash and grind dal to a very fine and light paste in a mixer. Add amaranth, salt and buttermilk, and mix well till the batter is of a thick pouring consistency. Add finely chopped ginger, green chillies, curry leaves, whole cumin, and baking powder and let stand for 5 minutes. Lightly brush oil in katoris. Fill half of each katori with the batter, sprinkle coarsely ground pepper, and steam till done. Serve hot with coconut chutney, Sambhar or chutney powder.

Ingredients

1 cup	white urad dal
1 cup	Navdanya amaranth (whole)
1 cup	buttermilk (more if needed)
1 tbsp	baking soda
1 tsp	Navdanya cumin/jeera (whole)
1 sprig	curry leaves (chopped)
1"	piece ginger
finely chopped	green chillies to taste
coarsely ground	Navdanya black pepper
salt to taste	

Paneer with Amaranth Gravy



Ingredients

200g	paneer (cheese)
50g	amaranth / ramdana / rajgira
2	medium onions
1tbsp	cashew nuts pieces
3	elaichi / cardamoms
2	lavang / cloves
1 stick	dalchini / cinnamon
1	tej patta / bay leaf
3	green chillies chopped
1	red chilli
1tsp	dhania / coriander seeds
1tea cup	fresh curd
¾ tea cup	coriander chopped finely
½ tsp	sugar
2tbsp	ghee / clarified butter
salt to taste	

Method

Cut the paneer into small cubes. Cut the onions into big pieces, add $\frac{3}{4}$ teacup of water and boil. When cooked, blend in a mixer along with the amaranth and cashew nut pieces. Heat the ghee and fry the cardamoms, cloves, cinnamon and bay leaf for $\frac{1}{2}$ minute. Add the paste and fry for $\frac{1}{2}$ minute. Add the ground onions and amaranth and fry for a little while. Add the green chillies and fry for little while. Pound the red chilli and coriander seeds and add to the gravy. Fry again for a few seconds. Remove from fire. Churn the curds and add to the gravy. Add salt and cook on a slow flame until the ghee comes on top. Add the coriander and cook for $\frac{1}{2}$ minute. Finally, add the paneer and sugar and cook for a few minutes. Serve hot with parathas.

Apple and Amaranth Crumble

Method

Peel the apples and cut into very fine slices.
Place the slices on a baking dish and squeeze the juice of the lemon over them.
Pour honey over it.
Sprinkle cinnamon powder, nuts and raisins over the apple slices.
Sprinkle amaranth over it, with little ghee.
Put the dish in the oven for 5 min.
Serve hot or cold.

Ingredients

250 gms	apples
100 gms	popped amaranth / ramdana / rajgira
10 gms	honey
2 tsp	ghee
1 tsp	dalchini / cinnamon powder
1 tbsp	cashew nuts
5 to 6	raisins
1 tbsp	almonds grated
1	lemon for the juice

Amaranth Ladoo

Ingredients

½ kg	jaggery the variety used for chikkies.
2 tbsp	water
2 cups	popped amaranth / ramdana / rajgira
2 cups	besan / chickpea flour
1 cup	water
	oil for frying

Method



First make besan boondi. In a bowl mix the besan and the water. Make sure there are no lumps. Mix to a dropping consistency.

Heat the oil and pass the besan paste through a slotted spoon so that it makes tiny little balls in the hot oil. Remove when crispy.

Note Boondi can be bought ready at any shop selling Indian sweets

Now heat the jaggery with a little water. Melt the jaggery.

Take a little melted jaggery in your index finger and thumb and roll it. Drop this tiny ball in cold water.

If the ball retains its shape the jaggery is ready.

Add in the amaranth and the boondi. Mix well.

Shape into ladoos / balls, when still hot, by rolling them in your palms.

Coat your palms with a little ghee or butter before rolling the ladoos.

Amaranth Bhaji / Lal Bhaji Amshi

Method

Take the amaranth leaves and separate them from the stems.

Cut coarsely.

Cook uncovered. The leaves lose their colour if cooked with a lid.

Grind the coconut, red chillies, tamarind to a fine paste.

Add this paste to the amaranth leaves.

Add salt to taste and the jaggery.

Cook for 2 minutes.

Heat oil and add crushed garlic to the oil. Do not peel the garlic.

When the garlic turns a slight golden brown add to the bhaji.

Serve with rice.

Ingredients

2 bunches red amaranth leaves / lal math

1 cup coconut grated

4-5 red chillies

1 small marble sized ball of tamarind

2 tbsp jaggery

For seasoning

2 tsp oil

5 cloves garlic

Kuttu Ka Halwa

Ingredients

1 cup kuttu atta / buckwheat flour

1 cup ghee

¾ cup sugar

1-2 cups water

Method

Roast atta in ghee, when done add sugar and water.

Heat till the sugar dissolves.

Kuttu Ka Meetha Cheela

Method

Make a batter with atta and sugar using water.
Cook pancake on a nonstick pan.

Ingredients

1 cup	kuttu atta / buckwheat flour
3 tbsp	sugar

Kuttu Dhokala

Ingredients

1 cup	kuttu atta / buckwheat flour
2 tbsp	jhangora / barnyard millet / samak
¾ cup	fresh curd
1 tsp	ginger green-chilli paste
1 tsp	oil
a pinch	soda bi-carbonate
salt to taste	
green coriander for garnishing	
oil for greasing	

Method

Wash and drain the Kuttu.
Add the curds and samak and mix well.
Keep aside for at least 3 hours.
Add the ginger-green chilli paste, oil, soda bi-carbonate and salt.
Mix well.
Pour the batter into a 200 mm. (8") diameter greased dish.
Steam for 8 minutes
Cool slightly and cut into diamond shaped pieces.
Serve hot, garnished with the coriander.

Kuttu Ki Puri

Method

Mix all the dry ingredients.
Add water a little at a time to make smooth dough.
Roll out small puris in your hand.
This is not like normal flour, so do not add too much water.
Heat the oil in a frying pan.
Fry puris until dark brown.
Repeat this with the rest of the flour mixture.
Serve with pickle and curd.

Ingredients

1 cup kuttu atta / buckwheat flour
1 tbsp oil
1 tsp ajwain
¼ cup dhania / coriander Leaves
¼ cup potatoes boil & mashed
2 green chillies chopped
1 tsp red chilli powder
salt to taste
water for kneading
oil for deep frying

Kuttu Flour Paḳora

Ingredients

½ cup kuttu atta / buckwheat flour
1 ½ tsp salt / rock salt
2 potatoes cut into thin round slices
10 yellow pumpkin cut into square pieces
water to make dough
oil for frying

Method

Mix the flour and salt.
Then slowly add water to make a smooth dough
Dip the slices of potatoes and pumpkin in this paste, one by one.
Heat the oil in a deep pan or a wok / kadai.
Deep fry the potato and pumpkin slices in the oil.
Remove on a kitchen towel; drain the extra oil
Serve when hot.

Kuttu Aur Pahari Alu Ka Paratha

Method

Boil potatoes, mash and mix with buckwheat flour, ajwain, chopped green chilly, salt and water

Knead well.

The dough is then flattened and cooked on the tawa with or without ghee.

Ingredients

100 gms kuttu atta / buckwheat flour
50 gms potatoes
¼ tsp ajwain
green chillies to taste
oil to grease

Kuttu Crepe

Ingredients

1 cup kuttu atta / buckwheat flour
150 gms capsicum chopped
150 gms tomato chopped
150 gms onion chopped
2 tbsps chilli powder

Method

Mix buckwheat flour with water and make a batter and add salt and chilli powder and mix well.

Heat the griddle or non stick pan, brush it with some butter, and grasp the pan in one hand.

Pour ¼ cup batter onto the pan while rotating it so that a thin layer of batter covers the surface.

Return pan to the heat.

Cook for 2 - 3 minutes or until the top dries and the bottom is just lightly browned.

Put the chopped vegetables on the top and close the pan with a lid to enable the vegetables to cook well in steam.

Repeat until all batter is used, keeping cooked crepes warm. Serve warm with a filling of your choice.

Jhangora Upma



Method

Clean jhangora thoroughly.
Blanch it in 2 cups of hot water for 4 minutes.
Drain and keep aside.
Heat the oil in a pan.
Add the onion and green chilli and sauté till the onion turns translucent.
Add the peas, carrots, jhangora and salt and sauté for 3 to 4 minutes.
Add 1 ½ cups of water and cook.
Add lemon juice and garnish with the coriander
Serve hot.

Ingredients

½ cup	jhangora / barnyard millet / samak
1	chopped onion
1	chopped green chilli
¼ cup	boiled green peas
¼ cup	carrots
1	lemon
1 tbsp	oil
	salt to taste
2 tbsp	chopped coriander

Phaphari Kauni Bhath (Alan Mange Jholi/Kaḍi)

Ingredients

200 gms	foxtail millet/kauni
200 gms	jhangora / barnyard millet / samak
400 ml	Butter milk
25 gms	ginger
½ tsp	jeera / cumin seeds
¼ tsp	methi / fenugreek seed
½ tsp	haldi / turmeric powder
2-3	green chillies
2 tsp	green coriander
	salt to taste

Method

Wash kauni and cook in water like rice to make phaphari kauni

For Kadi

Soak jhangora for 1 hour.
Drain and grind into a paste with ginger, green chillies, coriander leaves, turmeric powder and salt.
Heat oil in a pan and seasoned with jeera and methi
Now pour buttermilk into this and cook stirred continuously till the kadi/jholi is of a thin, smooth consistency.
Serve with the cooked kauni.



Jhangora Kheer

kewara essence as required

Method

First of all boil milk in a heavy bottom pan.
Add jhangora in it and then cook well.
Stir to avoid lumps.
Add sugar and cook till the sugar fully dissolves.
Add kewara essence to give it a sweet flavour.
Mix this essence well.
Garnish with chopped dry fruits.
Now this kheer is ready to serve.

Ingredients

500 gms	jhangora / barnyard millet / samak
200 gms	sugar
2 litre	milk
50 gms	cashew nuts
100 gms	chironji

Jhangora Ka Chencheda

Ingredients

100 gms	jhangora / barnyard millet / samak
200 ml	lassi (butter milk)
¼ tsp	jeera / cumin seeds
¼ tsp	haldi / turmeric
	a few garlic leaves
	black pepper to taste
	salt to taste
	chilly to taste

Method

Cook jhangora in lassi on slow flame for some time.
Remove the mixture from fire. temper with black pepper, garlic leaves, salt, chilly and cumin seeds.
The jhangora chencheda is a recipe of Garwhal and eaten during the rains and snowy windy winter as it is warming.



Jhangora Tabouleh

lemon Juice

Method

Clean the jhangora thoroughly and blanch it in two cups of hot water for four minutes. Drain and keep aside.

Finely chop all the vegetables

Tear the mint leaves into small pieces

Mix all the ingredients and garnish with coriander and lemon juice.

Ingredients

½ cup	jhangora / barnyard millet / samak
½ cup	onion chopped
½ cup	tomatoes chopped
½ cup	cucumber chopped
½ cup	capsicum chopped
8 to 10	mint leaves
1 small bunch	coriander leaves
a pinch	black pepper powder
¼ cup	raisins
2 tbsp	olive oil
2 tbsp	lemon juice
	salt to taste

Jhangora Phirni

No. of serving 5-6

Ingredients

500 gms	jhangora / barnyard millet / samak
200 gms	sugar
2 litre	milk
50 gms	cashew nuts
50 gms	raisins
a pinch	saffron / kesar

Method

Boil milk in a heavy bottom pan.

Clean the jhangora thoroughly then add jhangora to the milk cook well. Stir to avoid lumps.

Add sugar and cook till the sugar is fully dissolved.

Mix the kesar in one teaspoon warm milk, add to phirni.

Garnish with chopped dry fruits and serve hot or cold .

Nutritional Fact

Energy – 238Kcal,
Calcium – 1629mg,

Protein – 93.6g,
Iron - 24.7mg



Jhangora Sheera

Method

Boil milk in a heavy bottom pan.

Clean the jhangora thoroughly then add jhangora to the milk cook well.

Stir to avoid lumps.

Add sugar and cook till the sugar is fully dissolved.

Add the ghee, the mashed bananas, broken cashew nuts and the raisins.

Serve hot or cold

Ingredients

1 cup	jhangora / barnyard millet / samak
1 cup	boora / sugar
1 cup	milk
1 cup	ghee / clarified butter
1 cup	mashed bananas
¼ cup	cashew nuts broken
¼ cup	raisins



Glossary

Acuminate	Tapering concavely to a point
Acute	Tapering with straight or slightly convex sides to a point
Alkaloid	A powerful plant constituent containing nitrogen, which acts on the animal system
Alterative	Tending to restore to normal health
Anodyne	Capable of soothing or eliminating pain
Anther	The free end of the stamen that bears pollen; pollen sac
Anti-inflammatory	Preventing or reducing inflammation
Antiseptic	Counteracts infection by destroying or inhibiting the growth of bacteria
Apex	Tip of a leaf or flower
Apiculate	Having a short, sharp point
Astringent	Tending to draw together or constrict tissues; styptic
Axil	The angle between the stem and the leaf stalk of a plant
Axillary	The angle between the stem and leaf
Biennial	A plant with a life cycle of two years, blossoming and fruiting during the second year
Blade	Extended portion of a leaf
Blood purifier	Agent that rids blood of impurities; cleanse
Blood tonic	Invigorating, refreshing and restoring blood
Bract	A modified leaf or bud covering
Bulb	A swollen underground storage organ, made up of fleshy leaves
Calyx	Grouped sepals, the outer parts of a flower
Calyx	Outer whorl of floral envelopes, composed of sepals
Campanulate	Bell-shaped, cup-shaped
Capsule	Seed pod.
Carminative	Relieves flatulence by helping to dispel wind
Cilia	Small hairs, often present on leaf margins

Corolla	The petals as a whole
Cultivar	Shortened form of cultivated variety. A group of plants, selected for particular attributes, that are clearly distinct, uniform, and stable and that retain these characteristics when propagated by appropriate means
Cuneate	Wedge-shaped acute angle at the leaf base
Cutting	New growth cut for rooting or other vegetative propagation
Deciduous	Shedding leaves annually
Declinate	Bent or curved downward or forward
Decoction	Boiling or simmering the tougher parts of a herb in liquid to extract the active principles of the herb
Deflexed	Bent abruptly downward
Demulcent	Soothing, relieves irritation
Deodorant	Removes or lessens smells
Depurative	Purifying the blood
Detergent	A cleansing substance that acts similarly to soap
Diuretic	Stimulates the flow of urine
Double	Having more than one set of petals or petal-like structures, or with petaloid stamens
Elliptic	Oblong with rounded ends
Emollient	Softening and relaxing
Endemic	Native or confined naturally to a given geographical area
Epiphyte	A plant growing non-parasitically upon another
Evergreen	Bearing green foliage throughout the year
Expectorant	Helps clear phlegm from the bronchial tubes
Exserted	Projecting beyond, such as stamens projecting from the corolla
Family	A group of genera sharing certain characteristics
Febrifuge	Helps reduce fever
Feral	Wild or escaped from domestication and able to reproduce normally
Filament	The thread-like stalk of a stamen
Flatulence	A condition caused by gas accumulating in the stomach or bowels
Flower	The specialized reproductive structure of a seed plant. Rhododendrons have flowers, not florets

Form	A minor variation within a species that is sufficiently distinctive to warrant recognition as a separate taxon. In cultivated plants, it is current practice to name these forms as cultivars
Genus, pl. genera.	A taxonomic group comprising closely related species
Glabrous	Hairless
Glaucous	Having a gray or whitish cast, covered with a bluish, gray, or white bloom
Globose	Nearly spherical
Habit	General form of a plant
Hardiness	Cold hardiness is the lowest temperature a plant can tolerate without damage
Indigenous	Native to an area
Inflorescence	An arrangement of flowers on a stem or axis, it may comprise a cluster of flowers or a single flower
Involute	Rolled inward or toward the upper side
Lamina	Blade of a leaf
Lanceolate	Shaped like a lance head, widening above the base and tapering toward the apex
Lax	Not rigid, loose
Laxative	Stimulates evacuation of the bowels
Lepidote	Having scales. Tiny scales typically cover the undersides of the leaves. Characteristic used to separate the genus rhododendron into two major groups
Lobe	A rounded division of a flower or leaf
Lobed	Leaves that are divided but not into separate leaflets
Margin	Leaf or flower edge
Mucilage	A viscous, gelatinous substance obtained from certain herbs
Mucronate	Having a leaf tip terminating in a hard point that is a continuation of the midvein
Mutation	An inheritable change in genetic material
Narcotic	A substance that, according to dosage, soothes pain or induces stupefaction and death
Nectary	Nectar secreting gland at the base of the corolla

Nervate	Leaves with prominent ribs or veins
Oblanceolate	Widest near apex, tapering to base, longer than wide
Oblong	Much longer than wide, with sides roughly parallel for most of their length
Obovate	Egg-shaped with the broadest part towards the apex
Orbicular	Flat with the outline circular or nearly circular; disc shaped
Ovary	Seed bearing part of the pistil
Ovate	Egg-shaped with the broadest part towards the base
Panicle	Grouped flowers
Pectoral	Useful in relieving disorders of the chest or respiratory tract
Pedicel	The stalk of an individual flower in an inflorescence
Pendulous	Hanging down, drooping
Petal	One division of the corolla
Petiole	Leaf stalk
Petiole	The stack of a leaf
pH	A measure of acidity or alkalinity. A pH of 7.0 is neutral. Smaller numbers indicate acidity, larger numbers indicate alkalinity. Rhododendrons, like other members of the heath family, favor soils which are mildly acidic with a pH around 5.5
Pinnate	A leaf divided into at least four leaflets arranged in two rows along a stalk
Pistil	The female organ of a flower consisting of ovary, style and stigma
Pollen	Minute powder-like grains borne by the anther. Pollen contains the male gametophyte of a plant
Precocious	Flowering before the leaves appear
Pubescent	Covered with soft, short hair
Purgative	A powerful laxative given to evacuate the bowels
Quadrangle	Square or nearly square
Recurved	Curved backward or downward
Revolute	Rolled back or downward from the margins
Rhizome	Creeping, usually swollen, underground stem
Rotate	Wheel shaped, saucer-like

Scale	Tiny, plate-like structures appearing on leaves and other plant parts
Section	A division of classification. Sections and subsections are taxonomic groups between genus and species
Sedative	Soothing medicine that calms the nerves
Series	A category in an outdated system of rhododendron classification
Sessile	Without a stalk
Spatulate	Shaped like a spatula, spoon-shaped or paddle
Species	Basic classification unit of plants comprised of individuals that are recognized as distinct from other species, and which can freely interbreed among themselves
Stamen	The male organ of a flower consisting of an anther on a filament
Stigma	The tip of the pistil, usually sticky, which receives the pollen for fertilization of the ovule
Strigose	Rough with straight, short sharp appressed hairs
Style	Extension of the ovary in a plant
Subgenus	The principal subdivision of a genus
Suborbicular	Not quite circular
Subsection	See section
Taxonomy	Classification (based on study of morphology, geographic distribution, phylogeny) and nomenclature
Throat	The base opening of the corolla
Trifoliolate	Leaf that has three leaflets
Tuber	Swollen portion of an underground root or stem
Umbel	A flower head with stalks that radiate from one point
Undulate	Wavy
Variety	A naturally occurring group within a species that is distinct enough to warrant taxonomic recognition but not sufficiently distinct to be segregated as another species
Vein	A vascular bundle in a leaf blade or petal
Vermifuge	Expelling or destroying parasitic worms especially of the intestine
Whorl	Three or more leaves or branches at a node; circle of flower parts as sepals, petals or stamens
Woolly	Clad with long, soft more or less or matted hairs

