Small Millets: Not ‘Small’ in Nutrition!

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Introduction

A number of different small-grained cereal grasses are collectively described as ‘Millets’. Millets are one of the oldest cultivated foods known to humans. Two main groups of millets are major millets (sorghum and pearl millet) and small millets based on the grain size. Off late, the classification is also an indication of the area under these crops. Both major and small millets have traditionally been the main components of the food basket of the poor people in India. The group of small millets is represented by six species, namely finger millet (*Eleusine coracana* (L.)), little millet (*Panicum sumatrance*), kodo millet (*Paspalum scrobiculatum* (L.)), foxtail millet (*Setaria italica* (L.)), barnyard millet (*Echinochloa frumentacea* (L.)) and proso millet (*Panicum miliaceum* (L.)), representing the area grown in that order. These crops have traditionally been the indispensable component of dry farming system in India and elsewhere. Small millets are known by different vernacular names at different parts of the country (Table 1).

Table 1. Vernacular names of small millets

English	Finger millet	Little millet	Kodo millet	Foxtail/ Italian millet	Barnyard millet	Proso millet
Hindi	Mandua	Kutki	Kodon	Kangni, Kakum	Sanwa, Jhangon	Barre

Sanskrit	Nandimukhi, Madhuli	-	Kodara	Kanguni	Shyama	Chiná
Kannada	Ragi	Same	Harka	Navane	Oodalu	Baragu
Tamil	Kelvaragu	Samai	Varagu	Tenai	Kuthiravaali	Panivara
Telugu	Ragulu	Samalu	Arikelu, Arika	Korra, Korralu	Udalu, Kodisama	Varigulu Varagalu
Malayalam	Moothari	Chama	Varagu	Thina	-	Panivara
Marathi	Nachni	Sava	Kodra	Kang, Rala	Shamul	Vari
Gujarati	Nagli, Bavto	Gajro, Kuri	Kodra	Kang	Sama	Cheno
Bengali	Mandua	Kangani	Kodo	Kaon	Shamula	Cheena
Oriya	Mandia	Suan	Kodua	Kanghu, Kora	Khira	Chinna
Punjabi	Mandhuka, Mandhal	Swank	Kodra	Kangni	Swank	Cheena
Kashmiri	-	Ganuhaar		Shol	-	Pingu

Geographic distribution

Among small millets, finger millet is the most important crop grown in many states of Southern, Central, Eastern, Western and Northern India from sea level in coastal Andhra Pradesh to 8000 feet altitude in Himalayas. The loss of area under finger millet has been less during the past 3 decades but with significant improvement in productivity. On the contrary the area under other small millets has reduced by more than half with proportionate reduction in total production. The productivity remained low and stagnant around 450 kg/ha. Though more recent and accurate statistics regarding each of the small millets is lacking a broad picture is that more than 60% of area under small millets is occupied by finger millet, distantly followed by little and kodo millets (just above 10%) and rest by barnyard, foxtail and proso millets.

Though small millets are grown in almost every state/region, the distribution of individual millet is not uniform. The kodo, little and foxtail millets are grown widely in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Madhya Pradesh and Maharashtra. In Madhya Pradesh, both kodo and little millet are predominant, while foxtail millet is important in Andhra Pradesh and Karnataka. Barnyard millet and proso millet are grown largely in hills of Uttar Pradesh, North-Eastern region and plains of North Bihar and Western Uttar Pradesh and Maharashtra.

Physical properties and nutritional profile

The small millets are small seeded grains and resemble paddy or rough rice in the morphological features of kernel. The kernel consists of distinct husk, bran and endosperm tissues. Embryo is a distinct tissue, but its proportion in the kernel is around 2%. The husk is non-edible similar to the husk in rough rice or paddy where as bran may be part of the edible component but is separated to prepare milled millets for food uses. Normally, husk accounts to 15 to 20% of the kernel where as the bran amount to about 5% and the endosperm to about 75% of the kernel, respectively. These grains are round to oval shaped and their 1000-kernel weight and volume range from 1.9 - 5.5 g and 1.3 - 3.8 ml, respectively. The seed coat and husk of foxtail, little and proso millet are generally of single entity with glossy appearance whereas kodo and barnyard millet contain multiple layered seed coat. Normally the seed coat of kodo millet is of brown colour, foxtail millet is yellowish where as the other millets are grayish coloured. The husk is non-edible and unusually hard to digest similar to the husk in paddy, where as the bran is edible. To prepare edible items out of millets, the husk is separated by milling and along with that generally, the bran is also separated similar to milled rice. Hulling does not affect the nutrient

value as the germ stays intact through this process (www.smallmillets.res.in).

Small millets are more nutritious compared to fine cereals. Finger millet is the richest source of calcium (300-350 mg/100 g) and other small millets are good source of phosphorous and iron. The protein content ranges from 7 to 12% and fat content from 1 to 5.0% (Table 2). The millet protein has well balanced amino acid profile and good source of methionine, cystine and lycine (Table 3). These essential amino acids are of special benefit to those who depend on plant food for their protein nourishment. The millet grain contains about 65% carbohydrate, a high proportion of which is in the form of non starchy polysaccharides and dietary fibre which help in prevention of constipation, lowering of blood cholesterol and slow release of glucose to the blood stream during digestion. Lower incidence of cardiovascular diseases, duodenal ulcer and hyperglycemia (diabetes) are reported among regular millet consumers. Millet grains are also rich in important vitamins *viz.*, Thiamine, riboflavin, folin and niacin (Table 4). Millets are comparable to rice and wheat or rich in some of the minerals (Table 5) as well as fatty acids (Table 6). Millets vary largely in composition of carbohydrates as proportion of amylose and amylopectin content vary from 16-28% and 72-84%, respectively (Table 7).

Table 2. Nutrient composition of millets compared to fine cereals (per 100 g)

Food gain	Carbo-hydrates (g)	Protein (g)	Fat (g)	Energy (KCal)	Crude fibre (g)	Mineral matter (g)	Ca (mg)	P (mg)	I (r
Finger millet	72.0	7.3	1.3	328	3.6	2.7	344	283	3
Kodo millet	65.9	8.3	1.4	309	9.0	2.6	27	188	0
Proso millet	70.4	12.5	1.1	341	2.2	1.9	14	206	0
Foxtail millet	60.9	12.3	4.3	331	8.0	3.3	31	290	2

Little millet	67.0	7.7	4.7	341	7.6	1.5	17	220	9
Barnyard millet	65.5	6.2	2.2	307	9.8	4.4	20	280	5
Sorghum	72.6	10.4	1.9	349	1.6	1.6	25	222	4
Bajra	67.5	11.6	5.0	361	1.2	2.3	42	296	8
Wheat (whole)	71.2	11.8	1.5	346	1.2	1.5	41	306	5
Rice (raw, milled)	78.2	6.8	0.5	345	0.2	0.6	10	160	0

(Source: Nutritive value of Indian foods, NIN, 2007)

Table 3. Essential Amino acid profile of Millets (mg/g of N)

Millet	Arginine	Histidine	Lysine	Tryptophan	Phenyl Alanine	Tyrosine	Met
Foxtail	220	130	140	60	420	-	180
Proso	290	110	190	50	310	-	160
Finger	300	130	220	100	310	220	210

Little	250	120	110	60	330	-	180
Barnyard	270	120	150	50	430	-	180
Sorghum	240	160	150	70	300	180	100
Bajra	300	140	190	110	290	200	150
Rice	480	130	230	80	280	290	150
Wheat	290	130	170	70	280	180	90

(Source: Nutritive value of Indian foods, NIN, 2007)

Table 4. Vitamin profile of Millets

Millet	Thiamin (mg)	Niacin (mg)	Riboflavin	Vit A (carotene) (mg/100g)	Vit B6 (mg/100g)	Folic Acid (mg/100g)
Foxtail	0.59	3.2	0.11	32	-	15.0
Proso	0.41	4.5	0.28	0	-	-
Finger	0.42	1.1	0.19	42	-	18.3
Little	0.3	3.2	0.09	0	-	9.0

Barnyard	0.33	4.2	0.1	0	-	-
Kodo	0.15	2.0	0.09	0	-	23.1
Sorghum	0.38	4.3	0.15	47	0.21	20.0
Bajra	0.38	2.8	0.21	132	-	45.5
Rice	0.41	4.3	0.04	0	-	8.0
Wheat	0.41	5.1	0.1	64	0.57	36.6

(Source: Nutritive value of Indian foods, NIN, 2007)

Table 5. Micronutrient Profile of Millets (mg/100g)

Millets	Mg	Na	K	Cu	Mn	Mb	Zn	Cr	Su	Cl
Foxtail	81	4.6	250	1.40	0.60	0.070	2.4	0.030	171	37
Proso	153	8.2	113	1.60	0.60	-	1.4	0.020	157	19
Finger	137	11.0	408	0.47	5.49	0.102	2.3	0.028	160	44
Little	133	8.1	129	1.00	0.68	0.016	3.7	0.180	149	13
Barnyard	82	-	-	0.60	0.96	-	3	0.090	-	-

Kodo	147	4.6	144	1.60	1.10	-	0.7	0.020	136	11
Sorghum	171	7.3	131	0.46	0.78	0.039	1.6	0.008	54	44
Bajra	137	10.9	307	1.06	1.15	0.069	3.1	0.023	147	39
Rice	90	-	-	0.14	0.59	0.058	1.4	0.004	-	-
Wheat	138	17.1	284	0.68	2.29	0.051	2.7	0.012	128	47

(Source: Nutritive value of Indian foods, NIN, 2007)

Table 6. Fatty acid composition of millets

Millet	Palmitic	Palmoleic	Stearic	Oleic	Linoleic	Linolenic
Foxtail	6.40	-	6.30	13.0	66.50	-
Proso	-	10.80	-	53.80	34.90	-
Finger	-	-	-	-	-	-
Little	-	-	-	-	-	-
Sorghum	14.0	-	2.10	31.0	49.0	2.70
Bajra	20.85	-	-	25.40	46.0	4.10

Rice	15.0	-	1.90	42.50	39.10	1.10
Wheat	24.50	0.80	1.00	11.50	56.30	3.70

(Source: Nutritive value of Indian foods, NIN, 2007)

Table 7. Amylose & Amylopectin content of millets

Cereal grain	Amylose (%)	Amylopectin (%)
Proso millet	28.2	71.8
Foxtail millet	17.5	82.5
Kodo millet	24.0	76.0
Finger millet	16.0	84.0
Sorghum	24.0	76.0
Bajra	21.1	78.9
Short Grain Rice	12-19	88-81
Wheat	25.0	75.0

(Source: *MILLET in your Meals*)

Declining small millet cultivation

In spite of the extraordinary nutritional qualities of millet grains and capacities of millet farming systems, the area under millet production has been shrinking over the last five decades. The period between 1961 and 2009 saw a dramatic decrease in cultivated area under millets, more so in case of small millets (80% for small millets other than finger millet, 46% for finger millet). The area under all small millets other than finger millet has declined drastically in all states and the total production of small millets has declined by 76%. The productivity has remained more or less stagnant in the last two decades. The area declined by 83% from first five year plan to 11th plan whereas the production also fell by nearly 80%. The productivity of small millets (other than finger millet) remained almost stagnant till 11th plan with a slight decline during 3rd and 4th plans.

Small millets for nutritional security

From the data presented here it is evident that small millets are superior in some or most of the nutritional components compared to most widely consumed rice and wheat. These millets contribute towards balanced diet, and can hence ensure nutritional security more easily through regular consumption along with keeping the environment safe as they are low input crops mostly adapted to marginal lands. Declining small millets cultivation has resulted in reduced availability of these nutritious grains to needy population and also the traditional consumers have gradually switched over to more easily available fine cereals due to Government policies. This is a disturbing trend and needs urgent focus by the agricultural experts and policy makers. Immediate policy and market support, value addition and promotional activity are necessary for arresting the further decline not only in cultivation but also consumption. Improving productivity and enhancing demand should be the twin approaches. Development of health foods and their commercialization should receive focused attention to promote the millets among the urban elite, which would lead to reduction in life-style related disorders.

Source: Dr. Hariprasanna K., ICAR-Directorate of Sorghum Research, Hyderabad - 500030
