



## Studies on nutritional benefits and value addition in small millets under Bundelkhand Region

\*Amit Tomar<sup>1</sup>, Mahak Singh<sup>2</sup>

<sup>1</sup>Department of Genetics and Plant Breeding, College of Agriculture, R. L. B. Central Agricultural University, Jhansi, U. P., India

<sup>2</sup>Department of Genetics and Plant Breeding, College of Agriculture, C. S. A. University of Agriculture and Technology, Kanpur, U.P., India

\*Corresponding email: [tomarcsa@gmail.com](mailto:tomarcsa@gmail.com)

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<p><b>Original Research Article</b> Received on September 17, 2017 Revised on September 24, 2017 Accepted on, October 21, 2017 Published on October 28, 2017</p> <p><b>Article Authors</b> Amit Tomar, Mahak Singh <b>Corresponding Author Email</b> <a href="mailto:tomarcsa@gmail.com">tomarcsa@gmail.com</a></p>	<p>Small-grained cereal grasses are collectively called as ‘Millets’, being one of the oldest cultivated foods known to humans. There are two main groups of millets first group consist of major millets (sorghum and pearl millet) and second group has small millets this categorization is based on the grain size, this classification is also an indication of the area under cultivation of these crops, but both (major and small millets) have traditionally been the main components of the food basket of the poor people in India, especially in dry-land farming system in India and elsewhere.</p>
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The small millets are small seeded grains that 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 whereas 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 whereas 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 whereas the other millets are grayish coloured. The husk is non-edible and unusually hard to digest similar to the husk in paddy, whereas 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.

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 2) and are comparable to rice and wheat or even rich in some of the minerals (table 3) as well as fatty acids (table 4). Millets vary largely in composition of carbohydrates as proportion of amylose and amylopectin content vary from 16-28% and 72-84%, respectively (table 5). These results were also similar to (Miller, 2001, Mittal, 2002, Anderson, 2003, Manch *et al.*, 2005).

### **Declining Small Millet Cultivation**

Even though millets have extraordinary nutritional qualities of grains and capacities of millet farming systems, the acreage under millet production has been shrinking over the last five decades. The period between 1961 and 2009 witnessed significant 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% and the productivity has remained more or less stagnant in the last two decades.

### **Small Millets and Nutritional Security**

As it becomes clear from the data presented small millets are superior in one or more of the nutritional components compared to most widely consumed cereals, hence contribute towards

balanced diet and can 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 trend is disturbing which needs focus by the agricultural experts and policy makers. Immediate action on policy-guidelines, market support, value addition and promotional activity are necessary for checking the further decline in cultivation and also in consumption, improving productivity and enhancing demand should be the twin approaches that are to be followed simultaneously, which will ultimately help in promoting the production and consumption of millets. Developing health foods with their proper commercialization need special focus to promote the millets among the urban elite, which would lead to reduction in life-style related disorders.

Small millets consist of a about a dozen distinct species of small-seeded grasses that are grown for grain, each with their own unique traits and value. The most economically significant of these at present is finger millet, but the other small millets are each in their own way important to the farmers who grow them, and are also potentially important to breeders of other cereals as sources of traits that can improve the resilience and nutritional value of those more widely grown crops. Small millets provide staple food grain for millions of poor smallholders and households in the developing world's harshest, most food insecure regions, such as the Sahel in Africa and in South Asia's semi-arid zone, with feed grain and fodder for the livestock.

By default small millets are extraordinarily tolerant to drought and other abiotic stresses, which makes them "climate smart" and a good source for genetic traits that can strengthen the resilience of other crops in the face of climate change. As climate progresses to get hotter and drier, small millets and other dryland cereals will become increasingly well suited for production in areas where other crops are now grown comfortably. Millets in general provide many essential vitamins and micronutrients that can bolster nutrition for those living in dryland areas, particularly women and children, where small millets are especially rich in iron, zinc and calcium,

and have other dietary qualities that can help stave off anemia, celiac disease, and diabetes. The millets with exceptionally high nutritional value – coupled with the impressive hardiness against climate change makes them an important food security crops, for humans as well as for livestock. These findings were also similar to (Akeredolu *et al.*, 2005, Choi *et al.*, 2005, Dyes and Rooney, 2006, Chetham and Malleshi, 2007, Chetham *et al.*, 2008, Liang *et al.*, 2010, Chandrashekhara and Shahidi, 2010).

### Value Added Products from Small Millets

Millets are one of the oldest food grains known to mankind and possibly the first cereal grain used for domestic purposes. For centuries, millets have been a prized crop in India and are staple diet for nearly 1/3<sup>rd</sup> of the world's population. They can adapt themselves to marginal soils and varied environmental conditions. Small millets are more than just finger millet (*Eleusine coracana*) and include kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), foxtail millet (*Setaria italic*), proso millet (*Panicum miliaceum*) and barnyard millet (*Echinochloa frumentaceae*). Millets are most commonly available in the form of pearled and hulled kind. Millets are tasty grains that have a mildly sweet, nut-like flavour. Millets are rich sources of protein, dietary fiber, energy and minerals when compared to rice.

These millets have diversified high food value but the consumption of these millets has declined for want of standardized processing techniques to compete with fine cereals. Hence an effort was made to increase the utilization of small millets in popular foods which would find ready acceptability with the tag of 'Health Foods'. Small millet based value added products including traditional recipes, bakery products, pasta products; flaked and popped products instant food mixes were developed and standardized. The products which are commonly prepared by the farmers using cereals were replaced with small millets to increase their utilization. These findings were also similar to (Chndrashekhara and Shahidi, 2011b, Chndrashekhara and Shahidi, 2011c, Devi *et al.*, 2011, Mathangi and Sudha, 2012, Adekunle, 2012, Amir *et al.*, 2014).

### Bakery Products

People of all ages are affectionate of different bakery products, because of their taste, colour and easy to digest nature. Celebrating any moment of happiness is incomplete with bakery products. Bakery products are becoming prominent day by day. Nowadays individuals have virtually no time to invest much on making breakfast it is the bread and bun or biscuits which had occurred instead of other sorts of stuff. They are good supply of snacks and therefore are broadly available. Small millets were incorporated in different variations from 10% to 50% levels to standardize bread (20%), cake (30%), cookies (50%), soup sticks (20%) and khari (40%) replacing refined wheat flour.

### Pasta Products

Pasta meals like vermicelli, noodles, macaroni etc., are commonly liked by children of today's generation and by other age groups for their taste, inexpensive and easy method of preparation. Pasta is a perfect foundation for healthy, nutritious and satisfying meals, generally eaten with nutrient-dense food partners, such as fiber-filled vegetables and beans, heart healthy fish and monounsaturated oils, antioxidant-rich tomato sauce and protein-packed cheeses, egg, poultry and lean meats. For small millets to be competitive with important cereal foods, preprocessed or alternative millet based foods are required. Vermicelli, noodles Macaroni were prepared from refined wheat flour and blending with small millets at 30% incorporation levels.

### Flaked and Popped Products

Cereal popped products and flakes are popular breakfast foods and at present they are mostly made from corn. By suitable processing it might be feasible to produce popped foods and flakes from millets. These Ready-To-Eat products are very popular, being crisp and friable in texture. The relatively smaller size and quick hydration of millets make them most suitable for the production of flakes and popped products. Small millets were flaked and popped and a variety of recipes were standardized.

**Table1. Nutrient composition of millets compared to fine cereals (per 100 g)**

Food Grain	Carbohydrates (g)	Protein (g)	Fat (g)	Energy (KCal)	Crude fibre (g)	Mineral Matter (g)	Ca (mg)	P (mg)	Fe (mg)
Finger millet	72.0	7.3	1.3	328	3.6	2.7	344	283	3.9
Kodo millet	65.9	8.3	1.4	309	9.0	2.6	27	188	0.5
Proso millet	70.4	12.5	1.1	341	2.2	1.9	14	206	0.8
Foxtail millet	60.9	12.3	4.3	331	8.0	3.3	31	290	2.8
Little millet	67.0	7.7	4.7	341	7.6	1.5	17	220	9.3
Barnyard millet	65.5	6.2	2.2	307	9.8	4.4	20	280	5.0
Sorghum	72.6	10.4	1.9	349	1.6	1.6	25	222	4.1
Bajra	67.5	11.6	5.0	361	1.2	2.3	42	296	8.0
Wheat (whole)	71.2	11.8	1.5	346	1.2	1.5	41	306	5.3
Rice (raw, milled)	78.2	6.8	0.5	345	0.2	0.6	10	160	0.7

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

**Table 2. 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; MILLET in your, Meals, <http://www.sahajasamrudha.org/>)**Table 3. Essential Amino acid profile of Millets (mg/g of N)**

Millet	Arginine	Histidine	Lysine	Tryptophan	Phenyl Alanine	Tyrosine	Methionine	Cystine	Threonine	Leucine	Isoleucine	Valine
Foxtail	220	130	140	60	420	-	180	100	190	1040	480	430
Proso	290	110	190	50	310	-	160	-	150	760	410	410
Finger	300	130	220	100	310	220	210	140	240	690	400	480
Little	250	120	110	60	330	-	180	90	190	760	370	350
Barnyard	270	120	150	50	430	-	180	110	200	650	360	410
Sorghum	240	160	150	70	300	180	100	90	210	880	270	340
Bajra	300	140	190	110	290	200	150	110	140	750	260	330
Rice	480	130	230	80	280	290	150	90	230	500	300	380
Wheat	290	130	170	70	280	180	90	140	180	410	220	280

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

**Table 4. Vitamin profile of Millets (mg/100g)**

Millet	Thiamin	Niacin	Riboflavin	Vitamin-A (carotene)	Vitamin B-6	Folic Acid	Vitamin B-5	Vitamin-E
Foxtail	0.59	3.2	0.11	32	-	15.0	0.82	31.0
Proso	0.41	4.5	0.28	0	-	-	1.2	-
Finger	0.42	1.1	0.19	42	-	18.3	-	22.0
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	1.25	12.0
Bajra	0.38	2.8	0.21	132	-	45.5	1.09	19.0
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; MILLET in your Meals, <http://www.sahajasamrudha.org/>)

### Value Added Products from Popped Small Millets

Uppma, bhelpoori, masala corn, cheeian, flakes, boli, sweet balls, lemon bath, tamarind bath and tomato bath.

### Instant Food Mixes

In the modern days where the life is at fast pace with the time very valuable to every person, "Instant Foods" play an important role in everyone's day-to-day life. The very term 'instant food' means simple, fast and convenient food which is easy and fast to prepare besides being hygienic, free from microbial contamination and also convenient to eat. Unlike olden days where man used to have his food lavishly and slowly, the present trend changed the habits to foods which are simple and easy to digest. Hence, the existence of these foods fulfilled all the needs of modern human being. Traditional south Indian breakfast foods viz., adai, pittu, idiyapam, kali, roti, and kesari were selected. Instant mixes of these traditional products with the incorporation of small millets were standardized.

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