



MILLETS: THE NUTRITIOUS AND CLIMATE CHANGE COMPLIANT FOOD CROP

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ABSTRACT Millets are known to be ancient food grains which are reservoirs of nutrition for a better health. Once largely consumed in India and playing a key role in household food security and dietary diversity, during the last few decades, millets have been almost replaced by wheat or rice as the staple food grain. Nutritional quality of food is a possible answer to maintain overall physical well-being and millets offer better nutrition with various macro and micronutrients. Epidemiological studies have also showed that consumption of millets reduces risk of non-communicable diseases and several GIT disorders. Millets are known for their climate-compliant characteristics which are adaptation to a variety of ecological conditions, less irrigational requirements, good growth and productivity in low nutrient input conditions, not dependent on synthetic fertilizers and mostly remain unaffected by environmental stresses. It will be advisable to promote millet agriculture and awareness of millet nutrition for a healthy population.

KEYWORDS : Millets, Nutrition, Climate compliant ,Agriculture

Introduction

Millets are known to be ancient food grains which are reservoirs of nutrition for a better health. Millets are a group of highly variable small seeded grasses widely grown around the world as cereal crops or grains for fodder and human food that are cultivated as grain crops, primarily on marginal lands in dry areas in temperate, subtropical and tropical regions. The various species differ in their physical characteristics, quality attributes, soil and climatic requirements and growth duration.¹ Millets are unquestionably one of the traditional and oldest foods known to humans but they have been undervalued in when evaluated against wheat and rice with urbanization and industrialization. It was customary for the People in most parts of India, to eat a variety of millets until about 40 to 50 years ago as it was part of their staple food. Later on during green revolution in sixties agriculture in India improved due to the adoption of modern methods and technology in agriculture. Extensive use of high yielding crop varieties, irrigation, fertilizers and pesticides consequently resulted in a remarkable increase in food grain production in India. This program focused only major crops like wheat and rice. Consequently the crops that were more sustainable and could survive on rain rather than irrigation became less important. More than half of the energy supplying grains that are eaten as staple foods by the population are basically three grain varieties, wheat, rice and maize. They've been cultivated, for so many decades now, to produce food grains that are super-sized in relation to their stems. This is beneficial for crop production in bulk and economically lucrative, however not suitable to breed if growing conditions vary with a climate change.

Now, after decades of intensive farming and growth in urban populations with proportionate use of water resources, most of India is likely to deal with severe water crises. Many states are trying to come up with a more sustainable way to farm which again brought their focus on millets or coarse cereals. A variety of coarse cereals are grown throughout the country in different ecology, agroclimatic condition, but mostly as rainfed crop. Sorghum, pearl millet, maize, barley, finger millet and several small millets such as kodo millet, little millet, foxtail millet, proso millet and barnyard millet together called coarse cereals. Sorghum, pearl millet, finger millet, maize and small millets (barnyard millet, proso millet, kodo millet and foxtail millet) are also called nutriceals.²

Nutritional Importance:

Millets are nutritionally comparable to major cereals wheat, rice and maize and serve as good source of protein, micronutrients and phytochemicals. Processing methods like soaking, malting, decortications, and cooking affect the anti-oxidant content and activity³. Millets are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols and protein⁴. About 5-8% of protein is present in finger millet, 65-75% carbohydrates, 15-20% dietary fiber and 2.5-3.5% minerals⁵. Millet proteins are good source of essential amino acids except lysine and threonine but are relatively high in sulphur containing amino acids methionine and cysteine⁶. The use of millets as whole grain makes the essential nutrients such as dietary fiber, minerals, phenolics and vitamins concentrated in the outer layer of the grain or the seed coat form the part of the food and offer their nutritional and health benefits⁷. Essential fatty acids like linoleic acid, among others oleic and palmitic acids are found in free form and, diacylglycerols, digalactosyl diacylglycerols, phosphatidylethanolamine, phosphatidyl serine and phosphatidyl choline in the bound form present in millets⁸. Other fatty acids i.e. arachidic acid, behenic acid, erucic acid are found in trace amounts. Millet oil could be a good source of linoleic acid and tocopherols⁹ and these grains are also valued for their high content of vitamin B. Millets are also rich sources of phytochemicals and micronutrients¹⁰. Millets are a rich source of various phytochemicals including tannins, phenolic acids, anthocyanins, phytosterols and pinacosanols. These phytochemicals have potential positive impact on human health. All millet grain and especially sorghum fractions possess high antioxidant activity in vitro relative to other cereals and fruits¹¹. Pearl millet is a highly nourishing food and nutritionally superior to other major cereals with respect to energy, protein, vitamins and minerals. Indian Heritage Food – Kharodi could be successfully prepared by using pearl millet in addition to finger millet and sorghum. This combination increased the mineral content like calcium, iron, zinc and phosphorus of final product and also improved the sensory attributes and nutritional value of final product and stored throughout the whole year¹².

Nutrient composition of sorghum, millets and other cereals (per 100 g edible portion)

S. No.	Name of the food stuff	Moisture (gm.)	Protein (N*6.25) (gm.)	Fat (gm.)	Minerals (gm.)	Crude Fibre (gm.)	Carbohydrates (gm.)	Energy (Kcal.)	Calcium (mg.)	Phosphorus (mg.)	Iron (mg.)	Thiamine	Riboflavin	Niacin
1	Rice	13.7	6.8	0.5	0.6	0.2	78.2	345	10	160	0.7	0.06	0.06	1.9
2	Wheat	12.8	11.8	1.5	1.5	1.2	71.2	346	41	306	5.3	0.45	0.17	5.5
3	Maize	14.9	11.1	3.6	1.5	2.7	66.2	342	10	348	2.3	0.42	0.10	1.8
4	Bajra	12	11.6	5.0	2.3	1.2	67.5	361	42	296	8.0	0.33	0.25	2.3
5	Barley	12.5	11.5	1.3	1.2	3.9	69.6	336	26	215	1.67	0.47	0.20	5.4
6	Italian Millet	11.2	12.3	4.3	3.3	8.0	60.9	331	31	290	2.8	0.59	0.11	3.2
7	Jowar	11.9	10.4	1.9	1.6	1.6	72.6	349	25	222	4.1	0.37	0.13	3.1
8	Panivaragu	11.9	12.5	1.1	1.9	2.2	70.4	341	14	206	0.8	0.20	0.18	2.3
9	Ragi	13.1	7.3	1.3	2.7	3.6	72.0	328	344	283	3.9	0.42	0.19	1.1
10	Samai	11.5	7.7	4.7	1.5	7.6	67.0	341	17	220	9.3	0.30	0.09	3.2

11	Sanwa Millet	11.9	6.2	2.2	4.4	9.8	65.5	307	20	280	5.0	0.33	0.10	4.2
12	Varagu	12.8	8.3	1.4	2.6	9.0	65.9	309	27	188	0.5	0.33	0.09	2.0

Nutritive Value of Indian Foods ICMR¹³

Neutraceutical functions

Bioactive substances combined with nutrients such as oligosaccharides, lipids, antioxidants (phenolic acids, avenanthramide, flavonoids), hormonally active compounds (lignans, phytosterols) and anti-nutrients (such as phytic acid, tannins etc.) gives more positive health effects¹⁴. Several potential health benefits preventing cancer and cardiovascular diseases, reducing tumor incidence, lowering blood pressure, etc.) have been reported for millet¹⁵. It is reported that millet-consuming population has lower incidence of diabetes¹⁶. It is compared and analyzed that supplemented with ragi food for a month showed higher reduction of glucose in fasting and postprandial condition than other millets [21]. Finger millet seed coat phenolics and dietary fiber content⁵ act as inhibitors decreasing the postprandial hyperglycemia by blocking the action of enzymes (amylase, alpha-glucosidase) needed for hydrolysis of complex carbohydrates¹⁷. As millets are gluten free, they have considerable potential in foods and beverages and can meet the growing demand for gluten free foods and will be suitable for individuals suffering from celiac disease¹⁸. Millet is an alkaline forming food. Alkaline based diet is often recommended to achieve optimal health, meaning when it combines with digestive enzymes. The soothing alkaline nature of millet helps to maintain a healthy pH balance in the body, crucial to prevent illnesses¹⁹. Fermented millet products act as a natural probiotic treatment for diarrhea in young children²⁰. It is demonstrated that millet phenolics may be effective in the prevention of cancer initiation and progression *in vitro*²¹. Millets fraction and extract have been found to have antimicrobial activity.¹⁹

Cultivation and Storage of Millets

There is an emerging need for the world to feed its growing population, therefore, it is important to explore plants such as millets that are grown locally and consumed by low income households in places like India²². Millets are frequently cultivated with other millet varieties, pulses, beans, oilseeds, etc. as part of the mixed farming system. The rich crop and varietal diversity of millet based cropping systems foster and enrich agro-biodiversity of their ecosystems. Millets are C4 carbon sequestering crops contributing to the reduction of CO₂ in the atmosphere, besides being water efficient.¹⁶ For this they deserve to be cherished.²³. Due to their short growing season, these can very well fit into multiple cropping systems under irrigated as well as dry land farming; and provide nutritious grain as well as fodder in a short span. Their prolonged and easy storability under ordinary conditions has accorded them the status of "*famine reserves*"; and this feature is of great relevance for India, as our agriculture suffers from the vagaries of monsoon²⁴. Millets are known for their climate-resilient features including adaptation to a wide range of ecological conditions, less irrigational requirements, better growth and productivity in low nutrient input conditions, less reliance on synthetic fertilizers, and minimum vulnerability to environmental stresses²⁵. The areas which are economically weak and do not afford to have facilities for appropriate storage of grains, it is a privilege that millets preserve well in ordinary conditions without demanding special conditions. In particular finger millet is very resistant to grain mould and insect attack, a property that can be most probably attributed to the presence of tannins²⁶.

Conclusion

Considering nutritional benefits and extraordinary qualities of millets agriculture concerted efforts are required to promote millets as a staple food comparable to major cereals wheat and rice. Against the background of an unprecedented growth of the human population combined with increasing environmental pressures and competitive land use millet cultivation may prove to be solution for food security. Inclusion of millets in government-sponsored school feeding programs and in subsidized public distribution systems will improve health of socio-economically and nutritionally-vulnerable populations consequently leading to a healthier population.

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