



## Pearl millet : The Nutri-cereal

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Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is the sixth most important cereal crop after rice, wheat, maize, barley and sorghum. It is widely grown on 30 million ha in the arid and semi-arid tropical regions of Asia and Africa, accounting for almost half of the global millet production. Pearl millet is an important source of dietary energy, and provides nutritional security for people in the third world countries, particularly in Africa and Asia. Pearl millet is an excellent source of micronutrients like iron and zinc. Pearl millet is the staple food of majority of the poor and small land holders, as well as a source of feed and fodder for livestock in the rainfed regions of the country. Pearl millet excels all other cereals because it is a C<sub>4</sub> plant with high photosynthetic efficiency and dry matter production capacity. It requires less inputs, matures in short duration and is considered as nutritious food, feed and fodder. It is usually grown under the most adverse agro-climatic conditions where other crops like sorghum and maize fail to produce economic yields. In India, pearl millet is the third most widely cultivated food crop after rice and wheat.

### Pearl millet Cultivation and consumption

Pearl millet with restricted geographical distribution, is primarily cultivated in Africa and Asia in more than 32 million hectares. India has the largest area (8.8 million ha) under pearl millet cultivation in the world (FAO 2016). The world millet production is estimated at 30 million tonnes in 2016 (FAO 2016). In the late 1980s, pearl millet production in India remained relatively stable and increased steadily with the introduction of high-yielding hybrids. In 2016, nearly 8.8 million ha of land in Rajasthan, Uttar Pradesh, Haryana, Maharashtra, Gujarat, Madhya Pradesh and Karnataka.

It is grown on 7.128 million ha with an average productivity of 1132 kg/ha during 2015-16 (Directorate of Millet Development, 2017; Project Coordinator Review, 2017). The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana which account for more than 90% of pearl millet acreage in the country. Most of pearl millet in India is grown in rainy (kharif) season (June–September). It is also cultivated during the summer season (February–May) in parts of Gujarat, Rajasthan and Uttar Pradesh; and during the post-rainy (rabi) season (November–February) at a small scale in Maharashtra and Gujarat.

### Pearl millet : a super grainy Nutri-cereal

Pearl millet is called as the “Powerhouse of Nutrition” due to its richness with essential nutrients in good quantity and quality, which are vital for leading healthy and nutritious life. Pearl millet has elevated contents of various macronutrients as well as micronutrients like iron, zinc, magnesium, calcium, phosphorous, copper, manganese, riboflavin, and folic acid. Owing to such excellent nutritional values, it is gaining popularity and is preferred by people

all over the world including developed countries. Pearl millet is rightly termed as “nutricereal” as it is a good source of energy, carbohydrate, protein, fat, ash, dietary fiber, iron and zinc. Pearl millet is a rich source of energy (361 Kcal/100g) comparable with sorghum (349 Kcal/100g), wheat (346 Kcal/100g), rice (345Kcal/100g) and maize (325Kcal/100g). The carbohydrate content of pearl millet is 67.5 g/100g; with 56 to 65% starch comprising 20 to 22% amylose and 2.6 to 2.8% free sugars mainly sucrose. It is high in fibre (1.2g/100g) and in  $\alpha$  amylase activity, when compared with other grains. The protein content of pearl millet is (11.6/100g), comparable to wheat but higher than rice. It is rich in methionine but poor in Sulphur containing amino acids. With low prolamin fraction, pearl millet is gluten free grain and is the only grain that retains its alkaline properties after being cooked which is ideal for people with gluten allergy. Pearl millet is rich in fat content (5 mg/100g) with better fat digestibility as compared to other grains. It is rich in unsaturated fatty acids (75%) with higher content of nutritionally important n-3 fatty acids than other cereal grains. Higher activities of lipases result in rapid release of fatty acids, which limits its shelf life. Pearl millet is a rich source of vitamins and minerals. Overall mineral content is 2.3 mg/100g constituting potassium, phosphorous, magnesium, iron, zinc, copper and manganese. It is rich in B-vitamins (thiamine, riboflavin and niacin). It has 3 fold higher levels of fat, which are rich in n- 3 3 fatty acids than wheat. Among micro-nutrients, it is loaded with minerals with relative abundance of Iron and Zinc. Vitamin content of pearl millet is equally good with higher Vitamin A and folic acid compared to wheat. Pearl millet has high nutrient content but the nutrient bioavailability is low, inherent to the presence of certain anti-nutritional factors like phytic acid, polyphenol etc. Polyphenol content was found to range from 491 to 765 mg / 100g whereas phytic acid content ranged from 354 to 825.7 mg Protein and starch digestibility of pearl millet is low due to the presence of anti-nutrients in grains. Protein digestibility in pearl millet varieties range from 54.2 to 59.2 per cent. Starch digestibility of pearl millet has been reported to range from 12 to 18.7 mg maltose released/gram.

### **Pearl millet for diabetes and celiac disease**

Pearl millet is a sustainable cereal with superior glycemic control over Maize, wheat and rice. Genetic variations present in pearl millet for traits such as slowly digestible starch (SDS) and resistant starch (RS) known to contribute to low glycemic index (GI) in pearl millet. Low Glycemic index diets are good source of food for Diabetic patients. Low gluten level in pearl millet prevent the celiac disease that is a major problem with major staples like rice and wheat.

### **Pearl millet: A Climate resilient crop**

It is an under-utilised crop, however, its immense nutritional potential has not been tapped. In comparison to maize or wheat that are uncultivable in harsh conditions, pearl millet is cultivatable in areas with drought, low soil fertility, high salinity, low pH or high temperature. Even in case of climate change with harsh temperature conditions, pearl millet is adaptable. Djanaguiraman *et al.* (2017) reported that as compared to other cereals pearl millet showed greater ceiling temperatures for grain yield, making it a climate resilient crop suitable for semi-arid regions of the world.

### **Bio fortified varieties of Pearl millet**

Pearl millet has a huge potential to be enrich with deficit micronutrient that are essential for the human nutrition and health. Inherently Pearl millet is low in iron content that be fullfill using the strategy of embracing these nutrient through fortification methods. ICAR and other institutes have developed few excellent enriched varieties of Pearl millet as follows:

Variety	Fe (ppm)	Zn (ppm)
HHB 299	73	41
AHB 1200	73	-
AHB 1269Fe	91	43
ABV 04	70	63
Dhanashakti	71	40
ICMH 1201/ Shakti 1201	75	40

### Way forward in enhancing demand of pearl millet

The main constraint in enhancing the demand for Pearl millet has been the problem of rancidity in pearl millet flour as well as in value added products prepared using pearl millet flour. Thus, as discussed in the earlier sections appropriate research and development, leveraging on the past and ongoing research activities, towards tackling the issue of rancidity in pearl millet flour is the most important intervention required for ensuring a sustainable demand for pearl millet. In addition, focus on creating demand pull for pearl millet through an integrated value chain approach by linking the farmers to markets need. The typical grey colour of the pearl millet and its products due to polyphenolic pigment present in peripheral area of grains restricts its efficient use in food industry. Farm gate level pearl millet processing units equipped with primary and secondary processing machinery for directly processing the farmers produce, as per market demand shall result in additional income for the farmers, thus motivating them to grow pearl millet. These include equipment for destoning, sorting and grading, dehulling, roasting, pulverizing, shifting, flaking and packaging. Appropriate capacity building and leveraging of ICT technologies also needs to be encouraged.

### Conclusion

Pearl millet being a climate-resilient crop along with high nutritional value can be exploited for improving nutritional quality and combating malnutrition. It is almost free from major diseases and insect attacks and could be cultivated with a good harvest. Hence, the focus should be laid towards the development of food products from pearl millet to make it acceptable as an alternative crop of the future.