Millets: Potential and Challenges in achieving Nutrition Security in India

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Why in News: The U.N. Food and Agriculture Organisation (FAO) has declared 2023 to be the 'International Year of Millets', giving these crops a shot in the arm even as countries worldwide are looking to them for their ability to grow in environmental conditions that the climate crisis is rendering more common. Millets are becoming more popular in India as well because of their low input requirements and high nutritional density, both of which are valuable for a country whose food security is expected to face significant challenges in the coming decades. However, the consumption of millets faces one threat that has already overtaken India's major food crops: grain-processing.

A brief about Millets

Millets are fundamentally grasses. They are cultivated worldwide, but especially in the tropical parts of Africa and Asia, as cereal crops.

Some of the more common varieties include pearl millet (Cenchrus americanus), barnyard millet (Echinochloa utilis), finger millet (Eleusine coracana), and foxtail millet (Setaria italica).

There is both palaeontological and textual evidence to indicate that millets were being cultivated in the Indian subcontinent five millennia ago.

According to the Agricultural and Processed Foods Development Authority, India is the world's largest producer of millets. In 2021-2022, the country accounted for 40.51% of the world's pearl millet production and 8.09% of sorghum. Within the country, pearl millet made up 60% of all the millet production, sorghum 27%, and ragi 11%.

Sorghum (Sorghum bicolor), adlay millet (Coix lacryma-jobi), and teff (Eragrostis tef) – among others – are some grasses that differ in some respects from the millets but are grouped together with them.

Importance of Millets

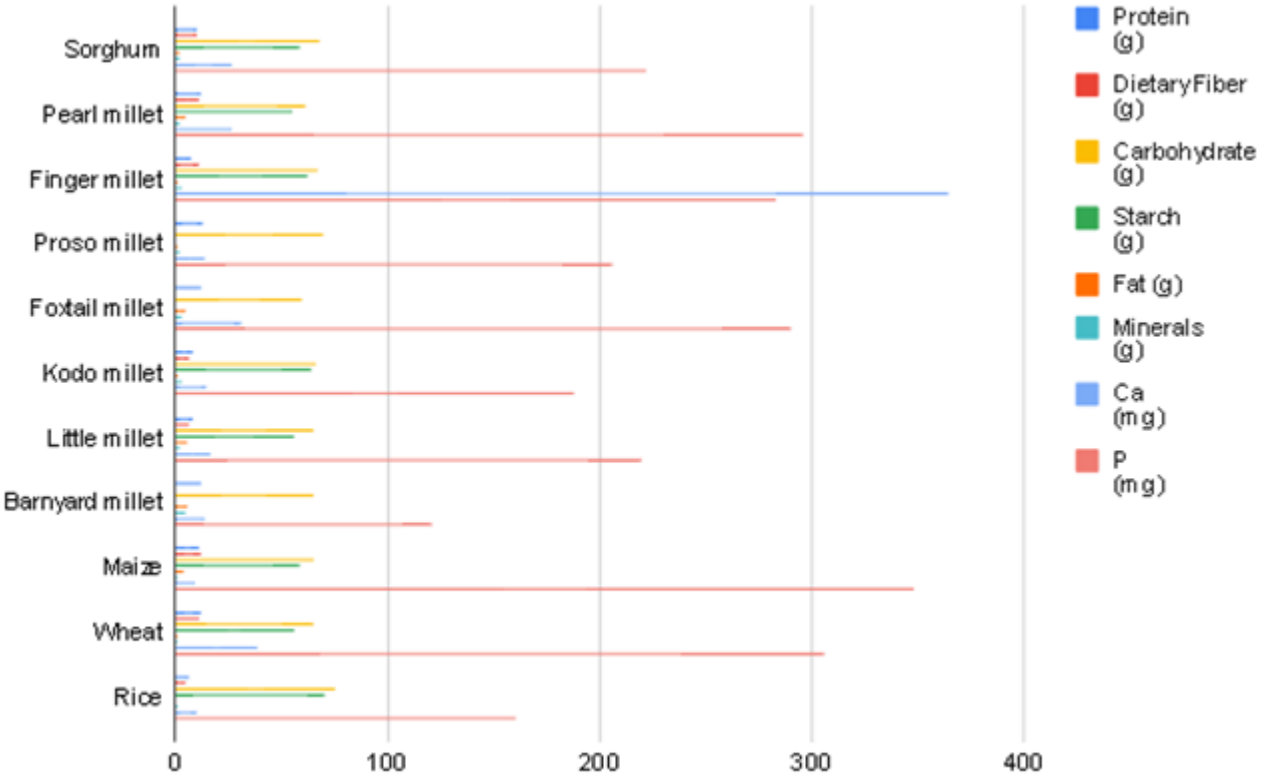
Millets have two broad features that render them attractive: their nutritional value being comparable to that of the major extant food crops (and better on some counts) and the ability of millet crops to reliably withstand harsh, resource-poor conditions.

They are drought-tolerant, adapted to growing in warm weather, and require low moisture (axiomatically, they are particularly efficient consumers of water) and loamy soil.

They don't grow well in water-logged or extremely dry soil, such as might occur after heavy rainfall or particularly bad droughts, respectively.

Nonetheless, millets have the reliability upper hand over crops like rice and maize with more drought-like conditions expected in many parts of the world, including the newly realised prospect of 'flash droughts'.

Millets don’t abhor better growing conditions, and respond positively to higher moisture and nutrient content in the soil.



Nutrition potential of Millets

The nutritional content of millets includes carbohydrates, proteins, fibre, amino acids, and various minerals. Different millet varieties have different nutrient profiles.

For example, pearl millet – one of the oldest cultivated varieties – has been found to have higher protein content than rice, maize, and sorghum, while being comparable to that of barley.

According to various studies, foxtail millet is rich in the amino acid lysine; finger millet has more crude fibre than wheat and rice; proso millet has a significant amount of the amino acids leucine, isoleucine, and methionine; and overall, millets have been found to be important sources of micronutrients and phytochemicals.

According to a paper published in 2021 in the journal Agriculture & Food Security, each millet kernel consists of three major parts, called pericarp, endosperm, and germ.

The pericarp has an outer covering called the husk. The husk and the pericarp together protect the kernel from inhospitable ambient conditions, disease, and physical damage.

The endosperm is the largest part of the kernel and its ‘storage’ centre. It has a protein covering called the aleurone.

According to an FAO article about sorghum, the endosperm is “relatively poor in mineral matter, ash and oil content” but “a major contributor to the kernel’s protein (80%), starch (94%) and B-complex vitamins (50-75%)”.

Similarly, pearl millet has a relatively larger germ, which is “rich in oil (32%), protein (19%) and ash (10.4%),” plus “over 72% of the total mineral matter”.

A February 2022 study summarised the nutritive contents of millets, relative to rice, wheat, and maize, as given in the figure.

This is why, according to various experts, millets deserve to be included in people's diets. But whether they're actually included depends on the availability of "delicious products to satisfy the taste, providing knowledge on nutritional and health facts on millets, and improving accessibility," per a 2021 study.

Grain processing of Millets: Concerns

Processing and preparing millets for consumption can affect nutrients in three ways: enhance them, suppress/remove them, and ignore them.

In this context, 'whole grain' refers to the endosperm, germ, and bran (pericarp + aleurone) whereas 'refined grain' refers only to the endosperm.

The husk is removed from the grains because it is composed of cellulosic matter that the human body can't digest. But at least one study has found that when this is done to pearl millets, their phytic acid and polyphenol contents drop.

On the other hand, a paper published in 2021 found that millet husk could be briquetted and used as household fuel, and potentially alleviate energy poverty in north Nigeria.

The second common step is to decorticate the grain, i.e. remove any other outer covering and expose the seed. While studies have found that mechanical and hand-worked decortication didn't have significantly different effects on the grain, they both removed crude and dietary fibre.

But decortication also makes the grain more edible and visually attractive – favourable factors in marketing in urban centres.

The typical next steps are milling, to grind the grains into flour, and sieving to remove large 'impurities', including bran.

One 2012 study of finger millet found that whole-flour had a high content of "total polyphenols and flavonoids" – while sieving made the flour more digestible and its nutrients more accessible to the body but reduced nutrient content due to the loss of bran.

On the other hand, according to the February 2022 study, germination and fermentation – in which the grains are soaked in water for an extended duration – "showed a positive improvement in the overall nutritional characteristics of millets".

Effect of Polishing

A frequent last step is polishing. The longer the grains were milled, the more protein, fat, and fibre contents the process removed.

A different 2012 study found that barnyard millet could be polished with a rice polisher for up to three minutes without significant nutrient loss. Polishing is the process whereby brown rice, for example, is changed to white rice by rubbing off the bran and the germ.

A 2012 study in the Journal of Cereal Science assessed the effects of polishing the two major Asian rice varieties – indica and japonica – on their nutritive value.

Using a combination of precision abrasive polishing, plasma mass spectrometry, and fluorescence microscopy, they found that polishing that removed 8-10% of grain weight also removed 60-80% of iron, magnesium, phosphorus,

potassium, and manganese in both varieties. The loss of bran also compromised the grains' fibre content.

Yet rice polishing is considered desirable because, per a 2009 study, most consumers favour the resulting taste and texture and prefer the shorter cooking time; and retailers want longer shelf-life, which can be achieved by removing the bran.