Futuristic view of Millets in India

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Abstract
Millets were main staple in India for many years before grains like wheat and rice took the front seat as main crop of the country. Due to the intake of these non-millet carbohydrates having high glycaemic index, there is an increase in diseases like diabetes. Malnutrition and stuntedness in children in India are another big challenge. This study investigates the nutritional value of millets which can be an answer to these challenges. The study found that millets are having a very high content of nutrients to tackle the issues of overall public health. The potential of these wonder crops is far-reaching and it is not only a good source of nutrients, it can also put a break on rising health issues like diabetes, blood pressure, obesity, cholesterol, heart attack, etc.

Keywords: Nutritional value, Millets, Public health, Food

1. Introduction

There was a time when millets were the main staple of India. With time paddy rice and wheat replaced millet in the priority list. In spite of being super crops, millets are not produced much because of their lower demand. If we see from the nutrition point of view these crops can be a very good substitute for rice and wheat in India. Malnutrition harms human growth, and despite various preventive measures, the entire race, especially children, remains malnourished. Malnutrition usually causes stunting and underweight. 161 million children under five are stunted and 99 million are underweight (Muthamilarasan et. al., 2016). Half of stunted and two-thirds of underweight children live in Asia. Malnutrition causes 50% of child mortality under five, and India has the greatest stuntedness rate in the world (Black et al., 2013; Jayachandran et. al., 2013). India has higher child malnutrition due to the inadequate nutritional value of primary non-millet grains (Deaton et al., 2009). Undernourishment is a problem in India and other countries that eat rice and wheat. Non-millet cereals are nutritionally deficient and have a high glycaemic index (GI), which rapidly raises blood glucose levels and causes hyperglycaemia. As per the WHO report on diabetes, there was a 3% increase in diabetes mortality rate between 2000 and 2019. Recent research on children's type 2 diabetes and WHO's prediction that diabetes deaths will double by 2030 necessitate healthy and low-GI diets. Preventing malnutrition and diabetes by providing supplementary foods, promoting immunisation, and monitoring feeding and caring practices is important, but so is introducing nutritious and low GI foods and improving staple crop nutrition. Thus, millets are needed to meet nutritional needs and avoid diabetes. Millets are extraneous fodder grasses with small grains. These are also drought- and salinity-tolerant, nutrient-rich, and pathogen-resistant (Lata et al., 2013). These are good staple crops for expanding populations like India since they grow quickly. Millets vary in size and bulk. Only foxtail millet and pearl millet have been widely studied, and their nutritional properties have not been systematically investigated. This review compares millet with non-millet cereals' nutrient profiles to show their value.

2. Nutrients in Millets

Millets are healthy, non-glutinous, and acid-free, but foxtail and proso millet have glutenous grains (Sakamoto, 1982). Millets are dubbed "nutritious millets" or "nutri cereals" because they have higher quantities of proteins, minerals, vitamins, and antioxidants than non-millet cereals. Millets are high in micro- and macronutrients, low-GI non-starchy polysaccharides, and dietary fibres. Millets are beneficial for type 2 diabetes due to their high content of slowly digested and resistant starch (Amadou et al., 2013). Table 1 below shows the comparative study of nutrients present in Pearl millet (Bajra), Sorghum (Jowar), Finger millet (Ragi), Wheat and Rice per 100 gm of edible portion:

Table 1

Nutrient	Pearl Millet	Sorghum	Finger Millet	Wheat	Rice
Calories	378 kcal	329 kcal	378 kcal	339 kcal	140 kcal
Carbohydrates	67.5 g	72.1 g	72.9 g	72 g	80 g
Protein	11 g	10.6 g	7.6 g	11.8 g	6.8 g
Fat	4.2 g	3.3 g	1.5 g	1.5 g	0.5 g
Fiber	8.5 g	6.7 g	3.5 g	12 g	0.2 g
Calcium	42 mg	28 mg	344 mg	42 mg	10 -30 mg
Iron	16.9 mg	4.4 mg	3.9 mg	16.9 mg	0.2-1.5 mg
Magnesium	114 mg	165 mg	137 mg	114 mg	25-65 mg
Phosphorus	285 mg	287 mg	283 mg	285 mg	100-150 mg
Potassium	254 mg	363 mg	408 mg	254 mg	30-100 mg
Zinc	1.7 mg	2.3 mg	2.7 mg	1.7 mg	0.2-1.3 mg
Vitamin C	0 mg	0 mg	0 mg	0 mg	0 mg
Thiamine (B1)	0.4 mg	0.4 mg	0.3 mg	0.4 mg	0.1-0.4 mg
Riboflavin (B2)	0.3 mg	0.1 mg	0.1 mg	0.1 mg	0.04 mg
Niacin (B3)	2.3 mg	2.5 mg	1.1 mg	2.3	1-2 mg
Vitamin B6	0.4 mg	0.2 mg	0.4 mg	0.4	0.1-0.2 mg
Folate	85 mcg	44 mcg	42 mcg	85 mcg	1-8 mcg

Ref. – Deshpande et al. 2015; Abdalla et al., 1998; Saleh et al., 2013, Sokrab et al., 2012.

The above figures are approximate values as they vary depending on the quality of grain and the condition in which they are grown.

2.1 Proteins

Proteins provide amino acids, including critical amino acids that the body cannot synthesise. After germination, millets and non-millet cereal grains provide nitrogen to embryos. Seed storage proteins (SSP) are nutritious because they are edible. SSPs are divided into four solubility categories: albumin (water soluble), globulin (soluble in dilute salt solution), prolamin (soluble in alcohol), and glutelin (extractable in dilute alkali or acid solutions) (Osborne, 1924). Wheat, like other non-millet cereals, has 11.8g/100g protein, but rice has 6.8g/100g. Wheat proteins lack critical amino acids, but most millet proteins do, preventing protein-energy deficiency (Table 1).

2.2 Starch

Starch, the main carbohydrate in human diets, is stored in agricultural plants' seed endosperms for development (James et al., 2003). Starch contains amylose and amylopectin, which hydrolyse to simple sugars when consumed. Starch is divided into three digestibility categories: RDS, SDS, and RS (Englyst et al., 1992). RDS-rich cereals release glucose immediately, raising blood glucose levels. Millets are rich in SDS and RS, which resist digestion and are catabolized by the gut microbiota to release glucose slowly into the bloodstream, reducing postprandial glycaemic and insulinemic responses, plasma cholesterol and triglyceride levels, whole-body insulin sensitivity, satiety, and fat storage (Higgins, 2004). SDS and RS are essential for preventing dyslipidemia, type 2 diabetes, obesity, and coronary heart disease. Studies show that diabetics can lower their glucose levels by eating millets.

2.3 Lipids

Lipids provide fat and necessary fatty acids. It is an important component of our diet as it contributes to storage stability, making bread, and brewing. Millets are rich in linoleic, oleic, and palmitic acids. Seed lipid fractions come from the germ and aleurone layers, and lipid bodies border cell periphery (Lorenz & Kulp, 1991). Pearl millet has the maximum fat (3–6%), while wheat and rice have much less. Pearl millet also has 46.3 percent linoleic acid and 75% unsaturated fatty acids (Taira, 1984; Lorenz & Hwang, 1984). Lorenz and Hwang (1984) also observed that proso millet flours have 3.2–4.0% free lipids and bran 3.4–6.8%. Hydrocarbons, sterol esters, triacylglycerols, diacylglycerols, and free fatty acids were discovered in linoleic, oleic, and palmitic acids. Phosphatidylethanolamine, serine, and choline are found in bound lipids (Sridhar et al., 1992). Linoleic acid made over 70% of the total fatty acids in glutinous and non-glutinous millets. According to another study foxtail millet bran oil contained linoleic (45.7%), oleic (24.7%), palmitic (16.7%), and stearic acids (8.2%) (Liang et al., 2010).

2.4 Micronutrients

Millets include vitamins and trace elements needed for proper body processes. Foxtail millet has 0.59mg/100g of thiamine, while proso millet has 0.28mg/100g of riboflavin. Rice and wheat had 0.04mg and 0.1mg riboflavin per 100g edible amount which is almost same as sorghum and finger millet (Table 1) and significantly less than pearl, foxtail, and small millet. Phosphorus and calcium regulate acid-base balance, energy production, cell signalling, and bone mineralization. Foxtail millet has the most phosphorus (422 mg/100g) whereas rice has much lesser phosphorus than millets. Finger millet is rich in calcium (344 mg/100g). Several enzymes use magnesium as a co-factor, and kodo millet, sorghum and finger millets have more magnesium than rice and wheat. Copper is high in proso millet (5.8mg/100g), manganese in finger millet (5.49mg), and chromium in little millet (0.240mg). Pearl millet has iron content as much as in wheat (Table 1). Girish et al. (2014) analysed barnyard, little millet, finger millet, kodo, and foxtail millets for iron and zinc and found that millets have more of these micronutrients compared to rice. Barnyard millet has (4.6mg/100g) iron, followed by finger millet, little millet, kodo, and foxtail. Foxtail millet had the most zinc (4mg/100g), followed by barnyard (3.6mg), little millet, and finger millets (2.7 mg/100). These reports show that millets have higher micronutrient content than main non-millet grains.

3. Potential and prospect of Millets

Millet is a wonder crop that is neglected in our country for some time now (Bergamini et. al., 2013). India faces significant nutritional challenges despite having numerous national nutritional intervention programmes because micronutrient malnutrition prevalence continues to be a significant public health issue with an associated economic impact of 0.8 to 2.4% of the GDP. According to estimates from National Family Health Survey, approximately 46% of children under the age of five, particularly those living in rural areas (Rajaram et al., 2007), are moderately to severely underweight (thin for age), 38% are moderately to severely stunted (short for age), and approximately 17% are extremely vulnerable (Arlappa et al., 2010). Numerous species and varieties of food plants have been marginalised and have lost importance in national agricultural production systems and economies as a result of the overdependence on a small number of species, including rice, maize, wheat, and potatoes, which account for more than 50% of the world's caloric intake (FAO, 2010). Since many of these species offer a wider range of macro and micronutrients than those found in major staple crops, less research on these so-called neglected and underutilised species (NUS) (Padulosi and Hoeschle-Zeledon, 2004) results in missed nutrition and health opportunities (Frison et al., 2006; Chadha and Oluoch, 2007; Hawtin, 2007; Smith and Longvah, 2009). Minor millets are one of these very promising crop groups. They are referred to as "minor" since they do not garner significant research funding and have little commercial significance in terms of production, consumption, and geographic scope (Nagarajan and Smale, 2007). This study shows that they are by no means 'minor' in terms of their nutritional and income-generating prospects. These millets were once widely consumed in India and were essential for ensuring family food security and nutritional variety, but rice has since overtaken them as the country's main grain. However, during the past ten years, there has been an increase in awareness of their advantageous nutritional qualities and related advantages, in part because of numerous national and international programmes aimed at valuing them in South Asia, particularly in India (Padulosi et al., 2009). Additionally, they are no longer associated with the negative connotations of "poor people's food," despite playing a crucial role as a staple crop in marginal agricultural regions, and are now valued as healthy foods for urban and middle-class populations (Bala Ravi et al., 2010).

4. Conclusions

Due to their nutrition, low GI, and climate-change resilience, millets are adaptable crops. With the presence of resistant starch, useful lipids, fibres, protein, micronutrients, and antioxidants like phenolic acids, millets are rich in all these nutrients and bioactive compounds, making them useful foods. Millets are "nutraceuticals" because they provide dietary fibres, proteins, energy, minerals, vitamins, and antioxidants. Millets reduce tumour incidence, blood pressure, heart disease risk, cholesterol, and fat absorption, prolong stomach emptying, and supply gastrointestinal bulk. Recent studies have shown that vitamins, minerals, essential fatty acids, and fibres can work with other bioactive compounds to improve health. Millets have received little scientific attention until recently, but several regional and global programmes have been announced to exploit their health benefits. In the Indian scenario millets have got high potential to improve general health and nutritional prospect.

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