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Review Article

Minor Millets: Abandoned Grains with Promising Prospects

Laghima Arora*, Shenazdeep Kaur and Renuka Aggarwal

Department of Food and Nutrition, Punjab Agricultural University, Ludhiana, India

Abstract

Despite the fact that the green revolution helped India become self-sufficient, the productivity of the wheat rice cropping system is now approaching stability. Agricultural diversification is required in order to introduce traditional grains that are both environmentally friendly and nutritionally sufficient. Millets are small seeded grasses that appear to meet this requirement. These are eco-friendly and have a well-balanced macronutrient and micronutrient composition. Millets also have nutraceutical properties and can help to prevent a variety of non-communicable diseases. Soaking, roasting, germination, and fermentation procedures improve the palatability of millets while simultaneously reducing anti-nutrients, enhancing the physiochemical accessibility of micronutrients and improving their bioavailability. Preparing value-added products and popularising them among the general public can boost millet demand as well as farmer's income. It is necessary to develop and popularise millet-based food products that provide poor people with convenience, flavour, texture, colour, and shelf-stability at a low cost.

Keywords: Foxtail millet; Minor millets; Nutraceutical value added products; Proso millet

Introduction

India is the second largest producer of wheat and rice [1], with 107.2 and 72.7 million tonnes of production in the year 2020, respectively [2]. Wheat-rice cropping system has emerged as a major production system in the Indo-Gangetic plains. The Indo Gangetic Plains through the cultivation of principal foods like wheat and rice, played a huge role in the green revolution and also ensured food security to the nation. Owing to green revolution in the 1960's, the production of these grains increased consistently in the country, with an increase of 70-74% for wheat and 40-45% for rice in the year 2018 [3]. The wheat rice production systems in Indo Gangetic plains play a very important role in providing countrywide food security, employment and livelihood to many population groups [4].

India became a self-sufficient country and started covering the food deficit and providing food security to the nation. However, there appears to be enough evidence through various studies conducted over time that the productivity in the country is approaching steadiness. The self-sufficiency of the production system is negatively affected by the factors like imbalanced application of fertilizers on the soil, diminished soil fertility due to depletion of nutrients, reduced recycling of soil and water resources leading to low pH of the soil and water balance abnormalities, increased incidence of diseases and rodents and the loss in natural ecosystem [5]. Other factors like lack of various facilities such as shortage in energy generation systems and grain storage, as well as a lack of residue management after crop harvesting, pose a significant threat to farmers, forcing them to use ineffective and inexpensive methods such as residue burning to ensure timely sowing of the next crop. This entire process has a negative impact on the environment since it pollutes the air with Carbon Dioxide (CO2), Carbon Monoxide (CO), Methane (CH4), and other toxic substances [6]. The rising atmospheric temperature due to climate change, increasing food prices and world population are posing a great risk to food security and agriculture worldwide, especially for the poorest people living in arid and subarid regions [7]. The rise in area under crops that demand more water, such as rice, cotton, and sugarcane, has resulted in a significant loss of water [8].

According to WHO, 820 million people in the world suffer from chronic hunger. As per Global Hunger Index, India has been ranked at 101 position out of the 116 countries with a score of 27.2, showing a serious level of hunger for the country [9]. The ongoing COVID-19 pandemic has double-hit the disease and number of hungry people especially in developing countries [10]. The main causes of this crisis include disruptions in the commodity supply chain caused by the prohibition of worldwide export, rising food costs, and financial constraints (due to job losses). The current epidemic has restricted food access among the poor, resulting in untimely deaths caused primarily due to lack of food rather than illness/ infection. The immediate measure to help the affected population is to provide sufficient quantity of food grains, whereas in long run, there is a need to take important decisions in the field of agriculture production system so that there would be enormous amount of food to overcome the challenges like the current pandemic [11].

Therefore, there is a need for diversification in agricultural practices so as to introduce the traditional grains which are sustainable to the environment and are nutritionally adequate.

This review aimed to evaluate the available information on the minor millets, its nutritional composition, effects of processing techniques applied on the nutritional composition, development of various food products from minor millets and also to evaluate the shelf life of minor millets under various processing techniques applied.

***Corresponding author:** Laghima Arora, Department of Food and Nutrition, Punjab Agricultural University, Ludhiana, India, Tel: +91 7009420021; E-mail: aroralaghima.la@gmail.com

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Millets: Power House of Nutrients

Millets also known as Nutri-cereals are a group of small seeded grasses. Millets have been reported to be nutritionally superior when compared to many cereals [7]. They are rich sources of macronutrients such as proteins, carbohydrates, dietary fiber and essential amino acids [12]. Millets have balanced nutritional composition and its consumption has proven health benefits. They are rich in phytochemicals and micronutrients [13]. Millets are reported to have potential in preventing cancer by lowering tumor incidence and cardiovascular diseases, reducing incidence of hypertension, higher levels of blood lipids, slowing down fat absorption in the body, delay gastric emptying and supplying bulk to the gastrointestinal contents and are gluten-free [14]. The literature reports that bioactive substances such as oligosaccharides, resistant starch, lipids, antioxidants like flavonoids and phenolic acids, hormonally active compounds like phytosterols and lignans, anti-nutritional factors such as tannins and phytic acid present in millets contribute for these positive effects [15].

Millets are classified into two categories: major millets and minor millets. Sorghum and pearl millets are among the major millets, while Little millets, Indian barnyard millets, Kodo millet, Foxtail millets, Finger millets, and Proso millet are among the minor millets. Minor millets are also a good source of essential amino acids and fatty acids. It was suggested that millets possess nutraceutical properties as they contain good amount of phytochemicals (lignans, β-glucan, inulin, resistant starch, phytates, sterols, tocopherol and carotenoids) [16] and are gluten free, it was also suggested that due to the presence of phytochemicals, millets can play important role in the prevention of many non-communicable diseases and are excellent food choice for people suffering from celiac disease [17].

Foxtail millet (*Setaria italica*) and Proso millet (*Panicum miliaceum*) are rich sources of nutrients [18]. These are nutritionally superior as compared to other cereal grains. Foxtail millet (*Setaria italica)* is the second largest grown millet crop which is self pollinating. It is 2-3 times nutritionally rich than the major cereal crops such as rice and wheat. It contains 11% protein, 3.9% fat, 7.0% ash, 59.1% starch, 19.1% dietary fibre and 106.6mg/100g of phenol content [18]. Being rich in protein and good quality of amino acids, foxtail millet could be used as a potential alternative to animal origin protein sources. As a nutri cereal, it has dual uses as it could be used as both food and feed [19]. It has antimicrobial potential, helps in detoxify the body, and is also considered as heart healthy food because of its high magnesium content [20]. Foxtail millet is traditionally been consumed as soup or gruel by pregnant and nursing women as nourishing therapy in northern china. It is considered as a functional food as it reduces the risk of developing various chronic diseases such as diabetes mellitus and metabolism of cholesterol [21]. Along with the antioxidant potential and gastric mucosa protection, foxtail millet also shows the anti-ulcer response [22].

Proso millet has a protein content of 11%, 3.5% fat, 9% crude fibre, 3.6% ash, 56.1% starch, 8.5% total dietary fibre, 13.3mg/100g of total phenol content. It is rich in minerals such as calcium 165mg/kg, iron 54mg/kg, zn 36mg/kg and vitamins like B complex vitamins such as niacin and folic acid. Proso millet contains good amount of amino acids particularly sulphur containing amino acids such as cysteine and methionine [23]. Proso millet also has good amount of magnesium and is inexpensive source of heart healthy foods. Proso millet has antiproliferative properties against liver cancer cells, and its carotenoid extract has a higher antioxidant capacity than carotenoids found in fruits and vegetables [20]. Proso millet starch is similar to the corn starch and it could be used as a sizing agents in the textile industry. Non waxy starch of proso millet has many benefits in reducing the risk of various diseases [24].

The dietary protein of proso millet play an important role in reducing the LDL cholesterol and increasing the HDL cholesterol in human body [25]. It was suggested that due to presence of favorable ratio of branched chain amino acids to aromatic amino acids (3:1), proso millet can be considered as a preventive food against liver diseases like hepatic encephalopathy [26]. Proso millet contains non-digestible carbohydrates and can be used as a prebiotic [27]. It was reported that resistant starch present in proso millet play an important role in decreasing blood glucose and influences the serum triglyceride level [28].

Like all the other millets, both proso millet and foxtail millet are gluten free and ideal for the gluten intolerant people [18]. These millets contain vitamins A and E along with many B-complex vitamins [16]. Foxtail millet and Proso millet are also rich sources of anti-nutritional factors like tannins (221.1mg/100g), phenols (352.64mg/100g), phytate (306mg/100g) and flavonoids. All these components are usually present in the hull and bran part of the grains. They bind with the minerals and make unavailable to the human body for the various body functions. They also bind to protein and carbohydrates, rendering them inaccessible to the body by blocking proteolytic and amylolytic enzymes [29]. Due to the presence of antinutritional factors, millets also possess the potential to act as a nutraceutical [30]. Antinutritional substances such as phytic acid suppress the formation of hydroxyl ions, resulting in carcinogenesis prevention [31].

Also, Diets based solely on wheat and rice lack many of the minerals, dietary fibre and antioxidants in adequate amounts. The increasing trend of high consumption of refined cereals worsens the health scenario. Highly refined cereals and sedentary lifestyle have increased the risk of chronic diseases like cardiovascular diseases, obesity, and diabetes among population. This situation has enforced agriculturists and nutritionists to shift their focus on underutilized crops including millets.

Along with higher nutritional attributes, Millets have a huge potential to lower agriculture's carbon impact, hence many global organisations are enforcing their production. Millets are considered unique because of its short growing season as they get ready within 70-80 days [32]. Millets can even grow upto 64˚C temperature and 340-400mm rainfall [33]. This is because of its efficient photosynthesis system as they are C4 cereals [34]. Millets, often known as "famine reserves" because of their prolonged and simple storability under normal conditions, are of major importance in India's agriculture, which is heavily influenced by monsoon. They are best suited for mixed and intercropping, providing farmers with sustainable resource use, food, and livelihood security [35]. Millets utilise 2.5 times lesser water as compared to other crops [36]. Therefore, Millets appear to have the potential to combat climate change, poverty, and malnutrition [37]. In developing countries, small millets are mostly produce by small farmers for trading and human consumption purposes as it has important role to play in the nutrition security but in developed countries, the production of small millets is less as they only use small millets for bird feed purposes because its nutritional value is not been explored much by the nutrition scientists [38].

The Market Share of Millets

These are cultivated worldwide as the cereal crop or grains for human or animal food. In 2021, the global millet production was 29.78 Million Tonnes (MT), with Asia and Africa contributing 28.29 million tonnes (almost 95%) to the total production. India produces 18 million tonnes of millets annually which contributes to about 10% of the country's food grain basket [39]. According to the first advance estimates of production of food grains for 2019-20 by Ministry of Agriculture and Farmers Welfare, the targeted production of small millets in India was 0.60MT whereas the actual production declined to 0.38 MT. The advancement of agricultural practices for crops like wheat, rice and maize has led to their increased cultivation and the potential of millet grains to provide sustainable agriculture and nutrition security has been ignored [40]. Before Green Revolution, the cultivation of millets in India was more than both rice and wheat i.e. around 40 percent. But due to green revolution, the share of millets has drastically decreased to 20 percent and the production of rice and wheat has increased doubled and tripled respectively [41]. Many factors are associated for the decreased production of millets like changes in the lifestyle patterns. Nowadays, people are more dependent on the processed foods which are easy to make from other major cereals and also due to the reason that consumers have developed the taste of other major cereals as compared to the millets [42]. Further, lack of knowledge of the nutritional virtues, difficulties faced in food preparation and lack of processing technologies are the other major contributing factors for its decreased consumption.

Processing Methods and their Effects on Millets

The anti-nutritional components present in millets can be greatly reduced with the application of suitable processing methods. The millet grains before consumption are subjected to commonly used traditional processing techniques resulting in its improved sensory and nutritional properties [7], as it generally affects the physical appearance, biochemical activity and the nutritional profile of the millets. The processing techniques like soaking, roasting, germination, or fermentation not only increase the palatability of millets but also reduce the anti-nutrients thereby, increasing the physiochemical accessibility of micronutrients and improving their bioavailability [43].

Given the current state of global food security, making the most of available millet crops to develop a cost-effective, tasty, and nutrient-dense product is crucial [44]. Among all the processing methods, germination is a technique which reduces the ratio of antinutrients present in the millets to a great extent with the improvement of the overall biological activity of the grains [45]. Germination, according to many authors, decreases phytates and tannins to a large extent. This is because germination activates the enzymes phosphatases and phytases, which convert phytic acid into numerous low-weight biomolecules such as inositol, phosphates, and others [46]. Germination also helps in releasing the bound bioactive compounds of millets and increases its bioactive constituents and antioxidant potential. This is because of the enzymatic degradation of the cell wall components due to germination which leads to their synthesis and improved extraction [47]. The literature reported that the germination of millets done for 3 days results in high proportion of the minerals [48]. The catabolism of antinutrients like as saponins and polyphenols, resulted in enhanced mineral availability during germination [49].

The roasting processes boost the iron content of the millets while also providing a specific odour by increasing the fragrance components [50]. The germination and fermentation processes have been demonstrated to impact the vitamin content of millets. Vitamin levels were shown to be increased after the fermentation procedure [51]. During finger millet germination, the vitamin C level increased from 0.04 to 0.06mg/100g [52]. Various vitamins, including thiamine, niacin, and riboflavin, were shown to be enhanced during finger millet fermentation [53]. The availability of important vitamins can be increased by germinating millets and creating by-products from germinated millets [44]. Millets must be soaked before they may germinate or sprout. In spite of mineral leaching in water, soaking the millet grains improves the bioavailability of the minerals due to the reduced amount of antinutrients [49]. Phosphatases enzymes are activated during germination, which aid in the hydrolysis of phytate into inositol and orthophosphate, as well as the release of micronutrients. Mineral concentrations increased when the foxtail millet was germinated, including Ca (from 17.43 to 25.62mg/kg), Fe (from 16.01 to 54.23mg/kg), Mg (from 101.16 to 107.16mg/kg), and Na (from 63.34 to 69.45mg/kg) [54]. Effects of cooking generally affects the invitro protein digestibility IVPD, as the digestibility of protein in raw millet is generally poor due to the presence of antiproteinase factors. Whereas, roasting helps to improve IVPD, although hydrothermal treatments have no effect on protein digestibility [55]. The two techniques i.e. germination and roasting improves the nutritional quality of grains but particularly improves the protein content and its quality. After germination, the protein gets converted into its soluble form. The content of free amino acids decreases during the steeping step, however the speed with which the remaining free amino acids were used to synthesise bio enzymes was faster than the proteins that were degraded into amino acids [56].

The alkaline heating, fermentation, germination (40 hours at 25˚C), and popping of foxtail millet increased the protein quality [57]. Heat treatment or high pressure caused the separation of starch granules from the protein matrix, as well as the destruction of anti nutritional components including trypsin inhibitors and phytic acid, resulting in improved protein digestibility [44]. Due to the mobilisation of stored nitrogen, the simple procedure of soaking pearl millet for 24 hours resulted in enhanced protein [58]. Germination and fermentation produce positive effects by lowering antinutrient factors due to polyphenol leaching during water soaking and increasing enzymatic activity during germination [59]. Phytic acid levels in untreated Proso millet, Foxtail millet and sorghum samples were 0.0500g/100g, 0.0860g/100g, and 0.0340g/100g, respectively. Fermentation resulted in a significant reduction in phytic acid when compared to other treatments [60]. Soaking also reduced phytic acid levels by allowing it to leach or wash away during the soaking step [59]. Germination reduces phytic acid considerably, with phytate levels dropping to 0.0200g/100g in Proso millet, 0.0180g/100g in Foxtail millet, and 0.0220.005g/100g in sorghum [61]. This decrease in phytic acid is caused by the activation of endozymes, or phytases, which consume phytate during germination [62]. All the cereals are consumed after applying some sort of processing techniques, millets contain anti nutritional factors that may affect bioavailability of nutrients.

Storage of Millet Flour

Millet flour preparation and storage presents a number of difficulties. Because millets are small grains, the separation of the oil-rich germ from the endosperm might pose issues when millet flour is stored. The lipids found in the germ and pericarp of millets are exposed to the environment during milling, resulting in lipolysis and the oxidation of generated de-esterified unsaturated fatty acids. The chemical changes that occur during this process frequently result in the production of off-flavors at some point during storage, particularly when held at high moisture levels with oxygen exposure. Millet flour has a short shelf life and poor quality. Bitterness and sourness occur quickly due to the high fat content and lipase activity [63]. This occurs as a result of the presence of high polyphenolic compounds in millets, as phytochemicals with more than one hydroxyl group in the phenolic structure contribute hydrogen atoms to lipid free radicals, resulting in off tastes and lowering millet storage quality [64]. Microorganisms also play an important role in determining the shelf life of the product, so microbial load is also an important indicators to assess during the storage period of the millets [65]. The keeping quality and shelf life of the flour mainly depends on the processing techniques and storage conditions [63]. The lipid content of foxtail millet is lowered by 27.98%, according to a study that looked into the effect of high-pressure soaking on the nutritional qualities of the grain.

Various processing techniques are helpful in improving the shelf life and reducing the rancidity of the millets [66]. During germination, the fat is catabolised for the production of energy during storage leading to lessen FFA and ultimately reducing rancidity [63]. Heat treatment of dehulled sorghum, foxtail millet, and pearl millet grains at 150-170°C for 1.5 minutes significantly reduced the total fungal count by 48.23% during initial treatment, and the count gradually decreased up to 60 days of storage because heat treatment at this temperature inactivates lipase, which minimises fat hydrolysis [61]. In case of hydrothermal treatments, the heat treatment of dehulled sorghum, foxtail millet, and pearl millet grains at 150-170°C for 1.5 minutes significantly reduced the total fungal count by 48.23% during initial treatment, and the count gradually decreased up to 60 days of storage because heat treatment at this temperature inactivates lipase, which minimises fat hydrolysis and improves the shelf life of millets [67].

Antioxidants, hot water blanching, refrigeration technique for millet flour storage, dry heat treatment to the grain or flour, usage of different storage containers like polythene bags, gunny bags, tin containers, might be used to avoid the development of rancidity in the stored flour [68]. The packaging material also influence the shelf life and deterioration of millets due to insect infestation. Various packaging could be used such as Polyethylene (PE), Polypropylene (PP) and Polyethylene Terephthalate (PET) to determine the shelf life influenced by different packaging materials during storage [69]. Further, environmental conditions like moisture and humidity also effect the storage of flour and can lead to rancidity and development of off flavour [68]. It was discovered that visible light increased the rate of lipid oxidation in rice bran and proposed that chlorophyll photosensitivity may play a role in this process [70].

Both proso and foxtail are under-researched millets that are highly nutritious and climate friendly. They could be utilised as catch-up crops after other crops' growing seasons are gone, or if the crop fails [71]. The less production, availability and lack of awareness about their potential economic and health benefits, keeps millets out of the plate of consumers. The rapid development of off flavour in millet flour, is also the major hindrance for wider consumer acceptability. The demand of millets can be increased by introducing new technologies for the development of alternative foods, industrial products and animal feed. Millets can be used for traditional as well as novel foods. The value-added region-specific food products using millet may find significant place in the dietaries of the farm families and urban population owing to their well proven health benefits.

Food Product Formulation from Minor Millets

Due to the enormous nutritional properties of millets and in order to achieve the target of doubling farmers' income by 2022, the millet production in the country should be increased [39]. Further, the preparation of value-added products and their popularization among general population can increase the demand of millets and ultimately then farmer income. The development of millet-based food products that deliver convenience, taste, texture, color, and shelf-stability at economical cost for poor people is needed. These newly developed millet based food products will help in opening new markets for farmers which will lead to their increased incomes [7].

Commercialization of alternative foods and industrial products is one of the ways to increase the demand for millets. These can be used as traditional as well as novel food preparations. Millets have traditionally been used in preparation of unleavened and leavened breads and beverages. Porridges made from millets are used as solid supplementary foods. Cakes, cookies, pasta, parboiled rice-like products and snack foods have been successfully produced from millets [72]. Multi-millet health mix from kodo millet, little millet, foxtail millet, finger millet and wheat with the inclusion of pulses were developed [14]. The supplementation of these value-added food products improved nutritional status of school going children.

Foxtail millet has been used to develop unfortified weaning mix with acceptable sensory and rheological properties [73], composite bread having low glycemic index [74], ready-to-eat extruded snack [75], biscuits and burfi with low glycemic index [76] and beverages with high anti-oxidant activity [77]. Besides, oil has been extracted from foxtail millet bran by subcritical propane extraction. It was found to have high tocopherol content and high oxidative stability [78].

Foxtail millet bran oil was examined and it was found that it has major portion of unsaturated fatty acids (83.76%) comprising mainly of linoleic acid and had high antioxidant activity and radical scavenging power [79]. The oil when fed to ethanol induced hepatic injury mice, the positive effects were seen in the level of aspartate amino transferase, alanine amino transferase, triglyceride and hepatic malonaldehyde. The study concluded that foxtail millet bran oil had hepatoprotective effects and could be utilized as a functional food for the therapy and prevention of liver disease [79].

Biscuits were prepared using foxtail millet (45%) and compared it with the biscuits made from refined flour. The millet flour biscuits had a higher content of crude fibre (2.01%), total ash (1.1%) and total dietary fibre (9.12%) than refined wheat flour biscuits. Biscuits made from foxtail millet flour had lower glycemic index of 50.8 compared to 68 for biscuits prepared from refined flour. Foxtail millet biscuits obtained a higher overall acceptability score (7.80±0.89) as compared to traditional biscuits (6.84±1.37). The shelf-life study indicated that biscuits prepared from millet flours can be successfully stored for a period of 60 days in a thermally sealed single polyethylene bag at room conditions [80].

Sugar free foxtail millet-based ice creams were pepared with different levels of incorporation (2%, 3%, 4%) and sugar was replaced with stevia (calorie free sugar) substitute at 3%. The ice creams were analyzed for sensory parameters like flavor, texture, color and appearance, sweetness and overall acceptability. It was found that the sample with 4% foxtail millet gained highest scores and was liked the most when compared to other samples [81]. Rao and Fatima used foxtail millet to prepare various recipes including laddu, peanut chutney, panjeeri, kheer, cutlet and chakli. The products were evaluated by numerical scoring by 38 semi-trained panelists. The results indicated that laddu, kheer and panjeeri were highly acceptable followed by peanut chutney whereas chakli was not acceptable. The study concluded that foxtail millet can be easily included in the preparation of different traditional recipes without affecting their sensory qualities [82].

In another study, physical and sensory characteristics of extruded snacks prepared from foxtail millet based composite flours and different types of combination flours were investigated. The results indicated that composite flour (Foxtail millet, Amaranth, Rice, Bengal gram, Cow pea in the ratios 60:05:05:20:10) could be used to produce quality extrudes with acceptable sensory qualities [75]. Millet-based food products namely laddu, vegetable biryani and halwa incorporated with foxtail millet were prepared and their acceptability compared to rice based food products. Foxtail millet-based biryani had the highest score for color, appearance, texture, taste and overall acceptability followed by laddu and halwa. All millet-based products had a higher content of protein, fat and fibre as compared to rice products [83].

In a study, Food products using proso millet (100%) were prepared and it was found that the products had Glycemic Index (GI) of 50-65 compared to 70-80 of refined corn and wheat-based products. The study suggested that proso millet has a low Glycemic Index (GI) as compared to wheat, rice and barley and is an ideal food for people with type-2-diabetes mellitus and Cardiovascular Disease (CVD) [84].

In another study conducted [85], three types of breads were prepared by using proso millet flour (100%), proso millet flour-corn starch (1:1) and Proso millet flour-potato starch (1:1). Physical and sensory properties were statistically evaluated. The results showed that the bread in with starch was added (irrespective of the type) was more acceptable as it added to a soft texture and increased light colouration of the bread. Scores of overall acceptability and purchase intent indicated that there is a potential market for millet-based gluten free breads in the market.

Pasta was prepared using proso millet flour and compared with commercial gluten free flour and wheat flour. Raw pasta was analysed for starch content, protein digestibility, colour and carotenoids whereas cooked pasta was analysed for cooking quality, *in vitro* starch, protein digestibility and sensory qualities. Millet pasta contained less rapidly digestible starch than commercial gluten-free pasta, however, millet and commercial gluten-free pasta had lower protein digestibility than wheat pasta. Sensory panelists detected more graininess and starchiness in millet samples than in commercial pasta. The results indicated that proso millet varieties are suitable for making fresh pasta [86].

In a study conducted, malted and popped proso millet were used to prepare two convenience mixes suitable for various baby foods viz. sweet gruel, salty gruel, halwa, burfi and biscuits. The results indicated that all the prepared foods were organoleptically acceptable and had higher amount of protein, energy, calcium and iron as compared to their traditional counterparts [87].

Proso millet (*Pannicum miliaceum)* was used for the preparation of different foods. Refined proso milllet and corn were used in different proportions to prepare muffins, couscous, porridge and extruded snacks. The study suggested that incorporation of proso millet significantly ($p \leq 0.05$) decreased the glycemic index of the food products [88].

Conclusion

Although the nutritional superiority of millets over other grains is well established, its benefits are not being harnessed on a commercial basis. Processing and value addition technology advancements have enabled the processing and distribution of value-added products to households. One of the constraints to various culinary usage of small millets is a lack of sufficient processing technology to make convenient ready-to-eat value added products. As a result, Indian policymakers must refocus their attention on millet farming systems and establish policies that provide an enabling environment for millet farmers.

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