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Mini Review

Millets the "Wonder Nutricereal" - As Complimentary Food

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Received: April 17, 2019; **Published:** January 31, 2020

Abstract

The transition from exclusive breastfeeding to family foods is referred to as complimentary feeding typically covering the period from 6 to 18 - 24 months of age and is a very vulnerable period. Complimentary food formulations should provide the infants with essential nutrients for their optimal growth and development and also introduce taste and variety to the baby's diet, including teaching the baby to swallow, chew and to develop eating skills and habituate the baby to the exact taste and flavor of the home meals. Complementary foods are best formulated using locally produced staple foods. Millets are unique among the cereals because they are drought resistant crops and can be stored for a long time without insect damage. Millets have better nutritive value when compared to major cereal grains like rice and wheat. Hence, many kinds of traditional foods and beverages can be made from these underutilized millet grains after processing, to increase their utility and to regain their importance in agricultural market. In developing country, cereal-based foods have low bioavailability of minerals like iron, zinc initiate critical problem for infants and young children. Food processing techniques are used to enhance nutritional quality, improve the digestibility and bioavailability of food nutrients by reducing anti-nutrients.

Keywords: *Malnutrition; Complimentary Foods; Nutricereals; Optimal Growth; Health Benefits; Anti-Nutrients*

Introduction

The name 'millet' is applied to the small seed grasses and is one of the most important drought-resistant crop and 6th cereal crop in terms of world agricultural production [1]. Most of the millets are being used as nutraceuticals as they are rich in antioxidants much higher than the major cereal crops. Hence, they are also called as 'nutricereals'. India is the largest producer of many kinds of millets called coarse cereals [2]. The small millets include 6 main grain crops which are finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense),* foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum)* and barnyard millet (*Echinochloa frumentacea).* The important nutrients present in millets include resistant starch, oligosaccharides, lipids, antioxidants such as phenolic acids, avenanthramides, flavonoids, lignans and phytosterols which are believed to be responsible for many health benefits [3,4]. In addition, because of their important contribution to national food security and potential health benefits, of combating various diseases millet grains are now receiving increased interest from food processors, technologists, industries and nutritionists [5,6].

Nutritional composition of millet grains

The average carbohydrate content of millets varies from 56.88 to 72.97 g/100g. The protein content of the millets ranges between 10 - 11 g/100g, with the exception of finger millet, its protein content ranges between 4.76 - 11.7 g/100g.

Finger millet protein is exclusively rich in essential amino acids such as methionine, valine and lysine. The protein in proso millet is comparable to wheat but the concentration of essential amino acids such as leucine, isoleucine are comparatively higher than wheat. Among the various millets, the least reported in finger millet and highest being pearl millet. The mineral content of millets ranges from 1.7 - 4.3 g/100g and is known to be several folds higher than the common staple cereals like wheat and rice. The calcium content in finger millet has been reported to be higher than wheat (348 mg/100g) and has the potential to prevent osteoporosis. Barnyard millet and pearl millet are rich in iron and consumption is known to effectively meet the requirement of pregnant women suffering from anemia. Barnyard millet has 17.4 mg/100g of iron which is just about 10 mg lower than the recommended daily value. Foxtail millet has been reported to be a good source of zinc with 4.1 mg/100g, and a significant source of iron (2.7 mg/100g) and thiamine (0.6 mg/100g).

Riboflavin content was reported to be several folds higher than the common cereals. Foxtail millet has 1.65 mg of riboflavin which is the highest among all the millets while pearl millet has 1.48 mg/100g. Millets are also rich in calcium, dietary fiber, polyphenols and essential amino acids particularly the sulphur containing amino acids (methionine and cysteine); they are also higher in fat content than maize, rice, and sorghum [7-10].

Effects of processing on the nutrient composition of millets

Millets are known to contain anti-nutrients which affect the rate of bioavailability of nutrients. Traditional as well as modern techniques of processing such as, dehulling, soaking, popping and malting, fermentation and enzymatic hydrolyzation improves nutritional quality, digestibility and bioavailability of nutrients that are present [8]. Several processing treatments have been evaluated to reduce the anti-nutritional factors. The phytic acid content was reported to be reduced upon germinating the grains by the action of phytase. It is a common characteristic feature observed in germinating cereal grains. The phytase activity helps to hydrolyze phytate to phosphate and myoinositol phosphates. The polyphenolic content was also shown to be reduced during the process of germination. It was also noticed that the germination of grains resulted in improved protein and carbohydrate content. The sprouting of pearl millet at 30°C for 48H was shown to reduce phytic acid content along with improved *in vitro* protein digestibility. Malting and blanching could also be used as measures to reduce the anti-nutrients. Significant reduction in polyphenols and phytic acid has been reported for malted grains than for blanched ones. Malting with 72h of germination was reported to be beneficial with respect to effective reduction in anti-nutrient levels in pearl millet. Fermentation is also known to yield beneficial results. Inoculating lactobacilli or yeast with natural flora singly or in combination after processing pre-treatments such as grinding, soaking, debranning, dry heat treatment, autoclaving and germination resulted in a significant reduction in phytic acid, amylase inhibitors and polyphenols. Soaking and debranning also helps to completely eliminate anti nutrients. For other millets such as maize, sorghum and finger millet lactic fermentation was highly effective with respect to reducing phytic acid, tannins and thus helps to improve protein and mineral bioavailability [11-13].

Health benefits of millets

Millets are considered to be superior to cereal grains. They comprise gluten free protein, high fiber, low glycemic index and rich bioactive compounds. All these factors have made it a suitable health food. Millets have potential health benefits and epidemiological studies have showed that consumption of millets reduces risk of heart disease, protects from diabetes, improves digestive system, lowers the risk of cancer, detoxifies the body, increases immunity in respiratory health, increases energy levels and improves muscular and neural systems and are protective against several degenerative diseases such as metabolic syndrome and Parkinson's disease [14,15].

Millet is gluten-free and is thus an excellent option for people suffering from celiac diseases often irritated by the gluten content of wheat and other more common cereal grains. It is also useful for people who are suffering from atherosclerosis and diabetic heart disease [16,17].

The important nutrients present in millets include resistant starch, oligosaccharides, lipids, antioxidants such as phenolic acids, avenanthramides, flavonoids, lignans and phytosterols which are believed to be responsible for many health benefits [3,4]. Studies show

that regular consumption of pearl millet helps to prevent gall stones especially among women. Pearl millet is known to increase transit time along with reducing the secretion of bile acids. Pearl millet increases insulin sensitivity and helps to lower the level of triglycerides. It is known to afford complete protection against breast cancer particularly among premenopausal women. Scientific investigation has revealed that this was effective in reducing the number of episodes of wheezing and asthma among children. Lignin a phytonutrient, is highly beneficial for the human body, it is converted into mammalian lignins with the help of the natural flora and helps fight against hormone dependent cancers and reduces the risk of cardiac arrest. It also helps to reduce the risk of type 2 diabetes mellitus. The amino acid in pearl millets is more easily digestible than those found in wheat. It also contains essential nutrients such as methionine, B complex vitamins, folic acid, potassium, magnesium, manganese and zinc which are reported to play rival role in several physiological functions [18-20].

Millet incorporated home based complementary food

Complementary foods are best formulated using locally produced staple foods**.** Staple foods are those that are needed and used in the kitchen all the time [21]. Cereal-based gruels are generally low in protein and are limiting in some essential amino acids, particularly lysine and tryptophan. Supplementation of cereals with locally available legumes rich in protein and lysine, although, often limiting in sulphur amino acids, increases the protein content of cereal-legume blends and their protein quality through mutual complementation of their individual amino acids. The use of local foods formulated at home are guided by the following principles: (i) high nutritional value to supplement breastfeeding, (ii) acceptability, (iii) low price, and (iv) use of local food items [22-24]. Studies on micronutrient deficiencies indicate higher prevalence of iron and zinc deficiency especially in young children. The situation is similar with Asian countries like India**.** Hence using millets can enhance the nutritive composition of the supplementary foods [25,26].

Processing techniques such as soaking, germination, roasting and sieving have been found to reduce the anti-nutritional factors. Germination specifically has been reported to improve the nutritional quality of the pearl millet seeds by increasing the availability of essential nutrients by lowering the levels of anti-nutrients. Hence, these flours can be used in food system formulations [27]. It is well known that the alpha amylase activity increases during germination of cereals and few millets, this enzyme hydrolyses amylase and amylopectin to dextrins and maltose, thus reducing the viscosity of thick cereals, porridges, without dilution with water while simultaneously enhancing their energy and nutrient densities. Therefore, with value-added strategies and appropriate processing technologies, the millet grains can find a place in the preparation of several value-added and health food-products, which may then result in high demand from large urban populations and non-traditional millet users [28-30].

Most children between the age of 4 months and 2 to 3 years suffer from malnutrition. The reason being low economic status, poor sanitation, poor purchase capacity and lack of education [31]. Poor feeding practices as well as lack of suitable complementary foods are responsible for under nutrition with poverty exacerbating the whole issue. The complementary foods are often of low nutritional quality and given in insufficient amounts [32,33].

A pilot study carried out in developing a complimentary food using pearl millet as one of the ingredients showed that the bulk density of the product was low and higher nutrient intake can be achieved with minimum consumption [34]. The formulation was analyzed for nutrient composition, storage stability, sensory, microbiological and functional properties. Proximate analysis showed carbohydrates 81%, proteins 9.8 - 10.5% and fat 1.9 - 2.2% indicating their utilization can fulfill 1/3 of the nutritional requirements in infants as per the recommended dietary allowance [35,36]. An acceptability trial of the complementary food was carried out by administering the food to the mothers of the infants. The product was rated good for all the sensory attributes viz; taste, aroma, flavor, texture and appearance at both room temperature and under refrigerator for 30 days. Subsequently, the infants were administered the millet based formula for a period of 7 days. No adverse gastrointestinal function were reported by the mothers. This formulation can be introduced as an alternative infant food especially for the low-income families. The developed product can help prevent protein energy malnutrition (PEM) and broad spectrum clinical disorders due to its higher nutritive value. Thus, use of millet grains as replacement in wheat composite flours, comple-

mentary food, and food blends seems the best method that can be used for the preparation of nutritional, "healthy" and safe, high-quality, and shelf-stable food products at household and commercial scales to promote utilization of millet grains.

Conclusion

Millets have potential health benefits and its cultivation is not too demanding from point of view of agriculture and it can be grown even in difficult terrain. It is essential to educate families to use locally produced grains and its nutritional benefits. Much as pearl millet is popular and widely used for health benefits, other variety of millets also needs to be explored for its health benefits, especially as complementary food as it can be practical solution to reduce the prevalence of malnutrition among the low socioeconomic group. It would be reasonable to summarize that kodo millet and foxtail millet have a promising role to play in enhancing nutritional status of children when administered as a complementary food and also provide food security. Household food processing strategies can be applied for improving the nutritional quality to promote millet utilization for better prospects.

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Volume 9 Issue 2 February 2020