Review article

MILLET: A PROMISING CROPS TOWARDS FOOD AND NUTRITIONAL SECURITY OF DEVELOPING COUNTRIES

Abstract

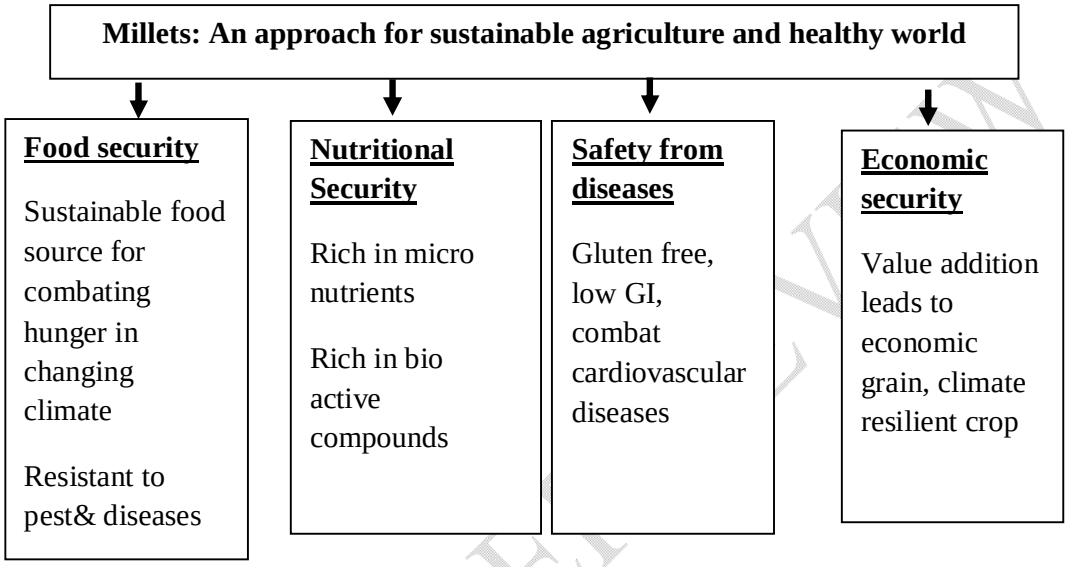
The world is facing challenges in agriculture and nutrition. Agricultural lands with irrigation facilities have been exploited to maximum, and hence we need to focus on dry lands to further increase grain production. Millets can easily thrive in extreme conditions like drought, and some wild varieties can even prevail in flooded areas and swampy grounds. As a climate change crop, millet outperforms other cereals such as wheat and rice in terms of marginal growing conditions and high nutritional value. These grains contain vitamins, minerals, essential fatty acids, phytochemicals and antioxidants which can help eradicate many nutritional deficiency diseases. Millet cultivation can keep dry lands productive and ensure future food and nutrition security. Role of millets in designing the modern foods like multigrain and gluten-free cereal products is well known. Due to the richness of millets in polyphenols and other biological active compounds, they are also considered to impart role in lowering rate of fat absorption, slow release of sugars (low glycaemic index) and thus reducing risk of heart disease, diabetes and high blood pressure. Due to increased awareness regarding the health promoting profile of millets, inclination towards their consumption has been observed. Present review envisages the agrarian requirements, nutritional information and health benefits imparted by these grains. Review also explores the millet-based products made traditionally along with the latest researches conducted worldwide.

Keywords: Millets, Dry lands, Nutrition, Nutri-cereals

Introduction

Millets are a highly varied group of small-seeded grasses widely grown around the world a serial crops or grain for fodder and human food. Millets grains have been discovered in post used for storing grains and seeds discovered at archaeological sites in present in day china ,India , Europe and different parts of Africa. Assam (18.82kg/hsh/m) and Bihar (18.69kg/hsh/m) states have highest consumption of small Millets found it all India and rural areas. Madhya Pradesh has highest area of small Millets (32.4%) followed by Chhattisgarh (19.5%) , Uttarakhand (8%) , Maharashtra (7.8%) , Gujarat (5.3%) and Tamil Nadu (3.9%) . Millets have been a good part of the staple diet among many communities across the world . millet are known for their potential health benefits which includes anti diabetic properties and

low glycemic index in millet based food product which may be helpful in reducing the post paid glucose level and glycosylated haemoglobin [9-11]. Millet also have antioxidant and antimicrobial properties and protein content. In general Millets are rich in source of fiber, minerals and B – complex vitamins. Millet are non – acid forming and easy to digest and non –allergenic [12-14].



Importance of millets:

Nutritional importance: Millets are important staples to millions of people worldwide. Generally, these are rain fed crops grown in areas with low rainfall and thus resume greater importance for sustained Agriculture and food security. Almost all the millets are used for humans consumption in most of the developing countries but their use has been primarily restricted in animal feed in developed countries [15,16]. Millets are nutritionally comparable to major cereals and serve as good source of protein, micronutrients and phytochemicals. Processing methods like soaking, malting, decortication, and cooking affect the anti-oxidant content and activity.

Nutritional Characteristics

- **Carbohydrates**- The carbohydrate content in sorghum composed of starch, soluble sugar and fibre (pentasons cellulose and hemislelu's)millet carbohydrates classified non- structural sugars starch and fructosans) and structural (cellulose hemi cellulosis and pactin substances)carbohydrates the chief non-structural carbohydrate (NSC) is starch.

- **Starch** - Form one half to three – fourth of the grain wait is starch starches exist in a highly organised manner in which amylays and amylo pectin molecules are held together by hydrogen bonds and arranged radically and spherical granules starch is the main source of energy utilised during germinationitiscomposedoflinearchainsofglucosejoinedbyalphaone4-glycoside it wants called amylopectin is a much larger branched polymer. The pigment of millet grain pericarp some times discolour the starch, yielding alight pink colour, green and yellow colour.

- **Soluble sugar**- The soluble sugar content of caryopsis process changes during development and is maximum 5.2% at maturity the average soluble sugar content was 1.3% with sucrose being 75% of the sugar contain mature caryopsis 2.2 to 3.8 percent soluble sugars 0.9 to 2.5% free reducing sugar and 1.3-1.4% non-reducing sugar glucose and fructose d from 0.6 to 1.8% and 0.3 to 0.7% respectively.

- **Dietary fibre**- The dietary fibre contain of several Indian foods have been determined dietary fibre components accept they are beneficial effects mostly by way of their swelling properties and buy increasing transit time in the small intestine the increase in transit time reflects reduce the rate of release of glucose and its absorption those helping in the management of certain types of diabetes.

- **Fatty acids** - Lipids are Relatively minor constitutes in millets .most of the lipids are located in the scutellar area of the germ . Thus lipid content is significantly reduced when the germs removed during the decortication or the germination .the typical fatty acid composition of Sorghum lipid as similar to that of maize oil (wall & Blessin) 1970 . The lipids can be subdivided into polar nonpolar and non saponifiable lipids the most abundant by far are the nonpolar lipids 72- 80% the composition of the nonpolar lipids was clearly dominated by triglyceride 85%, followed by sterols 4.1% diglycerides 4.0% triglycerides Serve as a reserve material for germination.

- **Protein**- Protein content & consumption very due to agronomic condition (water availability, soil fertility, temperature and environment condition during green development) and genotype. millet protein are located in the endosperm 80%, germ 16% and paricarp 3%.All amino acids in the fractions increased as total protein in the fractions increased. However, relative distribution of amino acids in the protein varied

as protein content of the sample changed; consequently, protein efficiencies should differ from one fraction to another. Percentages of lysine, cystine, methionine, threonine, and tryptophan of the protein decreased as protein content of the endosperm fractions increased. In fraction the percentages of valine, isoleucine, leucine, and phenylalanine in the protein were less than those found in the higher protein fraction.

Table 1: Nutrition Composition of millets per 100g of edible portion

Food grains	Proteins (g)	CHP (g)	Fat (g)	Crude fiber (g)	Mineral matter (g)	Ca (mg)	P (mg)	Iron (mg)
Millets								
Finger millet	7.3	72.0	1.3	3.6	2.7	344	283	3.9
Kodo millet	8.3	65.0	1.4	9.0	2.6	27	188	12.0
Proso millet	12.5	70.4	3.1	7.2	1.9	14	206	10.0
Foxtail millet	12.3	60.9	4.3	8.0	3.3	31	290	5.0
Little millet	7.7	67.0	4.7	7.6	1.5	17	220	6.0
Barnyard millet	6.2	65.5	2.2	9.8	4.4	11	280	15.0
Cereals								
Rice	11.8	71.2	1.5	1.2	1.5	41	306	5.3
Wheat	6.8	78.2	0.5	0.2	0.6	45	160	-

Table 2: Vitamins and Mineral composition of millet mg per 100 g of edible portion

Parameter	Finger	Proso	Foxtail	Little	Kodo	Barnyard	Pearl	Sorghum
Total Carotenoids	154	-	32	120	272	-	293	212
Thiamine	0.37	0.20	0.59	0.26	0.29	0.33	0.33	0.35
Riboflavin	0.17	0.18	0.11	0.05	0.20	0.10	0.25	0.14
Niacin	1.34	0.18	3.20	1.29	1.49	4.20	2.30	2.10
Minerals								
Calcium	364	14	31	16.06	15.27	20	42	27.6

Phosphorus	283	206	290	220	188	280	296	274
Iron	4.62	0.8	2.8	1.26	2.34	5.0	8.0	3.95
Magnesium	137	153	81	133	147	82	137	1.33
Sodium	11	8.2	4.6	8.1	4.6	-	10.9	5.42
Potassium	408	113	25	129	144	-	307	328
Copper	0.67	1.60	1.40	0.34	0.26	0.60	1.06	0.45
Zinc	2.3	1.4	2.4	3.7	0.7	0.3	3.1	1.96

Nutritional composition of millet grains

Millets are unique among the cereals because of their richness in calcium, dietary fibre, polyphenols and protein (Devi *et al*., 2011). Table 1 represent amino acids content in different types of millets. Millets generally contain significant amounts of essential amino acids particularly the sulphur containing amino acids (methionine and cysteine); they are also higher in fat content than maize, rice, and sorghum (Obilana and Manyasa, 2002). In general, cereal proteins including millets are limited in lysine and tryptophan content and vary with cultivar. However, most cereals contain the essential amino acids as well as vitamins and minerals (Devi *et al*., 2011; FAO, 2009). Plant nutrients are largely used in the food industry, and cereal grains constitute a major source of dietary nutrients worldwide (Amadou *et al.*, 2011a; Izadi *et al.*, 2012). Modification of a protein is usually realized by physical, chemical, biological such as fermentation or an enzymatic treatment, which changes its structure and consequently its physicochemical and functional properties (Lestienne *et al*., 2007; Amadou *et al*., 2011b). Table 2 represent the content of different varieties of millet, foxtail, fonio, proso, pearl and finger millets.

Table 3: Proximate composition of millet grain varieties.

Component (g/100g dry	Foxtail	Fonio whole	Proso millet dehulled	Pearl millet	Finger millet native

basis)	millet flour	grain	grain	whole grain	grain
Protein	11.50	9–11	11.58	14.8	8.2
Ash	0.47	1–1.1	NA	1.64	2.7
Fat	2.38	3.3–3.8	4.9	4.86	1.8
Total CHO*	75.2	84–86	80.1	59.8	83.3
Crude fiber	NA	NA	0.7	12.19	3.5

Carbohydrate(CHO) NA: Not available

Other health benefits

Millet grains based on literature values are known to be rich in phenolic acids, tannins, and phytate (Thompson, 1993). These nutrients reduce the risk for colon and breast cancer in animals (Graf and Eaton, 1990). The fiber present in sorghum And millet and also the phenolic have been attributed for lower incidence of esophageal cancer than those consuming wheat Or maize (Van Rensburg, 1981). Recent research has revealed that fiber as one of the best and easiest ways to prevent the Onset of breast cancer in women. They can reduce their chances of breast cancer by more than 50% by eating more than 30 gm of fiber every day. Many of the antioxidants found in millet have beneficial impact on neutralizing the free radicals, which can cause cancer And clean up other toxins from body such as those in kidney and liver. Quercetin, cucurmin, ellagic acid and various other Beneficial catechins can help to clear the system on any foreign agents and toxins by promoting proper excretion and Neutralizing enzymatic activity in those organs. Therefore, tremendous attention has been given to polyphenol due to their roles in humans health [17-20]. The antioxidant, metal chelating and reducing powers are shown by the soluble and insoluble bound phenolic extracts of Several varieties of millet (kodo, finger, foxtail, proso, pearl and little millets) (Chandrasekara and Shahidi, 2010). Foxtail Millet contains 47 mg polyphenolics/ 100 g and 3.34 mg tocopherol/100 g (wet basis); however, proso millet contains 29 mg polyphenolics/ 100 g and 2.22 mg tocopherol/100 g (wet basis). In addition, a positive and significant correlation ($R2=0.9973$, $P<0.01$) between polyphenolic content and radical cation scavenging activity was observed.

Table 4: Properties of Dietary fiber and their health consequences

Function	Health Consequences	Millet

Water absorbing and bulking property	Energy diluents to formulate low calories diet	All Millets
Increased transit time . of food in gut	Reduced risk of inflammatory bowel disease	Sorghum and finger millet
Bile acid and steroid binding	Hyper cholesterolemia activity and reducing the risk of cardiovascular disease	Pearl millet, Sorghum and finger millet.
Retardation of carbohydrate	Management of certain type of	Pearl millet, Sorghum and
Binding of toxins	As a detoxifying agent	Sorghum
Binding of divalent . cations	Reduced bioavailability of Ca, Mg, Zn, Fe	Proso Millet and Fox Tail Millet (Unprocessed)

Conclusion

Millets are still the staple food for millions of poor people in Africa and Asia. Like many other cereals, millets are high carbohydrate energy content and nutritious, making them useful components of dietary and nutritional balance in foods. Combination of millets with other sources of protein would compensate the deficiency of certain amino acids such as lysine. Successful improvement of these attributes would be a crucial key to expand the spectrum of applications of millet grains. Future trends should focus on the millet consumption in the developed countries that could help its industrial revolution.

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