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Post Harvest Processing of Millets: An Appraisal

S. Balasubramanian[1], R. Viswanathan[2] and Rajiv Sharma[3]*

ABSTRACT

Millets are used for traditional as well as novel foods. These foods could be further promoted through research, consumer acceptability, entrepreneurship development and demonstration to stimulate processing of high quality, competitive products. Thus, processing facilities are particularly vital for the future of millet farming.

Key Words: Millets, Coarse cereals, Small grain.

Introduction

In the current era of Intellectual Property Rights (IPR) regimes – that clash with community rights - are getting important around the world as the central instrument to open and control markets and to push new technologies. Farm inputs such as agricultural chemicals make soil very acidic and excessive irrigation has led to increased soil salinity. Growing population, urbanization and industrialization have reduced the cultivated land. The cereals belong to two main groups. These are the temperate cereals, namely wheat, barley, rye, oats and triticale, and the predominantly tropical cereals: rice, maize, sorghum, and millets. Of the temperate cereals only two, wheat and barley are grown on a wide scale practically in all the continents. Millet, contrary to rice and wheat, can be grown widely. Therefore, growing millet could be encouraged to increase food self-sufficiency. Millets in Indian diets are classified as coarse cereals with small grains having 2.1–7.1 g weight per 1000 grains. Well filled grains have 1.4–5.1 ml of volume per 1000 grains. They are spherical to oval in shape and have colored seed coat. Millets are rich sources of carbohydrates and minerals, such as calcium, phosphorous and iron.

In recent times breakfast cereal technology has evolved from the simple procedure of milling grains for cereal products that require cooking to the manufacturing of highly sophisticated ready-to-eat products that are convenient and quickly prepared. Modern dietetics and food culture needs to be re-examined from ecological as well as physiological cycle of human body. A paradigm shift is needed from modern dietetics to holistic, comprehensive dietetics. While efforts are being made world wide towards achieving self-sufficiency in food, conserving the environment, and solving health problems, millets have gained attention as important crops to overcome food crisis. The health benefits of millets include lower plasma cholesterol (Newman *et al.*, 1989; Davidsson *et al.*, 1991), reduced glycemic index (Jenkins *et al.*, 2002; Cavallero *et al.*, 2002), higher dietary fibre and availability of trace elements.

Millets and their Origin

Millets refers to a group of annual grasses mainly found in the arid and semiarid regions of the world. Millets belong to 5 genera: *Penissetum, Eleusine, Setaria, Panicum and Paspalum.* These grasses produce small seeded grains and are often cultivated as cereals. The millets are of paramount importance in Africa, Asia, China and Russia Federation. Elsewhere in the world, they are treated as minor crops. Table 1 shows the origin of **common names of sorghum and millets.** Millets can be used as grain or forage. When used as grain they are categorized as cereals. The group millets include; pearl (bulrush) millet, finger millet, prosso (golden millet) millet, fox tail millet, Japanese millet, Teff millet, Koda (ditch millet), Brown top millet plus four other species of limited importance.

*[1] Scientist (SS), [2] Senior Research Fellow Food Grains and Oilseeds Processing Division, Central Institute of Post Harvest Engineering and Technology, Ludhiana-141 004, India, *Email: balaciphet@yahoo.com; [3]Professor and Head, Department of Food and Agricultural Process Engineering, Agricultural Engineering College and Research Institute, Tamilnadu Agricultural University, Coimbatore-641003, India.*

Table 1: Origins and common names of millets

Crop	Common names	Likely origin
Sorghum bicolor	Sorghum, great millet, guinea corn, kafir corn, aura, mtama, jowar, cholam. kaoliang, milo, milo-maize	Northeast quadrant of Africa (Ethiopia-Sudan border)
Pennisetum glaucum	Pearl millet, cumbu, spiked millet, bajra, bulrush millet, candle millet, dark millet	Tropical West Africa
Setaria italica	Foxtail millet, Italian millet, German millet, Hungarian millet, Siberian millet	Eastern Asia (China)
Panicum sumatrense	Little millet	Southeast Asia
Paspalum scrobiculatum	Kodo millet	India
Panicum miliaceum	Proso millet, common millet, hog millet, broom-corn millet, Russian millet, brown corn	Central and eastern Asia
Echinochloa crus-galli	Barnyard millet, sawa millet, Japanese barnyard millet	Japan
Eleusine coracana	Finger millet, African millet, koracan, ragi, wimbi, bulo, telebun	Uganda or neighboring region

Source: FAO (1995)

Processing of Millets

Processing of millets involves the partial separation and/or modification of the three major constituents of the millets - the germ, the starch-containing endosperm and the protective pericarp.

Digestibility - processing is required to make dried grains edible and digestible.

Food safety- cooking inactivates natural toxins, such as trypsin inhibitors (enzymes) in oats and maize. Heat also prevents bacterial growth and food spoilage.

Organoleptic properties -processing can optimise the appearance, taste and texture of foods to meet the needs of consumers. Convenience - ready-to-eat food products meet consumer demand for quick and easy meal solutions.

Maximise nutritional value- processing can make it easier for nutrients from grains to be digested. Nutrients lacking in the diet can be added to staple grain-based foods (e.g. thiamin added to flour). Table 2 shows the nutrient composition of sorghum, millets and other cereals.

In general, the first operation in processing cereal or coarse cereal is usually the separation of offal (the portion not normally used for human consumption) from the edible portion. The offal consists of the pericarp and sometimes the germ. Offal removal is frequently called decortication or dehulling. The outer tough seed coat and the characteristic flavour associated with these millets (Malleshi, 1986) cultural attachments and the non-availability of processed products similar to rice or wheat (Malleshi and Hadimani, 1993) are the main reasons why they are less popular among rice and wheat eaters. While there are many machines available for processing cereals, there is unfortunately no well-proven industrial process available that is entirely satisfactory for making

Table 3: Nutritional composition of sorghum, millets and other cereals (per 100 g edible portion; 12 % moisture)

Food	Protein[a] (g)	Fat (g)	Ash (g)	Crude fibre (g)	Carbohydrate(g)	Energy (kcal)	Ca (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Rice (brown)	7.90	2.7	1.3	1.0	76.0	362	33	1.8	0.41	0.04	4.3
Wheat	11.6	2.0	1.6	2.0	71.0	348	30	3.5	0.41	0.10	5.1
Maize	9.20	4.6	1.2	2.8	73.0	358	26	2.7	0.38	0.20	3.6
Sorghum	10.4	3.1	1.6	2.0	70.7	329	25	5.4	0.38	0.15	4.3
Pearl millet	11.8	4.8	2.2	2.3	67.0	363	42	11.0	0.38	0.21	2.8
Finger millet	7.70	1.5	2.6	3.6	72.6	336	350	3.9	0.42	0.19	1.1
Foxtail millet	11.2	4.0	3.3	6.7	63.2	351	31	2.8	0.59	0.11	3.2
Common millet	12.5	3.5	3.1	5.2	63.8	364	8	2.9	0.41	0.28	4.5
Little millet	9.70	5.2	5.4	7.6	60.9	329	17	9.3	0.30	0.09	3.2
Barnyard millet	11.0	3.9	4.5	13.6	55.0	300	22	18.6	0.33	0.10	4.2

Source : Hulse *et al.* (1980); USNRC / NAS (1982). USDA/HNIS (1984).

white products from coloured minor millets. Decortication is sometimes accomplished by using rice dehullers or other abrasive dehullers. Pushpamma (1990) reported that decortication reduced total protein and lysine by about 9 and 21 %, respectively, but that it also improved the utilization of the remaining protein. The loss of minerals was minimal. Decortication improved the biological availability of nutrients and consumer acceptability.

Millets would probably be more widely used if processing were improved and if sufficient good-quality flour were made available to meet the demand (Eastman, 1980). Lorenz (1983) observed that the phytate content of common millet varieties ranged from 170 to 470 mg per 100 g whole grain, and dehulling resulted in a 27 to 53% reduction in phytate content. On dehulling, phytin phosphorus decreased 12% in common millet, 39% in little millet, 25% in kodo millet and 23% in barnyard millet (Sankara Rao *et al.*, 1983).

Traditionally, dry, moistened or wet grain is normally pounded with a wooden pestle in a wooden or stone mortar. Moistening the grain by adding about 10% water facilitates not only the removal of the fibrous bran, but also separation of the germ and the endosperm, if desired. Although this practice produces slightly moist flour, many people temper the grain in this way before they pound it (Perten, 1983). Parboiling is reported to help in dehusking kodo millet (Shrestha, 1972) and to eliminate the stickiness in cooked finger millet porridge (Desikachar, 1975).

Millets can be used for traditional as well as novel foods. Unprocessed or processed grain can be cooked whole or decorticated and if necessary ground to flour by any of the traditional or industrial methods. However, there is a need to look into the possibilities of alternative uses. Wheat has a unique property of forming an extensible, elastic and cohesive mass when mixed with water. Millet flours lack these properties when used alone. Hence fortification brings lot of innovative Ready-To-Eat / Ready-To-Serve minor millet based processed products. It is possible to fortify malted finger millet (rug)) weaning food with green gram. The food has the advantage of having low cooked paste viscosity and has high energy density when mixed in the proportion of 70 % malted ragi flour and 30% green gram flour, (Malleshi *et al.*, 1986). Table 4 depicts the forms of millet products in India.

Table 4: Utilization of minor millets in India

Millet/ Products	Nature of Products	Raw material form
	Finger millet	
Sangati	Stiff porridge	Rice brokens and flour
Roti	Unleavened bread	Flour
Ambali	Thin porridge	Flour
	Proso millet	
Annam	Rice-like	Dehulled grain
Muruku	Deep fried	Flour
Karappoosa	Deep fried	Flour
Ariselu	Deep fried	Flour
	Foxtail millet	
Annam	Rice-like	Dehulled grain
Ariselu	Deep fried	Flour
Sangati	Stiff porridge	Flour
Roti	Unleavened bread	Flour
	Kodo millet	
Annam	Rice-like	Dehulled grain

Source: Pushpumma and Chittemma Rao, 1981.

Position of millets in comparison to stable food grains in human food chain

The decline in consumption of millets based products, where in it is originated and grown is due to shifts in consumer habits, by a number of factors: the rapid rate of urbanization, the time and energy required to prepare food based on millets, inadequate domestic structure, poor marketing facilities and processing techniques, unstable supplies and relative unavailability of millets and its products, including flour, compared with other foodstuffs. Though mechanical pearling or polishing is well known for wheat, rice, and maize, but for millet, this primary step in the commercial processing of a food grain is essentially unknown. For instance, large imports of cheap wheat and rice and policies to subsidize production of those crops in some countries had considerable negative impact on the production of millets. Millets in particular could be in great demand in the future if the technology for specific industrial end uses is developed. The promotion of millets is essential, for a creative dietary life so that our earth may remain prosperously reproducible even when we will be gourmets. Thus we have to pay attention to coarse cereals/ millets for the following reasons.

(a) Delicious: Cereals, particularly millet is delicious and is widely acceptable to everyone.

(b) Ease of cultivation: It is easy to cultivate organically without the need for agricultural chemicals even in barren soil and/or unfavorable climate conditions. It has possibilities of cultivation even in marginal soils in the mountains.

(c) Excellent durability: As a staple food, it is easy to conserve and cultivate even with only a handful of seeds.

(d) Nutritious with well-balance nutrients: Cereals contain almost all the necessary nutrients needed for a well-balanced nutrition to supply the body's needs.

Some reasons for less popularity of small millets are

(1) Lack of technical-know-how among the farmers and processors about the processing methods with respect to their own old methods of processing

(2) Associated cultural issues in adoption and diversification of food.

(3) Lack of awareness among people about nutritive value of small millets and a general opinion that the small millets are poor men crop, and

(4) Reluctance among consumers to buy and consume.

Revival of Millets

The revival of millets can be achieved through concerted efforts of research, marketing testing, and entrepreneurial training and demonstration to stimulate the processing of high quality, competitive products for urban areas. These constraints can be grouped into four broad categories: (1) the inputs, the grain; (2) the output, the processed products; (3) the processing technology; and (4) the market.

Inputs

(1) Laboratory chemical and physical characterization of coarse cereals/ millet varieties for making the basic food products. This characterization should also involve their appropriateness through threshing, dehulling and milling. Economic evaluation of pearl millet and sorghum traits for making some preferred food products should be undertaken.

(2) Foster the adoption of appropriate technologies (e.g. improved varieties combined with soil restoration technologies and water conservation methods) that will increase the supply of grains through on-farm participatory methods.

(3) Improve information access to technologies by extension services, Non Governmental Organization, to food processors.

(4) Better understanding of the determinants of households' investments and consumption decisions.

(5) Better understanding of the structure, conduct and performance of coarse cereals/ millet national and inter-regional trade

Output

(1) Surveys on processed products likely to be preferred by consumers.

(2) Feasibility and market tests on new products.

Processing technologies

(1) Develop or adapt proper equipment that should reduce the unit processing costs for threshing, dehulling and milling compared to current traditional practices.

(2) Conduct feasibility studies on current traditional or improved processing technologies.

Markets

(1) Examine current formal and informal contractual schemes between buyers and producers for different stable crops, in order to draw lessons useful for coarse cereals.

(2) Improve the information flow between processors and consumers of coarse cereals.

(3) Examine the socio-economic, institutional and policy constraints faced by current food processors.

Conclusions

In a sense, it is imperative to find and develop good profitable uses coarse cereals/millet. With increasing urbanization and rising disposable incomes, the demand for preprocessed and convenience foods is accelerating. This is one reason why commercially milled wheat and maize flour are increasingly preferred. Millet is much cheaper, but they are unprocessed and therefore less convenient to use. As a result, markets for locally grown millet are diminishing, incentives for local production are deteriorating, and foreign exchange reserves are dwindling to meet ever-rising demands for preprocessed flours. Thus, in dry regions, processing facilities are particularly vital to the future of local cereal farming. Thus, millets are so compelling to agree their needs to educate consumers on the health benefits and to encourage increased consumption. To do this, a joint effort by health, food, and nutrition professionals, including industry, government, and health promotion organizations is required. As part of this effort, we need support from nutrition educators in industry, academia, and government to develop clear and consistent messages in *consumer language* to communicate the positive health benefits of millets products. Efforts to work with industry leaders to enrich their knowledge about the benefits of millets and encourage them to overcome barriers to the inclusion of more whole grains in their products, as well as continue to develop fortified products to meet consumers' needs. Commercial horizons would open up that have never before been contemplated.

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