Product Development from Millets

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Abstract

Whole grains are used widely from ancient times in human diet. They are universally recommended as an important source of energy, carbohydrate, protein, and fiber in human diet. In India millets and sorghum are preferred as a major income-generating crops for the majority of poor farmers exclusively in some farming regions. Millets are the main crop in some regions of the world and specifically in both seasons of Kharif and Rabi. Sorghum plays a major role in nutrient uptake which is about 35% of the total intake of calories, protein, iron, and zinc in the intake zones. Nutritional change and health scenarios indicate a high rate of lifestyle diseases both in developed and developing countries. Due to high nutritional composition millets are categorized as coarse cereals and used for the production of nutrient-rich food development. All millets are very rich in minerals and also have high antioxidant activity. Hence, millets are being consumed as a source of nutraceutical components for nutritional improvement of processed food products to augment their proposed health benefits. Incorporation of millet in various low-cost food formulations intended for adults and children could be used to alleviate malnutrition and other deficiency disorders and can serve as nutritionally dense value-added products.

Keywords

Millet · Malnutrition · Complemenary food · Health promotion

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7.1 Introduction

Making food for everyone is a major task of government and scientific communities. Sorghums and millets are considered as historic crops which were cultivated many times ago from civilization. Some evidence suggests that farming of sorghum and millets was initiated 4000 years ago (Shahidi and Chandrasekara 2013). These crops are categorized as drought-resistant plants mainly grown in hot climates. In some African and Asian countries, the major sources of daily nutrition of persons living in rural areas are millets. The biochemical composition of millet indicates a high amount of nutraceuticals in comparison to other groups of cereals. Presence of high amounts of nutraceuticals and health-promoting compounds are very helpful in diseases such as blood pressure, diabetic conditions, and cardiovascular problems. Millets are also rich in fiber content which reduces several health problems. The consumption of complete millet grains is very effective for controlling several-health related problems and liable for avoidance of cardiac problems, diabetic problems, obesity problems, breast cancer problems, and some cases of premature death (Balasubramanian 2013; Saleh et al. 2013).

Millets grains are generally of little size and can be easily ready for food use in native form. Millets are very primitive crops and are reported to be cultivated in very dry conditions in China and some African countries. Some evidence also suggests that in the middle age millet was widely consumed in comparison to wheat. The detailed description was also found in the Bible which also indicates their origin. The role of sorghum and millet crops is established in many developing countries which is very useful in their malnutrition and economy. Sorghum and millets show a very important part in the form of food and nutrition security and both types of crops include up to 10% of coarse grain in Asian countries. In case of India, the production of sorghum and millet comprises more than 80% of total Asian country's production but the crop yield in India is comparatively low.

The form of grain utilization in food purpose differs in many countries for both sorghum and millets. In the case of African countries, sorghum and millets are largely used as food grain and directly consumed as a major nutrition source by poor publics. In current times the utilization of sorghum and millet for beer manufacturing is increasing and supports the economy of African countries.

7.2 Features of the Millet Plant

Millet grain size is very small, grown annually, and belongs to the grass family. Millets are very tolerable in hot and extreme conditions. The appearance of millet grains depends upon crop variety. They habitually have rough stems, opaque bunches, leaves similar to grass, and mainly grow over 6 ft long.

The crop seeds are enclosed with colorful hulls. The grain hulls are very flexible in color depending on the crop variety (white, red, yellow, brown, or striped). In case of millet seed which is covered with hulls and hulls have not good digestive quality, it is necessary to remove the hull portion before utilizing it for food purposes.

Dehulling of millet seed is a very difficult process and after dehulling the color and appearance of the seed are changed and grains look like yellow balls.

7.2.1 Millets and Practices

Sorghum crops are broadly cultivated in different regions of India mainly Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, and Karnataka. Sorghums and millet are observed as significant coarse cereals for food and nutrition. Sorghum contains a very good amount of minerals such as potassium, phosphorus, calcium, and small amounts of iron and sodium. Presence of some micronutrients (iron and zinc) in grain makes it more valuable for reducing the problems of micronutrient deficiency and micronutrient malnutrition worldwide. Regular and proper use of sorghum in different food forms in the meals of pregnant ladies fulfills the need for nutrients and micronutrients.

Pearl millet is an important millet which is widely grown by farmers. The history of farming of pearl millet in Africa and India is not new but is reported from ancient times.

Pearl millet is tall, grows up to 8–16 ft in height, and can also grow in nutrient deficient, sandy soil conditions in low rainfall zones. It contains a high amount of phytochemicals and micronutrients as folic acid, vitamins E, B complex, magnesium, copper, and zinc which are suitable for heart and cholesterol-related issues. It has also a very high energy value in comparison to any other flours. Presence of high calcium and unsaturated fats in grains are responsible for good health.

Proso Millet is also known as common millet and treated as the most healthy and wonderful millet. It is a short season plant and mature within 60–70 days after planting and fit for various soil types and weather circumstances. Its seeds are round with a smooth and silky hull. The grain of Proso Millet is rich in indigestible fiber in comparison to other millet. The seeds are surrounded in the hulls and due to this, it is very difficult to remove by any conventional milling procedures.

Finger millet is a tillering plant which bears finger-like terminal and minor seeds. Maturity period varies from 3 to 6 months depending on millet varieties, climate, and other growing environments. It is mainly grown in dry regions, particularly the southern part of India. It is rich in essential amino acids, vitamin A, vitamin B, and phosphorus and also comprises a great quantity of calcium. In some regions of India, Finger millet flour is used in the preparation of several nutritious foodstuffs as ragi balls. The presence of a high amount of fiber is useful in digestive problems, blood cholesterol, and cancer.

Foxtail millet grain is one of the oldest cultivated millet and is known for gluten-free grain. It can grow in low watery conditions with a narrow root. The maturity period of this crop is short and it matures in 65–75 days. Seeds of this crop are spike-like structures with flattened panicles and show resemblance with rice. Seeds also contain an outer thick husk layer. Little millet can grow in very adverse conditions of drought and waterlogging. It is commonly grown as a mix cropped with pulses,

oilseeds, and millets. The seeds of this millet are not large and small as compared to other common millets.

Kodo Millet (*Paspalum scrobiculatum*) is a native of tropical Africa and is known as one of the ancient millet, and reported to origin in India before 3000 years back (De Wet et al. 1983). Kodo Millet is a key food in some parts of India and is used usually as nutritious and healthy foods in rural zones of India (Hegde and Chandra 2005).

7.2.2 Nutritive Summary

Millets are rich in nutritional compounds and have a higher value than wheat and rice specifically in terms of minerals and nutraceutical contents. In case of all the millets, the total fiber contents are very high than wheat and rice. In case of foxtail and little millet, the iron content of grain are also higher than rice. Most of the micronutrients which cause deficiency problems and malnutrition are rich in millets. In case of β-carotene mostly obtained from pharmaceutical sources is abundantly found in millets. In the perspective of micronutrients, each millet is very important and every millet is reported to be higher level to wheat and rice, therefore millet may be a good option for mineral malnutrition for majority of people of India.

7.3 Role of Processing for Food Uses

The seed coat of millets is very tough and mainly linked with flavor (Malleshi et al. 1986) and non-convenience of processing methods. The availability of processed millet is limited which is a major reason for little recognition of millets (Table 7.1). There are many types of machinery available for the processing of many cereals but poor availability of proper machines for millets processing.

The nutritional and functional properties of millet are required urgently for value addition and development of processed millet for nutritional and healthy food development and to satisfy the needs of consumers. In the current scenario, technology and skill for developing varieties of suitable food products specifically healthy food are changing. Proper processing methods with minimal nutritional loss are

Table 7.1 Parameters and impacts for food development

Parameters	Impacts
Enhancement of nutritional availability	• Make more digestible nutrient form • Nutritional fortification, e.g., thiamin
Ready to Eat (RTE) and Convenience	• Nutrient-rich easy and ready to eat options
Digestibility of millets	• Formulate food grade with good digestibility products
Safe food	• Without any harmful compounds • Acceptable microbiological level

Table 7.2 Some important biochemical value for dehulled millets (%)

Millet	True digestibility (%)	Biological value (%)	Net protein utilization (%)	References
Pearl millet	94.6	58.8	55.7	Singh et al. (1987)
Foxtail millet	95.0	48.4	46.3	Geervani and Eggum (1989)
Little millet	97.7	53.0	51.8	Geervani and Eggum (1989)
Kodo millet	96.6	56.5	54.5	Geervani and Eggum (1989)
Proso millet	99.3	52.4	52.0	Geervani and Eggum (1989)
Barnyard millet	95.3	54.8	52.2	Geervani and Eggum (1989)

required by the manufacturer. In case of millet during processing partial modification of some ingredients is possible which affects the edible portion and cost of products.

Currently, many suitable old methods are familiar in some regions of semi-arid tropics where millets are primarily utilized as a food source. In this process some are manual and some are labor-intensive. These methods are not suitable for complete decortication of millet grains and for food consumption after processing. Some manufacturers are not able to process the grain and they directly dry-mill the whole grains and utilize it for the development of several food products (Table 7.2).

7.3.1 Millet-Based Complementary Food

The availability of locally formulated complementary food is limited. Staple foods and components are required all-time for preparation of all types of food products (Samson 1993). The available complementary food with cereal-base are poor in protein quantity and limited in essential amino acids essentially lysine and tryptophan. Use of available legumes in cereal mixture increases the protein content and protein quality specifically essential amino acids. The food formulated at local level or home level must follow the following conditions: Great nutritional value, suitability, low cost, and use of local food items (FAO/WHO/UNICEF 1971; Dewey and Brown 2003).

Several studies found that in case of micronutrient malnutrition the case of iron and zinc deficiency is predominant in children. Due to being rich in micronutrients, utilization of millets will be effective in development of complementary foods (Pelto et al. 2003; Getahun et al. 2001). Some important processing methods have been found to be effective in reduction of anti-nutritional compounds in millet.

Use of the germination process particularly has been found to increase the nutritive value in pearl millet seeds. Germination process increases the accessibility

of crucial nutrients and reduces the quantities of anti-nutritional compounds. Millet flour is the best and suitable material for different types of food preparations (Hassan et al. 2006). Therefore, use of millet grains for the development of value-added and health food is a suitable and best approach which nowadays results in high demand for millet-based food in urban areas and also for nontraditional millet users (Obilana 2013). Lack of suitable complementary food and feeding process are major reasons for increasing the problem of under and malnutrition (Villapando 2000; Daelmans and Saadeh 2003). Millet-based complementary food formulation can play a very useful alternative for infant-based food for the low-income people. The formulated food product can be beneficial in avoidance of protein and energy malnutrition due to use of nutrient-rich components. Accordingly continued practice of millet grains in place of other cereal flour, cereal-based mixture, formulated complementary formula, and other blends will be used for development of high quality, safe and longer duration of food products at local level and also helpful in marketing of millet and millet-based formula.

7.4 Utilization of Sorghum and Millets in Food Application

Different regions of the country have their own food habits. The important approach for fighting malnutrition problems and hunger is to design and modify the local recipes as per the populations. Value addition in traditional types of existing recipes using sorghum and millet will be the best strategy for nutrition security. Some important and popular recipes are selected for value addition through millets, fruits, vegetables for enrichment of quality protein, micronutrients, and vitamins.

7.4.1 Sorghum and Millet

Several researches concluded about sorghum biochemical composition and indicated that sorghum has a good amount of quality protein, vitamin B1, B2, niacin, and micronutrients as iron and zinc. In some findings, it is found that sorghum is inexpensive source of iron and zinc after pearl millet (Parthasarathy Rao et al. 2006). The uses of sorghum in different regions of the world vary as per the choice of populations. In Asian countries, it is mainly utilized in food and industries and in African countries it is mainly utilized for food purposes. In European countries, North America, and Australia the sorghum grain is mainly utilized for the purpose of feed. In some developing countries, sorghum is used as livestock feed in some months when the weather is dry.

In the majority of developing countries, millets are preferably used for food purposes. Millet grains are very rich in energy, quality nutrients, and nutraceutical compounds. Currently, millet plays a major role in formulation and development of high market demand for healthy and baby foods. Millet grains are also used as feed in some of the regions of some countries. In the current scenario, the utilization of millet is changing and some countries also shifted for some more uses as alcohol

production, feed for poultry purposes and livestock, etc. Millet utilization pattern is altering in different countries and they are shifted to some other applications as alcohol manufacture, livestock, and poultry feed. In some regions of Africa and Asia millet is significant source of feed in post-monsoon seasons.

7.4.2 Uses in Food

Sorghum crop is one of the staple crops in African countries and also in some important regions of India. In these regions, it is consumed as traditional food. The uses of sorghum for food purposes are highest in case of African countries. In Asian countries, the trends of consumption of sorghum as food are decreasing due to increase in income, economic development, and consumer liking for food. In some urban regions of India although it is a staple crop its use and acceptance are decreasing for some years. The major reasons for this decline are substitutions of sorghum grain with some fine cereal grains, increasing pattern of income, and some government policies which favor the use of other grains.

The utilization of millet grains for food purposes in African and Asian countries is not favorable; therefore, use in food is limited. In the current scenario, the demand and use for food purposes increases and favors and increases in demand from African countries in the past two decades. The case of utilization of millet for food uses and demand in Asian countries has been decreasing for several years. In some countries, these trends affect the economy and production.

7.5 Value-Added Products of Sorghum and Millets

7.5.1 Conventional Food Products

Sorghum and millets are grains for very high energy which are exclusively suggested to all age groups. Small millet flour is very similar to rice in many cooking properties and can be used as a good alternative for the preparation of several types of food. In India, several types of food products are prepared at home in rural and urban regions.

7.5.1.1 Roti

Some important food products prepared using millets are roti, mudde, and porridge (Devi et al. 2014). Millet grains are gluten-free protein; therefore, it is not suitable for complete food product formulations and can be used only as a component for preparation of bakery products. In case of preparation of some important products as roti, the hot water is used with millet flour which favors the partial gelatinization of starch. This process is useful in necessary binding and involves rolling the thin leaves. In case of millet flour put off in cold water containing a little buttermilk and gone overnight which supports mild fermentation. After overnight we can use the slurry for preparation of porridge.

7.5.1.2 Multigrain Flour

Flours developed using several grains as multigrain are also known as composite flours. Composite flour is prepared by blending processed and unprocessed grains and pulses and this fulfills the major need of nutrition. The utilization of processed sorghum in sorghum enriched multigrain flour formulation is a very good option for enhancing taste, nutritional, and nutraceuticals value of roti (Rao et al. 2014) (Fig. 7.1). It is found that preparation of flour mixture using finger millet and wheat in the ratio of 3:7 develops favorable semi-finished products which are suitable for making chapatti. In finger millet fortified chapattis, it is found to increase taste as well as antidiabetic properties and found effective in diabetic patients (Ravinder et al. 2008). Composite flour with high fiber content is efficiently useful in constipation problems (Cade et al. 2007).

7.5.1.3 Fermented Foods

Fermentation is an important process which plays several major roles in food processing sectors. In this process, several anti-nutritional compounds which are responsible for nonacceptance of the grains are affected and their level reduces which improve the nutrition value, taste, and other food properties (Varma and Patel 2012). Several fermented foods that are very familiar in most parts of India specifically in South India are very useful for breakfast purposes some of them are dosa and idli. These fermented foods are good examples of fermented food where we can replace rice during preparation. During preparation, millet and black gram are mixed and ground and the resulting mixture is kept for fermentation overnight. The overnight fermented mixtures are steamed and prepared as dosa. Some other sorghum and millet fermented ready-to-cook food products are developed which are given in Figs. 7.2, 7.3 and 7.4.

7.5.1.4 Parboiled Millets Products

Parboiling is a familiar process mainly used in the processing of rice grain which improves the biochemical, milling properties, and yield. In some research, it was also

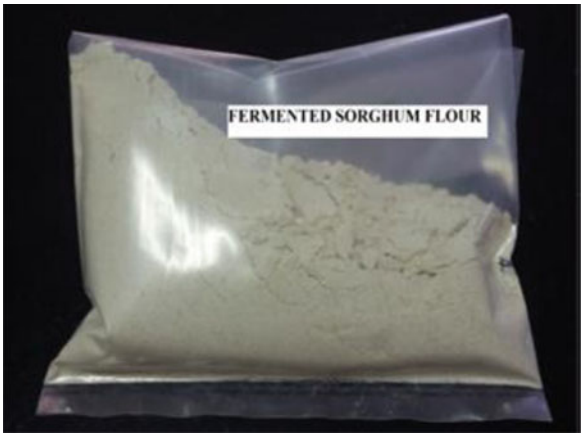

Fig. 7.1 Sorghum flour

Fig. 7.2 Sorghum masala

Fig. 7.3 Upma Mix

Fig. 7.4 Kodo Halwa mix

found that parboiling also affects the phenolic and antioxidant properties of the grain. This process is also beneficial to conserve nutritional compounds of grain from outer coating and bran of the grain. In some research, it was also stated steam treatment process of millet specifically finger millet supports the endosperm part and helps in grits production. Shreshta (1972) found that parboiling of kodo millet upgraded its milling quality. Similar to parboiled rice millets can also be used for development of ready-to-cook products.

7.5.1.5 Papad

In the current scenario, development of several processed food products for food uses are very fast growing some of them which are very popular such as chakli, papad, and idli. Several varieties of sorghum and millets are developed in India and have high yield and biochemical ingredients. Sorghum and millet might be very useful with higher demand in the upcoming time for development of the above types of food products for local and industrial uses.

Papad is one of the very popular food products in India used traditionally from a long time. Begum (2007) reported that adding finger millet flour for preparation of papad maximum up to 55–60% gives proper texture. Papad preparation methods include cooking millet flour in water to gelatinization, preparing thin pieces, rolling the dough, and drying of pieces to achieve moisture maximum up to 6%. Papad is a ready-to-cook product whose dark color changes to lighter color during frying (Varma and Patel 2012).

7.5.2 Nonconventional Food Products

There are several reports available which describe utilization of sorghum and millets in several traditional and healthy foods. Sorghum grains are used successfully in development of several snack foods as cookies, pasta, cake-like food products. Developments of such types of food products are very challenging without wheat and rice. Some additives are required during preparation of such food materials as starches, fat, and hydrocolloid for improvement of quality in case of some products. Sorghum grain might be significant for production of bioethanol and other industrial goods. Many research workers are trying to develop various demanding food products as flaked products, extruded products, popped products, fermented, malted, and composite flours; weaning foods, etc.

7.5.2.1 Flakes Food Products

The demand for sorghum and millet-based flakes products are increasing due to nutritional and nutraceutical behavior of such types of products. Sorghum and millets are exploring for development of ready-to-cook (RTC) flakes products to fulfill the desires of present users. Sorghum and millet flakes are prepared by using the following steps; debranne the millet, add in hot water, and cook for 10 min. Proper cooking procedures are adopted for all types of millet flakes (Rao et al. 2016).

The comparatively lesser mass and rapid hydration process of millets are responsible for preparation of suitable flake products.

7.5.2.2 Popped Products

Popping process is very common in the majority of cereals industries to prepare ready-to-eat (RTE) types of food products. After popping, the grain becomes crunchy and porous and also with improved taste and flavor. Popped products developed using finger millet have very acceptable flavor. In some of the regions of India popped products are available for marketing at small level food industries. In some study, it was found that a grain with moisture of around 18% and popping temperature up to 250 °C will be suitable for the preparation of complete expanded millet products (Malleshi and Desikachar 1981). The important factors responsible for optimum flattening of the grains are their shape and moisture. In case of decorticated finger millet, high temperature and quick time are desirable for expanded products and finally ready-to-eat products (Ushakumari et al. 2007).

7.5.2.3 Weaning Food

Most developed weaning foods are used as complementary food. The major aim of development weaning foods is to provide proper nutrition, taste, and safety aspects of baby food. The important cereals used in India are mainly staple food that provide energy and nutrients in human diets and comprise major components in daily diet intake. For baby complementary food it is essential to formulate energy-rich, nutritionally balanced, highly digestible, and with functional components. Millet, specifically Pearl Millet, is a staple food and favors the majority of the population in Asia and Africa. They are not only rich in protein and energy but also provide enough essential micronutrients.

Use of malting process is very common in some regions of India (Chandrasekhara and Swaminathan 1953). It is also established that the amylase activity in finger millet is higher than sorghum and other millets (Senappa 1988). Malleshi and Desikachar (1986) also found finger millet is suitable for development of weaning food because malt of finger millet is highly acceptable with high value of starch digesting enzymes. The higher level of enzyme activity is achieved at a very short time of 3–5 days of germination. Due to high levels of micronutrients specifically calcium and essential amino acids it can be used as a suitable ingredient for development of weaning food (Malleshi and Desikachar 1986). Malting processes not only increase the digestibility and nutritional properties but also reduces the level of anti-nutritional compounds (Desai et al. 2010).

7.5.2.4 Noodles-Vermicelli

Development of value-added products is one of the major challenges in food industries. Some novel process as extrusion technology is developed for restoring the ingredients in value-added products. Kurkure is one of the important and common products widespread in children who are developing through this extrusion process. Children and teenaged populations are very sensitive and choosy group who

like such type of products and therefore demand of millet and millet-based noodles due to nutritional awareness in worldwide is very high.

Millet-based noodles are prepared by using a mixture of legumes and millet flours and can be introduced in weaning foods programs for energy and nutrition balance. Development of such types of food products is very economical at cottage level industry because all the ingredients and machines are very simple with very low amount of investment (Kumate 1983).

7.5.2.5 Bakery Products

Several bakery products available in the market such as biscuit, muffins, and bread can be prepared by using millet flour. Although millet flours are gluten-free which is not favorable for use of entirely pure millet ingradients for preparation of bakery and noodle products. Use of millet flour in preparation of bakery products enriches them in fiber and micronutrients which enhance the overall quality and value of products. In some studies, it was found that the addition of malted finger millet flour improves the nutritional and function properties of cake-like products (Desai et al. 2010). Many studies were performed for development of convenient food using millets and sorghum variety (Singh and Raghuvanshi 2012). Several studies used for formulation of food products using millets found that sorghum, oat, and millet can be used as suitable alternatives (Angioloni and Collar 2013). Eneche (1999) formulated biscuits using legume and millet flour and found higher acceptability of the product.

7.6 Process of Preparation of Some Millet Products

In the current scenario, it is found in several studies that small millets are superior to any conventional food because of the presence of several value-added compounds. It contains a higher level of some complex carbohydrates and starch (resistant) which make it favorable for diabetic patients. Millets are also rich in β-glucans which help in glucose metabolic pathways. The important factor which limits their utilization is flavors and shelf life of flour-based products. Therefore, use of suitable processing conditions, use of pulses, vegetables, fruits, and spices during preparation may be useful to overcome the problems of flavor and improvement in nutritional and functional properties of the products.

7.6.1 Little Millet-Based Products

7.6.1.1 Dosa

Samai dosa is prepared by using one cup of little millet, half cup dhal of black gram, half cup processed rice (puffed), one tablespoon of fenugreek, and a desired amount of salt to taste. Soaked seeds of fenugreek, black gram, and rice are used in the preparation process. All the soaked ingredients are grind properly and kept overnight for fermentation. Mix all the processed ingredients and prepare the dosa.

7.6.1.2 Porridge

Porridge is prepared using the following ingredients; little millet, coconut milk, and salt. Rice is cooked in water and added to coconut milk for 10–15 min, add the desired amount of salt and cool. The porridge is ready to serve.

7.6.1.3 Payasam

Payasam is prepared by using little millet flour, sugar, ghee, milk powder, and milk. The product makes it more healthy and tasty by adding fruits before serving.

7.6.2 Foxtail Millet-Based Products

7.6.2.1 Porridge

Porridge is prepared by using foxtail millet, sugar, powder form of cardamom, and cloves. Foxtail millet is boiled in water, add sugar and further boil and at the final stage use powder of cardamom and cloves. Porridge is served with milk in hot form.

7.6.2.2 Pongal

Pongal is a very tasty and South Indian millet-based product. It is prepared by using foxtail millet, jaggery, coconut, mixture of cloves and cardamom powder. In the presence of millet pongal becomes healthier and can be utilized by any age group.

7.6.2.3 Burfi

This is sweet in nature and very popular after meals in Indian families. Burfi is very healthy, tasty with good texture. It is prepared by using the following ingredients; foxtail millet, grounded nut, dry coconut powder, cardamom, and ghee. Foxtail millet is roast and dry in powder form, make syrup of jaggery and mix all the ingredients. The dried form of final mix ingredients is cooled and made into desired shape.

7.6.2.4 Kabab

Kabab is a very delicious and popular form of millet-based food products in India. The important feature of kabab is its nature of melting in mouth with unique flavor. This is a very familiar food in both vegetarian and nonvegetarian populations. Major ingredients are foxtail millet, potato, raw banana, chilli and cumin powder, oil, salts, and spices.

7.6.3 Finger Millet-Based Products

7.6.3.1 Malt (Ambali)

Malt is a very energetic and good snack for a healthy and active life. Major ingredients used in preparation are finger millet powder, buttermilk, and salt for desired taste. Overnight finger millet is cooked with buttermilk at low temperature and made into a thin porridge form.

7.6.3.2 Idli

Regular use of idli in breakfast is nutritious and healthy for snacks in India. Major ingredients used for idli preparation are whole finger millet grain, parboiled rice, black gram dhal, and fenugreek seed. Finger millet grains are soaked in water for a day and drain the water and develop white sprouts after 3–4 h. Rice and black gram are also soaked for 4–5 h and drain the water. Grind all the soaked ingredients and make light and fluffy materials and add desired amount of salt and kept for overnight. Make the idli using steam with the help of a pressure cooker.

7.6.3.3 Halwa (Pudding)

Finger millet-based halwa is tasty and healthy in use. It is one of the healthy, easy to prepare, and lovely recipes. Major ingredients used for halwa are whole finger millet flour, jaggery, cardamom powder, cashew nuts, and ghee. Finger millet flour is mixed with water and kept for 10–15 min and poured into the pan and add sugar. Cook with ghee and make a thick mixer and in the final mixture add cardamom and cashew nut (fried form).

7.6.4 Kodo Millet Recipes

Kodo millet is popular in tribal regions of India and they are cooked similar to rice and develop several types of products.

7.6.4.1 Papad

The major ingredients used for preparation of papad are kodo millet flour and black gram flour. During preparation of papad both the processed ingredients are used in the same amount and add cumin, sodium bicarbonate, and salt for taste and texture. Finally the dough is rolled and made into circular shape.

7.6.4.2 Vadagam

Vadagam is a traditionally prepared recipe. Usually, it is sundried and whenever required, deep-fried in hot oil. It is prepared by using Kodo millet flour, chilli powder, cumin powder, and desired amount of salt in water. Final product is allowed to sun dry and packed in an airtight container for higher shelf life.

7.6.4.3 Idli and Dosa

Idli and dosa are very common products in south India and are now getting popular in other regions of India. Kodo millet can be used to prepare idli and dosa, using 3:1 ratio with black gram dhal. This product is prepared after soaking and grinding which play crucial roles in preparation.

7.6.4.4 Thatuvadai

This is a unique product and prepared by using kodo millet, Bengal gram dhal, curry leaves, chilli powder, and butter. Airtight packaging improves product quality and shelf life.

Fig. 7.5 Kodo Kheer

7.6.4.5 Kodo Kheer

Kheer is a very popular food in all regions of India. Fermented kodo millet is nutritionally rich with a minimum amount of anti-nutritional compounds (Fig. 7.5). Kodo millet kheer is prepared by using fermented kodo millet, dry fruits, and milk with some flavoring ingredients.

7.6.4.6 Muruku

It is popularly known as chakli in some regions of India. The major ingredients used in preparation of chakli are kodo millet flour, sesame seeds, cumin, chilli, butter, and salt for desired taste. Using coarse kodo (rawa) vadai, upma, kesari Bhat, and cheela (Adai) are also other recipes that can be prepared. Kodo kheer and halwa are other sweet items, which could be prepared using kodo grits.

7.6.4.7 Vadai

It is a soaked kodo millet product. Kodo millet and other ingredients such as Rice and Bengal green dhal are soaked for 4–5 h and properly grind the soaked ingredients to make dense consistency and made into round shape.

7.7 Conclusion

The nutritional and health welfare role of sorghum and millet grains are already established which is comparable to other major crops. The household-level utilization of sorghum and millets are not satisfactory which is urgently required to improve. In the last few years, the importance of sorghum and millets as a staple food has been falling due to a number of reasons such as increasing the income of populations, urbanization, and some important government issues. Due to these reasons, these crops are not mainly used for food purposes but they are becoming

alternatives as feed, processed food, and alcohol production in some industries. In some regions of India, the growth of these crops in value-added product development is increased due to health awareness. Development of suitable process technologies for farming, processing, and value-added products from these crops can overcome the limitation of these crops. Crop yield and yield stability in crop yield and improvement programs can play an important role to make these crops economical at farmhouse and end-use stages. Increasing use and demand of some coarse grains in the market for the development of healthy, gluten-free substitute, and value-added products with higher shelf life there is an urgent need for identification and development of processing technologies which will be helpful in development of healthy food with an increased shelf life of sorghum and millet food-based products. Establishment of a proper linkage between consumption of millet with health is urgently required for the promotion of sorghum and millets. It is also necessary to educate the farmers and other families to produce and use these grains for health and nutrition purposes. As per pearl millet which is popularized for health benefits, other millet varieties are also recommended for their health benefits mainly in development of complementary food development for malnourished populations and in mid-day meal programs.

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