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TRADITIONAL METHODS OF PROCESSING OF SORGHUM (SORGHUM BICOLOR) AND PEARL MILLET (PENNISETUM AMERICANUM) GRAINS IN INDIA

Introduction

Sorghum and millet are the major coarse grains in Asia and Africa and are mainly grown in rainfed areas in the semi-arid tropical (SAT) regions. These cereals provide the bulk of calories, protein and other nutrients to several million people of SAT areas, where they are used as a principal source of food. The status of sorghum and millet has for a long time been that of "poor man's food". However, recently these two coarse grain cereals have gained importance in many parts of the world and the potentialities of their use as a superior food by blending them with wheat flour have been explored in several places *(Kent,* 1975; Badi and *Hoseney,* 1976; Crabtree and *Dendy,* 1979; Miche et al., 1976).

In India, sorghum and millet cultivation occupies nearly 27 % of the total area under cereals and contributes about 14 % of the total cereal production in the country. Most of the Indian fanners, apart from grain production, are also interested in good quality fodder for their livestock. In addition to providing food for human consumption, sorghum and millet crops are also an important source of stover for livestock animals. .

Rural people represent the major proportion of consumers of sorghum and millet in India. The grain types, processing methods and food habits vary considerably in various parts of India. Despite low yields, local types are generally preferred by the consumers owing to their characteristic unidentified food quality attributes. *Rachie* (1963) has described the various aspects of utilization of sorghum and millet in India. The most common product of sorghum or millet is roti or chapati which is an unleavened flat bread prepared from ground flour. Porridge-like preparations and cooked grains are also common. In a few states (Rajasthan and Gujarat), millet is of seasonal preference, being used in winter while wheat is used in summer. With a wide diversity in food habits in various regions, there exist a number of recipes that could be made from sorghum and millet. In order to identify the various processing methods and food uses of these two cereal grains, a survey was undertaken in seven states of India.

Survey of villages

A survey of traditional methods of food preparations from sorghum and millet was carried out in villages of seven Indian states, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu. These states contribute about 77% of the sorghum and about 73% of the millet production in India. The area and production of sorghum and millet in each state is shown in Table 1. The villages surveyed were selected in a random fashion from each state, and as far as possible, a distance of 50 km or more was maintained between any two villages in the same area. Wherever possible, wives of farmers were interviewed using a standard questionnaire. In all, 171 villages ware surveyed and the information on traditional processing methods and foods that are prepared using sorghum and millet was gathered. A total distance of about 19,000 km was covered in carrying out the survey.

Table 1: Area and Production of Sorghum and Millet in India *

State	Sorghum		Millet	
	Area (000 ha)	Prod. (000 t)	Area (000 ha)	Prod. (000 t)
Andhra Pradesh	2,395	1,020	622	351
Tamil Nadu	696	609	460	342
Karnataka	2,071	1,790	530	268
Maharashtra	6,175	3,451	1,888	586
Gujarat	1,095	554	1,916	1,391
Rajasthan	702	186	3,706	1,125
Madhya Pradesh	2,047	1,395	186	106
Total	15,181	9,005	9,308	4,169
Total (India)	16,101	9,552	11,583	5,726

* Estimates of area and production of principal crops in India, 1975—'76. Government of India, 1977.

Processing *methods*

Our survey revealed that sorghum and millet grains are stored and used by villagers for a period of about one year after the harvest. Sorghum grains grown in India for food are predominantly white, pearly and with a corneous endosperm (Rachie, 1969). An account of the traditional methods of processing of sorghum and millet in several countries has been recently published by Vogel and *Graham* (1978). They have reported the various milling methods that are commonly used in India and Africa and there appear to be similarities in the processing methods used in different countries. During our survey, we have observed that sorghum and millet are processed for food in several ways depending upon the need and local habits. Dry milling into flour or grits is common in several villages. In some cases whole grains are also cooked or they are soaked and wet milled. In

other cases, the grains or the batter made from wet milling are fermented. Roasting and popping of sorghum is practiced in a few cases.

Dry Milling

In olden days, grains were ground in a hand operated wooden or stone rotary mill in village households. But nowadays whole grains are ground into flour in mechanically operated disc mills called chakki. The flour is used for making products like roti which is one of the major food products made from sorghum and millet in India.. For the preparation of sorghum grits (nuchu, rawa) the grains are first moistened and then pounded to remove the husk with a stone mortar and wooden pestle. The dehusked grains are pounded into grits. Further pounding is also done to get a fine flour. The husk is also fermented and the fermented water is used in some food products. Grits are used for various food products. The dehusking process is not commonly followed for millets.

Wet Milling

Wet milling is practiced in some villages in Andhra Pradesh, Karnataka, and Tamil Nadu by first soaking the grain in water or in buttermilk. The duration of soaking varies from a few hours to about 12 hours. Sorghum or millet grains alone or in combination with other legumes like black gram *(Phaseolus mungo)* are wet milled into a batter. The batter is mixed and allowed to ferment overnight before it is used for the preparation of food. Soaking of grain for prolonged periods up to 3 days is also practiced (Karnataka, Tamil Nadu) for obtaining the desired product.

For making papad (a snack), the grains are soaked overnight and excess water is removed the next day. After sun-drying, the grains are ground into flour. At times, the grains are also partially cooked. The husk is removed by rubbing over gunny cloth. The dehusked grains are pounded and sun-dried. Flour is made with the help of a hand chakki and used for papad preparation (Madhya Pradesh).

Popping and Roasting

Popping of sorghum is more common than popping of millet (Gujarat, Madhya Pradesh, Maharashtra).

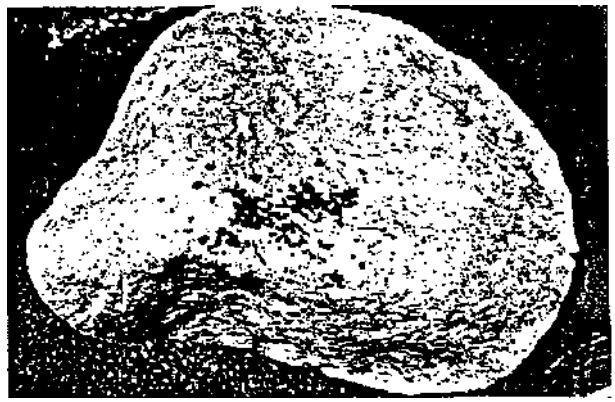

Plate 1. Roti.

Some cultivars possess the desirable popping characteristics. The grains are popped on special hot plates or on sand heated over hot plates. Sorghum earheads at soft-to hard-dough stage are roasted directly on hot coal and consumed (Pongda, in Madhya Pradesh). Millet grain or grits is roasted for certain snack-type preparations *(chikki, sukhadi,* in Gujarat; lapsi in Rajasthan).

Food preparations

After processing the grains into flour, grits or batter several food products are made in villages. Based on the information gathered from our survey, they could be classified into seven broad categories (Tables 2 and 3). Of course, this list is not exhaustive for all the products that are made in India, but it illustrates the kind of preparations that are usually made. A brief outline of the method of preparation of flour, grits and batter into various food products is given in the following sections.

Roti *products*

Roti is the most common product made from sorghum and millet (Plate 1). It is prepared from flour by making a dough, similar to that prepared from wheat. It is made in several ways to suit the preference of the consumer. Sieving the flour prior to making the

Table 2: Food Products prepared from Sorghum

Bread[1]	Porridge[1 2]	Gruel[1 2]	Cooked[2 3]	Steamed[1 2 4]	Fried[1 4]	Others (snacks)[1 3]
Roti	Muddhae	Kuzh	Anna	Idly	Dosa	Avilakki
Bhakri	Kanya	Ganji	Guguru	Savagi	Kurdigi	Halwa
Thalipith	Pulagam	Rabaldi	Sogari	Phundke	Papad	Phuli
Gurchandia	Dhalia	Sanja	Thuli	Dokla	Ponganum	Kohuri

[1] From flour [2] From grits [3] From whole grains [4] From batter

Table 3; Food Products prepared from Pearl Millet.

Bread[1]	Porridge[1 2]	Gruel[1 2]	Cooked[1 2 3]	Steamed[1 4]	Fried[1 4]	Others (snacks)[1 2 3]
Roti	Sankati	Kuzh	Ghugri	Idly	Dosa	Mavu
Rotla	Kichadi	Rabadi	Upma	Kudumu	Puda	Sukhadi
Debra	Kali	Rab	Anna-koot	Gutta	Gare	Chicki
Thepla	Lapsi	Ghense	Kolab	Dokla	Khurma	Ladwa

[1] From flour [2] From grits [3] From whole grains [4] From batter

dough is more common for millet. Hot or cold water is used for making the dough. Jaggery water (Madhya Pradesh), milk or even sugarcane juice (Maharashtra) is used for dough making. The dough is kneaded several times to make it consistent and is made into a ball shape and then flattened to a disc by deft strokes of the hand. This process is difficult and needs considerable practice in making uniform roties. The sorghum roti made in Maharashtra, and millet roti made in Gujarat and Rajasthan, are comparatively thick (3 to 4 mm) and about 15 cm in diameter; whereas in Karnataka, the rotis are baked on a hot iron or earthen plate. In Maharashtra, Gujarat, and Rajasthan the roties after baking on a hot plate are further baked by placing them directly on smoldering coal for a short period. The roties are either served fresh or consumed within a few hours of preparation (up to 6 or 8 hr). In some of the villages, the local residents feel that roties could be stored up to 1 week.

Wheat flour is mixed with either millet or sorghum flour and roties are made after the addition of spices. The product prepared from millet is called *Dhebra* or *Thepla* (Gujarat), and from sorghum is called *Bhandole* (Gujarat). In some villages, the dough with added spices is made to a round shape and then cooked in steam or fried in oil and consumed as a breakfast food or snack.

Porridge preparations

Sorghum flour or grits, or both of them together are used for porridge preparation. Rice or finger millet flour or grits is also mixed with sorghum flour for making porridge. The grits or flour is cooked in water or buttermilk (Madhya Pradesh), or in frementedbroth called *Emla* which is prepared by soaking sorghum husk for 15 to 20 days (Karnatka). The proportion of water to grits or flour varies widely and depends on food preference. Spices and whole green gram (*Phaseolus aureus)* are also added while cooking. The thick porridge obtained after cooking is called *muddhae* (Karnataka, Plate 2), *maheri* (Madhya Pradesh), sankati *(Andhra Pradesh),* ghense (Gujaret), kali (Tamil Nadu).

Thin porridge is also prepared, mostly using grits, but sometimes flour. Several snack items, such as laddu from sorghum (Madhya Pradesh), and *chikki, shira, sukhadi* (Gujarat), using roasted grits from millet are also prepared.

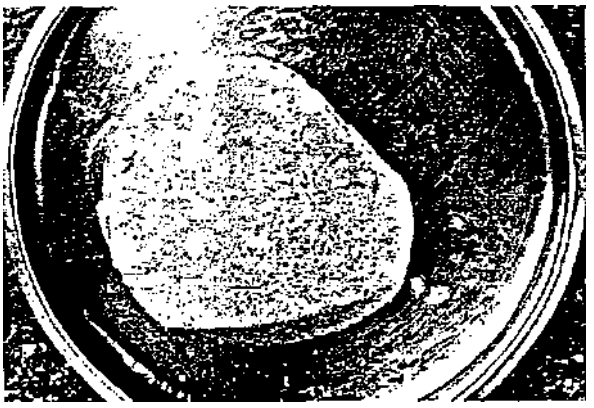

Plate 2. Muddhae.

Whole Grain Preparations

When sorghum is used in the form of whole grain, the husk is normally removed by pounding, but this is not common for millet. Sorghum or millet grain is then cooked like rice (kichadi, Plate 3). In some

Plate 3. Kichadi.

cases, spices are also added while cooking. In Gujarat, a product is made using sprouted millet by cooking it in the same way as the whole grain.

Other *Products*

Steamed and fried products are prepared from sorghum and millet and used for snack types *(ponganum,* Plate 4). Extruded products are also prepared

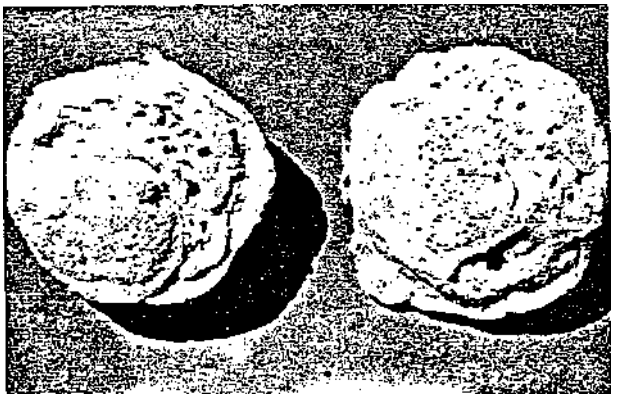

Plate 4. Ponganum.

(sawagi, in Karnataka; *nangal,* in Tamil Nadu). This is not very common as the flour does not possess the quality similar to wheat used for semolina or pasta products. *Raghavendra Rao* et al. (1979) indicated that due to the lack of gluten in maize, sorghum, and millet, the vermicelli (a pasta product) prepared from these grains completely disintegrated on cooking.

Snacks like papad (or papdi), *kurdigi, sandigai* etc. are prepared by making thick or thin spicy porridge with flour and are either extruded with moulds or directly spread on cloth and then sun dried. These are fried in oil and crispy snacks are consumed (Plate 5).

Conclusions

The food types that have been listed indicated clearly the vast utilization of sorghum and millet grains in villages and throw light on possible potential of

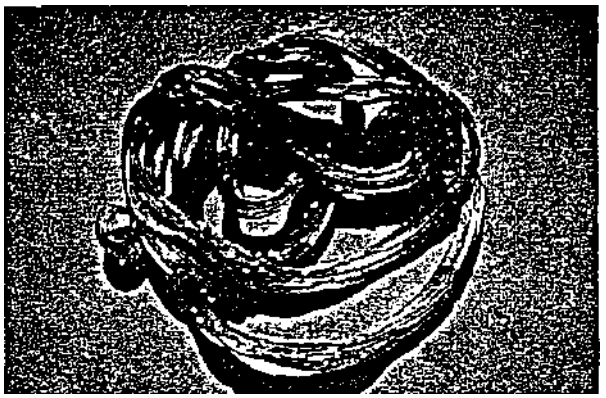

Plate 5. Sandigai.

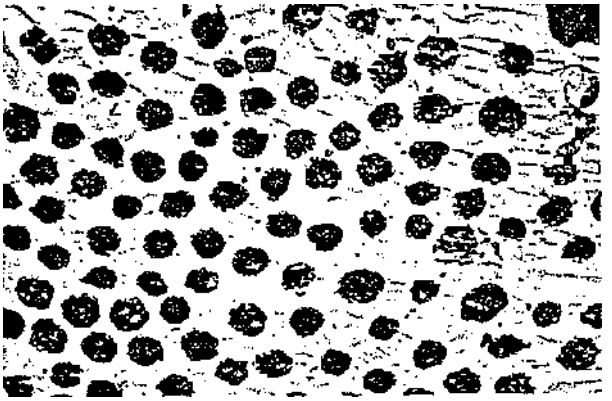

Plate 5 a. Papad.

these cereals for making food products. There is a good similarity in many food preparations in the different states surveyed. This list is by no means complete for all the food types prepared from sorghum and millet in India.

This information is of interest to breeders, nutritionists and processing technologists and should be useful in developing grain types more suitable for the consumer. Sorghum and millet have good potential for making bread *(Casier* et al. 1976) and cookies (Badi and *Hoseney,* 1976). *Rooney* et al. (1970) have indicated that wet milling, dry milling and baking processes can be adopted for sorghum. There appears to be a good possibility of a demand for commercial pearling, particularly for sorghum (Viraktamath et al., 1970). Though industrial processing procedures for sorghum and millet are not as advanced as that for wheat and rice in India, yet with increased production through the introduction of high-yielding varieties, there appears to be a good potential for. utilization of sorghum and millet.

Our survey revealed that several food products are made from these two coarse grain cereals in India. It is important to consider the acceptability by the consumer in developing grain types. Though yield may be the first criterion in any crop breeding program, grain quality acceptable to the consumer also deserves a serious consideration.

At ICRISAT, we have recently initiated experiments to understand the role of some physicochemical properties in making good, acceptable quality of roti from sorghum and pearl millet Our preliminary results indicate that some of the characteristics could be related to the general acceptability of roti of sorghum and millet. It remains to be seen whether this observation will hold good when we screen a large number of samples for their roti quality.

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