



Advanced Processing Machinery and Value Addition of Millets

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In past years, millets have gained a foothold due to the rigorous efforts made by the government of India through different programs. In contrast, we are celebrating the year 2023 as the International Year of Millets. As millet production has declined in favour of major cereals like rice and wheat during the last few decades, a horde of problems has surfaced globally. Changes in lifestyle, climate, shrinking farmland, soil health degradation, labour shortage, diminishing water table for farming, and malnutrition are some of the issues, which is why we are looking up to millets today. With a 2.5-million-hectare production area and a market share of more than 15%, India is recognized as a global leader in millet production. Rajasthan, Maharashtra, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, and Telangana are the states that produce millet. Small-seeded grasses that are frequently referred to as “nutri-cereals” are considered to be millet. Some of them are jowar (sorghum), bajra (pearl millet), ragi (finger millet), kutki (little millet), kakun (foxtail millet), cheena (proso millet), sawa (barnyard millet), and kodo millet (kodon). Currently, millets are being promoted as a “superfood. Millets, once considered the poor man’s food, have become the game changer now. Most of the urban population suffering from various lifestyle diseases, such as diabetes, cardiovascular diseases, and obesity, are following the millet diet religiously. This is a complete overturn of events that started during the Green Revolution. Insistent pumping of water has lowered the water table. Many of the states of India are now grappling with severe water shortages. In recent years, we have also witnessed a climate shift- playing havoc in our agriculture sector, and farmers’ distress has reached its pinnacle. Millets are rising to this occasion to solve a myriad of problems, being low input requiring, climate-resilient, C₄ crops with a nutritional upper hand over major cereals like rice and wheat.

Millet Processing

1. Primary processing: It is the process of cleaning the grain through grading (depending on the size of the grain), destoning (removal of stones), and dehulling (polishing). The bulk operations of these processes can be done mechanically. Primary processing of the grain is the removal of waste, stones, and glumes from the grain, which is very much necessary as it improves the storage of the grain and consumer acceptability for usage.

2. Secondary processing: It involves the use of the primary processed raw material into different ready-to-eat (biscuits, flakes, pops, and multigrain roti) and ready-to-cook sorghum products such as flour, sorghum-based multigrain flour, semolina (fine, medium) and parboiled sorghum.

3. Tertiary processing: It involves the use of the secondary processed raw material to produce commercialized products. Tertiary processing leads to high value-added, ready-to-

cook, and ready-to-eat products like extruded products (vermicelli and pasta), roti, and all recipes prepared.

Millet Processing Machinery: Primary processing of millets is a vital step to convert the grain into edible form thereby enhancing its quality. Although processing millets without husk (naked grains) i.e., sorghum, pearl, and finger millets is easy processing millets with husk i.e., little, proso, kodo, barnyard, and foxtail millets is difficult. ese has an inedible husk, which needs to be removed through processing.

The major challenges in processing small millets are:

Destoner Cum Grader Cum Aspirator is the machine used for this work.

- Dehulling –Cleaned raw grains are then subjected to dehulling, “which is the procedure to remove outer indigestible husk layer from the grains, thus improving its overall digestibility”
- Separation – Output from the dehuller is a mixture of dehulled grains, unhulled grains, and broken. In this step, each constituent of the mixture is separated

Destoner cum grader cum aspirator: - Conventionally impurities confined along with grains such as stones, muds, and grasses were separated by winnowing. The stones are collected on the back side and cleaned grains to the front, and lighter particles by the air. Destoner Cum Grader Cum Aspirator is based on conventional principles and aims at easing the burden, by providing benefits such as higher efficiency, high working capacity, lower labour requirement, efficient segregation based on size, and many more.

Dehuller:-Dehullers are the machinery employed to perform dehulling and works on various principle such as shear abrasion, centrifugal impact (single time), centrifugal impact (double time), roller mills etc. In small millets, dehulling is an imperative concern as the grain’s sizes are very small and their cohesiveness with the outer husk is greater, which makes it very difficult to dehull with higher recovery.

Dehusking:-It is the process of removing the outer layer of the millet. In ‘Millet dehusker’- Jowar, Pearl Millet and Finger Millet could be processed to remove the light outer layer. Whereas, hard-coated millets such as Barnyard, Brown Top, Kodo, and Proso Millet require husk conditioning/ scratching/softening.

Small-Millet Polisher:- It is used for polishing small millets along with ragi and houses a hopper of small capacity, wherein the grains are fed. It works on abrasive action and makes use of a rotary conical abrasive stone and a stationary peripheral stone. Upon completion of the required time, the outlet gate is opened and polished grains flow out through it, while abraded grain powder passes down the sieve provided at the bottom of the rotary conical abrasive stone and is collected at the side outlet. Some drawback associated includes grain jamming, periodic dressing of abrasive stones, and a lower working capacity.

Processing machinery used for millets

S. No.	Equipment Available	Processing methods	Process description	Advantages of process
1	Decorticator and Dehusking Machines	Decortication/ Dehusking	The outer layer of the husk removed from the kernel of the Grain	Significantly reduces anti-nutritional factors
2	Mechanical pearlers and millet mills	Pearling	In this operation, the aleurone layer from dehusked grain is peeled/scratched off	Reduces non-digestible and off-taste compounds
3	Millet mill, attrition mill	Grinding	Size reduction of the millet grainsbased	Grain converted into the suitable form required for

			onprocessed Product	the recipe
4	Open vessel and pressure Cooker	Cooking	Cooking, in which desirable changes take place like starch gelatinization.	Required physicochemical changes taking place to make it suitable for Digestion
5	Open pan, Specially Designed Roasters	Roasting	In the roasting operation, the grains are exposed to intensive high heat for a short time	Enhance the sensory qualities and decrease anti-nutritional constituents
6	In salt use the open hot pan	Puffing	In puffing whole unhusked or decorticated grains with defined moisture content are mixed with hot sand (250 C, about 15–60 s)	Reduces antinutrients and enhances the taste and flavor. The operation also deactivates the bacteria and hence improves storage quality
7	Incubators, Humidity chambers, Germinator	Sprouting	Soaking whole undamaged grains for 2–24 h, and kept in a humid space with desired humidity up to 24–48 h.	Increases the availability of micronutrients, improves digestibility, and reduces antinutrients
8	Fermenters	Fermentation	The fermentation process, growing specific strains of microorganisms at controlled conditions over the raw material as an identified medium.	Enhance the sensory qualities with improvement in nutritional value and digestibility. Also, a considerable reduction in anti-nutritional constituents

Value Addition of Millets

Millets need to be processed before being consumed, and they can be grouped under primary, secondary, and tertiary processing. Numerous valued added products of millets and/or millet enriched products such as sorghum flour, fermented pearl millet flour, masala sorghum, Kodo kheer mix, multigrain instant porridge, multi-nutrient bars, gluten-free eggless cakes, multi-nutrient biscuit, multi-nutrient laddoo, baked multigrain chips, millet, and sprouted legume beverage to enumerate a few.

Whole-grain products- nowadays the healthy whole-grain food concept is getting attention to harness the full potential of the available nutrients in the grain. For example, popped millet, and millet muesli are becoming popular. Millet popping and puffing are among the contemporary methods (roller-drying and extrusion-cooking) to process it for the preparation of expanded ready-to-eat products. Popping and puffing impart an acceptable taste and desirable aroma to the snacks.

Extruded Products- The extrusion technique is used for making millet-based puffed snacks and noodle-like products by hot extrusion and cold extrusion, respectively. Semolina of almost all the minor (finger, foxtail, pearl) millets and refined wheat can be blended to produce vermicelli, noodles, or pasta products.

Baked products- The baking technique is currently employed for making numerous coarse cereals-based bakery products viz. bread, biscuits, cakes, etc. Millets have been found

as a minor ingredient major ingredient or exclusive ingredient in almost all the baked products that are consumed daily such as cookies, bread, cakes, buns, pizza bases, etc.

Beverages and weaning foods-Millet-based beverages and weaning foods have also been developed with milk, malted cereals, soy milk, etc. as the base ingredient. Non-dairy plant-based lactose-free yogurt-like product with sorghum and soya milk is an acceptable product. Sprouted finger millet with other ingredients such as, - green gram, soybean, coconut, and milk powder has been used to make flavored beverages. To harness the potential of pearl millet, Upma, Halwa, and complementary mixes were developed. Nutritious complementary mix can be prepared from malted and non-malteredextruded pearl millet and barley.