

Value addition

in millets through agricultural processing techniques

P Hemasankari*, B Dayakar Rao, V M Malathi, E Kiranmai and C V Rathnavathi

ICAR-Indian Institute of Millets Research, Rajendranagar, Hyderabad, Telangana 500 030

Milletts play a major role in eradicating the malnourishment and are poor man's crop. Major millets include sorghum, bajra and ragi, and minor millets include proso, barnyard, little, foxtail and kodo millet. Value addition is defined as any activity that is done to improve the value of the product by both primary and secondary processing. Value addition in millets includes destoning, grading, cleaning and aspirating the dirt from the freshly harvested millets. Machines used in processing of millets generally reduce the drudgery of human effort and the time involved in processing. Dehulling is done for minor millets and polishing is done for major millets to make value added products. Puffed and flaked millets are produced to gain revenue for the underutilized marketable millets and to fetch most out of the millets.

Keywords: Dehulling, Millets, Nutritional value, Puffed and flaked, Value addition

THE value-addition of millets produces a variety of marketable products. The millet grains are grinded into flour, coarse flour usually called semolina and fine flour known as atta. For semolina preparation, first the millet grains are roasted at higher temperature for a specified time to improve the taste and shelf-life of the product. Then, it is conveyed through the pneumatic conveyor and it ends up in a pulverizer unit where the grain is coarsely grinded and passed through a set of sieves of different mesh sizes and the coarse grain of different grades are obtained. These different grades of semolina are used as idly rawa, khichadi rawa, upma rawa and atta.

Agricultural processing techniques used in millets

The atta that is prepared from coarse grains is used as raw material for making muffins, cakes, biscuits, cookies both sweet and spicy and bread. The hot extruded products produced include subjecting the flour prepared by sprinkling water and then extruding at high temperature. The cold extruder helps in extruding the flour in cold conditions through the die of different shapes to make pasta and vermicelli. This pasta and vermicelli are packed in different polyethylene packets and stored in refrigerated conditions. Quality control of these value added products includes estimation of shelf-life of the developed product that includes moisture content estimation through hot air oven method by

working out the difference in weight or by infrared moisture meter. Water activity meter is used to measure water activity as and then packed and accelerated shelf-life studies are tested using environment chamber. Temperature and relative humidity are tested for determination of longer shelf-life.



Different types of millets



Different puffed millets

Texture analyzer is used to analyse the firmness, adhesiveness, cohesiveness, springiness, gumminess, hardness and chewiness ability of the developed product. Calorific value, energy value is determined for each and every value added product that is developed out of millet. The nutritional significance of the developed value added product of carbohydrates, protein, fat, ash, mineral content and crude fibre are determined for all the value added product developed consisting of cakes, biscuits, vermicelli, pasta, bread, muffins, chikki bar and murukku using standard procedure.

The nutrient content and gluten free nature of millets even though makes it unsuitable for making certain value added products of bread and other cakes, if fortified with other cereal flour of wheat can be utilized for converting it into value added products. These value added products serve as snack food and at the same time are more nutritious, and can help in developing farm oriented small scale business at cottage level and then industry oriented technologies. The equipments and machinery are under development for both primary and secondary processing of these millets. The existing equipments are redesigned to suit the processing of both major and minor millets.

Drying is mainly done to eradicate/remove the excess moisture present in the product by tray drier of different capacity. Rotating tray driers are also used for drying value added products of vermicelli and pasta. Steamer is used for gelatinization of starch that is present in the millets to improve the digestible nature of the grain through amylase and amylopectin content determination. Color sorters are used for removing unwanted chaff, ill-filled and impure grain from good grain. Metal detectors are used to detect metal parts or staple pin in the packed value added products.



Ready to eat snack extruded food

Different flaked millets

Puffed and flaked millet value added products are prepared by roasting the grain in the roaster at a higher temperature for less time which are then puffed in a puff gun machine at a higher pressure. For flaking of millet grains, first the grains are soaked and then roasted in a roaster at a higher temperature for less time. The roasted grains are then pressed in an edge runner for getting thick flakes of millets. The gap between the rollers and the periphery is adjusted in such a way that the thickness of the flaked rice can be adjusted. Thin flakes are obtained by pressing the roasted grain in the roller flaker mill. Both circular roasters and conical roasters are used for roasting the grain for making semolina. Specific gravity separators are used in millet processing for separating the grain according to the differences in specific gravity. Rotary ovens are used for baking muffins and biscuits at a higher temperature. Paddler type wet cleaners are used for cleaning the millets before subjecting to processing. Dry cleaning is done using cleaner cum grader cum aspirator. Destoning is done by difference in density of the grains and the stones.

Dehulling in millets is mainly done to remove the outer seed coat called testa. This testa hinders the edible nature of the food, as it is cooked and causes indigestion

problem. Moreover, the anti-nutrients such as tannins and phytic acid are removed by removing the testa. The wear and tear of the machinery can be drastically reduced by removing the outer testa. The polishing is done to remove the bran that is present outside the grain that contains oil content and to remove the germ of the grain that also contains oil content. This presence of oil in the outer layers of the grain causes rancidity that reduces the shelf life of the millets. Free fatty acids present in the grain can be estimated to know the shelf life of the grain. Microbial counts are estimated using laminar flow chamber. Environment stability chambers are used to determine the accelerated shelf life of the stored millets for commercial prospects. For enriched nutrients, sprouted nature of the millets is preferred. Water activity meters are used for determination of water activity in the prepared value added products to determine the storage stability. Ball milling is used to reduce size of the flour obtained for making different value added products like vermicelli, pasta, ready to eat kurkurae, flaked breakfast cereals, etc. Tray driers and vacuum driers are used for drying of value added products such as vermicelli and pasta.

Primary processing is defined as the processing to clean the grains from un-wanted debris and farm level impurities, then the grains are graded for commercial usage and de-hulling is done to remove the outer husk called as milling. Cleaning and grading use different types of sieves and the perforation in the sieve varies in shapes of square, rectangle and oblong depending upon the shape of the millet that is to be cleaned and graded. The disadvantages of using these type of machineries are such that the initial investments are high, consume more power, and maintenance of machine is difficult in remote villages where electricity is not available. Polishing is mainly done to improve the appearance of grains for increasing the commercial value and attractiveness of the packaged product.

Infrared moisture meters are used to estimate the moisture in the millet grains in a batch process. pH meters are used to measure the pH of the millet milk beverage by measuring the difference in electric potential using two electrodes. Total soluble solids are measured using drying method of tray drier. Three types of conveyors are used for conveying value added products, viz. belt conveyor, screw conveyor and pneumatic conveyor. Flour pulverizing machine consisting of two stone rollers as grinding mechanism where the gap between the two rollers can be adjusted and fine atta can be achieved through the designed outlet chute fitted with sieve mesh of specified size depending upon the requirement. Baking of biscuits of different shapes can be done in a baking oven. The time taken to bake the biscuits in a closed tunnel varies from 5–6 min. The biscuits are cut in the shape of the fixed die which slowly moves through the mesh on baking zone and gets collected through the outlet as baked biscuits. Then the biscuits are tested for their taste, flavour, texture, hardness, chewiness, gumminess, breaking ability using a texture analyzer

and then calorific value is determined using a bomb calorimeter. Sensory analysis is done for acceptance among consumers by trained panel of 9 members with a score card prepared using hedonic scale with parameters of body and smooth texture, flavour and acceptability as standard procedure for any value added product.

Packaging of millet based products: Packaging is done of three types which includes nitrogen flushing packaging, vacuum packaging and ordinary form fill, and seal packaging for all the value added products developed using both major and minor millets. Hand sealing machines are used for sealing various value added products. Ziplock covers are used for storing the samples for analysis in refrigerated conditions. With different types of packaging for the value added products made from all different millets and their cultivars, the quality of the product at the consumer end is assured for extending the future market of millets in the international scenario.

SUMMARY

Millets being a gluten free food are best recommended for diabetic patients having a high sugar and blood pressure which can be regulated using value added products in their daily diet. Eating millets at regular intervals causes the body to function properly owing to its nutraceutical properties. Being rich in all minerals of calcium, zinc, phosphorous and magnesium needed for growth of vital organs of infants and growing children is good for health. Healthy life leads to a wealthy life. Hence eating of millets as day-to-day food is a must. Farmer friendly technologies can ensure to engage more land under millet, both in cultivation and related to agricultural processing of millets that will pave a way to success in global market.

*Corresponding author's e-mail: hema@millets.res.in

Nutritional Potential and value added products of pearl millet



Type	Food products
Traditional products	<i>Chapati, rabbari, porridges, khichri, kheer, churma, bakali, suhali, shakarpara mathi, namkeen sev, matar, ladoo, popped ladoo, burfi, pakora, chat, dhokla</i>
Baked products	Biscuits, <i>nan-khatai</i> , walnut cake, chocolate cake, chocolate muffin, sweet biscuit, coconut biscuit, sweet and salty biscuits, bun, pizza base, etc.
Extruded products	Pasta, macroni, vermicelli and its products.
Weaning foods	Weaning mixtures with combination of pulses.
Products for diabetes	Sweet and salty biscuits, <i>chapatti</i> mix, <i>dhokla</i> mix, instant <i>idli</i> mix, pasta.
Gluten free products	mathi, khichri, upma, cutlet and sweet biscuits and Sweet salty Ajwain biscuits
Sugar free products	Clove biscuits and Sweet and Salty biscuits
Convenience Mixes	Ladoo, halwa, upma, idli, dhokla, kheer, khichri mixes