Flour Milling and Blending Systems

Solution Holder is **Dougbedji Fatondji** and can be contacted through **d.fatondji@cgiar.org**

Summary

The time and energy required for grinding and cooking the grains of millet and sorghum for consumption poses a burden in home kitchens and restricts its appeal in urban centers. Farmers and traders can quickly add value to millet and sorghum by milling their grains into flour that is easy to use and ready for blending with other flours. Millet and sorghum flour are gluten-free and suitable for a variety of food products such as bread, biscuits, cakes, porridges, and even pasta. Techniques for flour milling however must meet industry quality standards and consumer preferences. Different small- to large-scale milling and blending systems are available that allow production of premium flour products in both rural and urban areas. The advantages of local flour processing are the reduction in transport and costs to rural consumers and value addition to raw grain of products sold to urban markets and food processors. Building capacity of rural communities for millet and sorghum milling and its blending into multi-purpose flour can massively boost output, value addition and competitiveness of local processors.

Technical Description

Millet and sorghum as food crops have a high protein content and well-balanced amino acid ratios. Their long cooking times that can be considerably reduced through processing. In this way, practical and economic advantage is derived through milling millet and sorghum into flour. Producing flour may be considered a business art that begins with selecting the right factory location, followed by procuring the right variety at the right price, followed by cleaning, milling, and blending. Locations for processing should be close to major growing areas that can provide a reliable supply of quality grains and have convenient transportation routes for easy delivery of raw and shipping of final products. In selecting the millet and sorghum varieties for milling and blending, it is important to take the hardness into consideration because it strongly affects annealing strategies of heat treatment to relax starch structures. Blending procedures must also be conducted in accordance with sedimentation and index values that determine flour quality which are closely watched by food manufacturers. Another purpose of annealing ensures the optimum moisture level for milling and to enhance flours wetting ability.

Uses

Sorghum flour is a gluten-free flour with a mild, sweet flavor and smooth texture. It's commonly used to make gluten-free cakes, breads, and other baked goods, either on its own or in combination with other gluten-free flours such as rice and cassava. It can be used as a 1:1 all-purpose flour substitute in just about any recipe. Sorghum and wheat flour blends are well suited to baked products, including yeast-leavened bread, flatbreads, cakes, muffins, cookies, biscuits, and flour tortillas. Millet flour has a subtle, slightly sweet flavor. It is used in the same way as sorghum flour and as a 1:1 substitute for wheat flour, particularly in pancakes, flatbreads, muffins and cakes. It works well in recipes such as pizza crust and fritters, and makes a good thickener for stews. In comparison to conventional preparation by lengthy boiling, use of flour offers substantial savings on cooking time and fuel cost, and improves the bioavailability of vitamins and micronutrient in derived food products. Flour milling and blending technologies for millet and sorghum improve African food self-sufficiency and promote business development in rural communities.

Composition

Pearl millet's average composition is 70% carbohydrates, 16% protein, 5% percent fat and 3% ash. It is higher in phosphorus, iron, and calcium than maize or wheat. Sorghum typically contains 63% carbohydrate, 11% protein, 3% fat and 2% ash, with varieties containing lower amounts of tannin most suitable to flour production. Both grains are gluten-free and have numerous documented health benefits including boosted immunity and reduced blood cholesterol.

Means of application

Before establishing a flour milling enterprise, one must be sure about location, supply, and market so investments are not made at the wrong location. Based upon this information, suitable finance mechanisms can be identified for approaching investors. When funding is secured, then equipment for cleaning, annealing, and milling must be purchased and assembled into a flour processing line. Reliable supply of electricity is very important and backup systems should be in place. There is need for continuous quality assurance of the flour to ensure product compliance with market standards on sedimentation and index values. There is a wide range of equipment for processing millet and sorghum grain. A typical air-screen cleaner consists of four screens that are located beneath a hopper. Grader machines that sort out impurities based on width and thickness are comprised of cylindrical screens that are horizontally positioned and have round perforations. Separators that select grains by length, density or gravity use angular sieves and forced air, which can be adjusted according to specific needs. An abrasive grain mill has a feed-in hopper, roller table for grinding, rotary sieve for bran separation, and a conveyor belt.

Agroecologies	Dryland area, Moist savanna.
Regions	Africa South of Sahara.

Developed in Countries	Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Available in	Ethiopia, Kenya, Mali, Niger, Nigeria, Senegal, Sudan, Tanzania, Zimbabwe.
Solution Forms	Equipment.
Solution Applications	Value addition, Agri-Food Processing.
Agricultural Commodities	Sorghum/Millet.
Target Beneficiaries	Women, Youth, Small-scale farmers, Agro-manufacturers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

The following steps are needed for enterprise development around flour milling and blending: 1) Raise awareness with farmers, agri-food companies and investors on the economic benefits of the technology, 2) Formulate appropriate product standards, packaging sizes and prices based on consumer demand, 3) Identify profitable, durable and equitable strategies for taking flour products to local, regional and international markets, 4) Establish reliable supply of high quality grain to processing plants through nucleus farming or sub-contracting, 5) Set up equipment and production lines that make efficient use of energy and labour, and 6) Train operators and workers on safety and quality adherence throughout the manufacturing process.

Production Costs

The prices of millet and sorghum at the farm gate are a major determinant of the economic viability of a milling enterprise. Exact costs of a flour milling depend on the geographic location, size of operation and equipment selection. In general, 60% of the capital investment that is required to set up a processing plant goes into equipment, while the rest to construction and marketing. A small flour mill that is manually refilled with an output capacity of 300 - 500 kg flour per hour costs around US $3,500. The base price for a fully automatic flour mill with a capacity of 30 ton flour per day is about US $38,000. Operating a flour mill requires skilled labour to ensure that production runs

smoothly, and equipment is properly maintained and a manager to keep track of expenses, supply, inventory, and sales.

Customer Segmentation

Flour milling and blending systems are applicable to industrial flour processors and food manufacturers and can be modified to suit the needs of more localized processors and community-based activities. It also requires that consumers accept the products resulting from blended flours.

Potential Profitability

High-performance cleaning systems ensure very low percentages of non-millable material that would otherwise reduce milling efficiency and revenues. In general, a 1% reduction in non-millable fraction provides an additional US $3 per tonne of flour. Modern equipment for annealing and milling wheat grain achieve maximal recovery of flour at 80%-82% and 18%-20% bran, whereas traditional manual techniques and older milling systems recover only 65%-70% flour. Better annealing and milling realized from modern equipment improve flour quality and market price. Altogether, the effect of running at higher efficiency versus lower milling efficiency provides additional net profit of about US $30 per ton of flour.

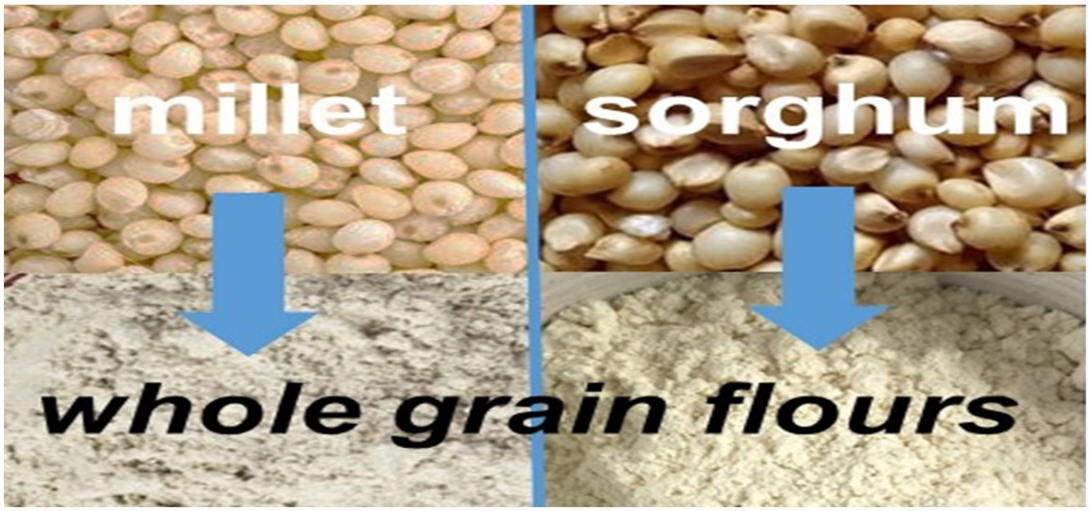
Licensing Requirements

Obtaining a license from regulators and registering your factory is important to the success of a flour milling business. This involves periodic inspection to assure that quality standards are met.

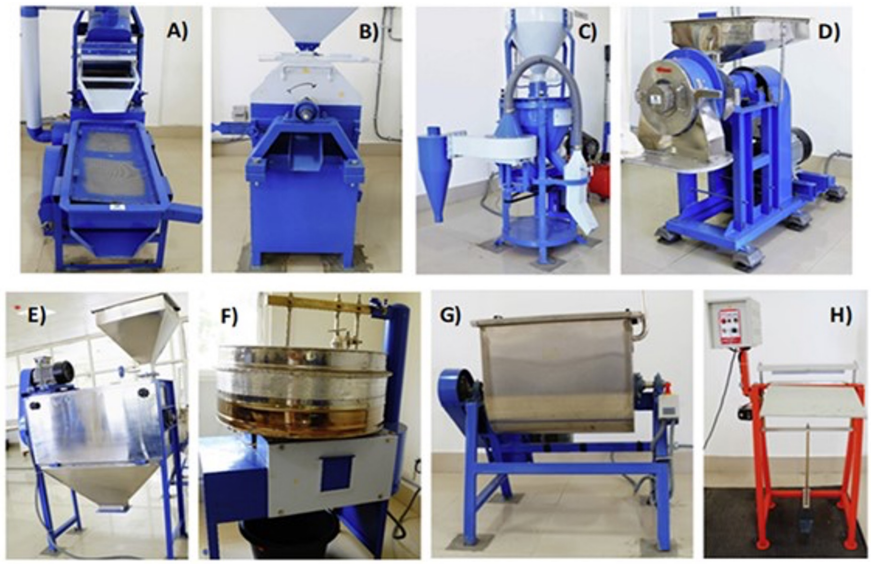
Innovation as Public Good

Techniques for production of sorghum and millet flour are a Public Good, and ICRISAT and other organizations, including National Bureaus of Standards, are actively involved in disseminating this information across Sub-Saharan Africa.

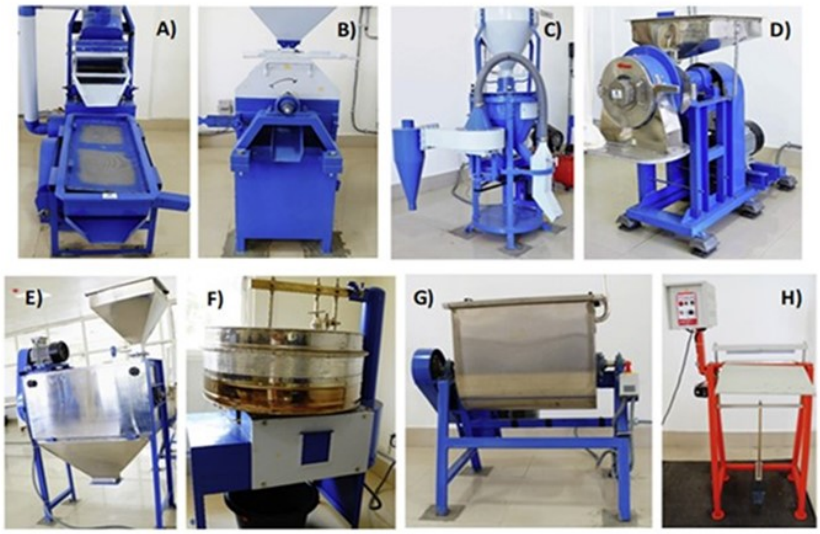
Solution Images



Flours prepared from pearl millet and sorghum



Key equipment for rural community-level millet and sorghum processing enterprises: A) Destoner with Aspirator and Grader, B) Dehuller, C) Mill, D) Pulveriser, E) Flour sifter, F) Roaster, G) Blender, and H) Bag sealer (Source: Alavi et al., 2019)



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Institutions

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