

Processing of Wheat

From field to flour, wheat is transformed into a shelf-stable product through processing. The intricate series of steps, which is both time-tested and highly scientific, begins the moment that the grain is harvested and transported to a processing facility.

Delivery and Testing:

Before wheat processing can begin, wheat has a sometimes-long journey from the field to processing plant. It is hauled from its place of origin in covered trucks or rail cars. In some cases it travels hundreds of miles; in other cases, from one side of town to another. Upon arrival it is inspected and sampled for moisture content, test weight, unfit kernels and foreign material. Based on the results from these tests, it is determined how the wheat is treated, handled and stored until processing. The wheat is moved to silos for storage, where heat and moisture control keep it fresh until the time of processing.

The Cleaning House

The grain begins the processing journey by entering the set of machines that clean it, called the cleaning house. Made up of as many as 6 steps, this process removes foreign matter that may be in the wheat, as well as scours its surface to prepare it for processing. This process uses a magnetic separator, separator, aspirator and de-stoner to remove all types and sizes of foreign matter. The grains are then separated based on size; with large, small and misshapen grains being removed and discarded. The scourer then removes the outer husk from the wheat and the impact entoleter uses centrifugal force to break apart unsound kernels of wheat before processing.

Tempering and Grinding the Wheat

Wheat is made up of three elements -- the bran, endosperm and germ -- and how it is processed to separate these determines if the subsequent flour will be whole-wheat or white. Before milling takes place, the wheat is conditioned. Called tempering, moisture is added to the grains to both toughen the bran and relax the endosperm, allowing the kernel to separate more easily. This process takes from 6 to 24 hours, depending on the type of wheat and its moisture level. Wheat kernels are fed into a milling machine where they pass through several roller mills where the bran, endosperm and germ are separated and removed from the kernel. By the end of the process, the wheat is reduced to granular pieces free from bran and germ when making white flour. For whole-wheat flour, the bran, germ and endosperm are all ground together to create a whole-grain flour.

Sifters

The broken particles of wheat are elevated through pneumatic tubes and then dropped into huge, vibrating, box-like sifters where they are shaken through a series of bolting cloths or screens to separate the larger from the smaller particles.

Inside the sifter, there may be as many as 27 frames, each covered with either a nylon or stainless steel screen, with square openings that get smaller and smaller the farther down they go. Up to six different sizes of particles may come from a single sifter. Larger particles are shaken off from the top, or “scalped,” leaving the finer flour to sift to the bottom. The “scalped” fractions of endosperm called middlings are reduced in a smooth roller system to the particle size of flour. In hard wheat mills, the product is then subjected to a purifying process. A controlled flow of air lifts off bran particles while at the same time a bolting cloth separates and grades coarser fractions by size and quality.

The process is repeated over and over again, sifters to purifiers to reducing rolls, moving up and down and across the mill in a series until the maximum amount of flour is separated, about 75 percent of the wheat kernel.

Bleaching the flour

Toward the end of the line in the millstream, if the flour is to be “bleached,” the finished flour flows through a device that releases a bleaching-maturing agent in measured amounts. This duplicates the natural oxidation that occurs when flour is allowed to naturally age as in the old days when flour was stored for a few months. This whitened the flour and improved its baking characteristics. The modern bleaching process simply duplicates this natural oxidation process, but does so more quickly.

In the bleaching process, flour is exposed to chlorine gas or benzoyl peroxide to whiten and brighten flour color. The bleaching agents react and do not leave harmful residues or destroy nutrients. In soft wheat products chlorine gas is also used to control cookie diameter and cake height.

Enrichment, malt and leavening

The flour stream passes through a device that measures out and releases specified quantities of enrichment. Malt may be added to bread flours at this point to add loaf height as well for flavor. Grains have been enriched since 1941 with iron and the B vitamins riboflavin, niacin and thiamine. As a result, the crippling diseases pellagra and beriberi have been eradicated from the U.S. population. In 1998, folic acid was added to the enrichment formula. Enriched grain products have more than twice the amount of folic acid as whole wheat. A slice of enriched white bread has 37 mcg versus whole wheat at 17.5 mcg. Studies show folic acid may also help prevent heart disease, cancer, strokes and Alzheimer’s disease.

Finished product testing

After milling, lab tests are run to ensure that the flour meets specifications. Millers also conduct routine monitoring of indicator natural organisms. Although dry flour does not provide an environment that is conducive to microbial growth, it is important to understand that flour is a minimally processed agricultural ingredient and is not a ready-to-eat product. Flour is not intended to be consumed raw. The heat processes of baking, frying, boiling and cooking are adequate to destroy any pathogens that may be present in flour and reduce the potential risk of food borne illness.

A number of steps in the milling process enhance product integrity

When it is time to mill the grain it moves from the bottom of the silo/bin through conveyors to the top floor of the mill where the cleaning process begins.

Cleaning the wheat -The first milling steps involve equipment that separates grain from seeds and other grains, removes foreign materials that might have originated during the farmer's harvest such as metal, sticks, stones and straw; and scours the kernels of wheat. It can take as many as six steps. The machines that clean the grain are collectively called the cleaning house.

Magnetic separator – The grain first passes by a magnet that removes ferrous metal particles. It will pass through other metal detectors after milling to ensure that no metal pieces are in the finished product. Magnets are also positioned throughout the milling process and at the last step prior to load-out.

Separator – Vibrating or rotating drum separators remove bits of wood, straw and almost anything else too big or too small to be the desired grain.

Aspirator – Air currents act as a vacuum to remove dust and lighter impurities.

De-stoner – Using gravity, the machine separates the heavy material from the light to remove stones that may be the same size as the desired grain.

Disc separator – The grain passes through a separator that identifies the size of the kernels even more closely. It rejects anything longer, shorter, more round, more angular or in any way a different shape. **Scourer** – The scourer removes outer husks, dirt in the kernel crease and any smaller impurities with an intense scouring action. Currents of air pull all the loosened material away.

Impact Entoleter – Centrifugal force breaks apart any unsound kernels or insect eggs and aspiration rejects them from the mill flow. From the entoleter, the sound wheat flows to grinding bins, large hoppers that control the feeding of the wheat to the actual milling process.

Color Separator – Newer mills may also utilize electronic color separators to simplify the cleaning process.