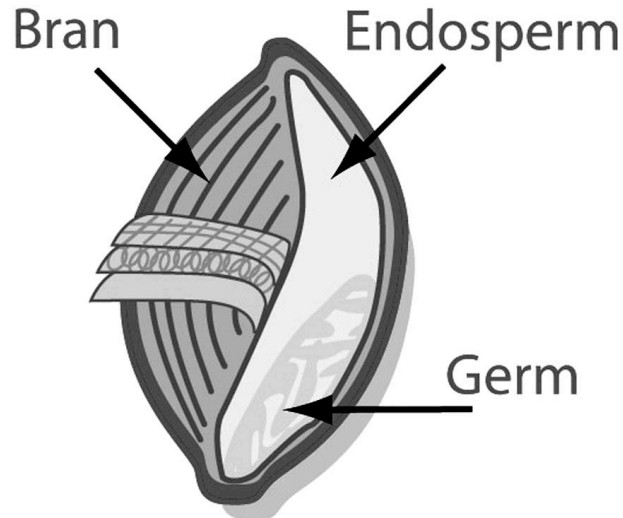


OVERVIEW OF THE TECHNOLOGY OF WHOLE GRAINS

This report summarizes the main food technology points presented at the Whole Grains Go Mainstream conference in New Orleans, November 14-16, 2004.

WHOLE GRAINS VS. REFINED GRAINS

Grains consist of three parts: an outer protective covering known as the bran; the germ, which contains the potential to become a new plant; and the endosperm, designed as food for the growing seed.



graphic courtesy of Bob's Red Mill

When grains are refined, the bran and the germ are removed, leaving just the endosperm. A separate Scientific Report generated by this conference discusses the nutritional changes that result from refining grains. This Technology Report will focus on the technological issues – in farming, milling and food technology – that separate whole grains from refined grains.

WHY WE HAVE FAVORED REFINED FLOUR

1) It's easier to cook with.

Breads, for example, depend on the elastic action of gluten strands to rise properly. But whole grain flour has a lower proportion of gluten, and sharp particles of bran tend to slice through what gluten exists, creating challenges for developing a fully-risen loaf.

2) It lasts longer before spoiling.

The germ of a grain contains healthy unsaturated fats which, after milling, can turn rancid with time and temperature. Whole grains and the products made with them will therefore have a shorter shelf-life than refined-grain products.

3) Its products have a milder taste and softer texture.

After more than a century of eating refined products almost exclusively, our collective palates have become accustomed to the taste, texture and appearance of soft, white grain foods.

4) We were unaware of the advantages of whole grains

Despite early scares – like the rise in beriberi that accompanied Asia's switch from brown rice to white in the 19th century – we had little real proof until recently of the major health benefits of whole grains. With few known disadvantages to refined grains, the advantages listed above were very compelling.

THE TECHNICAL CHALLENGES OF A GLOBAL RETURN TO WHOLE GRAINS

1) Disruptions in the farm sector

- a. One bushel of wheat yields approximately 42 pounds of refined flour. But the same bushel yields about 60 pounds of whole wheat flour (*Kansas Wheat Commission, www.kswheat.com*). Though different grains have different yields, all grains yield less refined flour than whole-grain flour. A switch to whole grains could lessen demand for grain for human consumption.
- b. At the same time, livestock farmers depend on inexpensive “waste” products of grain refining to feed their animals. Using all parts of the grain for human food may change the economics of feeding pigs, cows and chickens.
- c. Farmers will be presented with the opportunity – and the risk – of growing different grains like quinoa, amaranth and spelt and even new classes of wheat they aren’t used to marketing. Today, only small manufacturers can use these less common grains, as the supply is too small to meet the needs of mainstream manufacturers.
- d. Different grains and different types of wheat grow best in different climates. Quinoa thrives in dry, high-altitude conditions. Farmers growing red spring wheat today in the northern US cannot necessarily switch to hard white winter wheat usually grown in the Great Plains tomorrow.

2) Retooling of mills

Modern milling consists of as many as 180 different operations from removing foreign particles and conditioning the grain for a stable, consistent moisture content, to breaking the hard outer bran layer of the kernel and grinding the flour. Many of these operations must be modified in order to process whole grain flour instead of refined flour.

Mills must also be modified to accommodate different grains. Grains like teff and amaranth have very small kernels; the same equipment used to process wheat today cannot easily process amaranth tomorrow.

3) Reformulation of products

Working with different grains, and working with whole wheat instead of refined wheat, creates several challenges – and opportunities. Neither the home cook nor the food manufacturer can simply substitute whole-grain flour for the same amount of refined flour. Among the differences:

- a. The higher total fiber in whole grains generally requires more liquid in a formulation.
- b. A larger amount of soluble fiber in some grains means that fat can be reduced in many baked goods.
- c. Longer proofing and baking times may be required for some products, reducing throughput.
- d. Some types of soluble fiber actually result in better freeze-thaw stability than refined grains.
- e. Different grains need different quantities of yeast. Teff, for instance, has its own symbiotic yeast, eliminating the need for added yeast.

WE'VE COME A LONG WAY: SOLUTIONS IN THE MARKETPLACE

American and overseas ingenuity have made great progress in meeting many of the challenges listed above. Some of the solutions highlighted in this conference or currently available include:

1) Quicker cooking whole-grain rice

Whole grain rice (brown rice and other colored rices) takes about 40-50 minutes to cook – twice as long as refined white rice. Scientists at USDA ARS, led by Elaine Champagne, have developed a process to bombard brown rice with rice flour, creating tiny micro-perforations in the rice that allow it to cook in the same time as white rice – without the addition of any chemicals or additives. At the same time, Lotus Foods has introduced Bhutanese Red Rice, a whole-grain rice that naturally cooks in 20 minutes.

2) Softer, milder whole wheat

Consumers accustomed to refined white flour sometimes dislike the stronger taste and firmer texture of whole wheat products. By using Hard White Wheat instead of the Red Wheat traditionally milled in the US, manufacturers can create products with the nutrition of whole grain, but with a milder flavor and softer texture. Farmers in the cooperative run by Farmer Direct Foods have been working for sixteen years to increase the supply of hard white wheat, and this year ConAgra has introduced its UltraGrain white wheat flour.

3) New grains for soups

When a major soup company wanted to create a new line of soups, it needed grains that could stand up to the high heat and pressure of the canning process. By experimenting with different whole grains, they found that grano not only added extra nutrition to their soups, but also performed beautifully, allowing them to bring out new food service products in less than six months.

4) New cooking and packaging methods

A French company has developed a method of pre-cooking durum wheat berries and packaging them in shelf-stable pouches for use as-is in salads or warmed in side-dishes. Eibly Tender Wheat, as the product is called, is now on menus at restaurants from Delaware to California and in food service operations including Yale University Dining Service.

PREVIEWS OF COMING ATTRACTIONS

The products and processes above have already come to market and been eagerly accepted by a hungry public. Even more developments are now underway and will be coming soon to a table near you:

- 1) Many scientists are working on ways to improve the stability of whole grains without impacting their healthy nutrients. Solutions should be available in the near future that will improve shelf-life of whole grain products.
- 2) New ways of grinding are being developed that should make even the dark specks from red wheat virtually invisible, demolishing an aesthetic barrier. Some of these new processes use fewer steps, for greater efficiency in milling.
- 3) State universities are cross-breeding grains to increase the geographic range of niche grains, so that newly-popular crops can be more widely grown.

As the benefits of whole grains loom larger in consumers' minds and the perceived drawbacks become smaller and smaller, whole grains are daily gathering momentum and acceptance in the marketplace.

