

## GLUTEN PROTEINS HOLD KEY TO BREAD QUALITY

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Sixteen strains of curiously short, stiff-strawed, heavy headed wheat plants were sent to World Collection of Small Grains in Beltsville, Maryland by an agronomist who was assigned to General MacArthur's head quarters in Japan immediately after the second world war. Norman E. Borlaug, working at the International Maize and Wheat Research Centre (CIMMIT) in Mexico used these lines in his hybridization programmes to improve the wheat crop. Newly developed semi-dwarf varieties distributed by CIMMIT in the 1960's to India, Pakistan, Afghanistan, Mexico, Turkey and other developing countries sparked the Green Revolution which was later followed up with similar rice varieties developed at International Rice Research Institute, Philippines. Despite some negative side effects of green revolution, it helped countries often threatened by starvation grow into modern, self-sufficient, and in some cases, food exporting nations. Norman Borlaug was perhaps the first agricultural scientist to win a Nobel Peace Prize, which was awarded to him in 1970 for his contribution to peace and development through Green Revolution.

### Unique Products From Wheat Grain

Wheat products are becoming more and more important in our daily lives. When it comes to breakfast, bread is every working house wife's choice. For increasingly diet conscious urban dwellers, the bakers produce a vast array of breads from whole wheat (more fibre) to more airy Italian or French white breads. Besides a number of types of sandwich breads and rolls, there are other products from east, west and the new world such a tortillas, won-tons, pitas, bagels, croissants, couscous and the popular pizza. There are dozens of different kinds of cakes, cookies, doughnuts, crackers, and biscuits as our snacktime and dessert specialties. The flour crust on the fried fish, cutlet or patties add taste and colour to these products.

It's not only to the kitchen that wheat finds its way in our homes. Iron, thiamine and riboflavin extracted from wheat bran are more expensive and valuable than the cheaper synthetic vitamin or mineral substitutes. The shampoos containing wheat-germ oil and cosmetic powders made with wheat flour are common in the market. Today's most common building material - plywood makes use of wheat glue. However, the future of new wheat products is going to be predominantly in the food industry.

Why do we have to depend solely on wheat flour to bake our bread?. Wheat is the only grain that can be made into a dough that rises and produces light, sluffy baked products. The most important dough making components in wheat are it gluten proteins. the presence of glutens enable the wheat flour to produce strong but pliable doughs.

### History of the Wheat Crop

Bread has been one of the first words in the vocabularies of ancient civilizations. Scientists have unearthed kernels of wheat from the ruins 6700 years old ancient village of Jarmo in Iraq, which laid buried in the fertile plain of the upper valley between Euphrates and Tigris. Egyptian murals unearthed from tombs along the Nile depict the whole process of cultivation of wheat from sowing to harvest by sickle. Roman and Greek mythology also has much to say about wheat. Although early civilizations heavily depended on wheat, it was probably not for bread as we know it today, because original forms of cultivated wheats had seeds too tightly enclosed in hulls that pounding, perching or boiling would have been necessary to release the seeds. Such technology destroys the gluten which enables the dough to rise. Nevertheless, it will not be surprising if one day an archaeologist finds clues to milling technology that would have enabled our

ancestors to mill such primitive forms of grain, for they have created such wonders in the past leaving us to ponder even today.

There are about 20 closely related species which make up the genus of *Triticum* to which wheat belongs. The chromosome numbers vary from 14 in diploid primitive forms to 42 in hexaploid bread wheats having six sets of chromosomes. The intermediate tetraploids have four sets of chromosomes. It is believed that the bread wheat originated by the crossing of a diploid form with a tetraploid. Tetraploid wheats even now grown for special products such as macaroni's have higher protein content and could be the possible sources of genes for increasing the protein level in common wheat.

### **Nutrition Value**

Nutritional content of wheat depends on the climate, variety and many other factors. Wheat in general contains more protein than rice or corn and averages to 13.6% . The major component is carbohydrate averaging about 72.5% which gives a steady supply of energy.

The fibre in our bread along with those from other foods is undigestible but beneficial in helping to lower the risk of heart disease and colon cancer. It helps to control diabetes too. The wheat flour contains about 2% fibre whereas the bran, the fibrous covering of the kernel contains more than 7% fibre. The bran is removed in milling except in whole wheat flour which is a rarity in our country due to monopoly of certain companies that import whole grains of wheat for milling. The bran contains not only fibre in greater amounts, but also the bulk of the B vitamins and trace minerals.

The seed's embryo or the germ contains nearly all of the oils which are predominated by poly unsaturated fatty acids, mainly linoleic. These acids are the precursors of prostaglandins, which help the body to regulate its hormones. There are a number of vitamins and minerals which we get in relatively large quantities from wheat. There are the B vitamins thiamine, niacin

and riboflavin which help in the fat, carbohydrate and protein metabolism and their efficient use by the body. The trace metals like magnesium and potassium are useful for the proper functioning of the cardiovascular system, particularly the heart. Selenium helps in the protection of cell membranes.

### **Gluten too has It's Quality**

Improved nutrition and quality of baked products depend on the quality of the flour itself and also on the process baking. The flour quality can be improved by the use of advanced milling technology on the grains of improved varieties. Not only the total protein, but also the gluten part of it has captured the interest of plant breeders developing new cultivars. Gluten is composed of 100-200 peptides joined in numerous combinations that affect the nutritional as well as physical properties of the protein. The two main constituents in gluten are gliadins and glutanins. Recent developments in analytical procedures related to protein chemistry have enabled scientists to detect high quality genotypes early in the breeding process. For example, reversed-phase high performance liquid chromatography help the breeders to identify gliadins which relate to baking quality in small samples, as small as half the size of a single seed. Thus, they can use the endosperm part without the embryo to analyse the gliadins and use the part containing embryo to raise plants from seeds having high quality gliadins for multiplication.

During the period of green revolution less attempts were made on the improvement of quality. In striving for high yields the protein seem to have decreased. This is because the increased yield was achieved through increased carbohydrate content in the seed which requires less photosynthates to produce than a unit of protein or fat. Nevertheless, there is substantial variability within bread wheat for protein quantity which is now extensively used by breeders.

### **High-tech Research for Quality Improvement**

Recently biotechnologists successfully transferred a part of the rye chromosome that confers its high pro-

tein in seed to bread wheat. This part of the chromosome has genes conferring resistance to rust disease as well. Due to higher protein in these wheat lines the area under wheat having the IRS rye chromosome has increased in many countries. However, recent research has shown that the quality of protein from wheat seeds carrying IRS rye chromosome is not of high quality as pure wheat protein due to the presence of Secalins which are different from the wheat proteins gliadins and glutenins. Research is now underway to decrease secalin production in these high protein wheats.

Using chromatography techniques scientists have separated glutanins with different molecular weights. Results have shown that the glutanins of high molecular weights give greater strength and elasticity to dough, making better breads and rolls. These properties enable the protein to remain unaltered during the process of kneading. Further investigations have revealed that the disulfide bonds of glutanins can link one part of the protein chain to another part of the same glutanin chain. The disulfide bonds also help to attach one glutanin to another, glutanin thus making a mesh of interwoven threads of protein enabling the bread to 'rise' better. Identification of glutanin binding probes which comprise of specific antibodies has enabled scientists probe further into the structure of glutanins. This method is faster than others and is more accurate for testing the quality. Future research will be directed at modifying the glutanins to suit the requirements of bakers. At the moment, the difficulty is the lack of information on the details of disulfide bonds which impart greater strength to glutanins. Computer simulation is one way of overcoming this problem.

#### Standards Also Change with Time

For wheat grain importing countries like ours, it is important to know the standards that identify the qual-

ity of the flour by testing the grain. The price is determined by the hardness or softness and test weight, the weight of a unit volume of grain.

Conventional methods of testing by colour, shape and surface structure are no longer good indications of quality due to the presence of a large number of cross-bred varieties in the international trade. Nowadays, the classification into standard classes is not a guarantee of the quality of the grain.

Hard wheat is good for bread while white soft wheat is preferred for making cakes, biscuits, cookies, snacks, pastries etc. Unfortunately, there is very little choice for Sri Lankan bakers. With the fast sophistication of food industry in Sri Lanka, availability of different quality wheat flour will be a requirement in future. According to currently emerging technologies, near-infrared radiation is becoming a more objective and dependable method for testing the hardness of wheat consignments. Another possible alternative is particle size classification of milled flour. Distribution of particle size in milled flour is different in wheats of diverse origin and in wheats from different varieties and this can be related to the quality.

The challenge to scientists in the developing world is not only to develop good standards for identifying the quality of wheat that is being imported in large quantities from wheat growing developed world, but also to attempt the transfer of genes responsible for the breadmaking qualities of wheat to rice plant and other cereals that are widely grown in our countries. It is here that our officials responsible for disbursing research funds have to take bold decisions on funding biotechnology research, as no developed country will help us in research that will lead to drastic reduction of wheat imports from their own countries, as wheat holds the key to their economic strength.