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## **Creating new healthy ingredients by developing innovative milling techniques and processes for cereal grains**

**The bioactive compounds of cereals are concentrated in the peripheral layers of the grains (bran) but most of them have a low bio-accessibility. In the HEALTHGRAIN project of the European Union, new tools for process monitoring were developed that support commercial implementation of innovative milling techniques including partial grain debranning, fine grinding and classification of grain fractions, resulting in flours and ingredients with enhanced nutritional properties.**

The wheat grain is a heterogeneous structure with bio-active compounds unevenly distributed within its different parts. The bioactive compounds (fibres, micronutrients and phytochemicals) are mostly concentrated in the grain outer layers, each having its own compositional profile. Therefore levels of bioactive compounds in whole meal flour are at least two times higher than those in white flour. However, some of the bioactive compounds have a low bio-accessibility in peripheral layers as they are trapped in strong cell wall structures which resist conventional milling. They can also be localized close to undesirable contaminants such as microbes, mycotoxins, pesticide residues, heavy metals. Therefore novel technologies have been developed for the transformation of the grains to better exploit their nutritional potential and to ensure food safety requirements.

In order to develop new dry processing techniques, new tools based on new insights in grain tissue composition, structure and properties have been obtained. Biochemical markers of the different grain tissues (pericarp, intermediate layers, aleurone layers, germ) have been identified and allow to determine the tissue composition of the technological fractions and deduce the behaviour of the different grain parts upon fractionation operations. More rapid methods for fractionation monitoring using spectral signature of tissues are on the way. New mechanical devices coupled with microscopy and microspectroscopy have been developed to determine the local properties of tissues and of their interfaces to help the development of fractionation with improved resolution. Especially, the effects of temperature, water content and enzymatic pre-treatments have been investigated.

A way to enrich cereal products with bioactive compounds is to manufacture flours with high levels of selected parts of the outer layers. To remove the very outermost layers, partial debranning of grains in using friction (peeling) or abrasion (pearling), was combined with milling (grinding and sieving) to produce flours with tailored tissue composition and thus controlled in content of bioactive compounds, as monitored by the marker methodology. Flours made from peeled grains, peeled and pearled grains and grains with removed outermost layer and crease parts exhibited high contents of bioactive compounds and improved nutritional effects as compared to common flours.

Another way of exploiting cereal potential is to use the miller's bran, a by-product of the milling industry, as a source of healthy ingredients. Careful limited grinding and sieving of the bran allowed to prepare a concentrate of aleurone cells and aleurone layer, where most of the bioactive compounds of the grain are located. Further purification by electrostatic classification yielded practically pure aleurone cells that exhibited excellent nutritional properties.



## EXPLOITING BIOACTIVITY OF EUROPEAN CEREAL GRAINS FOR IMPROVED NUTRITION AND HEALTH BENEFITS

HEALTHGRAIN

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Another approach used ultrafine grinding of the bran in ambient or cryogenic conditions, to provoke a full dissociation of the material at a sub-cellular level. This resulted in an increase in bioactive compounds bioaccessibility. Classification of the fine particles in using a electrostatic separator made it possible to prepare fractions of very contrasted compositions in starting from bran. One of these ingredients, concentrated in fine aleurone particles, showed a good accessibility of anti-oxidants and mineral compared to bran and untreated aleurone. These technologies have been experimented at large-scale by industrial partners, to determine their feasibility and economics.

The work was conducted by INRA, in close collaboration with difent partners in charge of analyses (VTT, KU Leuven, University of Helsinki, University of Uppsala, Puratos, TNO), development of analytical equipment (Branscan) and industrial demonstration and cost evaluation (Barilla, Buhler, SD-Tech).

### **The EU Integrated Project HEALTHGRAIN**

The HEALTHGRAIN project has substantially strengthened the scientific basis for a new generation of cereal based products with enhanced health benefits. The project also has formed a network of research organizations, industries and organizations communicating to consumers that will continue as the HEALTHGRAIN Forum.

*Results of the project will be presented in  
the HEALTHGRAIN Conference on May 5-7 in Lund, Sweden:  
[www.healthgrain.org](http://www.healthgrain.org)*

### **INRA**

Ranked the number one agricultural institute in Europe and number two in the world, INRA carries out mission-oriented research for high-quality and healthy foods, competitive and sustainable agriculture and a preserved and valorised environment.

### **Barilla**

Barilla was founded in Parma back in 1877, as a small shop of bread and pasta, opened by Pietro Barilla. For over 130 years it has been guided by the entrepreneurial experience of a family that, with the advent of the siblings Guido, Luca, Paolo and Emanuela, has been at the helm for four generations. Today Barilla Group produces and sells, at international level, pasta, pasta sauces and bakery products. Current organizational structure is based on Barilla G&R, Fratelli, Harry's and Lieken, together with their subsidiaries. Nowadays, Barilla operates directly in more than 20 countries and exports its products to over 100 countries. It owns 54 production facilities in 10 countries and has more than 15,000 employees.

### **Buhler**

Buhler is market leader in grain processing technologies and speciality milling with a strong focus on innovative processes for healthier grain fractions and ingredients for their customers in the grain processing industry world-wide. Buhler is present in more than 140 countries.

### **SD-Tech**

SDTech is an industrial company specialising in the custom micronization and analysis of ultra-fine powders. SDTech delivers Process Expert services to various industries. SDTech offers its expertise for customized services in various areas such as custom milling (dry and wet processes), sieving, mixing and powder analysis.



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