Contents Digest

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Current potential and limitations of immunolabeling in cereal grain research

Immunolabeling techniques have made a valuable contribution to cereal grain research during the past decade in terms of precise localization of specific compounds. While these techniques have several limitations, such as the availability and specificity of the antibodies, immunolabeling has proven especially useful in cereal studies seeking a better understanding of grain development and characterization. On page 105, Jose Vazquez-Gutierrez and Maud Langton provide a review of immunolabeling techniques in cereal grain research and future developments. Immunolabeling has been applied consistently in a wide variety of cereal grain studies during the past decade, and is a useful tool in the characterization and localization of cereal components. Although fine spatial and temporal tuning of the biosynthesis of cell wall polymers has been achieved in recent years, further studies are needed to fully understand the heterogeneity of cell wall structure in cereal endosperm, and immunolabeling will be essential in this regard. Combined with the great advances in the past decade, the future development of more antibodies against specific fiber and protein fractions will contribute even more to a deeper understanding of cereal grain structure. Another step forward will be to study the relationship between this spatial, compositional information and grain properties, such as biomechanical properties that can affect the milling process. Progress towards establishing plants as a vehicle for the production of plant-made pharmaceuticals is likely to accelerate in the coming years. The achievement of appropriate levels of expression remains somewhat empirical, and to a large extent varies from one recombinant protein to another. Therefore, immunolabeling of recombinant proteins will be necessary in order to understand pathways and biochemical processes yet to be unraveled.

It can also be concluded that there are areas in cereal research where the potential of immunolabeling has not been properly explored as yet. New allergen-specific antibodies may be developed and used to localize allergens in cereal grains by immunolabeling, as has been already done in the characterization of a wheat serine proteinase inhibito and different gluten fractions. Immunolabeling may also be useful to evaluate the degradation of different components of cereals and cereal products during digestion. Moreover, most of the applications of immunolabeling have focused on wheat, rice, and maize, while studies using this technique for other cereals such as oat or rye have been relatively scarce. The potential of immunolabeling techniques could also be applied to cereal-derived products such as bread, porridge or extruded cereal.

The use of Arabidopsis thaliana and rice as model plants has greatly accelerated research in cereal biology but these plant models present drawbacks to addressing biological questions related to temperate grasses. Several studies using immunolabeling techniques have sought to gain insights into the usefulness of Brachypodium distachyon as a model for studies on cell walls and storage proteins in cereal grains. Therefore, immunolabeling techniques are expected to be useful in future studies on B. distachyon. In conclusion, immunolabeling techniques have made a valuable contribution to cereal grain characterization during the past decade when precise localization of specific compounds has been required. These techniques are especially useful in cereal studies seeking a better understanding of grain development and characterization.

How does wheat grain, bran and aleurone structure impact their nutritional and technological properties?

Epidemiological studies have reported that the consumption of whole grain products may reduce the risk of cardiovascular diseases, various types of cancer, and type 2 diabetes. Diverse potential mechanisms mediate the protective effects of whole-wheat grain since grains are rich in many nutrients linked to disease prevention. It was recently suggested that, besides the effects of dietary fibres (DF), the synergistic action of several bioactive compounds also contributes to health protection and/or physiological function maintenance. On page 118, Valerie Micard and coworkers review current knowledge on how the structure of cereal matrices affects both their overall health effects and technological properties, the structural parameters that could affect targeted physiological responses of foods containing wheat grain or fractions, i.e. starting from the particle size of grains and fractions until the release of their bioactive compounds, and lastly the effects of the cereal matrix structure on the processing and quality of cereal-based foods.

Wheat grain and technological fractions (notably bran and aleurone) are interesting sources of DF and bioactive compounds that can protect the body from many diseases. However, wheat fractions have complex structures and it is essential to gain further insight into their physiological relevance (called the “matrix effect”). At the macroscopic level, small particle size wheat fractions have beneficial effects due to their higher specific inter- action surface. These effects include improved antioxidant capacity, greater bioavailability of phenolic compounds and vitamin E, greater production of colonic beneficial SCFA, and reduced

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cholesterol levels. However, this higher surface interaction will induce a faster digestion rate, which can increase transit time, decrease fecal bulking and provoke a greater glycaemia response. Concerning the technological aspects, the effects of particle size reduction of wheat fractions on the quality of cereal-based products is unclear and still being discussed. The wheat fraction characteristics and also the matrices in which the fractions are added (type of bread, pasta, cake or extrudated products) seem to have a marked impact on the quality of the final food product.

At the molecular level, the structure of DF and phenolic compounds also strongly affects their physiological responses. While insoluble AX have beneficial effects by reducing transit time and increasing fecal bulking, soluble AX contributes to increase the digest viscosity in stomach, thus delaying gastric emptying and nutrient absorption, which might result in a lower postprandial glycaemic response and lower plasma cholesterol. Moreover, an important prebiotic effect is observed during the fermentation of soluble AX and notably AXOS. FA (ferulic acid) that is free or conjugated with arabino-xylo-oligossacharides is bioavailable in the upper part of the intestinal tract and beneficial for the treatment of disorders linked with oxidative stress due to their strong antioxidant capacity. Therefore, it would be interesting to release FA from the food matrix with enzymatic or fermentation treatments. However, FA also has beneficial effects when it arrives in the colon still linked with DF. The slow and continuous release of these bound phenolic acids in the gut can have even better effects on health than the fast plasma peak observed after ingestion of free phenolic acids. The rate of further metabolism of FA is also dependent on its rate of absorption, i.e. a different metabolite spectrum will be present after slow or rapid FA absorption.

The development of nutritious and healthy cereal-based food products that will attract consumers has given rise to new challenges for the food industry. High-quality cereal- based products require specific microstructures, which can be achieved by specific physical and/or biological pre- treatments of cereal and cereal fractions. However, the incorporation of wheat fractions, with more or less degraded cereal matrices, can also impact the technological properties of the food matrix itself. This issue opens new research perspectives in the field of food science and human nutrition based on the "reverse engineering" concept, i.e. the food matrix should be formulated and processed in order to obtain a specific structure that will deliver the desired health effects.

Influence of cheese manufacture parameters on cheese microstructure, microbial localization and their interactions during ripening

On page 135, J.J. Sheehan and coworkers review the relationship between cheese manufacture process parameters including high heat and high-pressure processes and protein standardisation techniques on the resultant cheese microstructure, microbial activity within the cheese matrix and the interactions between the cheese matrix and the entrapped bacteria during ripening. Particular consideration is given to bacterial location, localised ripening and mineral movement within the matrix as well as the effect of processing on milk fat globules and the influence of milk fat globule membrane material on cheese structure and ripening. Significant knowledge gaps which remain in areas including the milk fat globule and the role of MFGM components in cheese manufacture and ripening. In particular, the effects of processing parameters, both prior to and during manufacture, on the MFGM structure and the phospholipids, which occupy the MFGM merit investigation with a reference to achieving increased cheese quality at both localised level and throughout cheese blocks. The full role and influence that fat globule size has on cheese quality also requires further research. In addition the movement of both mineral ions and localisation of bacterial cells during ripening of cheese requires consideration using microscopic and fluorescent staining techniques. There is also a need to develop novel processes for monitoring localised bacterial ripening and pH change using novel stains and microscopy methods. The use of FCC for the enumeration and viability of bacterial cells within cheese has been demonstrated but the ability to use FCC for more expansive, multi-parametric purposes must be considered and developed in the future.

Optimising foods for satiety

The alarming rise in global rates of overweight and obesity does not only have profound implications for health and wellbeing but also for the environment and the economy. Foods that generate strong satiety sensations have obvious benefits for weight management. On page 149, Lucy Chambers and coworkers build on the understanding that a food's satiating power is dependent on the amount of protein, carbohydrate, fat and fibre it contains by examining evidence that the consumer's sensory and cognitive appraisal of the food is also important. Satiety research has traditionally centred on the metabolic effects of different food components in the gastrointestinal system. This important work has established that foods high in protein and fibre are particularly effective at generating satiety, due to the breakdown and