Grains, Pulses, and Innovation

While sitting in front of an empty screen preparing to write this column I began to wonder what grains and pulses have in common. Clearly they are seeds that mature on plants, and they form the basis of a plentiful food source for large sections of the human population worldwide. In their various forms they are widely cultivated, sometimes side by side. Their nutritional benefits are well documented and to some extent complementary. On the other hand, there are key differences between these two groups of important raw materials that have historically influenced the manner in which they are used for human nutrition.

Key Differences
An important difference lies in the degree of processing that is required to convert the seeds for human consumption and to unlock the nutritional benefits contained within them. In the case of pulses, processing is relatively straightforward and may simply consist of removing the seeds from the enclosing casing (pods), much as I do in my own vegetable patch when I pick peas. If I want to keep the pulse seeds for any length of time, then relatively simple drying or freezing processes are all that are required. In contrast, more complex processing methods are required for most grains in order to unlock their nutritional benefits. In addition, with grains such as wheat we can go one step further in processing and use milling and baking to produce a much wider range of food products.

So, although grains and pulses share some commonalities, it is when we look at how their nutritional benefits can be unlocked that we perhaps begin to understand why we seldom find them side by side in the same product. The simple processing and cooking requirements for pulses makes them readily available for inclusion in an array of nutritious and enjoyable dishes that have a wide range of flavors. It also is true that rapid preparation and processing of whole grains after harvesting can be achieved. This is demonstrated by the preparation processes for grain-based foods such as bulgur. Probably one of the oldest processed foods, bulgur has ancient origins in the Middle East—home of the wild grass progenitors of our modern wheat varieties. Bulgur is commonly prepared by soaking wheat grains and then cooking and drying them. After drying, they are lightly milled to remove part of the outer bran and crack the grains to provide access to the starchy interior. Bulgur is often eaten in soups and with meat.

In the case of bulgur-type products it is easy to see that the processed grains are utilized in a form that is similar to the most commonly eaten form of pulses. Having got this far in my think-

Barriers to Use
One of the barriers is related to the flavor profiles of the raw materials. Pulses tend to have stronger natural flavors than grains, and these flavors can dominate mixtures of grains and pulses when both are included in a baked product like bread. Some might consider that the addition of a new flavor to bread would be desirable, but consumers seldom expect that bread should have a strong flavor profile. This is essentially true of even sourdough breads, in which the level of acidity generated would not result in the classification of the bread flavor as “strong” compared with the flavor profiles contributed by many pulses. Even the addition of relatively low levels of dried bean flours (e.g., 2–3% soy flour) are readily detected as “different” by consumers and, in many cases, are not considered acceptable in bread products by consumers.

A significant technical barrier to using pulses and dried flours produced from them in baked products is that they contribute nothing to the formation of the product texture generally associated with baked products such as bread. We expect a bread crumb to have, to varying degrees, a soft and relatively chewy texture, and as we all know, this is achieved through the formation of a developed gluten network in the base dough, followed by expansion through yeast fermentation and setting of the structure in the oven, where the final conversion of dough to bread occurs.

As past work has revealed, a key role of the gluten network is that of trapping small gas bubbles in the dough during mixing and controlling their coalescence during subsequent transit through the rest of the process. The common reference is to a process that can be encapsulated by the phrase “foam-to-sponge” conversion: the gas bubbles are trapped in the dough forming the “foam,” and the setting of the structure in the oven forms the “sponge.” The challenge is that when particles or materials that do not contribute to the formation of the gluten network or that interfere with the foam-to-sponge conversion are introduced, it is a struggle to deliver the characteristic structures of common breads.

An example is provided by the fast-growing baking market segment associated with gluten-free products. In these types of

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products, there are no gluten-forming proteins present in the mixture, yet the formulations used still manage to deliver an aerated structure similar to that of standard gluten-containing bread. In the manufacture of gluten-free breads, the formation and stabilization of the foam remains a key requirement. This is commonly achieved through an understanding and utilization of the gelatinization properties of various types of starches coupled with the stabilizing mechanism delivered by gums.

If we are seeking to innovate and work with mixed grain- and pulse-based bakery products, are there lessons we can learn from the significant innovation that we see with gluten-free products? Maybe by using a mixture of standard and gluten-free technologies we can discover ways of introducing pulses in different forms into baked products.

**Keys to Product Innovation**

There is no doubt in my mind that managing consumer expectations for the texture of baked products would be critical to the delivery of grain–pulse hybrid baked products in mainstream markets. Although the creation of a stable foam in bread dough is largely a consequence of mixer design, there are ways in which we can impact the creation of that foam. Mixing times and dough temperatures are obvious choices, but there are also dough and batter mixing systems that allow manipulation of the initial gas bubble populations in the dough using variations in pressure inside the mixing chamber itself. There are also the ways in which the dough can be manipulated after mixing, as well as the potential contributions of the various sheeting and forming steps. With some innovative thinking, we should be able to overcome at least some, if not all, of the potential negative impacts of incorporating hybrid grain and pulse components on the final texture of baked products.

Of course, after texture we must circle back to the issue of flavor and, in some cases, color. But, maybe I am wrong to put up flavor and color barriers? Would it really be so bad to create bean-flavored bread? Is it just a case of using good marketing and branding to convince consumers that the health benefits outweigh the “different” characteristics of the final products? It might be. However, these days devising health benefit messages and getting them through to consumers is a more rigorous process than it was a hundred years ago. Today, to make any sort of health claim in most parts of the world we must first provide relevant evidence to support the claim. This is the right thing to do, since we in the food industry do not wish to deceive consumers, deliberately or unintentionally, but I wonder if the pendulum has swung so far that it is now the stringent control of health-related claims for foods that represents a real barrier to product innovation.

After all this talk of innovation you can bet that the next time I visit my vegetable patch to pick some peas or beans for dinner, I will be looking at them and wondering how I can incorporate them in my baked products rather than simply boiling them for supper. However, at the back of my mind will also be the thought, “Will I be able to convince consumers to buy my ‘pea-bread’ based simply on its different look, taste, and texture?” When asked if it will be better for the purchaser, my reply will be, “No comment.”