

CEREAL FOODS WORLD®

A PUBLICATION OF AACC INTERNATIONAL

NOVEMBER-DECEMBER 2018



In This Issue

*Incremental Innovation in
Grain Breeding and Milling*

*Creative Problem Solving
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Jayne Bock



Jess Sweley

Reimagining Farm-to-Fork: Innovation across the Value Chain

Jayne Bock and Jess Sweley
Guest Editors

The Merriam-Webster dictionary defines innovation as “the introduction of something new.” Innovation is the process by which science and invention are converted into commercially viable products. This issue of *Cereal Foods World* explores innovation along the entire market value chain for cereal foods—from producers to retail settings.

Cereal scientists must be aware of emerging consumer and end-user opportunities in order to create new product solutions. Emerging and dynamic consumer priorities, like non-GMO and organic ingredients, and diets like ketogenic, paleo, and Whole30 constantly change the food landscape. Seizing these opportunities requires awareness of consumer trends, disciplined use of basic and applied scientific and regulatory principles, and strong business acumen to successfully commercialize inventions. In effect, cereal scientists and engineers are very often the bridge between upstream capability and downstream demands that enable innovation to take place and be successful.

In this issue, we also challenge the narrow view that disruptive innovations (e.g., the iPhone created the smartphone category) are all that matter. The rare examples of disruptive innovation get a lot of fanfare, but incremental innovations accumulatively propel industries forward. Innovation is hard to quantify, especially when it is incremental.

Two articles in this issue illustrate incremental innovation in grains and milling. Kevin Kephart and his coauthors explain how Indigo Ag has developed a seed treatment that will drive efficiencies and improve sustainability through lower agronomic inputs (e.g., pesticides, herbicides, fertilizers, etc.) without altering the fundamental growing process. A panel discussion on “Incremental Innovation in the Milling Industry” showcases how various companies bring meaningful, smaller innovations to well-established processes.

Bringing innovation to any industry can be a challenge, but it can be enabled through creative problem-solving tools and processes. Lauren Shimek from Food.Tech.Design applies design thinking, an innovation model that has been gaining traction in the high-tech and healthcare industries, to various steps in the cereal and grain value chain. Brian Nash from Ingredion delves into a key step in today’s value chain—global sourcing of ingredients. Nash describes how a multinational corporation can successfully source sustainable raw materials on a global scale.

At the retail end of the value chain, dramatic shifts experienced in the past few years are expected to accelerate over the next several years. The rise of Amazon grocery delivery and its purchase of Whole Foods may provide a glimpse into the future, where brick-and-mortar retailers will integrate online shopping with “click and collect” grocery and “meal kit” delivery services. Wendy Liebmann from WSL Strategic Retail addresses these and other key consumer retail trends and reveals how meaningful (and often overlooked) retail solutions can create value.

Industries around us are innovating at a rapid pace—for example, artificial intelligence has exploded across multiple industries. Although consumers are generally quick to embrace technology innovations in other industries, they are more reluctant to accept and make giant leaps into the unknown with something as fundamental to survival as the food they eat. Lin Carson from BAKERpedia addresses how alluring messages can be utilized to overcome consumer resistance to technological breakthroughs in the foods they eat. Her article also provides guidance on crafting consumer-friendly messages across multiple digital platforms.

The collection of articles published in this issue reveals the range of opportunities available to bring cereal and grain innovations to the marketplace. Regardless of where innovation occurs in the value chain, it requires agility to connect capability and science to marketplace demand.



The theme of the November-December issue complements that of the Cereals & Grains 18 (C&G18) meeting. Keynote Speaker Ian Roberts discusses sustainability and innovation in the grain value chain during C&G18 presentation.

Harnessing Microbial and Agricultural Systems to Transform the Wheat Supply Chain

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Wheat (*Triticum aestivum* L. and related *Triticum* spp.) is one of the most important crops grown worldwide. Wheat and rice (*Oryza* spp.) each provide about 19% of global dietary energy, making these crops two of the most important sources of human nutrition (33). Wheat, however, is unique and complex in many ways. There are several classes of wheat that are adapted to specific geographic areas, have unique value chains, and are used as ingredients in many food products, such as breads, crackers, cookies, cakes, beer, and pasta. The wheat genome is complex as well: durum wheat (*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.) is a tetraploid with A and B genomes, and other classes of wheat are hexaploids with A, B, and D genomes (24). The three genomes originated from natural hybridizations between diploid ancestral species of *Triticum* and *Aegilops* that occurred 6.5 million years ago, evolving into

hexaploid wheat species about 400,000 years ago. As agriculture developed over the last 10,000 years, humans selected and cultivated lines that produced high yields, were free-threshing, and had nonbrittle rachis and plump grains.

Despite the critical role of wheat as a staple crop in many regions worldwide, there are concerns that the pace of improvement will diminish, and as the global human population and its affluence increase, it is predicted that wheat production will not meet demands. Ray et al. (33) conducted an analysis of the rates of production gains for four primary global crops: corn (*Zea mays* L.), rice, wheat, and soybean (*Glycine max* (L.) Merr.). From 1961 to 2008, the global average rates of yield increase were 1.6, 1.0, 0.9, and 1.3%/year for corn, rice, wheat, and soybean, respectively. To meet the projected food requirements of 9 billion people by 2050, however, average rates of yield gain must reach 2.4%/year for each of these four crops. Although certain localized areas have been realizing wheat yield gains of 2.4%/year, many more areas are either well below this rate of gain or have even experienced production declines.

The overall economic performance of U.S. agriculture has been slowing as well. From 1948 to 2015, the average annual rate of agricultural output growth was 1.48%/year, resulting in a 2.7-fold increase in output during the period (42). Input use increased by 0.1%/year over this period, so the resulting overall productivity was 1.38%/year. In recent years, however, the economic pace has slowed, with the output rate of gain dropping to 0.72%/year, input use nearly doubling to 0.19%/year, and a net productivity of 0.53%/year, which is 38% of the rate over the entire 1948–2015 period.

Wheat growers have long recognized that they have not benefited from the technological advancements and investments that corn and soybean producers have received, and the rela-

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tively slow yield gains of 0.9%/year for wheat substantiate this concern. In addition to yield, the sustainability of wheat production, which is often studied in terms of land use, soil conservation, and restricted use of irrigation and other practices that contribute to greenhouse gas emissions, has also lagged behind other row crops. From 1980 to 2015, wheat producers globally decreased irrigation water use by 26%, energy use by 22%, and greenhouse gas emissions by 9%; however, for corn and soybeans these metrics were double to triple those for wheat (10). Moreover, as a C₃ species, wheat is expected to be among the most vulnerable crops with regard to rising temperatures resulting from climate change—a 1 degree Celsius temperature increase is predicted to contribute a 4.1–6.4% decline in global wheat production (22). In 2007, the National Association of Wheat Growers and U.S. Wheat Associates passed resolutions to coordinate with growers in Canada and Australia to “research, develop, and commercialize” technologies for wheat that will improve the competitive position of wheat relative to other crops (7).

New technologies need to be developed to drive enhanced productivity and capture value from wheat and other staple crops. Improvements in traditional technologies, such as plant breeding and genetics, will continue to be critical for ongoing gains in agriculture. New technologies must be developed concurrently, however, to better realize the genetic yield potential that already exists in modern cultivars. Lee et al. (21) identified coordination of biological sciences, information and communication technologies, and robotics as necessary to drive improvements in production efficiency (operational excellence), innovative market development (supply chain orchestration), and nearly real-time access to supply chain information (transparency). Implementation of advanced analytical tools throughout the system will play a critical role in achieving the production gains necessary to meet projected demands.

Businesses have begun using advanced analytical tools to enhance agricultural productivity, deliver products that meet consumer needs, protect the environment, and improve economic conditions for growers. Indigo Ag, Inc. is an example of a company using advanced analytical tools to balance the many demands placed on agriculture through the lenses of farmer profitability, environmental sustainability, and consumer well-being. Indigo is using high-throughput genetic sequencing and machine learning to select natural symbiotic endophytes that can improve crop production. It is also using modern technologies, such as blockchains, to segregate and market crops to achieve greater supply chain efficiencies and capture value for growers. Indigo's endophyte technologies are being developed to optimize plant microbiomes that better capture crop yield potential, particularly crops grown under severe abiotic and biotic stresses, while concurrently reducing the use of irrigation, chemical fertilizers, and pesticides. Indigo's on-site crop advisors and post-harvest grain management strategies are aimed at more tightly linking crop production to food processors and consumers. Crop quality measures are obtained at the point of field production, so the crop can be delivered to better meet the specifications set by food processors, and crop quality analysis is used to segregate grains for identity preservation. When broadly implemented to support microbiome development, improved crop management, and sophisticated marketing, use of advanced analytical tools will also enhance crop quality for food manufacturers and consumers. Endophytes can be developed to improve the nutritional composition of wheat, such as increased protein concentration and mineral fortification, as well. In addition, routine

and rapid analysis of crop quality can provide growers with better supply chain orchestration. Ultimately, use of advanced analytics, the plant microbiome, and postharvest management strategies will generate better economic outcomes for growers and enhanced well-being for consumers. Given the demonstrated lags, compared with other row crops, wheat in particular stands to gain from the transformations that companies like Indigo can inspire.

The urgent needs to increase crop yields and improve the quality, resiliency, and sustainability of wheat go hand-in-hand. The necessary production gains of 2.4%/year must be achieved while concomitantly using less water and fewer chemicals, continuing production on degraded soils, and facing extreme weather shocks, gradual temperature rises, and new pests and diseases (11). Although there is no single solution that can address these obstacles, a systems approach, with the science of the microbiome at its core, can make great strides. This article presents an overview of the technologies that Indigo is using to enable its unique approach to improving agricultural production and rural economic growth.

The Plant Microbiome

Public awareness about the important interrelationships between humans and microorganisms is increasing. Throughout much of the 20th century it was widely believed that human health would benefit if microorganisms were controlled or eliminated on and in the human body. This turned out to be an arduous, risky, and unsustainable approach to human health. As time passed, human health scientists became increasingly aware of how people benefit from microorganism populations on and in our bodies. Savage (38) reported that the ratio of microbial cells to human cells for an individual person was typically 10:1, with the majority of the microbial cells located in the human gastrointestinal tract. More recent research indicates that a balanced microbial population base is an essential aspect of human health (29). In 2001, the term and concept of the “microbiome” was introduced by Lederberg and McCray (20) to “signify the ecological community of commensal, symbiotic, and pathogenic microorganisms that share our body space.”

The new emphasis on the human microbiome has led to the development of sensitive tools and approaches to studying and characterizing complex microbial populations. The human microbiome research community developed the approaches of metagenomics, metatranscriptomics, and metaproteomics, as well as the use of 16s rRNA and internal transcribed spacer (ITS) primers, to examine complex microbial populations and data archives with genetic sequence databases that are maintained and shared among scientists. These approaches allow for simultaneous study of the wide array of microbial populations in an ecosystem (41). This rapid development of sophisticated tools also benefits researchers investigating other microbiomes, including soil, animal, and plant microbiomes, as well as ecosystem-wide approaches to studying complex interactions involving microbial populations.

A clearer understanding of the symbiotic relationships between plants and bacteria has been acquired over many decades of research. In the late 19th century, Russian microbiologist Sergei Winogradsky discovered that the anaerobic bacterium *Clostridium pasteurianum* is capable of fixing atmospheric nitrogen. His discovery led to subsequent work on symbiotic relationships between *Rhizobium* spp. and plants in the family *Leguminosae* (6,31). Today, research and development is underway in

plants beyond the family *Leguminosae*, and understanding of synergistic plant–microbe interactions is expanding rapidly. The current state of knowledge indicates that all plant tissues are hosts to complex microbial communities, which are dominated by fungi and bacteria (37,41). These complex communities, known as the plant microbiome or phytobiome, are adapted to 1) the rhizosphere, which exists on the surfaces of plant tissues that are underground or in contact with the soil (e.g., roots, rhizomes, and stolons); 2) the phyllosphere, which exists on the surfaces of aerial plant tissues (e.g., leaves, stems, flowers, etc.); and 3) the endosphere, which exists internally within plant tissues.

Rhizospheres are regarded as having microbial species populations that are particularly rich compared with phyllospheric and endospheric populations (2). Consequently, most research on plant–microorganism interactions has focused on the rhizosphere (2). There is considerable overlap of endophytic species with those present in the rhizosphere, indicating that many rhizosphere microorganisms are capable of colonizing internal plant tissues (37,41). Primary access points include root nodules, cracks, wounds, lenticels, and points of emergence of adventitious roots (37). Phyllospheric microorganisms capable of colonizing the endosphere often enter through stomata and floral tissues (28,37). Additionally, plant endophytes may be passed along from one generation to the next by vertical transmission through seeds and vegetative propagation (37). Endophytic bacteria and fungi primarily occupy apoplastic spaces among plant cells or necrotic or senescing tissues (41). Moreover, endophytes can relocate throughout the plant through xylem transport (41).

Endophyte–Host Plant Interactions

Khan et al. (16) provided historic background on early observations of endophytes. Fungal endophytes were first reported in 1898 by Vogl and in 1904 by Freeman, and bacterial endophytes were first reported in 1926 by Perotti (16). Endophytic bacteria and fungi are of particular interest with regard to agronomic crop management. Because of their location inside plants, endophytes are uniquely positioned to influence plant growth and can be managed to help control plant diseases, increase and stabilize crop productivity, reduce chemical inputs, reduce agricultural greenhouse gas emissions, and meet other objectives that support greater sustainability. The interspersed population of endophytes within plant tissues in essence makes these endophytes an extended or second genome of the crop system, collectively functioning as a pan-genome (37,41).

Most of the recent literature defines endophytes as microorganisms that live inside plant tissues without causing symptoms of disease. With regard to bacteria, Turner et al. (41) recently stated “endophytic bacteria are those that reside for at least part of their lives within plant tissues...[t]hey are generally considered to be non-pathogenic, causing no visible symptoms, but they may include latent pathogens that, depending on environmental circumstances and/or host genotype, can cause disease.” In contrast, in 1866 De Bary defined endophytes as “any organism occurring within plant tissues” (2). Lata et al. (19) categorized endophytes into three types based on pathogenicity: 1) pathogens of another host that are nonpathogenic in their endophytic relationships; 2) nonpathogenic microorganisms; and 3) pathogens that have been rendered nonpathogenic but are still capable of colonization by selection methods or genetic alterations. Despite these definitions, which are based on degrees of pathogenicity, there is building interest in determining how endophytes enhance plant growth and mechanisms of plant–endophyte symbiosis.

Mechanisms of Growth-Promoting Endophytes

Many bacteria and fungi develop symbiotic communities in the rhizosphere, phyllosphere, and endosphere of host plants. Endophytes are of particular interest for technological development because these microorganisms can be placed to directly interact with and respond to signals from host plants. Khan et al. (16) stated that endophytes have coevolved with plants and developed chemical signals in complex systems, citing Schulz and Boyle (39), who reported that about 51% of biologically active metabolites in plants originate from endophytes.

Santoyo et al. (37) recently posited that endophytes promote host plant growth and health in two ways—either through direct or indirect mechanisms. Direct mechanisms entail facilitating acquisition of nutrients and water, as well as modulation of hormones and plant growth-promoting compounds in the plant (37). Examples of endophyte-produced plant hormones include auxins, abscisic acid (ABA), cytokinin, and gibberellins (32,37). Indirect mechanisms are primarily those that limit damage caused by phytopathogens, insects, nematodes, and herbivores, acting mostly through production of metabolites that confer containment, nutrient starvation, antibiosis, or nonpreference responses.

Accumulating evidence indicates that direct mechanisms of endophytic bacteria and fungi alleviate abiotic stress. One example is bacteria that produce 1-aminocyclopropane-1-carboxylate (ACC) deaminase, such as the endophyte *Burkholderia phytofirmans* PsJN (32,37). These bacteria have the capability to modulate ethylene status in plant cells. Increased ethylene production is a common plant response to chronic abiotic stress, such as osmotic stress from drought or saline conditions, water-saturated soils, heat, or cold. Common morphological and phenological responses to increased ethylene status include inhibited root growth, restricted stem elongation, reduced leaf area, and accelerated senescence. Plants increase production of ACC as a stress response, and ACC oxidase catalyzes conversion of ACC to ethylene. In turn, ethylene signals meristematic tissues to restrict growth. This plant response can be modulated by endophytic bacteria that produce ACC deaminase. The bacteria take up ACC produced by plant cells and metabolize it to ammonia and α -ketobutyrate, thereby preventing ethylene production. As a consequence, plants colonized by these endophytes have greater root growth than those not colonized by ACC deaminase-producing endophytes. Larger root systems provide increased access to water and oxygen in the soil, accumulation of greater carbohydrate reserves, and other factors that later support plant growth.

Endophytic fungi also facilitate host plant health under abiotic stress. Khan et al. (16) and Waqas et al. (44) studied associations between cucumber (*Cucumis sativus* L.) and the endophytes *Phoma glomerata* LWL2, *Penicillium* sp. LWL3, *Exophiala* sp. LHL08, and *Paecilomyces formosus* LHL10. In laboratory-based evaluations, plants colonized by these fungal endophytes had greater plant growth, chlorophyll concentration, and leaf area than noncolonized plants. Notably, the larger root systems of the endophyte-colonized plants were able to retrieve greater amounts of water from sources that noncolonized plants under stress could not access (16). Additionally, ABA synthesis was downregulated, and relatively greater stomatal conductance was likely maintained under stress. Khan et al. (16) postulated that endophyte-mediated modulation of plant ABA levels by fungal production of gibberellins occurred.

Shehata et al. (40) reported on their extensive work regarding vertical transmission of an endophyte for continued delivery of

an indirect antibiosis mechanism. Chapalote is a landrace of corn that has been grown continuously by subsistence farmers in southern Mexico for more than 3,000 years because it consistently demonstrates resistance to phytopathogens without use of fungicides. The research team isolated the endophytic bacteria *Burkholderia gladioli* 3A12 from Chapalote and demonstrated that it is vertically conserved in the seed from one generation to the next. The endophyte expresses antifungal properties by first swarming and attaching to fungal phytopathogens and then isolating the fungus with biofilm. Afterward, the endophytic bacteria kill the fungal hyphae. In short, the bacteria are able to recognize the pathogen, contain it, and facilitate control.

Endophytes in Wheat

Several investigators have conducted surveys to characterize endophyte communities in wheat. Marshall et al. (25) assayed wild species of *Triticum* that were collected in Turkey. Their work was done prior to development of metagenomic techniques and instead utilized microscopy to search for fungal hyphae. They found only two fungal endophytes in diploid *Triticum* spp., and although they did not observe expansive endophyte communities, they confirmed vertical transmission of *Neotyphodium* spp. endophytes. Shortly thereafter, Zinniel et al. (45) conducted a survey of 27 prairie plant species and 4 crop species, including wheat, for the presence of endophytic bacteria. They isolated 853 strains, including 28 isolates from wheat. Larran et al. (17) also reported on their survey conducted on wheat leaves. They isolated 130 fungal and 3 bacterial endophytes. They found that leaf endophyte communities became more abundant as the crop developed, but there were no differences among the three cultivars studied. Four of the fungi consistently dominated the endophyte community: *Rhodotorula rubra*, *Alternaria alternata*, *Cladosporium herbarum*, and *Epicothium nigrum*. Larran et al. (17) concluded that although a large number of endophytic species are often observed, only a few species are present in significant numbers. They categorized the endophytes they observed into three groups: 1) well-known and economically important pathogens of wheat; 2) commonly abundant phylloplane fungi considered to be primarily saprobic and minor pathogens; and 3) species only occasionally present in wheat.

Gdanetz and Trail (12) conducted an extensive field survey of microbiome communities on wheat produced in four production systems: conventional tillage, no-till, low-input, and organic. Although they used sensitive assays (ITS and 16s) and they examined leaf, stem, and root tissues, their study did not distinguish between epiphytes and endophytes. Nevertheless, they isolated 1,634 fungal and 1,112 bacterial species. They found that microbiome communities became more abundant as the crop developed; however, production systems did not have a strong influence on wheat microbiome communities.

Ofek-Lalzar et al. (30) examined fungal endophytes in wheat and two wild ancestors of wheat: wild emmer (*Triticum dicoccoides* L.) and Sharon goatgrass (*Aegilops sharonensis* Eig.). They observed a greater abundance of fungal endophytes in the wild grasses than in wheat, and there was a “narrow core community of *Alternaria* species” in all three plant species examined.

Robinson et al. (35) examined the effects of crop production system on wheat endophyte communities. Surprisingly, bacterial endophytes were most abundant when crop fertilizer inputs were minimized. They estimated that bacterial species abundance was 42% greater for the unfertilized entries than for five other fertil-

izer treatments, including manure, two nitrogen levels, and a mixture of Mg, P, and K. Manure applications had a negative effect on *Actinobacteria* populations.

Wheat Responses to Endophytes

Research conducted in laboratory, greenhouse, and field settings showed positive responses by wheat plants to endophytes affecting plant growth, grain yield components, and physiology. Reports of field observations conducted by Indigo indicate that the yield of hard red winter wheat produced from certified seed treated with a bacterial endophyte was 8.3% greater than for the crop established from untreated certified seed when averaged across 14 farm locations in Kansas during the 2016–2017 growing season (unpublished data). On average, the yield for endophyte-treated crops was 16% greater than for untreated controls for the seven driest or most heat-stressed farm locations, where yields for untreated controls ranged from 2.3 to 4.3 MT/ha. Initial reports for the 2017–2018 season indicate that the yield for endophyte-treated wheat seed was 13% greater than for untreated control seed on 24 farm fields in Texas, Oklahoma, and Kansas (unpublished data). Indigo endophyte-treated seeds produced 19% greater yields than untreated controls for the 17 driest locations, where yields for untreated controls ranged from 0.7 to 1.5 MT/ha. Indigo’s public reports claim improved crop production resulting from inoculation of seed with endophytes, with no difference in the chemical fertilizer or pesticide applications that were used for the untreated controls. Field harvest areas ranged from 0.4 to 63.0 ha. The endophytes used by Indigo are indigenous to U.S. agricultural croplands and are applied to crops as a seed treatment at the time of planting.

Indigo routinely conducts seedling growth studies in the laboratory and under field conditions to screen for endophytes and evaluate processes. Wheat endophytes of interest exhibit enhanced seedling growth (Fig. 1), which influences grain yield components during later stages of phenological development. Enhanced seedling development, especially root growth, is also often observed under field conditions (Fig. 2).

Indigo’s commercial-scale observations are consistent with experiments reported in the literature. Colla et al. (5) studied the



Fig. 1. Seedling growth of hard red spring wheat at 7 days postgermination on agar from seeds either treated with a fungal endophyte (right) or not treated with the endophyte (left).

growth responses of durum wheat to a combination of three endophytic fungi applied as a seed treatment: *Glomus intraradices* BEG72, *Glomus mosseae*, and *Trichoderma atroviride* MUCL 45632. In a growth chamber experiment they observed that endophyte-treated entries measured 17 days after planting had a 10.0% higher chlorophyll concentration and 23.1 and 64.2% greater shoot and root dry weights, respectively. Indigo also has often observed noticeably greater chlorophyll concentrations for endophyte-treated wheat than for untreated controls (Fig. 3). Colla et al. (5) conducted field-based experiments during two growing seasons, 2011–2012 and 2012–2013, with 313 and 900 mm of precipitation, respectively. Endophyte-treated entries had 32.1 and 8.3% greater grain yields than untreated entries for the 2011–2012 and 2012–2013 seasons, respectively. Endophyte treatments did not affect mean seed weight, so differences in yield were attributed to greater numbers of seeds per plant for endophyte-treated entries. Grain protein concentration was 6.3% greater for the endophyte-treated entries than for the untreated entries for the dry 2011–2012 season but did not differ significantly between treatments for 2012–2013. Mineral concentrations in leaf tissues were consistently higher for the endophyte-treated entries than for the untreated entries. Liu et al. (23) studied wheat plant responses to the bacterial endophyte



Fig. 2. Seedling growth of hard red winter wheat established from Indigo certified seed treated with a bacterial endophyte (left) or not treated with an endophyte (right). The sample date was January 8, 2018, approximately 14 weeks after planting in a farm field in Gove County, Kansas.



Fig. 3. Adjoining fields of hard red winter wheat established in Kansas for the 2017–2018 growing season. The Indigo endophyte-treated field is on the right, and the untreated control field is on the left.

Azorhizobium caulinodans ORS571. They reported that seedling root and shoot lengths were 17.0 and 8.4% greater, respectively, for the endophyte-treated wheat than for untreated wheat, which was consistent with observations at Indigo and in other reports. Amelioration of water stress can be visualized by multispectral imagery. Multispectral images obtained by Indigo show that endophyte-treated wheat exhibits less stress than untreated controls (Fig. 4). Colla et al. (5) also remarked that their observations were consistent with previous studies that showed endophytic-fungi treatments in wheat ameliorated drought stress and other forms of biotic and abiotic stresses, thereby providing enhanced yield stability and sustainability.

Hubbard et al. (14) studied the responses of durum wheat to heat and drought stress after treatment with six isolates of an endophytic ascomycetous mitosporic fungus. Three of the six fungal isolates ameliorated heat stress (36°C) better than drought stress. For average seed weight in the heat stress experiments, four of the isolates ameliorated stress, while one of the isolates exacerbated it. Although stem length did not differ among the entries when grown under drought stress, average seed weight was greater for four of the isolates than for the untreated control. Three of the four isolates alleviated both heat stress and drought. Stable carbon isotope discrimination is an integrated measure of stomatal conductance (9). Three of the isolate treatments resulted in increased stable carbon isotope discrimination under drought stress, indicating relatively greater conductance as a result of these endophyte treatments when wheat plants were stressed, which resulted in increased grain yields.

Chen et al. (4) described a novel species of bacteria (proposed as *Pantoea alhagi* sp. nov.) isolated from *Alhagi sparsifolia* Shap., a drought-tolerant legume native to northwestern China. *Pantoea alhagi* LTYR-11Z^T was studied for its effects on growth of water-stressed winter wheat. For well-watered entries, endophyte-treated wheat seedlings had 29.2 and 20.8% greater root length and plant fresh weight, respectively, than the nonstressed control. Water-stressed plants that were inoculated with the endophyte had 17.1, 41.8, and 112% greater shoot length, root length, and plant fresh weight, respectively, than the water-stressed control.

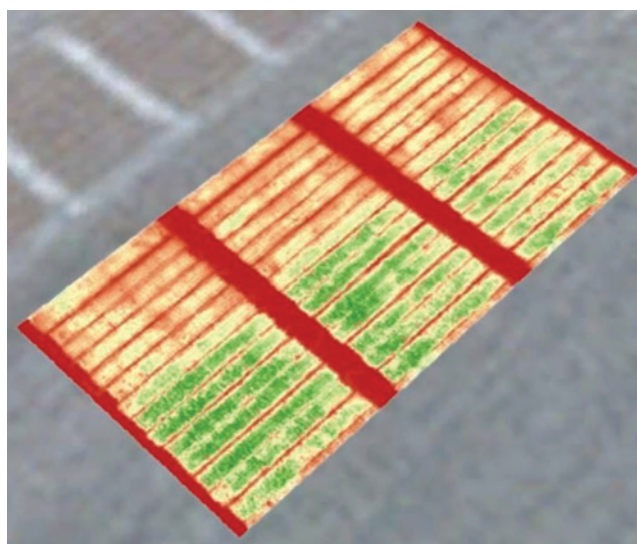


Fig. 4. A multispectral image obtained from an unmanned aerial system platform showing spectral differences between endophyte-treated wheat (lower right) and untreated wheat (upper left). The image indicates the endophyte-treated wheat is under less stress than the untreated wheat.

There are an increasing number of studies reporting on the plant growth-promotion properties of endophytes. In some instances endophytes exhibit no growth promotion when plant growth conditions are nearly optimal, as demonstrated by Sánchez-Rodríguez et al. (36) with bread wheat and durum wheat. Conversely, Chen et al. (4) reported that their novel bacterial endophyte both enhanced growth and ameliorated drought stress. They suggested that endophytes may provide “stress independent,” as well as “stress dependent,” direct mechanisms.

There have been other reports of direct synergistic mechanisms in wheat. Mitter et al. (28) observed that endophyte-colonized, field-grown wheat plants reached the heading stage of development 5 days earlier than untreated control plants. Vujanovic et al. (43) reported that treatment with a fungal isolate resulted in reductions in seed dormancy, faster germination, and improved seedling vigor in durum wheat. They suggested that the endophyte heightened the gibberellin status, resulting in breakage of dormancy.

Antagonism toward phytopathogens was described earlier as an indirect mechanism of plant growth promotion by endophytes. Recent research has shown potential for use of endophytes as bio-control agents for tan spot (*Pyrenophora tritici-repentis*) and head blight (*Fusarium graminearum*) in wheat. Herrera et al. (13) examined four bacterial isolates of the genus *Paenibacillus*, one of the genus *Pantoea*, and one isolate that was identified as being from either the genus *Bacillus* or the genus *Fictibacillus*. The *Pantoea* and *Paenibacillus* isolates restricted growth of *Fusarium graminearum* in bioassays, with the *Paenibacillus* isolates releasing antifungal substances into the culture medium. Larran et al. (18) examined nine bacterial and fungal endophytes for control of tan spot in wheat using greenhouse-based, dual-plate bioassays. Endophyte strains of *Bacillus* spp. and *Fusarium* spp. reduced spore germination of *Pyrenophora tritici-repentis* by 82 and 52%, respectively. The endophyte *Trichoderma hamatum* showed the greatest antagonistic effect—the mean percentage of leaf area diseased was 53% less for the endophyte-treated plants than for the controls.

Endophytes and Food

There is a paucity of information on the effects of endophytes on food quality and functionality. Because endophytes occupy internal plant tissues, they have the potential to affect the properties and functionality of foods. Khan et al. (16) listed several bioactive compounds that are produced by endophytes, including flavonoids, peptides, alkaloids, steroids, phenolics, terpenoids, lignans, and volatile organic compounds. These compounds are known to influence the sensory characteristics of foods (e.g., taste and smell), and there is increasing evidence that these groups of compounds may benefit human health (8). Additionally, endophytes in raw food products, such as fresh fruits and vegetables, can influence the human microbiome and potentially improve human health (2). Endophytes may also be used to improve plant access to soil nutrients.

Minervini et al. (26) reported on several endophytic bacteria isolated from durum wheat that produce lactic acid, including *Lactobacillus*, *Streptococcus*, *Enterococcus*, and *Lactococcus* spp. They observed that these bacteria, which were isolated from wheat spikes, were also present in the resulting flour. More recently, Minervini et al. (27) isolated specific lines from durum wheat spikes, including *Lactobacillus plantarum* LA1, LB2, OLB3, OLD1, OLB4, and OLC4; *Lactobacillus rossiae* OLC1; and *Enterococcus faecalis* LA2. They compared sourdough fermentation of

these lines with that of *Lactobacillus sanfranciscensis* A4 isolated from sourdough sponge. They reported that *Lactobacillus plantarum* LB2 persisted during dough fermentation and resulted in greater acidification of the dough than did the *Lactobacillus sanfranciscensis* A4 control.

Profitability for Growers

Although pressure is mounting for wheat farmers and technology providers to improve production practices to meet ever-growing consumer demands, the economics make it difficult for them to do so. Commodity wheat prices have historically been volatile but have followed a downward trend over the past decade, partially caused by a surplus global supply. Farmers who rely on wheat as a principal crop may not have sufficient liquidity to invest in more efficient equipment or implement new farming systems. They may also suffer from information asymmetry and not be able to access or afford data that would help them optimize their management decisions.

This cycle points to the need for a systems approach in the wheat sector; however, new technologies and methods for improving sustainability that are brought to market are often inaccessible or unaffordable to wheat farmers. Companies like Indigo are seeing successful adoption of more sustainable practices through sharing of the risks and rewards with growers. For example, Indigo enters into contractual relationships with farmers through which added value is created from 1) endophyte technologies; 2) continuous agronomic insights from crop advisors; 3) on-farm storage capacity; 4) extensive crop quality analysis; and 5) market analysis. Indigo also partners with seed companies to provide certified seed of modern cultivars that are sought by millers and food manufacturers. Farmers that contract their production to Indigo receive on-site consultation by trained agronomists who advise farmers on how to optimize crop yield and end-use quality. A portion of the anticipated added value is promised to the grower at the time of planting, when production contracts are executed. Grain samples are systematically collected during harvest to determine information on grain grade, structure, milling characteristics, and baking characteristics. Indigo also provides financial support for on-farm storage so that harvested crops can be segregated to maintain their inherent value rather than being commingled in community storage systems, where their inherent value is lost. Indigo leads grain marketing efforts before and after harvest to optimize profits for both the growers and Indigo.

When Indigo's endophyte seed treatments are combined with high-yield cultivars, it is reasonable to expect a 20% yield increase in stressful environments. In dryland production systems that typically produce 2.7 MT/ha based on USDA actual production histories (APHs), an increase of 0.6 MT/ha would be expected. The yield increase alone provides for added value to the farmer; however, Indigo also promises a contractual incentive payment for the total contracted crop produced. The incentive for the 2018 harvest was \$15.80/MT. In this scenario, the expected increase in gross revenue for the farmer would be \$141/ha.

Farmers not only have access to game-changing technologies, like endophyte seed treatments, but are also supported by education, finance, and robust data science systems, including the latest in sensor technologies. With this systems approach, Indigo not only mitigates trade-offs and risks for growers in adopting new technology, but also provides a solid knowledge base for future decision-making. This ultimately leads growers to make optimal decisions concerning planting, irrigation, chemical use,

and protecting soils and adjacent watersheds, all while increasing wheat yields and quality to meet and capitalize on growing global demand.

Consumer Benefits

Consumer food selections have historically been driven by taste, price, and convenience—all dubbed “traditional drivers.” New factors, including health and wellness, social impact, and transparency, are now influencing the purchasing decisions of roughly half of consumers (34). Consumers are more concerned than ever about food identity preservation and traceability. A growing number of consumers also want to know where their food comes from, what health-promoting attributes it possesses, and how it was produced, processed, and transported. Given the prominence of wheat in human diets, it does not escape consumer scrutiny, and knowing that these consumers are making decisions with their wallets, brands are inclined to be responsive. For example, the Campbell Soup Company recognizes that wheat is a high-priority ingredient and has committed to enrolling 28,000 ha in a fertilizer optimization program (3). The Kellogg Company has also set ambitious goals to reduce energy and water use that extend to its grain suppliers and supply chains, committing to responsible sourcing of wheat and helping more than 500,000 farmers adopt climate-smart agricultural practices (15).

The current commodity-based supply chain does not adequately address consumer desires for improved identity preservation, traceability, and sustainability. To bridge these gaps, companies such as Indigo are implementing several strategies. First, Indigo is more tightly linking growers, processors, and consumers to create a robustly documented and traceable supply chain, which will allow consumers to identify the source and unique features of their chosen wheat products, as well as how they were processed and handled. For example, should there be issues with product recalls, consumers would be reassured that the supply chain could be rapidly retraced to identify the origins and transportation history of the recalled product. Second, the identity of Indigo wheat is preserved by limiting grain comingling in grain elevators and instead supporting greater access to on-farm storage. Third, Indigo is improving agricultural sustainability on two fronts. Endophytes are used to improve plant root structure, enabling crops to access water from deeper within the soil profile and, thereby, reducing irrigation and fertilizer applications. Additionally, longer supply chains with multiple intermediaries negatively affect sustainability because they involve crop transport to nonlocal environments. By reorchestrating the wheat supply chain Indigo will enable greater local production and improve the connection between growers and consumers.

Partnering more directly with systems-minded agricultural technology and service providers (e.g., Indigo) can provide food companies with better access to and more influence in on-farm practices that consumers increasingly care about. These partnerships can also improve data measurement and capture sustainability successes throughout the supply chain, helping food companies to demonstrate accountability against their goals. Finally, more direct linkages to growers enables improved supply chain traceability and transparency, which is a factor increasingly influencing consumer food purchasing choices.

Conclusions

Knowledge about plant microbiomes and mechanisms in wheat growth and production is expanding; however, little is known about how these microorganism communities affect the quality

and functionality of foods. Endophytes are known to produce bioactive compounds that are of interest for flavor enhancement and health promotion. It is tempting to speculate that, perhaps, examples already exist where certain food sources are capturing added market value in part because of unique localized endophyte–plant environment combinations. As an example of how understanding these factors influences consumer decisions, the wine industry is built on traceability of production location, variety, vintage, and other factors that link consumers to brands. Use of analytical technologies will develop more of these linkages while also increasing production, improving farmer income, benefiting the environment, and enhancing human health. The global wheat industry is ready for these changes.

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PLoS Pathogens. Passionate about improving plant health and productivity by using natural microbes to meet future food demands, Slavica joined Indigo as one of its founding scientists. Currently, Slavica is a director of research at Indigo, leading efforts to understand and improve product performance.



Angelyca A. Jackson, Ph.D., is a microbiologist by training and a scientific communications professional by vocation. Her Ph.D. degree was awarded from Dartmouth Medical School, where she studied *Pseudomonas aeruginosa* pathogenesis in lipid-rich environments such as the human lung. Her postdoctoral studies at the University of Massachusetts-Amherst focused on developing microbial tools to detect bacterial pathogens in agricultural wastewater. She has diverse science communications experience, ranging

from scientific outreach events and seminars during her graduate studies and postdoctoral training, to explaining the science of brewing as a quality control scientist, to writing about the best evidence in medicine as a medical writer. Her love of microbiology and interest in sustainable agriculture brought her to Indigo Ag in Charlestown, MA, where she works as the scientific communications manager.

Design Thinking for Food: An Overview and Potential Application for Grains

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In the dynamic and changing world of food product development, design thinking is being used as an effective innovation tool kit to help researchers, product developers, and food designers create breakthrough solutions to complex challenges. The use of design thinking as a tool kit for innovation is not new; in fact, it has been utilized for more than 30 years and was first put into practice by companies and institutions such as IDEO and Stanford University. As described by Kolko (2), design thinking has been used in many different industries, including automotive design, health care, financial services, and consumer packaged goods.

What exactly is design thinking? Design thinking is a human-centered innovation process that uses three lenses to uncover what people need and design meaningful solutions: desirability (people), feasibility (technology), and viability (business) (Fig. 1). The design thinking process starts with understanding what people need and desire, whether they be consumers, internal stakeholders, or external customers. However, design thinking takes a more holistic approach by considering all three lenses throughout the process. The design thinking process traditionally has four phases: insight and inspiration, synthesis and strategy, design and iteration, and storytelling and communication (Fig. 2). Each phase has key activities and outcomes. It also uses convergent and divergent thinking in each stage to push the design team's thinking to the outermost areas in order to uncover breakthrough solutions, while mindfully applying constraints to make ideas actionable.

As much as design thinking is about the process, it is also very much about the people who use it. The design thinking process thrives in a multidisciplinary team environment, asking participants to be "T-shaped" (Fig. 3) and to use their depth of expertise at points of convergence and their adaptive qualities to be generative, collaborative, human-centered, and optimistic throughout the process. Although optimism often does not seem like a crucial team attribute, it is one of the most critical ingredients in a process that strives to deliver radical and relevant innovation.

Why is design thinking so important for food right now? Although the process has existed for many years, an increasing number of design thinking programs focused on food solutions are being established at universities such as the University of California, Davis; Stanford University; and the University of California, Berkeley. These programs apply design thinking to everything from new product development to food system challenges, such as reducing food waste. Consumer attitudes and

purchasing behaviors across many categories, including bread, baked goods, and breakfast cereals, have undergone significant changes in the last 5 to 10 years, as have consumer perceptions of larger food companies and the growing number of organic and natural food businesses. With such notable shifts in behavior and their effects on these categories and the respective business that serve them, the value of a human-centered innovation process has grown, driving a strong need to not only understand consumer behaviors and perceptions, but also to find and successfully execute the opportunities within them. Design thinking is a unique innovation process that bridges the gap between qualitative consumer learning and tangible product design—all through the efforts of a single project team.

The design thinking process is already changing the future of food production: whether through successful product launches or at a food systems level as we navigate the global challenges of sustainable food production. Five unique ways in which the design thinking process can help create this new future of food production are discussed.

Design Thinking Brings Everyone Together from the Start

Although it may sound simple, the design thinking process brings together team members from different disciplines within an organization at the start of the project and, as a result, creates a more collaborative and effective team. A multidisciplinary team inspires diverse perspectives, from the design research phase, through the synthesis phase, to the design and iteration phase. A typical project core team working on a product development challenge could include members from marketing, research and development, sales, packaging, and consumer insights.

Multidisciplinary teams help frame the problem in new, multifaceted ways. By looking at the design challenge from different perspectives, backgrounds, and, in some cases, even different vocabularies, highly creative solutions can be devised. This cross-disciplinary format also invites team members who might not traditionally be involved in a particular phase to be fully immersed throughout the project. For example, when food scientists and packaging engineers are included in consumer research,

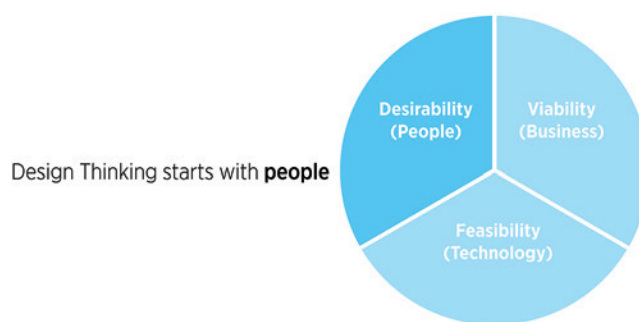


Fig. 1. The three lenses of design thinking.

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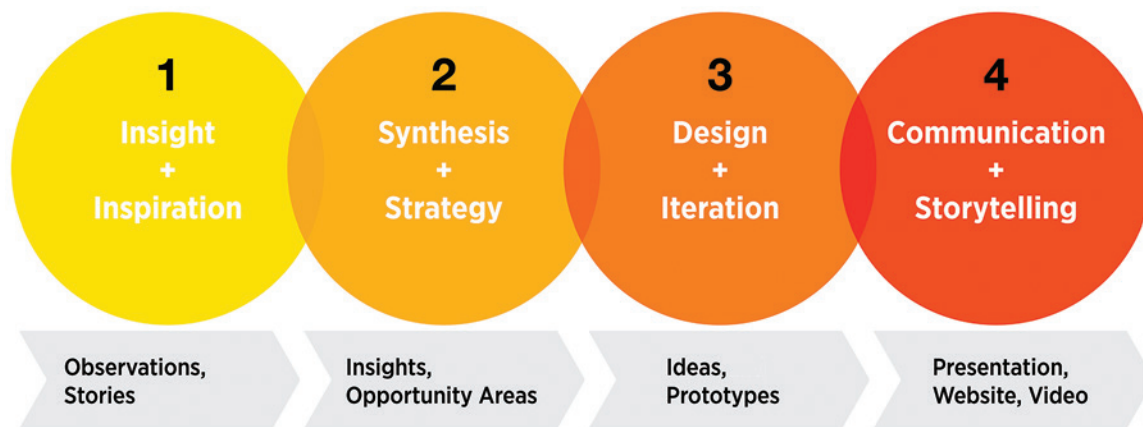


Fig. 2. The four phases of design thinking.

Team members are “T” shaped. Have a depth, or **expertise**, and a breadth, or **adaptability**.

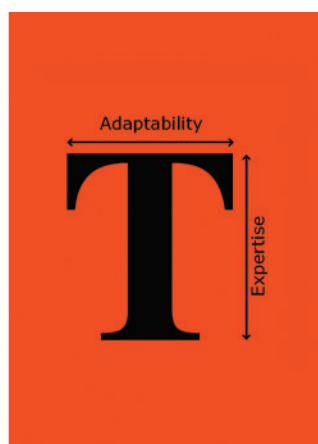


Fig. 3. A design thinking team.

they receive input directly from consumers and can more fully integrate those insights into the design phase. Working with team members from marketing and consumer insight disciplines during the design and iteration phase can help build empathy and understanding concerning technical constraints as the design is developed. Furthermore, involving team members from different parts of an organization at the start of a project creates ownership, resulting in a more closely aligned team.

Design Thinking Builds Empathy (Especially for Food Scientists)

Building empathy for the people involved (consumers, customers, and key stakeholders) is the heart of the design thinking process. Design thinkers strive not only to listen to what people say and watch what they do, but to also go a level deeper and seek to understand how people feel and what they think. This desire to empathize with consumers is particularly critical because consumer attitudes toward food are changing. In the grain category, there have been significant changes in the purchase and consumption of grains and, in general, carbohydrate-rich products such as breads, breakfast cereals, etc. With these changing attitudes and the emergence of new technologies, ingredients, and products, it is even more important to understand the attitudes and perceptions of consumers and to identify the opportunities that exist. For food scientists, engineers, and developers, it is often tempting to educate consumers about their misperceptions. With the recent waves of “low-carb, high protein” consumption that have followed trends such as the South Beach and Atkins diets and, more recently, the Whole30 diet, consumers

have a variety of opinions about carbohydrate-rich foods (e.g., breads, pastries, pasta, pizza, etc.). In these moments, however, the opportunity is not to correct consumers but to seek to understand why they believe what they believe, who or what is influencing them, and what new opportunities exist because of their beliefs. Today the marketplace is filled with a much wider variety of whole grain products, gluten-free alternatives, and ancient grain-based products, in addition to traditional products; clearly the food industry is leveraging new consumer behaviors and opinions.

Sometimes consumer behavior is more emotional than rational, especially as it pertains to food. As an example, research was conducted with consumers concerning breakfast. In the past, breakfast commonly consisted of ready-to-eat breakfast cereals and milk, toast, frozen waffles, and other prepared-at-home items. However, the frequency of consumption of these items for breakfast has been changing in recent years. When discussing breakfast, many consumers explained that they did not have time in the morning to prepare traditional foods. In some conversations, consumers said that they would leave the house and purchase their breakfast from a fast-food chain drive-thru or at a coffee shop.

It is clear that it takes less time to prepare ready-to-eat cereal or toast at home than to drive to a restaurant and purchase breakfast. The empathetic design thinker observed, however, that these consumers felt very differently about these two moments, and their perception of time spent was not solely quantified by actual time spent. Five minutes at home eating breakfast cereal or waiting for bread to toast was less desirable than ten minutes spent driving and waiting in a drive-thru line for a warm breakfast sandwich and a coffee. The design thinker saw these tensions and perceptions as opportunities to design differently. For example, what advantages of the drive-thru experience could be created in the home? How could the current stress points of preparing breakfast at home be addressed? How might food preparation time in the morning be rethought?

Consumers are more engaged than ever in their food choices, and developers, manufacturers, and researchers must understand the “why” behind their choices in order to create new and meaningful products. By spending time with consumers in their homes, workplaces, and grocery stores, the design thinking team can build empathy for consumer choices and integrate this understanding into the design, formulation, and commercialization of new products.

In addition to empathizing with consumers, understanding the needs of customers such as retailers and key stakeholders is

critical to the success of any new initiative. The design thinking process includes “looking in” interviews and observations that look into an organization and understand the desires of key decision makers, as well as looking into the needs of purchasing and retail customers. By taking this additional step early in the innovation process, these viewpoints can be addressed when creating the strategy, designing the product, and telling the story of the process.

Design Thinking Evolves Ideas from Good to Great

Although speed to market is often one of the biggest challenges of product innovation, the design thinking process allows time for ideas to incubate and grow during its design and iteration phase. By creating space in the innovation timeline, teams are given the time to evolve their ideas based on qualitative, iterative feedback from internal team members or external consumers and through building-to-think experiments, using rough and rapid prototyping.

Qualitative, iterative feedback can be obtained by showing consumers rough sketches or early, low-fidelity prototypes. When the resolution of ideas is kept low, consumers recognize that an idea is in development and often feel more comfortable suggesting changes rather than giving validation-type feedback. In an ideal feedback scenario, ideas are shown to consumers in their homes to elicit contextual feedback, with the option to pantomime or role play with the rough prototype. Such in-context sessions identify realistic constraints and scenarios that might not otherwise be considered during the development process. This feedback can be used to conduct additional brainstorming on ideas with both constraints and consumer needs in mind.

By spending time evolving and optimizing ideas, the team can better design products for success in the market, as well as for success in quantitative testing, which is often a key hurdle prior to product launch. This iterative step may be skipped by teams who are pressed for time or whose excitement and momentum move the process forward quickly. In skipping this step, however, teams run the risk of taking an idea forward before it is ready, which often results in the need to take additional time to redesign or react to less than desired quantitative outcomes. In a worst-case scenario, good ideas fail to make it to market entirely or launch with poor results because they were not given enough time to evolve and become market ready, wasting the efforts of the team and missing internal goals. Design thinking intentionally creates incubation time to give ideas the best chance for success.

Design Thinking Redefines Food Prototyping to Move Smarter, Faster

Food prototyping typically includes formulation in a test kitchen, lab, or pilot plant and often also includes sensory evaluation. Design thinking introduces the concept of rough and rapid prototyping as a way to build to think and improve ideas quickly without creating formulations or making edible prototypes. Rough and rapid prototyping uses simple materials to make a low-fidelity prototype that approximates the look, feel, size, shape, and packaging for a product in order to help teams think through ideas and improve them quickly without a large investment in time or money. This type of prototyping is especially useful early in the innovation process because it helps uncover important questions that need to be addressed.

As an example, imagine the design challenge of creating a new lunch-box bread product for school-age children. A typical pro-

totyping approach might entail going to the kitchen, choosing or creating a formula, and baking several variations of the items. Questions might ensue concerning the size and shape, taste, texture, ingredients, and nutritional profile of the product. After several hours, you might have several different prototypes of various formulas but likely will not have optimized the sensory attributes of the product. A rough and rapid prototyping approach might utilize something as basic as a modeling compound to create different shapes and sizes. Ingredients like sunflower seeds, poppy seeds, or oats might be pressed on top to approximate a seeded roll, sliced bread, or breadstick. New shapes, sizes, and forms can be quickly made, and questions can be explored concerning size, shape, appearance, ingredients, etc. Mocked-up primary packaging created using sandwich bags might be cut and heat-sealed over the prototype. Secondary packaging might be created using paperboard. The packaging could prompt questions about servings per package, fitting for store shelves, fitting in home cupboards or pantries, sustainability of materials, etc. These rough prototypes could also be placed in several types of lunch bags or boxes to determine which size and shape might fit best; what portion seems most appropriate; children's and parents' expectations for taste, texture, and nutrition; how it might pair with other lunch-box items, etc. In as little as an hour, several prototypes with packaging could be created, enabling the team to raise questions about the idea and more easily make potentially big changes to the idea.

The rationale behind building to think is to model ideas quickly so the end product can be understood more deeply. Rather than positioning prototyping as the high-fidelity production of an idea to its best formulation, it reframes prototyping to be a “designer’s playground,” where ideas can come to life, be questioned, safely fail, and evolve to be great. Rough and rapid prototyping gives teams permission to diverge from the plan and explore while asking tough questions and challenging themselves to create new solutions in a rapid timeframe.

Rough and rapid prototyping also plays an important role in the innovation process for key stakeholders and teams. For key stakeholders, prototyping can introduce an idea at an early stage and generate significant feedback without an overinvestment in time and money. It also helps the development team maintain a nimble and adaptive mindset. As the idea is iterated and refined, prototypes should be made with higher fidelity, including edible formulations. Design thinking introduces prototyping early in the innovation process as a tool to understand and better develop ideas from their infancy.

Design Thinking Uses Human-Centered Storytelling to Help People Connect with and Support New Ideas

Great ideas are key to innovation, but storytelling and communication are equally important steps in creating successful ideas. The fourth phase in the design thinking process focuses on human-centered storytelling, providing the time needed to help both key stakeholders and consumers understand and support new ideas. In this case, storytelling is not just another word for PR or marketing. In fact, it is quite different. Storytelling has three important parts: audience, content, and format.

Human-centered storytelling starts with the storyteller not only considering what should be communicated about a new idea, but critically asking, “Who is the audience and what are they thinking and feeling?” Taking a moment to consider who the audience is, whether it is a consumer, senior leadership team, or university department chair, gives the design team the oppor-

tunity to tailor their communication so they truly connect with their audience. Human-centered storytelling takes people's perceptions, misperceptions, priorities, and values into account when preparing to communicate a new idea. This strategy includes asking questions. Who is this for? What do they care about? What will they think about this idea? What burning questions might they have that must be answered immediately? Taking the time to frame the story for a specific audience and their needs and desires is essential in order for them to hear the story, connect with it, and ultimately support it.

Storytelling is not storytelling without great content to share, but how can content be shared in an engaging way that enables the audience to understand and receive the message? In his interview about storytelling, Ira Glass, executive producer of *This American Life* and master storyteller (1), discourages storytellers from writing in the style people were taught in high school, using a topic sentence and supporting points or facts, but instead to be constantly raising questions and answering them with your story. It is easy to become a "PowerPoint robot," using a template and falling into a pattern of presenting that may not communicate your ideas effectively and connect with the audience. Asking key questions can help focus the story. What is the big idea? What is the problem the idea is solving? What is the one thing the audience should remember? Asking how the audience should feel throughout can help provide structure for the story. Human-centered storytelling encourages the storyteller to think about communication and create a story arc. Stories from literature, such as Shakespearean tragedies or classic fairy tales, often use story arcs to engage the audience's emotions. Should the audience feel concerned, impassioned, or anxious? Should the big idea help them feel relieved, excited, or empowered? What questions should the story raise, and how can it answer them? Taking a question-based approach, you can create a focused and compelling story.

The third element of human-centered storytelling is the format—whether the story should be shared as a digital presentation, video, website, hands-on demonstration, etc. Once the audience and the content are identified, a format can be chosen to deliver the story most effectively. Several questions can be asked to aid in choosing the best format. What format would be most effective for the type of content? How does the audience prefer to receive information? Will the story be retold to others? The typical default format is a digital presentation, but in some cases the audience may be more receptive to a hands-on demonstration or to a more informal conversation. In one such example, a key stakeholder at a company was known for disliking long sets of digital slides and wanting to know the outcome as quickly as possible. The team recognized this and reframed their presentations to put the outcome in the first few slides, minimizing the total number of slides and creating a hands-on demonstration

when possible. In another scenario, a team successfully presented content in person to key stakeholders who wanted in-depth detail but found that when others shared the slide presentation, extended team members did not always take the time to read the entire presentation. In this situation, the team began to make 1–2 minute videos to accompany the slide presentation. These videos shared important highlights and could be easily shared throughout the organization. Those seeking more detail could read through the digital presentation. In both cases, the presentation format and preferences of the audience affected the way the content was received. Taking a human-centered approach to crafting your story can positively impact the support and adoption of new ideas.

Conclusions

The design thinking innovation process is well suited for food and beverage development, including grains, because of its focus on understanding the changing needs and desires of consumers, as well as key stakeholders and customers, and its primary objective—designing solutions to meet those needs. Design thinking challenges traditional food innovation practices with its human-centered approach and a building-to-think mindset, which is all in the service of creating meaningful and relevant breakthrough innovations.

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Good Health to All: Retail's Biggest Opportunity

Wendy Liebmann

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For more than two decades, we at WSL Strategic Retail have conducted proprietary quantified research called How America Shops®. Our objective in doing this research is to help our clients anticipate market changes that are emerging and how they will impact their businesses—be they manufacturing, retailing, or service industries. Over the last several years, we have closely tracked the attitudes of shoppers concerning their health: how they define being well, what they want and how they want to support their personal and their family's health, and where they want to buy these products. For those in the grain and grain-based industries, as well as those in U.S. industries at large, this is a macro trend that will provide significant growth opportunities for both the near and longer term.

Shifts in Consumer Attitudes toward Health

We first noted shifting attitudes toward health as the American economy was coming out of the recent global recession. These shifts were grounded in the changing values of American consumers: their drive for a better quality of life, more financial control, less stress, and greater well-being. Prior to the recession, Americans defined themselves much more by what they owned. "I Shop, Therefore I Am" was the title of one of our How America Shops studies in the early 2000s. For nearly two decades, from the late 1990s until global economies collapsed in 2008, American shoppers defined themselves by the brands they bought, the neighborhood in which they lived, and the car they drove, with little regard for the financial implications. By the second decade of the 21st century all that had changed. In 2014 How America Shops published a study called "The American Dream Reimagined," in which we first noted the emergence of new values. Although buying their own home was still at the top of Americans' lifestyle priorities lists, saving money and being smarter shoppers had moved up to numbers two and three on their lists. By 2016, the message that clearly resonated from consumers was that their focus had definitively changed. They were now (and are still) focused on what we termed "buying happiness," which was clearly reflected in their new purchasing desires.

It is important to recognize that this is where the new wellness movement began to take root. One of the reasons more and more Americans are immersed in the idea of health and wellness is because it supports their new value system. This is not a "here today, gone tomorrow" trend. It is grounded in a fundamental shift in how people want to live their lives.

Coming out of the recession Americans began to recognize that being healthy is both an economic imperative and a social proposition. "Economic" because of the cost of health care. In addition to the costs of seeking treatment and getting better, being sick often means there is an increased risk of being out

of work. "Social" because being well often means having a better quality of life.

It was at this point that Americans, as a broader group, began to read ingredient labels more closely, drink fewer carbonated beverages, eat less sugar and more organic or healthier foods, stop smoking, and get a little more exercise. For many, it was about being "a little less bad." For some, it became a passion.

This widespread interest in health has driven the growth of organic produce sales at retailers ranging from premium-priced chains such as Whole Foods to more affordable supermarkets such as Albertsons and Aldi. Water, vitamin drinks, smoothies, and herbal teas began to erode the carbonated beverage market, and healthier food options appeared at fast-food chains such as McDonald's. Probiotics and at-home health devices have become hot new health categories as well—new nutritional supplement brands such as Olly now abound among retailers, from big box discounters to drug stores.

Americans also began to look for ways to make their lives less stressful. Nine in ten women in our How America Shops survey said that simplifying their life has become imperative to their future wellness and their families' wellness too. The top five ways women said they were accomplishing this goal were through easier meal preparation, using simpler beauty products and routines, buying simpler products instead of those with inexplicable formulas, shopping more efficiently, and spending less time on social media—or at least trying to.

New Health-Related Business Opportunities

The chaos of 21st century life has created many new health-related business opportunities. One emerging opportunity is the American quest for energy. I don't mean energy as in gas and oil, but rather the energy required for everyday life. The two top barriers to good health today, as identified in our research, are stress and lack of sleep.

Being rested and physically fit translates into more energy, which is what shoppers tell us they want most and achieve least. Seven in ten shoppers tell us energy is a priority, yet only four in ten say they achieve it. The second key to overall health is a healthy mental outlook. Two-thirds of shoppers say it is a priority, but only four in ten say they achieve it. In addition, there is the "look of health": four in ten say it is a priority, but only one in four say they achieve it.

Many of the latest business success stories are grounded in addressing these gaps. Casper, a mattress company that has disrupted traditional mattress sales, offers a solution to better sleep and less stress, all at the same time, with its "one perfect mattress," easy delivery, 100 nights satisfaction guarantee or free return, affordable prices, and whimsical messaging. Since its initial success, it has expanded into healthier (breathable) bed linens and pillows, and a dog mattress (better sleep and less stress for the entire family).

Beyond mattresses, meal delivery services and meal kits such as Blue Apron and Go Fresh are now abundant in the market to



Energy is a priority;
only **40%** say they achieve it.



Healthy Outlook is a priority;
only **40%** say they achieve it.



Look of Health is a priority;
only **25%** say they achieve it.

Source: WSL How America Shops® 2017 Redefining Wellness for All, Base: Women | Copyright © 2018 WSL Marketing Inc.

Consumer priorities for promoting health and wellness.

Who is Trusted for Health Advice



Source: WSL How America Shops® 2017 Redefining Wellness for All, Base: Total Population | Copyright © 2018 WSL Marketing Inc.

Sources trusted by consumers for advice on health and wellness.

make people's lives easier and healthier. There are also health subscription services for vitamins (e.g., Wellpath and Care Of) and oral care (e.g., Cusp) and prescription delivery services such as [Capsule.com](https://www.capsule.com). These are just some of the many business innovations that have emerged.

Broader based opportunities are found in the "look of health" categories—both services and products. For example, health and beauty company Naturopathica offers consultative services, a "vitality bar" with custom drinks and teas, yoga classes, and health and beauty products in its stores and online, while Skin Laundry enables people to receive laser skin treatments in just 15 minutes. Fitness studios, such as Bandier, feature not only exercise classes but also cafés with healthier menus, music, and clothes.

Even department stores are getting in on the movement. London-based Selfridges department store has expanded its athleisure department to include a spa and yoga classes. It also offers an extensive selection of healthy food options in its food hall, including the Detox Salad Bar.

Of course, there is also a health and wellness app for everything, and alternative health and wellness "advisors," such as nutritionists (52% of shoppers surveyed), are beginning to rival pharmacists (62% of shoppers surveyed) as trusted sources of advice. This willingness to look beyond traditional sources and places is driven by a growing distrust of established institutions. Americans are now searching for and comparing products and services to decide for themselves what is best for them, and access to information enables them to do this. This is not to suggest that scientific-based sources are no longer relevant, but it does put increased pressure on companies to be more open about what they sell and say to shoppers.

This willingness to trust "alternatives" has opened the door for smaller companies and more one-of-a-kind artisan products (from breads to sneakers). Niche, personalized, and handmade



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provide insight into consumers, retail, and shopping. Wendy is a recognized speaker, addressing business and educational organizations around the world. She has been recognized by the National Retail Federation as an "Influencer Shaping Retail's Future"; by Women's Wear Daily/Beauty Inc. as "One of the 50 Most Powerful Women in Beauty"; and by the Path to Purchase Institute as "A Woman of Excellence." She is a distinguished faculty member of the Path to Purchase Institute, sits on the board of Cosmetic Executive Women, is vice chair of the advisory board of the Fashion Institute of Technology's master's degree program in cosmetics and fragrance marketing and management, and is a board member emeritus of Women In Need, an organization that helps homeless women and children build productive lives.

products and brands are the latest retail success stories—especially in foods and beverages.

Impact on Business

So, how does all this impact your business? In so many ways. First, the desire to be healthier (if even only a little bit) means that grain and grain-based products have a role to play. The key is to deliver ingredients and products in the ways in which shoppers now want them: with fewer additives and with simple, healthier, and transparent stories that tell shoppers why your ingredients and products are worth their time and money. Recognize too that there is a small but growing number of people interested in more exotic grains (e.g., faro). There is an opportunity to reach these adventurous consumers, but you need to explain what these grains provide and how they can be used—on the package, on the shelf, and in social media. These are educated and passionate shoppers who demand to know why they should make a purchase.

(continued on page 253)

Innovation Inside Ingredient Companies: Opportunities across a Global Supply Chain

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ABSTRACT

Ingredion is a leading global ingredient solutions provider that processes grains, fruits, vegetables, and other plant materials into ingredients that enhance our customers' products. As a supplier to the food, beverage, papermaking, animal nutrition, and other industries, Ingredion is frequently asked to support the overall sustainability strategies of our customers. One of the most common topics of engagement with our customers concerns sustainable sourcing of the crops we purchase to manufacture our products. Implementing a sustainable agriculture program across multiple geographic locations is challenging, and a level of creativity and innovation is required to develop a program that will work, for example, in Thailand as well as the United States. This article focuses on the complexity inherent in developing a global sustainable agriculture program, describes the types of hurdles Ingredion has run into along the way, and highlights how the company was able to start making progress in its sustainable agriculture program through collaboration with our growers around the globe. Key steps for other organizations looking to implement similar programs within their supply chains are also outlined

As a global provider of ingredient solutions, Ingredion seeks to bring value-adding innovation to our customers. Although we normally think of this innovation as it pertains to our products, we sometimes have to think more broadly to stay on top of food industry trends and deliver the innovation our customers want for their businesses. The growing need to produce products from sustainably sourced agricultural crops is one area of increasing interest for our customers. Many of Ingredion's customers, both large multinationals and smaller local companies, have established targets for the crops used to make the ingredients used in their products, requiring that crops be sourced from sustainable agriculture programs. Meeting these expectations across a varying global supply chain provides many challenges, and opportunities, for Ingredion and other suppliers.

The Scope of the Ingredion Supply Chain

Ingredion makes a variety of ingredients from nature-based raw materials that are sourced in many different geographic locations around the world. About 95% of our raw material base is corn (maize), about 3% is tapioca (cassava), and the remaining 2% is comprised from a variety of crops, such as potatoes, rice, peas, and berries. Globally, we purchase crops from growers in more than 20 countries. These different countries often have farming models that are very different from one another. For example, specialty corn is sourced from around 150 large-scale growers in the United States, and corn is also sourced from between 5,000 and 10,000 smallholder farmers in China. This means that implementing a sustainable sourcing program

is not a one-size-fits-all effort for Ingredion's global operations. Although we came to this realization very early in our efforts, determining the best path forward was something that took time and considerable collaboration between Ingredion and our growers. On this journey to increased sustainability, Ingredion continues to explore innovative solutions that streamline the process for us, our growers, and our customers.

Identifying a Path Forward

When Ingredion began its efforts to encourage and support sustainable agriculture among its growers, we immediately faced a considerable challenge—how to satisfy the emerging and varying demands of our customers. Early on we had a considerable number of meetings with our customers to determine the intention of their sustainable agriculture programs (e.g., risk management, consumer marketing, etc.) and whether they used any external standards beyond their own company-specific programs.

After nearly 18 months of discussions and research, we came to the conclusion that many of our large food and beverage customers, particularly those with sustainable agriculture requirements, were members of an organization called the Sustainable Agriculture Initiative Platform (SAI Platform). The SAI Platform was founded by the food and beverage industries, and the development of the program was shaped by the same customers with which we had been speaking.

In 2014 Ingredion joined the SAI Platform, at a time when there were not many suppliers of consumer goods companies on the membership list. SAI Platform membership had a significant influence on moving Ingredion's sustainable agriculture program forward, because it put us in the room with multiple customers at once, giving us the opportunity to discuss the practical applications of sustainable agriculture across a variety of geographic locations. Up to this point, Ingredion's progress had not advanced as much as we would have hoped. By 2015, the company had progressed to sourcing around 225,000 metric tons of crops from sustainable farms. Although this was relatively humble progress versus its overall sourcing volumes, it was a firm step forward and paved the way for Ingredion to start making step-change progress. By 2016 Ingredion's sustainable sourcing volumes had risen to more than 800,000 metric tons. By the end of 2017 nearly 1.7 million metric tons of crops were sustainably sourced (Fig. 1).

Assessing Program Gaps

With the SAI Platform program adopted as Ingredion's global benchmark for sustainable agriculture, the company focused on assessing our growers. This, it turned out, presented different sets of challenges in the different geographic locations from which our crops are sourced. For example, in the United States where Ingredion's specialty-corn growers were already providing detailed traceability data, it was easy to, at least, have discussions concerning collecting additional farm information. The

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growers understood the assessment questions we were asking; however, they questioned the value of the time it would take to provide additional data. This contrasted sharply with smallholder farmers in China, where we encountered issues of literacy, as well as understanding of the concepts in the assessment, such as biodiversity protection. There was also the challenge of how to reach a grower base of 5,000–10,000 farmers with these issues in mind.

Exploring Innovative Solutions

The challenges associated with assessments led to several innovative approaches implemented by Ingredion's agricultural teams, which were already focused on issues such as yield improvements, sourcing needs, and seasonal challenges such as pest management. For example, the Pakistan team took advantage of existing meetings to begin introducing growers to the company's sustainable agriculture program. This allowed the team to engage multiple growers at one time, decreasing the time needed get the effort off the ground with a group of growers. This also enabled Ingredion to identify common grower issues, such as inefficient use of water, which is a highly constrained resource in many parts of Pakistan. The team then worked with Pakistani farmers to introduce and install technology such as drip-fed irrigation systems. This substantially increased the water use efficiency and improved yields by around 30%.

A similar approach was used by growers in Colombia, where the Ingredion team actually helped organize a group of farmer suppliers into a cooperative. By forming a cooperative, the growers were able to leverage their collective size to buy more

cost-competitive seed for planting, and even equipment to help with harvesting. Through the cooperative, Ingredion personnel were able to introduce growers to items such as crop insurance, which had not previously been economically feasible for the smallholder farmers supplying tapioca root.

Perhaps one of the most innovative assessment solutions was launched in the United States, where the Ingredion agricultural team was already working to update the online system utilized to collect farmer traceability data. Working with the software firm MyFarms (www.welcome.myfarms.com), Ingredion personnel tackled the challenges of 1) creating a one-stop platform for growers to provide farm data; 2) minimizing the time spent by growers; and 3) providing additional incentives for growers to share their data. The solution was to integrate sustainable agriculture assessment questions into the background of the online data collection system. The resulting software solutions allow growers to enter data into one Ingredion system, without the need to access the SAI Platform online system, decreasing grower data-entry time from about 45 min to about 7 min/farm. In addition, growers are provided with a report that helps them identify where they might find on-farm efficiencies that could generate further cost savings. This system has been recognized by some customers as a tremendous effort by the company, and one that has the potential to help significantly accelerate Ingredion's efforts.

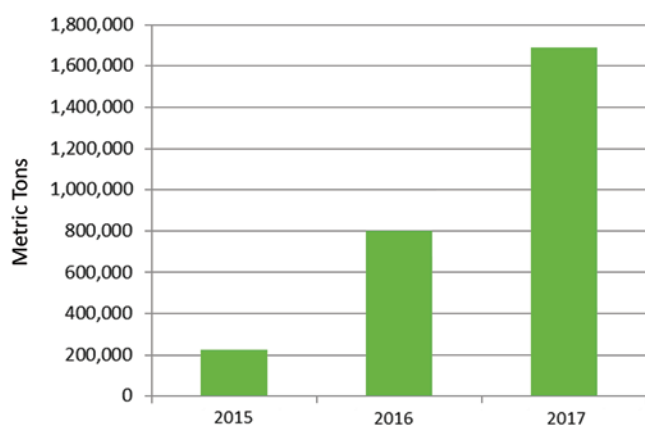


Fig. 1. Progress in sustainable sourcing of crops by Ingredion.



Ingredion agricultural team in Thailand working with local growers, government officials, and universities to help promote the Model Farmer program.



Ingredion agricultural personnel engaging with specialty grain suppliers to better understand their sustainable farming practices.



Ingredion agronomist at work in fields collecting data critical to supporting the efforts of local farmers to improve efficiencies.

Not all innovations that are helping to drive progress across Ingredion's supply chain have come from internal efforts. One of the most impactful and innovative tools we are working with to drive progress has come out of SAI Platform member collaboration. In March 2018, the SAI Platform launched a new tool called Spotlight (www.saiplatform.org/activities/sai-in-actions/spotlight). Spotlight is an online platform that allows member companies to register the areas where they currently have sustainable agriculture initiatives, highlighting any topics of particular interest or challenge (e.g., labor rights, water use, tillage practices, etc.). This tool shows member companies where other members are also working in the same geographic locations and on the same crops. It opens the door to collaboration so that companies can leverage their collective efforts to drive progress even faster.

Lessons Learned

Throughout Ingredion's journey to drive sustainable agriculture practices forward in our global supply chain, we have learned some valuable lessons.

- 1) **Adopt a global program for your organization** – Whether you utilize an existing global standard or create a program in-house having everyone in your organization working to the same standard is important to your success. The use of a common framework by Ingredion has enabled best practice sharing, tracking of progress, and allocation of support or other resources at the corporate level.
- 2) **Train your employees** – Once a global program (benchmark) has been selected or created for your organization, it is important to train all applicable personnel in the elements of that program. This was particularly important for Ingredion's agricultural teams, who were interacting directly with our farmer suppliers, as well as our sales team, which was interacting directly with our interested customers. Business leaders were another important group for us to train, because they help allocate resources for our efforts.
- 3) **Establish year-on-year targets** – In the early stages of our efforts, making progress was very difficult. We put a lot of pressure on our agricultural teams to make progress while trying to empathize when they encountered roadblocks. The problem with this approach was that it did not lead to actual progress. It wasn't until we worked with our agricultural teams and regional business leaders to establish year-on-year goals that we began to see step-change improvements. Having leaders buy in to the targets and internally reporting on the progress was critical to making certain sustainable agriculture was seen as a business imperative.
- 4) **Stay flexible** – Throughout our process we have tried to convey the importance of staying flexible. This may include the flexibility that helps us adjust our programs to meet individual customer needs or the flexibility required

to adopt local sustainable agriculture programs that will help us accelerate our efforts in a specific location. Sustainable agriculture is far from a one-size-fits-all solution that can be replicated and dropped into place in different countries around the world. It requires creativity and flexibility to drive progress and make certain that at the end of the day we are meeting our objective of producing mutual value within our supply chain.



Brian Nash is the senior director of sustainability for Ingredion, a global company operating in more than 20 countries around the world. He is responsible for implementing the company's global sustainability strategy and making certain it resonates with the expectations of its various stakeholders. He has more than 20 years of experience in sustainability and EHS (environment, health, and safety). Brian has a bachelor's degree in chemistry from Indiana University, a master's degree in environmental management from the

University of Findlay, and a master's degree in sustainability leadership from the University of Cambridge. He also serves as a global ambassador for the Cambridge Institute for Sustainability Leadership (CISL).

(Liebmann—continued from page 250)

Second, families want easier meal solutions. Help them save time and take the stress out of planning, shopping, and making meals, not only dinner but school lunches, quick to make and eat breakfasts, and snacks as well. Explain how different grains suit or can be used in different meal occasions, how they can address different health needs, and how easy they are to use.

Third, with an increasingly diverse American population remember that grains play different roles in different lives. Some communities have grown up thinking of grains solely as breakfast cereals. Educate them about how grains can play a broader, healthier role in the diet. Reach out to those who have grown up using grains and grain-based products for any eating occasion. Tell the right story to the right audience, so they know you understand their lives and values. Last, do not just sell ingredients and products, tell people how what you offer will make their lives easier and healthier, and how it is worth the price.

Conclusions

Health, wellness, and well-being will continue to be topics writ large for many Americans. As such, opportunities exist in the development of ingredients, product forms, delivery systems, packaging, and messaging. There are opportunities in every aspect of how you develop and deliver your products and services and, most importantly, how you communicate what you do and how you deliver products to shoppers and the retailers who sell them. View this as a friendly call to action—and fast. May good health be with you.

Incremental Innovation in the Milling Industry: A Panel Discussion

Jayne E. Bock¹ and Jess Sweley²

At first glance it seems oxymoronic to couple innovation and the milling industry. After all, the process itself has changed little over the millennia: milling is the sequential processes of particle size reduction and separation. Our means of achieving the final product have become more efficient with the advent of roller mills and automation, but the core principles have remained the same.

This is, of course, the opinion of outsiders. Few people outside of day-to-day milling operations realize the incremental innovation taking place within the industry. We sent out a brief survey to some of the key leaders in the industry to generate a panel discussion on the innovation taking place within their respective companies. The following is an abbreviated transcript of our discussion. [Click here](#) to read the complete transcript.

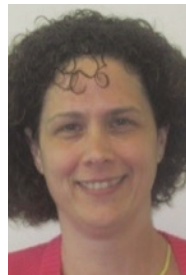
Q. How does your company define innovation? What role does innovation—small or large—play in your company's strategy?

Ruedi Weiss, Director of Sales – Grain Milling, Bühler: Innovation has been at the very center of Bühler's activities for more than 150 years, from the earliest days of mechanized food production to today's ever-evolving digital world. The company invests as much as 5% of its turnover in research and development each year, and works in close collaboration with customers, suppliers, start-ups, and leading academic institutions to continually drive innovation and help meet its ambitious sustainability goals.

Jennifer Robinson, VP Corporate Quality Assurance, Bay State Milling Company: At this time when consumer needs and demands are changing faster than ever, driven by the availability of information and technology, innovation is incredibly important to Bay State Milling. We look at innovation as a means for us to stay ahead of those changing needs, while adhering to our strategic intent of powering the next generation of plant-based foods that offer healthful and affordable choices for consumers. We believe that all employees have a role in innovation at Bay State Milling, and we foster a culture where people have the freedom to bring ideas to the table.

Kent Juliot, VP Research, Quality and Technical Services, Ardent Mills: Innovation plays a large role in our strategy at Ardent Mills. It's in our DNA and a key part of our vision. Innovation is expressed in many areas at Ardent Mills, such as 1) side-by-side customer collaborations to bring new products and right solutions to the marketplace; 2) traditional breeding and genetics programs; 3) R&D and culinary explorations of

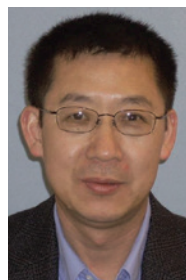
Panel Members



Janice Best
Director of Product Development and Technical Services Canada, Ardent Mills



Kent Juliot
VP Research, Quality and Technical Services, Ardent Mills



Gang Guo
Director of Wheat Research and Quality, Ardent Mills



Jennifer Robinson
VP Corporate Quality Assurance, Bay State Milling Company

Angela Ichwan
Senior Director and Technical Lead, The Annex by Ardent Mills

Ruedi Weiss
Director of Sales – Grain Milling, Bühler



Laurie Scanlin
R&D Culinary Manager, Ardent Mills

new ingredients; and 4) novel operational and food safety improvements internally and with vendor partnerships.

Q. What mind-set or attributes tend to characterize successful innovation in the milling industry?

Jennifer: The mind-set that helps drive success for us is not confining ourselves to the limits of the milling industry. We also remind ourselves that we are an agriculture-based company, and we look to the seeds that drive agriculture for sources of innovation, in addition to processing technologies. At the end of the day, everything we do is for customers and consumers, and we always consider their voices in our innovation work.

¹ Wheat Marketing Center.

² Conagra Brands.

Kent: Our core values help us bring our vision to life every day, enabling us to make a positive impact on our customers, communities, team members, and partners. We stay relentlessly curious about people, how things work, and the environment. Ardent Mills team members are constantly learning, reinventing, and challenging ourselves to do better.

Q. Do you have any examples of how incremental improvements or operational enhancements at your company have led to improved business performance?

Jennifer: We recently conducted our second Cultivating Excellence Awards celebration. Annually, the various Cultivating Excellence teams from across the organization submit their completed projects for award consideration in four categories. We have seen the projects progress in sophistication and delivered results as our associates apply more of the Lean Six Sigma philosophy. Some examples of incremental improvements and operational enhancements that have led to improved business performance include

- Year-over-year reduction in packing costs across the company.
- Significant improvements in yield in one facility where the team linked Six Sigma techniques with the art of milling.
- Use of Six Sigma tools by a team to reinvent our commercialization process to significantly improve the speed of delivering a new product to the customer.
- Reinvention of the sales funnel by our sales organization to decrease the amount of time from potential customer status to purchase order.
- Use of tools at one facility to accomplish “zero landfill waste,” which achieved community recognition.

Angela Ichwan, Senior Director and Technical Lead, The Annex by Ardent Mills: It is our goal to have an innovation culture in which innovation can come from any level of the organization—to have employees looking for incremental improvements and enhancements in our everyday tasks. This has resulted in improved overall equipment effectiveness (OEE) at each of our community mills.

Q. How do you measure the input, workflow, and output of innovation in your company? What does the process of innovation look like in your company? What are some of the key indicators that you have utilized and found successful for measuring innovation?

Ruedi: Investment needs, revenue (or savings) generation, and jobs creation are the key indicators for measuring innovation within Bühler. [Our strategic partnerships] alone have so far raised more than US\$2 billion, generated more than US\$900 million in revenue, and created more than 65,000 jobs.

Laurie Scanlin, R&D Culinary Manager, Ardent Mills: A key indicator of success is based on our customer's success. If our customers succeed with innovation, and we are able to bring our customers innovative grain-based solutions, then we succeed. Internally, we prioritize projects and frequently reevaluate to meet our customers' needs.

An area that is tied closely with innovation is our capital expenditures. It has a linear path of scoping, approval, installation, and measured outcomes compared with the initial expectations.

This process requires each part of the supply chain to work together to achieve the expected results.

Jennifer: We use metrics and scorecards to measure success against innovation projects. The final metric is not always revenue based—it may be learning, staff development, or incremental product improvements.

Q. Are there any examples of “disruptive innovation” in milling today?

Ruedi: The key driver of innovation across all sectors is digitalization. Bühler sees digitalization as a key enabler and genuine driver of value. When harnessed properly, the potential of digital innovations is immense, not just in dramatically cutting waste, downtime, operating costs, and energy use, but also in improving quality, safety, and productivity and boosting the bottom line.

Gang Guo, Director of Wheat Research and Quality, Ardent Mills: An example of “disruptive innovation” in milling is Ultragrain® High Performance (HP) [flour]. Ultragrain HP is the first in a generation of whole grain flours with baking advantages such as stronger gluten, higher absorption, and improved processing, including baking performance, which results in lower formulation costs. Breads made with Ultragrain HP have the potential to reduce the added vital wheat gluten requirement by 50% or more compared with traditional whole wheat flour for the same loaf volume and performance.

Another example is Ardent Mills SafeGuard Treatment and Delivery System. It is not just a product or a process, it's a proprietary, comprehensive, integrated solution that extends flour food safety assurance from our plant to our customers. It's the only functional flour on the market with up to a 5-log validated pathogen reduction that can be customized based on specific product requirements.

Jennifer: The milling process encompasses a wide array of processes and capabilities, from supply chain management to flour yields and feed deployment. We find innovation in milling by looking to the inputs or the seeds that we mill. HealthSense™ and SowNaked™ are examples of disruptive innovation in milling—delivering nutrient-dense ingredients without changing the milling process per se with HealthSense and enabling less processing and a more sustainable oat supply with SowNaked.

Outside of product development, we have experienced recent success in a collaborative technology application with Perten's doughLAB. The new application allows a customer to receive an aligned rheological value across multiple supply sources, resulting in an elevation for the entire industry. This partnership demonstrates how innovation can be the outcome of taking a fresh look at an existing solution and deploying it in a new way.

Q. How do you view “failure” as it relates to innovation? When is it part of the process, and when is it unacceptable?

Ruedi: Failure is part of the innovative process, but it has to be minimized. To avoid failure, most of our innovative initiatives are developed in phases and pass through several control gates. Such gates serve to validate the business plan behind each innovation. Many projects are rejected, forcing innovation teams to elaborate more consistent plans or to abandon them.

On the Leading Edge in Grain Science

AACC International's Official Approved Methods of Analysis



AACCI's *Methods of Analysis* stand at the forefront of the grain industry. More than 350 methods, spreadsheets and collaborative trial reports have been produced by the 23 AACCI technical committees and are continuously updated online. This, coupled with interactive guidelines, videos, and other enhancements ensures the highest, most consistent standards for your products.

Most recent updates include...

- A new method that contributes to uniform flour production in experimental milling using the Chopin CD1 laboratory mill
- A new method to measure β -glucan viscosity using the Rapid Visco Analyzer (RVA)
- A new visual supplement and procedural guide for determining total (gasometric) carbon dioxide in baking powder
- A new spreadsheet for calculating statistical figures in NIR Analysis
- High-speed mixing rheology of wheat flour using the doughLAB
- A new method to quantify total carotenoid content in cereal grains and flours
- Two new methods to determine gluten content to Codex Alimentarius standard



Janice Best, Director of Product Development and Technical Services Canada, Ardent Mills: If we fail, we want to fail fast and on a small scale. We aim to learn from our mistakes and try not to repeat failures or to invest our resources in projects with low ROI (return on investment). Failing is part of innovating throughout our company and acceptable early in the process. Failure is not learning from failing.

Jennifer: Failure to try is unacceptable. Failure is a means by which people learn, and therefore, it is supported as part of our innovation culture—the earlier in the process, the better. It is often said, “Your first loss is your best loss.” Lessons learned, pick up, and move on.

As the industry has been dominated by a number of acquisitions and consolidations over the past several years, traditional millers are endeavoring to find their niche in the cereal world. Searching out new ways to do things has been an integral part of Bay State Milling for 119 years, which is a credit to the acceptance of risk and consequences through five generations of family ownership.



Jayne E. Bock is the technical director at the Wheat Marketing Center and an adjunct professor at the University of Guelph. Her expertise is in grain and flour quality, gluten structure-function, and the influence of bran on product structure and quality in whole grain products. She has worked extensively with wheat breeders, agronomists, millers, and food processors on multiple collaborative projects in these areas. Her current work is at the interface of academia and industry, finding solutions for emerging issues in the milling and baking industries. Jayne earned her B.S. and M.S. degrees from Kansas State University and her Ph.D. degree from the University of Wisconsin-Madison. Jayne is an AACCI member and can be reached at jbuck@wmcinc.org.



Jess Sweley is the vice president of research and development at Conagra Brands, where he is responsible for the company's product development and culinary teams. He has worked in the food industry for almost 20 years in various positions at Frito-Lay, Kraft, and TreeHouse Foods, prior to his current role at Conagra. Jess holds both his B.S. degree in biological systems engineering and Ph.D. degree in food science and technology from the University of Nebraska and is also a graduate of the Masters of Engineering Management program at Northwestern University. He serves as an adjunct faculty member in the Department of Grain Science & Industry at Kansas State University.

Keeping the Lines of Communication Open— How to Make Science Alluring

Lin Carson¹

BAKERpedia, Portland, OR, U.S.A.

Where have all the customers gone? The lines forming behind traditional media forms (e.g., TV and print) are growing shorter, while consumers are flocking in masses toward digital media sources for information. As a result, the ways in which content is created and marketed are shifting as well.

How will this shift change the face of science-based industries? As the numbers show, digital media is growing rapidly and cannot be ignored. In 2005, 5% of U.S. adults had at least one social media account, according to the Pew Research Center. Fast-forward 13 years, and the percentage has risen to 69% (Fig. 1).

Even when broken down by platform, the number of users is up across the board:

- **LinkedIn:** From 37 million users in January 2009 to 500 million users in April 2017 (source: LinkedIn).
- **Facebook:** From 197 million users in January 2009 to 2.196 billion users in June 2018 (source: Facebook).
- **Twitter:** From 30 million users in January 2010 to 336 million users in June 2018 (source: Twitter).
- **Instagram:** From 90 million in users in January 2013 to 1 billion users in June 2018 (source: Instagram).

Surveys indicate it is not only millennials who are tipping the scale toward social media. In 2017, Facebook reached more than 80% of U.S. adults in groups 18–29 and 30–59 years of age and 67% of those over 60 years of age (Fig. 2).

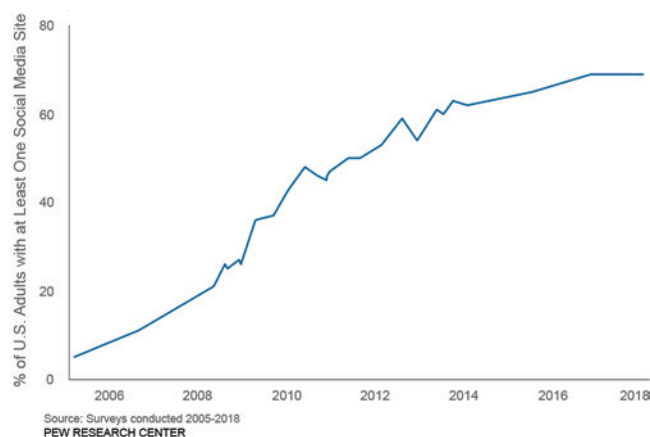


Fig. 1. Increase in number of U.S. adults who have at least one social media account (2005–2018).

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This cultural shift becomes even more significant when the amount of time spent on social media is taken into account. The “2016 Nielsen Social Media Report” revealed that adults spent 25 hours and 7 minutes on media, and 22% of that time was spent on social media—a 36% jump from quarter 3 of 2015 (8).

Digital Advertising

A growing digital audience means advertising opportunities are growing as well. Digital advertising sales have grown by 38% over the last two years (2016–2017), while traditional advertising (e.g., TV, radio, print, etc.) decreased by 7.1% (5). In 2017, for the first time, more money was spent on Internet advertising than on TV advertising (9).

If Everyone Is Running toward Digital Media, How Do You Get in Front?

Selling information in the information age takes a fresh approach. The floodgates are open, and sorting content is in the hands of the consumer. All the seller can do is package content in a way that stands out. As viewership on Netflix and other streaming services surpasses cable and broadcast TV viewership (1), consumers are increasingly accustomed to selecting and controlling the flow of information they receive. A few proven techniques for successfully grabbing the attention of consumers include keeping it short, keeping it visual, and keeping it real.

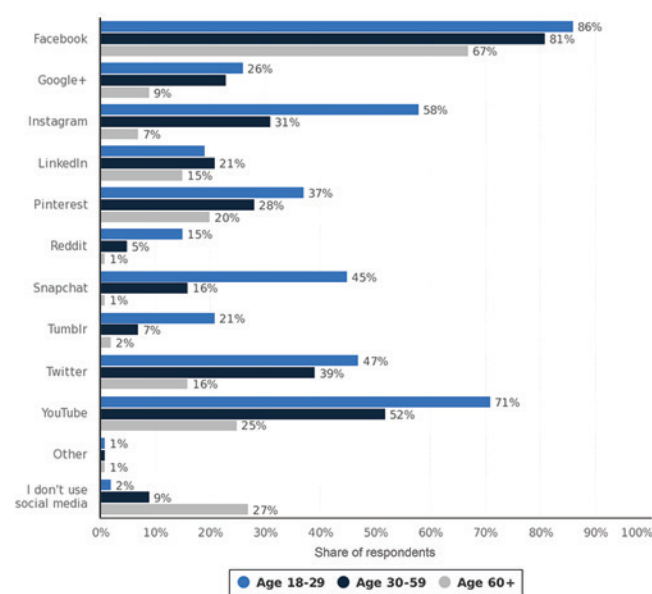


Fig. 2. Reach of selected social media networks in the United States as of February 2017 (by age group).

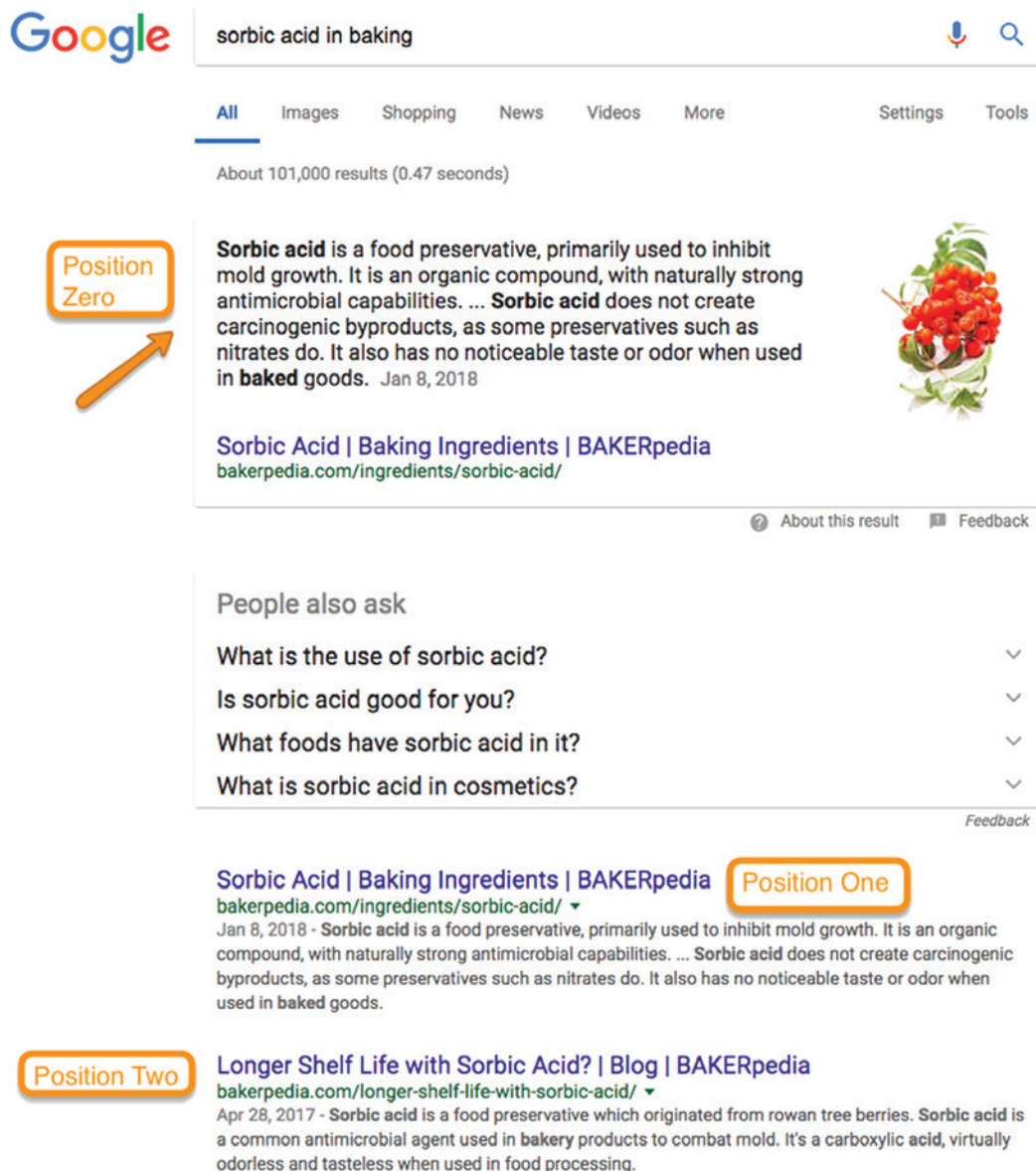


Fig. 3. Sample Google search engine result page (SERP) for “sorbic acid in baking” showing the impact of successful utilization of search engine optimization (SEO) techniques.

- **Keep It Short.** Even in the early stages of the migration toward digital media, research showed that less is more. One study revealed online readers scan web pages, reading only 20–28% of the words (7). Readers have more choices, so if they don’t instantly find what they are looking for, they keep searching until they find something better.
- **Keep It Visual.** What’s the best way to cover a lot of information with just a few words? Visual content. Images, infographics, and videos are eye-catching and convenient for sharing. In fact, visual content is shared on social media 40 times more often than all other content (6).
- **Keep It Real.** One survey found that 94% of consumers think they are likely to be loyal to a brand that offers complete transparency (3). This is also key for gaining a high search engine optimization (SEO) ranking. Google favors sites with quality content and backlinks that have a good reputation.

How Does Scientific and Industry-Specific Driven Content Fit into a Digital World?

Scientific content published online can usually be grouped into two main categories: 1) long-form scientific papers and journals with technically dense writing or 2) short, snappy articles that lack references and are sprinkled with pseudoscience and misinformation. This raises the question—is there space for a successful middle ground? Can scientific writing find a place in a digital world without sacrificing quality?

The BAKERpedia Approach

I had spent more than 10 years in the baking industry when I began to notice a gap in technical information sharing and in reliable, digestible baking information online. I decided to take a stab at filling that gap and launched BAKERpedia with the idea of creating an online technical resource that can spark ideas and innovation. From day one, I made sure our content is user-friendly, as well as scientifically sound. Four years, 700+ website pages, and 6,000+ social media followers later, there are a few tactics to which I attribute our success.

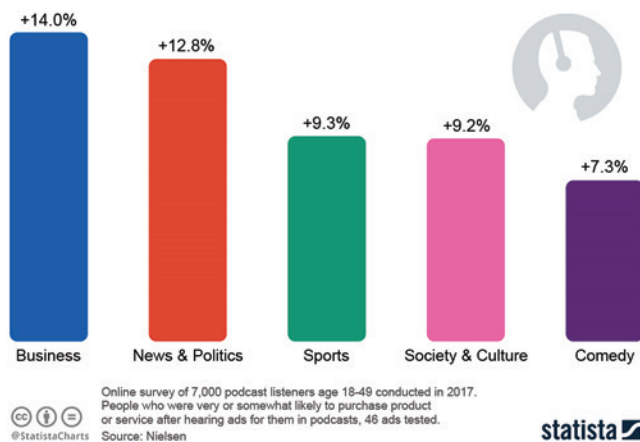


Fig. 4. Increases in consumer purchasing intent after listening to podcasts (by genre).

- **Smart Scientific Writing.** If your job involves any kind of science or technology, you know how exciting it is! When you share it with your consumers, you want that excitement to come across. Keep it short but sweet, conversational but authoritative. Back up your claims but do not overload the reference section. On BAKERpedia pages, we cite only a few of the latest studies and nothing older than 10 years if possible.
- **Own Search Engine Optimization.** SEO for Google is one of the most critical things you can do for your website. Research keywords, build a network of backlinks, and, most importantly, create quality, authoritative content. Many of BAKERpedia's pages are ranked first (at the top) of Google search engine result pages (SERPs) or are included in the featured snippet section. These are free spots and effective promotional vehicles. In Google searches, first position results have a 20.5% click-through rate (4). If you own your SEO techniques, you will own the top spots on SERPs. An example of a SERP for "sorbic acid in baking" is shown in Figure 3.
- **Be Tech Savvy.** Create a strategy for e-mail campaigns, blogging, and social platforms (especially LinkedIn). Social media is more than a place to create a brand. It is also a place to build backlinks and push content; stay up-to-date with media trends; and identify where your audience is and where it is headed. One area BAKERpedia has been focusing on lately is podcasts and voice searches. Why? Because podcast listening and advertising are on

the rise (2), and we don't want to get left behind! Increases in the influence of podcasts on purchasing intent are shown in Figure 4.

A New Normal

Why am I sharing my company's playbook? Because I want these strategies to be the norm. I would love to see more of our industry's companies and websites picking up on these strategies. If you would like to partner and share some backlinks, send me an e-mail at support@bakerpedia.com and let's talk! There is so much potential to reach consumers, attract new minds, and efficiently share our groundbreaking innovations in this digital world. Don't get left behind—embrace digital!

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Spotlight on Clyde Don

AACCI International members each have their own story, and we want to highlight all of their amazing accomplishments. "Spotlights" is a series of individual and institutional member interviews capturing the unique stories of our many volunteers and their journeys with AACCI.



Clyde Don
FoodPhysica R&D Laboratory
Member for 18 years

Q: What is your current position and what type of work do you do?

A: I am the owner/director of Clyde Don Consultancy a sole proprietorship and director of the FoodPhysica R&D Laboratory in the Netherlands. My laboratory is a multidisciplinary contract research lab—we support the R&D of several clients, from start-ups in food and agribusiness to multinationals. Around 80% of our contract research is related to foods and beverages, currently with

growth in research projects on plant proteins, sustainable proteins, and circular economy. About 20% of our business is related to nonfood research, which falls under ChemPhysica, a branch of our R&D lab that supports clients in upcycling waste streams, compostable packaging materials, and green chemistry.

Q: When and how did you first decide you wanted to work in cereal grain science?

A: To be honest, it was not really a decision. In 1997 I started at TNO (some readers may still remember the former TNO Cereals Institute). Initially, I had no clue about TNO's tradition in cereals. My first job was in the Protein & Meat Technology Department. After working on industrial proteins, other ingredients were integrated into my projects because around 2000 our strategy was focused on novel foods, healthier foods, protein allergens, edible coatings, and future product formulating. Gluten became part of my scope in a project to expand the application of gluten proteins. Concurrently, a TNO fund on gluten proteins became available. The fund was for a project with scientific merit; publishing papers and delivering a doctoral thesis were the targets. My manager at the time, Martin Hessing, saw fit to allocate this special fund to me, Prof. Rob Hamer was the doctoral advisor, and the rest is history.

Q: How have you been involved with AACCI? How has your involvement with AACCI enriched your career?

A: With the "gluten project" in place, it was suggested that I become an AACCI member. The early years of my membership were focused on presenting, publishing, and discussing scientific findings with my peers. The constructive conversations with experts in the field, such as the late Jerry Bietz, were most helpful. Scientific collaborations with George Lookhart, Finlay MacRitchie, Phil Williams, and Ferenc Bekes all started at AACCI Annual Meetings. Later on, I took on several leadership roles in AACCI Divisions and as Annual Meeting

Track Chair and Chair of the Protein Technical Committee. Currently, I am part of the CFW guest editors team. In short, AACCI enriched me in science, networking, leadership, organizational skills, peer review, and editing.

Q: What types of future innovation do you see in the field of cereal science? How are broader societal and technology trends affecting cereal science and the cereal grain industry overall?

A: Cereals and grain-based foods will always be dominant in a healthy human diet. The topics mentioned at Q2 are still important today. "Future product formulation" is a key phrase directing product innovations such as low salt, low sugar, low FODMAP, more fiber, free from, gluten-free, natural ingredients, etc., etc. At the same time, future formulation addresses human health, sustainability, quality, and consumer acceptance. With a growing population and a continuing trend toward eating less meat, we need the grain industry to provide nutritious food products. Society is concerned about health, authenticity, safety, and sustainability. Cereal scientists are seeking innovative solutions to address these concerns, using multidisciplinary approaches and connecting the innovation chain from seed to food.

Q: This issue of *Cereal Foods World* focuses on innovation through the value chain. Do you have any perspectives on this topic?

A: Cereal scientists are well adapted to face future challenges in the food innovation chain. Including the value chain is a prerequisite for motivating industrial partners to invest in private and public research programs. Public-private initiatives especially, such as in the Netherlands, have proven to be a powerhouse for delivering food innovation throughout the value chain, showing that fruitful and impactful collaboration among industry, private/institutional labs, and academia is the way forward.

Q: What's next for you?

A: Next year will be the 10th anniversary of FoodPhysica. A plan for a festive symposium is in the making. We are also celebrating ongoing laboratory expansion plans to deliver more contract R&D services to our clients. Answering the questions in this member spotlight made me realize how time has flown past. Over the previous 10 years, my research activities have diversified into areas other than cereal science, and this will probably continue over the next 10 years. Nonetheless, AACCI has played a role in enlarging my network and improving my skills to become a successful consultant, independent scientist, and lab owner.



Katharina Scherf
Leibniz-Institute for Food
Systems Biology, TUM
Member for 7 years

Q: What is your current position and what type of work do you do?

A: I am head of the Functional Biopolymer Chemistry research unit at the Leibniz-Institute for Food Systems Biology at the Technical University of Munich (TUM) in Freising (near Munich), Germany. Our research focuses on the multidisciplinary investigation of relationships between the structure, functionality, and bioactivity of cereal proteins and utilization of these insights to improve food security, quality, and safety. One key

area is focused on studying celiac disease, non-celiac gluten sensitivity, and wheat allergies. In my work, I supervise undergraduate and graduate students, teach courses in food chemistry at TUM, write scientific papers, devise new project proposals, lead several research projects, and am active in a variety of national and international advisory boards and committees.

Q: When and how did you first decide you wanted to work in cereal grain science?

A: As a Ph.D. student at the Chair of Food Chemistry and Molecular Sensory Science at TUM, led by Prof. Thomas Hofmann, I developed novel strategies for salt reduction in bread and worked on elucidating fundamental mechanisms of texture-taste relationships. My interest in cereals deepened during a research stay at the Cereal and Beverage Science Research Group, led by Prof. Elke Arendt, at University College Cork in Ireland. When a position as a research scientist in cereal science became available at the Leibniz-Institute in the group of Prof. Peter Koehler, I took the opportunity to pursue this path further and look into the complexity of cereals at all stages—from the grain to the bread. As one of the most fundamental components of the diet in Western countries, bread is a topic that generates huge consumer interest, especially as it relates to flavor, health nutrition, and well-being.

Q: How have you been involved with AACCI? How has your involvement with AACCI enriched your career?

A: My involvement with AACCI started when I was a finalist in the Best Student Research Paper Competition at the 2012 AACCI Annual Meeting in Hollywood, FL, where I won third prize. Soon after, I was asked by Dr. Clyde Don to become secretary-treasurer of the Protein Division, where I had the great opportunity to work with the other officers to increase the visibility of the division, organize scientific sessions at the annual meetings, and invite members to join. I took the lead in the Protein and Enzymes Technical Committee and was invited to become a member of the Annual Meeting Technical Program Planning Team in 2014. The exciting journey to becoming the 2018 Program Planning Team Chair had started, and I had the unique opportunity to organize the scientific content for the first-ever AACCI Annual Meeting held outside of North America. Especially when looking at the previous recipients, it was a great honor for me to receive the prestigious Young Scientist Research Award this year. Being involved in AACCI allowed me to take on leadership roles quite early in my career and offered the opportunity to meet many

new faces from both academia and industry—many of whom have become friends. My extensive network of collaborators grew through AACCI to a great extent and attending the AACCI Annual Meetings was like coming home to a huge family of all those concerned with cereals.

Q: What types of future innovation do you see in the field of cereal science? How are broader societal and technology trends affecting cereal science and the cereal grain industry overall?

A: Cereal science is such an exciting field to be working in, as it is highly relevant for sustainability, biodiversity, health, nutrition, product innovation, and food safety, quality, and security. Among technology trends, big data, industry 4.0, and traceability are transforming the cereal grain industry. These again pose new challenges, like data ownership and how data can be used in such a way that all players will profit equally. Societal trends include increasing consumer mistrust of the food industry combined with a desire for healthy, sustainable, regionally sourced, and individualized food products. This is an important area where cereal science needs to play a fundamental advisory role in communication and consumer education to help understand consumer preferences and improve consumer acceptance, while addressing consumer needs.

Q: This issue of *Cereal Foods World* focuses on innovation through the value chain. Do you have any perspectives on this topic?

A: One of the topics we are working on in my research group is the optimal gluten composition for different end uses, including extrusion, proofing interruption, and lamination. The idea is to develop tools to be able to predict breadmaking performance as early as possible. To achieve innovation through the whole value chain, it is critical to take everyone along and make sure that everyone involved talks to one another and understands the needs of the other participants and vice versa. One interesting example was when two wheat breeders argued that meaningful results cannot be derived from 60 wheat samples in total, whereas the food technologists argued this was the maximum number of samples they could run on their equipment in a reasonable timeframe. Bringing these two very divergent views together was challenging, but at the same time valuable, because there are so many different angles and ways of approaching questions.

Q: What's next for you?

A: First of all, I'd like to say that it was great to feel such a vibe of excitement at the 2018 AACCI Annual Meeting in London, because there were so many excellent scientific talks, new faces, inspiring keynote presentations, and networking opportunities. Now I am open to new challenges. My research area on wheat hypersensitivities opens up so many doors across the whole value chain—from plant breeding to plant genetics, bioinformatics, food technology, health and nutrition, immunology, gastroenterology, and gut microbiota. With all the media attention that wheat consumption has received in recent years, it will be especially important to regain consumer trust and lay solid scientific foundations to help dispel the many myths and unknowns currently surrounding cereals and cereal consumption.

The Cereals & Grains 18 Story

Jean Storlie, MS, RD
Executive Editor of Cereal Foods World and
President of Storlietelling LLC

Castles, moats, and bridges...

Cereals & Grains 18 in London brought together technical breakthroughs in cereal science with storytelling to put data and analytics into the broader context of major global trends like skeptical consumers, climate change, population growth, and food safety/security. Scientific sessions explored the latest advances in innovation throughout the value chain—from breeding in grain fields to messaging on labels in supermarkets—while participants also explored how to convey their data through stories and storytelling. Bridging logic and imagination, participants learned how to tell cereal stories.

This first AACCI Annual Meeting outside North America assembled more than 600 attendees from 36 countries in London; half of whom were first time attendees. The 2018 Annual Meeting Technical Program Planning Team, chaired by Katharina Scherf, pushed for fresh thinking. They approached this meeting with the overarching theme of Field to Fork, and for the first time, the program was shaped around daily themes. Key experts who are known and respected globally were invited to share their insights on

- Sustainability from Gene to Field (Sunday)
- Safe Ingredients and Quality Products (Monday)
- Formulating for Health and Wellness (Tuesday)

During the general sessions, attendees were also exposed to the storytelling movement, which was introduced in the corporate world in the early 2000s and has been gaining more momentum over the last 10 years. In fact, Nike, a forerunner in corporate storytelling, has had a chief storytelling officer since 1999 (E. Ransell, The Nike story? Just tell it! Fast Company, December 21, 1999). More recently, AACCI members from companies like General Mills and Kellogg's have been trained in storytelling.



View a presentation on the meeting content highlights, recorded by Jean Storlie.



AACCI President Laura Hansen

A storytelling framework helped attendees weave together the scientific sessions throughout the meeting.

To set the stage for the 2018 Story, outgoing AACCI President Laura Hansen, revisited information presented by 2017 keynote speaker Linda Eatherton, managing director and partner, Ketchum Global Food & Beverage Practice, who shared provocative data about the changing consumer landscape. Eatherton revealed some disruptive new truths:

- Consumers fear science
- Science denialism meets "fake news." Consumers don't trust science or the agriculture/food industry
- Science rejection leads to food inspection
- Skeptical consumers trust "Food eVangelists" (self-proclaimed experts) more than scientists!

Eatherton challenged us to communicate with these skeptical consumers in their language—through stories and dialogue.

While skeptical consumers challenge manufacturers and retailers, stressors like climate change and population growth will strain the capacity of the global food system to feed the world over the coming decades. Cereal scientists must innovate more rapidly to address these challenges.

"I found that this meeting gave me an opportunity to learn a lot of what is currently happening in the science world plus passing on some contact details regarding new product or machinery available on the market."



Professor Achim Dobermann

Professor Achim Dobermann, director and chief executive, Rothamsted Research, a leading authority on sustainable management of agricultural systems, led the first 2018 keynote session on Sunday. His presentation, “Leading from an Illustrative Past into a Demanding Future,” offered an aggressive and integrated approach to innovation.

He distinguished the differences between science, invention, and innovation. Innovation, which goes beyond science and invention, is the process by which science and invention are converted into commercially viable products. He asserted that the all-too common occurrence of “excellent science but poor innovation” will be insufficient to tackle tomorrow’s challenges. Doberman offered a model for merging visionary thinking with lean start-up. Rather than testing and refining until near perfection, he urged scientists and innovators to scale up while they build and learn in order to solve problems faster.

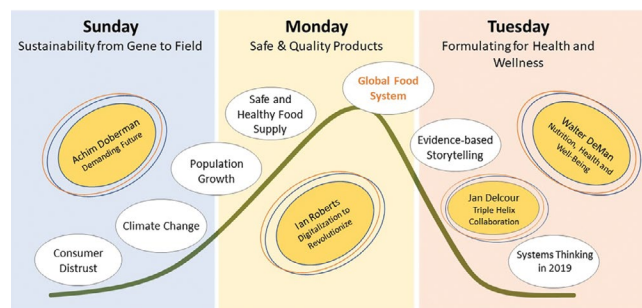


Dr. Ian Roberts

After an exhilarating first day connecting with colleagues from around the world and attending scientific sessions on breeding and sustainable agriculture, attendees gathered on Monday morning for the second keynote session. Dr. Ian Roberts, chief technology officer, Bühler Group, also stressed the impacts of climate

change, but he brought deforestation, free trade, the sharing economy, and food fraud into consideration. Roberts proposed that the grain value chain of the future can be enabled through digital tools, which are accelerating innovation in grain fields through “smart farms” and breeding technologies. Plus, digital tools throughout the value chain are contributing to innovations. With more consumers buying their food online and using smart technology to research their choices at point of purchase, the digital revolution is disrupting the landscape.

The Cereals & Grains 18 Story



Both Dobermann and Roberts pushed attendees to think beyond the traditional bounds of cereal and grain science. These keynote sessions revealed how cereals and grains fit into larger global and societal trends. The range of Monday sessions on Safe and Quality Products provided opportunities for attendees

to delve into the complexity of producing cereal products for a global food supply.

Operating and innovating within the web of interconnected, moving parts that comprise the global food systems will require new types of collaboration and push cereal scientist to find connections beyond traditional partners. Civil engineers will be needed to solve the problem of safely and efficiently transporting food around the world. Solving sociopolitical barriers will require the “soft skills” of influence and persuasion, as well as facts and data. Attendees had opportunities to explore one of these soft skills through an Evidence-Based Storytelling Workshop on Tuesday morning (see 264 for highlights).

“I was inspired by the Keynote presentation given by Ian Roberts from the Bühler Group. The insights he shared to the benefits and challenges posed by the implementation of emerging technologies, such as blockchain, were thought-provoking. This forward-thinking approach is something I am excited to bring back to my workplace.”

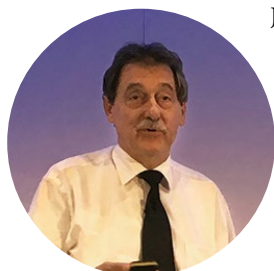
A wealth of valuable sessions on Tuesday explored facets of health and wellness, such as “Processing for Health” and “How to Define Whole Grains.” A provocative symposium on carbohydrate quality and lively debate on glycemic index provided a range of viewpoints on the controversies surrounding the role of carbohydrates in the diet and how to measure the quality of carbohydrate choices.

Cereals & Grains 18 Key Insights...

- “Excellent science but poor innovation” – insufficient to tackle challenges
- Food industry is fertile ground for blockchain use cases
- Think beyond traditional partners/ collaborators
- Soft skills of influence and persuasion = storytelling
- Top-down leadership buy-in + nutrition science expertise = shift in thinking
- Collaboration of government, academia, and industry (triple helix) = solutions/growth
- Explore the future through systems thinking

A dynamic panel discussion on fostering innovation, facilitated by Thorsten Koenig, EIT Food, closed out the Tuesday sessions. The Closing General Session featured two insightful keynote presentations. Walter de Man, global nutrition and science and regulatory affairs director, MARS Food and Drinks, shared one

industry case study on how nutrition can be used as a driver for health and well-being. He illustrated how it took top-down leadership as well as nutrition science expertise to shift the internal thinking within MARS to prioritize health and nutrition.



Jan Delcour

Jan Delcour, professor, KU Leuven, and past president of AACCI, summarized the scientific highlights and proposed the triple helix model approach to innovation, involving collaboration among government, academia, and industry, which is a critical plot point in the Cereals &

Grains 18 story. Delcour argued that one of these sectors alone cannot tackle the challenges of today and tomorrow. Instead, win-win partnerships among these sectors will result in research funding and new consumer solutions, as well as drive economic growth.

"I really liked the open forum concept to discuss key issues."

Incoming AACCI President Maureen Olewnick offered the final lesson from Cereals & Grains 2018 by challenging attendees to explore the future through "systems thinking," which involves integration and collaboration across the globe. In 2019, AACCI will build on the concept of systems thinking. Look for more on this in *Cereal Foods World* and other AACCI programs in coming months.



Maureen Olewnick

"This meeting offered high scientific value."

Special thanks to all the volunteers, from the program team to the session organizers, moderators, and presenters, who made this event such a success. It was a remarkable experience, with a wealth of science and stories to share and from which to learn. Make sure to mark your calendars for Cereals & Grains 19, which will be held in Denver, Colorado, U.S.A., November 3–5.

Why Storytelling? Introducing Evidence-Based Storytelling

Scientists are taught that anecdotal evidence is not valid, and stories are anecdotes. So why did AACCI promote storytelling at Cereals & Grains 18? Evidence-based storytelling conveys the idea that you don't replace data with stories, but rather package data in a story so that facts fall on more fertile ground.

Evidence from the field of neuroscience reveals why stories are transformational. In response to a good story, the brain releases oxytocin, a hormone associated with empathy, compassion, and trust.¹

Simply introducing a set of facts or series of events with the statement, "I'm going to tell a story," does not produce these changes in brain chemistry. The story must include four key elements: character(s), struggle, moment of truth, and change. Simply put, a character encounters an obstacle and during the struggle to overcome it, he/she experiences a "moment of truth" that results in an emotional transformation. When a story is well told, the audience takes the journey with the character and feels their emotions.

Business storytelling is an advanced communication skill that takes training, practice, and discipline to master and use

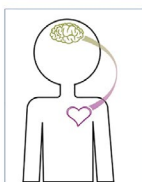
effectively in work settings. Using a three-phase approach, scientists and business leaders can build skills in storytelling:

1. Mine for Story Gems—Look for human angles about your research and technical projects. This phase involves brainstorming for "story gems," which are raw story ideas that have the potential to be developed into a story. Four pathways to find cereal story gems are
 - Inventor's journey
 - People who helped you
 - People who benefit from your work
 - How your work fits into the global food system
2. Develop Plot and Meaning—Use the story plotting visual to diagram the key elements of the plot. Distill down to the key plot points that set the stage, build tension, reveal the "Ah ha" moment of truth, and bring resolution/closure. Clarify what changed for the character during this journey and make sure that your story conveys the new truth.
3. Polish with Salient Details—Describe the setting and develop characters by including sensory details that bring an audience into the setting. Imagine the people and place through all five senses (sight, sound, smell, touch, taste).

Good stories change brain chemistry

- Character-driven narrative
- Struggle against an obstacle
- Emotional transformation

↓
Empathy



Zak, P.J. Why Your Brain Loves Good Storytelling. Harvard Business Review, 2014

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For an example and tools to learn this process, visit the AACCI Continuing Education page (www.aaccnet.org/meetings/continuinged). You will also find an example that shows how a business experience can be turned into a story using the tools.

Reference

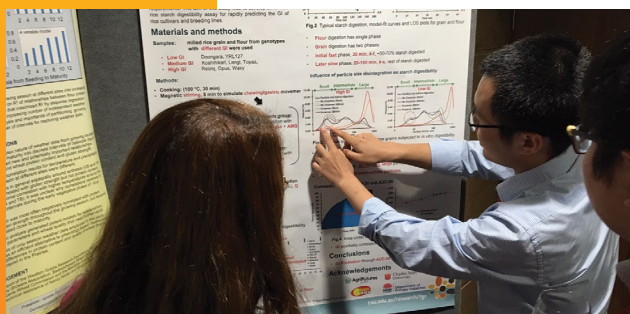
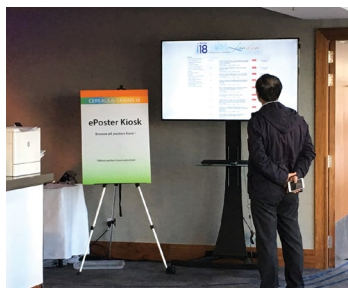
1. Zak, P. Why inspiring stories make us react: The neuroscience of narrative. *Cerebrum* Jan-Feb:2, 2015



Program Chair Katharina Scherf



Jean Storlie



Thank You Program Planning Team

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Leibniz-Institute for Food Systems Biology @TUM

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Shintaro Pang

General Mills

Simon Penson

ADM Milling

Joke Putseys

DSM

Nesli Sozer

VTT Technical Research Centre

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Gregory Vericel

CHOPIN Technologies

Peter Weegels

Sonneveld Group BV

Daniel Wefers

Karlsruhe Institute of Technology

Board Liaisons, Ex-Officio:

Anne Birkett

Kellogg Co.

Christophe Courtin

KU Lueven



Watch a recap of all the action during the meeting, with this photo video!



2018 Technical Committees Report

The AACCI International Technical committees held annual meeting sessions in London during Cereals & Grains 18.

All committees reported active work agendas ranging from proposed new methods to method revisions and method

enhancements. Some committees are undergoing routine member updates and introducing new chairs. The technical committees work on a year-round basis, and all of them will have follow-up conference call meetings in the next three months and continue their work in the online discussion forum. The committees welcome new methods and

guideline ideas and encourage you to contact the Approved Methods Technical Chair to share your ideas.

The technical committees are also working on plans for method training modules. In addition, they have formed a close liaison with

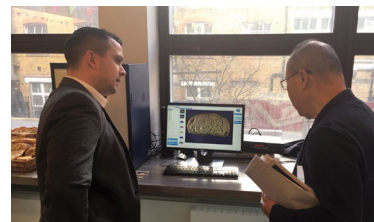
the AACCI Check Sample and Laboratory Proficiency Program. The launch of the new proficiency rating program in July 2018 was reviewed, and several new

series and reference materials are under discussion. Watch for the AACCI webinar series, which provides a general discussion on laboratory data management and evaluations.



Enriched Educational Opportunities

Attendees seeking additional professional education took advantage of a pre-meeting course during Cereals & Grains 18. The onsite Enzymes in Cereal-Based Foods short course welcomed attendees who work as application bakery technologists, cereal scientists, bakery plant supervisors, and quality assurance employees from cereal-based product industries. The workshop was designed in response to enzymes' increasingly important role in the baking industry. It gave an overview on the latest developments in enzyme applications in baked goods via professionals from the leaders of enzyme research and development in the enzyme industry and academia.



Hands-on lab demonstration at the pre-meeting Methods in Action – Practical Baking Quality Workshop

A short tube ride away, participants traveled to the London Southbank University to take part in the Methods in Action – Practical Baking Quality Workshop organized by Calibre Control. The university environment provided the optimal setting for this practical, hands-on workshop. Following the methods through the grain chain relevant to research and professional organizations, three major global manufacturers gathered to present the AACCI Approved Methods.

Another unique opportunity was offered after the conclusion of the meeting – a field trip to tour the oldest continually operating agricultural research station in the world – Rothamsted Research.

Participants were welcomed with an introductory talk on the history of Rothamsted and its contribution to agriculture and an introduction to the wheat program. They were then divided into four groups who rotated through each of the following expertly guided:

- tour of the Broadbalk continuous wheat, planted since 1843 and the Park Grass continuous permanent grassland, since 1856
- visit on the farm to see two of the "Classical" experiments which established the science of plant nutrition
- tour of the automated field phenotyping system complete with a demonstration of drones
- tour of the archive of samples from the classical experiments (dating back to 1843)



Rothamsted's Malcolm Hawkesford explains the Broadbalk Wheat Experiment – running since 1843.

CEREALS & GRAINS 18 EXHIBITORS



The following exhibitors shared the latest products and services available to meet the industry's challenging need for solutions.

Agri-Neo, Inc.
AMETEK Brookfield
Ardent Mills
Avena Foods Limited dba Best Cooking Pulses
Baker Perkins Ltd.
BASTAK Instruments
BENEO Inc.
Brabender GmbH & Co. KG
Budenheim
Buhler
C.W. Brabender Instruments, Inc.
C-Cell
Campden BRI
Carmi Flavors
Cereal Ingredients, Inc.

Cgrain AB
CHOPIN Technologies
DSM Food Specialties USA, Inc.
Edlong
Elsevier
EnviroLogix
FOSS Analytical
FrigorTec GmbH
GlycoSpot
Gold Coast Ingredients, Inc.
Grain Millers, Inc.
Henriette (Flag Shop for The Low Carbohydrate Bread Society of Japan)
ICL Specialty Solutions
Klaus Ruttman GmbH
Lallemand Baking Solutions

Northern Crops Institute
NOVOLYZE
PacMoore Products, Inc.
Palsgaard, Inc.
Perten Instruments AB
Perten Instruments, Inc.
PGP International, Inc.
QualySense AG
Randex Food Diagnostics
REPCO
REVTECH Process Systems
Siemer Specialty Ingredients
Stable Micro Systems
U.S. Highbush Blueberry Council
Wenger Manufacturing, Inc.
Wiley



Reach all segments of the grain science community by reserving a booth at
Cereals & Grains 19 | November 3–5 | Denver, Colorado, U.S.A.

Contact:

Brianna Plank • bplank@scisoc.org • +1.651.994.3819

THANK YOU

CEREALS & GRAINS 18 SPONSORS



WILEY

2018 AACC INTERNATIONAL AWARD RECIPIENTS

Congratulations to AACCI's most prestigious awardees who are being recognized for their significant contributions in the field of cereal grain science!

AACC International Fellows



Marta Izidorczyk
Canadian Grain
Commission



Kristof Brijs
KU Leuven

Thomas Burr Osborne Medal



Kaisa Poutanen
VTT Technical
Research Centre

Phil Williams Applied Research Award



Vijay Singh
University of Illinois

William F. Geddes Memorial Award



Jon M. Faubion
Kansas State
University

Excellence in Teaching Award



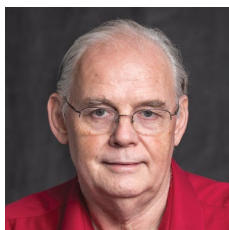
Weining Huang
Jiangnan University,
China

Young Scientist Research Award



Katharina Scherf
Leibniz-Institute for
Food Systems Biology,
Germany

Edith A. Christensen Award



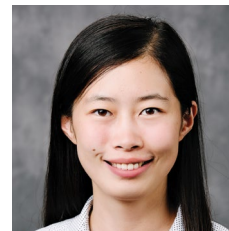
Ray Shillito
BASF Corporation

Texture Technologies Quality Research Award – Best Paper



Jayne Bock
University of Guelph

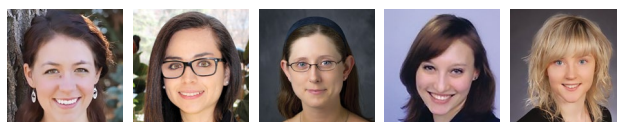
Texture Technologies Quality Research Award – Best Presentation



Fang Fang
Purdue University

Student Competition Winners

Best Student Research Paper Competition



In order of appearance:

First Place, **Emma Jobson**, Montana State University
Second Place, **Ana Maria Magallanes Lopez**, North Dakota
State University
Third Place, **Leigh Schmidt**, Purdue University
Finalist, **Sabina Jakobi**, Technical University of Muni
Finalist, **Anke Boeswetter**, Technical University of Muni

Student Baked Product Competition Awards

Core Breakfast Bar – London Southbank University – Best
Overall, Best Taste & Texture
QuickStick – Università degli Studi di Milano – Most
Nutritious, Overall runner-up
Pinole – CeProBi-IPM – Most Novel Use Ingredients
Grainious, University of Wisconsin, Madison – Best Overall
Appearance

Carbohydrate Division Megazyme Awards

First, **Denisse Bender**, University of Natural Resources and
Life Sciences Vienna
Second, **Elena Marasca**, ETH Zurich
Third, **Mankea Malalgoda**, North Dakota State University

Engineering and Processing Division Best Student Paper Award

Sravanthi Budaraju, University of Minnesota

Nutrition Division Best Student Research Award

Anna Hayes, Purdue University

Student Travel Awardees



For the 2018 meeting, students applied for an AACCI Student Travel Award to help support their participation in the AACCI Annual Meeting as part of the annual meeting abstract submission process form.

Student Travel Awards were limited to the first 50 students who had requested the support, who had an accepted abstract, and who are members of AACCI. **Awards of \$500 were provided from the AACCI Foundation as a credit toward registration for the meeting.**

Elisa Arte, University of Helsinki
 Eden Barrett, University of Wollongong
 Yaiza Benavent-Gil, IATA-CSIC
 Jose Bonilla, Purdue University
 Julia Brantsen, Texas A&M University
 Andrea Bresciani, University of Milan
 Sravanthi Budaraju, University of Minnesota
 Esther Callcott, Charles Sturt University
 Gaetano Cardone, University of Milan
 Kristina Cook, Louisiana State University
 Stephen Cork, Functional Grains Center
 Cesar Cornejo Hurtado de Mendoza, Universidad Nacional Agraria La Molina
 Janelle Courcelles, University of Manitoba
 Princess Tiffany Dantes, Iowa State University
 Jaya Dhungana, University of Minnesota
 Sabrina Geisslitz, Leibniz-Institute for Food Systems Biology at the Technical University of Munich
 Audrey Girard, Texas A&M AgriLife Research
 Stefanie Hackenberg, Technical University of Munich
 Jenny Hayek, University of Minnesota
 Anna Hayes, Purdue University
 Ye Eun Hong, Pusan National University
 Brasathe Jeganathan, University of Alberta
 Soojeong Jeon, Pusan National University

Duyun Jeong, Chonnam National University
 Amber Kaiser, North Dakota State University
 Xiaojing Li, Jiangnan University
 Misen Luu, University of Minnesota
 Maneka Malalgoda, North Dakota State University
 Coline Martin, INRA Montpellier -UMR IATE
 Juan Mogoginta, University of Minnesota
 Zeinab Mohammadi Shad, University of Arkansas
 Yujin Moon, Pusan National University
 Sviatoslav Navrotskyi, University of Nebraska
 Olivia Ogilvie, University of Auckland
 Mayra Perez-Fajardo, Kansas State University
 Rachana Poudel, University of Nebraska Lincoln
 Laura Roman, University of Valladolid
 Aylin Sahin, University College Cork
 Nancy Saji, School of Biomedical Science
 Xiaojuan Tang, Jiangnan University
 Alfonso Topete-Betancourt, CINVESTAV Unidad-Querétaro
 Pablo Torres Aguilar, Purdue University
 Michelle Toutounji, Charles Sturt University
 Min-Hui Tsai, University of Idaho
 Annelien Verbauwhe, KU Leuven
 Yujie Wang, University of Helsinki
 Yingxin Zhong, University of Minnesota

Treasurer's Report for AACC International FY2018

Dave L. Braun
AACC International Treasurer



During the fiscal year ending March 31, 2018, the AACCI Finance Committee, Board of Directors, and staff stayed on track throughout. We were diligent in looking for ways to invest within the association to enhance member value and increase revenue, identifying "Value Creation" initiatives that will move the association forward into the next fiscal year and beyond. We will continue to focus our attention on our financial

health, while striving to share quality cereal science information globally through our signature programs. Several of the Value Creation initiatives introduced in FY2017 drove our focus in FY2018: *Cereal Chemistry* was moved to a commercial publisher to gain greater exposure and make it easier to be discovered by new readers; steps are being taken to reinvent *Cereal Foods World* (CFW) thanks to its new editor-in-chief and help from guest editors and an outside consultant; declining attendance at the AACCI Annual Meeting led us to rethink the model for Cereal & Grains 18 in London; the transition of AACCI Check Sample to AOCS continues to move this program forward; partnering with Elsevier has begun to show a significant decrease in book publishing costs, and several new titles have been acquired.

The process of transitioning the publication of *Cereal Chemistry* to a partnership with Wiley began with a \$200,000 signing bonus to AACCI, which gave credence to the strength of *Cereal Chemistry* and to the competitive process of working with a commercial publisher. The transition of all subscriptions, advertising, and royalties to Wiley began on January 1, 2018. The AACCI *Approved Methods of Analysis* continues to grow and remains one of our most important assets, showing an average compounded annual growth of 30% over the past 10 years.

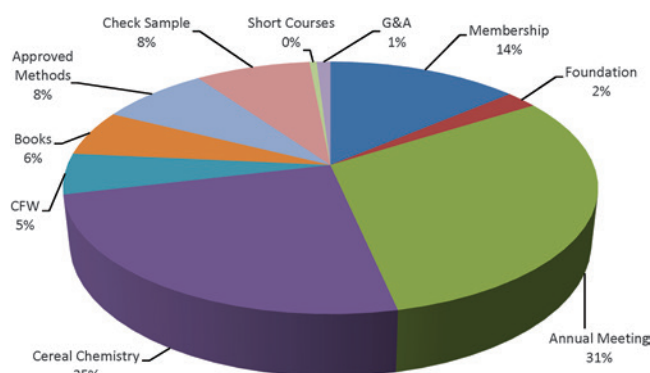
AACCI's relationship with Elsevier continues to strengthen as we develop and grow our book marketing plan. Although there were no new books released in FY2018, we are scheduled to release six new books in FY2019. CFW continues to be a flagship, member-valued publication. Investment in migrating CFW to an online platform with improved member experience of the content, as well as mobile access, was implemented during the past year. The new editorial approach with Editor-in-Chief Jon Faubion and guest editors developing content for each issue is enhancing the content quality, and an effective operational plan is successfully identifying a pipeline of motivated contributors. Increased communications and social media promotion are adding to the increased visibility of the publication as well.

The AACCI Annual Meeting continues to offer an opportunity for us to invest in young professionals and students, as evidenced by the student travel awards granted, student activities that highlight new technologies and techniques, and inclusion of emerging science and technology in every programming segment, increasing the appeal to a global audience. Additionally, the AACCI Foundation remains active and strong, providing more than \$30,000 in scholarships to students who are excelling in relevant curriculum. For Cereal & Grains 18, there was a strong international and student presence.

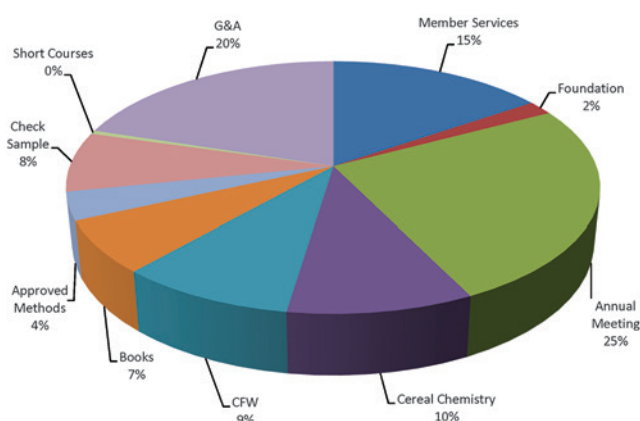
For FY2018, the net operating profit was \$212,110. This exceeded budgeted profit by \$198,991. Operating revenue came in over budget, with expenses contained at \$2.09 million, coming in \$117,000 underbudget and \$316,000 better than the previous year.

I want to take this opportunity to thank the entire AACCI organization for their continuing commitment to financial responsibility, which ensures that we as an organization can remain focused on quality and innovation, while providing enhanced member value through new products and services.

Income



Expenses



AACC International 2019 Board Election

Voting members will soon have the opportunity to cast their ballots for who they think will best lead our association. Board members play a major role in determining what programs and services AACC International provides to advance not only the industry, but you as a member. The Nomination Committee has put forth the following list of candidates for the 2019 election. **Running for the position of president-elect are Marta Izydorczyk and Sergio Serna-Saldivar.** The president-elect will also later serve as president, followed by a year as chair of the board. **Running for a position as director are Larisa Cato and Sheryl Tittlemier.** The person elected to this position will serve a three year term, beginning the day after the 2019 AACCI Annual Meeting. Your involvement in this process is essential, and your vote is critical. Look for an e-mail on January 15, 2019, that will include a link to your personalized electronic ballot. For eligible voting members without access to e-mail, a paper ballot will be mailed. Voting closes on February 28, 2019.

Candidates for President-Elect



Marta S. Izydorczyk is currently a research scientist and program manager of milling and malting and research on barley and other grains at the Grain Research Laboratory, Canadian Grain Commission, and an adjunct professor in the Department of Food Science, University of Manitoba, Winnipeg, Canada. Marta holds a bachelor's degree from the Ryerson Polytechnical University in Toronto and a master's

degree in food science and Ph.D. degree in food and nutritional sciences from the University of Manitoba.

Marta's research program is focused on identifying and characterizing constituents and molecular mechanisms responsible for functionality, quality, and performance of barley and other grains in food products. She is responsible for evaluating instrumental techniques and developing methods and protocols for measuring physical and biochemical grain parameters for assessment of quality and value. The aim of her research program is to develop effective strategies for improving the quality of grains and for better adapting them to current and future needs. She has been responsible for representing the Canadian Grain Commission in domestic and international forums; establishing liaisons and technology transfer activities with producers, industry, and marketers; providing advice; and responding to queries from clients and the public.

In addition to research, Marta offers her services to many professional organizations and committees: she has chaired the Barley Quality Evaluation Team for the Prairie Recommending Committee for Oat and Barley, served as treasurer and secretary on the Board of Directors of the Canadian Malting Barley Technical Centre, and served as a scientific advisor for the Brewing and Malting Barley Research Institute. Marta co-organized the 2006 International Plant Polysaccharide Workshop, a satellite meeting to the International Carbohydrate Symposium, in Winnipeg, and co-organized a joint conference of the 5th Canadian Barley Symposium and the District of Western Canada Master Brewers Association of the Americas in 2007 in Winnipeg. She was a member of the Scientific Committee of the 6th International Dietary Fiber Conference 2015 in Paris. Recently, she chaired the Scientific Committee of the 8th Canadian Barley Symposium and 22nd North American Barley Researchers Workshop held in June 2017 in Winnipeg.

Marta's first encounter with the AACCI community took place at the 1989 AACCI Annual Meeting in Washington, DC, where she delivered her first international presentation and received the Best Student Paper Award from the Rheology Divi-

sion. Since then, she has been an active participant in AACCI endeavors, serving as a member of the Publications Task Force, Scientific Advisory Panel, Program Team for the 2006 World Grain Summit, and AACCI Board of Directors (2011–2014). She co-edited the first Special Issue of *Cereal Chemistry* in 2010 focused on Molecular Diversity and Health Benefits of Carbohydrates from Cereals and Pulses. She has served as an associate and senior editor of *Cereal Chemistry* and as a member of the AACCI Oat and Barley Products Technical Committee and Carbohydrate Division.

Marta was honored with an invitation to deliver the 2007 Belfort Carbohydrate Lecture at the Whistler Center for Carbohydrate Research, Purdue University, West Lafayette, IN. She received the William F. Geddes Memorial Lectureship Award in 2011 from the AACCI Northwest Section in Minneapolis; was invited to deliver a keynote lecture, entitled "Delivering Functional Barley Fibre Constituents: From Plant Breeding to Grain Processing, at the 6th International Dietary Fiber Conference 2015 in Paris; and was invited to present a lecture on the "Effects of Agronomic Practices and Soil and Climatic Zones on the Content and Molecular Structure of Dietary Fibre Constituents in Food Barley Genotypes," at the 2016 International Barley Genetics in Minneapolis. She was awarded a Certificate of Appreciation in recognition of her valuable contribution to the Career Mentor Program at the University of Manitoba and, most recently, was elected an AACCI Fellow for her significant contributions to the field of cereal science and technology at the 2018 AACCI Annual Meeting in London.

Marta's Views. It is a great honor and privilege to be nominated to serve as AACCI president-elect, a premier worldwide organization for the advancement of grain science. AACC International has always supported its members through services, publications, and meetings and served the global community with trustworthy and scientifically verified information on grains and grain-based products. With rapid changes in science, technology, environment, and the global economy, the association needs to continuously develop and adapt in order to address the changing needs of its members. I feel, therefore, that it is a great privilege but also a great responsibility to participate in building the strength and shaping the future of this organization.

In my view, it is of utmost importance that we expand and promote scientific excellence and technological expertise within the organization and continue to disseminate high-quality information in an effective and useful manner. AACCI can play a key role in fostering international research collaboration, not only across geographies, but also across disciplines. Facilitating contact among academic and industrial members from various parts of the world, reaching out to other scientific and technological societies, and linking with other disciplines, such as biomedical, environmental, and material sciences, will deepen and

expand the scientific dimensions of the AACCI community. Our association must spare no effort to attract burgeoning scientists, students, and technologists by supporting and nurturing their career development and encouraging them to undertake in-depth, cutting-edge, highest quality research. We can do this in a variety of ways, including by offering special workshops, apprenticeships, visiting stipends, acknowledgments, and announcements of achievements, tribute lectures, and similar initiatives.

AACCI must remain attentive to the regional differences and varied needs of its members. Through focus groups, forums, and discussions, AACCI may provide opportunities for adapting internationally available knowledge to local conditions and specific requirements and accepting novel technologies, as well as play a role in harmonizing definitions, regulations, and legislation.

With the knowledge, expertise, and scientific wisdom of its community at its disposal, AACCI is in an excellent position to assume a leadership role in formulating credible and reliable statements on emerging and sensitive issues relating to the safety, health benefits, processing, and quality of cereal-based products. Providing such trustworthy, scientifically verified information to its members, health professionals, the public, and policy makers is especially important in the modern era of overabundant news.



Sergio O. Serna-Saldivar is a professor in the School of Sciences and Engineering and head of CIDPRO (Research Center for Protein Development) at Tecnológico de Monterrey, Mexico. Prior to this, he was a research scientist in the Soil & Crop Sciences Department at Texas A&M University for five years, a consultant for EMBRAPA in Rio de Janeiro, Brazil, and an associate professor at the University of Sonora. He is currently the research chair leader regarding nutraceuticals associated with cereals and other grains. He has been a member of AACC International for 35 years, as well as the Institute of Food Technologists, and has acted as an associate editor for the journals of *Cereal Chemistry* and *Cereal Science*. He has also served on the AACCI Board of Directors. Sergio received his B.S. degree in animal science/agricultural engineering from Tecnológico de Monterrey and M.S. and Ph.D. degrees in scientific nutrition and food science and technology from Texas A&M University. He has authored and edited 12 books, including the recent AACCI titles *Tortillas: Wheat Flour and Corn Products*

and the third edition of the globally recognized *Corn: Chemistry and Technology*. In addition, he has authored 50 book chapters, 205 referred journal articles, and 16 encyclopedia articles and is the inventor on 9 registered patents and 4 patent applications and codeveloper of the U.S. wheat variety TAM-202. Sergio's scientific and book publications have been cited more than 5,300 times. He has given more than 330 presentations at international and national conferences and symposia and directed 66 M.S. and 19 Ph.D. students. His research interests focus on the biotechnology of cereal grains and legume seeds, nutraceutical properties of grains and indigenous Mexican foods, and vegetable proteins. Sergio belongs to the highest category of the Mexican National Research System and the Mexican Academy of Sciences. In addition, he received the 2004 AACCI Excellence in Teaching Award and the National "Luis Elizondo," 2008 *Yum Kax*, and AgroBio México Awards for his contributions to the science and technology of cereal-based products.

Sergio's Views. I am honored and privileged to be nominated as a candidate for president-elect of AACCI. I first became a member in 1983 after being encouraged by my dear professor and advisor Dr. Lloyd Rooney when I was his graduate student at Texas A&M. Since then I have been actively associated with this organization that has provided value to my teaching and research skills and, especially, has broadened my global network to many people who share the same passion: the betterment of societies throughout the production and utilization of value-added grain-based foods. I strongly feel that we belong to a great association that has positively affected many professional careers of different generations. The challenge is to properly evolve and adjust to meet the needs of new generations (e.g., millennials) who are interested in emerging global issues related to product development, food safety, health, and well-being. Our association has expanded internationally, and we should continue to work to ensure that we remain relevant to all members and recruit young professionals and students who are the future of this organization. In addition, we should continue to offer the best workshops, symposia, annual meetings, specialized e-books, and methods in order to provide value to members, academia, and grain-based industries. I strongly feel that AACCI should keep increasing its visibility in countries outside the United States and enhance the interaction between academia and industry to meet global challenges on issues related to production of the most relevant foods for humanity for generations to come. In short, with your support, I would like to give back to AACCI the countless benefits that the organization has provided to me since I joined the organization 35 years ago.

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Larisa Cato is a wheat quality technical markets manager in the National Wheat Quality Research & Innovation Division of the Australian Export Grains Innovation Centre (AEGIC). Prior to assuming her current position Larisa was a cereal chemist with the Department of Agriculture and Food WA responsible for research, development, and innovation, ensuring the Western Australia wheat industry was interna-

tionally competitive. Previous to that position she was a research scientist with the Australian Wheat Board (AWB Ltd.) leading the Asian Products Division.

Larisa holds a Ph.D. degree from RMIT University, Melbourne, Australia, and is well versed in the wheat quality requirements of Australian international markets. Larisa is internationally recognized as an expert in the field of wheat quality and end-product requirements. She possesses a unique set of skills, combining scientific, technical, and market expertise. Her research interests include Asian products (starch and protein quality requirements for various Asian noodle styles) and baking systems (innovation in baking).

Larisa has served as a cochair of the AACCI Asian Products Technical Committee since 2009 and in 2017 began cochairing the Bread Baking Methods Technical Committee.

Larisa's Views. It is an honor and a privilege to be nominated to serve the organization as a director on the 2019 AACCI Board of Directors. I fully respect the past accomplishments of AACCI and look forward to contributing to the even greater future of the rebranded Cereals & Grains Association, making it a truly global leader for cereal grain science, innovation, research, collaboration, and technical/training education worldwide.

I would stimulate partnerships with other scientific organizations, advocating for science as fundamental for well-being and core to the mission of the organization.

In my role as a director I will strive to

- Provide scientific leadership to AACCI
- Work with other relevant organizations to coordinate scientific and technical/training programs
- Support the development of young and new AACCI members

I look forward to continuing to support AACCI in its growth and evolution, as the association has helped me over the last 15 years.



Sheryl Tittlemier is a research scientist and manager of the grain safety program at the Grain Research Laboratory of the Canadian Grain Commission (CGC). Sheryl received her Ph.D. degree in analytical chemistry from Carleton University in Ottawa. She has been working in the area of food contaminants and food safety for 17 years, beginning with Health Canada in 2002. Since 2010, Sheryl has managed grain monitoring

for mycotoxins, pesticides, and heavy metals at the CGC in Winnipeg, MB. Her current work also involves analytical method development, research into sampling techniques, and research on the fate of contaminants during processing. She also routinely interacts with stakeholders from the grain value chain, including producers, grain handlers, and end users.

Sheryl is an active member of the AACCI Food Safety and Microbiology Technical Committee and co-organized and co-moderated two sessions at Cereals & Grains 18. She also coauthored the AACCI white paper on the North American perspective on deoxynivalenol in grains, which was heavily considered during the Codex Alimentarius Commission's adoption of a maximum limit for this mycotoxin in cereals. In addition to AACCI, Sheryl leads the annual review of developments in the analysis of mycotoxins for the *World Mycotoxin Journal*, and she is an editor for *Mycotoxin Research*, a member of the expert roster of the Joint (FAO/WHO) Expert Committee on Food Additives, and a member of the ICC working group on sampling.

Sheryl's Views. If elected as a director, I will bring my scientific background in food safety, my experience with the grain value chain, my experience in working with international groups, and a fresh set of eyes to the association. Although I am relatively new to AACCI (I became involved in late 2014 and attended my first annual meeting in 2015), I have seen the value of the association for scientists, processors, end users, and others involved with grains. Personally, I have benefited from connections made during the annual meetings, as well as short courses and web-based seminars organized by the association.

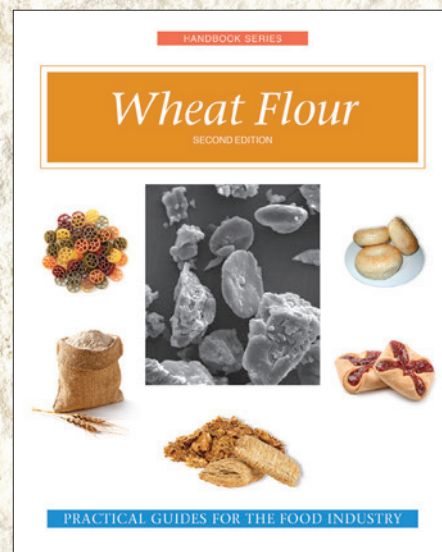
I see great potential for increasing the ability of the association to connect people in the grain world together and to connect us with the technical information we need. I feel holding the annual meeting in London in 2018 was an exciting move that will allow us to evolve into a truly international association. Grains are a global food, and the desire for safe, nutritious, and quality food transcends borders. We have an opportunity to help provide the technical support required to meet the global desire for safe, nutritious, and quality grain-based foods.

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Thank You AACC International Corporate Members

Thank you to all our corporate members, who contribute their knowledge, expertise, and professional involvement to ensure the continued strength of the association and to promote excellence in cereal grain science worldwide. We appreciate their support and encourage you to contact them directly for detailed information on their products. Visit the [AACCI Corporate Member web page](#) for comprehensive company and contact information.

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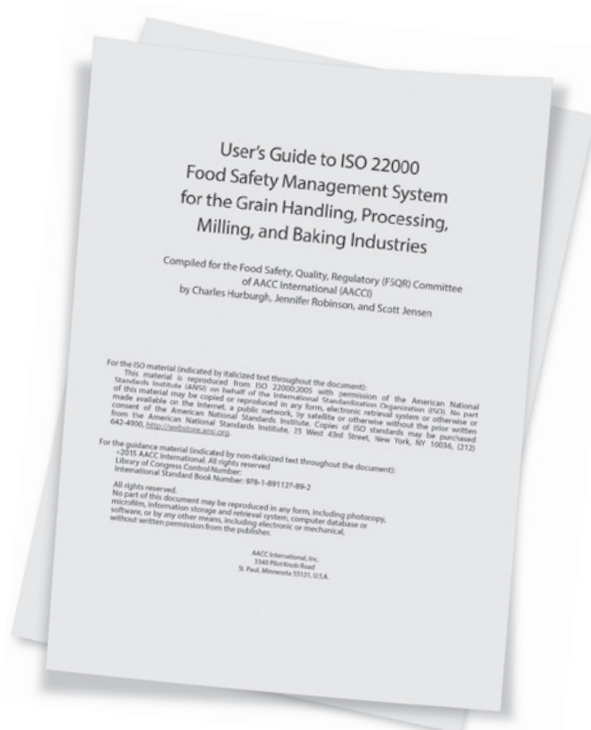
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AACC International Rebranding Update



Dear AACCI Members,

In previous communications, I've shared updates on the branding process and efforts that have been underway for our association during the past year. I am pleased to notify you that during the meeting in London, we announced that the name "Cereals & Grains Association" was approved by a majority of the voting members.

A little more work needs to take place now that we have the approval from the membership, and we anticipate a full launch of the new brand and name by mid-2019. A transition plan is currently in development for outlining communications leading up to the brand launch.

The board is very excited to have this future-focused branding approved and underway. The impressive response and success in London are definitely a great sign of the next phase for the association! Thanks to all of you for your continued dedication and commitment to move AACCI forward! If you have any questions or suggestions in this regard, feel free to contact any member of the AACCI Board.

Laura M. Hansen
AACC International Chair of the Board

Important AACCI Dates

February 2019

18. Nominations for AACCI Awards deadline

March 2019

17. 18th European Young Cereal Scientists and Technologists Workshop abstract submission deadline

April 2019

15–17. 18th European Young Cereal Scientists and Technologists Workshop, San Benedetto del Tronto, Italy

17–19. Milling & Baking Spring Technical Conference, Austin, TX, U.S.A.

November 2019

3–5. Cereals & Grains 19, Denver, CO, U.S.A.

For more information visit
aaccnet.org

New AACCI Divisions Announced

The AACCI Board of Directors officially announced in London the addition of two new divisions: the Food Safety and Quality Division and the Pet and Animal Food Division. Each of these divisions hopes to help support current and emerging member interests and attract new members. Members are encouraged to sign up through their renewal forms to become active members of these divisions.

People



The Wheat Marketing Center (WMC) has announced the selection of Jayne Bock as its new technical director. Bock will lead WMC's research and technical training efforts focused on demonstrating the value of U.S. wheat. Bock is an experienced research leader with a specialty in grain and flour quality. She earned her B.S. and M.S. degrees in food science at Kansas State University and her Ph.D. degree in food science at

the University of Wisconsin-Madison. She spent several years at the University of Guelph as an adjunct professor and, more recently, as global technical leader with Brabender Instruments and as a consultant with CHOPIN Technologies. Bock is also active in wheat industry associations, including AACC International and has coauthored an impressive list of refereed publications. For more information about WMC visit www.wmcinc.org.

New Members

Aigbe, M., School of Applied Sciences, University of Huddersfield, Huddersfield, U.K.

Basto, D., University of Milan, Milan, Italy

Benavent-Gil, Y., graduate student, IATA-CSIC, Paterna-Valencia, Spain

Bohmdorfer, S., BOKU–University of Natural Resources and Life Sciences, Tulln An der Donau, Austria

Cannata, A., University of Milan, Milan, Italy

Carcea, M., IRAN, Rome, Italy

Daang, T. C., quality assurance analyst, Pilmico Foods Corporation, Illigan City, Philippines

Detzel, P., health economics manager, NESTEC, Vevey, Switzerland

Ferrazzi, I., University of Milan, Milan, Italy

Funkquist, O., innovation, Oatly, Lomma, Sweden

Gangur, V., associate professor, Michigan State University, East Lansing, MI, U.S.A.

Grausgruber, H., BOKU–University of Natural Resources and Life Sciences, Tulln An der Donau, Austria

Gregory, G. D., senior vice president of business development, Western Foods, Decatur, IL, U.S.A.
Guilfoyle, E., R&D project manager, T. Marzetti, Columbus, OH, U.S.A.
Hong, M. G., Gachon University, Seongnam, South Korea
Joyce, G. E., graduate research assistant, University of Kentucky, Lexington, KY, U.S.A.
Kong, Z., CEO, Outsect Corporation, Oceanside, CA, U.S.A.
Larkin, P. J., CSIRO Agriculture and Food, Canberra, ACT, Australia
Li, C., Yangzhou University, Yangzhou, China
Miller, R., chemist, Ingredion, Indianapolis, IN, U.S.A.
Morantes, G., director of food safety, Buhler Inc., Plymouth, MN, U.S.A.
Nagel, E., president, H. Nagel & Son Co., Cincinnati, OH, U.S.A.
Ozpinar, F., Pak Gida, Izmit, Turkey
Saibene, D., PepsiCo, Leicester, U.K.
Sakakibara, M., Fujimino-City, Saitama, Japan
Schuhmacher, T., Arbeitsgemeinschaft Getreideforschung e.V., Detmold, Germany
Seegers, S., technical operations manager, Bunge, St. Charles, MO, U.S.A.
Sim, Y.-E., Gachon University, Seoul, South Korea
Talia, M., University of Milan, Milan, Italy
Velazquez, J., R&D supervisor and chef, Ateeco, Inc., Shenandoah, PA, U.S.A.
Vercesi, F., University of Milan, Milan, Italy
Whelan, K., King's College London, London, U.K.
Zorrilla, W., Earth's Harvest, Manhattan, KS, U.S.A.

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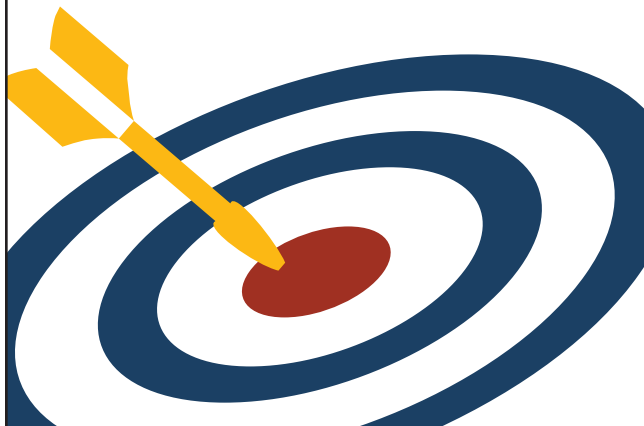
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2019 Themes

January-February—Global Food Systems / Analytical

Ad Close: December 3, 2018

March-April—Safety & Security

Ad Close: February 8, 2019

May-June—Health & Nutrition

Ad Close: April 10, 2019

July-August—Processing / Pre-annual Meeting

Ad Close: June 14, 2019

September-October—Cereal Foods

Ad Close: August 9, 2019

November-December—Product Development & Innovation

Ad Close: October 28, 2019

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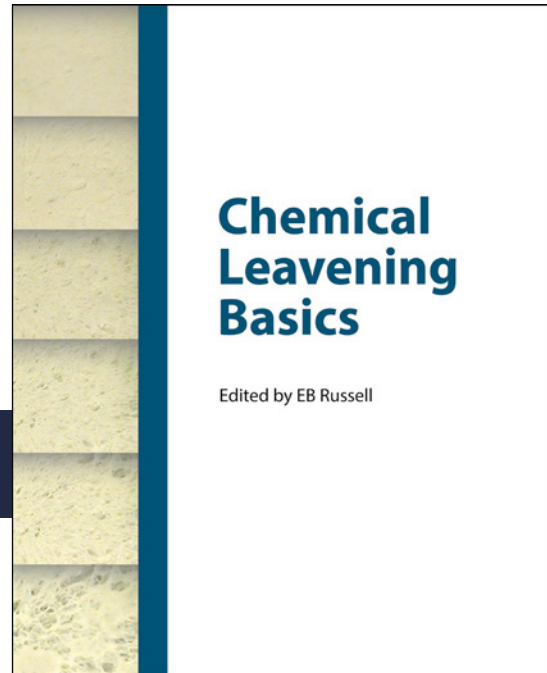
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Produced by the AACC International Chemical Leavening Agents Technical Committee, this technical guidebook helps food professionals understand each of the individual components used in baking powder, why to use them, where to use them, when to use them, and their importance.

Chemical Leavening Basics will become the go-to reference for product developers, bakers, ingredient suppliers, technical service production personnel, quality assurance staff, mix manufacturers, or anyone else using baking powders or chemical leaveners.

CEREALS & GRAINS 19



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