

# The Second C&E Spring Meeting and Third International Whole Grain Global Summit

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Progress has been made with respect to whole grains on many fronts. Participants at the Third International Whole Grain Summit held in Newcastle, U.K., in late March 2009 agreed that there have been many steps forward since the first (Porvoo, Finland) and the second (Minneapolis, MN, U.S.A.) whole grain summits. Despite this, there are a number of areas where further research is needed because of confounding and other issues. The confounding was underscored when intervention data and carefully designed meta-analyses and reviews failed to corroborate findings from many observational studies. Participants welcome further research to help clarify the relationship between whole grains and health outcomes, the effects of processing on whole grain bioactives, and physiological mechanisms. The groups were keenly aware of the need to have international harmonization. Some of the conundrums that result might be addressed if there was better characterization of what is being fed, what is used as the control, and characteristics of the subjects involved.

This paper will give an overview of the conference and try to summarize what we know and agree upon and where we need more information. Thus, the recommendations and directions from the different workshop groups will be discussed.

## Conference Characteristics

The Newcastle Whole Grain Global Summit was organized by Chris Seal, University of Newcastle. The meeting served as Cereals&Europe's (a regional section of AACC International) spring meeting, which had the subtitle "Whole Grain Products: The Holy Grail for Health Conscious Consumers." The conference attracted nearly 200 participants from 21 countries to the two-and-a-half day conference, with seven exhibitors and nine sponsors. Abstracts from the meeting are available online at [www.aaccnet.org/cerealfoodsworld/pdfs/CFW-54-2-suppl.pdf](http://www.aaccnet.org/cerealfoodsworld/pdfs/CFW-54-2-suppl.pdf).

The summit was preceded by two workshops. One was the AACC Intl. HEALTHGRAIN Whole Grain Task Force Workshop, which dealt with whole grain definitions issues surrounding the European Food Safety Authority's (EFSA's) pending health claim legislation. The other workshop was about the GRAINITY Project Symposium—Nordic experience and approaches on using grains for health. The latter focused on the benefits of whole grain rye and oats.

The venue and schedule allowed for a stimulating mix of knowledge dissemination and interaction—both formal and informal. For formal interaction, participants chose one or two of the four working groups: 1) Nutrition and Health; 2) Technology and Consumer Products; 3) Phytochemicals, Processing, and

Analysis; and 4) Definitions, Health Claims, and Consumer Communication and Understanding.

## Nutrition and Health Working Group

The case for whole grain health benefits was strengthened by some of the studies presented at the summit. However, intervention studies failed to support findings gleaned from previous observational data. Some meta-analyses and systematic reviews, which were conducted using strict inclusion criteria, also suggested that the relationships, if real, were not strong. Study details, such as type of design, diet used as control, the definition of a whole grain food and what is included, became issues that impacted the results.

Since some studies classified bran foods and other fiber sources, such as psyllium, as whole grain foods in the analysis, it was agreed that care must be used when researching whole grain and health, that the criteria for including a food is carefully described, and that there must be adequate ability to accurately characterize the foods being ingested. Further, it was agreed that the experiment and analysis need to be designed to account for other possible influences on the health outcome(s) being tested and, where possible, to minimize confounding. For example, studies on the relationship between heart health and whole grain need to account for the impact of heart-healthy aspects of the diet, such as the amount of  $\beta$ -glucan. In a similar manner, studies looking at whole grains and digestive health need to consider both the amount of whole grain and the amount of bran or total fiber. Precision with regard to these issues will help ascertain the impact of the whole grain and its different components. Furthermore, outcomes of a study must be reported in comparison with what has been chosen as a control. The outcomes of intervention studies in which whole grains are added to a baseline diet might be different than in those experiments in which whole grain foods are compared with their refined grain counterparts. While interventions in which consumers are asked to increase consumption of whole grains might predict consumer behavior regarding general dietary advice to eat more whole grains, the outcomes might be very different if the intervention directly substitutes refined grain with whole grain products.

There was consternation that the intervention study conducted by Chris Seal, Iain Brownlee, Carmel Moore, Mark Chatfield, David Richardson, Peter Ashby, Sharon Kuznesof, and Susan Jebb (unpublished data) successfully increased whole grain intakes but failed to alter any health outcome over the course of the study. This finding caused vigorous discussion about various types of evidence.

The Nutrition and Health working group recognized that each type of scientific study has its strengths and its weaknesses and this should be taken into account. It was questioned as to whether a randomized clinical trial should be viewed as the gold standard for making dietary recommendations. Even having "clinical" in the name begs the question of their appropriateness. Should interventions conducted on healthy, not clinical, populations be called clinical trials? It is possible that a food category

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may contribute a beneficial effect as part of the diet and yet may not show dose response and other outcomes that are expected from a clinical trial. The chance of finding a positive result in interventions using healthy people for relatively short periods of time may fail to show significance for many reasons. These might include but are not limited to the fact that there might not be the right mix of people who are at risk for a certain disease endpoint in the intervention or that the marker for the disease endpoint is not like having the disease. Observational and epidemiological studies also have weaknesses, including imprecise characterization of what was eaten and confounding issues caused by the fact that healthy people are the ones who often follow dietary and health promotion advice.

The Nutrition and Health working group agreed that:

- There was enough information on certain specific components of whole grains to further delve into mechanisms.
- While we know that whole grains can be contaminated with deleterious compounds, such as mycotoxins and heavy metals, and that during processing compounds such as acrylamide form, the benefits of ingesting whole grain products far outweigh their risks. In fact, it was pointed out in the working group that with good manufacturing practices the levels of mycotoxins and heavy metals are controlled, so that any risks would be completely minimized. Similarly, technical solutions to reduce acrylamide formation are known and can be invoked. It was concluded that the potential negative effects pale in comparison to the positive health benefits.
- Epidemiological evidence is suggesting multiple beneficial effects of diets high in whole grain and/or high in cereal bran/fiber compared with lower variants of these diets.

Further research is needed on the following aspects:

- The relevant true endpoints (biomarkers and or disease outcomes) in order to look at public health effects of eating whole grain and high-fiber foods.
- A characterization of which confounders make the difference in health studies.
- Definitions of whole grains, dietary fiber, and refined grains, preferably internationally agreed upon, for use in research, as well as generally.
- Agreement as to how to best measure relevant whole grain and food consumption.
- A delineation of the synergy that exists between the single components in the grain, such as what role the endosperm, germ, and bran play in affecting the bioactives, and their health role, or the nature and effect of the interaction of various bioactives with each other.
- The effects of different specific grains and how these particular effects have influenced specific outcomes of the different studies. Further, there needs to be delineations of the strength of evidence for whole grains as a category and for the different grains.

The Nutrition and Health working group recommended that:

- A re-evaluation of all available scientific data with perhaps an overarching review, including an exploration of plausible mechanisms. “Omics” approaches can be used to scan for theories but will only be useful if they are linked to physiological parameters.
- Subsequent intervention studies must clearly identify the nature of the intervention, the target population, and the outcomes. This degree of specificity will be important for research and for health claims. Characterizing and focusing the investigation of subgroups or populations that are at

highest risk or who might receive the greatest potential benefit has the chance to have the biggest impact on public health.

- There be precision in discussing biomarkers with clear differentiation between exposure biomarkers and physiological effect biomarkers.

The Nutrition and Health working group concluded that:

- There is sufficient evidence showing that higher whole grain diets compared with refined grain diets are beneficial for several health outcomes.
- While diets high in bran and fiber are not the same as whole grain diets, they also have many beneficial relationships to health outcomes.
- Whole grains, bran, and dietary fibers may exert multiple physiological benefits.
- Not all whole grains (or dietary fibers) have equal effects on health, the same physiological benefits, or equal levels of evidence. In terms of levels of evidence regarding various whole grains and health, the following continuum exists: oats > barley > rye > wheat >> rice > corn.

### **Technology and Food Processing Working Group**

The Technology and Food Processing working group posed this important question: “Should we strive for getting 100% of the grain for 10% of the people or 90% of the grain for 90% of the people?” The group noted that the “everything or nothing” approach may not be helpful and suggested a gradual increase in consumption of the outer grain layers to let the consumer adapt in changes in food sensory attributes. This group noted that:

- There are good technology tools available, and more are being developed.
- The bottleneck for development of products lies in consumer acceptability. More research should address the interface between technology and sensory attributes and consumer acceptance. Communication is important to create a consumer demand vs. technology push.
- There should be an effort to broaden the use of other raw materials besides wheat in attempts to deliver more grain benefits in human food.
- There should be work not only on bread, where much effort has been concentrated, but on other product categories and on new technologies for innovative product concepts.
- There should be attempts to look at nutritional profiling for whole grain foods.
- There needs to be discussion on the use of additives, such as folate, in whole grain foods.

### **Phytochemicals, Processing, and Analysis Working Group**

The Phytochemicals, Processing, and Analysis working group agreed that:

- Improvements in analytical skills have allowed more different phytochemicals to be discovered.
- It is likely that all categories of phytochemicals have been identified, but we have not as yet identified all the phytochemicals.
- Further characterization of all the known phytochemicals is desirable. Such work would include an understanding of the behavior of the phytochemical in the matrix compared with that observed in isolation.
- Phytochemicals measured in the food may or may not be what we measure in the circulation.
- Modern varieties of grains do have higher levels of phytochemicals.

The Phytochemicals, Processing, and Analysis working group wanted more quantitative data overall. They agreed that further research was needed that would:

- Determine the bioactivity of the various compounds and the reliability of tests for bioactivity.
- Characterize the relationship between in vitro tests with isolated chemical moieties and in vivo physiological effects of the moiety fed as part of a whole grain food in a food matrix and with other dietary constituents.
- Track the digestion and metabolism of the compounds and show any relevant biochemical changes that occur.
- Find the mechanistic link between whole grains and their constituents and physiologically relevant effects.
- Characterize the physiological relevance of the whole grain bioactives at levels provided by a diet of whole grain foods. This is important since much of the existing data come from experiments employing extracts and other protocols, which provide bioactives at levels far higher than those that would be delivered with a diet rich in whole grains.

In terms of methods of analysis, there needs to be:

- Validation of methods and development of a set of standards for studies (analogous to AACC Intl. check samples).
- Improvement of methods of determining antioxidant capacity and the relevance to human health.
- Development of methods for valid testing of relevant biological effects in humans.
- Development of validated, quantitative methods to test for bioactivity. Such methods could serve as vehicles for studying the influence of processing on the bioactivity of phytochemicals.
- Development of methods that are capable of showing the relationship between results derived from the analysis of an isolated component and the component embedded in a food matrix.
- Development of procedures that can address both the nutritional and antinutritional factors in grains and grain-based foods.
- Development of methods that are cost effective and that can be used by industry and government for labeling.

This working group agreed that an interdisciplinary approach, involving analytical chemists, nutritionists, food scientists, and others working together, is needed. The AACC Intl. working group on bioactive components (abdelaale@agr.gc.ca) could set up an overarching plan to address these issues.

### **Definitions, Health Claims, and Consumer Communication and Understanding Working Group**

This section will summarize the work of both the Whole Grain Task Force Workshop and the working group.

The Whole Grain Task Force emphasized the need for a definition since it can contribute to consumer understanding and harmonize industrial manufacturing and labeling practices, and it is necessary for whole grain health claims. There was strong feeling that a definition that is accepted worldwide is by far the most desirable. Definitions by countries or regions (North America, EU, etc.) are certainly second best.

It was reaffirmed that cereal grains are from the family of Gramineae/Podaceae. It was discussed that pseudocereals and other minor cereal grains would also be included because of their similar uses and macronutrient composition. There were a couple participants who felt that pulses, nuts, and seeds should also be included, but an overwhelming majority disagreed. While all

agreed that these very nutritious foods should be encouraged in the diet, they would not be included in a whole grain definition since 1) they are not classified in the bread and cereal groups in dietary guidance in most countries; they are classified with either the protein group or the fruit and vegetable group; and 2) they have dissimilar macronutrient content, e.g., more protein and fat, and limiting amino acids.

Existing definitions were discussed, including:

- The 1999 AACC Intl. definition: “Whole grains shall consist of the intact, ground, cracked or flaked caryopsis, whose principal anatomical components—the starchy endosperm, germ and bran—are present in the same relative proportions as they exist in the intact caryopsis.”
- The definition from the HEALTHGRAIN Workshop, Paris, November 2008: “Wholegrain is defined as intact and/or processed (e.g., de-hulled, cleaned, ground, cracked, flaked or the like) grains, where the fractions endosperm, bran and germ are present in the same proportion as found in the least processed traditional forms of the edible grain kernel of the same species.”
- The Barilla 2009 definition: “Wholegrain is defined as intact and/or processed (e.g., de-hulled, lightly peeled, cleaned, ground, cracked, flaked or the like) grains, where the fractions endosperm, bran and germ are present in the same proportion as found in the least processed traditional forms of the edible grain kernel of the same species.”
- The Institute of Grocery Distribution (IGD) definition from the United Kingdom Whole grains refer to the edible grain, including the germ, endosperm, and bran, from cereals and related plants. (Note: This definition was built on the AACC Intl. definition but eliminated the word “caryopsis.”)

The definitions generated the following agreements:

- While both the HEALTHGRAIN and the Barilla definition contained “...the same proportion as found in the least processed traditional forms of the edible grain kernel of the same species,” participants felt that this phrase was not acceptable because it is too vague and would likely not be accepted by regulatory bodies.
- All agreed that while the term “caryopsis” was accurate botanically, it was not consumer friendly and should be replaced by the word “kernel.” It was agreed that the term “whole grain” refers to the entire edible grain after removal of inedible parts, such as the hull and glume. It must include the entire germ, endosperm, and bran.
- All grain types from the AACC Intl. Task Force on Defining Whole Grains in Food letter of 2006 (Table I) should be included. Malted grains are included, provided that 1) the amount of whole grains stated for the product is computed on the dry weight; 2) any sprout growth does not exceed kernel length; and 3) nutrient values have not diminished. (The full letter is available online at [www.aaccnet.org/definitions/pdfs/AACCIntlWholeGrainComments.pdf](http://www.aaccnet.org/definitions/pdfs/AACCIntlWholeGrainComments.pdf).)

In terms of processing and milling, the following was agreed:

- Criteria for processing should not be included in the definition, but details may be included (e.g., in product specifications as applicable). However, all agreed that processing (e.g., milling, cracking, crushing, rolling, flaking, extrusion, malting) be allowed but only if, after processing, the proportions of the germ, endosperm, and bran are present in the same or virtually the same proportions as the original grain.

- Temporary separation of whole grain constituents during processing for later recombination in the milling process is acceptable, provided the proportions of the germ, endosperm, and bran are in virtually the same proportion as in the original grain. (It was noted that adding together the three whole grain constituents by a food manufacturer would require the food label to list the individual ingredients separately [e.g., bran, germ, and starch] and such a food would not be considered to be whole grain.)

There are several rationales for this:

- The ratio of endosperm, bran, and germ varies even among kernels in one ear or grain head.
- The ratio of endosperm, bran, and germ varies among varieties of one type of grain.
- The practice of adding a fixed percentage of bran and germ to endosperm (white flour) in modern milling ensures a constant quality among batches of wholemeal flour.
- Recombination of bran, germ, and endosperm in which one of the components (bran, germ, or endosperm) has been stabilized or treated to remove contaminants (e.g., mycotoxins, heavy metals, etc.) should be allowed. Removal of contaminants in the very outer bran layer by a process called peeling will remove less than 2% of the grain and 10% of

the bran. This loss of bran should be compensated by addition of bran from more inner layers.

- Different varieties of the same grain may be combined during processing and be called whole grain (e.g., different varieties of wheat), as long as the final product contains the component parts of the grain in line with their preprocessed proportions. However, recombined bran, germ, and endosperm from different cereals (e.g., wheat plus oats) would not qualify as whole grain.
- There needs to be science-based, grain-specific specifications of what the proportion of bran, germ, and endosperm should be. Grains that are most common should be defined first.

The following issues need further discussion and research:

- What is the definition of a whole grain food? How much whole grain should be present in a food for it to be called a “whole grain” food?
- Should a food contain a minimum level of whole grain in order to mention whole grain attributes of a food? Should there be any rules regarding “made with whole grain” or “contains whole grain” on packaging or in advertising?
- The U.S. FDA and proposed regulations from EFSA indicate a level of 50 or 51% whole grains as the criteria for health claims. Should there be different specifications for products with different moisture contents? It was noted that “contains XXX” is already covered in the EU under Quantitative Ingredient Declarations (QUID) regulations, where percent content is reported. However, should there be some help for the consumer to translate the various percentages to help them know how much whole grain food to choose? It was noted that standards and allowed statements may be different for foods carrying health claims, and there may be rules about ingredients of concern, such as fat, sugar, and salt.
- What would be some relevant markers of whole grain in a whole grain food? Markers for whole grain are useful in the United States since current FDA policy would like to test label claims with analytical tests rather than by using a paper trail. A test for whole grain in a food is not needed in Europe because no analysis is required; QUID labeling and inspection are possible. Neither dietary fiber nor fat are useful as a marker to determine whether oil or fiber are integral to the whole grain or may be added. It is possible that newly available analysis techniques can detect different fiber types and may become cost effective.

**Table I. The AACC Intl. Task Force on Defining Whole Grains in Foods’ list of cereals and pseudocereals that when consumed in whole form, including the bran, germ, and endosperm, are considered whole grains**

Cereal	Scientific Name
True cereals	
Wheat, including spelt, emmer, farro, einkorn, kamut, durums	<i>Triticum</i> spp.
Rice, African rice	<i>Oryza</i> spp.
Barley	<i>Hordeum</i> spp.
Corn (maize, popcorn)	<i>Zea mays</i>
Rye	<i>Secale cereale</i>
Oats	<i>Avena</i> spp.
Millets	<i>Brachiaria</i> spp.; <i>Pennisetum</i> spp.; <i>Panicum</i> spp.; <i>Setaria</i> spp.; <i>Paspalum</i> spp.; <i>Eleusine</i> spp.; <i>Echinochloa</i> spp.
Sorghum	<i>Sorghum</i> spp.
Teff (tef)	<i>Eragrostis</i> spp.
Triticale	<i>Triticale</i>
Canary seed	<i>Phalaris arundinacea</i>
Job’s tears	<i>Coix lachrymal-jobi</i>
Fonio, black fonio, Asian millet	<i>Digitaria</i> spp.
Pseudocereals	
Amaranth	<i>Amaranthus caudatus</i>
Buckwheat, Tartar buckwheat	<i>Fagopyrum</i> spp.
Quinoa	<i>Chenopodium quinoa</i> Willd.—is generally considered to be a single species within the Chenopodiaceae
Wild rice	<i>Zizania aquatica</i>

In conclusion, the HEALTHGRAIN objectives state the objective of the conference extremely well. It is to increase the intake of health-protective grain components and to increase understanding of the health effects of grain components. Further research on whole grains as a category and on wheat, rye, barley, rice, and corn will hopefully lead to products with more of all health-protective components and to products with high levels of selected components in order to improve public health. The Third C&E Spring Meeting, hosted by Peter Köhler, will be held April 10–14, 2011, in Freising, Germany.