

Perspectives on Wheat Quality: Why Does the Definition Keep Changing¹?

- ▶ The “Assessment of Grain Quality: From Breeding to Store Shelf” symposium, to be held at the 2010 AACC International Annual Meeting in October hopes to illuminate the elusive nature of quality.
- ▶ This year’s presenters will explore “quality” at various steps in wheat development and utilization.
- ▶ As whole grain products receive more attention from scientists and consumers, new methods and definitions of what constitutes quality for consumers becomes more important.

A. D. BETTGE
 USDA-ARS Western Wheat
 Quality Lab
 Pullman, WA, U.S.A.

S. M. FINNIE
 Katholieke Universiteit Leuven
 Laboratory of Food Chemistry and
 Biochemistry
 Leuven Food Science and Nutrition
 Research Centre
 Heverlee, Belgium

Achieving quality, especially in wheat, is difficult at the best of times. Quality is an elusive goal in science generally and in cereal chemistry in particular. Science concerns itself with concrete, quantitative information—measurements of amounts, weights, and performance. But “quality” is an elusive and malleable concept that defies exact definition because it essentially comes down to people’s perception. Quality is what people determine the sum of traits to be; there is no right or wrong, just degrees to which complex attributes are perceived in their totality. And because people differ in their perceptions, individually and culturally, obtaining a single definition of quality is nearly impossible.

Not only is quality a difficult goal when people’s judgments are involved, but the

definition of what wheat quality is differs depending on the particular portion of the wheat development, marketing, and end-use spectrum being discussed. Each phase of wheat development and marketing requires different definitions of quality. At each stage, the definitions may not only be different, but occasionally contradictory.

Moreover, within portions of the wheat utilization community, little understanding exists as to why the definitions of quality at one phase do not imply that quality exists in another phase. For example, some wheat buyers are disappointed that buying U.S. number-one wheat for milling does not translate into providing stellar end-use functionality in bakeries. The fact that grading and marketing standards primarily reflect the soundness and cleanliness of grain (which do not characterize anything about end-use functionality) is not always completely understood.

At this October’s AACC International Annual Meeting in Savannah, GA, U.S.A., a symposium, entitled “Assessment of Grain Quality: From Breeding to Store Shelf,” will feature six speakers who will discuss aspects of quality and meaningful current and potential testing methodologies. Since the definition of quality changes during each stage of the breeding, marketing, milling, and end-use of grain utilization process, the symposium will focus on new and novel analytical tools and techniques, based on cereal chemistry, appropriate to defining quality at each stage of grain production and utilization. Techniques discussed range from molecular marker technology to analyses of bioactive compounds. Newer, nontraditional methods of analysis will be emphasized. Basic chemical and molecular biological tests will be discussed to a greater extent than

¹ Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture and does not imply its approval to the exclusion of other products that also may be suitable.

analytical methods that have been used for many years. Also incorporated will be a discussion of how knowledge gained from end-user feedback is reworked into new breeding strategies. Understanding what quality is, and how working definitions vary, provides the basis for informed, economically sound decisions in the marketplace.

The symposium's goal is to shed light on the elusive nature of wheat quality, allowing participants to gain a better understanding of what "quality" is at various steps in wheat development and utilization. The presentations will take about one and a half hours, leaving time for a half-hour discussion and question-and-answer period that enlists the audience as symposium participants, using the new "Science Café" format at this year's conference.

Determining Quality

Robert Graybosch (USDA-ARS, Lincoln, NE, U.S.A.) will discuss the first phase of quality determination in wheat. Over the past four decades, the area of plant breeding and genetics has been revolutionized by technological advances in the areas of DNA manipulation and evaluation. These approaches have brought new products to market via genetic transformation and have vastly improved the efficiency of selection in breeding programs. At the same time, technological advances in the fields of immunology and spectroscopy have improved breeders' ability to rapidly describe the phenotype of new selections.

This portion of the symposium will examine some of the advances in genetic manipulation, DNA marker assisted selection, and rapid phenotyping that have impacted breeding efforts to improve or alter wheat quality. Attention will be focused on efforts to alter grain polyphenol oxidase activities, starch composition, gluten strength, and tolerance to preharvest sprouting. The optimal method for each approach will be identified.

Glen Weaver (Conagra, Omaha, NE, U.S.A.) will discuss aspects of quality during the marketing and grain movement portion of wheat trade and utilization. The quest for knowledge, and the definition of "wheat quality," is a goal of every person in today's wheat business and scientific environment. This is especially true when defining the term "quality" in the channels dealing with a vast range of wheat classes and potential functionality. The process begins with the inception of a variety and is present all the way to the consumer searching through retailer shelves for products that meet an individual's product quality ideals.

The range of what "quality" means in marketing and trade channels today will also be explored. Virtual integration, as the next frontier of refining what "quality" means, in the entire wheat supply, will be discussed. Furthermore, economic implications to business growth and the assessment of how to align consumer satisfaction with quality determinants in the marketing chain will be addressed. Quality alone is a desirable goal, but it has to be defined in ways that allow success both for end-users and in a fashion that makes economic sense to grain marketing and the grain trade.

Defining Quality

Chris Miller (Kansas State University, Manhattan, KS, U.S.A.) will discuss "what is quality and how is it defined for milling?" To preface a discussion of experimental milling techniques, a short reiteration of current quality parameters (i.e., kernel plumpness, kernel size uniformity, intrinsic flour yield, etc.) will be undertaken. Wheat millers need to meet customer expectations. The customers in this case being large bakeries and other flour users who have distinct requirements that need to be achieved economically. How do com-

A Perten ad appeared here in the printed version of the journal.

mercial mills manage the quality requirements of their customers, while trying to obtain quality from their grain suppliers who have different definitions of quality?

In experimental milling, there are two basic approaches for defining quality. First (which certainly exists), is an experimental method that minimizes variability due to the milling process, so we can evaluate the differences in intrinsic wheat performance. Second (which doesn't necessarily exist), reflects commercial mill performance, where a flour mill sets the extraction based on a budgeted amount for maximum economic gain.

Mills, as customers, use data from experimental milling to make decisions about which wheat to buy. However, the milling yield and rheological/end-use data are based on wheat and flour from the standardized experimental method. For example, will a wheat lot exhibiting great baking performance at 65% extraction, demonstrate the same great baking performance when the wheat is milled at the "budgeted"

**Come to the
2010 AACC International
Annual Meeting to Experience
this Article in Person**

The 2010 AACC Intl. Annual Meeting will take place October 24–27, 2010, in beautiful and historic Savannah, GA, U.S.A. The 2010 Program Planning Team, led by Christophe Courtin of Katholieke Universiteit Leuven, has listened carefully to your feedback and implemented changes to the program that make it easy to meet with the presenters and fellow attendees who share your areas of interest.

In 2009, the annual meeting was focused on AACC International's 7 Key Scientific Initiatives throughout all aspects of the program. Based on your feedback, the scientific sessions and posters will continue to be organized in this manner, but will list all applicable initiatives for each session instead of only one per session. For instance, the session featured in this article, will be categorized under both Quality and Analytical Methods and Ingredients and Cost of Goods Sold.

Also new for 2010, four of the 12 symposia, including this session at the meeting, will be in the new Science Café format. This twist on the traditional symposium format will consist of shorter talks on multidisciplinary, cross-scientific initiative topics with additional time built in for discussion, questions, and debate.

extraction of 75%? Commercial and experimental milling data can be correlated, but are these data reflected in end-use performance at bakeries? Information will be presented about the degree to which experimental milling techniques agree with commercial milling results.

Ian Batey (CSIRO Food Science, North Ryde, Australia) will take up the discussion of how to analyze and define flour quality. Traditional methods of measuring flour quality require significant amounts of material, time, and the availability of appropriate (and usually expensive) equipment. While the amount of material is not usually an issue in the commercial world, time and equipment are not always on hand. Sometimes the equipment is present but the amount of material required for testing (such as in breeding programs) is not. There are many predictive tests for flour quality that can be applied in appropriate situations. Some of these require high-tech equipment, such as high performance liquid chromatography (HPLC), while others are much more basic. They all give the possibility of allowing the selection of samples of suitable quality for the purpose in mind.

Sometimes, exactly defining end-use applicability in a specific product is not necessary; in which case, predictive tests may be applied. Furthermore, predictive testing has advanced over the years and has moved beyond traditional testing instruments that still have substantial deficiencies, although the methods have served the industry well in the past. Newer chemical and physical testing methods have the capability of more exactly and/or more quickly defining the potential quality of more flour lots.

New Quality Methods

Mirko Bunzel (University of Minnesota, St. Paul, MN, U.S.A.) will discuss new aspects of wheat quality that are becoming increasingly important to the consumer after production. Phytochemicals from cereal grains, e.g., hydroxycinnamic acids, lignans, phytosterols, etc., have been determined to be responsible for a range of health-beneficial effects and are related to whole grain consumption. However, some of the beneficial compounds to human health create challenges in the processing and production aspects of wheat utilization.

Recently, a lot of publications contain data about different cereal grain phytochemicals and their amounts in cereal-based products. However, since the methods are often nonvalidated and/or utilize unspecific methodologies, it is hard to compare results from different laboratories. Minimum requirements for analytical

methodologies (e.g., determination of the limit of detection, limit of determination, recovery, etc.) used to analyze phytochemicals from cereal grains will be discussed in this presentation. Also, widely used but unspecific methodologies, to determine, for example, total phenolic content, etc., will be discussed as well as what conclusions can be drawn from applying these methods.

As whole grain products receive more attention from scientists and consumers, new methods and definitions of what constitutes quality for consumers becomes more important. Quality, as it is reflected in nutrition and health, requires better and more standardized methodology to allow discussion and comparisons to be made in an informed fashion.

The Grain Chain

Ed Souza (USDA-ARS Soft Wheat Quality Lab, Wooster, OH, U.S.A.) is the last speaker in the symposium's program. He will address the sum of the laboratory-based techniques and how researchers can use wheat breeding programs to advance the knowledge available in the whole wheat marketing and utilization chain.

Wheat evaluation programs receive large numbers of newly bred wheat lines. Sometimes, lines stand out as having either excellent or extraordinarily poor quality attributes (per the definitions provided by the previous speakers). These samples provide subject matter for further research into the causes of their quality attributes or deficiencies. The identification of the biochemical components that influence quality leads to the development of new techniques and tests. Much of AACC Intl.'s approved methods have tests derived from just such research. The development of new testing methods is crucial to implementing new knowledge of critical quality attributes into the wheat breeding and development process.

Furthermore, the tests that are developed can point the way to "backtracking" to the genetic underpinnings of the biochemical influences on quality. Identification of genes of interest, genes that the utilization community either wants to have emphasized or deleted, is critical to the advancement of quality in the marketplace and the economic benefits that can be derived. Deploying molecular markers or DNA sequences to wheat breeders allows them to rapidly identify parental sources of the genes of interest and to screen large numbers of progeny for potential advancement in breeding programs.

Breeding new, high-quality wheat lines requires informed decisions about the selection of lines. And the information to

power these decisions comes from the culmination of the tests that have been designed to measure and track “quality” all the way back to the genes that can be emphasized or removed from the wheat’s genome.

Overall, consumers pay for the perceived quality of products, balancing their desire for quality with the cost of obtaining it. If wheat breeders, marketers, millers, and end-users can efficiently and economically provide quality to consumers at each point of the wheat utilization chain everyone benefits. The “Assessment of Grain Quality: From Breeding to Store Shelf” symposium hopes to illuminate the elusive nature of quality.

We encourage attendees to come to the symposium with their thoughts and questions as well provide an even more beneficial and educational experience through an animated half-hour discussion and question-and-answer period after the presentations have concluded. We, the authors and organizers of the symposium, also wish to thank the presenters for their time in both presenting and contributing their thoughts for this article.



Arthur D. Bettge began his post-college career with two years in the Peace Corps in Niger, followed by two years as a porpoise observer for the National Marine Fisheries Service. He changed his focus to cereals when he began working as a technician at the USDA-ARS Western Wheat Quality Lab in 1980. He obtained an M.S. degree in food science, working under Y. Pomeranz and became manager of the WWQL’s research lab. He has been a part of more than 30 published research articles. He has served as an officer in the Pacific Northwest Section of AACC International, served as a faculty member in short courses, and is chair of the Soft Wheat and Flour Products Technical Committee. He has also organized several symposia for AACC Intl.’s annual meetings. He is a proud recipient of the Milling and Baking Division’s John C. Halverson Memorial Lectureship and has been recently elected to AACC Intl.’s Board of Directors. He can be reached at art.bettge@ars.usda.gov.



Sean Finnie is currently a post-doctoral research fellow at the Katholieke Universiteit Leuven in Leuven, Belgium. He received his Ph.D. degree in grain science and industry from Kansas State University, studying the sources of variation in wheat polar lipids. He has an M.S. degree in food science from the University of Idaho, where he conducted research at the USDA-ARS Western Wheat Quality Laboratory on soft wheat flour quality evaluation. His current research focuses on understanding lipid functionality in gluten/starch separation and breadmaking. He is the recipient of the C. W. Brabender Ph.D. Fellowship (2008–2009) and the winner of the AACC Intl. Best Student Research Paper Competition (2009). He can be reached at sean.finnie@biw.kuleuven.be.

A Stable Micro Systems ad appeared here in the printed version of the journal.