March 30, 2007

Dr. Rolf Grossklaus
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Dear Dr. Grossklaus,

Background

AACC International fully supports the definition of dietary fiber currently under discussion by the Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU) and at Stage 6 of the Codex process. This definition is in general accord with a definition arrived at by AACC International (CEREAL FOODS WORLD 46(3); 112-126, 2001).

AACC International further supports adoption of the 29th Session of CCNFSDU and by the CAC of the definition of dietary fibre[1] as proposed for final adoption at the 28th Session of CCNFSDU in November 2006 (ALINORM 06/29/26).

Key Issues:

1. **Why is there an interest in dietary fiber contents in foods?**

A definition of dietary fibre needs to include the recognition of physiological effects as well as structural/component classifications. If it were not for the physiological effects of dietary fibre, there would be little or no interest in the subject on the part of researchers, consumers, regulators, and manufacturers. The term dietary fibre was coined and its definition refined based on observations of positive health effects related to consumption of diets rich in this component [1].

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[1] **Definition:**
Dietary fibre means carbohydrate polymers with a degree of polymerisation (DP) not lower than 3, which are neither digested nor absorbed in the small intestine. A degree of polymerisation not lower than 3 is intended to exclude mono- and disaccharides. It is not intended to reflect the average DP of a mixture. Dietary fibre consists of one or more of:

Edible carbohydrate polymers naturally occurring in the food as consumed
Carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means,
Synthetic carbohydrate polymers

Properties:
Dietary fibre generally has properties such as:
• Decrease intestinal transit time and increase stools bulk
• Fermentable by colonic microflora
• Reduce blood total and/or LDL cholesterol levels
• Reduce post-prandial blood glucose and /or insulin levels.

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1. **How is dietary fibre defined and measured?**

The definition and analysis of dietary fibre are intimately related. Analysis methods have to be developed in accordance with the conceptual definitions, but in practice, compromises must be accepted due to constraints of cost and time. All types of dietary components can be separated at different levels of complexity and determined separately for research purposes, though short-hand methods are needed for labelling and control purposes [2].

Measurement of dietary fiber

As defined, dietary fiber is resistant to hydrolysis (digestion) by the alimentary enzymes of humans, but partially or wholly fermented in the large intestine. Based on this definition, appropriate methodology has been developed and validated through international interlaboratory studies, and became standard methods of AOAC International (Official Method 985.29, 991.43 and 994.13) and AACC International (Methods 32-07, 32-21 and 32-05). As our knowledge of dietary fibre and dietary fibre measurement has advanced, it was recognised that some components were either underestimated or not measured at all. Such components include resistant starch (RS) and non-digestible oligosaccharides (NDO), which include inulin-type oligosaccharides (fructo-oligosaccharides; FOS), galacto-oligosaccharides (GOS), polydextrose (PDX), and resistant maltodextrins (RMD). Subsequently, methods were developed to specifically measure these components; FOS (AOAC Methods 997.08, 999.03), GOS (AOAC Method 2001.02), PDX (AOAC Method 2000.11), RMD (AOAC Method 2001.03), and RS (AOAC Method 2002.02)). To assist particular food claims, a specific method for cereal -glucan (AOAC Method 995.16) was also developed. Almost universally, dietary fiber databases, essential for scientific nutrition research and nutrition monitoring are populated with pertinent data generated utilizing the applicable methods (discussed above) consistent with the final adoption of dietary fiber definition at CODEX stage 6 (ALIMORM 6/29/26). The data populating these data bases is the result of dietary fiber analysis and research of over a quarter of a century, utilizing Official and Approved methodology based on scientific consensus of methods standard setting entities. Adopting ALINORM 6/29/26 will further enhance the utility of this wealth of scientific information.

Because dietary fiber is a multicomponent carbohydrate mixture, several methods are currently used to ensure measurement of all relevant components. However, scientists working in dietary fiber are fully appreciative of the need for an integrated procedure to measure all the dietary fiber in a single assay. Appropriate methodological research is currently in progress.

Issues arising from the FAO/WHO Experts meeting on Carbohydrates in Human Nutrition; Geneva, 17-18th July, 2006 and resulting in the definition of dietary fiber introduced at the CCNFSDU meeting in Thailand in November 2006.

Key recommendations/conclusions from this meeting:

1. Dietary fiber consists of intrinsic plant cell wall polysaccharides only. It does not include carbohydrate polymers that have been obtained from plant products by physical, chemical or enzymic means. It also does not include NDO or resistant starch.

2. Any reference to specific physiological properties within the definition is neither appropriate nor manageable. Non-digestibility cannot be measured in the laboratory.

3. Methods of analysis are stated as being a secondary issue. However, the Englyst non-starch polysaccharides (NSP) method is used as a base reference method.

AACC International offers the following comments for consideration:

1. As stated in the opening paragraph of this document “a physiological basis for the definition of dietary fiber is necessary. If it were not for the physiological effects of dietary fiber, there would be little or no interest in the subject on the part of researchers, consumers, regulators, and manufacturers [1].” Exclusion of carbohydrate polymers, independent of their means of formation, that have numerous well-designed studies consistently showing them to have physiological properties consistent with those included in a definition of dietary fiber does not appear to be warranted on a scientific basis.

2. In response to the claim that non-digestibility cannot be measured, this may be true if related to the whole human digestive tract, but in both the proposed CODEX and the AACC International definitions, digestibility is related solely to the alimentary enzymes of humans. This, in fact can be simulated in *in vitro* laboratory experiments employing either pancreatic enzymes, or purified bacterial and/or fungal enzymes with very similar action patterns and specificities, and devoid of activities not present in the human small intestine.

3. The NSP method advocated in point 3 above, does not assay food samples for DF, not even DF using the definition advocated by the WHO/FAO expert group. The NSP method measures any and all polysaccharides that are in a food sample, not only cell wall polysaccharides, but plant storage polysaccharides, synthetic or modified polysaccharides, polysaccharides whose conformation is altered during processing and polysaccharides isolated from various sources and added as in ingredient to make a food product. The advocacy position of the WHO/FAO expert committee is that the NSP method will be indicative of the relative amount of fruits, vegetables, and whole grains in the diet. The content of fruits, vegetables, and whole grain can be determined in their own right, typically by counting the number of items eaten (oranges, apples, carrots tomatoes) or the number of servings consumed (oatmeal, whole wheat bread). The NSP method, which measures all polysaccharides not digested by amylase results in quantification of a mass that in no way relates to the fruit, vegetable and whole grain content or the dietary fiber content of the food. Further, the NSP method advocated has been submitted on several occasions to AOAC International and to AACC International for adoption as an Official Method of AOAC or as an Approved Method of AACC. Said method was not adopted by either standard setting organization due to unanswered questions regarding the performance of the method and the fact the method does not measure a nutritionally relevant component of foods.

   This NSP method proposed requires the complete hydrolysis of polysaccharides to constituent monosaccharides and analysis of these by HPLC, GLC or colorimetrically. Acid hydrolysis does not give quantitative conversion of polysaccharides to the constituent monosaccharides; while some of the more difficult polysaccharides are being hydrolyzed, particular monosaccharides are being "lost" as furfural and methylfurfural. Measurement colorimetrically is complicated by the fact that the color response with various monosaccharides varies, and the ratio of monosaccharides in different plant preparations varies. Further, the results obtained by the colorimetric method do not agree with either the results obtained using HPLC or GLC.

1. DeVries J W (2004) J AOAC Int, 87: 682-706

2. Asp N-G (2001) Advanced Dietary Fibre Technology (B. V. McCleary and L. Prosky Eds.) Blackwell Science Publishers, Oxford, U.K.

Best Regards,

Rob Hamer, Ph.D.
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