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FAO/WHO Scientific Update on carbohydrates in human nutrition: introduction

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Carbohydrates in human nutrition

Since the 1950s, FAO and WHO have regularly held joint expert meetings to review the state of scientific knowledge on the role of various nutrients in the human diet, that is, proteins, fats and oils, and most vitamins, minerals and trace elements, to provide guidance on their requirements and recommended intakes (Weisell, 2002).

The Joint FAO/WHO Expert Meeting on Carbohydrates in Human Nutrition held in Geneva from 16 to 26 September 1979 was the first to focus on the topic of carbohydrates (FAO, 1980) and aimed to review the role of carbohydrates as determinants of human health and diseases. It was wide ranging in scope and addressed the important role of carbohydrates (1) as sources of energy contributing to the improvement of human nutritional status; (2) as determinants of the sensory qualities of foods, that is, flavour and texture and the acceptability of foods; (3) and their influence on the physiology and pathology of the large intestine, particularly through a deeper understanding of the role of dietary fibre; (4) as potential determinants of dental caries, obesity, cardiovascular disease and diabetes; and (5) as they relate to the nutrition of infants and young children, including the role of lactose and its inclusion in weaning foods.

The Expert Meeting recognized, however, that it was inappropriate to focus on the nutritional effects of a single dietary component due to the wide range of carbohydrates consumed in the diet, and the fact that the overall nutritional consequences of any dietary pattern represents the integration of a wide range of interactive effects. Further studies were, therefore, considered to be necessary for understanding the interactions between carbohydrates and many other components of the diet to contribute to the improvement of the health and nutritional well-being of the world's population (FAO, 1980).

Eighteen years later, the Joint FAO/WHO Expert Consultation on Carbohydrates in Human Nutrition was convened in Rome from 14 to 18 April 1997 (FAO, 1998). Much progress was made in understanding the role that carbohydrates play in human nutrition and health. These included the following: (1) additional understanding of the role of dietary fibre, and in particular, its role in moderating the process of digestion in the small intestine and its potential as a major substrate for fermentation in the colon; (2) increased understanding of the diverse physiological roles that carbohydrates have, dependent upon the site, rate and extent of digestion and fermentation in the gut; (3) the potential of carbohydrates to enhance physical performance through glycogen loading; and (4) further understanding of the relationship between the diet and various noncommunicable diseases, including obesity, type II diabetes, coronary heart disease and some forms of cancer. Thus, it was again confirmed that carbohydrates are not only an energy source, but also have important impacts on the maintenance of health. The following recommendations were derived: (1) the terminology used to describe dietary carbohydrates should be based primarily on molecular size (degree of polymerization), with additional terms used to define nutritional groupings based on physiological properties; (2) the total carbohydrate in the diet should be measured as the sum of the individual carbohydrates rather than 'by difference', as was also recommended by the 1979

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Expert Meeting; (3) the analysis and labelling of dietary carbohydrate should be based on chemical divisions; (4) at least 55% of total energy should be provided from a variety of carbohydrate sources, regardless of the nature of the dietary pattern; and (5) the glycaemic index—which measures the impact of foods on the integrated response of blood glucose—be used to compare foods of similar composition within food groups (FAO, 1998).

Two other joint FAO/WHO meetings convened in early 2000 also contributed in part to recommendations relevant to carbohydrates. These were the Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases convened in Geneva, from 28 January to 1 February 2002 (WHO, 2003; Nishida and Shetty, 2004) and the Technical Workshop on Food Energy—Methods of Analysis and Conversion Factors held in Rome, from 3 to 6 December 2002 (FAO, 2003).

The overall objective of the 2002 Joint WHO/FAO Expert Consultation was to update current international recommendations on diet, nutrition and the prevention of chronic diseases. The Consultation evaluated the latest scientific evidence and lessons learned from implementing national intervention strategies to reduce the burden of noncommunicable diseases. On the basis of more recent evidence, the earlier recommendations on population nutrient intake goals to prevent diet- and nutrition-related chronic diseases formulated in 1989 by the WHO Study Group (WHO, 1990) were updated. Industrialization, urbanization, economic development and market globalization have resulted in rapid changes in dietary patterns described as 'nutrition transition' which reflects both quantitative and qualitative changes in the diet. The adverse dietary changes include shifts in the structure of the diet towards a higher energy density with a greater role for fat and sugars in foods, greater saturated fat intake (mostly from animal sources), reduced intakes of complex carbohydrates and dietary fibre and reduced fruit and vegetable intakes (WHO, 2003). This, together with a decline in energy expenditure associated with a sedentary lifestyle, has significantly impacted the health and nutritional status of the population. This phenomenon has been most marked in developing countries and those undergoing rapid socioeconomic transition, and has contributed to the increasing burden of diet- and nutrition-related noncommunicable diseases, such as obesity, type II diabetes, cardiovascular disease, including hypertension and stroke, and some forms of cancer. Population nutrient intake goals updated by this Consultation have provided the basis for dietary recommendations for the prevention of these diseases when formulating national dietary guidelines and national food and nutrition policy. The outcomes and recommendations of the Consultation also provided the scientific basis for the WHO Global Strategy on Diet, Physical Activity and Health endorsed by the 57th World Health Assembly (WHA 57.17) in 2004 (WHO, 2004).

The range of population nutrient intake goals for carbohydrates recommended by the Consultation was 55–75% of total energy (WHO, 2003), the same as that recommended by the 1989 WHO Study Group (WHO, 1990). The wide range was based on the consideration of protein and fat requirements as well as the observation that intakes of carbohydrates over this range were not always compatible with optimal human health. Furthermore, the Consultation emphasized that the aim of the recommendation was to maximize the intake of minimally processed carbohydrates and minimize the intake of free sugars (<10% of energy intake). The Consultation further indicated that regular consumption of whole-grain cereals, fruits and vegetables, which are preferred sources of nonstarch polysaccharides, were likely to reduce the risk of diet- and nutrition-related noncommunicable diseases. The Consultation agreed that the best definition of dietary fibre remains to be established, given the potential benefits of resistant starch (WHO, 2003).

The 2002 FAO Technical Workshop on Food Energy—Methods of Analysis and Conversion Factors (FAO, 2003) was organized as a follow-up to the 2001 Joint FAO/WHO/UNU Expert Consultation on Human Energy Requirements convened in Rome, 17–24 October 2001 (FAO, 2004; Shetty and Martinez Nocito, 2005) to review the issue of how best to match energy requirements with food intakes, given the new energy requirement values based on energy expenditure. The Technical Workshop also addressed the request made by the Codex Committee on Nutrition and Foods for Special Dietary Usages (CCNFSDU) for harmonizing energy conversion factors, and thus enabled uniformity in labelling and information provided to consumers (CCNFSDU, 2001, 2002). The workshop reviewed the commonly used analytical methods for protein, fat and carbohydrate, and made recommendations regarding the preferred state-of-the-art methods and the most appropriate technology, as well as existing acceptable methods used in the absence of preferred methods.

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As part of the normative work and the complimentary mandates of the two organizations to periodically update nutrient requirements and regularly develop related global guidelines, FAO and WHO have been exploring the possibility of holding an expert consultation to update the work of the 1997 Expert Consultation. Considered necessary given the developments and other relevant recommendations made during the intervening period, including those from the 2002 Joint WHO/FAO Expert Consultation (WHO, 2003), FAO and WHO agreed in 2005 to undertake a scientific update on some of the key issues related to carbohydrates in human nutrition. The key issues identified included terminology and classification, measurement, physiology, carbohydrates and diseases (that is, obesity, diabetes mellitus,

cardiovascular diseases and cancer), and glycaemic index and glycaemic load. This update of existing knowledge and evidence relating to the current recommendations was viewed as essential in the process leading up to a forthcoming Expert Consultation on Carbohydrates in Human Nutrition.

Process of undertaking the scientific update and criteria for selecting experts

The process and criteria for selecting experts to be invited to prepare the scientific papers on each identified issue relating to carbohydrates were discussed and agreed upon by FAO and WHO. The identification of the issues to be reviewed and possible experts to prepare these papers began in June 2005. The names of possible experts who might prepare or peer-review each scientific review paper were identified after consulting various other nutrition experts on the basis of their competency and expertise in each of the identified areas of work, as well as their independence. The consultation and review of selecting possible experts continued until September 2005. It was agreed that the review papers would be a thorough scientific update of those identified issues related to carbohydrates and of topics for further consideration, both of which are presented in this supplement. It was further agreed that the outcomes of this review process should be seen as the conclusions of the scientific update, not as updated recommendations.

By June 2006, the scientific review papers had been completed and peer-reviewed. The papers were then further examined, together with peer reviewer comments, at an authors' meeting held in Geneva from 17 to 18 July 2006, to identify any gaps or issues needing further consideration before being finalized. The authors' meeting was also attended by selected expert peer reviewers to ensure a high level of critical review and analysis of each paper. Taking the critical comments received from the peer-review process and the discussions at the authors' meeting, the scientific review papers were further revised and sent for a second round of peer review before their finalization.

Transparency of the process

Forty experts were involved in this scientific update, serving either as an author of a review paper or as an expert peer reviewer. Before being officially invited to take part in this work, all experts were requested to declare any possible conflict of interest to ensure the integrity of each expert's contribution. These declarations of interest, which were carefully assessed by FAO and WHO, would be publicly disclosed after obtaining the expert's agreement in writing to do so. Public disclosure of experts' declaration of interest involved (1) announcing the declarations at the authors' meeting; and (2) appropriately disclosing the declaration in the subsequent publication of the papers prepared for the scientific update, that is, this supplement. The primary purpose of this transparency was to ensure open and productive debate on the key issues selected for the scientific update by providing insight into the differing perspectives of all participating experts.

The review papers published in this supplement provide the rationale and scientific basis supporting the conclusions and proposals presented by the Scientific Update. In addition, they provide the scientific community with a valuable resource relating to several important nutrition topics. Rapid progress is taking place in a number of scientific fields that affect issues related to human nutrient requirements. Evidence derived from a range of different scientific approaches has helped to clarify the role of diet, some individual dietary components and even particular nutrients in the aetiology of various diseases. Thus, changes in diet have strong effects, both positive and negative, on the health and nutritional status of people throughout the life course, and the potential to promote human health and reduce the risk of a number of chronic diseases. FAO and WHO are committed to continue to provide scientifically sound, evidence-based advice and guidelines on human nutrient requirements and other related topics through a transparent and neutral process.

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Conflict of interest

The authors, Dr Chizuru Nishida and Mr Frank Martinez Nocito, declare no conflict of interest.

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