See corresponding article on page 30.

Building scientific consensus: the importance of dietary fiber[1,2]

Barbara O Schneeman

Consumption of foods high in dietary fiber has been associated with lower risk of cardiovascular disease. As a consequence of this epidemiologic observation, many clinical trials have been conducted in the past 25 y to examine the ability of fiber to reduce plasma cholesterol concentrations. Fiber sources in these studies included isolated fiber supplements, fiber-enriched ingredients, or whole foods that provide dietary fiber. In this issue of the Journal, Brown et al (1) report the results of a meta-analysis of studies in which isolated polysaccharides (pectin or guar gum) or fiber-enriched ingredients (oat bran or psyllium) were fed in human clinical trials to determine the quantitative effect of these fiber sources on blood lipids. All of these fiber sources provide polysaccharides that are viscous as well as fermentable in the large bowel. This meta-analysis confirms that viscous polysaccharides significantly reduce total blood cholesterol concentrations, specifically LDL cholesterol, but do not alter concentrations of HDL cholesterol or triacylglycerol. Although there is a strong scientific consensus that certain types of fiber can lower plasma and LDL cholesterol, there is less agreement regarding the mechanism or mechanisms of this effect. Confusion over the mechanism exists in part because we have tried to simplify the complexity of fiber with the notion of soluble and insoluble fiber and because we have assumed that only one mechanism can account for the protective effects of fiber. If we are to use dietary fiber effectively in lowering cardiovascular disease risk, it is important to focus our efforts on discovering the mechanism or mechanisms by which different fibers affect lipoprotein metabolism.

The concept of soluble and insoluble fiber developed through the fractional extraction of polysaccharides from foods by controlling pH. Initially, this simple division appeared to aid in our understanding of the diverse physiologic effects of fiber: soluble fibers blunted glucose and lipid absorption whereas insoluble polysaccharides improved bowel habits. Unfortunately, this distinction is not that useful because variables such as the extent of fermentation, viscosity of the polysaccharides, and binding capacity are more important in understanding the physiologic response to consumption of different fiber sources (2). For example, Chen et al (3) reported that both wheat bran (a source of insoluble fiber) and oat bran (a source of soluble fiber) increase stool weight in human subjects. When wheat bran was fed, undigested plant residue was the most significant contributor to increased stool weight, whereas bacteria were the major contributor when oat bran was fed, presumably because of the highly fermentable nature of the polysaccharides in oat bran. The recent FAO/WHO report (4) on dietary carbohydrates recommends that the terms *soluble* and *insoluble fiber* be phased out of usage because these divisions are useful neither analytically nor physiologically. The recommended chemical divisions are based on degree of polymerization and include monosaccharides, disaccharides, polyols, oligosaccharides, starch, and nonstarch polysaccharides. The combination of chemical divisions and functional characteristics will provide greater insight into the role of fiber in nutrition and health.

Many scientists resisted the notion that fiber could modify cardiovascular disease risk because fiber is not digested in the small intestine. All other dietary factors that affect cardiovascular disease risk do so after they are absorbed and are in the circulation or in tissues. The indigestible nature of fiber suggests that we need to change our thinking about the role of the gastrointestinal tract in metabolism and health. The viscosity of dietary components can modify the rate and site of nutrient absorption, fermentation of polysaccharides in the large bowel can produce products that affect metabolism, and binding of compounds, such as bile acids, affects the excretion of the compounds. All of these characteristics can modify metabolism in ways that affect disease risk.

Finally, recognition of the role of fiber in lowering risk of cardiovascular disease reminds us of the importance of food-based strategies for maintaining health. The meta-analysis conducted by Brown et al indicates that the effect of fiber by itself on plasma cholesterol is likely to be modest. However, when intact foods are considered as the source of fiber, the overall effect on disease risk appears to be greater. Such observations suggest that fiber serves as a marker for diets rich in plant foods, which provide additional benefits for maintaining health. Perhaps future meta-analyses will review the potential for disease risk reduction of foods that provide fiber.

REFERENCES

1. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. Am J Clin Nutr 1999;69:30–42.
2. Schneeman BO. Dietary fiber and gastrointestinal function. Nutr Res 1998;18:625–32.
3. Chen H-L, Haack VS, Janecky CW, Vollendorf NW, Marlett JA. Mechanisms by which wheat bran and oat bran increase stool weight in humans. Am J Clin Nutr 1998;68:711–9.
4. Joint FAO/WHO Expert Consultation. Carbohydrates in human nutrition. Geneva: Food and Agriculture Organization, World Health Organization, 1998. (FAO Food and Nutrition Paper 66.)

[1] From the Department of Nutrition, University of California, Davis.
[2] Address reprint requests to BO Schneeman, Department of Nutrition, One Shields Avenue, University of California, Davis, CA 95616. E-mail: boschneeman@ucdavis.edu.