Wheat Bran Fibre and Regularity: the original functional food

Highlights from the Plenary Session at the Canadian Nutrition Society Annual Meeting in Edmonton, Alberta on June 5th, 2010.

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LORETTA DiFRANCESCO
PhD, RD, MBA
Source! Nutrition®

Dr. Loretta DiFrancesco is Principal of Source! Nutrition, a consulting business in scientific and regulatory affairs in food and nutrition. Prior to establishing this business, she held various food industry positions in nutrition research, product development and scientific and regulatory affairs in the United States and Canada. She earned her PhD in nutrition from the University of Guelph and MBA from New York University. Through her professional memberships and experience, she has chaired the Scientific and Regulatory Affairs Council for Food & Consumer Products of Canada and held appointments on Health Canada’s advisory panels on food fortification and health claims. She has also served on the Board of Directors of the Canadian Foundation for Dietetic Research and as Chair of its Scientific Review Committee.

Wheat bran fibre has long been recognized for its superiority in promoting regularity. As cited in the Institute of Medicine Dietary Reference Intake Report, “wheat bran provides more stool per gram of fiber than any other source studied.” The most recent research on wheat bran fibre and the promotion of regularity – including effects on gut health, implications for children and looking beyond the gut to other metabolic advantages – was showcased at the plenary session of the 2010 Canadian Nutrition Society Annual Meeting.

DIETARY FIBRE AND GUT HEALTH: NOT ALL FIBRES ARE ALIKE

Joanne Slavin, PhD, RD – University of Minnesota

Dr. Joanne Slavin is Nutrition Professor at the University of Minnesota. She has authored more than 150 scientific publications, including the fibre position paper for the American Dietetic Association and serves on the USDA 2010 Dietary Guidelines Advisory Committee. Dr. Slavin received BS, MS and PhD degrees in Nutritional Sciences from the University of Wisconsin-Madison and is a Registered Dietitian.

Fibre intakes in North America fall short of recommended levels of 25-38g per day, with typical adult daily intakes at 15-19g. Most of the commonly consumed fibre-containing foods provide only 1-3g of fibre. For example, white flour and potatoes are the largest contributors of fibre to the U.S. diet not because they are concentrated fibre sources, but because these foods are widely consumed. There is both a challenge to adding fibre to the diet without consuming added calories and an interest in using functional fibres and other foods that are concentrated fibre sources to help meet the North American fibre deficit.
Fibre in Normal Digestion and Absorption

Typically, about 95% of macronutrients get digested and absorbed and the leftovers (feces) include fibre, bacteria and water. As carbohydrates move through the digestive tract, those that are fermented include lactose, dietary fibre, functional (isolated) fibre, oligosaccharides, resistant starch and sugar alcohols. Non-fermentable or poorly fermentable carbohydrates include some celluloses and hemicelluloses and resistant maltodextrins; and lignin (a polyphenolic compound) also falls within this category.

Fibre digestibility – how much of a fibre is broken down and fermented – ranges from 2-100% depending on the compound. For example, little purified cellulose is degraded during transit and it is almost all still in the feces. The rate of fermentation also varies by fibre source; and rapid fermentation results in greater intestinal gas. An advantage of wheat bran is that it is slowly fermented compared with other more isolated or functional fibres.

Fibre in Gut Health

Gut health as related to regularity or laxation is described by several subjective factors. Generally, it is seen as normal bowel function, regular and desirable bowel movements (not diarrhoea or constipation) and the absence of symptoms such as bloating, gas and pain. Individuals may see fecal consistency (texture) as more quantifiable measures.

Defining Gut Health

Abnormal Diarrhea

<3 stools per week or >3 stools per day
>200g stool weight per day

(many vegetarians have stool weights >300g per day)

One of the most common gut health issues is constipation – how easily and regularly a bowel movement occurs – and the main dietary link to constipation is a low fibre diet. Other factors are also associated with constipation, including sedentary lifestyles, resisting the urge to have a bowel movement, stress, associated habits such as smoking and coffee drinking, long-term laxative use and some medications. Given these confounding issues and the difficulties in collecting fecal samples, there is some thought on whether fecal samples are required or if subjective measures such as ease and frequency of elimination and bloating and gas are sufficient. In other words, if everything is “going well,” individuals feel good and quality of life does not suffer.

Despite this subjectivity, ways to standardize regularity or laxation effects of dietary components have been developed in relation to the effects of wheat bran, which is considered in the laxation literature as the “gold standard” for regularity and increasing fecal weight. For example, the fecal bulking index (FBI) is the increase over baseline in rehydrated fecal weight induced by a food, as a percentage of the increase induced by an equal weight of wheat bran; and in the Canadian guidelines for novel fibre approval, the fibre source in question must show a laxative effect of at least 50% of that of wheat bran. Data on increase in fecal output per gram of fibre fed also show wheat bran to have the greatest effect and generally, that more fermentable fibres have a lower impact.

<table>
<thead>
<tr>
<th>Fibre Source</th>
<th>Increase g/g Fibre (SEM)</th>
<th>Number of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psyllium</td>
<td>5.4 (0.7)</td>
<td>41</td>
</tr>
<tr>
<td>Polydextrose</td>
<td>4.0 (0.5)</td>
<td>14</td>
</tr>
<tr>
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</tr>
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<td>4</td>
</tr>
<tr>
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</tr>
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Fibre in Gut Health

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Fibre Benefits in Children

Many of the gut health and chronic disease benefits of dietary fibre in adults are applicable to children. Constipation is a common pediatric problem and children have many of the same gastrointestinal diseases as adults. Obesity and high blood cholesterol as risk factors for heart disease are prevalent in children; and there has been a rapid rise in type 2 diabetes and the metabolic syndrome in children and teens. Although chronic diseases are multi-factorial and develop over a lifetime, dietary fibre plays a role and the aim in children is to preclude the development of these diseases in adulthood.

Evidence on the Benefits of Dietary Fibre in Children

Increased dietary fibre and physical activity are associated with decreased symptoms of constipation among pre-adolescent children.

Dietary fibre does not displace energy (thus growth is unaffected) and lowers blood cholesterol in children.

A lower fibre intake is associated with increased abdominal adiposity among Latino children.

Cereal (breakfast) consumption as a means to achieve fibre intake is associated with reduced risk of heart disease as measured by various biomarkers and body mass index.

Stool weight and stool frequency are higher in pre-school children consuming 5-10g of dietary fibre compared with 3g of plant stanols.

Safety concerns about very high fibre intakes in children include the displacement of energy required for growth and/or excess calories from adding more foods to the diet in order to increase fibre intake, gas and abdominal discomfort and decreased bioavailability of essential vitamins and minerals. These concerns are generally unfounded and do not outweigh the benefits of ensuring children eat enough fibre. Children need sufficient energy for growth; and gastrointestinal effects can be managed by gradual introduction of tolerable foods.

“Age +5” and “Age +10” as a Guide to Children’s Fibre Intakes

The general rules of “age +5” and “age +10” to help determine how much fibre children should eat were established 15 years ago\(^5\) and still hold true today to help meet the current fibre recommendation of 14g per 1000 kcal per day. “Age +5” (g per day) is the minimum fibre guideline for children over two years. It is based on the amount of fibre needed for normal laxation, to increase fecal weight to the amounts observed in countries with low levels of colon cancer and to help reduce blood cholesterol. The suggested and safe range of intake is “age +5” to “age +10” and the upper end of this range is useful particularly in older children.

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DIETARY FIBRE: IMPLICATIONS IN CHILD HEALTH

Roger Clemens, DrPH – University of Southern California

Dr. Roger Clemens is Associate Director of the Regulatory Science program and Adjunct Professor of Pharmacology and Pharmaceutical Sciences at the USC School of Pharmacy. He is also the consulting Scientific Advisor for ETHorn. He is an active member in the American Society for Nutrition, and a Fellow in the Institute of Food Technologists (IFT), the American College of Nutrition and the Marilyn Magaram Centre for Food Science, Nutrition and Dietetics. Dr. Clemens also serves on the USDA 2010 Dietary Guidelines Advisory Committee and is president-elect for IFT.

Similar to the dietary fibre deficit in North American adults, fibre intakes in North American children also fall short of recommended levels. Across all provinces in Canada, the usual fibre intake for all child age and gender groups is less than 8g per 1000 kcal per day, which is well short of the daily Adequate Intake (AI) of 14g per 1000 kcal; and even the 90th percentile of fibre intake for all groups is below the AI.\(^6\)

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Increasing Fibre in the Food Supply

Progress toward narrowing the North American dietary fibre deficit can be made by changing agricultural policies and practices to increase the fibre content of the food supply. In the United States, wheat acres (all wheats) planted and harvested have declined from 1969 to present; and in Canada, cropland acreage dedicated to wheat has also decreased. For example in Canada, data show a 10% decline in total wheat for the year June 2006 to 2007. A renewed focus on agricultural practices and development of new cultivars to increase grain and fibre crops could help to support fibre intake goals.

WHEAT BRAN, DIETARY FIBRE: GASTROINTESTINAL HEALTH AND METABOLIC ADVANTAGES

Cyril WC Kendall, PhD – University of Toronto and St. Michael’s Hospital

Dr. Cyril Kendall is a Research Associate in the Department of Nutritional Sciences at the University of Toronto and the Clinical Nutrition and Risk Factor Modification Centre at St. Michael’s Hospital. He is also an Adjunct Professor in the College of Pharmacy and Nutrition at the University of Saskatchewan. Dr. Kendall’s primary research interest is the role of diet in the treatment and prevention of chronic disease and he has over 100 publications in peer-reviewed journals.

Documentation of the health effects of dietary fibre has its origins in the “fibre hypothesis” from Dr. Dennis Burkitt. His observational studies in Africa in the 1960s showed the high fibre and low fat African diet is associated with high fecal output and low rates of cancer, heart disease and diabetes. Over the past century and with prosperity, dietary patterns have shifted. The modern diet – very low in fibre and higher in fat – is in large part responsible for the dramatic increase in obesity and the metabolic syndrome and associated chronic diseases, including diabetes and heart disease.

Dietary Changes with Prosperity

<table>
<thead>
<tr>
<th>Traditional, Developing Countries</th>
<th>Modern, Developed Countries</th>
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<tbody>
<tr>
<td>Protein</td>
<td>Vegetable</td>
</tr>
<tr>
<td>Starch</td>
<td>Animal</td>
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<tr>
<td>Fat</td>
<td>Sugar</td>
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<td>Salt</td>
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Wheat Bran Fibre and Colonic Function

There is significant scientific agreement on the laxation benefits of high fibre diets and the majority of this evidence is on cereal fibres, primarily wheat bran. Both a metabolic and ad libitum feeding study have shown positive effects on colonic measures with 17-19g of wheat bran fibre of various particle sizes added to a low fibre control diet. Increases in fecal output ranged from 60-70g per day above control, which approximates an increase of 3.5-4.0g per gram of wheat bran fibre consumed. Interestingly, wheat bran fibre also produced an increase of 40-50% above control in total fecal short-chain fatty acids and fine grind wheat bran significantly increased breath hydrogen. These findings indicate wheat bran has metabolic activity and contrast the view that insoluble fibres in general are not metabolically active and not acted upon by gut bacteria.

Fibre and Heart Disease

There is significant scientific agreement on the heart health benefits of dietary fibre and most of this evidence is on the cholesterol lowering effects of viscous fibres such as psyllium and oat and barley beta-glucan. However, dietary fibre in total is also associated with reduced risk of heart disease. In 2001, the National Cholesterol Education Program (NCEP – ATP III) for the first time acknowledged fibre in its guidelines for a heart healthy diet and recommended 20-30g of fibre per day along with its traditional focus on total fat, saturated fat and cholesterol.

### Dietary Fibre and Reduced Risk of Heart Disease

<table>
<thead>
<tr>
<th>Fibre Increase (g/day)</th>
<th>Heart Disease Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>6</td>
</tr>
<tr>
<td>Women</td>
<td>10</td>
</tr>
<tr>
<td>Women</td>
<td>5</td>
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</tr>
<tr>
<td>Women</td>
<td>14</td>
</tr>
<tr>
<td>Meta-analysis</td>
<td>10</td>
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Fibre and Diabetes

Risk of type 2 diabetes and measures of diabetes control have also been investigated for cereal fibre vis-à-vis glycemic load and glycemic index, which are two of the more typical dietary variables in the study of diabetes. In a randomized trial of a low glycemic index or a high cereal fibre diet, the cereal fibre diet produced modest reductions in body weight and diastolic blood pressure not significantly different from the low glycemic index diet; and reductions in fasting glucose and glycated hemoglobin (HbA1c) were also observed on the high cereal fibre diet.

The “Bottom” Line

- Not all fibres are equally effective in increasing fecal weight. Wheat bran is the most effective and fibres that are extensively fermented during gut transit have little impact.
- Dietary fibre has important health benefits in childhood for both current health and future adult health. No longer viewed as an adult nutrient – kids need fibre.
- High fibre intake – which is predominantly wheat bran in North America – is associated with reduced risk of heart disease and diabetes. Wheat bran and other insoluble fibres are to some extent fermented, which may produce metabolic advantages other than the traditional markers of these two diseases.

References Cited

6. Rautiainen S et al. Dietary fiber does not displace energy but is associated with decreased serum cholesterol concentrations in healthy children. AJCN 91:651-661 (2010)

Recommended Readings

DO ALL HIGH FIBRE FOODS CONTAIN WHEAT BRAN?

No, not all foods that are high in fibre contain wheat bran as their primary source of fibre. By looking for products that list wheat bran or whole wheat as the first ingredient, you can know you are getting the “gold standard” fibre for regularity.

WHEAT BRAN & REGULARITY

The scientific evidence supporting the benefits of wheat bran fibre for the promotion of regularity is extensive and has attained significant scientific agreement from authoritative bodies, including Health Canada and Institute of Medicine.1,2 Health Canada uses wheat bran as the control treatment which other fibres are measured against to scientifically verify regularity effects.1 In other words, wheat bran is the “gold standard” fibre when it comes to regularity.

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WHEAT BRAN: THE BEST FIBRE FOR PROMOTING REGULARITY

All fibres play a role in a healthy diet, but did you know that there are different kinds of fibre and they each work differently in the body? When it comes to regularity and keeping your digestive system on track, it’s important to know what type of fibre to look for.

- Insoluble fibres - found in wheat bran, fruits, vegetables, nuts and seeds - help to promote regularity, a factor in good digestive health
- Soluble fibres - are known to contribute to healthy blood cholesterol levels and regulate blood sugar

5 TIPS TO KEEP YOUR DIGESTIVE SYSTEM ON TRACK

Regularity is different for everyone. Here are some suggestions to help you stay regular:

1. Eat a healthy diet that includes high fibre foods
2. Choose foods that contain wheat bran fibre, the best fibre for promoting regularity
3. Increase your fibre intake slowly so that your body can adjust to the change; for example, begin with 1 tbsp of All-Bran Buds® cereal and increase up to 1/3 cup per day.
4. Drink fluids throughout the day
5. Be active to help keep your digestive system working smoothly – aim for at least 30 to 60 minutes of physical activity every day

References: