

# Grains and Health – An Update

Brought to you by the Team of Registered Dietitians at Kellogg Canada Inc.



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Dr. Alison Stephen is one of Canada's leading nutritionists in the area of grains, fibre and carbohydrates. Her experience includes Professor in the College of Pharmacy and Nutrition, University of Saskatchewan; Project Coordinator for the Department of Environmental and Preventive Medicine, St. Bartholomew's Medical College, London; Research Associate at the Department of Medicine, Case Western Reserve University, Ohio; and Postdoctoral Research Fellow at the Gastroenterology Unit, Mayo Clinic, Minnesota. Dr. Stephen's extensive research in carbohydrates and fibre has focussed on human colonic function, particularly the roles of dietary fibre and starch, and she continues to study trends in consumption of fat, carbohydrate and energy in Canada, the United States and the United Kingdom. Dr. Stephen was Principal Investigator of the Saskatchewan Nutrition Survey, one of the provincial surveys conducted across Canada. She was involved with the proposed definition of Dietary Fibre for the National Academy of Sciences in the United States and a member of the FAO/WHO Expert Consultation on Carbohydrates in Human Nutrition in 1997. Dr. Stephen was a founding member of the Board of Directors of the Saskatchewan Nutraceutical Network, and has recently completed terms on the Board of Trustees and Executive of the National Institute of Nutrition, a number of NSERC Grant Selection Committees and the Scientific Advisory of the Canadian Sugar Institute. Dr. Stephen is Director, Research at the Heart and Stroke Foundation of Canada, a position she assumed in May 2002.

## Introduction

Since 1990, when Health Canada published Canada's Guidelines to Healthy Eating, Canadians have been advised to increase their consumption of "cereals, breads, other grain products, vegetables and fruit". While the positive image of fruits and vegetables continues to grow among Canadians, questions are being posed about whether the message about grains still holds. If it does, should it be more specific and less encompassing of all grain products? A number of studies published in recent years have questioned the broadness of the advice, suggesting that there are differences between whole grains and refined products in their influences on health. In addition there is much debate about the role of the diet in the growing epidemic of obesity, which many attribute to high intakes of carbohydrate, a major source of which is grains. Vocal critics abound and many new dietary regimes suggest limiting grain products rather than encouraging them. Should recommendations change? Are these new directions the correct ones? Why are disorders like obesity and diabetes increasing if we are heeding the advice given in the early 1990s?

## History of Grain Consumption in Canada

Grains have been the mainstay of the diet of most of the world's populations for centuries. The types of grains consumed around the world vary, depending on dietary preferences, home production and ability to import from other producing countries. In Canada, wheat has been the dominant grain crop grown since the expansion of agriculture across the prairies and represents nearly 90% of all grains consumed. Corn, oats, rye and other specialized grains make smaller contributions to dietary intake. Most wheat consumed in Canada has been refined to remove the outer bran and aleurone layers, leaving the inner layer of the kernel, the endosperm. As white flour, wheat endosperm makes up the largest contributor to grain intake in the diet. Intakes of whole grains, with the bran and aleurone layers intact, are considerably lower than white grain products, but this consumption has been increasing steadily for more than two decades.

Grain products are well known as sources of carbohydrate, mainly in the form of starch, and dietary fibre. Much less widely recognized is the fact that they are an important contributor of protein to the diet, representing some 20% of all protein consumed by Canadians. Depending on the type and degree of processing, grains also provide important minerals and vitamins. Refined grain products in Canada are restored with many of the vitamins and minerals removed during processing, while whole grains naturally contain a wide array of these micronutrients concentrated in the aleurone layer beneath the outer bran. Emerging evidence suggests that protective effects of whole grains once attributed solely to their fibre content, may actually be due to the vitamins and minerals they contain.

## Should the Messages be Changed?

Dietary recommendations are based on the entire body of scientific evidence around an issue, derived from many studies with varying study designs and approaches. Nutrition research is complex, since dietary manipulations to test one component of the diet almost always result in changes to nutrients or dietary components not under test. Assessment of intakes in epidemiological studies is fraught with problems, and no perfect method of intake assessment exists. Many studies report intake of nutrients while others examine intake of foods and food groups. These are not equivalent, yet extrapolations not always justified, are often made. Major nutrients, such as carbohydrate, are described in terms of percent contribution to total energy, which by definition means that all sources energy will add up to 100%. This is not equivalent to absolute intakes in g per day, though often this is misinterpreted in this way.

Equally confusing is reporting of results in terms of percent change over time or over another nutrient or food grouping. Percent change tells us nothing about the denominator, and unless this is given, the real magnitude of the difference is unclear. All these complications in nutrition research mean that we must be very cautious when hearing about new evidence contradictory to accepted beliefs. We must also not be swayed by a single study. It is the weight of evidence which must guide our recommendations about the relationship between diet and disease. If we consider all the evidence about grains, the weight of evidence would suggest that for the major health issues facing Canadians today, such as cardiovascular disease, diabetes, cancer, gastrointestinal disorders and obesity, grains, particularly whole grains, have a protective role.

Evaluation of the evidence for the relationship between a food or nutrient and disease is facilitated by comprehensive reviews of the literature, undertaken by respected bodies. In the Fall of 2002, the Institute of Medicine of the National Academy of Sciences published the draft report of the Dietary Reference Intakes (DRI) for Macronutrients, including energy, carbohydrate, fibre, fatty acids, cholesterol, protein and amino acids. This report followed similar reports for vitamins and minerals, published since 1997. These reports present up to date

evidence on intakes of nutrients, relationship to chronic diseases and recommended levels of consumption for North Americans. Just as earlier reports and recommendations suggested increased consumption of carbohydrate and fibre, these more recent summaries of the available evidence do not suggest that consumption of carbohydrate should be limited.

## Grains and Gastrointestinal Disorders

Because whole grains are a concentrated source of fibre in the diet, and fibre has long been known to have effects on the colon, there is a wealth of scientific literature on the relationship between fibre, grains and a number of gastrointestinal conditions, like constipation, diverticular disease and colon cancer. With the revival of interest in dietary fibre in the 1970s, one of the main areas of focus for research on the health effects of fibre was in the area of colonic function. Early work in the 1930s had indicated beneficial effects of wheat bran and other grains on constipation, but this was largely forgotten until Denis Burkitt renewed the connection following observations in Africa.

There is indisputable evidence that grains affect colonic function; these effects are, however, limited to those grains which resist fermentation, like whole wheat, wheat bran, rye and corn bran. Fermentable grains, like oat bran, have some effect on fecal bulking, but of a markedly reduced magnitude compared to wheat. Fermentation of the grain converts the polysaccharides in oats into bacterial cells, which increase fecal mass, but not to the extent that would occur if fibre resists fermentation. For optimal effects on constipation, whole wheat or wheat bran are the recommended sources.

## Colon Cancer

Clarifying the relationship between the intake of grains and colon cancer is a challenge. Cancer is a slowly developing condition, multifactorial, with both genetic and environmental components, and without easily measurable biological markers. Influence of diet on cancer risk can be examined using a variety of methodologies, including epidemiological studies of populations or very large groups, case-control studies, human interventions and animal experiments. Much of the epidemiological work has focused on nutrients, particularly dietary fibre. Interventions, whether human or animal, have tended to examine the effects of a single component, like wheat bran, rather than grains in the larger context.

There are numerous studies on the relationship between dietary fibre intake and colon cancer incidence. The majority of these, but not all, show a protective effect of high fibre diets. Some believe that it is the multiple benefits of whole grains, including their vitamin content, which confer protection. This would explain why protection might not be seen in studies of dietary fibre alone. Both the DRI report on Macronutrients and a comprehensive report of the role of diet on cancer, published by the World Cancer Research Fund (WCRF) in 1997, indicated that the issue remains unresolved. As concluded in the WCRF report :

For those epidemiological studies where colon cancer has been examined in relation to the intake of whole grains, the overall direction of the research would suggest a protective effect. Protection has also been indicated for whole grain intake in relation to the development of adenomatous polyps, the precursor to cancerous growths. The protective effect seen did not hold for refined grain products, which concurs with other work suggesting that the protection is limited to whole grains.

*"The diversity of cereals and cereal products largely precludes a summary assessment of the association with colorectal cancer risk. There may be a difference in the effects of whole grain and refined cereal products. Most of the risk estimates, nonetheless are either less than 1.0 or null. The evidence suggests that cereal may reduce the risk of colorectal cancer but is currently insufficient."*



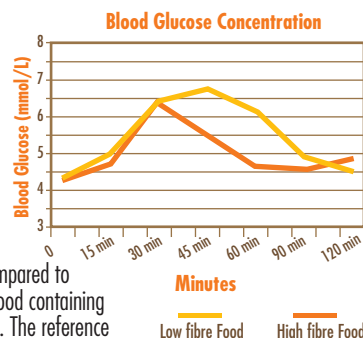
## Glycemic Response and Diabetes

The glycemic response, the body's ability to respond to an influx of glucose into the bloodstream from the ingestion of food, is influenced by any factor which alters the rate of carbohydrate digestion and absorption in the small intestine. This includes the type of carbohydrate in the food, the amylose:amylopectin ratio, ripeness, degree of grinding and hence particle size, extent of gelatinization, food processing or preparation procedures, including cooking, and the content of soluble fibre. Hence dietary fibre, which may delay gastric emptying or impede access of enzymes to digestible carbohydrates, may reduce the glycemic response, but so will pasta, where fibre is not present to the same degree, but where the structure of the starch granules prevents rapid starch digestion. The effect of grains on the glycemic response is therefore not straightforward. Where wheat kernels are largely intact, much lower responses are seen than when the same grain is ground. Oats, with their high content of viscous B-glucan, elicit a lower glycemic response, as do products made from durum wheat, like pasta or parboiled rice.

The GI was intended to overcome the problems of the many factors which alter the response by enabling a classification based on the glycemic effect, rather than the chemistry, food type or degree of processing. While many countries have adopted the GI, there remains reluctance, particularly in the United States, to recommend its use for making food choices. This reluctance is based on problems in extrapolating from the GI of individual foods to entire meals and its limited ability to predict metabolic responses following consumption. The DRI Macronutrient committee therefore did not recommend the use of the GI to guide food choices. Similarly, the American Diabetes Association, in guidelines published in 2002, was reluctant to recommend use of the glycemic index. On the other hand, the Canadian Diabetes Association has adopted the GI as a useful tool to guide patients in the food choices. These discrepancies are unfortunate, as it indicates that different opinions can be drawn from the same scientific information, and it creates different guidelines for different organizations, many of which are trying to achieve the same goals in terms of dietary change.

### Glycemic Index

In an attempt to provide an easily usable tool to distinguish foods with low glycemic responses, the Glycemic Index (GI) was created by Jenkins *et al.* in the early 1980s. The GI represents blood glucose response of a test food containing a set amount of carbohydrate, compared to the blood glucose of a reference food containing the same amount of carbohydrate. The reference food is usually white bread. The response is measured as the area under the blood glucose curve over a period of 2 hours.



### Diabetes

In addition to the wealth of literature on the glycemic effects of foods over a period of a few hours, studies have been conducted on the effects of grains and high carbohydrate, high fibre diets over periods of several weeks. In general, these show beneficial effects on blood glucose and insulin levels that are consistent with the short term effects. Dietary patterns altered to contain a high proportion of low GI foods result in improved diabetic control and reduced use of insulin over the long term. In prospective studies on large numbers of subjects, low GI diets, or diets high in cereal fibre, have been found to reduce the risk of non-insulin dependent diabetes. These studies suggest a low GI diet is of benefit not only for the treatment of diabetes, but also in reducing incidence.



## Coronary Heart Disease

A number of large scale epidemiological studies from a number of countries and conducted at various times over the last 30 years, have shown protective effects of diets high in cereal grains against coronary heart disease. Three of these studies were sufficiently large and adequately powered to establish the quantitative data needed to establish reference amounts of dietary fibre by the DRI Macronutrient committee. The evidence of the protective effect of grains against coronary heart disease has also been considered sufficient to permit health claims for whole grains and high fibre foods and cardiovascular disease in the United States.

The mechanism for the heart disease benefit may relate in part to cholesterol lowering effects of some grain types. Oat bran and psyllium fibre for example, have consistently been shown to lower serum cholesterol levels in well designed and controlled studies with sufficient subjects studied over adequate time periods.

This evidence, too, is sufficient to allow a health claim for whole oats, oat bran and psyllium fibre and cardiovascular disease. Wheat bran and wheat products do not lower cholesterol; however, with the dominance of wheat as the major grain in western countries, the epidemiological studies would suggest a protective effect of diets high in whole grain wheat foods. Changes in intake of other foods, effects on triglyceride levels, effects on body weight and provision of important vitamins and other beneficial compounds in grains, may contribute to the reasons why grains are protective against coronary heart disease. These factors remain to be explored further.

## Weight Maintenance and the Prevention of Obesity

One of the most commonly believed myths is that grains and the carbohydrate they contain, provide excess energy to the body and are therefore "fattening". With such notions gaining in popularity, there has been a growth in the diet book industry of low carbohydrate diets, with advice to avoid grain products. Obesity is currently rapidly increasing in prevalence in Canada, and when questioning the reasons why, carbohydrate is often blamed. Part of the reason for this is that fat as a % energy has fallen in Canada in last few decades, and carbohydrate, which makes up the major proportion of the diet, has increased as a proportion of energy. However, this does not mean that carbohydrate in absolute terms has increased and there is very little evidence that this has actually occurred. Moreover, the literature concerning carbohydrate intake, satiety, energy intake and BMI does not support these popular beliefs. Add to this the literature in relation to fibre and obesity, and the case is not strong that grains are the culprit. The weight of evidence suggests, as it has done for decades, that grains, particularly whole grains, have a preventive role in relation to obesity, rather than a causal one.

As with other health issues, the amount of research specific to grains and weight control is limited. There is considerable research on grain products in relation to satiety over the short term, but for long term studies and for most work examining dietary patterns in relation to energy intake, body weight or BMI, the literature on carbohydrate and fibre must be used to draw conclusions.

Satiety research is often conducted by providing specific foods or meals to volunteers and examining energy and food intake at timed intervals over a period of some hours. Grain products have been found to lead to reduced energy consumption at later time periods, compared to high fat products. Grain products in general have benefits, but those high in fibre are particularly effective. Dietary fibre is thought to have an influence on subsequent food intake through:

Reducing energy density, thereby limiting the amount of food that can be consumed

Increasing chewing time, resulting in less consumption at a meal

Extending gastric emptying, thus maintaining stomach distension for longer periods

Prolonging and lowering the glycemic response, leading to less stimulation of hunger

Feedback on satiety mechanisms through production of fermentation products in the colon

Delivery of starch to the colon rather than digestion and absorption in the small intestine

All these possible reasons could contribute to reduced energy intakes with high fibre foods like whole grains. Longer term feeding studies conducted over several weeks also show reduced energy intake with higher fibre, as do studies of usual diets. In many populations studied, those who consumed high carbohydrate, high fibre diets have been found to have lower energy intakes and lower BMI than those with low carbohydrate, low fibre diets. Moreover those who are obese are repeatedly found to have lower fibre and carbohydrate intakes than those who are not obese.

Little evidence suggests that consumption of grains leads to obesity. Clearly what is consumed alongside grains may have an influence, such as what is spread on bread or accompanies a grain dish, but the grains themselves do not appear to be the issue. The DRI Macronutrient report discusses the role of total carbohydrate in relation to obesity very little, and concentrates discussion on the role of sugars. Much of the work discussed above was not presented in the Macronutrient report. The committee was less persuaded by the scientific data demonstrating benefits of fibre, indicating that there are studies that do not show the protective effects. The weight of evidence would point in the direction of protection against obesity.

## Conclusion

**In recent years**, grains have been receiving a negative popular press, as they have often done in the past. As the problem of obesity increases, many are trying dietary regimes that are contrary to the guidance in *Canada's Food Guide to Healthy Eating*. It is clear that there needs to be some separation in messages about types of grains. For some health conditions, some refined grain products are as beneficial as those of unprocessed products, as in the glycemic responses following ingestion of pasta or whole wheat; for other conditions, whole grains are clearly preferable, as with colonic effects, influences on cancer and influences on weight control. It may be fair to say that while evidence appearing in the last four to five years has not changed recommendations in a major way, more specific advice about specific types of grains and degree of refining are indicated. For knowledgeable consumers, there would appear to be some merit in providing more information on the different grain types and variations in composition. For others, a focusing of advice on "whole grains" irrespective of the source, would provide a simple yet beneficial message. There is little new evidence to radically change the overall messages given ten years ago. Increased grain consumption continues to be a desirable goal.

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Grains and Health

Brought to you by the Team of Registered Dietitians at Kellogg Canada Inc.

As an important group in *Canada's Food Guide* and the foundation of a healthy diet, grain products continue to be perceived controversially among consumers. Health professionals promote the benefits of a diet rich in whole and fibre containing grains to a public that remains confused about what to eat to be healthy. People seem to believe foods like bread, cereal, pasta and rice will make them fat, and opt for fad diets that practically eliminate important grain products. Consumers are hearing the message to eat more protein and less carbohydrate containing foods. How can we change our communication to help them understand grain and high fibre products in a balanced diet are essential to good nutrition and health?

With obesity and chronic diseases like heart disease, Type-2 diabetes and cancer on the rise, it is concerning that there is little evidence that Canadians are heeding advice to emphasize whole and high fibre grain products in the diet, which can offer protection against these very risks (*Grains in the Canadian Diet NIN Review No. 28, 1999*). How do we ensure this food group gets the recognition it deserves? We know people are drawn to foods that offer convenience and diets that offer quick fixes for weight loss. How can we make our message inviting and believable?



## As part of a balanced diet, re-introduce the Great Grains Way

### Balance the fat

Easily lower total fat intake by eating more whole and fibre containing grain products and vegetables and fruit.

Have a whole grain cereal breakfast with fresh fruit and skim milk several times a week.

Replace snacks of potato chips and chocolate bars with cut-up vegetables.

### Grains, Vegetables and Fruit go together:

Combine a delicious variety of grain products and vegetables and fruit to add interest and taste to your daily diet.

Combine your favourite cereal and dried fruit for a tasty snack

Stuff a whole wheat pita with tomatoes, green peppers and feta cheese for a delicious sandwich

### Help protect against chronic disease

Whole and fibre containing grain products may help protect against chronic diseases like heart disease and cancer.

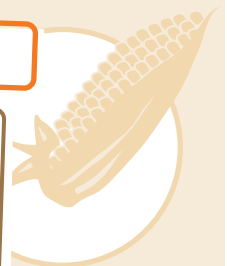
Aim for 10g of soluble fibre in your daily diet by choosing foods that contain psyllium, oats, vegetables and fruit Canadian Journal of Dietetic Practice and Research, Vol.63, No.4, Winter 2002.

1/3 cup Kellogg's\*  
All-Bran Buds\* cereal  
with Psyllium  
3/4 cup oatmeal  
1/2 cup Broccoli  
1 medium banana

3 g soluble fibre  
1-2 g soluble fibre  
1-2 g soluble fibre  
1 g soluble fibre

### Fibre helps keep you regular

Eating a variety of fibre containing foods, such as whole grain and wheat bran cereals and bread, brown rice, couscous, vegetables and fruit, help keep you regular.



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