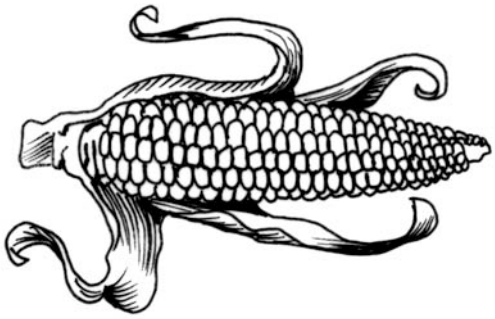
Resistant Starch FAQ



The New Fiber Story:
Natural Resistant Starch
September 29, 2007, Philadelphia

Oldways
Hi-maize® Resistant Starch

Natural Resistant Starch
Is The New Fiber Story
Frequently Asked Questions (FAQ)

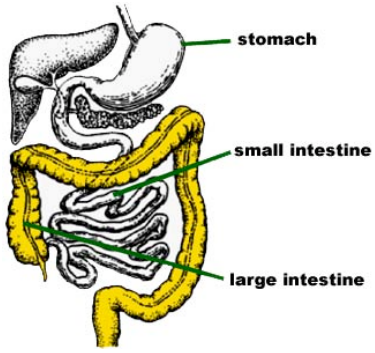
When it comes to eating fiber, just about everyone could do a lot better. In fact, many American adults could double their current fiber intake and still not reach the recommended targets of between 25 grams (for women) and 38 grams (for men) each day. The World Health Organization currently recommends consumption of foods containing more than 25 grams of total dietary fiber per day. In fact, the WHO has identified dietary fiber as the only dietary ingredient with "Convincing Evidence" showing a protective effect against weight gain and obesity.[1]

Yet, not all fiber is the same. Traditionally, people get their fiber from sources like whole grains, produce and beans. Now there's a new way to reach these goals and gain a wide variety of additional important health benefits from a previously unrecognized type of dietary fiber – resistant starch.

Without changing their diets, without sacrificing taste and convenience, consumers can obtain additional fiber and other valuable health advantages related to weight control, glycemic and energy management, and digestive health by eating popular foods like breads, pasta and cereal containing this natural dietary fiber.

This FAQ explains what resistant starch is, its many health benefits and its unique advantages over other fiber sources.

Q: What is resistant starch and what is it resisting?



A: Most starches are digested and absorbed into the body through the small intestine, but some resist digestion and pass through to the large intestine where, through fermentation, they act like dietary fiber. This type of starch is called "resistant starch." The formal definition of resistant starch is the total amount of starch, and the products of starch degradation that resists digestion in the small intestine of healthy people.[2]

In terms of physiology, carbohydrates can be divided into two groups: those that are digested in the small intestine and those that are not.

- **Sugars and most starches** fall into the first group. They are rapidly digested and absorbed, and subsequently used for short-term energy needs or stored. These are referred to as *available*, *digestible* or *glycemic* carbohydrates.

- **Resistant starch and dietary fiber** constitute the second group. By definition, they pass through the small intestine and provide no short-term energy but have a variety of physiological effects in (and emanating from) the large intestine. They are referred to as *non-glycemic* carbohydrates.

Q: Doesn't dietary fiber just pass through the large intestine?

A: No, not all dietary fiber passes through the large intestine intact and un-changed. Some insoluble fibers pass through relatively intact (*i.e.,* wheat fiber and cellulose). These fibers are well known for their bulking effects and are widely used to promote regularity. Other soluble fibers are fermented in the large intestine (*i.e.,* inulin and fructo-oligosaccharides), and impact the colonic environment because of that fermentation. Even though natural resistant starches are insoluble, they are fermented within the large intestine. This fermentation is believed to be responsible for important colonic and metabolic health benefits.

Q: Is resistant starch new?

A: Not at all. Resistant starches have always been with us. But it is only recently that we have begun to understand them. For many years, scientists thought that all starches were fully digested. Today, more sophisticated research techniques have disclosed that some starches move undigested into the large intestine where, through fermentation, they take on many of the roles – and provide the benefits of – other carbohydrates long recognized as dietary fiber. New research is identifying that resistant starch has important metabolic benefits as well.

For the past two decades, there has been a steady increase in our knowledge of the sources, uses and physiological effects of resistant starch. However, it has only been in the past decade that the use of ingredients with high resistant starch content has occurred in foods. For instance, the recent inclusion of resistant starch in the Australian Government's revised dietary fiber recommendations acknowledges resistant starch as a key dietary component vital for good health. This awareness is spreading throughout the world, allowing consumers everywhere to take advantage of the important health advantages of this ingredient.

Q: Are all resistant starches the same?

A: No, they're not. Unlike most other ingredients, resistant starches are identified by a physiologically-based definition, not the chemical-based definition. Because of this, today's resistant starches are typically categorized into four classes:

RS1: Physically inaccessible or digestible resistant starch, such as that found in seeds, legumes and unprocessed whole grains. These starches resist digestion because they are protected by a barrier which slows down digestion.

RS2: Resistant starch that occurs in its natural granular form, such as uncooked potato, green banana flour and high amylose corn (*i.e.* Hi-maize® resistant starch).

RS3: Resistant starch that is formed when starch-containing foods are cooked and cooled such as in bread, cornflakes and cooked-and-chilled potatoes. In this process, known as retrogradation, parts of the starch chains can crystallize into components that are less digestible.

RS4: Selected chemically-modified resistant starches. These starches have been treated with chemical agents to introduce bonds that cannot be digested by human enzymes within the digestive tract. They are not found in nature. The potential benefits of this type of resistant starch are largely unknown.

Q: Which type of fiber is resistant starch?

A: It's long been thought that there were only two kinds of fiber – soluble and insoluble. Over the last 20 years nutrition research has demonstrated that there is a third kind – resistant starch. All three kinds of fiber are essential to health.

- **Soluble Fiber (e.g., pectins, gums, mucillages, and some hemicellulose):** Helps lower blood cholesterol levels and controls blood sugar. It is found in fresh and dried fruit, vegetables, oats, legumes and seeds. Soluble fibers can be fermented by the bacteria in the large intestine, and may promote intestinal health (known as a "prebiotic" fiber).
- **Insoluble Fiber (e.g., cellulose, lignan and hemicellulose):** provides bulking and helps keep us "regular." It is found in whole grain bread, wholegrain cereals, fruits, vegetables, unprocessed bran and wheat germ.
- **Resistant Starch:** These are starches that escape digestion in the small intestine. Natural resistant starch (RS2) is insoluble, is fermented in the large intestine and is a prebiotic fiber, providing some of the health benefits of ***both*** soluble and insoluble fiber – plus some unique advantages of its own. The characteristics of other types of resistant starches vary and the benefits are largely unknown.

Q: How much resistant starch SHOULD we consume daily?

A: Public health authorities and governments have not yet set recommended levels for resistant starch consumption. The Joint Food and Agricultural Organization of the United Nations/World Health Organization Expert Consultation on Human Nutrition stated "Perhaps the greatest impact of recent knowledge is our growing understanding of the diverse physiological roles that carbohydrates have, depending to a great extent on the site, rate, and extent of their digestion and fermentation in the gut**…**One of the major developments in our understanding of the importance of carbohydrates for health in the past twenty years has been the discovery of resistant starch."[3]

An immediate goal for consumers is to simply **double** the amount of resistant starch they are currently eating. This can be done quite easily: Just one medium underripe banana added to your diet can double the average resistant starch intake. For home cooking, it's good to know that each tablespoon of Hi-maize you mix into batters, casseroles and smoothies adds an extra 6.5 grams of natural resistant starch to your diet.

The entire U.S. daily recommended intake of dietary fiber (25-38 grams) could be consumed from resistant starch without digestive side effects. Clinical studies have shown that high levels specifically of Hi-maize (even those exceeding the recommended intake of dietary fiber) can be consumed with modest or no digestive side effects.

Q: How much resistant starch DO we consume already?

A: Worldwide levels are low according to CSIRO Division of Human Nutrition, Australia, which advises that *"...intakes in the order of 20 grams per day of resistant starch may be needed to obtain some of the bowel related benefits."* That is almost four times greater than a typical western diet currently provides.

Currently most developed countries consume between 3-7 grams of resistant starch per day**.** In the U.S., we consume about 4.9g daily, on average. A complete table showing intake for nine countries is in the RDs' Toolkit section of this binder.

Q: Is resistant starch in the foods we already eat?

A: Resistant starch is naturally present in foods such as unprocessed whole grains, legumes, cooked-and-chilled pasta, cold rice (as in sushi) and potato salad. As researchers learn more and more about its health benefits and ease of use, resistant starch is quickly gaining attention as an ideal way to add fiber to a wide range of foods. Many public health authorities and food organizations such as the Food and Agricultural Organization, the World Health Organization[4], the British Nutrition Foundation[5] and the U.S. National Academy of Sciences[6] now recognize resistant starch as a beneficial carbohydrate and a type of dietary fiber.

Currently, there is only one commercially-available natural resistant starch from corn on the market – Hi-maize® resistant starch. This natural fiber made from corn can be added to breads, cereals, pasta, nutrition bars and more. It's easy to use at home, too. Replace 10-25% of the flour in a recipe with Hi-maize. You can also add it to smoothies, mix it into mashed potatoes and more.

Q: What are the health benefits of RS2 natural resistant starch?

A: There is substantial research on the health benefits of RS2 resistant starches from high amylose corn, including more than 160 published, peer-reviewed studies that indicate benefits in intestinal/colonic health as well as metabolically important benefits in weight control and glycemic and energy management.

Of the more than 160 nutritional studies mentioned above, more than 50 studies in humans using high amylose corn (RS2), show that RS2 starches contribute specific health benefits. Just a few examples:

- A 2007 study by Dr. Wen-qing Zhang at the Chinese Center for Disease Control and Prevention in Beijing, China found that eating foods made with 30 grams of Hi-maize resistant starch per day for four weeks decreased the Body Mass Index (BMI) of 40 diabetics and that Hi-maize increased insulin sensitivity in patients with Type 2 diabetes.

- A study led by Dr. Kay Behall and colleagues at the Beltsville Human Nutrition Center at the USDA found that consumption of a moderate amount of natural RS2 resistant starch from high amylose corn lowers the glucose and insulin responses of both normal and overweight women by 24% and 38% respectively.

- A published clinical trial by Dr. Janine Higgins and her colleagues at the University of Colorado demonstrated that eating food made with RS2 resistant starch from high amylose corn can increase your body's fat-burning ability by 20-25%. This may be important for maintaining healthy weight and healthy body composition.

- Two clinical trials published by Dr. Denise Robertson and her colleagues at the Oxford Lipid Metabolism Group in England show that RS2 resistant starch from high amylose corn increases insulin sensitivity in healthy people. Insulin sensitivity is a critical factor in maintaining healthy blood sugar levels. It is also one of the major underlying mechanisms of metabolic syndrome, which confers increased risk of cardiovascular disease, diabetes, and obesity.

- Animal studies published in 2007 by Dr. Shusuke Toden at CSIRO and the University of Adelaide in Australia showed that Hi-maize resistant starch protected colonic cells from genetic damage induced by high protein diets. It also prevented thinning of the protective mucous layer, a feature in ulcerative colitis and a biomarker for colon cancer.

This substantial amount of data provides a high level of confidence in the benefits that can be obtained through the consumption of RS2 resistant starches.

Q: Is there any upper limit for resistant starch consumption?

A: The entire daily-recommended intake of dietary fiber (more than 25 grams according to the World Health Organization) can be consumed from natural resistant starch without digestive side effects. Clinical studies have shown that high levels of RS2 resistant starch from high amylose corn (even those exceeding the recommended intake of dietary fiber) can be consumed with modest or no digestive side effects.

Q: How many calories does resistant starch have?

A: RS2 resistant starch actually delivers fewer calories than flour and is a valuable part of diets designed for maintaining healthy weight. The energy value has been estimated to be between 2 and 3 calories (8-12 kilojoules), depending on each individual's metabolism. By comparison, digestible starch – like flour – delivers 4 calories (16 kilojoules).

Q: How is resistant starch made?

A: Natural resistant starch used as food ingredients begin with high amylose corn hybrids produced through traditional plant breeding. Other naturally occurring sources do not have the process tolerance offered by high amylose corn. A mild heat/moisture treatment helps to align the amylose chains within the natural starch granule. Because it retains its natural granule structure, it is a Type-2 resistant starch (RS2).

Retrograded resistant starches used as food ingredients can also be made from high amylose corn. An enzyme treatment combined with a mild heat/moisture treatment helps align the amylose chains outside of the starch granule. Because it is "retrograded" or crystallized after the starch granule has been disrupted (known as "gelatinization"), it is a Type-3 resistant starch (RS3).

Q: How is natural resistant starch labeled?

A: Consumers may not see "resistant starch" in a list of food ingredients. Different types of resistant starch must be labeled in different ways as food ingredients. Natural RS2 analyzes as dietary fiber and is listed as fiber on the nutritional information on product labels. The Type-2 resistant starches are usually designated simply as "starch", "resistant corn starch" or "cornstarch" on food product labels.

Q: What foods can feature resistant starches?

A: Resistant starches have been used successfully in breads, cakes, pasta, cereals, snacks and other baked goods. They can also be added to some beverages, mashed potatoes, casseroles and other mixed entrees.

Q: What advantages does RS2 resistant starch offer, over other fiber sources?

A: Resistant starch offers three main advantages over other fiber-fortification options like bran, cellulose and inulin.

1) Resistant starch is "invisible" in foods – it doesn't affect taste and texture like other insoluble fiber sources often do. It is especially appropriate for grain-based low- and moderate-moisture foods because it commonly replaces flour in food formulations and recipes. Its physical properties enable it to be used to provide good food processing characteristics and desirable textural attributes such as crispness and expansion when compared to foods of similar fiber content.
2) RS2 resistant starch offers unique health benefits, particularly metabolically important benefits in glycemic and weight management. Other non- or less fermentable fibers such as wheat bran and cellulose cannot match RS's benefits because these unique benefits stem from RS's fermentation within the large intestine.
3) Due to the slow fermentation characteristic of resistant starch's insoluble structure, RS2 can be consumed at significantly higher quantities without digestive side effects common to soluble fibers like inulin and fructo-oligosaccharides.

It cannot be overlooked, however, that natural resistant starch also delivers benefits traditionally associated with dietary fiber – *i.e.,* it promotes regularity and helps maintain a healthy digestive tract.

References:

1. World Health Organization, Joint WHO/FAO Expert Consultation "Diet, Nutrition and the Prevention of Chronic Diseases" 2003, WHO Technical Report Series 916.
2. Asp, N-G. Resistant Starch. Proceedings from the second plenary meeting of EURESTA: European FLAIR Concerted Action No.11 on the physiological implications of the consumption of resistant starch in man. Preface. *European Journal of Clinical Nutrition*, 1992 46 Suppl 2 S1
3. de Haen, H. (FAO Assistant Director-General, Economic & Social Dept), *Carbohydrates in Human Nutrition, FAO Food & Nutrition Paper – 66. A* Joint FAO/WHO Expert Consultation on Human Nutrition, Rome, April 14-18, 1997.
4. *Ibid*
5. Nugent, A.P., *Health properties of resistant starch*, 2005, British Nutrition Foundation Nutrition Bulletin, Vol. 30, No. 1:27-54.
6. "Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fatty Acids, Cholesterol, Protein and Amino Acids (Macronutrients)" The Institute of Medicine of the National Academies, September 5, 2002.