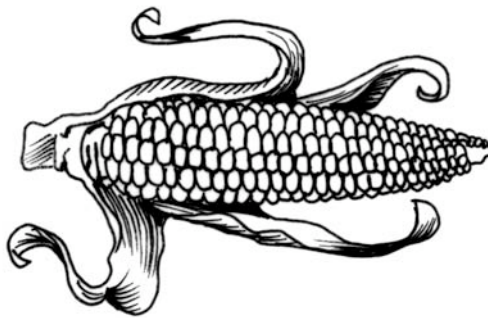


# Toolkit for RDs



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

**Oldways  
Hi-maize® Resistant Starch**

# NATURAL RESISTANT STARCH

## FACT SHEET

### The New Fiber Story – Natural Resistant Starch

When it comes to eating fiber, we can still 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.

Traditionally, people get their fiber from sources like whole grains, produce and beans. Now there's an exciting new way to augment these traditional sources and increase fiber intake. It's called natural resistant starch, a newly-discovered fiber that offers a wide variety of additional important health benefits.

#### Not all Fiber is Alike

Resistant starch is one of three main categories of fiber, along with soluble fiber and insoluble fiber. It is important to have all three types in your diet to provide different health benefits. Natural resistant starch contributes some of the health benefits of soluble fiber, some of the benefits of traditional insoluble fiber and some unique benefits as well.

Hundreds of scientific studies have shown that including natural resistant starch in a healthy eating plan can

- help with weight control
- help maintain healthy blood sugar levels
- help balance energy
- promote digestive health

It is also a safe and healthy alternative for those needing gluten-free foods.

The key to these benefits is the way resistant starch is digested. While most starches are digested in the small intestine and absorbed as sugar, resistant starch gets its name because it resists digestion until it reaches the large intestine. There, through fermentation, it takes on many of the roles – and provides the special benefits – of other undigested carbohydrates long recognized as dietary fiber.

#### Discovering Resistant Starch

Natural resistant starch is found in common foods such as legumes (beans and peas), grains, and even bananas. When cooked and served cold as in salads, several starches, including potatoes, pasta and rice, are especially rich in natural resistant starch.

| Food             | Serving Size        | Amount of Resistant Starch |
|------------------|---------------------|----------------------------|
| Wholegrain bread | 2 slices            | 0.5g                       |
| Oatmeal          | 1 cup cooked        | 0.5g                       |
| Cold potato      | 1 medium (2" diam.) | 1.1g                       |
| Cold pasta       | 1 cup               | 1.4g                       |
| Pearl Barley     | 1/2 cup cooked      | 1.9g                       |
| Lentils          | 1/2 cup cooked      | 3.4g                       |
| Navy beans       | 1/2 cup cooked      | 3.8g                       |
| Green banana     | 1 medium, peeled    | 4.7g                       |
| Smoothie*        | 8 ounces            | 6.5g                       |

\* Yogurt and berries, with 1 TBS Hi-maize® resistant starch

Natural resistant starch is also an ingredient, with the brand name Hi-maize® resistant starch, found in a growing number of supermarket foods, such as bread, cereal and pasta. Hi-maize is all natural and made from corn.

You'll be glad to know that when Hi-maize is added to your favorite foods, they retain their familiar taste and texture even with a fiber boost. And, unlike many other fibers, most people experience minimal or no digestive side effects from this type of fiber, even after consuming as much as 40 grams of fiber a day from resistant starch.



Peas and beans offer a great way to enjoy more natural resistant starch.

# THE RESISTANT STARCH CHALLENGE

## Double the Amount of Natural Resistant Starch You Eat

The challenge for Americans today is to eat enough resistant starch – 15 to 20 grams a day – to obtain these optimum health benefits.

In the U.S. we currently consume only 4.9 grams of resistant starch daily, on average. In countries where rice and pasta are diet staples, resistant starch intake is significantly higher. In India, for example, resistant starch intake is more than double our national average, and in China it is almost 3 times greater.

Start by simply trying to double your daily intake. This can be done easily by enjoying beans and bananas, or cold potatoes, rice and pasta (most simply in the form of salads). You can also buy foods containing Hi-maize® resistant starch.

It's easy to use Hi-maize at home, too. Replace 10-25% of the flour in a recipe with Hi-maize. Add it to smoothies. Mix it into mashed potatoes or pancake batter. Bake it into better-for-you cookies. Your family won't even notice.

| Instead of this...             | Try this...   |
|--------------------------------|---|
| Chicken soup                   | Chicken & lentil soup   |
| Hot pasta with sauce           | Pasta salad   |
| Turkey sandwich on white bread | Turkey sandwich on bread with added natural resistant starch (Hi-maize) |
| Krispy Rice cereal             | Oatmeal or Meusli   |
| Breadsticks                    | Potato or rice salad  |
| Potato chips                   | Underripe banana  |

People who eat a healthy mix of natural resistant starch-enhanced processed foods and fresh, minimally-processed foods will easily be able to double their resistant starch intake.



*Cold potato salad and pasta salad are rich in natural resistant starch.*

As the numbers on the previous page show, just one medium underripe banana added to your diet can double the average resistant starch intake.

Eating well to maintain good health and wellness requires some effort. Increasing the amount of natural resistant starch you eat is one easy way to move a step closer to achieving your nutrition and health goals.

For information on how to find foods with resistant starch, please visit [www.resistantstarch.com](http://www.resistantstarch.com). There, you'll also find delicious, easy-to-make recipes.

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. Your body will thank you! You can order Hi-maize from [www.kingarthurfLOUR.com](http://www.kingarthurfLOUR.com).

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# Where to Find Resistant Starch

In the United States, there are currently three ways to get natural resistant starch:

- from naturally-occurring sources
- from commercial foods with added resistant starch
- by adding resistant starches to dishes prepared at home.

## Naturally Occurring Sources

Resistant starch occurs naturally in certain foods such as:

- Intact wholegrain cereals, seeds and nuts (unprocessed) such as oats, rye, wheat, barley, semolina wheat, corn, flax, sesame
- Legumes such as lentils, black beans, kidney beans and baked beans
- Under-ripe fruit, especially bananas
- Uncooked corn starch
- Cooking and cooling may also increase the resistant starch content in foods so look for cooked, cold rice, pasta or potatoes in dishes like sushi, pasta salad and potato salad.

As diets become more processed, with fewer raw fruits and vegetables and fewer unprocessed grains, the consumption of naturally-occurring resistant starch decreases. Therefore, processed foods with added resistant starch are valuable sources for helping increase resistant starch consumption.

Just as the vitamin C content of an orange will vary with the type of orange, size, ripeness and growing conditions, the resistant starch content of any food – and its availability to the body – can vary. The amount of resistant starch available can be influenced by various factors including:

- **Ripeness** (especially in fruit). As the fruit ripens, the resistant starch turns into sugar, so underripe fruit contains more resistant starch.
- **Serving temperature**. For instance, a cold boiled potato has almost twice as much resistant starch as a hot one.
- **Digestive factors**. The longer it takes food to digest, starting with chewing in the mouth, the more resistant starch is available to the large intestine. Therefore, a particular individual's metabolism can affect the amount of resistant starch available.
- **Type and amount of starch present**. Amylose (the relatively straight chains of glucose in starch) resists digestion more than amylopectin (the branched chains of glucose in starch); different plants contain different amounts of each.

Despite these variations, scientists have recently made progress in measuring typical resistant starch content levels that are widely accepted – just as nutrition tables regularly state the vitamin C in oranges.

The table on the following page shows the amount of resistant starch that occurs naturally in a variety of foods.

## Resistant Starch Content of Foods in the American Diet

| Food Group                            | Resistant starch<br>g per 100 g <sup>a</sup><br>(range) | Example food<br>and portion size<br>amount <sup>b</sup> | g <sup>c</sup> | Resistant Starch<br>g per portion<br>(range) |
|---------------------------------------|---|---|----------------|--|
| <b>bread</b>                          |   |   |                |  |
| white wheat                           | 0 - 4.4   | 1 slice   | 25             | 0 - 1.1                                      |
| whole wheat/other grains              | 0 - 4.5   | 1 slice   | 28             | 0 - 1.3                                      |
| corn tortillas                        | 2.3 - 3.5   | 1 8" tortilla   | 50             | 1.1 - 1.7                                    |
| pizza crust                           | 2.7 - 2.8   | 1 slice   | 55             | 1.5 - 1.5                                    |
| <b>cakes/muffins/pie/waffle</b>       |   |   |                |  |
| cakes                                 | 0.1 - 1.8   | 1/12 of 8" cake   | 68             | 0.1 - 1.2                                    |
| muffins/quick bread                   | 0.1 - 1.0   | 1 small muffin  | 66             | 0.1 - 0.7                                    |
| pie crust/pastry                      | 0.4 - 0.5   | 1/8 of 9" crust   | 16             | 0.1 - 0.1                                    |
| waffles                               | 0.5 - 0.6   | 4" round or square                                      | 33             | 0.2 - 0.2                                    |
| <b>cookies/crackers</b>               |   |   |                |  |
| cookies                               | 0.2 - 2.6   | 2 sugar cookies   | 30             | 0.1 - 0.8                                    |
| crackers                              | 0.3 - 4.3   | 5 whole wheat crackers                                  | 30             | 0.1 - 1.3                                    |
| <b>grain products</b>                 |   |   |                |  |
| pasta/noodles (cooked)                | 0.4 - 1.6   | 1/2 cup spaghetti                                       | 70             | 0.3 - 1.1                                    |
| rice, white or brown (cooked)         | 0 - 3.7   | 1/2 cup white rice                                      | 79             | 0 - 2.9                                      |
| other grains (cooked)                 | 0 - 4.2   | 1/2 cup pearly barley                                   | 79             | 0 - 3.3                                      |
| <b>ready-to-eat breakfast cereals</b> |   |   |                |  |
| RTEs                                  | 0 - 6.3   | 1 cup   | 30             | 0 - 1.9                                      |
| <b>chips/snacks</b>                   |   |   |                |  |
| potato chips                          | 2.9 - 4.5   | 1 oz  | 28             | 0.8 - 1.3                                    |
| other chips/snacks                    | 0 - 1.0   | 1 oz  | 28             | 0 - 0.3                                      |
| <b>fruit</b>                          |   |   |                |  |
| banana                                | 0.3 - 6.2   | 1 small   | 101            | 0.3 - 6.3                                    |
| plantain                              | 3.5 - 3.5   | 1/2 cup cooked  | 77             | 2.7 - 2.7                                    |
| <b>legumes</b>                        |   |   |                |  |
| legumes (cooked)                      | 0.6 - 9.1   | 1/2 cup kidney beans                                    | 89             | 0.5 - 8.1                                    |
| <b>vegetables</b>                     |   |   |                |  |
| potatoes, yams                        | 0.2 - 5.5   | 1/2 cup cooked potatoes                                 | 78             | 0.2 - 4.3                                    |
| corn, peas, lima beans                | 0.3 - 2.2   | 1/2 cup cooked corn                                     | 82             | 0.2 - 1.8                                    |
| <b>miscellaneous</b>                  |   |   |                |  |
| starch/flour                          | 2.6 - 12.0  | N/A   |                |  |

<sup>a</sup> Values of 0 indicate that no resistant starch was found in the food sample.

<sup>b</sup> Typical portion amounts based primarily on recommended serving sizes in the MyPyramid Food Guidance System (27)

<sup>c</sup> Weights based on USDA National Nutrient Database for Standard Reference, Release 19 (28); weights of typical portions may vary depending on specific type of food.

Source: Environ report prepared for National Starch Food Innovation. Parts of this report are in press.

## Commercial Food Products with Resistant Starch

Australia led the way with resistant starch with the introduction of Goodman Fielders' Wonder White bread in 1994 which made natural resistant starch, branded as Hi-maize, a household name. The addition of resistant starch from high-amylose corn doubled the fiber content of this bread without changing its taste or texture, an important indicator of consumer acceptance.

In the United States, consumers wanting to supplement the fiber intake they're already getting from whole foods, can find natural resistant starch (Hi-maize) on supermarket shelves in popular products such as breads, muffins, cereal, pasta, cookies, nutritional bars and other snacks. There are some of these foods available from both national and regional food companies including:



- HEB® Extra Thin Glycemic Health Bread



- Aunt Millie's® Healthy Goodness Fiber & Flavor Potato Bread
- Aunt Millie's® Healthy Goodness Light Potato Bread
- Aunt Millie's® Healthy Goodness Light 5-Grain Bread
- Aunt Millie's® Healthy Goodness Light Whole Grain Bread
- Aunt Millie's® Healthy Goodness Whole Grain White Bread
- Aunt Millie's® Fiber for Life Healthy Whole Grain Bread
- Aunt Millie's® Fiber for Life 12 Whole Grains Bread



- Ener-G Foods® Wylde Pretzels (gluten and dairy free)
- Ener-G Foods® Cinnamon and Seattle Crackers (gluten and dairy free)
- Ener-G Foods® Cinnamon Rolls (gluten and dairy free)
- Ener-G Foods® Yeast Free Sweet Loaf, Seattle Brown Loaf, Seattle Hamburger Buns, Seattle Hot Dog Buns & Corn Loaf (gluten and dairy free breads)
- Ener-G Foods® Brown Rice English Muffins with Sweet Potato (gluten and dairy free)
- Ener-G Foods® Chocolate Chip Snack Bars (gluten and dairy free)
- Ener-G Foods® Plain Doughnuts, Chocolate Iced Doughnuts and Doughnut Holes (gluten and dairy free)



- ExtendBar® (source of natural corn resistant starch) – low glycemic nutritional snack clinically proven to stabilize blood sugar for 9 hours

## **Adding Resistant Starch at Home**

Some home cooks may prefer to add resistant starch to the dishes they create in their own kitchens, and this is easy to do. Consumers can buy resistant starch and use it to replace part of the flour in their favorite recipes – or they can simply sprinkle it into casseroles and other dishes as an easy fiber booster. The added bonus is that it has fewer calories than flour (2-3 calories per gram vs. 4 calories of digestible starch).

## **Substituting Resistant Starch in Recipes**

In most recipes, it's possible to substitute up to 10-25% of the flour in a recipe with natural resistant starch. Recipes vary, though, and you may have to experiment. Adding resistant starch to cookies, for instance, is easier than incorporating it into more sensitive cake recipes.

Whether resistant starch is baked into foods or simply sprinkled onto them to boost the fiber content, typical recipes provide anywhere from 2.5 to 6 grams of additional fiber per serving.

## **Buying Resistant Starch by Mail Order**

While bags of natural resistant starch are not yet widely available in supermarkets, U.S. consumers can order bags of Hi-maize<sup>®</sup> resistant starch online at:

[www.kingarthurfLOUR.com](http://www.kingarthurfLOUR.com)



Hi-maize<sup>®</sup> Natural Fiber  
Item # 1587

# Resistant Starch Intakes Worldwide

Resistant starch intakes vary greatly around the world. Currently most developed countries consume between 3-7 grams of resistant starch per day.

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.”

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.

| Country            | Resistant Starch Intake (grams/day) <sup>1</sup> |
|--------------------|--|
| UK                 | 2.8  |
| Sweden             | 3.2 (1.3g bread, 1.2g potatoes)                  |
| Norway             | 4.2 (42% cereals, 27% potatoes)                  |
| United States      | 4.9  |
| Spain              | 5.7  |
| Australia          | 5-7 (42% cereals, 26% vegetables, 22% fruits)    |
| Italy              | 8.5 (7.2g Northern, 9.2g Southern)               |
| India <sup>2</sup> | 10   |
| China <sup>2</sup> | 18   |

<sup>1</sup> Commercial availability of foods enriched with RS would likely raise the levels calculated.

<sup>2</sup> More analysis is needed for those countries with high intakes of starchy staples, particularly if these are cooked and cooled as in traditional eating practices.

## Sources for intake data:

|           |   |
|-----------|---|
| UK        | <i>The British Journal of Nutrition</i> 1990; 64:589-95   |
| Sweden    | <i>European Journal of Clinical Nutrition</i> 2002; 56(6):500-5   |
| US        | Murphy MM, Douglass JS. <i>Resistant starch intakes in the United States. The FASEB Journal</i> 2007;21:533.8 |
| Australia | <i>CRC Handbook of Dietary Fibre in Human Health</i>  |
| Italy     | <i>The British Journal of Nutrition</i> 1998; 80:333-4  |
| India     | <i>Plant Foods for Human Nutrition</i> 1994; 45:91-5  |
| China     | <i>The American Journal of Clinical Nutrition</i> 1998; 68:372-9  |



# The Fiber Boost: Before & After Resistant Starch

Adding Hi-maize<sup>®</sup> resistant starch to processed foods often increases the resistant starch content as much as 200%.

| Food              | Amount       | As is  | With Hi-maize 260 | % increase |
|-------------------|--------------|--------|-------------------|------------|
| White Bread       | 2 slices     | <1.0 g | 3.0 g             | 200%       |
| Multi-Grain Bread | 2 slices     | 3.0 g  | 5.0 g             | 66%        |
| Pasta             | 1 cup cooked | 1.5 g  | 4.5 g             | 200%       |
| Orange Muffin     | 1 medium     | <1.0 g | 3.0 g             | 200%       |

*Dietary fiber values for breads and muffin were estimated in Genesis Nutritional Software; pasta fiber determined in laboratory testing.*

People who eat a healthy mix of natural resistant starch-enhanced processed foods and fresh, minimally-processed foods will be able to reach the 20 gram per day levels of resistant starch that research associates with important health benefits. Below are some ideas for incorporating both these improvements into a typical diet.

## Easy Ways to Add More Resistant Starch to Your Diet

| Instead of                     | Try   |
|--------------------------------|---|
| Chicken soup                   | Chicken & lentil soup   |
| Hot pasta with sauce           | Pasta salad   |
| Turkey sandwich on white bread | Turkey sandwich on bread containing natural resistant starch (Hi-maize) |
| Rice Krispies <sup>®</sup>     | Oatmeal   |
| Breadsticks                    | Potato or rice salad  |
| Potato chips                   | Underripe banana  |

## Double or Triple your Resistant Starch

Americans average just under 5g of resistant starch per day. Here are some delicious ways to double or even triple the resistant starch in your diet:

| Double Your Resistant Starch |              |
|------------------------------|--------------|
| Corn tortilla 8"             | 1.4 g        |
| Black beans (1/2 cup)        | 2.0 g        |
| Potato salad (1/2 cup)       | 1.3 g        |
| <b>Total</b>                 | <b>4.7 g</b> |

| Triple Your Resistant Starch |              |
|------------------------------|--------------|
| Banana, medium               | 4.7 g        |
| Lentils (1/2 cup)            | 5.1 g        |
| <b>Total</b>                 | <b>9.8 g</b> |