

*Natural*<sup>®</sup>  
**Hi-maize**  
*Resistant Starch*

**Proven health benefits  
in 1 easy-to-use ingredient**

 **National Starch**  
FOOD INNOVATION

# Hi-maize<sup>®</sup> resistant starch

**Nutrition and great taste are key consumer drivers... so is trust in your brand. Only Hi-maize resistant starch supports that trust with great taste and strong scientific support.**

Hi-maize resistant starch is a natural, nutritional ingredient derived from high amylose corn. Rich in a form of dietary fiber known as resistant starch, it delivers four important benefits consumers demand:

- **Weight management**
- **Glycemic management**
- **Energy management**
- **Digestive health**

Hi-maize is easily incorporated into a broad range of low-moisture foods, including breads, muffins, cereals, crackers, snacks and pasta, without compromising taste, texture or appearance compared to other forms of fiber. It helps food marketers produce unique, differentiated foods with meaningful consumer benefits.

Using Hi-maize resistant starch with structure-function claims on your food package maximizes your foods' marketability beyond those customer segments seeking dietary fiber.

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## Weight Management\*

Hi-maize delivers dietary fiber benefits, but also has unique benefits important in weight management.

- **Calorie reduction:** Hi-maize reduces the caloric content of foods when it replaces flour.
- **Satiety:** Numerous studies have suggested that Hi-maize increases satiety and lowers caloric intake over 24 hours in healthy people. Unlike other types of dietary fiber, its fermentation in the large intestine increases satiety hormones (GLP-1 and PYY) over many hours.
- **Fat burning:** One clinical trial demonstrated that Hi-maize switches your body to burning more fat and less carbohydrates for energy. Additional studies are needed to confirm the health consequences of this effect.

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## Glycemic Management\*

Hi-maize helps to maintain healthy blood sugar levels in three ways. Hi-maize lowers the glycemic (blood sugar) and insulin response of foods when it is used to substitute for a portion of flour or other digestible carbohydrates. In addition, clinical studies have also shown that Hi-maize increases insulin sensitivity in healthy people, in individuals with insulin resistance and in individuals with Type II diabetes.



## ***So good, even children don't know it's high in fiber!***

**Consumer confidence – the better-for-you carbohydrate.** More than 220 published nutritional studies support the beneficial health properties of RS2 Hi-maize from high amylose corn. This wealth of data substantiates meaningful structure-function claims on the label and provides added value beyond the benefits traditionally associated with dietary fiber.



### **3**

#### **Energy Management\***

People experience swings in blood sugar levels as energy changes throughout the day. For example, immediately following a meal, rapidly rising blood sugar levels give people more energy. An hour or two later, when blood sugar levels fall, energy levels decline as well. This drop in blood sugar can lead to drowsiness, lack of concentration and increased appetite.

Hi-maize reduces the glycemic and insulin impact of foods and increases insulin sensitivity. Reduced glycemic foods containing Hi-maize can help balance your energy levels in the hours following a meal.

### **4**

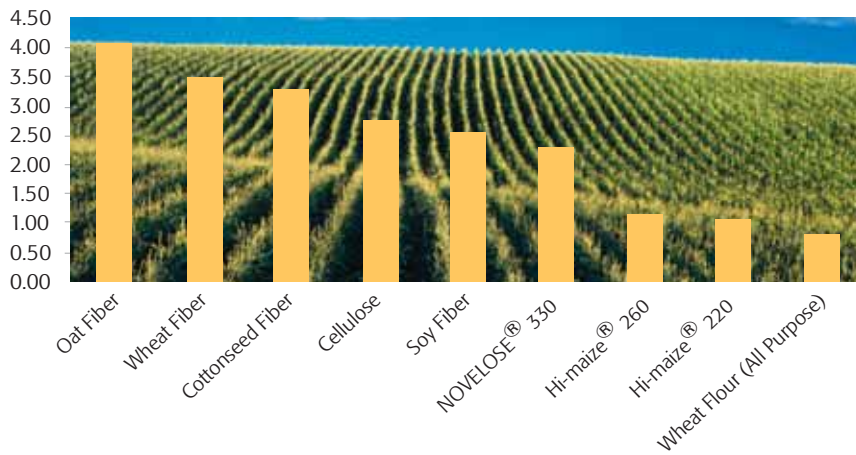
#### **Digestive Health\***

Maintaining good digestive health is essential to physical well-being. Consumption of foods containing Hi-maize positively affects digestive health by:

- Selectively increasing beneficial bacteria, while suppressing harmful bacteria – a 'prebiotic' fiber
- Helping to maintain a healthy colon by increasing short-chain fatty acid production (particularly butyrate, which is important for colon health)
- Reducing intestinal pH and the production of potentially harmful ammonia and phenols
- Promoting regularity with a mild laxative effect



\*The information contained in this document was developed based on review of published studies performed to evaluate the benefits of high amylose corn resistant starch. More than 220 published in vitro, animal and human studies support the health benefits of Hi-maize RS2 resistant starch from high amylose corn. For a summary of the clinical studies, go to [www.resistantstarch.com](http://www.resistantstarch.com). Any claim made on the label of a product is the responsibility of the manufacturer and seller of that product.



**The low water holding capacity of Hi-maize makes formulating easy.**

### Hi-maize® in action

As an ingredient in foods, Hi-maize provides several processing and aesthetic advantages when compared to other sources of fiber.

### Invisible Fiber

White in appearance, neutral in taste with a small particle size and low water-holding capacity relative to other fibers, Hi-maize has minimal effect on organoleptic profile. Consumers can benefit from healthy, fiber-fortified products which look and taste appealing, while manufacturers profit from differentiated brands.

Hi-maize's low water holding capacity is especially important when processing doughs and batters. As a substitute for flour, Hi-maize does not change handling characteristics during processing. It also means reduced cooking times and/or temperatures when compared to foods made with high water holding fibers or whole grain flours.

Foods made with Hi-maize are pleasing to both the eye and palate. Textures are appealing without being grainy or gummy, and the taste of the original formulation is less affected by the addition of Hi-maize relative to other fibers.

### Consumer Friendly

Hi-maize is well tolerated. Up to 45 grams of fiber from Hi-maize can be consumed without significant digestive side effects.

### *Hi-maize strikes the right balance between*

- exceptional sensory performance,
- meaningful label claims, and
- dietary fiber content

### Where to use Hi-maize

Many successful consumer brands are made with Hi-maize. These include bread, muffins, cookies, nutrition bars, wraps, snacks, crackers, breakfast cereals and pasta. Commercial production and extensive testing in the National Starch Food Innovation labs and pilot plants convincingly demonstrate how easy it is to incorporate Hi-maize into many types of food formulations. The products can generally replace a portion of either all-purpose or whole wheat flour on a one-for-one basis without adversely affecting processing.

In addition to the dietary fiber and health benefits, Hi-maize contributes valuable functional and processing attributes to many foods.

### *These include:*

- Improved yield in breads
- Higher crumb moisture content in cookies
- Increased crunchiness and bowl life in cereals
- Crispiness in sheeted goods
- Al dente texture in pastas



## The Main Processing Advantages a guide to ingredients and common usage levels

Applications	Key processing benefits	Recommended usage level
Breads	<ul style="list-style-type: none"> <li>• Process tolerant - including yeast, acid and heat</li> <li>• Low water-holding capacity</li> <li>• Improves yield</li> <li>• Excellent crumb characteristics</li> </ul>	5-20% of dry mix
Bakery products (including cakes, pastries and dry mixes)	<ul style="list-style-type: none"> <li>• Low water-holding capacity</li> <li>• Higher crumb moisture content</li> </ul>	5-10% of dry mix
Nutrition bars	<ul style="list-style-type: none"> <li>• Easy to use - no impact on processing or eating quality</li> </ul>	5-20%
Biscuits and cookies	<ul style="list-style-type: none"> <li>• Versatile in a wide range of biscuit / cookie formats</li> <li>• Very fine particle size allows easy incorporation</li> <li>• Low water-holding capacity</li> </ul>	5-20%
Breakfast cereals	<ul style="list-style-type: none"> <li>• Improves cell uniformity</li> <li>• Increases bowl-life</li> <li>• Increases crunchiness</li> </ul>	3-15%
Pasta and noodles	<ul style="list-style-type: none"> <li>• More tolerant to overcooking</li> <li>• Helps maintain "al dente" texture</li> </ul>	3-20%
Sheeted baked snacks and crackers	<ul style="list-style-type: none"> <li>• Improves texture</li> <li>• Increases crispiness</li> <li>• Reduces cracking and breakage</li> <li>• Low water-holding capacity</li> </ul>	3-20%
Extruded snacks	<ul style="list-style-type: none"> <li>• Increases cell uniformity</li> <li>• Improves stability</li> <li>• Increases crunchiness</li> <li>• Low water-holding capacity</li> </ul>	3-20%
Soups and ready meal components	<ul style="list-style-type: none"> <li>• Increases crunchiness of croutons</li> <li>• Improves bite of pasta / noodles</li> </ul>	3-10%
Thickened beverages	<ul style="list-style-type: none"> <li>• Good processing tolerance</li> </ul> <p>Note: as Hi-maize is an insoluble particle, beverage applications generally need to be thickened or an anti-sedimentation rheology modifier used.</p>	1-3%

National's technical team has a portfolio of successful commercial and pilot trial formulations and can help you develop new high-fiber foods or revise existing formulations to differentiate your products in the market with meaningful health benefits.



### What is Resistant Starch?

Resistant starch has been defined as starch that resists digestion within the small intestine. Many public health authorities and food organizations such as the Food and Agricultural Organization, the World Health Organization, and the U.S. National Academy of Sciences recognize resistant starch as a beneficial carbohydrate. In addition, Hi-maize resistant starches qualify as dietary fiber for labeling purposes by the official AOAC methods 985.29 and 991.43.

Resistant starches are classified as type 1-4 according to their physical and chemical characteristics. Only type 1, 2 and 3 resistant starches are naturally present in foods. It has been estimated that up to 5% of all starches consumed may be resistant to digestion. Hi-maize resistant starch is unique because it is the only natural RS2 currently available in the US market.

There is overwhelming scientific evidence that natural resistant starches offer significant nutritional benefits. For example, more than 220 published peer-reviewed studies have shown that RS2 and RS3 resistant starches from high amylose corn contribute specific metabolic and digestive health benefits. National Starch continues to work with researchers around the world to investigate the health benefits of natural resistant starch.

### Classification of Resistant Starches

- RS1** physically trapped starch, as in legumes and partially milled and whole grains
- RS2** natural granular starch (no chemical modification); examples include green banana starch, raw potatoes and Hi-maize 260
- RS3** retrograded starch which can be found in foods like cooked and cooled potatoes, NOVELOSE® 330
- RS4** chemically modified starches; these cannot be found in nature

## Rely on National for product success

As the global leader in food starch technology, National Starch Food Innovation has produced a broad portfolio of products specifically developed to improve the nutritional content of foods. Our unique ability to solve the nutritional benefit/eating quality/processing equation inspires food formulators to create innovative, healthy and appealing foods.

National Starch Food Innovation has the experience, the expertise and the resources to develop application-specific solutions for consumer food products. Over the last 60 years, our work with the food industry has taken us into virtually every facet of formulation and production for almost every food type.

Our expertise covers core attributes, like starch technology, processing, shelf life and rheology optimization and also today's most pressing issues like nutrition, flavor, texture modification, mouthfeel, and natural and organic formulations.

We offer our customers a host of support services in their efforts to create new formulations, improve existing formulations or improve processing.

Our large staff of food technologists, chefs and engineers is available to assist you from idea inception to manufacturing scale up.

At their disposal are comprehensive pilot plant facilities in the US, Europe and Asia that allow them to replicate nearly any food processing environment on a scale-up base to ensure that the bench-top formulation succeeds in the plant.

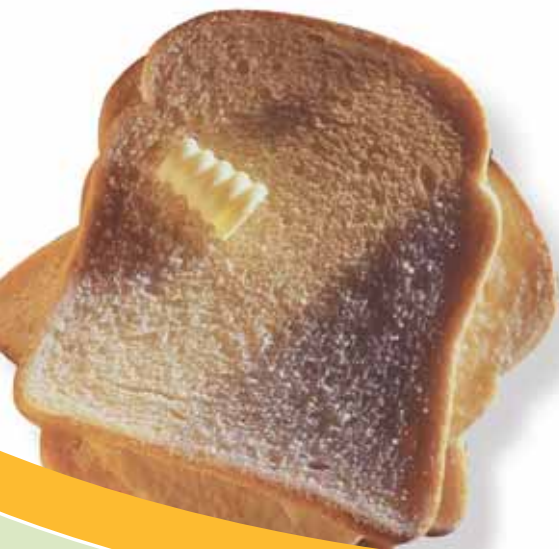


## Full support... on the phone and online

National's staffs of technical and customer service professionals are available to answer product, ordering and delivery questions. In addition, we maintain two websites to assist formulators in their information gathering and product recommendation phases. [5-in-1-fiber.com](http://5-in-1-fiber.com) describes the health benefits of Hi-maize, along with summaries of clinical and consumer validation, plus product information, usage recommendations and sample ordering. [Foodinnovation.com](http://Foodinnovation.com) has the technical data on all of National's food products and some tools that have proven to be very popular with food formulators, such as our food starch glossary and measurement conversion calculator.

If you're looking to improve the nutritional content of your foods and differentiate your products with appealing consumer benefits, then it's time to look to Hi-maize resistant starch. Your National Starch Food Innovation sales representative will be happy to get you started.

Just dial 1-866-961-NATL (6285) or go [www.foodinnovation.com](http://www.foodinnovation.com) to contact us.



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**Directory Assistance**

Telephone: 1-866-961-NATL(6285)

Fax: 1-609-655-4402

Canada Telephone: 1-905-799-2009

The information given and the recommendations made herein are based on our research and are believed to be accurate but no guarantee of their accuracy is made. In every case we urge and recommend that purchasers before using any product in full scale production make their own tests to determine to their own satisfaction whether the product is of acceptable quality and is suitable for their particular purposes under their own operating conditions. No representative of ours has any authority to waive or change the foregoing provisions but, subject to such provisions, our engineers are available to assist purchasers in adapting our products to their needs and to the circumstances prevailing in their business. Nothing contained herein shall be construed to imply the nonexistence of any relevant patents or to constitute a permission, inducement or recommendation to practice any invention covered by any patent, without the authority from the owner of this patent.