



HI-MAIZE® RESISTANT STARCH

Proven health benefits in one easy-to-use ingredient



HEALTH & NUTRITION™ 

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IDEAS TO SOLUTIONS

About HI-MAIZE[®] resistant starch

Consumers are increasingly interested in appealing foods and beverages with improved nutritional profiles. HI-MAIZE high-amylose maize resistant starch is a nutritional ingredient derived from a conventionally bred variety of high amylose corn that contains high levels of non-digestible starch. Rich in a form of dietary fiber known as resistant starch, it delivers three important benefits consumers demand:

1. **Glycemic management**
2. **Energy management**
3. **Digestive health**

HI-MAIZE resistant starch is available under Ingredion Incorporated's TRUETRACE[®] Identity Preserved Program for non-GM products and under non-GMO Project[®] Verified.

Health benefits and claims

Using HI-MAIZE resistant starch with scientifically validated structure-function claims on packaging maximizes marketability beyond fiber claims. Other meaningful claims that HI-MAIZE resistant starch can provide include:

*Glycemic management**

HI-MAIZE resistant starch helps to maintain blood sugar levels in two ways:

- **Reduced glycemic response:** HI-MAIZE resistant starch lowers the short-term glycemic (blood sugar) and insulin response of foods when it substitutes for flour.
- **Improved insulin sensitivity:** With the recent FDA-authorized qualified health claim, products containing HI-MAIZE resistant starch may be able to communicate the relationship between high-amylose maize resistant starch and a reduced risk of type 2 diabetes, citing limited scientific evidence (see side bar for more). HI-MAIZE resistant starch increases long term insulin sensitivity in healthy people and in individuals with insulin resistance and type 2 diabetes.

*Energy management**

People experience swings in blood sugar levels as energy changes throughout the day. Reduced glycemic foods containing HI-MAIZE resistant starch can help balance energy levels in the hours following a meal.

The latest breakthrough is a qualified health claim

An important tool in the fight to reduce the risk of type 2 diabetes is now available. In late 2016, the U.S. Food and Drug Administration authorized a qualified health claim for Ingredion's high-amylose maize starch, citing limited evidence that it may reduce the risk of type 2 diabetes. In its Letter of Enforcement Discretion, FDA has provided the following claim statement options:

"High-amylose maize resistant starch may reduce the risk of type 2 diabetes. FDA has concluded that there is limited scientific evidence for this claim."

"High-amylose maize resistant starch, a type of fiber, may reduce the risk of type 2 diabetes. FDA has concluded that there is limited scientific evidence for this claim."

These claims can be used on the packaging of conventional foods, as defined by 21 CFR 101.14. Such products include bakery items, nutrition bars, cereals and pastas, among others. Foods that contain at least 1 gram of fiber from high-amylose maize resistant starch per serving or 1.8 grams of HI-MAIZE per serving may bear the qualified health claim. Additional requirements are described in the FDA letter of enforcement discretion.

The qualified health claim language cites "limited scientific evidence" given the relatively small number of studies compared to a health claim with significant scientific agreement and given that some studies showed an improvement in one marker, but not in other markers.

HI-MAIZE[®] resistant starch from Ingredion is the only high-amylose maize starch on the market today.



Digestive health*

Maintaining good digestive health is essential to physical wellbeing. HI-MAIZE® resistant starch improves digestive health by:

- Helping to maintain healthy colon cells by increasing short-chain fatty acid production (particularly butyrate, which is essential for colon health).
- Reducing intestinal pH and the production of potentially harmful ammonia and phenols.
- Promoting regularity with a mild laxative effect.

What are resistant starches?

Resistant starches have been defined as starches that resist 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.

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. HI-MAIZE® resistant starch is unique because it is the only non-chemically modified (type RS2) resistant starch derived from high amylose corn currently available in the US market.

Classification of resistant starches

RS1	Physically trapped starch, as in partially milled whole grains
RS2	Granular starch with no chemical modification; examples include green banana starch and HI-MAIZE resistant starch
RS3	Retrograded starch which can be found in foods like cooked and cooled potatoes
RS4	Chemically modified starches; these cannot be found in nature

Technical attributes and superior functionality

As an ingredient in foods, HI-MAIZE resistant starch provides several processing and aesthetic advantages when compared to other sources of fiber. White in appearance, neutral in taste with a small particle size and low water-holding capacity, HI-MAIZE resistant starch 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 resistant starch has a low water holding capacity, which is especially important when processing doughs and batters. As a substitute for flour, HI-MAIZE resistant starch 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.

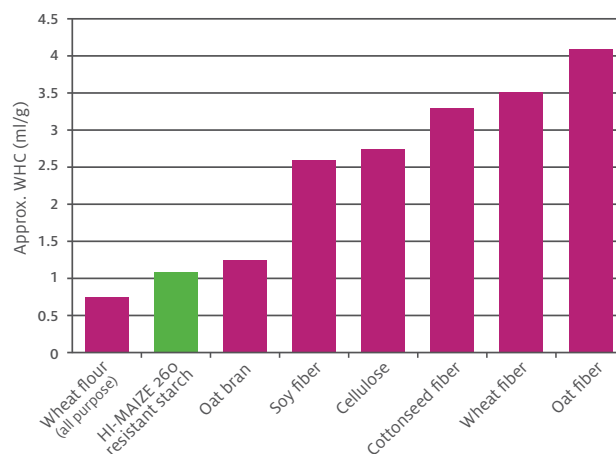
Foods made with HI-MAIZE resistant starch are pleasing to both the eye and palate. Textures are appealing without being grainy or gummy, and the taste of the original formulation is not affected by the addition of HI-MAIZE resistant starch relative to other fibers.

In addition to the dietary fiber and health benefits, HI-MAIZE resistant starch 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

FIGURE 1: WATER HOLDING CAPACITY OF DIFFERENT INSOLUBLE FIBERS



* The information contained in this document was developed based on review of published clinical studies performed to evaluate the benefits of resistant starch. More than 120 published nutritional studies confirm the health benefits of HI-MAIZE resistant starch. This wealth of clinical data substantiates meaningful label claims and provides added value beyond the benefits traditionally associated with dietary fiber. Any claim made on the label of a product is the responsibility of the manufacturer and seller of that product. The information presented is not legal or regulatory advice and it is not to be acted on as such.

Where to use HI-MAIZE® resistant starch

Many successful consumer brands are made with HI-MAIZE resistant starch. Commercial production and extensive testing in the Ingredion labs and pilot plants convincingly demonstrate how easy it is to incorporate HI-MAIZE resistant starch into many types of food formulations. The products can generally replace a portion of either refined or whole wheat flour on a one-for-one basis without adversely affecting processing.

Ideal applications for HI-MAIZE resistant starch include:

- Breads and bakery products
- Nutrition bars
- Biscuits and cookies
- Breakfast cereals
- Pasta and noodles
- Sheeted baked snacks and crackers
- Extruded snacks
- Soups and ready meal components
- Thickened beverages

Ingredion's food formulating and processing technical team has a large portfolio of successful commercial and pilot trial formulations on which they can rely to help manufacturers develop a HI-MAIZE-enriched food or revise an existing formulation to differentiate products in the market with meaningful health benefits.

Rely on Ingredion for product success

Ingredion has the experience, the expertise and resources to develop appealing consumer products. Our work has taken us into virtually every facet of formulation and production in almost every application. What's more, we apply our marketing intelligence and consumer trend insights to develop innovative solutions that address emerging consumer demands.

There is an ever present need for ingredient innovation to include new technologies and process improvements to positively affect product development and ultimately deliver better tasting, better-for-you food and beverage products to consumers.

Ingredion is at the top of our field in anticipating consumer needs and delivering solutions to our manufacturing partners. Our global innovation center in Bridgewater, NJ includes capabilities unmatched by others suppliers to include sensory analysis, consumer focus groups, pilot plant, Texture Robotics Experimenter, a Culinology® center and more, all staffed by a team technical specialists and experts with a broad and deep knowledge, who understand the unique needs of specific markets, applications and customers.

Look to us to partner with you to produce products that deliver on-trend products with the same tastes and textures consumers have come to expect from traditional offerings.

Innovate with HEALTH AND NUTRITION

To learn more about the benefits of HI-MAIZE resistant starch, contact your Ingredion sales representative or visit us online.

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Delivering solutions.™**

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