RESISTANT MALTODEXTRIN

Consideration for maltodextrin as an allowed food additive in Grain-Free, Paleo, and Keto Certification

Is Resistant Maltodextrin a Toxic Food Additive?

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Abstract

Maltodextrin is a polysaccharide that is most often added during processing of foods and is used as a thickener, filler, to add texture, or to improve the mouth-feel of a food. As a processed food additive, many have suggested that maltodextrin in any amount or form is "toxic." However, this review covers the toxicity and properties of the most processed form of maltodextrin, known as resistant maltodextrin (RMD).

KEYWORDS
Prebiotics, Fiber, Resistant Maltodextrin

1 | PREFACE

The gastrointestinal tract of the human body is inhabited by a diverse microbial community with specialized function and clinically significant effects. The host's microbiota mediates homeostasis in health and disease.

Unfortunately, infectious diseases have led to the increasing use of antibiotics, which at high doses are capable of killing 95% of all microbes, including symbiotic, beneficial ones. These alterations in the gut microbiome have profound consequences, as the use of antibiotics can change the chemical composition of the microbiome, completely.

Protecting the microbiome from adverse effects associated with the use of high-dose antibiotics requires interventions that include prebiotic fibers that provide a substrate to specific species of regulatory bacteria such as bifidobacteria and lactobacilli.

In the USA, dietary recommendations suggest a dietary fiber intake between 25 and 38 grams per day for adults, [1] while the European Food Safety Authorization (EFSA) recommends a daily intake of 25 g of fiber per day [2].

And, the United Nations Food and Agriculture Organization (FAO) and World Health Organization (WHO) recommend a fiber intake of 38 g for men and 25 g for women of fiber [3, 4]. Current dietary guidelines for fiber from various organizational bodies are based on evidence obtained over the course of decades to support these recommendations.

Unfortunately, "Western" eating habits have led to an unparalleled reduction in the consumption of dietary fiber [5, 6]. On average, Americans only consume less than 40% of the recommended dietary fiber intake per day [7].

2 | STUDIES ON FIBER

A recent meta-analysis [8] published last month pooled data from 185 publications involving just under 135 million person-years, 58 clinical trials, and 4,635 adult participants. Of the randomized trials pooled, higher intakes of dietary fiber were shown to reduced fat mass, lower blood cholesterol, and systolic blood pressure. These findings were also supported by cohort studies that reported that fiber intake was associated with reduced heart disease incidence, diabetes, and mortality.

Additionally, the data show support for dose-response relationships for significant reductions in all-cause mortality, total cancer deaths, total cardiovascular disease deaths, stroke, and incidence of colorectal, breast, and esophageal cancers.

Given the consistency in findings between the trials and the dose-response relationships reported and the final results from the meta-analysis, there is ample support for the inverse causal relationship of low fiber intake between metabolic disease and unlikely to be a consequence of confounding variables.

DIETARY FIBER

Dietary fiber can be defined from multiple points of view. The Codex Alimentarius Commission's Committee on Nutrition and Foods for Special Dietary Uses defined dietary fiber as "carbohydrate polymers with 10 or more monomeric units, which are not hydrolyzed by the endogenous enzymes in the small intestine of humans" [9]. This definition also encompasses fiber subclasses such as resistant starches, oligosaccharides, polysaccharides, and other non-digestible carbohydrates [10].

Consumers are increasingly demanding foods with a variety of specific properties, from low-calorie to low fat, to low carbohydrate content, as well as other features that confer beneficial health effects.

With a re-emerging focus on dietary fiber due to its increasingly supported health benefits to the microbiome and metabolic disease, the food industry has tried to offer products within this context having improved flavor and appearance, as well as enhanced benefits to health that are strengthened by the addition of food additives, especially the emerging dietary fibers known as prebiotics.

WHAT ARE PREBIOTICS?

Prebiotics are often defined as non-digestible polysaccharides and oligosaccharides that are selectively capable of promoting the growth of beneficial lactic acid producing bacteria in the colon such as bifidobacteria and lactobacillus.

These beneficial bacteria are antagonistic to pathogenic bacteria including Salmonella sp., Escherichia coli, and Shigella, limiting proliferation [11, 12]. A prebiotic is fiber, but not all fibers are prebiotic. To be considered a prebiotic, fibers must meet specific criteria, including:

- Resistance to gastric acidity
- Resistance to hydrolysis by mammalian enzymes
- Resistance to gastrointestinal absorption
- Selective fermentation by beneficial microflora.

There is an array of prebiotics of various origins and chemical properties. Some are more established, and some emerging. Established classes of prebiotics include:

- Inulin
- Fructooligosaccharides (FOS)
- Galactooligosaccharides (GOS)
- Trans-galactooligosaccharides (TOS)
- Lactulose
- Polydextrose
- Resistant Starches.

Emerging classes of prebiotics include:

- Hydrocolloids
- Isomaltooligosaccharides (IMO)
- Xylooligosaccharides (XOS)
- Arabinoxylooligosaccharides (AXOS)
- Glucans
- Lactilol
- Raffinose
- Lactulose
- Sorbitol, and…
- Resistant **Maltodextrin**.

While less processed maltodextrin has been associated with microbiome dysregulation, the more processed form of maltodextrin is resistant to digestion, and has *prebiotic activity* [13].

3 | PRODUCTION OF RESISTANT MALTODEXTRIN

Maltodextrin is a white, non-viscous, hygroscopic spray-dried powder and used as a food ingredient that is used to improve the texture and mouthfeel of various food. Maltodextrin is manufactured by enzymatic hydrolysis from starch derived from corn, wheat, or tapioca, and is readily soluble in water.

Resistant maltodextrin is a glucose polymer that undergoes controlled dextrinization and hydrolysis, and subsequent re-polymerization. The re-polymerization results in other linkages associated with indigestible starch. These include linear and branched linkages β-1,6, α-1,2 and/or β-1,2, α-1,3 and/or β-1,3, and β-1,4. Thus, re-polymerization of the starch molecules results in maltodextrin that is resistant to hydrolysis by endogenous enzymes, resulting in a compound that is resistant to digestion and degradation by human enzymes [14].

As such, maltodextrin that has undergone re-polymerization has been classified as a resistant, soluble dietary fiber, containing a total fiber content of 85% [15].

4 | HEALTH OUTCOMES OF RESISTANT MALTODEXTRIN

Resistant maltodextrin (RMD) is a soluble fiber ingredient whose physiological functions are recognized by the Foods for Specified Health Use (FOSHU) for its ability to maintain healthy intestinal regularity, blood glucose levels, and serum lipids [16].

Resistant maltodextrin has been found to have shown a number of beneficial physiological effects, demonstrated by both in-vitro, in-vivo in experiments. [17, 18, 19, 20]. A randomized, double-blind, placebo-controlled parallel-group trial was conducted to study RMD on humans with metabolic syndrome.

In the trial, 30 subjects with metabolic syndrome were allocated into two groups at random. One group took either tea containing 9 grams of RMD (treatment group). The other group received placebo tea at three mealtimes daily for 12 weeks (control group)[21].

After the 12-week RMD treatment, the resistant maltodextrin group had significantly decreased waist circumference, visceral fat, fasting blood glucose, HOMA-R, and serum triacylglycerol (TG) levels.

The change ratio of the visceral fat area showed a negative statistical correlation with the baseline value, suggesting that the efficacy of RMD was increased in subjects having a larger visceral fat area. Further, the total number of metabolic syndrome risk factors decreased to from 32 to 20, with two subjects showing no risks, whatsoever.

The data suggest that the continuous ingestion of 15–30 grams per day of resistant maltodextrin significantly improves glucose and lipid metabolism, and may improve risk factors associated with visceral fat accumulation [22, 23, 24]. Thus, the continuous consumption of resistant maltodextrin shows promise as a potential strategy or adjunct treatment for obesity and metabolic syndrome.

5 | RESISTANT MALTODEXTRIN IN FOODS

Not only is resistant maltodextrin a bioactive and effective ingredient whose regular consumption results in metabolic improvement, but is also a non-viscous, palatable, water-soluble, dietary fiber ingredient often used in various food and beverage applications.

Resistant Maltodextrin is most often used as spray-drying aids for flavors and seasonings, carriers for sweeteners, for flavor enhancement, fat replacers, and bulking agents [25].

Maltodextrins have well defined physical properties, and, unlike natural starches, are soluble in water, which first popularized their use as an additive in the food industry. However, from a physical and chemical context, different methods of maltodextrin production can result in more highly branched polysaccharide molecules of higher weight (branched amylopectin polymer), to lower molecular weight and more linear polysaccharide molecules (linear amylose polymer) based on the production techniques involving acid, or by acid and alpha-amylase enzyme. [26]

Because maltodextrins present a wider distribution of molecular weight, they offer different shear, viscosity, rheological property, and prebiotic function [27]. Maltodextrin is a Generally Recognized as Safe (GRAS) ingredient by the FDA. In the FDA Code of Federal Regulations directory, maltodextrins are defined as non-sweet, nutritive polysaccharides consisting of D-glucosyl units linked with alpha-1,4 bonds [28].

6 | DISCUSSION

It often suggested that prebiotic fiber will eventually replace the use of antibiotics in various applications. And it seems that the introduction of prebiotic fibers would be an attractive possibility to improve states of metabolic dysregulation including obesity, heart disease, as well as other degenerative diseases, and some types of cancer.

And while the metagenomic data provided by the Human Microbiome Project should revolutionize applications of prebiotics with specific functional properties for these conditions, there have been some serious political and ideological obstructions to the acceptance of resistant maltodextrin and other types of prebiotic fibers as functional ingredients that could potentially offer cheap, effective fortification in foods.

While detailing the full array of political obstructions would be too large to encompass in this particular article, a few are worth mentioning:

- “Whole foods only” zealotry without respect for socio-economic disadvantage, or evidence of benefits from isolated compounds.
- Other naturalistic fallacies.
- Unsubstantiated fear of ingredients that contain the letter ‘x’ (i.e xanthan gum, maltodextrin, polydextrose, xylooligosaccharides which are all prebiotic fibers.)
- Dichotomous beliefs that fiber is unnecessary because low-fiber ketogenic diets have shown metabolic benefits without respect for findings that show that adverse effects begin to appear in the absence of fibrous substrates, and improve after reintroduction.

While the dairy and cereal industry have long fortified products with vitamins and minerals, the idea of adding low-cost prebiotics that improves taste and mouth-feel while enhancing product quality and biological benefit has been met with increasing amounts of resistance.

This occurs despite overwhelming evidence to support potential benefit to a society plagued with obesity, diabetes, metabolic derangements, neurological degeneration, and all other disorders associated with microbiome disturbances and dysregulation.

Supported claims about the benefits of prebiotics range anywhere from their ability to prevent weight gain in adolescents, to improving tolerability as adjunct treatments in cancer, to improving a myriad of metabolic diseases and immune functions. And still, fleshing out the clinical significance and potential therapeutical applications of prebiotic fibers remains in its infancy.

Nevertheless, due to its functional properties, resistant maltodextrin should be reevaluated by the food industry and the medical community alike for its potential as an important and functional food ingredient, as well as its clinical relevance.

7 | CONSIDERATION OF MALTODEXTRIN AS AN ALLOWED FOOD ADDITIVE IN GRAIN-FREE, PALEO, AND KETO CERTFICATION

Maltodextrin in Keto Certification: All forms of maltodextrin are allowed in Keto Certification, including those derived from potato, tapioca, wheat, and corn. KETO Certified standards do not require that a product be grain-free. Maltodextrin is counted when calculating net carbohydrates in KETO Certified products. however, resistant maltodextrin is not.

Maltodextrin in Paleo Certification: Wheat and corn-derived maltodextrins are not allowed in the Certified Paleo Standards. However, root and tuber-based maltodextrins such as tapioca, cassava, arrowroot, and potato maltodextrins are allowed.

Maltodextrin in Grain-Free Gluten-Free Certification: Although maltodextrin is gluten-free, wheat and corn-derived maltodextrins are not allowed in the Grain-Free Certification program. However, root and tuber-based maltodextrins such as tapioca, cassava, arrowroot, and potato maltodextrins are allowed provided that they meet the requirements for containing less than 10ppm of gluten and gliadin competitive as evidenced by lab testing.

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