

# New Dextrins Supplementing Fiber with Innovation

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**Formulations containing a novel soluble dextrin fiber have been shown to exhibit several advantages in processibility and clinical response over those containing existing fibers.**

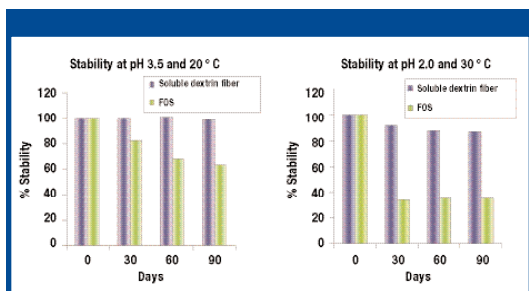
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Despite the increasing recognition of dietary fiber as an important constituent of a healthy diet, refined modern diets still provide less than half the 30-g daily-recommended amount of fiber. The American Association of Cereal Chemists defines *dietary fiber* as “the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine.”

Besides maintaining general digestive health, fibers also promote beneficial physiological effects such as attenuation of blood cholesterol, triglycerides, and reduction in glucose responses. In addition, some fibers contribute to prebiotic effects in the digestive tract and improve colonic health (1). On the basis of their water-solubility, dietary fibers are classified into two major categories and a balanced intake of both types is recommended for optimum digestive health. Insoluble fibers consist of lignin, cellulose, hemicellulose, and bran as well as



**Figure 1:** Comparative stability of FOS and dextrin fiber under acidic conditions.

**Table I: Comparison of taste and sweetness characteristics of some soluble fibers.**

10% solution of	Sweetness (sucrose = 1)	Overall taste
Soluble dextrin fiber	<0.1	Neutral
Polydextrose	0.1	Slightly chalky and bitter
Inulin (standard)	0.15	Floury and pasty
Maltodextrin 20DE	0.2	Neutral
FOS	0.25	Slightly caramel

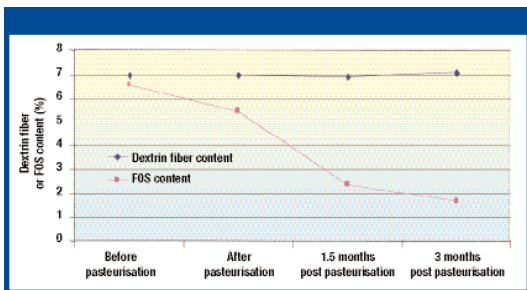
digestion-resistant starches, and soluble fibers include polyfructoses [inulin, fructooligosaccharides (FOS)], galactooligosaccharides, gums, mucilages, and pectins.

**Choosing the right fiber supplement**

A variety of fiber supplements are currently available as reconstitutable powders, drink mixes, capsules, as well as swallowable or chewable tablets to correct dietary fiber deficiencies. Fiber supplements based on

psyllium or methylcellulose generally swell in water, becoming sticky or gummy, imparting high viscosity and a gritty mouth feel. Such fibers must be consumed with large quantities of fluids and have a low consumer acceptance. Consequently many of the recently marketed nutraceutical and over-the-counter fiber supplements have focused on using fully soluble, low-viscosity fibers such as inulin, FOS, and hydrolyzed guar gum. These fibers are generally available in a fine-powder form and suffer from poor flow and lack of direct compressibility, necessitating additional agglomeration or granulation before formulating into tablets or drink mixes. Some of the low-

viscosity fibers such as inulin and FOS also present disadvantages of poor heat and acid stability, off-taste, and low digestive tolerance. An ideal soluble dietary fiber should exhibit instant and complete water solubility, low viscosity, neutral taste, high-fiber content, high digestive tolerance, excellent stability (heat and acid), and easy processability (good flow and direct compressibility). A novel soluble dextrin fiber, possessing all the above-mentioned characteristics, can overcome the



**Figure 2: Comparative post-pasteurization stability of FOS and dextrin fiber.**

stability and application limitations of most soluble fibers (2).

Dextrins are generally obtained by treating starch with a food-grade acid at elevated temperature, which enables the addition of 1-2 and 1-3 glycosidic links to the starch polymer. The 1-2 and 1-3 glycosidic links cannot be digested by any of the normal human enzymes and hence dextrins are classified as fiber. The dextrinization process generates a product with broad molecular weight range, leading to high viscosity upon solubilization in water, discoloration, and a development of off-taste (3). Narrowing the molecular weight distribution by eliminating higher molecular-weight fractions can reduce viscosity of the resulting solution. Eliminating low molecular-weight fractions can make the dextrin sugar-free and significantly improve its digestive tolerance and reduce hygroscopicity.

Spray agglomeration of the purified dextrin solution provides a granular, free-flowing, and directly compressible fiber product. The high stability (heat and acid) and excellent digestive tolerance allow use of the soluble dextrin fibers in a

wide variety of fiber supplements such as re-constitutable powders, beverages, nutrition bars, or directly compressed tablets as well as clinical enteral nutrition formulations. Such improved fiber excipients ultimately allow faster processing times, significant

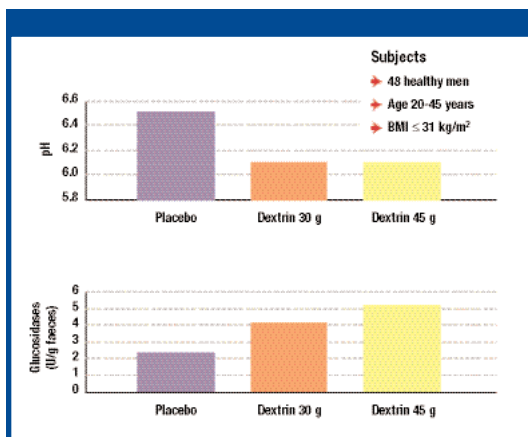
cost savings, and shorter cycle-time for the manufacturer while promising a highly stable and more acceptable fiber supplement for the consumer.

### **Neutral taste, excellent heat , and acid stability determine application versatility**

Many soluble fibers impart characteristic taste to the formulations they are incorporated into, limiting their level of use or requiring taste masking. Results from a taste panel in Table I show that a 10% aqueous solution of dextrin fiber exhibits neutral taste compared with other fibers, implying minimal impact on the overall formulation taste.

In addition to taste, many acidic formulations demand high stability of the fiber excipient at low pH. As seen in Figure 1, the stability of a 10% aqueous solution of fibers such as inulin or FOS under acidic pH of 3.5 or 2.0 is quite low compared with that of dextrin fiber (2). Thus, inulin or FOS may not be the soluble fibers of choice for use in acidic formulations.

Many fiber-fortified ready to drink beverages must be pasteurized



**Figure 3:** Effect on fecal pH and glucosidase levels following 35-day administration of dextrin fiber.

or sterilized to ensure long-term shelf stability. Figure 2 exhibits the excellent postpasteurization stability of dextrin fiber compared with FOS in an acidic beverage. Similar results also have been observed in acidic beverages that were sterilized at 110 °C for 50 min (unpublished data).

The neutral taste, excellent thermal and pH stability of the novel dextrin fiber is a direct consequence of its purity and robust chemical structure, enabling its use in various fiber formulations in which stability and taste are important.

### High tolerance and prebiotic effects enhance digestive health

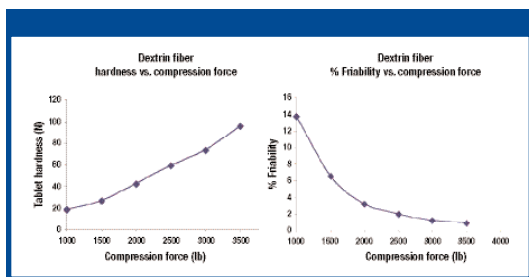
Many commonly used soluble fibers undergo fermentation in the digestive tract, leading to the generation of gas, uncomfortable bloating, and flatulence. Fibers containing smaller molecular-weight components also tend to induce significant laxation and diarrhea. Soluble fibers such as inulin and FOS are well known to

exhibit low digestive tolerance, thereby causing laxation and flatulence at relatively low doses. In a randomized, double-blind, placebo-controlled clinical trial involving 48 healthy men, the dextrin soluble fiber was shown to exhibit no laxation at a 90 g/day dose, which is significantly higher than most other soluble fibers (4,5). An individual could thus obtain the

daily-recommended fiber requirement (30 g/day/person) entirely by consuming the dextrin fiber without experiencing any unwanted digestive side effects.

Besides good digestive tolerance, the prebiotic effects of soluble fibers are also important. A wide variety of microorganisms tend to naturally flourish in the human digestive tract; however, exposure to stress or use of antibiotics can diminish the population of these good bacteria. Some soluble fibers act as prebiotics, nourishing and replenishing beneficial microorganisms such as *Lactobacilli* and *Bacteroides* in the digestive tract while limiting the growth of harmful bacteria such as *Clostridia*. Prebiotics also have been associated with a variety of health benefits such as preventing diarrhea, controlling ulcers, reducing cholesterol, enhancing immunity, and preventing colon cancer.

These effects have been attributed to a reduction in the colonic pH, as



**Figure 4:** Compression and tablet hardness profile of dextrin fiber.

a result of a generation of short-chain fatty acids (SCFA) by increases in the levels of  $\alpha$ - and  $\beta$ -glucosidase enzymes. In a randomized, double blind, placebo-controlled clinical trial involving 48 healthy men, the dextrin soluble fiber exhibited a significant pH lowering in the digestive tract along with an increase in levels of glucosidases after 35 days of administration (see Figure 3). This was accompanied by an increase in *Lactobacilli* (beneficial bacteria) levels from 7.2 to 8.2 log cfu/g and Bacteroides (responsible for SCFA generation) level from 8.5 to 8.9 log cfu/g with 45-g dose of dextrin. On the other hand, levels of harmful Clostridia were lowered from 5.9 to 5.6 log cfu/g (6). The excellent digestive tolerance and beneficial prebiotic effects (7) make this new dextrin the ideal soluble fiber to enable significant improvement in overall digestive health.

### Improved processability of fibers enables cost-savings and shorter cycle time

Most soluble fibers are currently available as fine powders, suffering from problems of poor flow and

lack of compressibility. Using these fine powders in formulating drink mixes, bulk fiber supplements, or tablets, mandates the use of granulation or agglomeration processes to improve the flow and/or compressibility. Such processing takes time, requires elab-

orate equipments, and is labor intensive and expensive. Figure 4 shows the direct-compression tableting profile of this dextrin fiber exhibiting good tablet hardness and low friability. The granular nature of dextrin fibers thus enables good flow and direct compressibility, allowing their use in the preparation of fiber supplemented swallowable caplets and chewable tablets by direct compression without any need for additional agglomeration.

### Future trends in fiber supplementation and innovation

Traditional fiber supplements have always revolved around bulk powders, swallowable capsules, or tablets. The introduction of newer dosage forms such as chewable fiber tablets, nutrition bars, chewies, and health drinks fortified with fiber, proteins, and vitamins is steadily increasing. Consumer acceptance of fully water-soluble, low viscosity fibers is steadily increasing compared with that of traditional bulk forming fiber supplements. The other upcoming trend is fortification of fiber supplements with minerals such as calcium. For example, a

combination of specially granulated directly compressible calcium carbonate (8) along with dextrin fiber enables the formulation of a chewable fiber tablet, which not only acts as a good source of fiber (3 g fiber/serving) but also provides the daily adult requirement of elemental calcium (1 g/serving) and functions as an antacid. Such a unique multifunctional (fiber + calcium + antacid) chewable tablet formulation provides significant advantages and appeal over traditional formulations. Additional innovations in fiber supplementation such as formulating combinations of soluble and insoluble fibers can provide a more balanced fiber intake as is usually recommended.

Thanks to the innovative ideas from experts in carbohydrate excipients, soluble dextrin fibers can be used in nearly any type of pharmaceutical, nutraceutical, or over-the-counter fiber supplements because of its complete water solubility, low viscosity, neutral taste, high fiber content, high digestive tolerance, excellent stability (heat and acid), and easy processability (good flow and direct compressibility). Further innovations in the field of soluble fibers are on the horizon and will transform the act of consuming a fiber supplement from a "thick and gritty" affair to a more pleasant and enjoyable experience.

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