

# THE DEVELOPMENT AND BENEFITS OF SUGARBEET FIBER

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## HISTORY

Hieroglyphics in temple drawings in Egypt over 4000 years ago demonstrate the use of beetroot as a food. The origin of the species beta is believed to be in the Mediterranean, and numerous references can be found in the literature of Greek and Rome. Cato Major (234-149) anticipates our current dietary concerns related to fiber and laxation by recommending it as a remedy for constipation: (1)

"To open the bowels proceed in this way ... when it (the broth) is nearly cooked, add two small heads of cabbage and two beets, each with their roots." (2)

By the fifteenth century beets appeared to have become common all over Europe. With the discovery by Andreas Marggraf of sugar in beets in 1747 and the development of the beet sugar industry by Franz Achard (1753-1821), sugar from beets began to be a serious competitive rival to imported cane sugar. (3)

With the development of the beet sugar industry and the increased tonnage of sugar production, by-product production of pulp and molasses increased proportionally. Dried pulp historically has been used principally as an inexpensive cattlefeed. Only in recent times has the pulp been evaluated for its potential as a dietary fiber component for humans. This interest in the dietary benefits of sugarbeet fiber parallels the growing interest and understanding of the benefits of dietary fiber in the diet.

## DIETARY FIBER

Rising living standards brought upon by the Industrial Revolution led to the consumption of more refined grains and higher levels of meat, dairy products, and sugar. This change in food consumption coupled with the establishment of New World crops (Potato, Sweet Potato, Corn) resulted in a significant lowering in the levels of dietary fiber in European and American diets. In the first 50 years of this century, fiber was a poor handmaiden to the interest and research in vitamins, minerals, and digestible nutrients. The undigestible portion of the diet held little interest to nutritionists, physiologists, and physicians. (4)

It has been only in the last 35 years that dietary fiber has become one of the most controversial and scientifically stimulating areas in human nutrition. Dietary fiber is being investigated for its beneficial role in: (5)

- Laxation
- Diverticular Disease
- Colon Cancer
- Glucose Absorption and Metabolism
- Lipid and Cholesterol Metabolism

Dietary guidelines recommended by the National Cancer Institute call for an increase of dietary fiber in the U.S. diet from its current level of approximately 11 grams/day to 25-30 grams/day.

It is unlikely that Americans will completely abandon their current diet and return to that of our Neolithic ancestors in order to achieve the increase in fiber recommended from natural sources. To get an additional 20 g/day of fiber from fruits one would have to eat 4-5 apples or bananas each and every day. What is practical, desirable and now underway in the food industry is to supplement currently acceptable food groups in the diet with additional fiber from a variety of sources.

Fiber supplementation has dominated the cereal market in recent years. In 1987 less than 5% of the items were high-fiber cereals, and now approximately 30% of the \$7 billion Ready to Eat cereals are positioned as high fiber. (6) The baking industry has successfully marketed whole grains and fiber supplemented breads to such an extent that they now have a larger market share than white bread. Fiber supplementation has proceeded at such a pace that foods as diverse as chocolate chip cookies and baby foods now boast of added fiber. Because of the current market growth, fibrous products which once were used for animal feeds or disposed of with little return now are being utilized or investigated for their dietary value.

### SUGARBEET FIBER

All fibers are not equal.

There are two broad classes: those containing a significant "soluble" fraction, e.g. sugarbeet, psyllium, and oat fiber, and those which are primarily "insoluble," e.g. cellulose, wheat bran. While the insoluble fibers provide bulking and laxation effects, the soluble fibers appear to be much more physiologically active in regards to cholesterol lowering, modulation of the glucose response, and reducing risks of colon cancer.

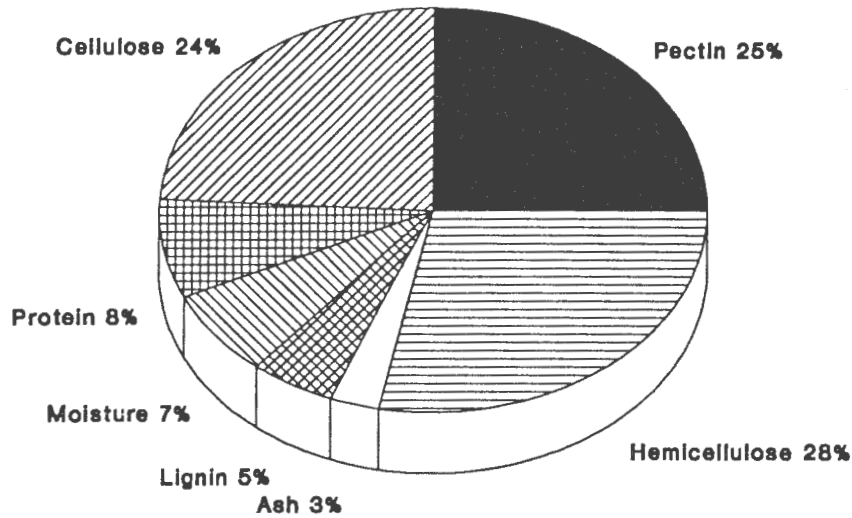
Sugarbeet fiber is unique in that it has an excellent balanced blend of both soluble and insoluble fractions along with a higher total of dietary fiber. The comparisons with wheat bran, oat bran, and sugarbeet fiber is given below:

	<u>TOTAL DIETARY FIBER</u>	<u>SOLUBLE FIBER</u>
Wheat Bran	42-47%	3-7%
Oat Bran	12-19%	5-7%
Sugarbeet Fiber	78-81%	10-25%

While psyllium has more soluble fiber than either oat fiber or sugarbeet fiber -- approximately 85% -- because of regulatory delays in obtaining GRAS status and recent adverse publicity concerning allergic reactions, I do not foresee psyllium being a major factor in the fiber market in the foreseeable future.

A typical composition of sugarbeet fiber is:

# SUGAR BEET FIBER



AMERICAN CRYSTAL SUGAR CO.

While the minor components may vary depending on the individual process, it is important to note the high level of pectin in the composition. Pectin is the chief contributor to the soluble fraction and may contribute significantly to sugarbeet fiber's physiological effects. The isolation and characterization of the cellulose, hemicellulose, and pectin fractions in sugarbeet fiber was carried out at North Dakota State University and published in the Journal of Food Science in 1988. (7,8)

The pectin which was analyzed in this study had a high methoxy content with more than 60% degree of methylation. The pectin contained 10-17.5% neutral sugars -- mainly arabinose and galactose. The peak molecular weights ranged from 35,000 to 45,000 Daltons.

## CLINICAL STUDIES

The number of clinical and nutritional studies of sugarbeet fiber showing its beneficial effects continues to grow each year. A survey of the literature both in the U.S. and Europe found 19 clinical studies since 1981 with 4 major studies released since 1987. Two studies are of particular note.

A study at the University of Minnesota was published in 1990 by Lampe, Slavin et al (9).

The study concluded that sugarbeet fiber is more effective than wheat bran or vegetable fiber in lowering total and LDL cholesterol while maintaining HDL cholesterol, probably because of its pectin content. Laxation effects were the greatest with wheat bran, followed by sugarbeet fiber and then vegetable fiber.

A study conducted at the University of Illinois by Sugarman et al and reported in 1989 (10) again demonstrated the benefit of sugarbeet fiber when compared against three other dietary fibers -- oat,

psyllium, pea. The comparisons involved laxation, glucose modulation, and effects on HDL and LDL cholesterol. The conclusion was:

"We conclude that, while all four varieties of dietary fiber displayed some positive physiological effects, those of beet and psyllium appeared to be the most robust."

## COMMERCIAL PRODUCTS

There are three companies currently offering fiber or fiber by-products in the U.S..

DUOFIBER - American Crystal Sugar Company

FIBREX - Delta Fibre Foods

PCC/HCP - Tate & Lyle/Amstar

DuoFiber process is based on a series of patents 1987-89 which describe the slurring, washing, and purification of the sugarbeet pulp. Other patents are pending.

Fibrex appears to be based on a Swedish Patent issued in 1979. The beet fiber was developed by the food division of the Volvo group of companies. The process consists of pressing, a patented technique of drying in steam atmosphere, grinding, and size classification.

The Tate and Lyle entries were announced in Food Processing in December 1990. Their work appears to be based on a U.S. Patent issued in 1983 (U.S. 4,831,127). This patent teaches a method to hydrolyze parenchymal cells under extremes of pH with elevated temperatures for short periods with physical shearing of the material.

PCC stands for Parenchymal Cell Cellulose and HCP for Hemicellulose Pectin Complex. The claim is that sugarbeet pulp contains approximately 25% PCC and 60% HCP. PCC appears to be positioned as more of a functional ingredient, i.e. a hydrocolloid, for its water binding and stabilizing characteristics. HCP has a soluble fiber content of 95% and is positioned as a means of increasing the soluble fiber content of foods without changing their texture and quality. The ingredients are produced at a North American plant.

## CONCLUSIONS

Ongoing medical and nutritional research strengthens the relationship of fiber and health. The need to increase fiber in our diets from a current 11 grams/day to approximately 25-30 grams per day will require fiber supplementation of approximately 12-16 lbs/capita/year or over 1 million tons of added fiber per year.

While conventional fiber sources such as wheat and oats have been studied and marketed for decades, sugarbeet fiber is a new entry in the competitive fiber arena. Wheat and oat bran were once considered troublesome, low margin by-products of the flour milling operations. Now they have become marketing centerpieces in the baking and cereal industries. Over time, sugarbeet fiber's superior nutritional qualities should enable it to obtain an important share of the dietary fiber market.

## REFERENCES

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