fibrex®

Physiological effects and clinical results.

Nordic Sugar
Member of Nordzucker Group

General information about dietary fibre.

This brochure has been produced in cooperation with Professor Nils Georg Asp at the University of Lund.
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Dietary fibre

Like protein, fat etc., dietary fibre is a generic term that characterises carbohydrates (polysaccharides), which are not digested and not absorbed in the stomach or the small intestine but pass to the large intestine. This term also includes lignin, a very inert substance found in some cell walls.

The importance of fibre for the function of the intestines has been known for a long time. However, research during the past decades has shown that the fibre in food not only influences all areas of the stomach and intestinal tract – it also affects our metabolism (fig. 1).

Fibre in food has been ascribed a steadily increasing role in our health and well-being. Today, its positive effects are also mentioned in connection with overweight, blood sugar and insulin levels, blood lipids, gallstones and cancer.

In recent decades, dietary fibre has attracted increased attention, both in nutritional studies and other kinds of medical research. People in general have become aware of the importance of fibre for our overall well-being. More and more authorities in industrialized countries are recommending an almost doubled intake of dietary fibre, which implies an increase to at least 25 grams of daily intake for adults.

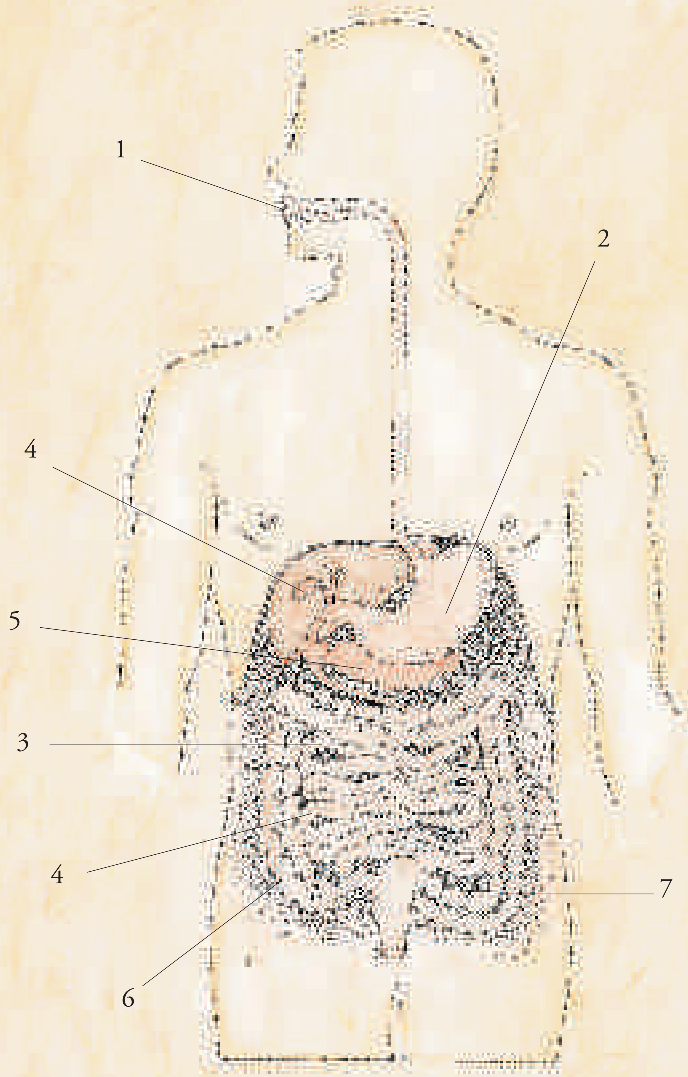
Extensive research is presently underway worldwide to further pinpoint the relationships. This research is being conducted experimentally in laboratory animals and clinically in humans.

Nutritional and physiological effects of dietary fibre

1. Dietary fibre provides chewing resistance and a feeling of satiety.
2. Dietary fibre provides an increased volume and slower emptying; the food stays in the stomach longer and is emptied over a longer period of time. This contributes to a slower digestion and absorption of nutrients.
3. A larger portion of the small intestine is used for absorbing the nutrients.
4. Bile salts and cholesterol adhere to certain types of fibre and are excreted with them. This means that less bile salts are reabsorbed. The formation of bile salts in the liver from cholesterol is therefore increased, which lowers the plasma cholesterol level. The gelling function of some fibres means a slower absorption of nutrients.
5. The effects mentioned under point 2 and 3 influence both blood sugar and hormone levels.

6,7. In the large intestine (the right section) dietary fibre is partially fermented, increasing the bacterial mass. The remaining fibre retains water and contributes to the bulking effect. Thus, the function of the large intestine is improved overall, the transit time of the intestinal contents is decreased, and constipation is counteracted or eliminated. Products from the fermentation favourably affects the mucous membrane of the large intestine.

Fig 1



FIBREX characteristics and composition.

Average composition/ 100 g

73 g dietary fibre* of which 1/3 is soluble

22 g pectin
29 g hemicellulose
18 g cellulose
4 g lignin

10 g protein (no gluten)
4 g sugar
4 g mineral substances
0,5 g fat
Energy content 254 kJ (60 kcal)

** According to the difference method.*
(67 g dietary fibre according to AOAC.)

FIBREX is a dietary fibre product consisting of plant cell walls. Many other dietary fibres originate from plant cell walls, e.g. those made from bran fractions (pea fibre, soybean fibre, wheat and oat bran etc.). Oat husks are also used as a source of dietary fibre. FIBREX is a sugar beet fibre, and due to its function in the plant it has characteristics different from those of husk and bran fibres. Since the task of the cells in husks is to protect the seeds, they are largely hard and lignified, whereas the cells in sugar beets are mainly assigned to store nutritional reserves. Hence they do not have to be lignified to the same extent. FIBREX is more easily hydrated and therefore retains fluids better than husk or bran fibres. Figure 2 gives a schematic view of a non-lignified cell and a portion of a lignified cell wall, where the secondary cell wall has been substantially thickened and infiltrated with lignin.

FIBREX is made from sugar beets. After careful washing, the material is thinly sliced and immediately extracted in warm water (70-72º C).The sugar extraction is continued until less than 1 % of the sugar remains in the pulp that is left after the water has been pressed out. This pressed pulp is screened and dried by pure steam in a special, patented process into the final product, FIBREX.

The difference method

The dietary fibre content averages 81% of the dry matter, calculated as what remains after analysis of all the other substances (the difference method). There are several different analytical methods for determining the dietary fibre content directly. The oldest one (the Weende crude fibre method) yields only a part of the cellulose + lignin content. The NDF method (van Soest´s "Neutral Detergent Fibre") yields an approximate estimate of the cellulose + lignin + insoluble hemicellulose content of a sample, but the result, like that of other methods, is heavily dependent on the type of fibre in the sample. Even the increasingly accepted enzymatic methods for determining dietary fibre (AOAC or Asp et al) yield somewhat lower values than expected when used to analyse FIBREX. The reason is that certain polysaccharides in FIBREX are also alcohol-soluble and alcohol precipitation is used in these methods.

This is the reason why we determine the dietary fibre content of FIBREX with the difference method.

Quality

The hygienic quality is very high. The total number of micro-organisms (colonizing units) is < 1 000 per gram, of which the totals for yeast fungus and mould are less than 100 each.

Water absorption

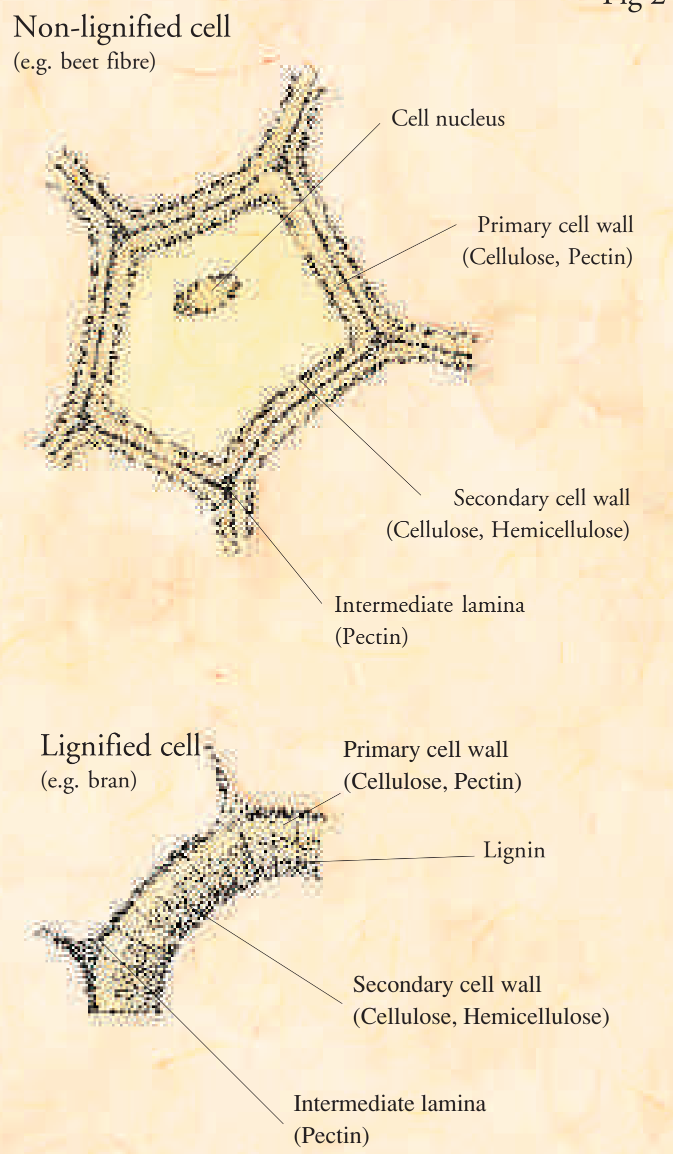
In FIBREX the drying collapses the cell structure, but when water is added, the cells resume their original form, taking up water and retaining it within the cell wall structure, gelling with the pectin (fig 3 and 4).

Water Uptake Capacity, WUC, is approx. 7-8 g per gram of FIBREX. That is the amount of water absorbed by FIBREX, if it is allowed to soak in water, and retained, when the fluid has been allowed to drain off.

Water Holding Capacity, WHC (= water retained at a pressure of 10 kPa) is approx. 3,5 -4 g per gram of FIBREX. That is how much water FIBREX retains in most foodstuffs, where several components "compete" for the water. FIBREX water retention capacity is thermostable, i.e. it is not affected by freezing, thawing, baking, frying or autoclaving.

Some of the dietary fibre in FIBREX is water soluble. This part consists mainly of pectin and constitutes approx. 22% of the dry matter. This soluble fibre part contributes to the increase in the viscosity of foodstuffs containing FIBREX, and is undoubtedly important for FIBREX ability to lower blood sugar contents after meals, and to reduce blood cholesterol levels.

Fig 2



Unsoaked FIBREX. (Fig 3)
Soaked FIBREX. (Fig 4)

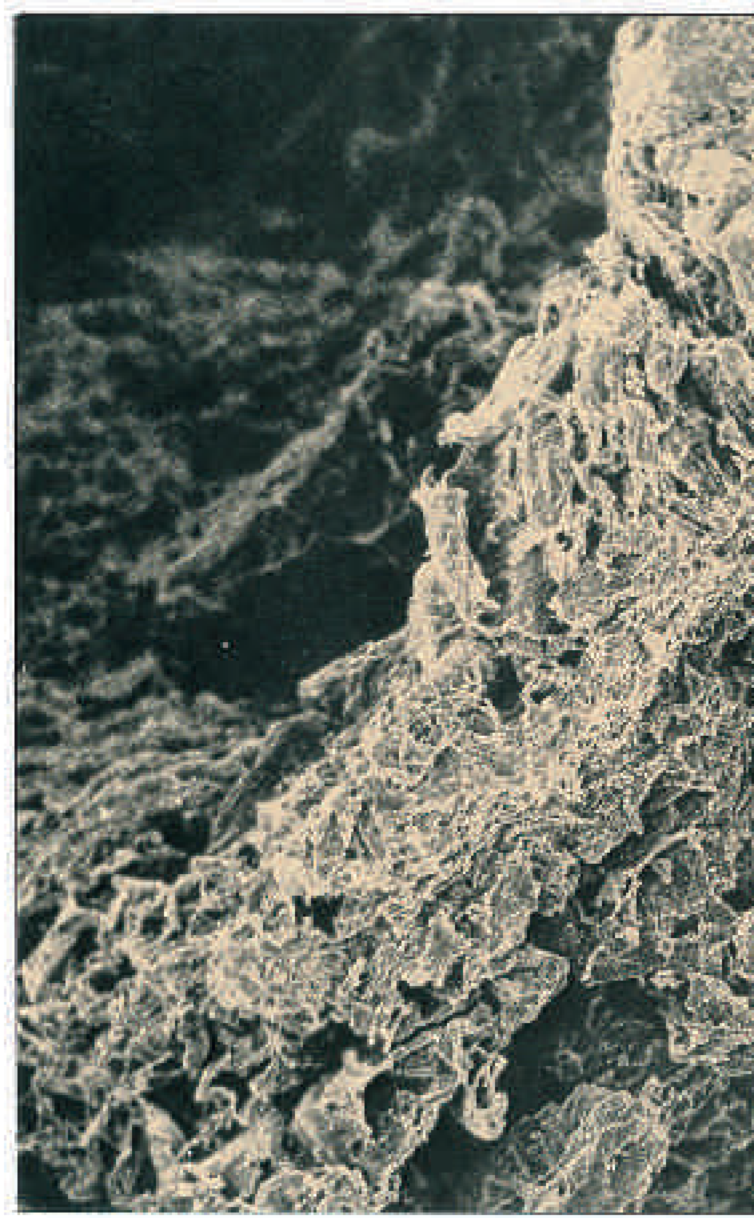
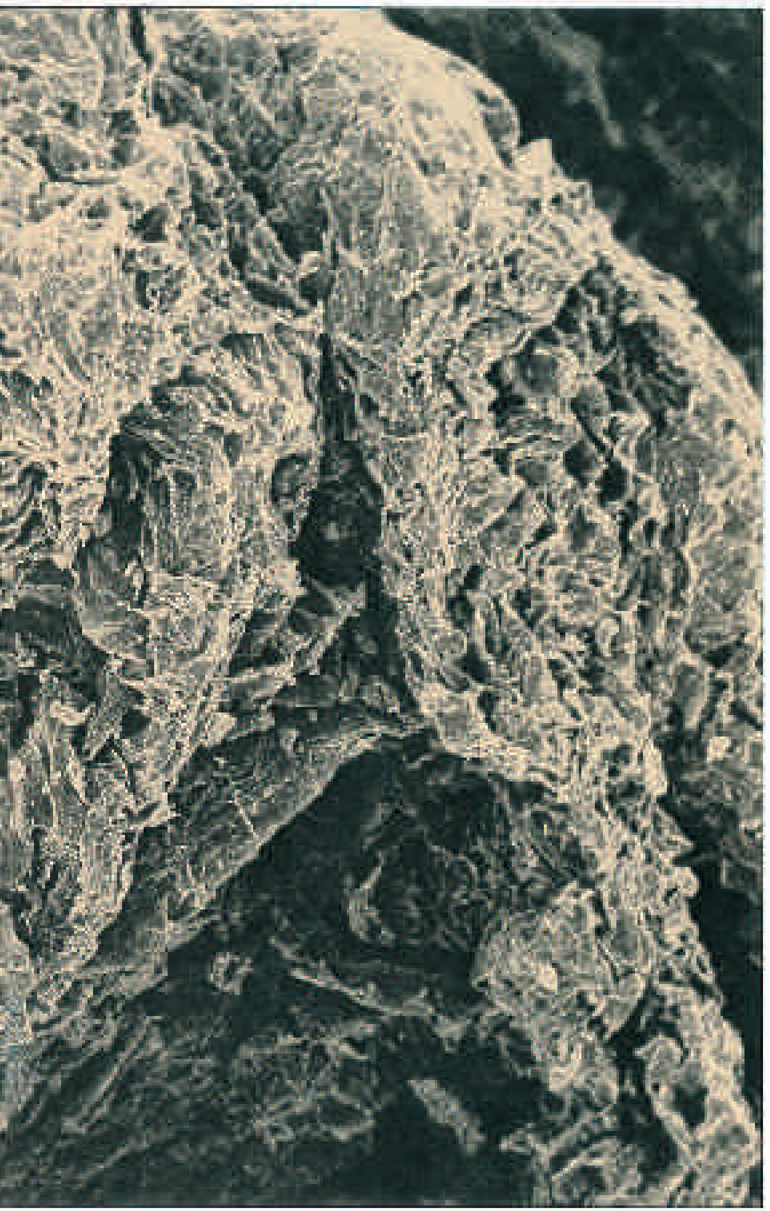


Fig 3. Unsoaked FIBREX. Enlargement approx. 300 ti



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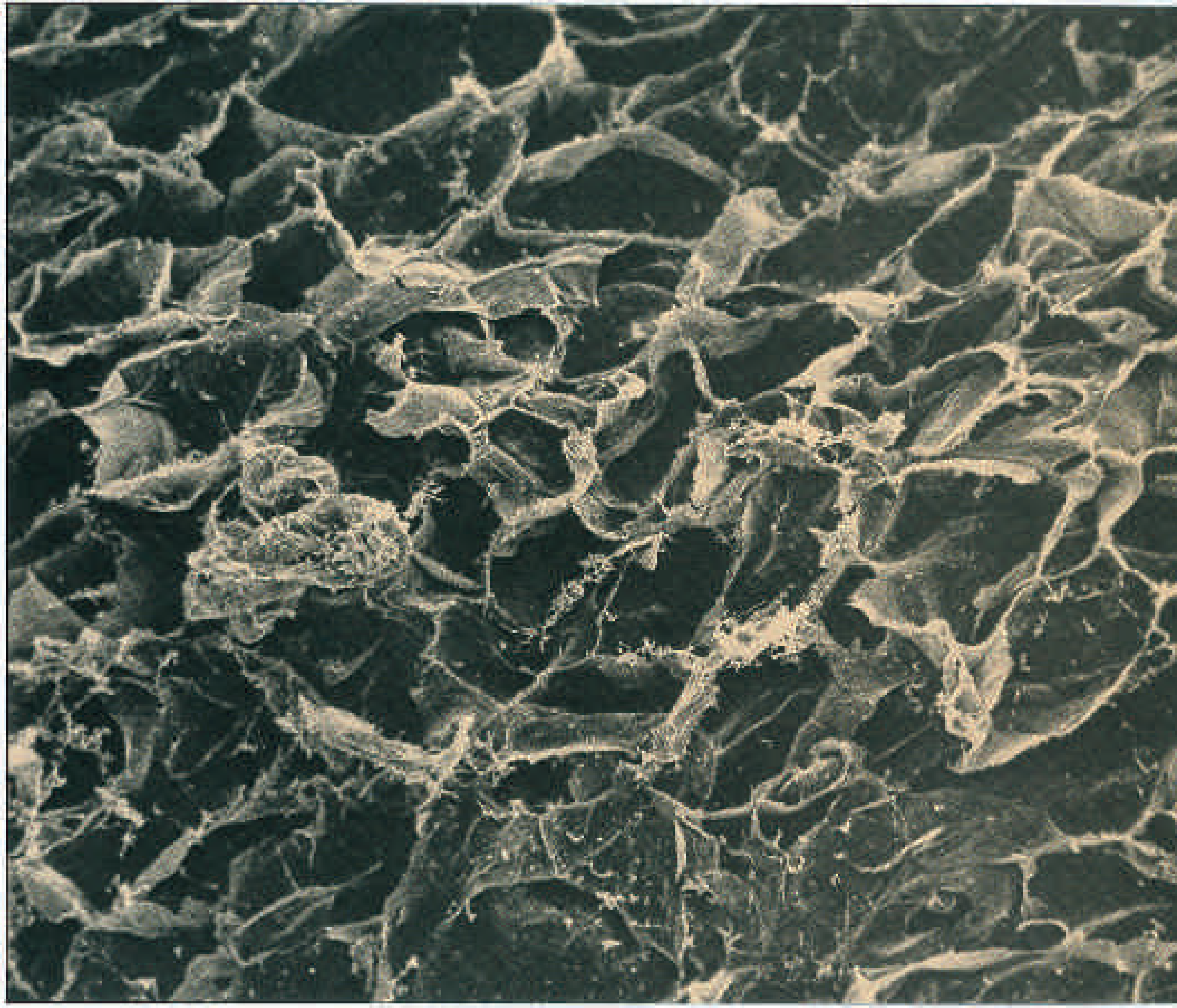


Fig 4. Soaked FIBREX. Enlargement approx. 300 times.

Clinical testing of FIBREX.

FIBREX as a bulking agent

Problems such as constipation can generally be prevented by consumption of dietary fibre. This is due to the so-called bulking effect, which is based on two mechanisms:

1. Dietary fibre absorbs water during passage through the intestines.

2. The fibre produces more bacteria mass through fermentation in the large intestine.

The bulking effect of FIBREX has been demonstrated in experiments in both animals and humans. A comparison of different fibre sources, measuring the increase in the volume of faeces in rats, showed that a 10% fibre supplement in their feed produced an obvious bulking effect, i.e. increase in faeces. In terms of the effect per gram of dietary fibre, wheat bran had the greatest effect, but since FIBREX contains 50-60% more dietary fibre per gram of product, the bulking effect of FIBREX exceeds that of wheat bran (fig 5). An experiment with pigs revealed that a 33% addition of FIBREX produced a 56% increase in faeces.

Clinical tests in humans in Germany showed that a 12 g fibre supplement (of which 10 g was FIBREX) produced a faecal mass increase of 3.3 g per gram of added fibre. A study of 5 adults at the University of Edinburgh yielded an increase of 3.7 g faeces per gram of added FIBREX. These studies prove that FIBREX has a good bulking effect in humans.

FIBREX and diabetes

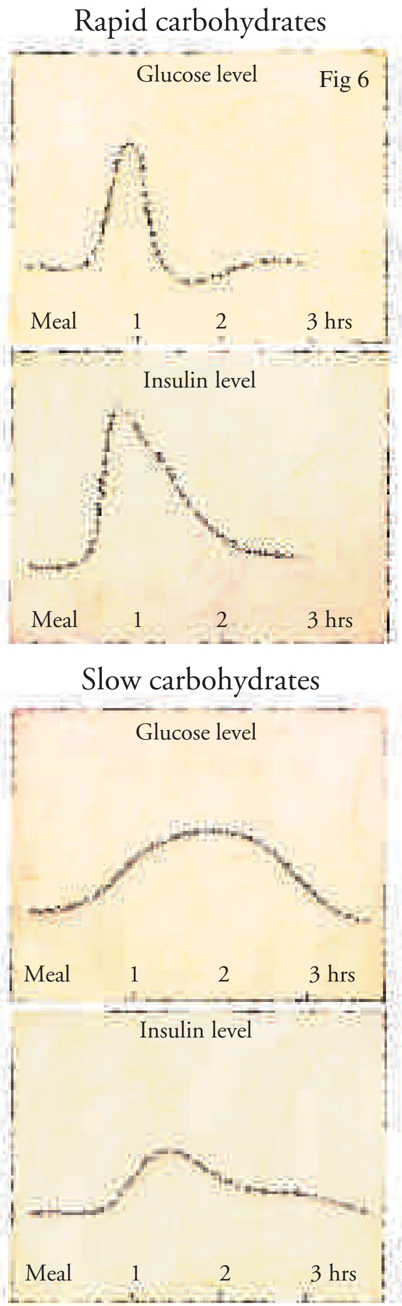
Diabetics have for long been instructed to select primarily carbohydrates that yield a slow increase in blood sugar, so-called slow carbohydrates. This kind of diet demands less insulin, which is important to diabetics. Also non-diabetics will benefit from slow carbohydrates as a low insulin level may contribute to a lowered risk of storage of fats, high blood pressure and arteriosclerosis (fig 6). We now know that fibre in food, and especially the gelling type of fibre, makes carbohydrates slower.

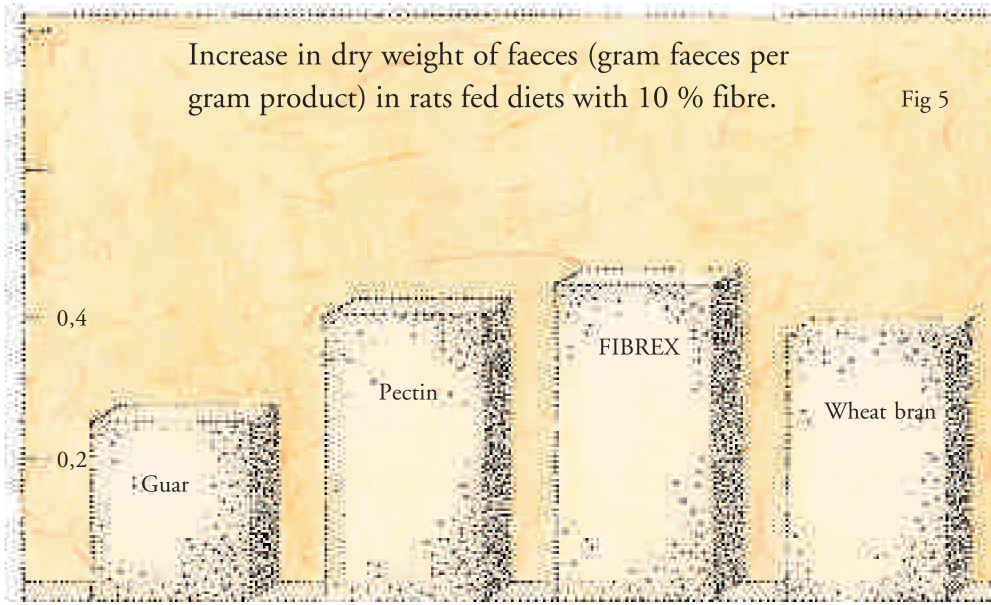
The mechanism underlying this effect is a retardation of the passage of food through the stomach and intestines and a slower absorption of nutrients through the intestinal walls. This was demonstrated in a rat study, showing that FIBREX-enriched bread was emptied more slowly from the stomach.

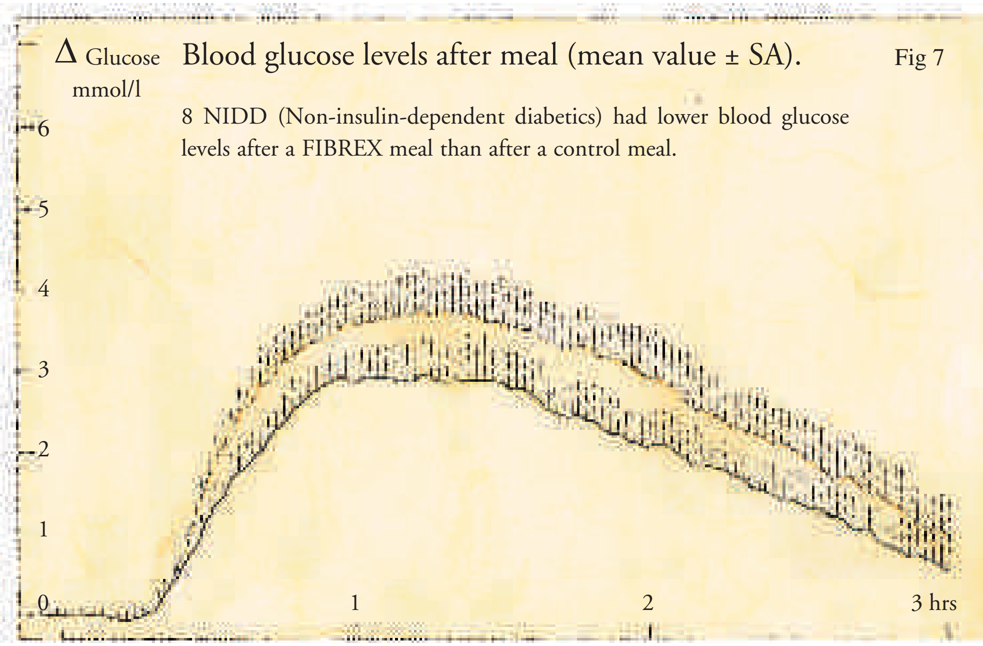
In a clinical study 8 elderly diabetic subjects were served a breakfast containing 15 g of FIBREX, and, on other mornings, the same breakfast without FIBREX. Their blood glucose levels were significantly lower after the FIBREX breakfast than after the normal breakfast. The effect was similar to that achieved by treatment with antidiabetic drugs (fig 7). This study also revealed a previously unknown effect of fibre supplementation – an increase in somatostatin. This may be one contributing explanation to the lower blood glucose level.

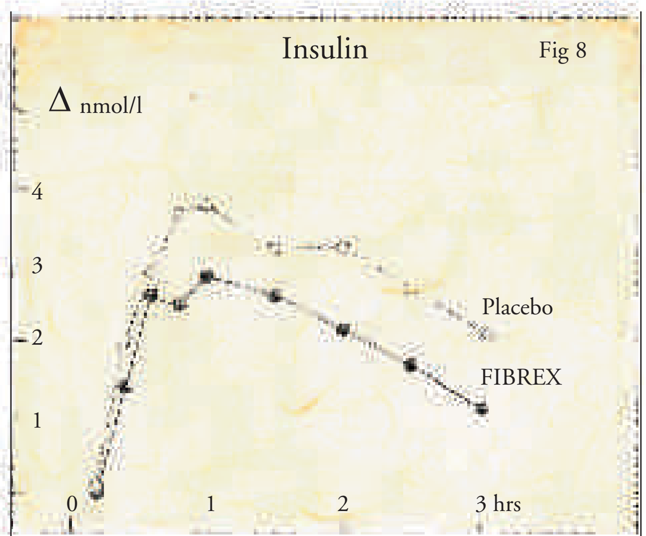
No effect of FIBREX was recorded on the blood glucose level of non-diabetic subjects, but the insulin response was lower (fig 8). Low insulin levels are favourable with regard to e.g. blood pressure.

Long-term studies have also been conducted in 16 elderly diabetic subjects to study the effect of fibre on diabetes over a longer period of time. In a cross-over study of 8 + 8 weeks FIBREX was used to increase the fibre content in food from 15 g per day to 40 g during the high-fibre period. The result was a significant improvement in the fasting blood glucose level.









FIBREX and blood lipids

The risk of cardiovascular diseases depends partly on the blood lipid content, particularly cholesterol. There are two main kinds of cholesterol containing blood lipids: LDL, or so called "bad" cholesterol, and HDL, "good" cholesterol. A lower amount of LDL and a low LDL/HDL ratio imply less risk of harmful effects.

The effect of FIBREX on blood lipid levels has been tested in several clinical studies, e.g. at the Malmö General Hospital, where 28 women participated in the study. They lowered the cholesterol levels initially by approx. 9% through an improved diet. Subsequently, a double-blind cross-over study of 4 + 4 weeks was conducted with FIBREX and a similar product with a low fibre content (i.e. a placebo). During the "fibre weeks" the total cholesterol content decreased markedly, especially the amount of LDL ("bad") cholesterol, whereas the amount of HDL ("good") cholesterol tended to rise (fig 9). The LDL/HDL ratio changed in a favourable direction, which means a lower risk of cardiovascular diseases (fig 10).

In the previously mentioned 8+8 weeks study in diabetic subjects, favourable effects on blood lipids were also seen during the FIBREX period.

A study at the Sahlgren's Hospital in Gothenburg showed that 30 g FIBREX per day decreased the cholesterol absorption from the small intestine, which may explain the lowering effect on the blood cholesterol content.

In another study with 10 nomad men, a supplement of 26 g FIBREX per day resulted in a 13,4% reduction of total cholesterol and a 16,8% reduction of the LDL-cholesterol (fig 11). The LDL/HDL ratio and the triglyceride value both decreased by approx. 10%.

FIBREX and mineral absorption.

In several studies, cereal brans have been shown to inhibit the absorption of the important minerals iron and zinc. This effect is ascribed to phytic acid, the level of which is relatively high in cereal brans but virtually nil in FIBREX.

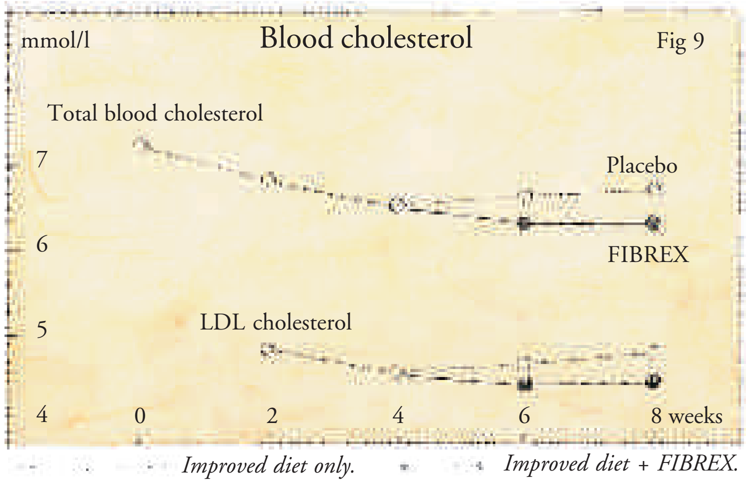
To study the influence on the absorption of iron, a study was conducted at the Sahlgren's Hospital in Gothenburg, where 10 people were given spaghetti with meat sauce, with and without FIBREX. Using isotope labelled iron, the amount absorbed was checked after two weeks. No difference was found between the groups, which proves that FIBREX has no inhibiting effect on iron absorption. Zinc absorption was similarly studied, and again, FIBREX had no inhibiting effect.

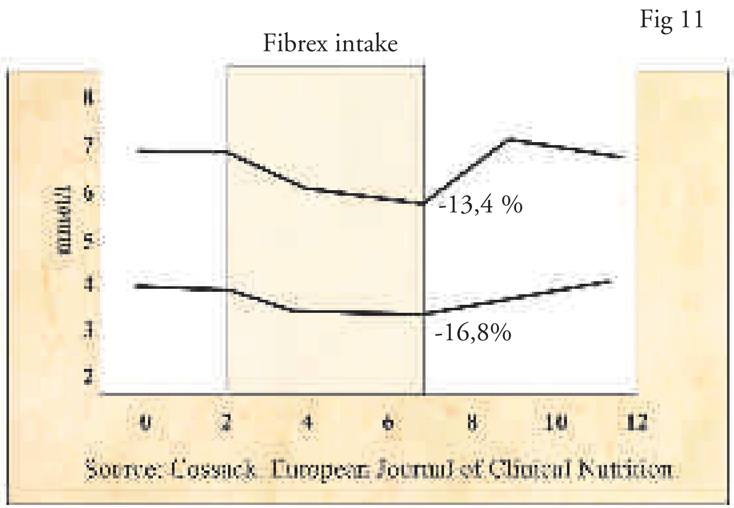
FIBREX and celiac disease

People suffering from hypersensitivity to gluten – celiac disease – must avoid cereal fibre in their diet. This often implies considerable constipation problems. FIBREX is by nature free of gluten and has proven to be an excellent source of fibre for people with celiac disease.

Tolerance to FIBREX

Consuming high amounts of fibre can imply problems, such as gas and abdominal distension. Such problems usually disappear after some time. Test subjects in our clinical studies have eaten up to 56 g of FIBREX per day for 8 weeks with no side effects. Nor could any negative alterations in blood chemistry be ascertained. A tolerance test carried out at the University of Edinburgh required test subjects to eat 40 g of FIBREX every day for 3 weeks, and their blood chemistry was then examined by means of 26 different analyses. No negative alterations could be found.





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