Active Food Scientific Monitor

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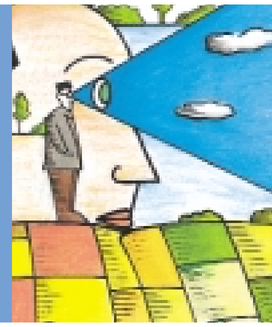
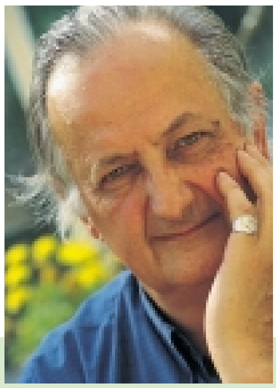


Interview

of Prof. Dr. M.B. Roberfoid

«My aim is to improve the functions of our food»



Prof. Dr. M.B. Roberfroid of the Unité de Biochimie Toxicologique et Cancérologique, Department of Pharmaceutical Sciences, Université Catholique de Louvain, authored and co-authored more than 200 peer-reviewed publications.
He is recognized for his research contributions on functional foods in general and the dietary fibers inulin and oligofructose in particular.

From Toxicology to Functional Food Science

He started his academic career as a toxicologist and became very soon interested in the relationship between nutrition and cancer. «Most of the time toxicology is considered as something negative: how to stop a product because it is toxic. But I have always had a more positive scientific philosophy, I was more interested in what I call the 'positive' aspects of toxicology, in the possibility of modulating the toxic effects in order to reduce or suppress them. At the early beginning I did research on the so-called metabolic activation, the fact that most of the chemicals which induce cancer are metabolized in the body. At the same time we have some enzymes which protect against cancer. It is always a question of balance. And this balance can be modulated. So, in our early research, we looked for ways to increase or decrease the activity of these enzymes.
Some fifteen years ago, I became interested in the positive effects of dietary fiber on cancer, and later in the possible beneficial effects of non-digestible oligosaccharides which are part of that dietary fiber. It is very exciting and it really fits into my philosophy to improve the functions of nutrition. So we developped also the concept of 'functional foods',
«I think that the case of Inulin and Oligofructose is exemplary of what should be done with regard to functional food ingredients. It is really necessary that we have good scientific evidence for the health and nutritional claims made for functional food ingredients.
The story started several years ago in Japan by the observation that this kind of carbohydrate may have a beneficial effect on the large bowel (the colon) by modifying the flora. Based on these observations and our own research, we developed the concept of prebiotics which is now generally accepted. Based again on

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An amateur-chef

The interest of Prof. Dr. Roberfroid in healthy food is not purely scientific. As an outstanding amateur-chef he also puts into practice what he is preaching. «Oh, yes, I like good food. When I was at University in Louvain-la-Neuve, I even founded with some friends a restaurant.» For health reasons he prefers to cook and eat vegetarian. «I am not a full vegetarian, I still eat some meat, but not often, most of the time it is vegetarian, or fish. It is definitely more healthy not to eat a lot of meat , and you can prepare very fine meals without it.»
Does he also use oligosaccharides in the kitchen? «Almost every day. I add them for instance to yoghurts and other foods, I also buy products to which they are added... Yes, I really believe in those food ingredients!»

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Preface

A Unique Opportunity

by Dr. Anne Franck

As the science of nutrition progresses, it is becoming more and more evident that, above and beyond the basic and essential nutritional requirements, food products contain both nutritious and non- nutritious components which modulate body functions and contribute to well-being and health.

As the Consensus report from the European project on non-digestible oligosaccharides clearly states, chicory inulin and oligofructose are natural food ingredients for which both experimental and human data have been accumulated, which demonstrate nutritional and physiological effects on the composition and the activity of the colonic microflora (prebiotic effect), on the gut function (bulking effect), on the absorption of minerals, on lipid metabolism, and even on reduction of cancer risk. The development of functional foods offers a unique opportunity to contribute to food quality for the benefit of health and well-being. This constitutes also an exciting challenge for the nutritionists as it needs a rigorous scientific approach.

While the overall benefits likely depend on the entire diet, the concept of functional foods is more than a marketing strategy. Continued probing scientific investigations are needed to identify under what circumstances maximum benefits accrue from increased consumption of functional foods or their components, including the chicory fructans inulin and oligofructose.

Functional food science will be of the benefit of consumer's health if it is scientifically justified. As Prof. Dr. Marcel Roberfroid declares in this first issue of 'Active Food Scientific Monitor', «it is essential that all health claims associated with this kind of products are carefully evaluated and based on solid scientific research.» Chicory inulin and oligofructose may be an example of how such research and development should be designed and performed for an optimum nutrition.

research that we and others did, we observed also that the products not only have a beneficial effect on the gut flora, but also on the bioavailability of Calcium, probably on the metabolism of lipids and, as it is suggested more recently, on the development of cancer.
At the same time as the biological effects of these products became clear and supported health claims, there was also a growing interest from a technological point of view to include them in food preparations like dairy products and so on.»

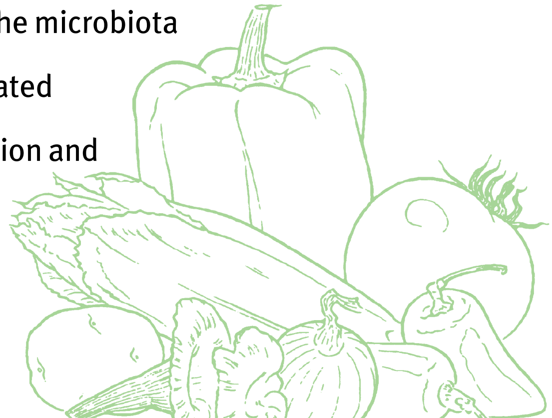
Why do these ingredients have to be added to food products as various fructan-containing plants are often eaten as vegetables, for instance asparagus, garlic, leek, onion, artichoke, scorzenera, etc. ?

«Inulin-type fructans are indeed present in significant amounts in several fruits and vegetables. If you are a vegetarian and if you eat a lot of onions, artichokes and so on, you will probably get a sufficient intake of what you need. But the point is that not everyone is ready to become a vegetarian or to eat everyday this kind of vegetables.
That is precisely what is meant with the concept of functional food: if you discover that one component of a food product has particular effects, it is important to try to identify that component, to try to have it produced in an industrial way and to add it to other food products. We have to accept that most of the people today eat industry-processed foods. So the message to the industry is: if you prepare foods, do it as correctly and as healthy as possible.
Of course, a natural food product can be classified as a functional food, as for instance the onion because of its inulin content. But most functional foods are products to which some components are added.
A third element in the functional food concept which is also very promising is the increase of the bioavailability of some minerals or other nutrients. Oligofructose has for instance a positive effect on the bioavailability of the Calcium present in food.
And finally, inulin-type fructans are also low-calorie carbohydrates used as sugar substitutes and as fat replacers in miscellaneous food products, which is also an important development from a health point of view.
I think that the non-digestible oligosaccharides in general and the inulin-type fructans in particular, may be one of the most fascinating functional food ingredients in the next decade.»

What future developments do you expect in this field?

«What certainly has to be done is to strenghten the scientific research on these products, further demonstrating that they affect various physiological functions in such a way that health claims might become authorized. I keep saying that functional food is a marvellous thing, but if the industry is not doing it correctly and is not using strong scientific arguments, then they can forget it. The consumer will not be interested and will refuse these products. So, it is important too to inform and to educate the consumer with a clear message. If we do this, I am convinced that it will be a success. If we fail, it will be a disaster.» ■

The human colonic flora has both beneficial and pathogenic potentials with respect to host health. As the microbiota of the human large intestine can be modulated towards an improved community composition and activity, this may have health benefits.



State of the Art:

Gut Flora & Health

Through the process of fermentation, colonic bacteria are able to produce a wide range of compounds which have varying potential effects on gut physiology, as well as other systemic influences. Better resistance to pathogens, reduction in blood lipids, antitumour properties, improved nutrient absorption, hormonal regulation and immune stimulation may all be possible through gut microflora manipulation. One approach advocates the oral intake of live microorganisms (probiotics). However, survival after ingestion is difficult to guarantee and to prove, and very strain dependent.

The prebiotic approach dictates that non-digestible food components are specifically fermented in the colon by indigeneous bacteria thought to be of beneficial value (e.g. bifidobacteria, lactobacilli) so that these selectively increase in numbers. The principal substrates for bacterial growth in the colon are dietary carbohydrates that have escaped digestion in the upper gastrointestinal tract. These include resistant starch, non-starch polysaccharides, unabsorbed sugars, non-digestible oligosaccharides, and sugar alcohols. Whilst any food ingredient that enters the large intestine is a prebiotic candidate, it is selectivity of the fermentation in the complex mixed bacterial gut environment, that is critical and required for a prebiotic effect. According to G. Gibson (1998) most scientific evidence has been derived from ß (2-1) fructans (inulin and oligofructose). Various studies have shown that these food ingredients are specifically fermented by bifidobacteria in the colonic ecosystem and have confirmed the bifidogenic nature of chicory inulin and oligofructose at a daily dose of 5g, both in vitro and more importantly in vivo (human volunteers). As part of a synbiotic-type product (a product in which both a probiotic and a prebiotic are combined) the chicory fructans are already bifidogenic at a dose of 2.75 g/day and the effect lasts for at least 5 weeks (M. Roberfroid, 1998/1).

The bifidogenic effect of RAFTILOSE® oligofructose was again confirmed in a recent study on humans (V. Rao, 1998). Consuming 5 grams per day of oligofructose for 11 days resulted in close to one log unit increase in the numbers of bifidobacteria. Ingesting oligofructose for another 10 days did not result in further increase in the numbers of bifidobacteria. Two weeks after stopping the ingestion of oligofructose the levels of bifidobacteria started to decline and were only slightly higher compared to placebo treatment.

Future human studies that exploit the use of modern molecular-based detection methods for gut bacteria will help to determine the efficacy for improved health through dietary means that involve the use of prebiotics. According to M. Roberfroid (1998/2) it is certainly worthwhile exploiting this research because of possible health advantages and because nutrition of the general population could be vastly improved. There is probably also a role for prebiosis in the prophylactic prevention and possible treatments of gut diseases, especially those induced by the resident microbiota. ■

Human studies involving globally more than 100 volunteers have demonstrated that both chicory inulin and oligofructose are prebiotic and bifidogenic in humans:

- **they induce a major shift in fecal bacterial composition**
- **bifidobacteria selectively increase in numbers and become numerically predominant**
- **pathogens (clostridia) decrease in numbers**
- **there is no significant correlation between the dose (from 5 to 20 g/day) and the importance of the increase in bifidobacteria**
- **there is correlation between the increase and the initial level of fecal bifidobacteria.**

Gibson, G.R. (1998), *Dietary modulation of the human gut microflora using prebiotics*, Brit. J. Nutr., 80, Suppl. 2, S209-S212.

Gibson, G.R. et al. (1995/1), *Dietary modulation of the human gut microflora using prebiotics*, J. Nutr., 125, 1401-1412.

Gibson, G.R. al. (1995/2), *Selective stimulation of Bifidobacteria in the human colon by oligofructose and inulin*, Gastroenterology, 108, 975-982.

Kleessen, B. et al. (1994), *Effect of inulin and lactose on fecal microflora, microbial activity, and bowel habit in elderly constipated persons*, Am. J. Clin. Nutr., 65, 1397-1402.

Rao, V.A. (1998), *Bifidogenic effect of oligofructose in humans*, Orafti-report November 1998, non-published.

Roberfroid, M.B. (1998/1), *Prebiotics and synbiotics: concepts and nutritional properties*, Brit. J. Nutr., 80, Suppl. 2, S197-S202.

Roberfroid, M.B. et al. (1998/2), *The Bifidogenic Nature of Chicory Inulin and its Hydrolysis Products*, J. Nutr., 128 (1), 11-19.

Salminen, S. et al. (1998), *Functional food science and gastrointestinal physiology and function*, Brit. J. Nutr, 80, Suppl. 1, S147-S171.

In the following pages we offer you the latest nutritional information on chicory inulin and oligofructose, summarized from key articles in major scientific journals.

The European project on non-digestible oligosaccharides (ENDO-project), a European Commission funded research project has reached a consensus on the possible functional food properties of non-digestible oligosaccharides (NDO). This consensus of experts in the field evaluates current scientific knowledge of the nutritional properties of NDO and makes proposals for future research.

Oligofructose decreases blood triglycerides

Oligofructose (OFS) is able to decrease triacylglycerols (TAGs) in very-low-density lipoproteins (VLDL) when it is given in a standard diet of rats (containing 3% of fat and 10% of OFS). The triglyceride-lowering action of OFS is due to a reduction of the de novo fatty acid synthesis in the liver, through inhibition of all lipogenic enzymes. The activity of acetyl-CoA carboxylase, fatty acid synthase (FAS), malic enzyme, ATP citrate lyase and glucose-6-phosphate dehydrogenase is decreased by about 50%. These findings support the hypothesis that OFS administration could modify lipogenic enzyme gene expression.

The mechanism by which such non-digestible nutrients modify hepatic metabolism remains to be clarified. It may be due to modifications of glucose and/or insulin levels, the production in the large bowel of short-chain carboxylic acids and/or to changes in the Glucose-Dependent Insulinotropic Polypeptide (GIP) and Glucagon-Like Peptide-1 (GLP-1) release. In fact, supplementation of diet with OFS improves glucose disposal and decreases post-prandial insulin level in rats. It increases GIP secretion as well as GLP-1 concentration.

The relevance of these observations to humans requires trials in hypertriglyceridaemic patients in whom lipogenic homeostasis could be disturbed.

Delzenne, N.M. and Kok, N. (1988), *Effect of non-digestible fermentable carbohydrates on hepatic fatty acid metabolism*, Biochemical Society Transactions, 26, 228-230.

Kok, N., Morgan, L.M., Williams, C.M., Roberfroid, M.B., Thissen, J-P. and Delzenne, N.M. (1998), *Insulin, Glucagon-like Peptide 1, Glucose-Dependent Insulinotropic Polypeptide and Insulin-Like Growth Factor 1 as Putative Mediators of the Hypolipidemic Effect of Oligofructose in Rats*, J. Nutr., 128 (7), 1099-1103.

Extra-hepatic effect of Oligofructose in a fat-rich diet

The previous observations were made in rats fed a diet containing only 3% fat, whereas the typical human diet in the Western world contains a relatively high proportion of fat (30-40% of energy). The aim of this study was to test the hypothesis that OFS is able to decrease post-prandial lipidaemia in rats fed a human Western-style high-fat diet (HF) composed of 10% lard, 4% corn oil and 0.15% cholesterol.

The OFS supplementation (10% of the diet) reduced post-prandial triglyceridaemia by more than 50% compared to the reference high-fat diet. It also protected rats against the increase of serum free cholesterol level induced by the high-fat diet. The OFS did not prevent the high-fat induced hepatic accumulation of triglycerides, phospholipids and cholesterol. However, histochemical analysis showed smaller lipid droplets in the liver with OFS. These results suggest that, when given in a high-fat diet, OFS decreases serum triglycerides through an extra-hepatic event, namely by enhancing triglyceride-rich lipoprotein catabolism. If such a protective action of OFS on serum lipids is confirmed in humans, it could be interesting for human health.

Kok, N., Taper, H.S., Delzenne, N.M. (1998), *Oligofructose Modulates Lipid Metabolism Alterations Induced by a Fat-rich Diet in Rats*, J. Appl. Toxicol., 18 (1), 47-53.

Protective role of Oligofructose and Bifidobacteria on necrotising enterocolitis

Clostridium spp. and E. coli are known to be implicated in the etiology of necrotising enterocolitis (NEC), one of the most common serious gastrointestinal diseases in neonatal intensive care units. Butel et al. (1998) and Catala et al. (1999) showed how oligofructose (OFS) helps to prevent the overgrowth of bacteria implicated in NEC and participates in the health-promoting effect of bifi-

The functional food properties of non-digestible oligosaccharides: a consensus

1. Definition, classification and analysis

NDO can be distinguished from other carbohydrates on the basis of their solubility in vitro under specified conditions and their resistance to human intestinal enzymes. Very few NDO have been tested for indigestibility in vivo, but for inulin-type fructans (inulin and oligofructose) the data from in vitro studies match those obtained in vivo, especially in ileostomized volunteers. Methods for the quantitative analysis of NDO in general, and the inulin-type fructans in particular, are available.

2. Effect on colonic microflora

2.1. There is consistent evidence of an effect of NDO on bowel habit, which results in a typical faecal bulking effect of 1.5-2 g increase per gram NDO ingested, and in a normalization of stool frequency (aiming at daily defecation).

2.2. Inulin-type fructans increase the production of acetate and butyrate (indicating that populations other than bifidobacteria also benefit), whereas galacto-oligosaccharides increase the production of acetate and propionate, and xylo-oligosaccharides that of acetate only.

2.3. There is now strong evidence that inulin type fructans are prebiotic in humans. A prebiotic effect is a food-induced increase in numbers and/or activity predominantly of bifidobacteria and lactic acid bacteria in the human intestine. Few human feeding studies investigating the bifidogenic potential of galacto-oligosaccharides seem to indicate that they may have a prebiotic potential.

There are preliminary animal studies indicating prebiotic effects of soybean-oligosaccharides. A fraction of these latter compounds is absorbed in the small intestine, and thus becomes unavailable for colonic fermentation. Very little scientific information on xylo-oligosaccharides and pyrodextrins is available.

3. Effect on mineral absorption

The stimulation of mineral (Ca, Mg, Fe) absorption by inulin-type fructans and transgalactosylated oligosaccharides has been repeatedly confirmed in animal studies. There is further promising evidence that the consumption of inulin-type fructans results in increased Ca absorption in humans, and thus has the potential to prevent or postpone osteoporosis. There are no data available indicating comparable effects for other NDO.

4. Effect on lipid metabolism

There is preliminary evidence from animal studies that lipid metabolism is affected by inulin-type fructans. The data available from human nutrition studies indicate that the intake of moderate levels of inulin or oligofructose may affect human lipid metabolism. There is no indication of an effect on lipid metabolism in human subjects for galacto-oligosaccharides or any other type of NDO.

5. Interaction with the carcinogenesis process and immunology

The available data from animal studies with inulin-type fructans consistently demonstrate a reduced risk in experimentally induced carcinogenesis processes. These data are sufficient to claim preliminary evidence for interaction of NDO with colon carcinogenesis in experimental animals and to support the investment for performing human nutrition studies. ■

Van Loo et al. (1999), *Functional food properties of non-digestible oligosaccharides: a consensus report from the ENDO project* (DGXII AIRII-CT94-1095), Brit. J. Nutr., 81, 121-132.

dobacteria against NEC-like lesions induced in gnotobiotic quails.

Clinical trials of colonisation of the immature bowel of preterm infants with probiotics (Lactobacillus GG, B. breve) have shown that they need to be administered regularly (once or twice a day). In this quail study, the daily intake of OFS contributed to long-term colonisation with bifidobacteria at a high level after a single administration of the probiotic and reduced colonisation by potentially pathogenic bacteria, such as C. butyricum, C. perfringens and C. difficile. As an alternative to

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antibiotic therapy or to prophylactic treatments, an early administration of probiotics associated with a nutritional programme including the use of OFS could be a promising approach to the prevention of NEC, especially in newborns.

Butel, M.J., Roland, N., Hibert, A., Popot, F., Favre, A., Tessedre, A.C., Bensaada, M., Rimbault, A. and Szylit, O. (1998), *Clostridial pathogenicity in experimental necrotising enterocolitis in gnotobiotic quails and protective role of bifidobacteria*, J. Med. Microbiol., 47, 391-399.

Catala, I., Butel, M.J., Bensaada, M., Popot, F., Tessedre A.C., Rimbault, A. and Szylit, O. (1999), *Oligofructose contributes to the protective role of bifidobacteria in experimental necrotising enterocolitis in quails*, J. Med. Microbiol., 48, 89-94.

Inulin and Oligofructose inhibit the growth of mouse tumours

The growth of transplantable mouse tumours is significantly inhibited by the supplementation of the basal diet of mice with 15% inulin or oligofructose. The tumour growth was nearly 50% lower than in the control group, and the increase in lifespan was 16%. The dietary treatment was performed starting at day 7 before tumour transplantation and continued until the end of the observation.

Further investigations are necessary to elucidate if the inhibitory effect on tumour growth may be due to selective alterations of colonic microflora as inulin and oligofructose are bifidogenic substrates, to a decrease of the serum glucose level and the level of insulin and insulin growth factor which are important regulators of cell proliferation, or to an inhibition of the de novo lipogenesis in hepatocytes. Such investigations may enable us to introduce non-digestible carbohydrates as a non-toxic and easily applicable adjuvant treatment in the classical protocols of human cancer treatment.

Taper, H.S., Delzenne, N.M., Roberfroid, M.B. (1997), *Growth inhibition of transplantable mouse tumours by non-digestible carbohydrates*, Int. J. Cancer, 71, 1109-1112.

Taper, H.S., Lemort, C., Roberfroid, M.B. (1998), *Inhibition effect of dietary Inulin and Oligofructose on the growth of transplantable mouse tumour*, Anticancer Research, 18, 4123-4126.

Colon tumour inhibitory properties of chicory fructans

Dietary administration of inulin and oligofructose inhibits the formation of azoxymethane (AOM)-induced preneoplastic lesions such as aberrant crypt foci (ACF) in the colon of male rats. The rats received either a control diet or a diet with 10% inulin or oligofructose at 5 weeks of age. At 7 weeks they received a s.c. injection of AOM dissolved in normal saline at a dose rate of 15mg/kg body weight, once weekly for 2 weeks. They were necropsied 7 weeks after the last AOM-injection.

There were no signs of any adverse effects in liver, kidneys, stomach, intestine or lungs of animals fed inulin or oligofructose. On the contrary, inulin and oligofructose significantly reduced the number of ACF in the rat colons, suggesting a potential decrease in the risk for colon cancer. It is likely that the effect of these agents proceeds through the selective modulation of the microflora (increase of bifidobacteria and decrease of bacteroides, clostridia and fusobacteria and/or gram-positive cocci) and the production of short-chain fatty acids (SCFA) in the colon, especially butyrate, by microbial fermentation.

The degree of ACF inhibition is more pronounced in animals fed inulin than in those fed oligofructose, which is probably due to the slower fermentation rate of inulin allowing it of being fermented in the more distal part of the rat colon where most ACF take place.

Reddy, B.S., Hamid, R., and Rao, C.V. (1997), *Effect of dietary oligofructose and inulin on colonic preneoplastic aberrant crypt foci inhibition*, Carcinogenesis, 18 (7), 1371-1374.

Probiotics and the prevention of colon and mammary cancer

Since the prebiotics oligofructose and inulin selectively stimulate the growth of bifidobacteria, this study investigates tumour inhibitory activity of lyophilized cultures of Bifidobacterium longum (BL).

Dietary administration of BL (2%) strongly suppressed AOM-induced colon tumour development in male rats. This was associated with a significant decrease in colonic mucosal cell proliferation, ornithine decarboxylase (ODC) activity, and ras-p21 oncoprotein expression.

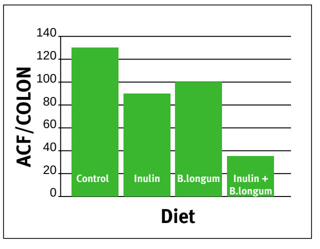
BL also significantly inhibited quinolin (IQ)-induced incidence (percentage of animals with tumours) of colon cancer (100% inhibition) and multiplicity (tumours/animal) of tumours in male rats. In female rats, dietary supplements of BL cultures also suppressed the IQ-induced mammary carcinogenesis to 50%.

Reddy, B.S. (1998), *Prevention of colon cancer by pre- and probiotics: evidence from laboratory studies*, Brit. J. Nutr, 80, Suppl. 2, S219-S223.

Synbiotic effect of bifidobacterium longum and inulin on colon carcinogenesis

Consumption of either Bifidobacterium longum or inulin is associated in rats with a decrease (26 and 41% respectively) in azoxymethane (AOM)-induced small colonic aberrant crypt foci (ACF).

Combined administration of B. longum and inulin resulted in much more potent ACF-inhibition (80% inhibition of small ACF), providing good evidence for a synbiotic effect. Furthermore, the combined administration of the synbiotic also decreased the incidence of large ACF by 59%. ACF are considered to be early precursor lesions of colon tumours in rodents and humans.



Since the dietary treatment started 1 week after the carcinogen dose, these results suggest that inulin and B. longum may be affecting the early promotion phase of the carcinogenic process. Furthermore, consumption of diets with inulin and/or B. longum were also associated with decreases in beta-glucuronidase activity and ammonia concentration in the caecal contents, two factors associated with carcinogenesis of the colon. ■

Rowland, I.R., Rumney, C.J., Coutts, J.T. and Lievense, L.C. (1998), *Effect of bifidobacterium longum and inulin on gut bacterial metabolism and carcinogen-induced abberrant crypt foci in rats*, Carcinogenesis, 19 (2), 281-285.

This page is entirely reserved for your FAQs. It is meant to give answers to the most imminent questions that may arise.

Are Inulin and Oligofructose accepted as dietary fibres?

In Europe

The European Directive on Nutrition Labelling provides no definition for 'dietary fibre'. A decision from the European Standing Committee on Foods in 1994 has issued some guidelines that allow to add 'other' substances to the Dietary Fibre group, and warns the Member States against creating barriers to free trade based on these issues.

Today, both inulin and oligofructose can be labelled as dietary fibres in practically all European countries except the United Kingdom. Each country has decided on this independently. In many countries, this decision was based on a scientific evaluation by the local advisory committees.

The United Kingdom has always taken a special position on 'Dietary Fibre'. Since a long time, it has based its evaluations on the concept of 'Non-Starch Polysaccharides as measured by the Englyst methods'. This restrictive approach was not followed by the European Scientific Committee on Foods in 1994, and has only few followers today. Therefore, the U.K. may adapt its opinion to the scientific evolution and broaden its definition of dietary fibre, in line with the rest of the European Union.

In the USA

The NLEA (Nutrition Labelling and Education Act) does not provide a definition for 'dietary fiber'. The AOAC 'Total Dietary Fiber (TDF)' methods which are used by everybody, don't analyze inulin or oligofructose. However, the regulations do not restrict the methods only to the AOAC TDF ones.

Recently, L. Prosky, as General Referee for Dietary Fiber and Complex Carbohydrates of AOAC International, has published a statement under the title «Inulin and Oligofructose Are Part of the Dietary Fiber Complex» (1999). This publication describes the AOAC acceptance of a new method for measuring inulin and oligofructose (Fructan Method AOAC 997.08), and concludes that both inulin and oligofructose should be included in the Dietary Fiber fraction. This can be achieved by combining both the AOAC TDF and Fructan methods. So, the U.S. regulations in principle allow to label inulin and oligofructose as Dietary Fiber. More and more scientific and expert support for this is available. Today, several U.S. producers are already labelling the inulin or oligofructose fraction in their products as Dietary Fiber.

In other countries

In Canada and Australia, the decision process is running. In most Asian and South-American countries, requests are being prepared. In Japan, practically 100% of both inulin and oligofructose can be labelled as fibres.

In practice

Hundreds of food products are on the market around the world labelling inulin and oligofructose as fibres. These include yoghurts, milks, bakery products, table spreads, cereals, dairy drinks, meal replacers, and many others. In many products, inulin and oligofructose are used together with other fibre sources.

Although there are still some differences in opinion around the definition of Dietary Fibre, there is a growing body of consensus. This consensus accepts that 'Dietary Fibre' is a nutritional concept which should not be defined by an analytical method. The essential dietary fibre properties are centered around two functions : their positive effect on stool bulking and stool frequency, and their stimulation of colonic fermentation. Both inulin and oligofructose fulfil these requirements. It is logical therefore that these substances are considered as 'Dietary Fibre' and are further taken into account in the development of any new definition of Dietary Fibre for labelling purposes.

Prosky, L. (1999), *Inulin and Oligofructose Are Part of the Dietary Fiber Complex*, J. AOAC Int., 82 (2), 223 - 226.

What is a synbiotic ?

A synbiotic has been defined by Gibson et al. (1995) as a mixture of probiotics and prebiotics that beneficially affects the host by improving the survival and the implantation of live microbial dietary supplements in the gastrointestinal tract, by selectively stimulating the growth and/or by activating the metabolism of one or a limited number of health-promoting bacteria, and thus improving health. Whereas the concept of prebiotics has become very popular since its introduction in 1995, synbiotics are now more and more applied too for the development of new food products, especially functional dairy foods. From the scientific point of view the concept of synbiotic has been recently validated and it certainly retains further attention for more research in the near future. Rowland et al. (1998) indeed demonstrated in a rat model that a diet containing chicory inulin (a prebiotic) and Bifidobacterium longum (a probiotic) was significantly more efficient for reducing the number of colonic aberrant crypt foci, which are pre-neoplastic lesions recognized as markers for colon cancer risk, than inulin or Bifidobacteria alone, thus confirming a synergistic synbiotic effect. Already in 1996, Bouhnik et al. had shown that a fermented milk containing Bifidobacteria and inulin can prolong the bifidogenic effect after the ingestion of the dairy product, in comparison with a fermented milk containing only the probiotic. This could indicate either a better implantation of the probiotic in the colonic microbiota or a prebiotic-type effect of inulin on endogeneous Bifidobacteria. In 1998, Roberfroid also reported a bifidogenic effect of a rather low daily dose (2.75 g) of chicory oligofructose when combined with Lactobacilli in a fermented milk. The bifidogenic property may well have resulted from a synbiotic-type effect.

Bouhnik, Y. et al. (1996), *Effects of Bifidobacterium sp. fermented milk ingested with or without inulin on colonic bifidobacteria and enzymatic activities in healthy humans*, Eur. J. Clin. Nutr., 50, 269-273.

Gibson, G.R. et al. (1995), *Dietary modulation of the human colonic microbiota-Introducing the concept of prebiotics*, J. Nutr., 125, 1401-1412.

Roberfroid, M. B. (1998), *Prebiotics and synbiotics: concepts and nutritional properties*, Brit. J. Nutr., 80, Suppl. 2, S197-S202.

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Agenda

Norwich, UK
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International Conference on Food and Cancer Prevention. Chemical and Biological Aspects of Dietary Anticarcinogens and Antimutagens.
Organized by The Royal Society of Chemistry, under the auspices of the Food Chemistry Division of the Federation of European Chemical Societies (FECS).
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Dr. Leon Prosky, co-chairman/AOAC International USA - *What is Dietary Fibre? - A new look at the definition.*
Prof. Marcel Robertfroid, Université Catholique de Louvain Belgium - *Inulin and Oligofructose: Dietary fibres and functional ingredients.*
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