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Agenda

► Rovaniemi, Lapland, Finland
February 25-28, 2000

Functional Foods for EU Health in 2000 4th Workshop on Demonstration of the Nutritional Functionality of Probiotic Foods, Fair CT96-1028

Organized by VTT, Biotechnology and Food Research and European Commission DG XII, B.I.1

Speakers
- Liam Breslin - EU - *5th frame for the 2000.*
- Erika Isolauri & Seppo Salminen - *Probiotics for children.*
- Kevin Collins - *Pro-biotics for adults.*
- Willem De Vos - *GI-tract diagnostics. Tools for 2000*
- Glenn Gibson - *Probiotics and Prebiotics in 2000.*
- Philippe Marteau - *Clinical approach in 2000.*

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www.vtt.fi/bel/sympo.htm

► Washington, USA
March 20-23, 2000

The Millenium Vahouny Fiber Symposium

Among the speakers:
L. Prosky, M. Roberfroid,
D. Kritchevsky, N. Asp

Info: E-mail: clin.review@erols.com

► Dublin, Ireland
May 14-17, 2000

ICC/AOAC International Conference Dietary Fibre - 2000, Processing, Milling and Nutritional Effects.

Speakers
- Ir. Paul Coussement, ORAFTI, Active Food Ingredients Belgium - *Regulatory aspects of dietary fiber.*
- 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.*
- Prof. Ian Rowland, University of Ulster Northern Ireland - *Non-digestible carbohydrates and gut function.*
- Prof. Takashi Sakala, Ishinomaki Senshu University Japan - *Fermentation of oligosaccharides by hindgut bacteria and effects of fermentation products.*

Info: Megazyme International Ltd, Bray Business Park, Bray, Co. Wicklow, Ireland - Fax: (+ 353) 1 286 1264
www.megazyme.com

► Heraklion, Crete
May 18-20, 2000

European Conference Nutrition & Diet for Healthy Lifestyles in Europe: Science and Policy Implications.

Info: University of Crete, Dept. of Social Medicine, Preventive Medicine & Nutrition Unit, PO - Box 1393, - 71110 Iraklion Crete
www.eurodiet.med.uoc.gr

► Helsinki, Finland
June 7-9, 2000

Developing & Marketing Future Foods – The Challenge of Communication

Organized by VTT Biotechnology and Food Research

Ir. Paul Coussement (Orafti) will give a lecture on '*Communicating Health Benefits to the Consumer*'

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► The Hague, The Netherlands
February 29 – March 1 & 2, 2000

Functional Foods 2000

Organized by Leatherhead Food Research Association (UK)

The conference will combine broad sessions considering the key commercial, regulatory, strategic, investment and consumer issues likely to impact on the European functional foods market, with seven focused workshop sessions on Cardiovascular disease, Bone health, Gut health, Oral health, Cancer, Immune function, Performance, and a workshop on Communication issues.

Among the speakers:
- Dr. Anne Franck (Orafti) – *Prebiotics and Calcium Absorption*
- Dr. Geert van Poppel (TNO) – *Keynote presentation on Cancer*
- Dr. Martin Playne – *Probiotics and Prebiotics Being Developed by the CRC for Food Industry Innovation*
- Ir. Paul Coussement (Orafti) – *Communicating about Gut Health to the Consumer*

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Colophon

Active Food Scientific Monitor is published by ORAFTI, a daughter company of RAFFINERIE TIRLEMONTOISE (B), which is part of the SÜDZUCKER Group (D).
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The commercial department of ORAFTI is based in Tienen and operates worldwide in 50 countries through own sales offices and distributors.
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It will be sent free to anyone else who is interested.

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Interview

of Geert van Poppel

Dr. Geert van Poppel is business director of 'Food and Health' at the TNO Nutrition and Food Research Institute in Zeist in the Netherlands, which means that he is responsible for the functional foods within the Institute.

A mountaineer who likes good food

Geert van Poppel is 39 years old, he studied human nutrition at the Agricultural University in Wageningen (Holland) and did a Ph.D. on beta-carotene and cancer at the University of Maastricht. He is not married, but lives happily together with his partner,who is a mechanical engineer. "Her work is completely different from what I am doing and I must say that it is much too complicated for me. That's why I became a nutritionist..." He is also a mountaineer. Mountaineering is an area where traditionally a lot of food research has been done because the nutritional requirements at high altitude are very important. "There is also a lot of physical exercise, but on the other hand the quantity of food that you can take with you is very limited. This explains why a lot of the traditional food research was performed during alpine expeditions. So there is certainly a link between my hobby and my work. But I did not start to study nutrition because of that. I studied human nutrition basically because I was always interested in biology and biomedicine, and because I like good food. So, that was a nice combination. That is something I want to emphasize: functional foods have to taste very good, otherwise nobody will buy them."

" I studied human nutrition basically because I was always interested in biology and biomedicine, and because I like good food."

A mountaineer involved in functional foods

He was previously head of the Department of Nutrition and Physiology at the same Institute, where recently some important human volunteer studies on functional foods were performed.
"The Institute where I am working has been involved in nutritional research for a long time. One of the first major research items, which was initiated by Professor De Groot, was the precise relationship between fibre and cholesterol reduction, as well as the effect of functional foods on mineral absorption.

I have just stepped into this field of research, which is done by a number of excellent colleagues, such as Ellen van den Heuvel and Henk Hendriks. What is fascinating in this field is that it provides the opportunity to take the science of nutrition beyond the traditional nutritional values.
After the discovery of vitamins, essential fatty acids, etc., all these nutrients that we know are essential to maintain human health, we are now trying to discover other nutritional components that may help to maintain health and reduce the risk of disease, even beyond what we traditionally already know."

One of our recent research projects was on the effect of oligofructose on calcium absorption.

"In this study, we used a dual stable isotope technique in human volunteers to measure true calcium absorption. One isotope was given in the meal

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Preface

A research-driven approach

by Dr. Anne Franck

The concept of functional foods refers to foods similar in appearance, taste and texture to conventional foods, consumed as part of a normal diet, but having demonstrated physiological benefits beyond basic nutritional requirements.
Chicory inulin and oligofructose are ideal ingredients for functional foods because of their natural and vegetable origin, their important technological properties with respect to taste and texture, and their interesting nutritional benefits. They may help to improve the quality of life and increase disease resistance, in both humans and animals. Inulin-type fructans allow the development of new concepts in nutrition, moving from an emphasis on the absence of adverse effects to the positive use of foods to promote well-being and health, and even to reduce the risk of disease. For inulin and oligofructose, there is evidence for enhanced functional effects but scientific research still has to be completed to support claims relating to the reduction of disease risk.
From the very beginning, Orafti has opted for a research-driven innovative approach and has invested massively in scientific research and nutrition. We are collaborating with over 50 universities and renowned research teams and experts worldwide. We participate in government-funded and international research projects on functional foods, inulin and oligofructose.
The results of these scientific studies are published in peer-reviewed scientific journals. In recent years, more than 60 nutritional studies supported by Orafti have been published.
Through participation in and organization of international conferences and through publications of reports such as this Active Food Scientific Monitor, we hope to contribute to a better understanding and a wider interest in these functional food ingredients. We are very proud that we can count today on collaboration with an important worldwide network of key scientific experts, including yourself.
We will continue this effort, because we wish to maintain leadership in functional foods, especially non-digestible oligosaccharides, and because we are convinced that only a rigorous scientific approach that yields sound and reliable data will justify any health claim.
There is already a great deal of very interesting and exciting evidence available but the challenge remains for both the scientific community and the food industry to convince consumers that functional foods offer an opportunity to better control their health. Let us work together to meet this challenge.

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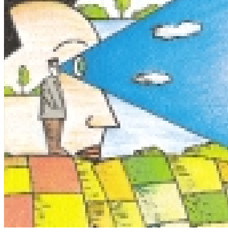
and the second one was injected. By measuring the ratio of both isotopes in urine, we can determine precisely what proportion of calcium from the meal is absorbed in the body.
In the study, adolescent boys received 15 g/day of oligofructose.
Whereas these boys normally absorbed 48% of the calcium ingested, when they were administered oligofructose, this value was raised to 60%. This was a very important finding."

What do you expect for the near future in this field?

"What is really essential in the field of functional foods in the years to come is that all health claims made are shown to be trustworthy and that they are relevant to the consumers. So, we must develop good methods to measure the beneficial effects in humans.
There is also an urgent need to develop relevant biomarkers for human studies and we need studies in humans with these products to further demonstrate their effects.
I am convinced that we must elucidate the mechanisms by which these products work by doing more molecular biology research and so on to find out why and how they work to maintain health and to influence certain physiological processes.
For oligosaccharides, especially, there is good evidence that they increase calcium absorption. If we assume that all the extra calcium we absorb is incorporated into the bones, this would have a tremendous impact on, for instance, osteoporosis later in life.
The data showing that fructans indeed influence bone density and structure are rather scarce at the moment.
There are some data from animal studies, but human data are still lacking. We need human studies on the effects of oligosaccharides on bone density and bone metabolism, to make it clear that these benefits occur in humans." ■

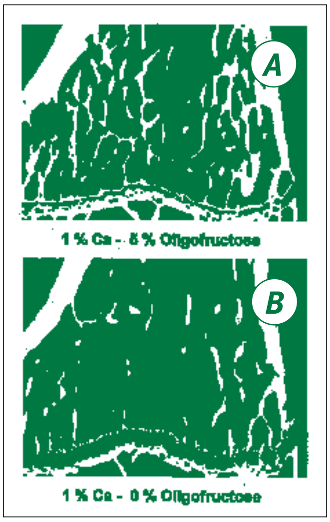


Unlike the effects reported for some other types of dietary fibres (containing phytic or uronic acids) inulin and oligofructose do not impair but rather improve the bioavailability of minerals such as calcium (Ca), magnesium (Mg) and iron (Fe), resulting in an increased calcium uptake in the bone tissue and improved bone mineral density.

State of the Art:

Inulin and oligofructose stimulate calcium absorption

In populations consuming a typical Western-type diet, there is a high incidence of bone fractures due to osteoporosis with advanced age in both men and women. It is strongly suggested that besides minimizing bone resorption in old age, maximizing peak bone mass building during adolescence may be the key to postpone and even prevent bone fractures due to osteoporosis later in life. As the human body absorbs only 25 to 50% of dietary calcium, improved calcium (and magnesium) absorption in the body may have important consequences on the occurrence of osteoporosis and bone fractures. Recent scientific findings with inulin and especially oligofructose offer new nutritional perspectives.



Microradiographs of proximal tibia from ovariectomized rats.

A: Presentation of ovariectomy-induced loss of bone structure by oligofructose.

B: Ovariectomy-induced loss of bone structure without oligofructose.

Animal studies

The stimulation of mineral absorption by inulin-type fructans is an observation that has been confirmed repeatedly in experimental rat studies despite an increase in total fecal mass (for reviews of these studies, see Franck, 1998; Greger, 1999). The use of different models showed an increase in the absorption of calcium and magnesium at the level of the large intestine (this was a new concept, as it was generally accepted that mineral absorption occurs mainly in the small intestine), as well as an increased calcium uptake into the bone tissue, resulting in improved bone mineral density. The study by Delzenne et al. (1995) indicated that a diet supplemented with 10% of either inulin or oligofructose leads to an increase of about 60% in the apparent retention of Ca, Mg and Fe. A similar increase (about 65%) in Ca absorption was observed by Brommage et al. (1993) with 5% oligofructose or other non-digestible carbohydrates. Chronic ingestion of oligofructose decreased or prevented the loss of bone mass, calcium and phosphorus from the bones of gastrectomized anemic rats (Ohta et al., 1998) and the loss of bone mineral density in ovariectomized rats (Taguchi et al., 1994). Scholz-Ahrens et al. (1998a, 1998b, 2000) observed a dose-effect of oligofructose (2.5-10% of the diet) on increased Ca absorption in ovariectomized rats and demonstrated that the increased amount of absorbed Ca was effectively used to increase bone mineral content (femur, vertebra). Oligofructose was able to reduce the loss of bone trabecular structure in this rat model

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for post-menopausal osteoporosis. Oligofructose was more effective in these rats at a high calcium intake, i.e. when depression of mineral solubility may occur. In a long-term study on the effect of inulin on the whole-body bone mineral density in growing male rats, Lemort et al. (2000) observed that inulin might be more efficient to increase bone mineralization on a long-term perspective when calcium is relatively deficient in the diet (40% of recommended daily intake for rats), since supplementing a low calcium diet with inulin had the same effect on bone density as doubling, or more, the calcium content in the diet. The increased calcium absorption lasted as long as the inulin-type fructans were consumed, even for long periods.

The improved absorption of minerals was associated with decreased pH of the ileal, cecal and colonic contents, hypertrophy of cecal walls, and increased concentrations of volatile fatty acids, bile acids, soluble calcium and, to a lesser extent, magnesium in the cecal contents. Ohta et al. (1994) reported that, although ingestion of oligofructose improved Ca and Mg absorption in normal rats, only Mg absorption was increased in cecectomized rats. This suggests that the effect of fermentation in the cecum was particularly important for Ca absorption.

Human studies

These findings were confirmed in some recent human experiments. Ellegard et al. (1996) studied patients with conventional ileostomy because of ulcerative colitis. The intake of 17g of inulin or oligofructose did not alter the mineral excretion from the small intestine and thus, it hardly affected their absorption in this part of the gut, suggesting that any effect of the fructans on mineral absorption takes place mainly in the colon.

In a French study (Coudray et al., 1997) nine healthy young men were given a control diet (with 18 g/day dietary fibre) or the same diet supplemented with either chicory inulin (soluble) or sugar beet fibre (partly soluble) during 28-day periods (2 days of control diet, 14 days of progressive increase in fibre intake and 12 days of constant fibre consumption). During the 20-day adaptation period to fibre ingestion, experimental fibres were incorporated into bread (60%) and liquid foods (40%) up to a maximum of 40 g/day. Ca, Mg, Fe and Zn were measured in diets and in 8-day urine and faecal samples to assess absorption and balance. Upon inulin ingestion, the apparent Ca absorption increased significantly from 21.3% (±12.5) to 33.7% (±12.1), which represents a relative increase of 58%. The increase in Ca absorption did not negatively influence the absorption of other minerals such as Mg, Fe or Zn. Sugar beet fiber ingestion resulted in a significant increase in Ca intake without modification in its apparent absorption.

In another study (Van den Heuvel et al., 1999a) 12 healthy male adolescents aged 14-16 years consumed orange juice supplemented with 5 g oligofructose (Raftilose® P95) or sucrose (control treatment) three times a day. The experiment was conducted in two 9-day periods separated by a wash-out period of 19 days. A dual stable isotope technique was used to make a distinction between exo- and endogeneous Ca and therefore to measure 'true' intestinal Ca absorption. The measurements were based on the contents of calcium isotopes in urine samples during a 36-hour period. An increase of 26% in true fractional calcium absorption from 47.8% (placebo) tot 60.1% (oligofructose) was observed. The oligofructose-induced enhancement of calcium absorption was not correlated with an increase in urinary calcium excretion.

In a previous study among adult healthy men, Van den Heuvel et al. (1997) did not find an improved calcium absorption upon intake of 15 g of oligofructose per day. This study, however, did not include completely the colonic component of Ca absorption because the urine collection was limited to 24h after isotope administration.

A very recent study using stable isotopes in 29 adolescent girls confirmed an increased Ca absorption of 20% (from 32% to 38%) upon ingestion of only 8 g/day of chicory fructans (S. Abrams, confidential report).

These human experiments show that, as in rat models, the consumption of chicory inulin or oligofructose results in increased Ca absorption.

These observations indicate that adding inulin or oligofructose to foods can increase the uptake of calcium present in the diet. No human data on the effect of fructans on bone development are available yet. ■

References : See page 8

Monitor

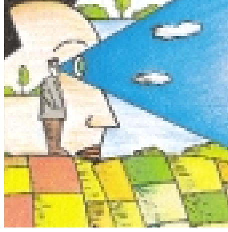
In the following pages we offer you the latest nutritional information on chicory inulin and oligofructose, summarized from key articles in major scientific journals.

Effects of fructo-oligosaccharides on stool frequency

In this study the effects of fructo-oligosaccharides or FOS (3 g/day) and placebo on stool frequency and stool condition were investigated in 34 healthy female volunteers (18-21 years old). The subjects were stratified into three classes according to their inherent (non-intake period) stool frequency: normal (> 5 times/week); lower (3 to 5 times/week) and lowest (< 3 times/week).

For the subjects in the lowest frequency class there was a significant difference in stool frequency comparing the FOS-intake or placebo-intake periods and the period of no-intake. For subjects in the lower frequency class the stool frequency in the FOS-intake period was significantly higher than in the placebo-intake period. For subjects in the normal class, there was no significant difference among the three test periods.

Regarding stool condition, only the quantity was found to



change while the two other factors, hardness and color, showed no change. The increase in stool quantity was consistent with the change in frequency.

Tominaga S., Hirayama M., Adachi T., Tokunaga T. & Iino H. (1999). Effects of Ingested Fructo-oligosaccharides on Stool Frequency in Healthy Female Volunteers: A Placebo-controlled Study, Bioscience Microflora, 18 (1), 49-53.

Nutritional and Health Benefits of Inulin and Oligofructose

Proceedings of a Conference held May 18-19, 1998, in Bethesda

Scientists from around the world gathered in May 1998 at the United States National Institutes of Health in Bethesda to share the results of the most recent research on the nutritional and health benefits of inulin and oligofructose.

In his opening remarks co-chairman Dr. John Milner (Head of the Department of Nutrition at the Pennsylvania State University) noted that legislators and consumers were very keen for scientists to continue to unravel facts from fantasies about how specific foods or their components might alter physical and mental performance as well as overall disease risk. Evidence that inulin and oligofructose alter several biomarkers, including bowel habits, colonic microflora, blood lipids, mineral absorption and experimentally induced neoplasia, suggests that these non-digestible carbohydrates are naturally occuring dietary constituents that may improve the quality of life and increase disease resistance in both humans and animals.
Nevertheless, it is imperative that these food ingredients be considered as part of a healthful diet and that additional attention be devoted to the identification of factors that may increase their benefits.

The other chairman, Dr. M. Roberfroid (Catholic University of Louvain, Belgium), adressed fructans more specifically and explained that inulin and oligofructose are natural food ingredients for which both experimental and human data have been accumulated that demonstrate nutritional and physiological benefits, and which may be used to support health claims. Only a rigorous scientific approach that yields sound and reliable data will justify any claim. The major challenge is to give the consumers the guarantee that these new food products represent genuine progress toward (allowing them) a better control of their health.

The first session provided a general overview of inulin and oligofructose, including nomenclature, chemistry, manufacturing, applications, functional and nutritional properties, etc.

In the session on the effects of non-digestible carbohydrates, Barbara Schneeman discussed the actions traditionally associated with dietary fiber in the small and large intestine. She noted that a large body of evidence indicates that dietary fructans are fermented in the large intestine, resulting in an increase in microbial mass and production of short chain fatty acids. Henrik Andersson reported that the fructans are not digested and do not affect the absorption of minerals in the small intestine. David Jenkins explained how inulin and oligofructose are fermented in the colon, resulting in increases in bifidobacteria and production of short chain fatty acids. Janet Greger commented on recent studies indicating that inulin and oligofructose increase calcium absorption and retention in humans and animals. On day 2, the potential health benefits of inulin and oligofructose were discussed by key experts: prebiotic effect and better resistance to pathogens, reduction in blood lipids and the risk for coronary heart disease, antitumor properties, hormonal regulation and immune stimulation. The results of many experimental and human studies were presented.

To end the conference, Dr. Milner concluded that dietary fiber status and GI health were areas where the research is well established in humans. Increase in calcium absorption and protection against cancer are newer areas where results are extremely promising. In the area of lipid modulation there are promising indications of triglyceride reduction. ■

The Proceedings of the Conference are published (1999) as a supplement to the Journal of Nutrition, 129 (7S), 1395S-1502S.

Fructans to be labeled as dietary fiber

In this comment, Leon Prosky, General Referee for Dietary Fiber and Complex Carbohydrates of AOAC International, argues that because of the natural occurrence of inulin and oligofructose in vegetables and fruits and because of their physiological effects, they have to be considered as part of the dietary fiber complex and labeled as such. They possess many physiological attributes normally associated with dietary fiber. But they escape detection by the TDF-methods which are used in most countries for nutritional labeling purposes.
In fact, they do not precipitate in 78% ethanol, the usual reagent for precipitating dietary fiber in analytical procedures.
In 1997, AOAC International adopted the ion-exchange chromatographic method for determination of fructan in food. AOAC International usually does not define the substance to be analyzed but leaves it up to the regulatory agency to decide on the definition, with AOAC International carrying out the requisite studies for determination of the analyte in question. In this case, however, the AOAC proposes oligofructose and inulin to be labeled as dietary fiber.
Results of AOAC surveys and workshops strongly suggest that resistant oligosaccharides such as inulin and oligofructose ought to be included in the dietary fiber complex.
Further, they have been accepted as dietary fiber in several countries, and in many other countries the decision process is running.
Both inulin and oligofructose also meet the Codex Alimentarius definition of dietary fiber, which is «edible plant and animal material not hydrolyzed by the endogenous enzymes of the human digestive tract as determined by the agreed upon method».

Prosky L. (1999) Inulin and oligofructose are part of the dietary fiber complex. Journal of AOAC International, 82, 2, 223-226.

Inulin decreases blood triacylglycerol levels in humans

Studies in rats have shown markedly reduced fasting plasma total cholesterol (TC) and especially plasma triacylglycerol (TAG) concentrations with diets containing significant amounts of fructans. Animal studies have also

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demonstrated significantly lower blood insulin and glucose concentrations with a fructan-enriched diet. In human studies, inconsistent findings with respect to changes in blood lipids and blood glucose and insulin concentrations have been observed.

The aim of this double-blind randomized placebo-controlled study was to examine the effects of the daily intake of inulin on blood lipids, glucose and insulin in healthy, middle-aged men and women with moderately raised TC and TAG levels. Fifty-four volunteers received either 10 g/day inulin (RAFTILINE® HP) or placebo (maltodextrin) for a period of 8 weeks. Fasting blood samples were collected before the supplementation period and at weeks 4, 8 and 12 (i.e. after 4 weeks run-out).

Insulin concentrations were significantly lower at 4 weeks (P<0.01) in the inulin group. TAG values were slightly lower in the inulin group after 8 weeks, returning to baseline concentrations at week 12. The fasting TAG responses over the 8-week period were significantly different between the inulin and placebo groups (P<0.05), which was largely due to lower plasma TAG levels in the inulin group at week 8. The percentage change in TAG levels in the inulin group during the 8-week study was shown to correlate with the initial TAG level of the subjects.

These results support the finding from animal studies that inulin influences the formation and/or degradation of TAG-rich lipoprotein particles. The insulin data are consistent with recent studies showing attenuation of insulin levels in fructan-treated rats. This has not previously been reported in healthy humans and requires further investigation.

Jackson K., Taylor G., Clohessy A. & Williams C. (1999) The effect of the daily intake of inulin on fasting lipid, insulin and glucose concentrations in middle-aged men and women, British Journal of Nutrition, 82, 23-30.

The mechanisms of the lipid-lowering effect of inulin

The mechanism by which inulin may elicit its lipid-lowering effect in animals is not well elucidated.

To examine this effect, especially on bile acid metabolism, male golden Syrian hamsters were fed semipurified diets containing 20 g/100 g fat, 0.12 g/100 g cholesterol and 0 (control), 8, 12 or 16% inulin (RAFTILINE HP®) for 5 weeks. Plasma cholesterol concentrations were lowerd by 15 to 29% in hamsters fed 8 to 16% inulin. Inulin especially decreased VLDL cholesterol.
LDL and HDL cholesterol were not significantly affected by inulin. Plasma triacylglycerol was reduced by 40 and 63% in hamsters fed 12 and 16% inulin, respectively. Hepatic total cholesterol accumulation was significantly lower in hamsters fed 8% inulin. All three levels of inulin caused distinct alterations in the bile acid profile of gallbladder bile.
Taurochenodeoxycholic acid was significantly lower, whereas glycocholic and glycodeoxycholic acid were higher in hamsters fed inulin.
Daily fecal bile acid excretion tended to be greater, whereas daily neutral sterol excretion was not affected, suggesting that cholesterol digestibility was not impaired.

These data demonstrate that the lipid-lowering action of inulin is possibly due to several mechanisms, including altered hepatic triacylglycerol synthesis and VLDL secretion through inhibition of lipogenic enzymes, and impaired reabsorption of circulating bile acids.

Trautwein E., Rieckhoff D. & Erbersdobler H. (1998) Dietary inulin lowers plasma cholesterol and triacylglycerol and alters biliary bile acid profile in hamsters. Journal of Nutrition, 128, 1937-1943.

Synbiotic effects of Lactobacillus paracasei and oligofructose in weanling pigs

Probiotics, including yeast, lactobacilli, bacilli, and streptococci, have been reported to improve intestinal microbial balance of neonatal and weaned pigs. Oligosaccharides can significantly modulate the colonic microbiota by increasing specific bacteria counts and thus changing the composition of the microbiota.

The aim of this study was to confirm the 'synbiotic' effect of the administration of Lactobacillus paracasei and oligofructose (RAFTILOSE® P95) on bacteria counts in the faeces of weanling pigs under field conditions. When combining both a probiotic and a prebiotic, the expected benefits are an improved survival during the passage of the probiotic bacteria through the upper intestinal tract and a more efficient implantation in the colonic microbiota, together with a stimulating effect of the oligosaccharide on the growth and/or the activities of both the exogenous (probiotic) and endogenous bacteria.

The administration of L. paracasei alone significantly decreased Clostridia and Enterobacteria counts as compared to controls. Administered in combination with oligofructose it significantly increased Lactobacilli and Bifidobacteria, and decreased Clostridia and Enterobacteria counts.

These results provide evidence for a synbiotic effect of the combination of L. paracasei and oligofructose on the intestinal bacterial population of weanling pigs.

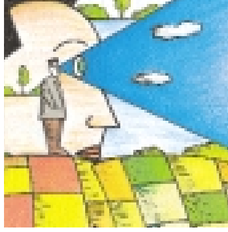
Nemcová R., Bomba A., Gancarciková S., Herich R. & Guba P. (1999) Study of the effect of Lactobacillus paracasei and fructo-oligosaccharides on the faecal microflora in weanling piglets, Berl. Münch. Tierärztl. Wschr., 112, 225-228.

The net energy value of non-starch polysaccharide isolates

The energy value of non-starch polysaccharide (NSP) isolates has been expressed as their metabolizable energy (ME) content. However, this energy unit does not take into account energy lost as fermentation heat, or differences in efficiency of glucose and volatile fatty acid energy utilization, or the probable increase in the metabolic rate of the large intestine. The aim of this study was to compare differences in ME and net energy (NE) contents for insoluble and soluble NSP. Nine healthy young men were offered three diets with three repetitions: control, control + 50 g sugarbeet fibre/day and control + 22 g inulin/day. After a 16 d. adaptation period to NSP isolate, food intake was controlled (duplicate meal method) and faeces and urine were collected for 8 d. A period of 60 h was devoted to measurement of energy expenditure (EE) by whole-body indirect calorimetry.

Inulin ingestion induced significant increases in the number of defecations (+ 15%) and stool weight (+ 55%), resulting from increases in water, dry matter (DM) and microbial mass excretion. The bulking index of inulin was 3.4 (g increase in stool weight per g inulin ingested). Inulin was entirely fermented while fermentability of sugarbeet fibre averaged 0.886. Sugarbeet fibre and inulin ME values averaged 10.7 and 13.0 kJ/g DM respectively. NSP isolate ingestion caused significant (sugarbeet) and non-significant (inulin) increases in daily EE. The maintenance NE content of sugarbeet fibre and inulin were 5.0 and 11.9 kJ/g DM respectively. ■

Castiglia-Delavaud C., Verdier E., Besle J.M., Vernet J., Boirie Y., Beaufrere B., De Baynast R. & Vermorel M. (1998) Net energy value of non-starch polysaccharide isolates (sugarbeet fibre and commercial inulin) and their impact on nutrient digestive utilization in healthy human subjects, British Journal of Nutrition, 80, 343-352.



FAQ

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

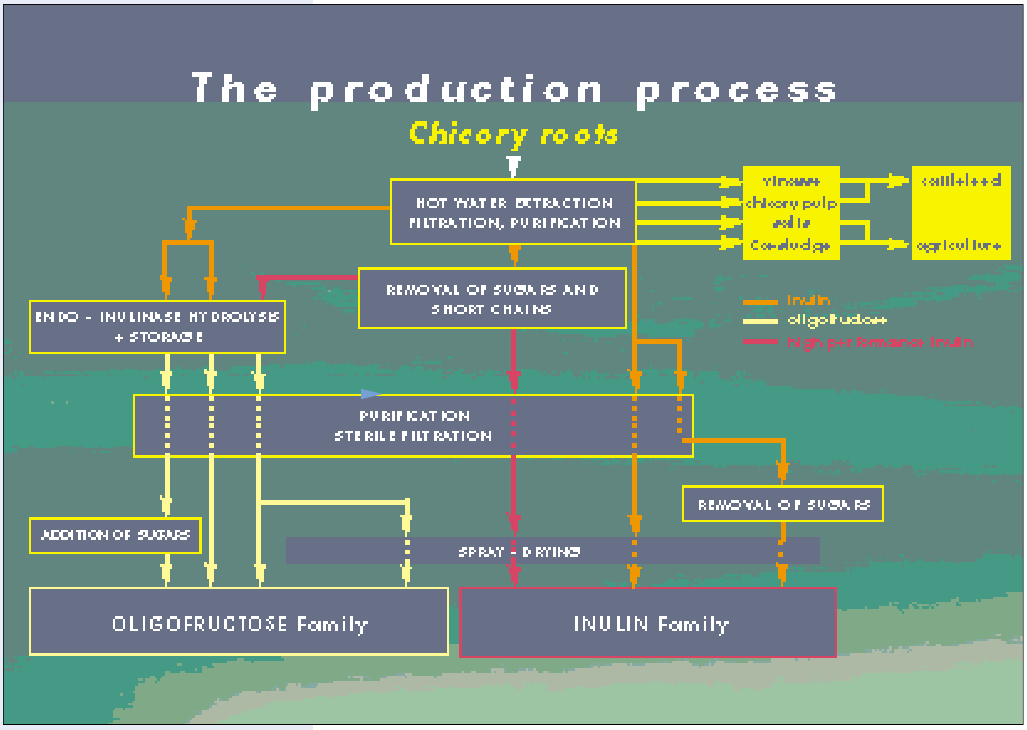
Why is chicory the best source of inulin?

Inulin is a polydisperse product, which means that it is a mixture of oligomers and polymers of different degree of polymerisation or chain length. The composition of the mixture is not constant; each source of inulin has its 'fingerprint' composition of chain lengths. Moreover, the composition varies depending on climatic conditions during growth, and the harvest time and conditions have an influence.

Compared to several other sources of inulin, chicory root inulin has a moderately long chain length, on average. This has several processing and application advantages. For example, fat replacement with inulin from most other fructan sources is simply impossible. Apart from differences in chain length, the composition of chicory inulin is essentially constant, being composed of linear ß(2-1) linked chains of fructose, with practically no side-chains. Therefore, the extracted product has reasonably constant technological and nutritional properties year after year.

Another advantage is the fact that chicory contains only small amounts of mono- and disaccharides, and chicory root has relatively high concentrations of inulin.

The chicory root physically resembles sugar beet, which makes its handling rather easy for a beet sugar producer, since comparable agricultural equipment can be used. The process used for extraction of inulin is similar to sugar beet processing; and the refining procedure is similar to that used for glucose refining. ■



We have performed extensive, detailed comparisons of the material before and after processing. The differences are extremely small: we find a minimal breakdown of inulin chains to shorter molecules, and sugars are found in quantities that are of the same magnitude as the variation of the analytical method itself. Such breakdown processes are similar to those that occur naturally in the mature chicory root.

The basic chemical structure of inulin is unchanged: no side-linking or chemical modification can be detected.

In the chicory root, inulin is present in a soluble form. It is not part of the physical structure of the cell walls. During the extraction procedure, inulin is separated from the cell walls. The aqueous extract is then spray-dried. In most food systems, and in the stomach, inulin returns to the soluble form that it has in the root.

In conclusion, the production process does not significantly change the structure or composition of the inulin extracted. ■

Is inulin modified during the extraction process?

We probably come down to the Heisenberg principle with this question. The fact that you look at inulin may already have changed it. Indeed, to study 'native' inulin, it has to be extracted from the plant, dissolved and analysed,usually by chromatographic techniques. Doing all this might already result in small changes.

In our case, the industrial extraction process with hot water is essentially the same as what would be used in the laboratory. In the factory, the extraction is followed by purification (adsorption, ion-exchange), filtration and spray-drying.

Is inulin 'natural'?

The answer to this question depends on the chosen definition of 'natural'. Chicory root inulin is not synthesized or modified, it is an extract from a natural plant. As we mentioned above, industrially extracted inulin is chemically indistinguishable from 'native' inulin. Several definitions for 'natural' have been adopted for use in food labelling regulations. Most of these definitions apply only to flavouring substances.

In some labelling regulations, 'natural' is defined as: 'unprocessed', with the result that chicory meets the criterion, but inulin (extracted, purified, spray-dried) does not. ■

References : See page 8