20th International Congress of Nutrition

GRANADA CONGRESS CENTRE | GRANADA | SPAIN | 15 – 20 SEPTEMBER 2013

BENEÖ SPONSORED SYMPOSIUM
Weight Management and the role of carbohydrates
Chair: Jeyakumar Henry

PARALLEL SYMPOSIUM
Functional roles of prebiotic inulin-type fructans
Chairs: Nathalie Delzenne, Olga Martínez
The programme of the 20th International Congress of Nutrition is outstanding. It is in fact the best evidence to demonstrate the diversity of nutrition topics related to metabolism, physiological effects, health, and disease. Short and long-term effects, ingredient- and diet-related effects need to be scientifically assessed. Avoiding deficiencies in essential nutrients and related illnesses due to malnutrition is one aspect of research – this was a major driver in nutrition research in the past and still is today. A conceptual step further is what I would like to call the “better nutrition for all” research – a nutritional research domain BENEo is committed to. This is research about healthy nutrition, with the long-term aspect of prevention of diet-related diseases and postponing the onset of diet- and lifestyle-related diseases to add quality of life years.

“Weight management and the role of carbohydrates” is the theme of the BENEo-Institute’s sponsored symposium at the International Congress of Nutrition 2013. More than 50% of the caloric intake is recommended to come from carbohydrates. However, the diversity of carbohydrates, their very different physiological profiles and consequently different metabolic influences have been more or less ignored up to now. There are very good reasons to have a closer look and discover the chance of a healthy, prevention-oriented nutrition. BENEo is glad to have key researchers – from Asia, North America and Europe – addressing this important field of research.

In addition to this exciting BENEo symposium, I would like to draw your attention to a specific section in the parallel programme which is related to prebiotic inulin-type fructans from chicory. This session will focus on the human being as the host of a very complex gut microbiota including interactions and the functional roles of prebiotic inulin-type fructans in this context. BENEo’s mission is “connecting nutrition and health”. The physiological background of our ingredients is sound science with a continuous extension of knowledge around our ingredients in nutrition, health and disease prevention. This is what BENEo wants to share with you, the research and health care community, for further development.

I would like to take this opportunity to thank all researchers involved for the top quality work and I thank all speakers for developing the presentations and making it possible to be here in this wonderful place.

Please join us and enjoy interesting discussions!

Matthias Moser, Member of the Board (CEO), BENEo GmbH
**BENEO SPONSORED SYMPOSIUM (SPS3-24)**

18 September 2013
5 – 7 pm, Room D
Chair: J. Henry

"Weight Management and the role of carbohydrates"

Physiological diversity of carbohydrates
(S. Theis)

Recent advances on the role of low glycaemic carbohydrates in weight management
(J. Henry)

Obesity, microbiota and the effect of inulin-type fructans
(B. Rastall)

Prebiotic fibres and weight management
(R. Reimer)

**PARALLEL SYMPOSIUM (PS4-54)**

19 September 2013
11:30 am – 1:30 pm, Room C
Chairs: N. Delzenne, O. Martínez

"Functional roles of prebiotic inulin-type fructans"

Prebiotic modulation of the human gut microbiota
(B. Rastall)

Gut microbiota impact on metabolic disorders associated with obesity
(N. Delzenne)

Prebiotics in infant nutrition
(R. Closa)

Role of prebiotics in regulating energy intake and body weight
(R. Reimer)
Prof Dr Ricardo Closa

Professor Ricardo Closa Monasterolo is a Full Professor of Paediatrics at the Universitat Rovira i Virgili, School of Medicine, Department of Medicine and Surgery, Catalanian Institute of Health. He is the director of the Neonatal Unit, University Hospital Joan XXIII of Tarragona, Spain. After his Medical Degree from the Universidad de Cordoba, Argentina in 1975 and Paediatric training at Ciudad Sanitaria, Valle de Hebrón', Barcelona (1976/1981) he was a Fellow in Neonatology at CVRI, University of California SF (1985/1986) and obtained a doctorate from the Universitat Rovira i Virgili in 1993. Prof Closa has been a member of the board in Neonatology of the Asociación Española de Pediatría since 1996. He has been involved as a partner in several international, European and national research projects such as CHOPIN and EARNEST on childhood obesity and early programming by infant nutrition, and projects on the effects of diets on the mental performance of children, FP7 NUTRIMENTHE.

He is author of numerous papers in peer-review journals. The main research lines are programming by infant nutrition, childhood obesity, nutrition and development, renal metabolism, pulmonary function and infections in childhood.
Professor Nathalie Delzenne is Full Professor at the Université catholique de Louvain. She is a lecturer in Nutrition Biochemistry and Metabolism and is the leader of the Metabolism and Nutrition Research Group at the Louvain Drug Research Institute. She has been involved in international scientific committees (editor for the current Opinion in Clinical Nutrition and Metabolism, member of the scientific board of the European Academy of Nutritional Science, former member of the board of the Nutrition society (UK), vice-president of the Belgian Nutrition society, former member of the board of directors of the International Scientific Association for Probiotics and Prebiotics).

After a PhD in pharmaceutical sciences obtained in 1991, and a post-doctoral certificate in nutrition (Lausanne, CH), she performed a post-doctoral research in Paris (Inserm Unit 342) to analyse the effect of nutrients on gene expression in the field of obesity. Back at the Université catholique de Louvain, she started an academic career and has been involved in the experimental approach allowing to assess the functional effect of prebiotic-type nutrients, and in several international European projects devoted to functional food. By working with prebiotics, her group has published more than 100 papers describing their effect on glucose/lipid metabolism, obesity-related disorder and inflammation. The current hypothesis is the involvement of intestinal peptides/hormones and of specific G-coupled protein and nuclear receptors in the modulation of energy metabolism and systemic inflammation by nutrients targeting the gut microbiota.
Professor Jeyakumar Henry initially trained as a food scientist and subsequently obtained his MSc and PhD in nutrition at the London School of Hygiene and Tropical Medicine. He is Professor of Human Nutrition at Oxford Brookes University and the Chinese University of Hong Kong. Currently he is Director of Clinical Nutritional Science at Singapore Institute for Clinical Sciences. Professor Henry was a board member of the UK Food Standards Agency between 2000 – 2003. He regularly acts as a consultant to the WHO and UNICEF and advises several multinational food companies worldwide.

His research interests are on obesity, diabetes, energy regulation and nutrition in the elderly. In 2010 he was awarded the British Nutrition Foundation award for his outstanding contribution to nutrition in the UK.
Professor Bob Rastall is Head of the Department of Food and Nutritional Sciences at the University of Reading in the UK and also holds the post of Professor of Biotechnology. He has a BSc in Applied Biology and a PhD in Microbial Biochemistry from the University of Greenwich, London. His PhD research was on cell surface carbohydrates of Erwinia amylovora, the causative agent of Fireblight disease in apple and pear trees. He held research fellowships in the field of carbohydrate bioengineering at the University of Westminster where he developed methods for synthesising oligosaccharide structures using glycosidase enzymes acting in reverse and investigated computation methods of sequence analysis for complex mammalian oligosaccharide. He joined the University of Reading in 1993 and has continued to develop his interests in carbohydrate bioengineering in a food and nutritional context.

Professor Rastall now leads a personal research team developing novel enzymatic manufacturing technologies for functional carbohydrates targeted at gut health. His research is focused on understanding structure-function relationships in prebiotic carbohydrates in the context of the functional ecology of the gut and the application of that knowledge to the rational development of functionally enhanced prebiotics. He is also developing concepts around the rational targeting of synbiotics to specific health outcomes and to specific population groups. He is also interested in investigating the potential of antiadhesive oligosaccharides to control gastrointestinal infections.
Dr Raylene Reimer joined the Faculty of Kinesiology at the University of Calgary in May 2000 and holds a joint appointment in the Faculty of Medicine, Department of Biochemistry and Molecular Biology. Dr Reimer came to Calgary after completing a 2-year postdoctoral fellowship in Lausanne, Switzerland at the Nestlé Research Center in the Molecular Nutrition Team. Her work focused on identifying novel food ingredients and examining the molecular mechanisms by which they influence glucose and lipid metabolism and the prevention of obesity and diabetes.

Dr Reimer obtained her B.Sc. in Foods and Nutrition from the University of Alberta. She completed her PhD in Nutrition and Metabolism under the direction of Dr Michael McBurney in the Department of Agricultural, Food and Nutritional Science at the University of Alberta. She is also a registered dietitian and worked briefly at the Diabetes and Lipid Education Centre in Lethbridge, Alberta prior to moving to Switzerland.

Dr Reimer has a keen interest in nutrition education and works in various capacities to promote healthy eating and the achievement of healthy body weights across the lifespan. Her research programme is aimed at unravelling the complex interaction between diet composition and body weight control. Maternal and fetal health, prebiotics and probiotics, and modulation of gut microbiota are all active areas of research in the lab. Translating findings from animal models to human clinical studies is a key way in which the Reimer lab spans bench to bedside discovery and application.
Dr Stephan Theis is Head of Nutrition Science at BENE0-Institute and his responsibilities include the research activities on the nutritional benefits of BENE0’s functional carbohydrate ingredients worldwide. Dr Theis joined the company in 2001. He graduated with a diploma in Nutrition Science from the University of Giessen, Germany (1997) and obtained a PhD (Dr. rer. nat) from the Technical University of Munich (2002). Dr Theis is also a member of the German Nutrition Society.

He has been involved in international scientific committees and collaborative research activities in the field of functional food and carbohydrates including the ILSI Europe coordinated PASSCLAIM project.
Carbohydrates in foods comprise a great variety of structures. These in turn determine a wide range of physiological effects in the human body. The specific functional potential of carbohydrates starts with their digestive properties in the gastrointestinal tract. Classical nutritive carbohydrates such as starches, sucrose or lactose are rapidly hydrolysed into their monosaccharides, glucose, fructose and galactose, which are absorbed and metabolised. They have a standard caloric value of 4 kcal/g. Functional carbohydrates are either slowly, partially or not digested in the upper gastrointestinal tract. They may thus provide metabolic energy from monosaccharides more slowly or display their specific functional effects by their action on or through the gut flora.

Their diverse digestibility also determines the diverse impact of functional carbohydrates on the body’s energy balance: their caloric value can be lower; the rate and extent of carbohydrate digestion and absorption effects blood glucose levels, insulin release and subsequent fuel partitioning can differ; or they can increase satiety and thus reduce energy intake. Further aspects might come from the role of the gut flora in weight management.

Slow-digestible carbohydrates have been in the focus of research for many years in order to lower the glycaemic load of foods and diet, but still allowing the full contribution of metabolic energy from carbohydrate in view of dietary recommendations. Palatinose™ (isomaltulose) is such a slow-release and low glycaemic carbohydrate. It is a disaccharide that is slowly hydrolysed by intestinal enzymes, allowing a slow and sustained glucose release which results in a low effect on blood glucose and insulin levels. In terms of Glycaemic Index categories, GI values determined for isomaltulose as such and in applications generally fall within the “low GI” range. Studies with normal-weight as well as overweight individuals have demonstrated that the lower postprandial glucose and insulin response with Palatinose™ impacts energy metabolism and fuel partitioning towards a higher level of fat oxidation. Longer-term benefits from a higher fat oxidation for body weight management have also been addressed in clinical investigations. Inulin-type fructans derived from chicory, namely Orafti®Synergy1 (oligofructose-enriched inulin) and oligofructose, are prebiotic fermentable fibres with specific effects on the microbiota composition. Their caloric value is determined by their short-chain fatty acid yield and it has been estimated approx. 1.5 kcal/g. Apart from their reduced caloric content and their ability to replace more energy dense ingredients such as digestible carbohydrates and fats, oligofructose and oligofructose-enriched inulin have been shown to particularly contribute to energy homeostasis by decreasing the level of energy intake. Comprehensive research from several human intervention studies and numerous animal studies concomitantly show that daily supplementation of the diet with Orafti®Synergy1 or oligofructose reduces food intake and thus daily energy intake. The lower energy intake was associated with beneficial effects on body weight changes and effects on appetite sensations such as less hunger feelings and higher fullness ratings.

In summary, scientific evidence today suggests several possibilities how functional dietary carbohydrates can influence energy metabolism and contribute to a successful body weight management. Their physiological diversity allows several targets for modulation, be it through direct reduced energy content, influence on fat metabolism or via satiety signalling.
Recent advances on the role of low glycaemic carbohydrates in weight management

In 1981, Jenkins and co-workers devised a system of comparing the postprandial blood glucose response of different carbohydrate foods – the concept described as Glycaemic Index (GI). This idea revolutionised our understanding of carbohydrate nutrition. It also stimulated an interest in the dietary management of obesity and diabetes. Indeed it has been proposed that the quality of carbohydrates we consume may have a greater influence on adipose tissue accretion than previously recognised. In the intervening thirty years, over 3,500 foods have been tested worldwide for their GI values. This database has enabled the consumer to select low GI foods. In addition, a series of natural Low GI food ingredients have also been developed that may be incorporated into food systems. Using clinical studies, epidemiological observations and intervention trials, the presentation will highlight how a low GI diet can improve glucose control, increase fat oxidation, increase satiety and minimise adipose tissue accretion. All of these clinical observations reported above, have been attributed to the slow release of glucose when low GI foods are consumed. Close collaboration between food manufacturers and physiologists has enabled the development of a series of low GI foods. Since the consumption of a low GI diet appears to elicit comparable health benefits as those from pharmacological interventions, the challenge is to translate these clinical studies into practical advice to the community.
In recent years there has been a lot of interest in the idea that the composition and activities of the gut microbiota may play a role in contributing to obesity. Elegant research in animal models has strongly suggested that we may be able to recognise an obese microbiota which contributes to increased energy harvest from the diet and also to the chronic low level inflammation associated with obesity. Human and in vitro studies have shown mixed results, however, the role of the gut microbiota in obese humans is still a matter of scientific investigation and debate. It is far from clear whether the changes observed are cause or consequence. It may, however, be possible to use prebiotic fibres such as inulin and oligofructose to modulate any potential imbalance in the gut microbiota, to regulate production of short chain fatty acids and to reduce the intestinal permeability that allows inflammatory markers into the circulation.

This presentation will review the development of the obese microbiota concept and evaluate the weight of the evidence in humans. It will also review recent data on the potential of inulin-type fructans to bring about positive changes in the colonic microbiota of obese humans.
Prebiotic fibres and weight management

The development of functional foods that will help curb the obesity epidemic is an area of intense interest. Food-based strategies that target the incorporation of functional ingredients into the food market have the potential to enhance satiety and reduce energy intake. The effectiveness of dietary fibre, and particularly prebiotic fibres, to act as a functional food ingredient and aid in weight management is supported by convincing data in animal studies and a growing body of evidence from human clinical studies. This presentation will foster a deeper understanding of the mechanisms by which prebiotic fibre acts to regulate body weight, including fermentation, gut satiety hormones, appetite, and energy intake. Foundational data from animal studies showing regulation of energy intake and modulation of gut microbiota will be presented. A more in-depth examination of data from human studies will also be discussed. Given that a successful weight management plan, at the individual and population level, requires that the foods be satiating and reduce energy intake, studies showing the effectiveness of prebiotic fibres in lowering energy intake will be highlighted. The overall goal of this presentation is to provide the latest evidence for the promising role of prebiotic fibres in weight management.
It is recognised that the complex microbial ecosystem in the human colon has a profound impact on health. This has led to approaches to improve health via the nutritional manipulation of this ecosystem.

Functional food ingredients have the potential to modulate the colonic microbiota and its metabolic profile to promote health. Traditionally, this has been by the administration of live bacterial supplements, or probiotics. Whilst specific, carefully selected bacterial strains can have health benefits, it is not possible to bring about large changes in the colonic microbiota this way. In 1995 the concept of prebiotics was introduced and several definitions have followed with the most recent one published in 2010. Essentially prebiotics are food ingredients, supplements or components that escape digestion in the small intestine and reach the colon largely intact. They are then selectively fermented by health-positive members of the colonic microbiota. All recognised prebiotics are carbohydrates such as fructo-oligosaccharides, inulin and galacto-oligosaccharides. Many more are being investigated.

Much of the early work on prebiotics focused on increasing the relative populations of *Bifidobacteria* and *Lactobacilli*. These are non-pathogenic species with a range of recognised health-positive attributes including inhibition of intrinsic and extrinsic pathogens, modulation of immunity and vitamin synthesis. The health attributes of these organisms are still being explored in laboratory and human volunteer trials and data are accumulating to support their use in a range of chronic and acute gut disorders. Recent thinking, however, has focussed increasingly on the metabolites produced by the colonic microbiota and the impact of these metabolites on health is being studied. This widening of emphasis is stimulating debate over the definition of prebiotics.

This speech will examine the evolving view of what is meant by a prebiotic, and critically examine how they might act to increase health.
Experimental data in animals, but also observational studies in patients, suggest that the composition of the gut microbiota differs in obese versus lean individuals, in diabetic versus non-diabetic patients, or patients presenting other diseases associated with obesity or nutritional imbalance, such as non-alcoholic steatohepatitis. Several observation studies in humans allow to point out interesting bacterial targets, such as *Bifidobacterium spp.*, which abundance is inversely correlated to obesity and diabetes; *Faecalibacterium prausnitzii*, that could be involved in the control of diabetes-related inflammation, or *Akkermansia muciniphila*, involved in mucus layer regulation, which has been shown to be inversely correlated with obesity. We have recently confirmed, in an intervention study with fructan prebiotics versus placebo in obese women, that, even if the increase in *Bifidobacteria* remains the major and common signature of the prebiotic approach, a complex modulation of the gut microbial ecology – that can be studied through both bacterial genomic analysis and host fluids metabolomics – occurs upon prebiotic treatment in obese individuals. Some bacterial changes are clearly related to a decrease in inflammation, others the improvement of fat mass and of metabolic alterations. The mechanistic studies suggest that the changes in the gut microbiota occurring upon prebiotics, can be related to an improvement of gut bacterial functions implicated in the regulation of host energy homeostasis. The promotion of gut hormones release, changes in the gut barrier integrity, and/or the release of bacterial-derived metabolites could all participate in the improvement of host health in the particular context of overfeeding and obesity.

Related References
Before birth, the gastrointestinal tract is sterile; it occurs immediately after birth that the gastrointestinal tract becomes colonised by bacteria from the mother and the birthing environment. The developing microbiota and its composition is thereby influenced by a number of factors such as the type of delivery (caesarean section showing lower numbers of *Bifidobacterium fragilis* and higher counts of *Clostridium difficile* in comparison to vaginal birth), the stage of maturity, antibiotic therapy and feeding practices. Breastfed infants, for instance, have different flora that is mainly composed of *Bifidobacteria* and *Lactobacillus* in comparison with formula-fed infants, displaying a more complex flora with a predominance of *Clostridia, Bacteroides* and *Streptococci*. Moreover, it has been observed that breast-fed infants grew and developed differently with reduced incidences of late-onset neonatal infection, necrotising enterocolitis, infections, allergy and childhood obesity. There is also evidence that infant feeding can influence the risk of metabolic syndrome later in life.

Whereas human milk contains about 8% of total carbohydrates in the form of prebiotic oligosaccharides that selectively favour the growth and residence of lactic acid bacteria in the infant gut, infant milk formulas do not contain such prebiotics unless they are enriched. Meanwhile several studies have examined the impact of prebiotic supplementation with inulin, oligofructose and Orafti®Synergy1 to infant formula in paediatric populations, feeding improvement in gut flora composition, increased stool frequency and promoting softer stools.

Further benefits of prebiotic supplementation show preventive protection against the development of atopic dermatitis or infections.

One of these studies published recently by Veereman-Wauter and co-workers assesses the effects of an infant formula supplemented with 0.8g/dL Orafti®Synergy1 in newborns in a randomised controlled trial of 4 weeks. Orafti®Synergy1 supplemented formula showed similar efficacy to a GOS:FOS (90:10) supplemented formula in promoting a stool consistency and microflora closer to the breastfed pattern. This work led to the development of the Bambinol study which addresses tolerance, safety, and efficacy of an Orafti®Synergy1 supplemented infant formula during the first four months of life.

The Bambinol study was set up in double-blind, randomised, placebo-controlled design with two groups of neonates receiving an infant formula supplemented with 0.8g/dL Orafti®Synergy1 or an infant formula without prebiotics as control (n=252) for four months. An additional reference group of breast-fed infants (129) was monitored in parallel. Results showed similar growth, milk intake, and fluid balance and biochemical values in the intervention and control groups, demonstrating the safety of Orafti®Synergy1 supplementation. Additionally, Orafti®Synergy1 promotes a deposition pattern closer to the mother milk with improved stool frequency and consistency versus the control formula. An important finding from this study is that the favourable softer stools were not associated with disturbed water balance. Moreover, a trend of increasing *Bifidobacterium* in faecal flora was seen with Orafti®Synergy1, without any side effects compared to the standard formula. In conclusion, the study demonstrates that the supplementation of 0.8g/dL Orafti®Synergy1 to formula milk during the first four months of life is safe and effective in terms of gut health.
The human food supply has changed drastically over the past 50–75 years, including reduced dietary fibre content, with an alarming increase in obesity following close behind. In response, there is a growing interest in value-added foods that will help curb the obesity epidemic. The effectiveness of dietary fibre, particularly prebiotic inulin-type fructans, to aid in weight management is supported by convincing data in animal studies and a growing body of evidence from human clinical studies. This presentation will highlight the mechanisms by which prebiotic fibre acts to regulate body weight with a special focus on gut satiety hormones. Furthermore, given the demonstration that the susceptibility to obesity can be programmed early in the course of development, the influence of prebiotic fibre on maternal health during pregnancy and offspring health will also be discussed. The overall goal of this presentation is to highlight the latest evidence for the role of prebiotic fibres in body weight management across the lifespan.
Further contributions from research that relate to BENE0 ingredients:

16 September | 4 – 4.30pm | Room C | Special lecture

“Modulation of the gut microbiota by nutrients with prebiotic and probiotic properties”
Nathalie Delzenne, Université Catholique de Louvain, Belgium

tbc | Poster presentation

“Effects of long-term supplementation with a mixture of short and long chain inulin-type oligosaccharides on faecal microbiota in infants”
C. Campoy; O. Urraca; V. Varea; J. Alonso; J. Palencia; G. Veereman-Wauters; M. Rodriguez-Palmero; M. Rivero; F. Neumer; Y. Vandenplas