Nutrition from infancy through adolescence – benefits of choosing smart ingredients.

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connecting nutrition and health

Nutritional benefits of prebiotic inulin and oligofructose in infancy, childhood and adolescence.

It is never too early, nor too late, to begin thinking about a healthy diet – and people of all ages are increasingly aware of this fact. BENEO offers functional ingredients and innovative product concepts that support healthy lifestyles at every life stage. With a careful and scientifically substantiated approach, BENEO ingredients – inulin/oligofructose from chicory and Palatinose™ from sugar beet – can answer the youngsters' needs in nutrition.

Nutrition early in life is crucial for the development of the infant and child and is recognised to have repercussions across the lifespan of the individual. Inulin can play an important role in health during infancy and later in life. Inulin is a non-digestible carbohydrate naturally occurring in many fruits and vegetables – chicory root is an abundant source. It has been consumed for thousands of years.[1] While the chicory root today is no longer a regular part of our diet, its fibres (inulin and its short-chain form, also called oligofructose (synonym fructo-oligosaccharide – FOS)) still are, and they are used in many fibre-enriched food products for the general population. In food for infants, children and adolescents, prebiotic inulin and oligofructose are used for the bifidogenic effect, selectively stimulating the bifidobacteria in the large intestine so that the microbiota composition is supported from early life on.

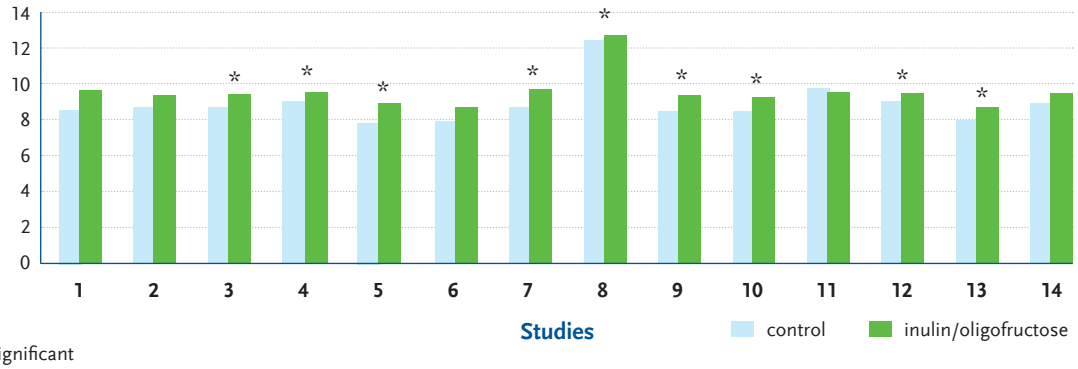
Let's start from the beginning – importance of early colonisation.

Babies are born with an immature immune system and an almost sterile gut. Early programming of their innate and adaptive immune system is strongly influenced by the multitude of bacteria colonising the gut in their first weeks and months to form the gut's microbiota. This is a critical and essential process early in life as it may impact later health outcomes by potentially reducing the risk of obesity, inflammatory bowel disease and allergies.[2,3]

Nutrition in infancy can make a big difference. Bifidobacteria are the dominating microorganisms in the gut microbiota of breastfed infants, independent of the region they were born. High levels of bifidobacteria in breastfed infants have been associated with reduced counts of potentially harmful bacteria like E. coli and others. Human milk oligosaccharides (HMOs) are the first prebiotics in the diet of a baby. They greatly influence the infant's microbiota composition. Breastfeeding is the best nutrition for babies and is associated with a protective role in the development of a number of diseases later in life.[4] There are important differences between breastfed and formula-fed infants. Formula-fed babies tend to have lower levels of bifidobacteria, firmer stools and are more prone to infections compared to breastfed infants.[5-7] When breastfeeding is not chosen, the baby's nutrition should nevertheless be as close as possible to that of a breastfed child. This is the reason why inulin and oligofructose are part of infant and follow-on formulas around the world supporting the microbiota composition, increasing levels of bifidobacteria, softening stools and strengthening the immune system. These beneficial effects are also relevant for periods later in life.

The figure below reflects the impressive amount of 14 trials with infants and small children demonstrating that supplementing infant formulas or follow-on formulas with inulin and oligofructose (oligofructose/FOS, long-chain inulin, mixtures of shorter and longer chain inulin including Orafti®Synergy1 were used in those studies) as bioactive prebiotics increase the bifidobacteria count which positively affects the infant's microbiota and brings it closer to that of breastfed babies.

Figure 1. Prebiotic data with inulin and oligofructose in infants and small children



*significant

The beneficial effects of BENEO's prebiotics on the gut microbiota have also been proven in older children. Levels of bifidobacteria and lactobacilli significantly increased in kindergarten children, 3 to 6 years old, after inulin supplementation.[8] Similar results were seen in 7 to 12 year old boys and girls consuming Orafti®Synergy1 which induced higher bifidobacteria counts.[9]

As natural food components, prebiotic inulin and oligofructose are safe for feeding to infants and small children. Food legislation around the world has approved the safe use of inulin and oligofructose for infants and children, recognising that there is no difference in normal development and growth and acknowledging their selective effect on the growth of bifidobacteria, the so-called prebiotic effect.[10]

"A 0.8 g/dL Orafti®Synergy1-supplemented infant formula during the first 4 months of life is safe and effective, promoting a gut microbiota closer to that of breastfeeding."

Quote by Dr. Closa-Monasterolo

Healthy bowel habit, more important than ever.

Hard stools are among the most common gastrointestinal complaints in children. There are many things that can affect bowel movements, such as nutrition, age and different feeding habits. During infancy, there is a major difference in stool consistency of breastfed compared to formula-fed infants, with breastfed babies having softer stools, often even liquid stools because of the HMOs in breast milk.

In order to promote a healthy bowel habit, prebiotics are added to infant formulas to get closer to a breastfed situation. Supplementing formulas with inulin and oligofructose from chicory has been shown to benefit stool consistency by providing softer but not too watery stools.[10,11] Constipation continues to be a concern when children get older and are faced with new and unfamiliar situations, e.g. introducing regular food (weaning period), beginning toilet training, starting daycare or kindergarten. Orafti® prebiotics have illustrated to improve stool consistency in constipated children (2 to 5 years of age)[12] and positively influence stool frequency in 3 to 6 year olds[8], supporting normal bowel habits in young children.

The consumption and following fermentation of inulin can give relief. The mechanism behind this was evaluated and accepted by EFSA (European Food Safety Authority) in the context of a claims approval dossier submitted by BENEO. The dossier was evaluated positively and a claim proprietary to BENEO was approved.[13]

Increased inner protection.

The time period right after birth is crucial for programming the immune system. A major part of the immune system is located in the large intestine, the place where the microbiota resides. A balanced microbiota plays a fundamental role in the development of the immune system, making nutrition during early life even more important. In addition, the newborn has an immature immune system that increases its susceptibility to infections. This vulnerability is even more pronounced in formula-fed infants. A healthy gut microbiota composition with increased levels of bifidobacteria seems to benefit the immunity of infants. Since higher levels of bifidobacteria are found in breastfed infants, a similar microbial colonisation should be encouraged for formula-fed infants. Adding prebiotic inulin and oligofructose to the formula is a step in the right direction. Through their effect on the growth of bifidobacteria, prebiotics may offer additional protection and strengthen the mucosal barrier that can be essential for a newborn's immune system, in particular if formula-fed. Babies in day care centers (4 to 24 months old) receiving oligofructose-enriched cereals experienced significantly less symptoms associated with diarrhea, such as fever and physician visits as well as reduced antibiotic treatment.[14] The results of a review and meta-analysis showed that the number of infectious diseases requiring antibiotic therapy decreased with supplementation of prebiotics from the chicory root. From studies available to date, we can assume that prebiotics may be effective in reducing the rate of overall infections in infants and children aged 0 to 24 months.[15] A recent trial confirmed this immune strengthening effect even in an older age group where prebiotic treatment led to fewer incidents of fever and sinusitis in 3 to 6 year old kindergarten children.[8]

Building stronger bones.

Osteoporosis is one of the most common chronic diseases, leading to low bone mass, reduced bone density and reduced bone quality with a consequently higher risk of fracture. The number of people living with osteoporosis worldwide is expected to increase dramatically in the coming decades.[16] Our body builds bone mass during childhood into the mid-twenties where the peak bone mass is reached. After that, bone mass decreases with an even faster demineralisation process in women after menopause. It is therefore important to maximise peak bone mass during adolescence in order to compensate bone loss later in life.

Chicory root fibre increases calcium absorption as studies have illustrated. The unique combination of longer chain inulin and shorter chain inulin (oligofructose/FOS), aka Orafti®Synergy1, has been shown to change the environment of the whole length of the large intestine so that the complete large intestine environment is influenced to promote calcium absorption. An additional place of absorption, besides the small intestine, is made available due to this and the bioavailability of calcium in the normal diet is significantly increased.[17] These beneficial effects of Orafti®Synergy1 have been demonstrated irrespective of the food matrix and have no negative effect on other minerals and vitamin D levels.

A one year intervention study in adolescents (9 to 13 years of age) demonstrated that Orafti®Synergy1 intake significantly increased calcium absorption and bone mineral density. The additional calcium truly reached the bones, confirming long-term benefits of Orafti®Synergy1 for bone health in this important age group.[18]

Maintaining a healthy weight.

The prevalence of overweight and obesity has become a leading health concern worldwide. Childhood overweight and obesity are increasing in all regions of the world at alarming rates. Children who are overweight or obese are at higher risk of developing serious health problems later in life.[19]

It is an important public health goal to stop the increase of childhood overweight in the near future. One of the strategies focuses on the development of healthier food choices.[20] This can be achieved with BENEO's chicory root fibres which have shown to help you eat less calories, naturally. A study in overweight and obese children (7 to 12 years old) confirmed beneficial effects of chicory root fibre supplementation on body weight and body composition. Consumption of Orafti®Synergy1 resulted in less appetite and higher satiety with the consequence that the kids ate less calories, decreased their BMI and body fat mass and improved obesity related inflammatory markers.[9,21]

"The intake of [BENEO's] prebiotic fiber ... [is] one more tool to use in the obesity epidemic."

Quote by Prof. Reimer

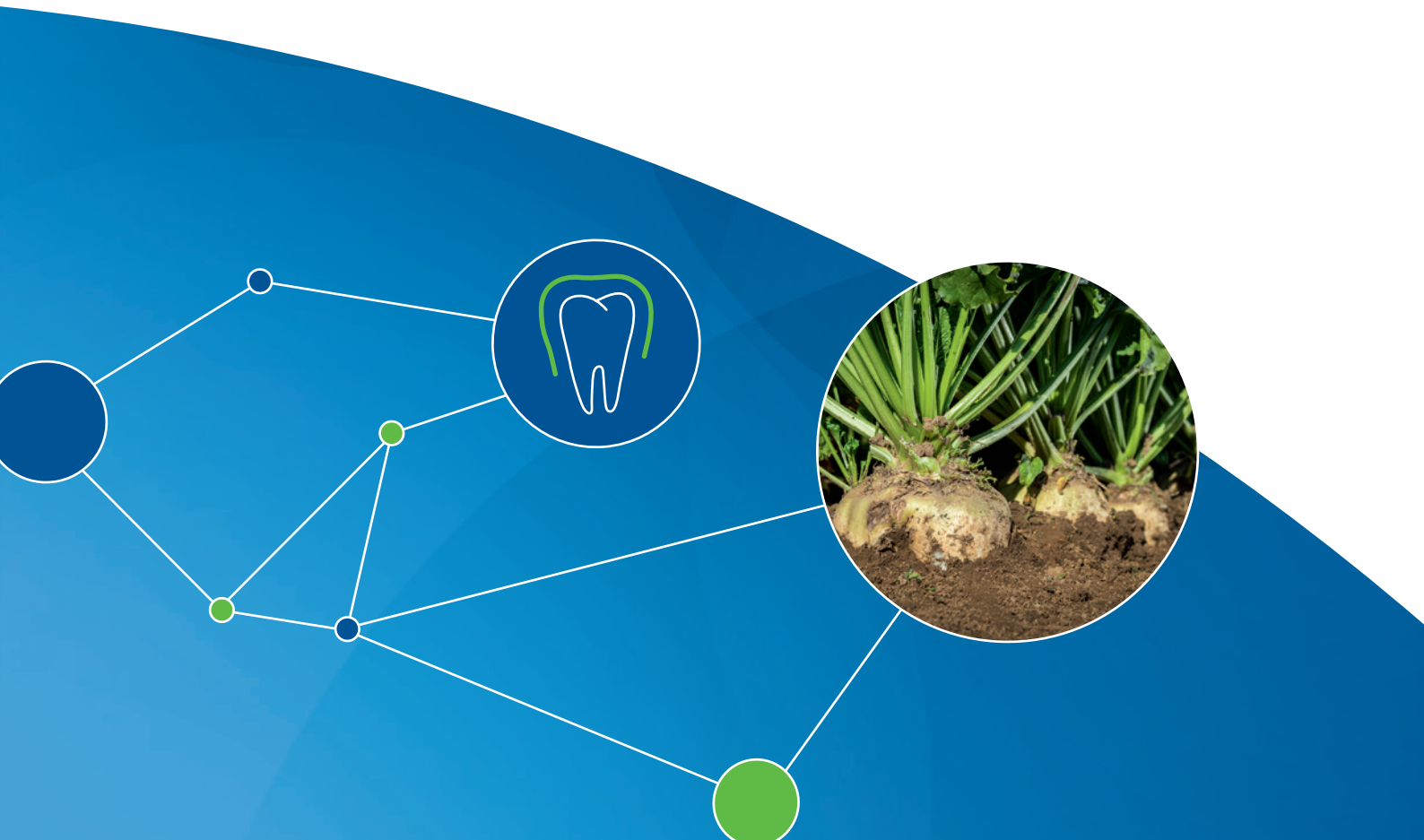
Conclusion:

Altogether, results from various studies show that prebiotics (inulin and oligofructose) increase bifidobacteria and shift the composition of the microbiota closer to that of breastfed babies, supporting a healthy gut for growth and development during infancy through adolescence. Additional benefits of inulin and oligofructose for infants and children are softer and more frequent stools allowing for a healthy bowel habit that is especially crucial during this time of life where constipation is of concern. Scientific evidence offers promising results of BENEO's prebiotic ingredients when it comes to strengthening the immune system of infants and kindergarten children. In older children, inulin and oligofructose positively influence the path towards a healthy body weight and building stronger bones.

Palatinose™ – the slow release carbohydrate and its nutritional benefits from birth to adulthood.

Diet matters from the very beginning, and so does the right type of carbohydrate. New insights show that early nutrition goes beyond a healthy development during childhood and sets the foundation with outreach to metabolic health and disease later in life. According to a recent review of the EarlyNutrition project of the EU, slowly available carbohydrates, among other recommendations, should be the preferred choice in nutrition of infants and young children for health benefits later on.[22] Slow release carbohydrates support a lower, smoother metabolic profile closer to that of breastfed babies. Slow release carbohydrates further help to reduce and smoothen blood glucose levels beyond infancy. Nowadays many foods for kids of all ages contain fast and high glycaemic sugars and carbohydrates following the idea to provide children with energy loads for their development and growth. While they provide glucose – the body's main fuel – in a fast way with high impact on blood glucose levels, lowering blood glucose levels has been postulated as beneficial, supporting long-term metabolic health. Slow release carbohydrate can help to lower blood glucose excursions supporting a more balanced metabolism.

The slow release carbohydrate Palatinose™ (generic name: isomaltulose) fulfills these criteria. It is a carbohydrate derived from the sugar beet, that supplies the body with the full carbohydrate energy (4 kcal/g) in a slow and balanced way. Naturally occurring in honey and sugar cane juice, this disaccharide carbohydrate is made from sucrose by enzymatic rearrangement of the α-1,2-glycosidic linkage into a stronger, more stable α-1,6-glycosidic bond. This different linkage makes Palatinose™ a fully digestible carbohydrate with slow release properties. Its digestion and absorption takes place along the entire length of the small intestine and results in a slower and sustained release of glucose into the blood.[23,24] These unique properties as well as the ability of infants and children to use and metabolise Palatinose™ have been successfully proven in scientific studies. Palatinose™ is a carbohydrate that can be used in various applications as a slow release carbohydrate alternative to commonly used highly available carbohydrates like maltodextrin, sucrose or others. It is only half as sweet as sugar with a natural and pleasant taste.



Introducing Palatinose™ to the diet.

During the first months of life, the infant's gastrointestinal tract is not developed to the same extent yet; it gradually adopts to external feeding, first with mother milk, and from about 4 to 6 months of age with complementary feeding. With the introduction of new foods, also Palatinose™ can be introduced to the diet with follow-on formulas, weaning food, baby teas or regular foods.

Its suitability and safe use in infants and small children was confirmed in a study that was part of the EarlyNutrition Project of the EU. Prof. Koletzko, Professor of Paediatrics at the University of Munich, assessed the acceptance, tolerance and safety of a Palatinose™ containing follow-on formula in 50 healthy term infants aged 4 to 8 months, in a randomised, double-blind, placebo-controlled, parallel study.[25] Prof. Koletzko concluded from this study that:

"The Palatinose™ formula is as good as a conventional formula with respect to the acceptance and tolerance in infants beginning at 4 months of age."

The physiology of Palatinose™ is well established; and it has been confirmed by all major regulatory bodies around the world that Palatinose™ is safe for human consumption, including children and adolescents as much as adults. Thus, from early on when children learn from their parents and social community about healthy food choices, Palatinose™ can serve as carbohydrate alternative with slow release as well as toothfriendly properties.

Palatinose™, a toothfriendly carbohydrate.

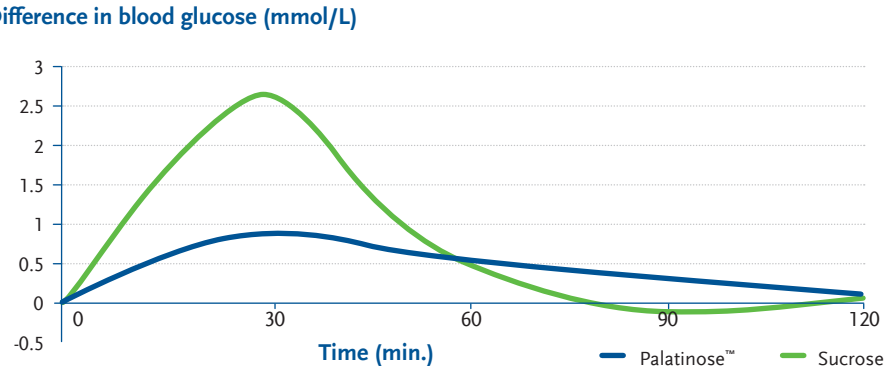
Dental caries is one of the most prevalent diseases in children worldwide.[29] It is linked with the breakdown of sugars and carbohydrates by oral bacteria, whereby resulting acid initiates tooth demineralisation and tooth decay (dental caries). Palatinose™ is not a substrate for oral plaque bacteria and thus, is a carbohydrate that is kind to teeth. This is rather unique for a fully digestible carbohydrate since usually, toothfriendly carbohydrates are not fully digested (e.g. polyols) and do not provide the full energy of 4 kcal/g, needed for the growth of children. The tooth friendliness of Palatinose™ has been confirmed in pH telemetry studies. A corresponding health claim has been accepted in the EU[26] following the publication of a positive EFSA opinion as well as in the USA by the FDA (Food and Drug Administration) and implemented in the Code of Federal Regulations.

Palatinose™ is low glycaemic.

Due to the stronger linkage, Palatinose™ provides benefits to children's foods when used in place of malto-dextrin, glucose or other high glycaemic carbohydrates as it is slowly and fully available, leading to a low and sustained blood glucose response as well as less insulin release.

The low glycaemic properties of Palatinose™ have been experimentally verified in extensive research initiated by BENEO in more than 33 interventions from 19 human intervention studies conducted according to inter-nationally recognised standard methodology in leading test centres worldwide. Over 250 adults (male and female), with mostly normal weight, but also overweight to obese individuals with normal or impaired glucose tolerance as well as type 1 and type 2 diabetes mellitus, were included (see Figure 2).

Figure 2. Blood glucose response to Palatinose™ in comparison to other carbohydrates in healthy adults



The findings from the extensive research in adults have been experimentally verified for children.[28] Using the low glycaemic carbohydrate Palatinose™ instead of traditional medium to high glycaemic carbohydrates can reduce the postprandial blood glucose response of foods.

The potential of Palatinose™ to reduce the glycaemic response of foods when replacing other sugars has been acknowledged by a positive EFSA opinion and corresponding health claim.[26]

Palatinose™ as the better alternative for milk formulas with reference to lactose.

Studies have shown that formula-fed infants have a higher insulin response compared to breastfed babies.[27] It is possible that reducing glycaemia during the first year of life, bringing it closer to that of mother milk, may beneficially influence metabolic programming and lower the risk of future diseases, such as obesity, type 2 diabetes and cardiovascular disease. Therefore, a smart choice of carbohydrates during infancy and childhood matters!

Lactose is recommended as sugar in infant and follow-on formulas, as it is the dominant digestible carbohydrate present in breast milk. The relevance of lactose as a sole source of carbohydrate energy declines from 6 months onwards with complementary feeding and the introduction of foods and other carbohydrates into a baby's diet. Products currently on the market contain mostly a blend of lactose and high glycaemic carbohydrates, like maltodextrin. Here, Palatinose™ is a better "partner" for combinations with lactose.

Beyond the age of breastfeeding, the prevalence of lactose intolerance is global reality and most common with the exception of Northern Europeans.[30] In most ethnicities, enzyme activity to digest lactose declines within the first years of life. Lactose becomes non-digestible, causing digestive discomfort and loose stools. There is a need for lactose-free milk alternatives. Formulas or growing-up milks with low or no lactose are usually using high glycaemic carbohydrates. Palatinose™ is a better "alternative" in lactose-free milk formula resulting in a more balanced blood glucose profile, compared to traditional high glycaemic carbohydrates.

Fuel for active kids, Palatinose™ for sustained energy.

Kids are always active and eager to move, learn and try new things. With the idea to fuel their active life, growth and development, foods for kids are often rich in fast carbohydrates like sugars or maltodextrin. While the young and healthy body still handles blood sugar fluctuations easily, recommendations to reduce fast sugars can also be heard for kids' foods with reference to a healthy diet. Palatinose™ can provide carbohydrate energy to kids in a more balanced way over longer time. It can help to reduce the blood sugar ups and downs, and the active body can be fuelled in a more steady and sustained way, supporting its physical and cognitive activities throughout the day.

Fuel for the brain, Palatinose™ improves cognition and mood.

Glucose is the most important source of energy for the body, especially the brain is dependent on it. This supply of energy is in particular important during infancy and childhood, a time of rapid growth and development. In children, breakfast is of central importance and has an impact on mental performances. Since glucose is the exclusive carbohydrate used by the brain, the rate and duration of glucose delivery is presumed to play a role in cognitive aspects. Therefore, the type and quality of carbohydrates that are consumed matter![31,32]

Palatinose™ is a slowly, yet completely absorbed carbohydrate. Due to this property, Palatinose™ provides energy to the body in a sustained way. A study in 5 to 11 year old school children assessed the effects of Palatinose™ on cognitive function and mood. The Palatinose™ sweetened breakfast resulted in overall better mood and mental performance in the late morning when compared to the high glycaemic breakfast with glucose.[33] This is consistent with the balanced and sustained blood glucose response from Palatinose™.

Conclusion:

Overall, it can be summarised that Palatinose™ is a valuable carbohydrate alternative for children. It is suitable and can be introduced to the children's nutrition from the age of 4 to 6 months, when complementary feeding starts, and provides benefits to children of all ages when used in place of high glycaemic carbohydrates. Providing a better metabolic profile that is closer to that of breastfed infants in early nutrition, it further provides opportunities for healthy food choices for children who strive to do well every day. Palatinose™ is helping to keep teeth healthy by avoiding caries, a very unique property of a fully digestible carbohydrate. In school children, the consumption of Palatinose™ instead of high glycaemic carbohydrates has shown to improve mental performance, particularly memory and mood.

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Want to know more?

We invite you to check out www.beneo.com for more information on chicory root fibres and Palatinose™.
If you have any questions, please contact us at contact@beneo.com.
We will be happy to assist you.

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