Innovation in the beverage and juice sector:

how to add a spoonful of high quality science and technology to a bowl of consumer desires and expectations.

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Introduction.

The consumption of fruits and vegetables has been promoted intensively by national and international cancer institutes and governmental bodies, all over the world, over the last 2 decades. This recommendation is based on epidemiological studies that show a reduced disease risk in individuals that are in the higher range of consumption. There are several reasons why fruits and vegetables have the potential to help reduce risk factors that are related to a number of chronic disease states. The high content of antioxidant compounds, specific types of dietary fibres and carbohydrates and the content of specific bioactive substances (phyto-bioactives) that may impact on metabolic processes related to maintenance and repair of vital cell functions in our organs are important in this respect. Moreover, fruits contain virtually no fat and are very low in sodium The type as well as the content of antioxidants and other bioactive substances is specific for each type of fruit and vegetable.

Modern processing techniques allow the extraction and concentration of bio-actives, making it possible to achieve higher concentrations than normally present traditional juices. The latter development, as well as blending of specific fruits and vegetables, makes it possible to obtain combinations of compounds that potentially may allow targeting specific health concerns. Historically, the first functional foods segment that developed significantly was dairy. The reason was that dairy products fitted well with concepts related to growth and development as well as intestinal health. However, recent consumer research has shown that also fruit juice is perceived as an excellent carrier for health ingredients. Developing functional foods and beverages is more than just mixing ingredients.

There are a number of key-issues that need to be addressed in order to be successful in the market. In order to create a sufficient market-pull, functional drinks should have a proven benefit that is well understandable to the consumer. They should also fit consumer trends and have a significant impact on the mental state of “being well”. Above all they should have a great taste. In this respect, there are a number of critical questions to be dealt with when developing a functional beverage and placing it on the market. For example: does the ingredient have the desired health effect? Is the ingredient safe? Can the ingredient be added to drink or is there a legal or regulatory hurdle in this respect? Is the ingredient stable in the liquid matrix? What is the minimal effective dose required to make a claim. These and other related issues are relatively new to the beverage industry.. Crucial to successful product innovation is getting an appropriate focus on the essentials as early as possible. The present overview will address many of these aspects in more detail below.

Consumer research has shown that fruit juice is perceived as an excellent carrier for health ingredients.

Health has become a main market driver

Over the last decades significant efforts have been made by the food industry to implement knowledge derived from scientific studies showing that certain food components can have either less desired effects, no effect or beneficial effects on selected biomarkers of health. This knowledge has lead to recommendations to avoid what is often referred to as “negatives” and/or

increase “positives” in the daily diet. The food industry reacted with various measures. As an example, the desire to reduce the consumption of saturated fats resulted in using alternative fat sources or using fat substitutes.

Needs to reduce trans fatty acids, sodium, caloric content, etc have recently been discussed intensively and have either lead to exclusion of these compounds, or to the development of alternative, new hydrogenated oils with a low trans-fatty acid content, the use of alternative salts (e.g. potassium-chloride), or the use of low- or non- caloric sweeteners (polyols such as erythritol and maltitol and high intensity sweeteners such as aspartame). The result was the introduction of “Light”, “Low Salt” and “Low Trans” products in the market.

Recently the World Health Organization issued a report, which advises a reduction in the overall consumption of sugars and other rapidly absorbable carbohydrates, along with an increase of daily physical activity. This recommendation was made with the expectation that this may help reduce the dramatic increase in the incidence of obesity, type 2 diabetes and related health care costs. There is currently an international debate on this topic because causal links between sugar consumption (as present in the usual diets) and overweight in humans have never been proven.

In this respect, one of the scientific observations during the last decade has been that type 2 diabetes concerns carbohydrate (CHO) metabolism but is not a CHO related disease in itself. It was observed that the majority of cases of insulin resistance and type 2 diabetes are related to the development of overweight resulting from an imbalance between total daily energy intake and daily energy expenditure.

A high percentage of overweight individuals develop a certain degree of insulin insensitivity, which, in the end may lead to a persistent elevation of blood glucose. The latter is thought to be involved in the development of cardiovascular disease and diabetes related complications. As a result of the increased incidence of obesity and type 2 diabetes and exponentially increased healthcare costs, there is intensified focus on how dietary manipulation can help modify risk factors to develop these disease states.

One of the actions being discussed is modifying the diet by consuming foods that have a reduced content of sugars that rapidly lead to a blood glucose increase. Such sugars are often referred to as low glycemic (Low GI) sugars. Fundamental to these developments are the questions:

1. *do health professionals support the contention that GI is of such importance that food authorities should be advised to adapt food labeling legislation in such a way that GI becomes part of the food information panel on the product packaging? , and*
2. *is labeling possible in a way that the consumer understands what it is all about?*

With respect to the first question there is considerable controversy among scientists.Partly this is caused by confounding factors that surround many studies performed thus far. First of all, epidemiological studies indicate a relationship between consumption of rapidly absorbable, high glycemic carbohydrates and overweight and type 2 diabetes. However, it should be noted that these are **observational data** that do not allow for making conclusion about a cause-result relationship. Similarly, there may be a perfect correlation between getting gray hair and developing osteoporosis but causality requires other data.

Another example is that a range of animal studies has shown that chronic consumption of fructose or sucrose induces weight gain and insulin resistance. However the picture of available human intervention studies is less clear, some showing a positive relationship, some no effect at all and some a negative relationship. This makes it not easy to differentiate for health effects of certain carbohydrates based on GI alone. Although insulin resistance affects carbohydrate metabolism, it is not a carbohydrate consumption disease”. Inherent to this statement is also the

observation that healthy subjects can perfectly regulate their glucose homeostasis despite very high intakes of high glycemic carbohydrates or fructose containing sugars, which is evident from careful performed studies in children, adolescents and elite athletes. Thus, it seems that other factors than carbohydrates and their GI's are required to develop overweight and insulin resistance, especially the effects of a chronic imbalance between daily energy intake and energy expenditure. Thus, although the public perception has been driven towards sugars being a cause of overweight, it should be emphasized that the real cause is related to an unhealthy lifestyle in general. How these developments impact on the beverage industry will be dealt with below.

Functional Foods and Drinks

Other developments were nutraceuticals - food supplements that contain isolated compounds in concentrated form - and functional foods and beverages. The latter are "enriched with compounds that have a beneficial effect on health." Functional foods are defined as "a food or beverage, being part of a normal diet, supporting health benefits beyond normal nutritional value of nutrients and effective in recommended dose for the health benefit concerned" (ILSI, European PASSCLAIM project). The element "beyond normal nutritional value" stands for delivering more than just the energy and nutritional value of the macro- and micronutrients that are normally present in such a food. A few examples to illustrate this point: Calcium is generally known to be important for bone growth and maintenance of bone health. Increased calcium consumption during early years will increase bone density and thereby delay the effects of bone loss (osteoporosis) later in life.

Dairy products are heavily promoted in this respect. Children that dislike drinking milk may have inappropriate calcium intakes and may therefore benefit from the consumption of fruit juice that has been enriched in calcium. Since the nutritional value, in terms of energy, carbohydrate, vitamins, etc, of this juice, compared to regular juice is similar, the addition of calcium introduces a functional effect beyond that. In this respect, the consumer will see 2 juices on the shelf. The one may be more expensive than the other and there may be some questions that come up if the beverages have a different price.

Why the difference in price?
What is the difference in the functionality?
Why calcium? Does this benefit my kid?

Such questions point to a key element of functional foods to be successful in the market. - Has the functional ingredient benefit been well enough understood by the consumer to justify paying more for a product containing that benefit

Health as base of choice

Many factors impact on changing consumer behaviour and food choices. In the area of "healthy foods" it are in particular the health concerns, beliefs and desires, which play a significant role. Actual health concerns are primarily based on the perceived association of the impact of the daily diet on health and disease and the risk of being subject to that. Knowledge about this association is still fragmented, often confusing and subject to continuous change. In the past the diet was primarily seen as the "needs for growth and development"

Today, however, poor diet choices, often in combination with an inactive lifestyle are known to be associated to a variety of chronic diseases, such as obesity, heart disease and diabetes.

This information reaches the consumer primarily by opinion makers in different types of media followed by ""hear-say". In turn, the info that opinion makers spread is based on "what info they have access to" in the medical and nutrition research arena. In other words, an answer to the

key-question “what will be the consumer concerns that will impact on their food and beverage choices in the market of tomorrow” can be found by tracing back the information flow directing the consumer. Since new discoveries in nutritional science are often the beginning of new directions for the consumer, the basic question is: ‘what direction does science take?”

Do you know what will be the consumer concerns that will impact on their food and beverage choices in the market of tomorrow?

Consensus is a key issue

It is known that only in case that the information being spread by various spread the same message, the impact on consumer behaviour and choice will be significant. As an example, if the British Government launches a national information to make clear that Great Britain is the leading country in Europe with respect to mortality from Heart Attacks and the UK health professionals point to the fact that cholesterol lowering is a key-measure to change that, then industrial promotions for food products that, in a proven way, help lower cholesterol will be potentially successful. In other words, a functional food or beverage will only create significant market pull only in the case that the benefits have been widely communicated, **scientifically accepted and understood by the public**.

Do we know what determines risk and success?

When targeting innovation the level of consumer understanding and related communication needs is an issue that should be understood as early as possible. To explain this a bit more, there are a number of ingredients that are well accepted as important to health, for example, vitamin C.

Because of its long history this ingredient has little complexity in the consumers mind. If a product contains it, the acceptation will generally be quick and without too many questions. On the other side of the spectrum, new ingredients have gone to market that the consumer did not know about at all. An example is that of probiotics, defined as living bacteria that are beneficial to the gut flora and to health. The question “ why should I eat bacteria, I thought bacteria are bad for my body?” is in place here. Accordingly, the producers of products that contain probiotics and went to market first had to spent very large budgets to inform consumers about the why’s, how’s and when’s. Such required communication plans will only pay back if the target population that will consume the product is large and the benefit claimed will be accepted. Those who follow later, enter a more mature market with the benefit of less communication needs. Fig 1 visualizes these relationships.

The level of consumer understanding of an ingredient and its potential benefits is an issue that should be known as early as possible in the process of developing new functional foods/drinks.

Proven benefits?

Still a few other prerequisites should fall into place. For example, the scientific substantiation of a health benefit or product benefit claim. What is required in this respect? Do I have a basic understanding of what type of claims there are and what can be claimed, under which approval conditions?

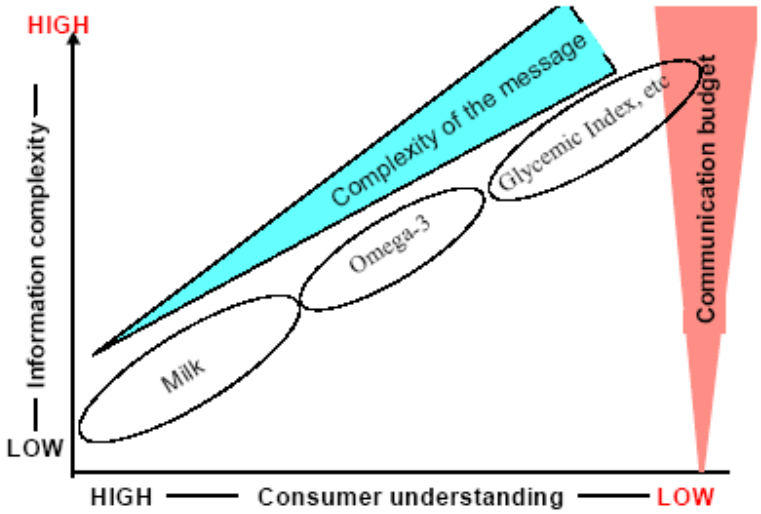

Fig 1: The level of consumer understanding has a crucial impact on "go to market" strategies and related communication budgets

A claim is "any message or representation, (including pictorial, graphic or symbolic), which states, suggests or implies that a food has particular characteristics'. According to current law in the EU this not only applies to what is written on the product itself but also what is suggested in product related information such as consumer leaflets. As example to the latter, the printing of a "red heart" pictorial on a packaging suggests that the product is good for the heart. The printing of a winning athlete suggests that the product improves performance. Are these messages supported by generally accepted evidence?

Misleading claims may end in court!

Depending on the available knowledge and the regulatory environment in the country and/or the region, such messages may be tackled by health professionals, consumer groups or even by your competitor. Costs of reprinting the packaging can be overcome but, when hitting the press, the c company and the brand name will suffer significantly. Three recent examples to put this into perspective: recently, a company is USA, filed a class action lawsuit in California contending that the "low sugar" claim on certain breakfast cereals is misleading because the sugar was replaced with "other carbohydrates" resulting in no significant nutritional benefit.

Another company promoted "Wheat bran, High in fiber. Helps remove toxins that can build up inside" resulting in a public complaint of an unsubstantiated claim. The court ruled that the complaint was upheld in that the evidence provided did not support this claim. A third company promoted a health drink rich in collagen "which can rebuild cartilage lost through arthritis" resulting in a public complaint and ruling to withdraw the claim.

Self regulatory bodies, like the UK-ASA may also create a lot of harm to brand equity/reputation, as they publish their opinion on claims that are not supported/misleading and UK press is keen to give a large audience to such negative opinions.

What types of claims can be made?

The regulation of the European Parliament and Council on nutritional and health claim, which is likely to be adopted and published will allow 3 categories of claims. It organizes the transition through specific mechanisms for each category of claims

1. ***Nutrition Claims***: are permitted only when included in the Annex given by the EU commission. E.g. “Low energy” but, under the conditions described in the Annex e.g., Not more than 40kcal/100g for solid, or, not more than 20kcal/100ml for liquids. Other examples: Contains …mg Calcium. Excellent source of vitamin B. Low in sodium. Etc. However, the prohibition to make other claims than listed will only be fully applicable after 1 year, which will allow the EU institutions to add those claims that have, by lack of time, being unduly disregarded.
2. ***General health claims***: “ health claims describing the role of a nutrient or of another substance in growth, development and the normal functions of the body, which are based on generally accepted scientific data and well understood by the average consumer”. Such claims are only permitted when included in the approved EU List, which shall be established in consultation with the European Food Safety Authority, primarily based on Member states proposals, but can be incremented based on petitions of stakeholders. Claims related children development and health are not eligible to that group and are regulated as other health claims
3. ***Other Health Claims***: apart from claims on health and development of children, these include innovative health claims (i.e. other claims that generally accepted claims), and reduction of disease risk claims (e.g. product x helps lower blood cholesterol). At the end of the transition period, each of these 3 categories of health claims are only permitted for use when explicitly authorised based under the EU Standing Committee procedure, based on the opinion of the European Food Safety Authority.

An example of a reduction of disease risk claim first established in US and later endorsed by European authorities is the one that can be made for soy protein. On May 4, 1998 the US FDA received a petition requesting a health claim on “ soy protein and risk of CHD” resulting in allowing a health claim “ 25g of soy protein a day, as part of a diet low in saturated fat and cholesterol may help reduce the risk of heart disease “ An inclusion of 6.25 g/serving qualifies for making this claim (Nov 10, 1999 / Fed. Reg. Vol.63, 62978 - 62997). In July 2002, the expert committee of the UK Joint Health Claim Initiative expert (a voluntary scheme for evaluation of claims set up by all stakeholders) concluded that the totality of the evidence substantiates the health claim that “ The inclusion of at least 25g soy protein per day as part of a diet low in saturated fat can help reduce blood cholesterol”.

Products carrying this claim must contain a minimum of 5g* of soy protein per serving (the 5 g amount resulting from a later expert committee opinion). This example shows that beverages to which required amounts of soy protein are added can be marketed with a claim related to heart health.

(Foot note: Interesting is that recently, the French expert committee on nutrition (AFSSA) published an opinion that the minimum proven effective was 30 g rather than 25g.Thus depending on the regional panels put in place there may be differences in interpretation of the data)

The totality of the evidence is what counts

Basic to the approval of a health claim is that the level of scientific substantiation is high and generally accepted. It is the totality of the evidence that will determine YES or NO in the approval process. Thus, if only one study is done and the outcome is positive, there is only little evidence. But, when 10 studies have been done and 8 are positive than you start to have a good case!

Accordingly, preparing a petition for a health claim requires significant investment in time and money. Once established and approved, a health claim will attract media attention and create public awareness. Regularly, statements are being made by certain opinion makers who claim to be knowledgeable but in fact are unqualified to make sound statements The latter may pose a problem, in that the consumer cannot separate good science from bad science. Thus, the best scenario is one in which claims are endorsed by both food authorities and health professionals.

It is the **totality of the evidence** that will determine YES or NO in the health claims approval process.

Nutrient profiling

By 2 years after publication of the European regulation on claims, nutrient profiles will be established by the Commission, with the effect that foods that do not meet these profiles will not be eligible to any nutrition or health claims. The Commission has already asked EFSA to provide advice on how to set these nutrient profiles, and EFSA will organise a stakeholder meeting on this issue by the end of the year. As the regulation allows setting up nutrient profiles by food categories, heavy discussions are predictable. The nutrient profiles shall be based on scientific knowledge about diet and nutrition, and their relation to health. According to the regulation, the nutrient profiles for food and/or certain categories of food, shall be established taking into account in particular:

a. the quantities of certain nutrients and other substances contained in the food, such as fat, saturated fatty acids, trans-fatty acids, sugars and salt/sodium;
b. the role and importance of the food (or of categories of foods) and the contribution to the diet of the population in general or, as appropriate, of certain risk groups including children;
c. the overall nutritional composition of the food and the presence of nutrients that have been scientifically recognised as having an effect on health.

An important question in this respect is how the authorities will deal with beverages that are relatively high in intrinsic (fruit) sugars, compared to drinks where sugars have been added.

Food & Drink fit

New product development should include an evaluation of factors that are related to the question: ‘does the ingredient and the benefit that I want to claim through consuming a particular beverage or food, fit with the perception “around” that specific food or beverage of the consumer. As example, carbonated soft drinks are now generally being perceived as “drinks for moderated intake”. Accordingly, it will be a real challenge to turn such drinks into a healthy or functional beverage by simply adding a special ingredient. Thus, because of a poor “food fit” carbonated soft drinks are less recommendable as a carrier for nutrient enrichment. Milk and fruit juice in contrast, have a general perception of being good for health. Thus, milk and fruit juice are a more suitable carriers for functional ingredients. See also later.

Another aspect is the “fit of food” with specific health concerns. For example, market research has shown that consumers do not associate food well with cancer development or prevention of it. If anything, drugs or chemotherapy are being considered as most suitable and effective. Consumers are also difficult to persuade that consuming certain ingredients/foods during many years will help them reduce an uncertain risk to get a disease in maybe 30 or 40 years from now”. Thus, “cancer as communication medium” in food marketing does not work very well. But, terms of “healthy ageing” may! Related to the latter, protein is required for muscle growth and strength. This is globally accepted.

Accordingly, protein rich foods and supplements, to which ingredients are added that further will support muscle growth and repair, form a huge opportunity in the world of sports, fitness and bodybuilding. With recent research showing consistently that the elderly can also have significant adaptations in muscle strength when taking part in appropriate training sessions, this may have a spin off also for foods designed foods for "healthy ageing and vitality" The food -function fit is perfect!

Key- question: "Does the ingredient and the benefit that I want to claim through consuming a particular food or beverage, fit with the perception "around" that food or beverage of the consumer"

Ageing and Healthy Drinks

Diabetes type II is predicted to increase by >200% in the next 20 years, mainly due to the rapid increase in overweight and obesity, known to be closely associated to it Due to an ageing population there will also be a significant increase in prevalence of osteoporosis, joint problems, memory decline, loss of sight, as well as age associated impaired immunity. The elderly has also increased difficulties to chew and digest. Can such problems be reduced by consuming drinks or easy digestible foods that have been enriched with bioactive ingredients to support specific body functions? The ageing population is an enormous market with future potential. All developed countries show an increase in life expectancies. In the current decades the population above 65 years of age will increase significantly while that of below 65 years will be significantly reduced. Predictions by Eurostat indicate that in most European countries in 2030 the 65+ years population will be reaching 22-30% of the total population! Similar predictions are made for the US. Are we prepared to have the right products and communications in place?

Fruit and Vegetable Juice as "a base carrier of healthy ingredients"

The World Health Organisation recommends increasing vegetables and fruits consumption to reduce incidence of certain cancers and heart disease. Health professionals as well as governmental bodies follow this advice by recommending several (depending on the country 3 to 5) portions of fruit and vegetables per day. A rapid increasing body of evidence points to the fact that fruit and vegetable is full of substances which have strong antioxidant as well as anti cancer and inflammation reducing properties. Examples of such antioxidants are polyphenols for example flavonoids, lycopene and vit C. Substances with anticancer properties are for example sulforofane (in cruciferous vegetables.), folate (in green vegetables.) and plant estrogens (e.g. genistein from soy). Fruits and vegetables also contain significant amounts of fibers such as pectins (apple and citrus) that are known to lead to production of beneficial short chain fatty acids in the intestine.

Thus, juices from fruit and vegetable have a perfect link to a general understanding of being healthy. One aspect should be taken into consideration: many of the health substances in fruits are present in or just under the peel. Studies addressing the bioactives content of apple pomace, the left over after juice pressing, have shown that the content of polyphenols is very high. Accordingly, processing of apple pomace into extracts that can be used in beverages or in food has proven to be feasible. Moreover, some types of fruits such as cranberries, and blackcurrant are very high in specific bioactive substances that can help reduce urinary tract infections and blue berries are known to contain very high levels of antioxidants. This opens the door to ***enrich*** a beverage selectively by blending it with other juices or their extracts.

Juice as a healthy alternative to dairy

Many people do not like to consume milk products for various reasons. Adding fruit flavours and "juice base" to dairy products has changed this significantly. Fruity yoghurt drinks became a

booming market. Consumer research showed that fruit juices are the second choice, after dairy, to deliver healthy ingredients. Thus, general consumer perception indicates that juice is also a perfect carrier for nutrient enrichment. In line with this recognition, applications have recently been introduced in the market in different regions of the globe. For example juice based drinks with added pre- and probiotics for gut health or calcium and magnesium for bone health (global), added glucosamine for joint health and phytosterols or betaglucan for heart healt (USA). Also other bioactives, targeting to support the immune system, body relaxation and mental performance are increasingly being promoted for use in functional beverages. A number of compelling combinations pop up in this respect: juice based-dairy, juice based-soy-dairy, Juice enriched with peel extracts, juice-vegetable, etc. A careful check concerning what is regulatory allowed in the country of “Go to Market”, is of significant importance in this respect.

Successful innovation and NPD is “adding cross fertilizing good science and technology with knowledge of consumer desires and expectations, resulting in “a taste” that everyone, including our food authorities like.

New Juice based soft drinks and waters

Increased health concerns related to a high prevalence of overweight in young children and the knowledge that even a low level of overweight can contribute to type 2 diabetes and cardiovascular disease, has impacted significantly on the beverage industry. Single dose studies showed that sugars in solution trigger the satiation system in the body less compared to sugar in solid meals and foods. Despite the fact that sugar consumption in healthy, non-overweight individuals was not shown to be harmful in this respect and that very recent research indicated that, when studied over a longer period of time, the consumption of added sugars in drinks lead to a level of compensation similar to that of solid food, the public perception and reaction was significant and resulted in a market pull for sugar reduced beverages.

In line with this development, the beverage industry has reacted in various positive ways:

1. The reduction of sugar content and the use of intense sweeteners to compensate for the related loss of sweetness.
2. Increased use of fruit juice or fruit flavours in combination with mineral waters also resulting in a reduced sugar content.
3. The use of innovative alternative sugar types that have a slow rate of digestion, leading to a blunted blood glucose and insulin response.

The latter are known to positively impact on suppressing feelings of hunger and on use of fat as a fuel. Isomaltulose (Xtend Isomaltulose, Cargill) is an example of such a sweetener. It contains glucose and fructose, just as table sugar, but is digested much more slowly resulting in a lower blood glucose response (see fig 2). It has a taste like sugar but a sweetness that is only half of that. Isomaltulose is tooth friendly because it cannot be fermented by bacteria in the mouth. Accordingly, isomaltulose will be a perfect sugar substitute for drinks to be consumed by children and overweight individuals. The low insulin response makes it also very attractive to use in fitness and sport drinks. Because of these new findings Xtend -Isomaltulose received the golden award for innovation in health ingredients at the recent international “Hi”exhibition, Nov 2006 in Frankfurt.

Isomaltulose elicits a blunted blood glucose/insulin response in healthy and in diabetic individuals

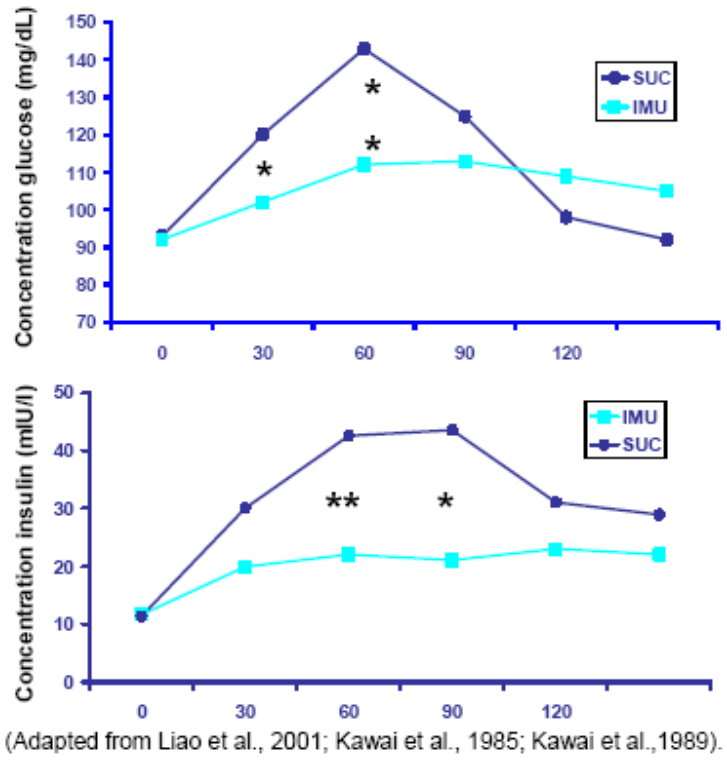

Fig 2. Blood glucose response after consumption of isomaltulose compared to sucrose. The data show the very low glycemic in insulinemic response of isomaltulose. (Modified form Liao et al., 2001; Kawai et al., 1985; Kawai et al.,1989)

Concluding remarks:

Typical formulation challenges for functional beverages include stability, taste, cost, and scale up to commercial processes. The extent of the challenge will vary dependent on the type of the beverage and its intended package and shelf life. In some cases an ingredient may need a hydrocolloid stabilizer such as a pectin or carrageenan. In other cases some flavour innovation may be needed to improve the taste and acceptability. Some ingredients are “lipid like” and rather difficult to incorporated a watery matrix.

Other bioactive components may affect taste and flavour or colour in undesirable ways. A clear regulatory understanding can help prevent a lot of lost time. This points to the fact that Innovation and new product Development (NPD) in the beverage industry is more than just mixing ingredients! What is needed is a careful evaluation of all factors that impact on the process of initial development ideas until the finalisation of “go to market” by a successful product launch. The Market for beverages with a functional ingredient is developing rapidly and globally. In this respect, fruit juices are being perceived by the public as optimal carriers for health ingredients. The high content of bioactive components in specific fruits and vegetables allows for many blending and enrichment opportunities. NPD in the area of functional foods requires Consumer, Nutrition & Health, Regulatory and Technological Expertise “in one Basket”.

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Acknowledgement:

Thanks to Cargill Flavouring Solutions- Aukje van Kooij and Myriam van Veldhuizen (Juice & Beverage Team Amsterdam) and John Sweeney (Beverage Team Minneapolis) for their most helpful inputs and suggestions.

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Cargill Flavor Systems has access to a team of beverage professionals that can help you with all phases of NPD, from market definition and trend research to ingredient sourcing, blending, taste improvement as well as health claim or consumer benefit substantiation.