

**Flavour Horizons** is a new quarterly, bulletin providing expert interpretation and analysis of flavour technologies and regulatory issues for senior managers, technologists and innovators in the food, beverage and flavour industries.

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## *Flavour precursors and Schrödinger's cat*

The new flavourings regulation (1334/2008) which came into force last year gave birth to a completely new category of flavourings - 'flavour precursors'. These flavourings are individual components or mixtures that when added to a food product, generate flavour by reaction either with themselves or components of the food matrix or both as the food is being processed. Their literal definition in 1334/2008 is:

'Flavour precursor' shall mean a product, not necessarily having flavouring properties itself, intentionally added to food for the sole purpose of producing flavour by breaking down or reacting with other components during food processing.



Schrödinger's cat or so it is said,  
Sits in its box both alive and dead.  
A quantum mechanical sleight of hand,  
A superposition from electron land.

Flavouring substances in eigenstates,  
In one they're natural, in the other they ain't.  
EU directives with confusing articles,  
Are more like waves and quantum particles.

Quantum mechanical legislation,  
Misleads consumers and creates frustration.  
It should be easy to understand,  
But this is EU Higgs boson land.

This all seems very reasonable until we consider their status. The only flavourings that can receive the 'blue ribbon' status of natural are flavouring substances that meet certain criteria and flavouring preparations. Consequently, flavour precursors cannot be 'natural' and in this respect may be regarded as 'second class' flavourings, inferior to their natural counterparts. And this is where the difficulties arise.

## Flavour precursors and Schrödinger's cat

If we take, for example, the amino acid glycine, which is a flavouring substance included in the impending 'Union List' with a Flavis number 17.034 and a FEMA number 3287, and manufacture it to satisfy all the requirements to make it 'EU natural', i.e. derived from natural source materials and manufactured by methods and conditions that satisfy traditional food preparation processes laid out in Annex II of 1334/2008, then it is natural. However, if it is added to a food that is going to be processed in some way that will cause the glycine to react, it is no longer a flavouring substance but a flavour precursor and it loses its natural status.

Surely if a flavouring compound is natural, then this is a property of that material, analogous to its melting point, refractive index, etc, and it cannot be arbitrarily removed. The breakdown products from this natural glycine are also

going to be natural because the carbon, nitrogen, oxygen and hydrogen atoms making up the glycine molecule are all derived from natural sources and are inherently natural. It reminds one of the Schrödinger's cat conundrum where quantum mechanical objects can occupy a superposition of states simultaneously and in one state an electron will shatter the poison vial and the cat in the box will be dead and in the other state the electron will not shatter the vial and the cat will be alive. The glycine in this case is like a quantum mechanical object occupying a superposition of states where it is both natural and un-natural depending upon where it is located - in a food to be heated or in a food that will not be heated.

This is all very confusing and is essentially doing what the regulation 1334/2008 purports not to do - it misleads the consumer. Quoting from Recital 7 of 1334/2008:

'Flavourings should, in particular, not be used in a way as to mislead the consumer about issues related to, amongst other things, the nature, freshness, quality of ingredients used, the naturalness of a product or of the production process, or the nutritional quality of the product'.

It doesn't really make sense that flavour precursors cannot be natural and likewise this also applies to thermal process flavours that in essence are flavour precursors that have been thermally processed prior to addition to a food product.

## Does Kerry lead the flavour market?

The recent purchase of Cargill Flavor Systems for €168m is another step in the relentless acquisition strategy Kerry Group has been pursuing since the late 1980s. Cargill is the latest in a series of 81 acquisitions made by Kerry since 1988. Cargill's strengths in beverage and dairy applications and cheese-based savoury flavours are a natural, complementary fit with Kerry's dairy, flavour and ingredients businesses. Cargill also brings technical strengths in taste modification, where it possesses patented technology for taste tissue imaging that claims to allow the measurement of the response

of taste cells (in a section of taste bud) to taste stimulants, enhancers and blockers. In addition the acquisition brings enhanced access to markets in North America, Brazil, Eastern Europe, South Africa and Asia. The strategy of acquiring businesses with high profit margins that bring complementary products as well as innovative technology and access to new markets has allowed Kerry to expand at a dramatic rate to take a leading position in the flavour and ingredients market. The acquisitions have provided the infrastructure, including distribution routes, R&D and

technology, to support the rapid growth of the business. Since Kerry Group commissioned its first dairy and ingredients plant in Listowel, Ireland in 1972, it has had a meteoric rise to become one of the world's largest manufacturers of ingredients and flavours. Kerry currently has manufacturing facilities in 23 countries supplying over 15,000 foods, food ingredients and flavourings to customers in more than 140 countries worldwide. It sees itself as a trail blazer leading the development of 'Customised Ingredient & Flavour Systems' that speed product development and reduce manufacturing investment.

## Does Kerry lead the flavour market?

Another area where Kerry has been adding value is in the meat sector by identifying functional benefits of ingredients over and above the prime flavour or initial functional requirement (described as Synergistic Formulation Technology).

Despite sales in Kerry's Ingredients and Flavour business being in excess of €3.7b in 2010 (a 6.6% increase on 2009), the company does not appear in Leffingwell's Top 10 '2006 - 2010 Flavor & Fragrance Industry

Leaders'. Givaudan, ranked number one in the Leffingwell list, had total sales of \$4.5b in 2010, significantly less than those of Kerry's Ingredients and Flavour business. This may reflect the fact that Kerry combines its flavour business with other ingredients, such as seasonings, coatings, proteins and yeast extracts, rather than fragrances, making the positioning of Kerry Ingredients and Flavours in the Top 10 'Flavor & Fragrance Industry Leaders' a difficult proposition.

Kerry's forward strategy for success in Ingredients & Flavours

is to continue investment in market-focused innovation as well as brands and marketing, to expand its geographic market base, to develop customer-specific solutions and alliances, to drive efficiencies and to continue to purchase value-enhancing, bolt-on acquisitions. Kerry anticipated spending up to €1.5 billion on acquisitions in 2011. The business will specifically target the flavourings sector and emerging markets. This approach has led to considerable success in the past and is likely to continue to do so.

### Key Sources

<http://www.ingredientsnetwork.com/story/full/kerry-acquires-cargill-s-flavour-business>

[http://www.leffingwell.com/top\\_10.htm](http://www.leffingwell.com/top_10.htm)

<http://www.kerrygroup.com/pdf/CAGE%20Conference%20March%202011.pdf>

<http://www.farmersjournal.ie/site/farming-Kerry-Group-s-profits-surge-by-11-to-470m-euro-12628.html>

<http://www.ausfoodnews.com.au/2011/03/31/kerry-group-hints-at-acquisition-plans-for-2011.html>

<http://www.thepigsite.com/processing/news/14981/latest-developments-at-57th-icomst>

## Stevia: the market opportunities



Stevia is a new, natural sweetener derived from the leaves of the plant *Stevia rebaudiana*, a member of the sunflower family. It has been approved in Japan, Russia, Australia, New Zealand and Brazil, while in the US it is generally recognised as safe (GRAS) in food and beverages. It gained an official EU-wide approval in December 2011 and current estimates indicate that already around 150 million people around the world consume stevia in food or beverage products every day.

### Why such an interest?

The recent engagement with stevia has occurred because it is the first natural, high potency, calorie-free sweetener to be generally available in a world of otherwise chemical sweeteners. Stevia's key properties are:

- Natural sweetener
- No nutritional value in the formulation
- Process stable: temperature, pH 3 - 8, light-stability
- Non-fermentable
- Does not affect blood insulin & sugar levels
- Anti-cariogenic

This may sound too good to be true, however, stevia application does have some limitations, namely those of taste acceptability. Whilst having a better sweetness profile than most other natural sweeteners, the sweet glycoside compounds in stevia extracts have a characteristic harsh back taste and bitterness which limits its acceptability as a sweetener.

## Stevia: the market opportunities

The EU legislation defines maximum use levels for stevia extracts in various food categories. It tells us what is permitted but it sheds little light on the opportunities in the market place.

Category	Maximum Level of steviol equivalents (mg/l or mg/kg)	Restrictions
Flavoured fermented milk products	100	Only energy reduced products or with no added sugar
Flavoured drinks	80	Only energy reduced products or with no added sugar
Fruit nectars and vegetable nectars	100	Only energy reduced products or with no added sugar
Table top sweeteners	Q.S.	

In fact, stevia sweeteners are self-limiting in the majority of applications as, particularly approaching and at 6% sucrose equivalence the bitterness associated with the glycoside moieties blocks any greater sweetness even at increased concentrations. The reality is that taste acceptability will be the

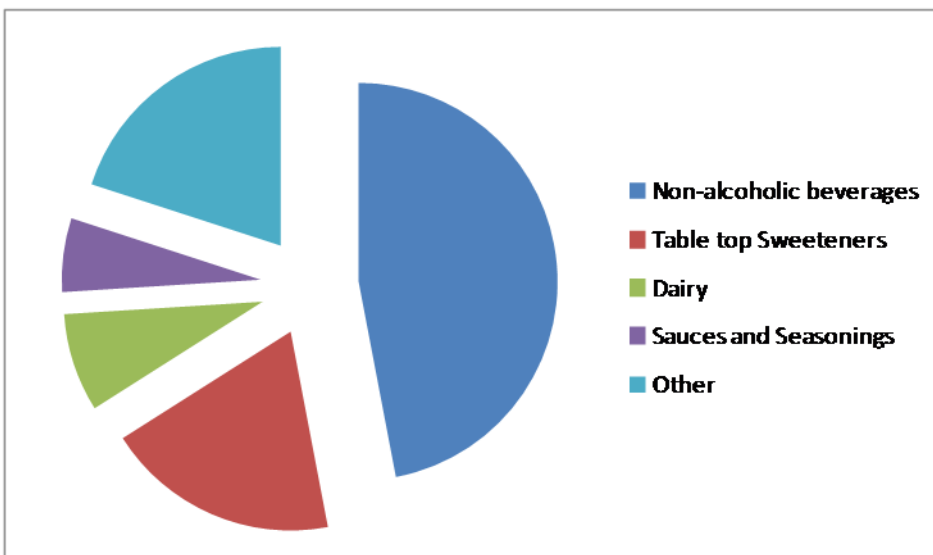
limiting factor associated with stevia opportunities. Whilst consumers are actively seeking reduced calorie foods and beverages to manage their weight, taste remains the overriding factor in consumer preference. With approval for stevia sweeteners having been granted in the USA in 2008, and with

France taking a leap of faith by adopting the approval legislation in 2009, it is possible to look at the inroads made in these markets and take a view on how the ideas and practical limitations will translate into the rest of Europe.

### Global product launches since 2007

If we remove snacks, which are exclusively a Japanese market peculiarity, we can see that, as would be expected with any new high potency sweetener, it is beverages and table top categories that have dominated new product launches involving stevia. Dairy applications follow as the next most dynamic market.

### Global product launches (excluding snacks) since 2008



## Stevia: the market opportunities

### Non-alcoholic beverages: fruit juices

One of the main beverage sectors to leverage the benefits of stevia is juice drinks. Here, as natural fruit sugars contribute a significant level of sweetness, stevia tops up the sweetness to enable a 'No added sugar' or 'Lower Sugar' claim. This is not possible in the main beverage categories which rely totally on added sweeteners for their palatability and therefore would have to use a combination of sugars and stevia to achieve acceptable sweetness intensity whilst maintaining the 'naturally sweetened' position.



In the USA PepsiCo has launched a new stevia-sweetened product, Trop50, in its Tropicana range, which has achieved \$71m sales in its 1st year.

In France, the message is also that stevia has found early application in reduced sugar, not sugar free or reduced calorie, beverages.

September 2010

February 2011



### Other beverages

Stevia was launched in the USA in 2008 and by 2010 had achieved a 27% penetration of the diet soft drinks market. The principal players in the beverage market have all been focused on determining just where the openings are.



In the US, Coca Cola has extended its regular Vitaminwater 10 range (launched 2009) by creating Vitaminwater Zero. Sweetened with stevia, sales of this new offering have overtaken the regular range. Average weekly sales are currently \$2.1m and total sales in the 1st year were \$110m. This represents a 2.4% share of the US functional water market.



Unilever in the US introduced a Lipton 100% natural iced tea in citrus, pomegranate, blueberry, and passionfruit mango varieties in 2011. The products are made with ingredients derived from natural sources with no preservatives, artificial colours or flavours. They are sweetened with sugar and stevia and contain 50 kcal per serving. Unilever has achieved \$12m sales in 32 weeks since the launch.

### Table top

Stevia in table top sweeteners has revitalised this category in France. A year after approval, stevia grew the normally sluggish table sweeteners market by a record 22%. Whole Earth's Pure Via brand achieved sales of €6.2m in the first year; average weekly sales of €133,000 and 90% distribution were achieved.

Evidence indicates that growth is from new users, rather than from consumers substituting stevia products for those containing other sweeteners. In the UK market shelves have become overwhelmed with a choice of 'green' sweeteners and it will be interesting to follow the survival rate.

## A smoking gun

Mankind has been smoking foods for thousands of years to preserve perishable products such as meat, fish and cheese. Smoking foods changes their colour and flavour character yielding palatable, appealing, nutritious but potentially harmful food products. The first record of the production of a liquid smoke was in Kansas City in the 1880's but it wasn't until the middle of the last century that the technology developed and smoke flavours obtained by fractionation and purification of condensed smoke became popular. Smoke flavourings in the European Union (EU) are governed by two pieces of legislation. Regulation 2065/2003 establishes a procedure for the safety assessment and authorisation of smoke condensates and regulation 1334/2008 lays down the labelling requirements for smoke flavourings among other things. Over the past few years the European Food Safety Authority (EFSA) has been evaluating smoke flavourings used in the EU from dossiers submitted by smoke flavour manufacturers to establish a list of primary smoke condensates and primary tar fractions, the use of which will be authorised to the exclusion of all others - a positive list of smoke flavours. Additionally, the application and use levels of these smoke flavourings will also be authorised. Manufacturers were required to provide detailed information on the composition, the production method, toxicological studies, analytical data and intended uses and use levels. The reason for all the fuss was that in December 2002 the Scientific Committee on Food



concluded that polycyclic aromatic hydrocarbons (PAHs) in smoke and hence smoked foods and smoke flavourings are genotoxic carcinogens. They are of course the same compounds that cause lung cancer in smokers and epidemiological evidence has linked them to the incidence of liver cancer in countries where smoked foods are consumed in significant quantities. So it is not surprising that there should be surveillance and adequate controls over the use of smoke flavourings and tighter controls governing smoked food products. In January 2010 EFSA completed its evaluation of 11 smoke flavourings from a starting point of 16 and published use and

application levels for 10 of them. Further submissions were made by two companies and EFSA reviewed and revised their evaluations for these two manufacturers. The results of these evaluations are shown in the table. NOAEL is the 'no observed adverse effect level' and reflects the highest intake level at which each product was shown not to cause adverse health effects in animals. The margin of safety is the ratio between the NOAEL and the anticipated dietary exposure of consumers. The two results in the margin of safety column come from two separate models of dietary exposure. The margins of safety were considered for 18 food categories.

SMOKE PRODUCT	NOAEL mg/kg/bw/day	MARGIN OF SAFETY (upper use levels)	COMPANY	COUNTRY	EFSA OPINION
Tradismoke A Max	1000	30 and 61	Sofral S.A,	France	Safety concern for proposed uses and use levels
Scansmoke R909	1250	100 and 160	ProFagus GmbH	Germany	Safety concern for proposed uses and use levels
Scansmoke PB 1110	700	23 and 32	Broste A/S	Denmark	Safety concern for proposed uses and use levels
Scansmoke SEF 7525	210	350 and 1050	Broste A/S	Denmark	No safety concern for proposed uses and use levels
SmokeEz C-10	300	9 and 14	Red Arrow Products	Germany/ USA	Safety concern for proposed uses and use levels
SmokeEz Enviro 23	300	9 and 14	Red Arrow Products	Germany/ USA	Safety concern for proposed uses and use levels
Fumokomp	400	2000 and 3077	Kompozicio KFT	Hungary	No safety concern for proposed uses and use levels
Unismoke	300	14 and 24	Unilever Foods	UK/The Netherlands	Safety concern for proposed uses and use levels
Zesti Smoke Code 10	664	77and 99	Mastertaste	United Kingdom	Safety concern for proposed uses and use levels
AM 01	250	16 and 19	Aromarco s.r.o.	Slovak Republik	Safety concern for proposed uses and use levels
Smoke Concentrate 809045	1000	2000 and 3400	Symrise GmbH & Co.	Symrise GmbH & Co.	No safety concern for proposed uses and use levels

Three smoke flavourings emerged from this study with no safety concern for the proposed uses and use levels submitted to EFSA. For the remainder there are safety concerns of different magnitudes based on the calculated margins of safety using two human exposure models. We now await the outcome of further deliberations to determine the use and application levels for the two smoke flavours where additional data was submitted. When this has been published the legislation can be enacted and the positive list of smoke flavourings implemented.

This work raises some important questions. Flavourists working with smoke flavours are tasting them at levels which are much higher than the levels at which they are eventually being used in food products. If there are safety concerns for the use of some of these smoke flavours at the upper levels of application in food products, then there must be even greater concerns for the health of flavourists developing products

based on these smoke flavourings. Their exposure levels are likely to be significantly higher than the upper levels applied to food products and companies need to take cognisance of this and apply the necessary risk assessments. Another concern relates to the exposure of consumers from smoked foods themselves. One of the reasons given for permitting the use of smoke flavourings in the EU is because it was felt that by using smoke flavourings consumers were exposed to lower levels of PAHs than from traditionally smoked food products and it would be easier to regulate these flavours though a positive list. However the EFSA evaluations concluded that there is cause for concern for the majority of smoke flavourings on the list. So where does this leave smoked foods? EFSA published a major piece of work on PAHs in food in June 2008 and one of their conclusions was that for high level consumers of smoked foods there are potential health concerns and a possible need for risk

management action. PAHs in food in the EU are regulated through 208/2005 which sets out maximum levels for PAHs in a range of foods and even though there have been a number of surveys of PAHs in food categories, little seems to have been done to implement this regulation for smoked consumer products. On one side we have a tightly controlled positive list for smoke flavourings and on the other anyone can place smoked food products on the market with undetermined levels of PAHs. Clearly there is not a level playing field.

The smoking gun is the increasing awareness of the public health issues associated with PAHs in the food supply and their potential to cause human disease. The Holy Grail must be to reduce the level of PAHs in food products and for the flavour industry to develop smoke flavourings that contain no PAHs and replicate the authenticity and desirable character of condensed smokes such as mesquite, hickory and oak.

## 25 years of ingredient innovation

The Fi Europe food exhibition was first launched in 1986, when there were only 20 exhibitors. FiE Paris in November 2011 attracted 1000 exhibitors and after viewing their wares, **Flavour Horizons** took time to reflect on changes that have occurred in ingredient use, availability and perception during the last 25 years. The tables below summarise the result.

Ingredient portfolios		
	1986	2011
Antioxidants	BHA, BHT	Rosemary, tocopherols
Colours	Bright and stable Azo dyes.	Naturally derived colours across the spectrum now the recognised standard.
Dairy	Whey protein powders and caesinates	Fractionated dairy proteins for sports performance, blood pressure, sleep and relaxation.
Fibre	Cellulosic or viscous	Wealth of options. Depending on level required and on the product these can be 'invisible' to the sensory acceptability.
Fruits	Berries	Açaí, Cloudberry, Noni and Sea buckthorn
Functional Ingredients	Hydrocolloids!	Ingredients with proven impact on cholesterol, blood pressure, cognitive function, gut health, satiety.....
Low-Calorie sweetness: Chemical HIS	Aspartame, Acesulfame K and saccharin	Aspartame holds its market with the additional choice from sucralose, neotame and others
Low-Calorie sweetness: Natural HIS	Thaumatococcus	Stevia creates opportunities in this category for the first time.
Prebiotics	What?	Inulin, FOS, GOS and others
Starch	Chemically modified for specific functionalities	Physically modified native starches with 'natural' label declarations
Salt reduction	Potassium chloride	Yeast extracts, natural flavours, and nanotechnology.
Vitamins And minerals	Synthesised with no regard for derivation. From rocks	Naturally derived and source all important for open dialogue with consumers. From algae and herb concentrates

Flavour progression			
	1986	2011	
Flavours	Nature identical desirable	Naturals and extracts define the standard. Now process stable, natural flavours exist for most categories of flavour.	
Oriental cuisine	Chinese	Cantonese Malaysian	Szechuan Thai
Indian cuisine	Indian	Bihari Goan Kerala	Kashmiri Gujarati Punjabi
Chicken Flavour types	Chicken	Chicken stock Chicken soup Chicken bouillon Grilled chicken	Fried chicken Boiled chicken Roasted chicken
Tea Flavour types	Darjeeling Earl Grey	Green Honeybush Osmanthus White Dragon Well (Long Jing)	Silver Needle Oolong Rooibos Yerba mate
Fruit Flavour types	Fruits of the Forest Elderflower	Star fruit Lotus blossom Mexican lime Italian Mandarina rosso	Mirabelle Pomegranate



## 25 years of ingredient innovation

Consumer affluence, aspirations and demographics have all changed these ingredient dynamics. We have determined the top five trends as follows:

### Pure and natural

Clean label continues to rule and push the boundaries of natural manipulations of materials. Consumers demand a minimalist ingredient declaration of 'store cupboard' ingredients. Pure and green have recently taken a strong position as 'natural' becomes a more hazy position from a regulatory perspective. Ingredient manipulations demonstrate a move away from overt chemistry to that designed to extract the maximum from nature.

### Shifting demographics

European population is shifting to an older average age with greater affluence amongst those elderly people. Products are being designed to meet the specific needs of the over 50s.



### Provenance and sustainability

Out of nowhere corporate, social and ethical positioning has become a front line issue. Locally sourced adds value as does known provenance. Corporate positions on Fair Trade are high profile and seasonality is regaining relevance.

### Health and wellbeing

Forty is the new 20 and all that. We understand more about what we need to stay fit through our middle years. Products focus on prevention of onset of some conditions such as brain, eye, bone and gut diseases to assist healthy aging.

### Scientifically proven

Research is helping to underpin suggested function with supportive clinical data and regulators are demanding this before claims can be made.

Scientific understanding of a healthy diet and the health implications of a non-healthy one are also driving reformulation of traditional foods. Trends include sodium reduction and trans fat removal.

## Japan leads the field on flavour patents in 2011

A **Flavour Horizons** study of food and beverage flavour-related patents published in 2011 has revealed that Japanese food, beverage and flavour companies are leading the field in the protection of flavour-related inventions. The bar chart below gives an overview of patenting activity (defined by the publication of three or more patents) in the flavour field among leading food, beverage and flavour companies in 2011.

Japan dominates the field with fifteen food and beverage companies publishing three or more patents (a total of 241 patents) during 2011. In the USA, three or more patents were published by eight companies (a total of 91), in Europe by seven companies (a total of 95) and in China by seven companies (a total of 50).

Worldwide, five companies (Givaudan, Nestec, Ajinomoto, Kao Corp and Suntory Holdings) each published more than 20 flavour-related patents in 2011, indicating that innovation and research and development continue to be key drivers for these organisations. The focus of Givaudan's patent activity has been the protection of novel flavour (and fragrance) compounds, including umami flavouring agents and umami flavour enhancers, as well as methods for flavour modulation. Nestec has focused on methods for

preparing new flavour compositions for food products and dairy beverages. Ajinomoto's patents principally concern flavour compositions for particular foods and include flavour enriching and improving agents. Suntory Holdings has patented a range of novel beverage products with improved taste or flavour, while Kao Corp has been active in novel

seasonings and new beverages as well as novel fat compositions for deep fried foods.

Future editions of **Flavour Horizons** will be looking at some of these patents in detail, assessing the level of innovation and giving straight forward explanations of the claims.

### Food and beverage flavour related patents published in 2011

