Flavour Horizons

Flavour Horizons is a 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.

in this issue:

Issue 6 Summer 2013

Deadlines for EU Flavour Legislation

by Dave Baines

The Union List

The clock is ticking for submissions for inclusion in the new Union List of flavourings and source materials. The Union List will contain five categories of flavourings and a list of source materials; a variety of transitional periods apply which are explained below. The completed Union List for flavourings and source materials is scheduled for full implementation on **22 October 2016**, which is not very far away.

1) Part A: Flavouring substances.

This came into effect on **22 April 2013**. All restrictive, positive lists operating in the EU will be repealed by this date - applies only to Italy and Germany. The list will be fully implemented from the application date of **22 October 2014** when the 18 month transitional period has ended. From this date only flavouring substances in Part A of the Union List can be used in and on foods to the exclusion of all others. Additional requirements such as purity criteria, restrictions of use, etc., have to be met by this date. From a total list of 2543 flavouring substances, 397 have yet to be evaluated by the European Food Safety Authority (EFSA).

Part B: Flavouring preparations.

This lists the flavouring preparations made from source materials other than food [Regulation 1334/2008, Article 3 (2)(d)(ii)]. It does not apply to flavouring preparations made from food; these do not have to be submitted for inclusion on the list and are deemed to be safe. Submissions for inclusion on the list must be made by **22 October 2015**.

2) Part C: Thermal process flavourings.

This lists the thermal process flavourings made from source materials other than food [Regulation 1334/2008, Article 3 (2)(e)(ii)]. It also applies to thermal process flavourings made outside the specified conditions of production listed in Annex V or those that contain dangerous substances at levels above those specified in Annex V (see below). Thermal process flavourings made from food source materials do not have to be submitted and are considered to be safe. Submissions for inclusion on this list must be made by **22 October 2015**.

3) Part D: Flavour precursors.

This lists the flavour precursors made from source materials other than food [Regulation 1334/2008, Article 3(2)(g)(ii)]. Flavour precursors made from food source materials do not have to be submitted and are considered to be safe. Submissions must be made by **22 October 2015**.

4) Part E: Other flavourings.

All flavourings falling into this category have to be evaluated by EFSA, approved and listed. Submissions must be made by **22 October 2015**.

5) Part F: Source Materials.

This will be a list of all 'source materials other than food' referred to in Article 3(2)(j)(ii) used for the preparation of flavourings. Submissions to this list must be made by **22 October 2015**. It is important to understand what constitutes 'food' and therefore what qualifies as 'source materials other than food' and this is explored in the following section.

Deadlines for EU Flavour Legislation

22 October 2016 is the application date for the Union List Parts B to F. From this date only those flavourings and source materials that are included in the Union List Parts B to F can be used in or on foods to the exclusion of all others.

The final deadline relating to the Union List involves food products. Foods containing flavourings and source materials which are lawfully placed on the market or labelled prior to 22nd April 2018 but which do not comply with Parts B to F of the Union List may be marketed until their date of minimum durability or use by date.

	2 October 2012	22 October 2012	2 April 2013	22 October 2014	22 October 2015	22 October 2016	22 April 2018
PART A: FLAVOURING SUBSTANCES	Publication	Entry into force	Application	End of transitional period	-	-	-
PART B: FLAVOURING PREPARATIONS	Publication	Entry into force	-	-	End of time window for submissions	Application	End of transitional period
PART C: THERMAL PROCESS FLAVOURINGS	Publication	Entry into force	-	-	End of time window for Submissions	Application	End of transitional Period
PART D: FLAVOUR PRECURSORS	Publication	Entry into force	-	-	End of time window for Submissions	Application	End of transitional Period
PART E: OTHER FLAVOURINGS	Publication	Entry into force	-	-	End of time window for Submissions	Application	End of transitional Period
PART F: SOURCE MATERIALS	Publication	Entry into force	-	-	End of time window for submissions	Application	End of transitional period

What Constitutes 'Food'?

It is important to understand what the definition of food is in order to determine what qualifies as 'material other than food' to avoid what could be a very expensive dossier submission for evaluation and approval by EFSA.

What constitutes food as far as flavourings are concerned is laid out in 1334/2008 Article 3(3) which states:

'…..source materials for which hitherto there is significant evidence of use for the production of flavourings shall be considered as food for the purpose of this Regulation'.

It is further clarified in Whereas 16 in the preamble at the start of the Regulation which states:

'Regulation (EC) No 178/2002 defines food as any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be, ingested by humans. Materials of vegetable, animal or microbiological origin, for which it can be sufficiently demonstrated that they have hitherto been used for the production of flavourings, are considered to be food materials for this purpose, even though some of these source materials, such as rose wood and strawberry leaves, may not have been used for food as such. They do not need to be evaluated'.

The weasel words are 'significant evidence' and 'sufficiently demonstrated'. It is important to have records of source materials that have been used for the production of flavourings and to be able to present such a list if challenged. It is uncertain how this will be progressed but moves are afoot in the European Flavours Association (EFFA) to compile a list from sources previously published by for example, the Council of Europe, FEMA GRAS, the International Organisation of the Flavour Industry (IOFI) and the old but comprehensive Miltitzer Berichte list produced by Schimmel & Co circa 150 years ago.

Minerals are not included in Whereas 16 above which suggests that it may be necessary to submit flavourings that use a mineral as a source material. Minerals are permitted source materials for flavourings as defined in Article 3(2)(j) which states:

(j) 'source material' shall mean material of vegetable, animal, microbiological or mineral origin from which flavourings or food ingredients with flavouring properties are produced: it may be (i) food or (ii) source material other than food.

The absence of minerals in Whereas 16 would suggest that they fall into the category of 'source materials other than food' and flavourings produced incorporating minerals and minerals themselves used as source materials should be submitted for evaluation and approval by EFSA.

Salt is used as a bulking agent and a taste component in thermal process flavourings. It is a table condiment, a component of most seasonings, a preservative and it is nutritionally necessary for cellular sodium balance; we have a specific taste receptor that selects for this mineral. So on balance most reasonable people would classify salt as food. However, other minerals listed in the IOFI Guidelines for the Production of Thermal Process Flavourings for which there is 'significant evidence' of their use for the production of flavourings are on more dubious grounds. These are sodium, potassium and ammonium sulphides and polysulphides; their status as minerals is well founded but using these as sources of sulphur in thermal process flavourings is likely to require the beady eye of EFSA.

Minerals remains a vexed area but the use of mineral acids and bases such as hydrochloric acid and sodium hydroxide to adjust the pH of flavourings should qualify as processing aids as defined in the Food Additives Regulation 1333/2008 Article 3.2 (b) which states:

(b) 'processing aid' shall mean any substance which:

(i) is not consumed as a food by itself;

(ii) is intentionally used in the processing of raw materials, foods or their ingredients, to fulfil a certain technological purpose during treatment or processing; and

(iii) may result in the unintentional but technically unavoidable presence in the final product of residues of the substance or its derivatives provided they do not present any health risk and do not have any technological effect on the final product.

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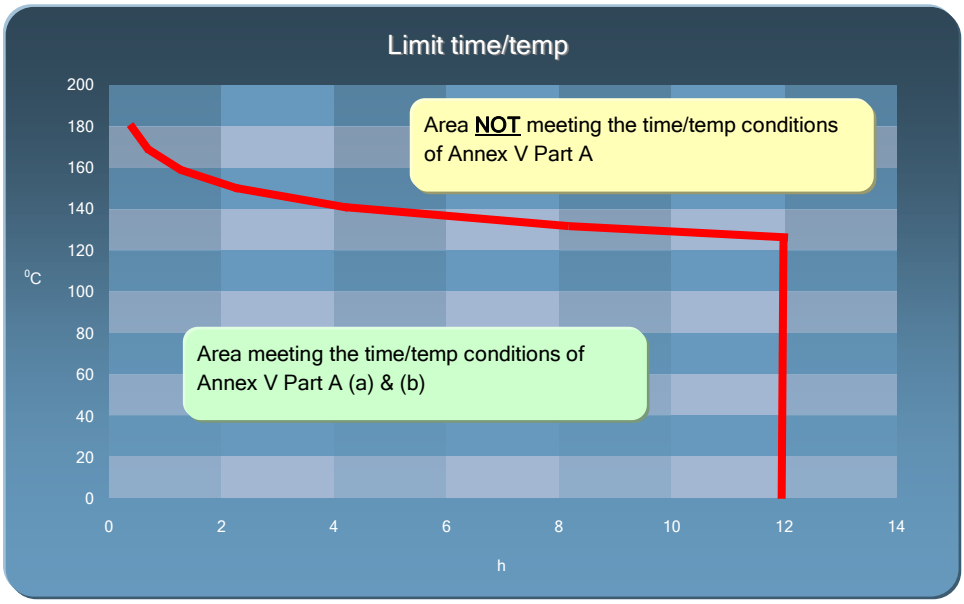
Thermal Process Flavourings

Additional rules apply to thermal process flavourings if they are to avoid submission for inclusion in Part C of the Union List. They must be produced within the conditions described in Annex V, i.e. at a pH below 8.0 and they must not exceed a reaction time of 12 hours at or below 125°C. Above 125°C reaction times are progressively shorter up to a maximum temperature of 180°C and these are defined in Annex V, Part A (b) which states:

'The duration of the thermal processing shall not exceed 15 minutes at 180°C with correspondingly longer times at lower temperatures, i.e. a doubling of the heating time for each decrease of temperature by 10°C, up to a maximum of 12 hours'.



The time/temperature graph above prepared by EFFA gives a good overview of the parameters. Conditions below the red line satisfy the Regulation and no submission is necessary; conditions above the red line will necessitate a dossier submission for evaluation and approval by EFSA.

Thermal process flavours must also comply with Part B of Annex V to avoid a dossier submission to EFSA. This section lists two substances that are members of a group of approximately 25 heterocyclic aromatic amines (HAAs) formed in meat during cooking processes and in thermal process flavourings that are known to be mutagens and in some cases carcinogens. The two compounds specified along with their maximum levels are listed in the table below:

Substance	Max. levels µg/kg
2-amino-3,4,8-trimethylimidazole[4,5-f] quinoxaline (4,8-DiMeIQx)	50
2-amino-1-methyl-6-phenylimidazol [4,5-b] pyridine (PhIP)	50

It will therefore be necessary for flavour companies producing thermal process flavourings to have them analysed to ensure that they comply with the Regulation with respect to these compounds. It would also be prudent to have them tested quickly because the time window for submissions is just over two years away and changes to the formulation or reaction conditions will be necessary to bring the flavour below the maximum HAA levels. Otherwise toxicological testing will have to commence to prepare a dossier for evaluation by EFSA. The thermal process flavourings at greatest risk of exceeding the maximum levels are those with added creatine/creatinine or those containing meat extracts or enzyme digests of meat.

Analytical Laboratories

Some laboratories that analyse heterocyclic aromatic amines are listed below:

The Flavour Centre, University of Reading.
Website: http://www.reading.ac.uk/flavourcentre
Contact: Dr Jane Parker.
J.k.parker@reading.ac.uk
Tel: +44 (0)118 387 7455

Graz University of Technology
Contact: Prof. Dr Michael Murkovic.
michael.murkovic@tugraz.at
Tel: +43 (316) 873 6495

Safety of Thermal Process Flavourings - Heterocyclic Aromatic Amines

by Dave Baines

Will thermal process flavourings be given the same treatment as smoke flavourings? Smoke flavourings have recently been through a full evaluation by the European Food Safety Authority (EFSA) and in the end 10 out of the 16 originally submitted have emerged and will be approved for use in specified food products in Europe later this year. The successful companies have spent in the region of $1M on each successful smoke flavour to reach this point.

The problem with smoke flavours is that they contain polycyclic aromatic hydrocarbons which are notorious carcinogens. Thermal process flavourings can also harbour dangerous compounds in the form of heterocyclic aromatic amines (HAAs). Two of them are listed in the new flavourings regulations but they are not new: they were present in the previous flavourings regulations which go back to 1988. However, two things have changed since then that are likely to promote them up the EFSA agenda. The first is the deadline for the submission to EFSA of any thermal process flavourings that exceed a level of 50µg/kg described in the previous article and the second concerns the toxicity of this group of amines. In comparison to other known food mutagens it is now known that HAAs are over 100 fold more mutagenic than Aflatoxin B1 and over 2000 fold more mutagenic than the polycyclic hydrocarbon benzo[a] pyrene[1], one of the polycyclic aromatic hydrocarbons present in smoke flavourings. A small but growing number of HAAs have been found to be human carcinogens and are among the most dangerous substances consumed in food.

The formation of HAAs in cooked meats

HAAs were discovered in food by Sugimura and co-workers[2] 35 years ago and since then over 25 HAAs have been isolated and identified in cooked meat and meat products. The structures of the principle HAAs identified are presented in Figure 1.

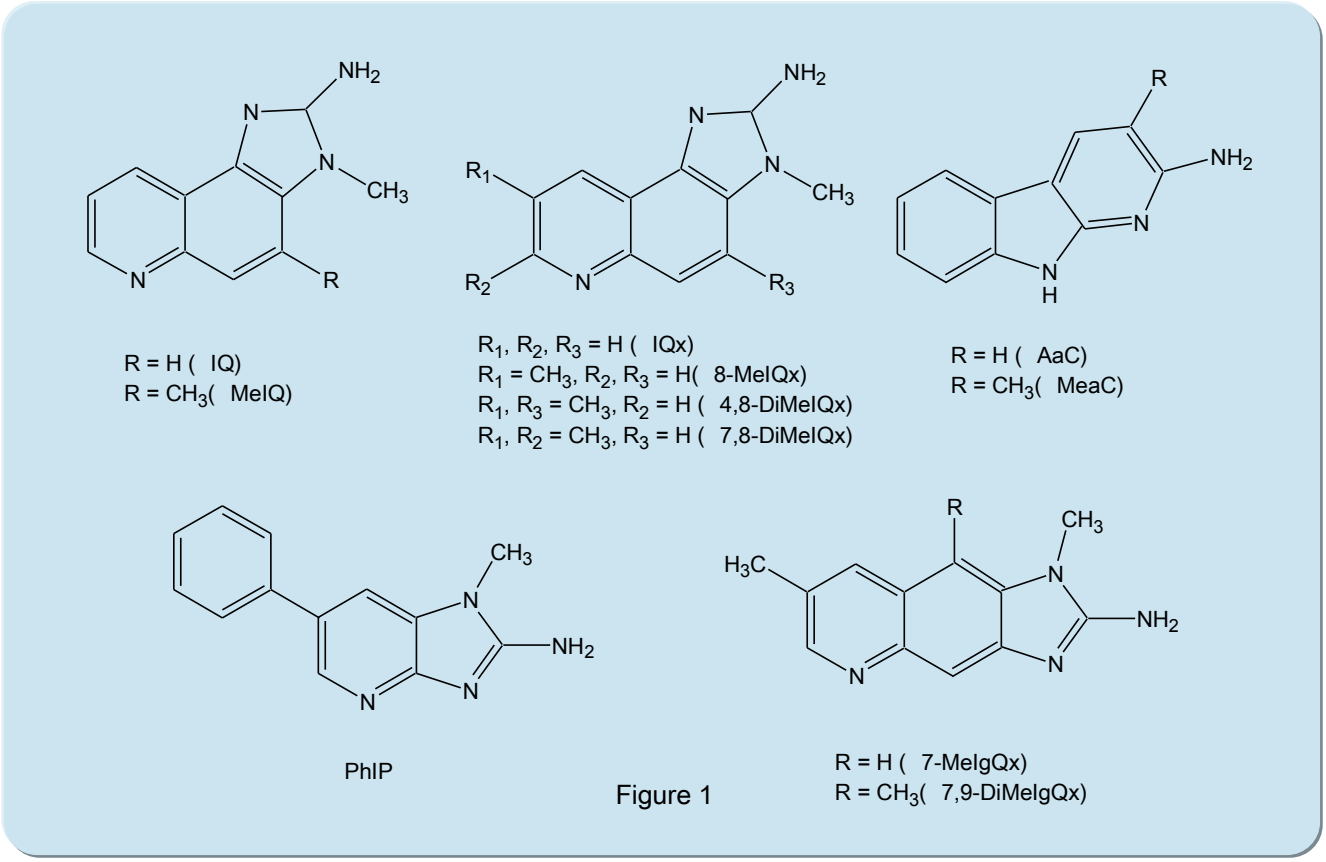


Figure 1

[1] Warzecha, L. et. al. (2004) Determination of heterocyclic aromatic amines content in samples of household-prepared meat dishes. J. Chrom. B., 802: pp 95-106
[2] Sugimura, T. et al, (1977), Mutagen-carcinogens in food with special reference in highly mutagenic pyrolytic products in broiled foods. Book: Origins of Cancer; Eds, Hiatt, H. H., Watson, J. D. Cold Spring Harbor, NY, pp. 1561-1577

Two classes of HAAs are formed in cooked meats. HAAs that contain the N-methyl-2-aminoimidazole moiety (polar HAAs) are formed by the reaction of amino acids, sugars and creatine to produce the PhIP, IQ and IQx compounds. These compounds form in meat at temperatures of around 150°C or higher. The second class of HAAs (non-polar) include 2-amino-9H-pyridole[2'3-b]indole (AαC) and 2-amino-3-methyl-9H-pyridole[2,3-b]indole (MeAαC) formed by thermal degradation of proteins or by the direct pyrolysis of glutamic acid or tryptophan at high temperatures (250°C and above).

A number of model studies have established the following;

- IQ compounds are formed from the reactions of an amino acid, a reducing sugar and creatinine[1].
- The addition of sugars and creatine/creatinine to ground beef increased the mutagenicity of cooked beef and the precursors of HAAs were sugars, amino acids and creatine/creatinine[2].
- A dramatic increase in mutagenicity was observed on adding creatine to a recipe combining pork, beef, veal, starch and milk[3].
- PhIP is formed from phenylacetaldehyde, the Strecker aldehyde of phenylalanine, by heating phenylalanine and creatine at 37°C in the presence of a sugar or an aldehyde[4] (Figure 2).
- HAAs can be formed under mild conditions - when glucose, glycine and creatinine are left at room temperature in a phosphate buffer for 84 days HAAs are formed[5]. The study concludes that the long term storage of manufactured foods may produce HAAs.

From the point of view of thermal process flavourings creatine/creatinine is the common denominator and must be present for the formation of HAAs. Creatine is in equilibrium with its closed ring equivalent, creatinine, in aqueous solution and is responsible for the N-methyl-2-aminoimidazole moiety present in PhIP, IQ and IQx HAAs.

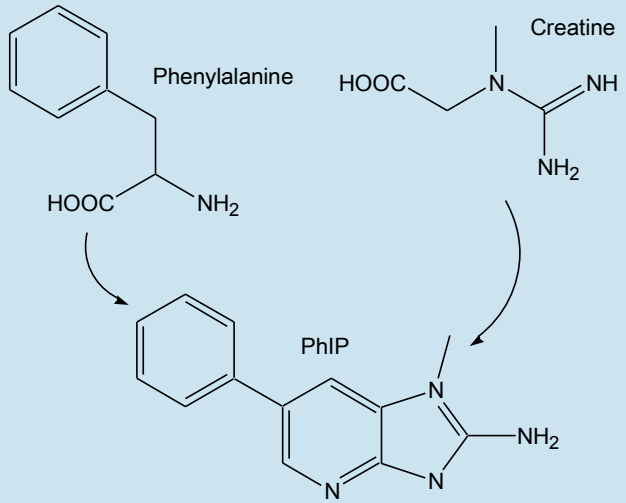


Figure 2 - Formation of PhIP

We can conclude from the above that if creatine and creatinine are not used as ingredients in thermal process flavourings we would not expect to find any HAAs. The use of meat extracts and enzyme digests of meats, however, will provide a source of creatine/creatinine and in such systems we would expect to find HAAs.

An ironical point here is that natural flavouring preparations produced with over 95% of the named ingredient that can be labelled, for example 'natural beef flavouring' in the EU are likely to contain the highest levels of HAAs. As they are flavouring preparations produced from food, Annex V of the Flavourings Regulation 1334/2008, requiring testing for HAAs, does not apply to them and they do not have to be evaluated by EFSA.

[1] http://www.ncbi.nlm.nih.gov/pubmed/1858429
[2] Jägerstad, M. et al. (1983) Creatinine and Maillard reaction products as precursors of mutagenic compounds formed in fried beef. In Walker, G.R. and Feather, M.S. (eds), The Maillard Reaction in Foods and Nutrition. American Chemical Society, Washington, DC, pp. 507-519.
[3] Nes, I.F. (1986) Mutagen formation in fried meat emulsion containing various amounts of creatine. Mutat. Res., 175, 145-146.
[4] http://www.ncbi.nlm.nih.gov/pubmed/1586994
[5] http://www.sciencedirect.com/science/article/pii/S0531513102009020

Carcinogenicity of HAAs

HAAs are some of the most potent mutagens detected using Ames/ salmonella tests and most have been clearly shown to induce tumours in experimental animals. A mutagen is defined as a chemical agent that induces or increases a change in genetic material (DNA) and they are not automatically considered to be carcinogens. Likewise carcinogens, defined as agents that cause cancer, may not be mutagens.

To identify a substance as a mutagen in an Ames test or a carcinogen in animal studies is just the first step. Mutagens and carcinogens may vary greatly in their potency in rodents and extrapolation of risk from rodents to humans is difficult due to longevity differences and the multicausal nature of most human cancer. Epidemiological evidence in human populations must be painstakingly uncovered through many studies and this process usually takes decades to accumulate enough reliable scientific data. The relationship between cigarette smoking and lung cancer is just one obvious example but uncovering causative agents in food is more problematical because, unlike smokers where exposure is habitual due to addiction, food consumption is more varied and random.

Over the past 15 years an increasing number of epidemiological studies have evaluated the association of well -done meat intake and meat carcinogen exposure with cancer risk and these studies were reviewed by Zheng and Lee. The table below presents a summary of their findings.

In general there is a large body of evidence linking colorectal cancer with exposure to HAAs in the diet. The authors concluded that exposure to HAAs through consumption of well-done meat may increase the risk of certain cancers in humans. PhIP, MeIQ, MeIQx and IQ are listed in the International Agency for Research on Cancer (IARC) Report on Carcinogens as possibly carcinogenic to humans (Group 2B). Another factor implicating HAAs in human cancer is the detection of HAA-DNA adducts in human colon, breast and prostate cancer following exposure to HAAs.

Exposure	No. of Studies Evaluated	No. of Studies Reporting Positive Associations %	Cancers Implicated
HAAs General	10	7 (70%)	Colorectal, breast, pancreatic, stomach, esophagus, squamous cell carcinoma, lung.
PhIP	13	8 (61.5%)	Colorectal, breast, pancreatic.
MeIQx	12	6 (50%)	Colorectal, lung.
DiMeIQx	11	6 (54.5%)	Colorectal, pancreatic.

Summary of Epidemiological Studies Evaluating the Association of HAA Exposure with Cancer Risk

The Occurrence of HAAs in Meat Products

PhIP is the most abundant HAA detected in meat products and has been found in cooked beef, pork, chicken and fish with upper levels of 30-40ng/g (30-40ppb) in well done pan-fried beef and deep fried chicken products. Mean intakes of PhIP ranged from 285-457ng/day in three large cohort studies in the US. In 2006 a US doctors' group sued seven leading fast food chains including McDonalds and Burger King because their meals contained a 'dangerous carcinogen' namely PhIP[2].

The IQ and IQx HAAs are produced at much lower levels in cooked meat products, ranging from 1-10ng/g, and it has been estimated that they account for around 5-15% of the mutagenic potential of these products the remainder being derived from PhIP.

[1] Zheng, W. and Lee, S-A. (2009) Well-done meat intake, heterocyclic amine exposure and cancer risk. Nutrition and Cancer, 61(4), pp 437-446

[2] http://www.chinadaily.com.cn/lifestyle/2006-09/29/content_699872.htm

The Occurrence of HAAs in Thermal Process Flavourings

A number of studies have been undertaken on the presence of HAAs in thermal process flavourings. Mark Kinze of the Lawrence Livermore National Laboratory, USA, made a study of the occurrence of HAAs in process flavours in 1999. He analysed 101 samples and found HAAs in just 12. The levels detected ranged from 0.01-253ng/g. After comparing these findings to HAAs present in restaurant foods he concluded that the exposure to HAAs from eating food containing process flavours is quite low.

Solyakov and co-workers[1] analysed seven process flavours, five process flavour ingredients, four bouillon concentrates and a pan residue for HAAs. The levels detected ranged from 0.3-20.3ng/g. The polar HAAs including PhIP and the IQ and IQx groups were only found in samples of animal and mixed animal and vegetable origin indicating that creatine was present. Polar HAAs were also found suggesting that some of the samples were produced at temperatures exceeding 150°C.

Jackson and co-workers[2] analysed 24 commercial beef flavours and two food-grade beef extracts for creatine, creatinine, mutagenic activity and HAAs. The creatine and creatinine levels in the flavours ranged from 0 to 73 and from 0 to 21mg/g, respectively. Flavours with high mutagenic activity contained measurable amounts of HAAs at levels ranging from 4.2-21.2ng/g.

All but one of the above is over the specified EU level of 50µg/kg (50ng/g or 50ppb).

Concluding Remarks

HAAs are potent mutagens and a number are listed on the IARC list of carcinogens. The two compounds listed in the flavourings regulations 1334/2008 are there for historic reasons and since they were first included in 1988 other HAAs have been filed as carcinogens. It would be prudent for companies to have their thermal process flavourings analysed for the full range of HAAs even though compliance relates to just two of them.

Thermal process flavourings have been analysed by a number of workers and the findings to date suggest that the levels of HAAs detected are similar to the levels found in food and lower than those in well-done meat products. Considering that thermal process flavourings will be used at concentrations in the range 0.5-2%, this gives a considerable margin of safety over cooked meat products. Also thermal process flavourings that do not contain a source of creatine or creatinine have an even greater margin of safety.

So thermal process flavourings are not analogous to smoke flavourings and will not be given the same scrutiny as smoke flavourings. We know this because the EU has not taken out separate implementing legislation as it did with smoke flavourings in the form of EC No. 2065/2003 which ordered companies to submit smoke flavourings to EFSA for evaluation.

As a final point, public awareness of health associated problems with meat products is on the increase. The mounting body of evidence implicating well done meat products and HAAs in human cancer may change the situation and EFSA may turn their attention to evaluating the health associated risks from flavourings containing HAAs. If such a situation arises they would be advised to focus their attention on flavouring preparations containing meat and fish products where creatine and creatinine are present rather than thermal process flavourings where the margins of safety are high. This is one instance, where on public health grounds, thermal process flavourings are much safer than the meat products they simulate.

[1] http://www.ncbi.nlm.nih.gov/pubmed/10069477
[2] http://www.ncbi.nlm.nih.gov/pubmed/7506378

Flavour Horizons Review: Ginger Flavours

by Lindsey Bagley

Ginger or ginger root is the rhizome of the plant Zingiber officinale, which is consumed as a delicacy, medicine, or spice. Other notable members of this plant family are turmeric and cardamom. Ginger cultivation began in South Asia and has since spread to East Africa and the Caribbean.

Ginger produces a hot, fragrant culinary spice. Young ginger rhizomes are juicy and fleshy with a very mild taste. They are often pickled in vinegar or sherry as a snack or just cooked as an ingredient in many dishes.

Fresh ginger is also prepared in more shelf stable forms such as dried, ground ginger and crystallised ginger (cooked in sugar), although the flavours are significantly different. These are the forms more typically used as a flavouring for recipes such as gingerbread, cookies, crackers and cakes, ginger ale, ginger wine and ginger beer. Ginger is also used in many cultures as a spice added to hot coffee and tea.

The characteristic odour and flavour of ginger is caused by a mixture of zingerone, shogaols and gingerols, volatile oils that compose 1-3% of the weight of fresh ginger. Ginger contains up to 3% of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Smaller amounts of other sesquiterpenoids (β-sesquiphellandrene, bisabolene and farnesene) and a small monoterpenoid fraction (β-phelladrene, cineol, and citral) have also been identified.

The pungent taste of ginger is due to non-volatile phenylpropanoid-derived compounds, particularly gingerols and shogaols, which form from gingerols when ginger is dried or cooked. Zingerone is also produced from gingerols during this process; this compound is less pungent and has a spicy-sweet aroma.

Interestingly, ginger also has a sialagogue action, stimulating the production of saliva, which makes swallowing easier. Tea brewed from ginger is a common folk remedy for colds. Ginger ale and ginger beer are also drunk as stomach settlers in countries where the beverages are made. Ginger wine, a popular UK digestive, has been made commercially since 1740.

As ginger flavoured foods and beverages have become increasingly popular in recent times we decided to critique available flavours in this year's flavour review.

Method

Flavour Horizons invited all the exhibitors at the Table Talk Exhibition Amsterdam in February 2013 to submit samples for our review and extended this to other subscribers. This article summarises the findings from the exercise.

Samples were submitted by the following companies: Biolandes, David Michael Europe, Doehler, Flavex, Firmenich, Frutarom, Lionel Hitchin, Naturex, Omega Ingredients, Prova, and Sensient.

Ingredient	% w/v
Sugar	9.000
Sodium Benzoate	0.018
Citrate	0.030
Citric	0.280
Flavour	q.s.
Water	To 100.000

Samples were assessed in a model soft drink formulation with 9 % sucrose (see below).

The sensory comments were generated in a round table tasting by a small group of tasters, familiar with generating objective comments; they simply reflect our personal opinions.

Conclusions

The range of flavour styles possible from 'ginger flavour' is wide and varies from highly citrus to very pungent and spicy packing a heat tingling punch. Some extracts were non-water miscible and these would lend themselves to formulation into emulsions for beverage application or to other applications such as confectionery and baking. House styles were noted in some collections of flavours.

It would clearly be possible to blend different ginger flavours to obtain the exact balance of different characteristics for any particular application.

We have not attempted to analyse the potential cost impact as any cost indications are likely to be erroneous without a true commercial analysis but in terms of taste there is real choice in creating a unique ginger character for all applications.

▸

DESCRIPTION	DOSAGE % w/v	COMMENTS
Biolandes		
Ginger Oleoresin: F9600	0.02	Non-miscible, natural and complex with spicy camphor character and strong heat with lip 'tingle'.
Doehler		
Natural Ginger + other: 2.07730	0.10	Mildly citrus with back heat
Natural Ginger: 5.82767	0.10	Slightly opaque, more complex citrus juice & peel character with musty notes & heat in aftertaste
Natural Ginger: 5.11782	0.10	Fresh lemony flavour with spicy earthiness and warm aftertaste
Natural Ginger: 5.80226	0.01	Fresh ginger with citrus and musty tones and warm aftertaste
Flavex		
Ginger Blend Tincture: F32076/L6723	0.10	Mildly citrus character
Natural Ginger: F31803	0.05	Non-miscible, fresh citrus nose and flavour with spicy, prolonged heat
Strong Ginger Tincture BP: F000516	0.10	Slightly opaque citrus peel character with mild heat in aftertaste
Ginger Extract: L7545	0.10	Slightly opaque citrus character with mild heat in aftertaste
Frutarom		
Ginger CO_2: FP24057	0.05	Non-miscible fresh citrus flavour with spicy heat in aftertaste
Ginger Oleo resin BPC/EOA: FP22951	0.02	Non-miscible, earthy, spicy citrus character with significant heat and lip 'tingle' in aftertaste
Ginger Oil Chinese: FP23024	0.02	Non-miscible, citrus peel character with some heat
Firmenich		
Gingembre Indes EXT SFE: 946417	0.02	Non-miscible, fresh citrus character with spicy notes and strong heat with lip 'tingle'
David Michael Europe		
Ginger Flavour: 12147D	0.04	Mild balance of citrus, spice with musty aftertaste
Lionel Hitchen		
Natural Ginger: FE11731		Slightly opaque with strong citrus peel notes
Ginger: FE10203		Slightly opaque, full bodied citrus style flavour with mild heat and spice in aftertaste
Ginger: FE11998		Fast onset of citrus peel character with warm spicy heat in aftertaste
Ginger Washing: FE12984		Strongly citrus peel character with clean warm heat in aftertaste
Ginger Washing: HD7760		Musty, slightly earthy flavour with citrus aftertaste

continued on page 11

DESCRIPTION	DOSAGE % w/v	COMMENTS
Omega		
Natural Ginger: R177	0.05	Bright clean flavour with citrus notes and warm heat
Natural Ginger: R372	0.05	Non-miscible, woody and citrus character
Natural Ginger: R993	0.05	Strong citrus ginger with strong heat and lip 'tingle' in aftertaste and some woody characteristics
Natural Ginger: R1069	0.05	Fuller, integrated spicy, flavour. Complex and complete with warm aftertaste
Natural Ginger: R1295	0.05	Mild citrus type ginger
Natural Ginger: R1314	0.05	Slightly opaque, very citrus in character with mild heat
Organic Ginger: R496	0.05	Woody & earthy with some citrus notes and good heat
Organic Ginger: R1317	0.05	Slightly opaque, floral, woody and musty character
Conventional Ginger: R497	0.05	Mild ginger-beer style with good heat
Jamaican Ginger: R1098	0.05	Non-miscible strong ginger with distinctive cardamom, camphor and citrus notes and back heat
Prova		
Natural Ginger: PD051A	0.05	Mildly citrus with good body and musty, earthy aftertaste
Sensient		
Natural 'Ginger Ale' with colour: Sell/ Res No:1010723	0.10	Mild ginger with citrus notes and some 'bite' and a warm aftertaste
Natural 'Ginger Beer': Sell/Res No:1115786	0.10	Opaque, strongly citrus in character with mild heat
Natural Chinese Ginger: Sell/Res No:1022280	0.08	Non-miscible, strongly citrus with good heat and 'tingle' in after taste
Natural 'Heat' Flavour: Sell/Res No:1115359	0.10	Slightly opaque, up front and continuing , non-harsh heat
Natural Ginger: Sell/Res No:1108347	0.15	Slightly musty, earthy flavour with citrus notes

Footnote: Table Talk Exhibition Amsterdam 2013

The fifth British Society of Flavourists' Table Talk exhibition held in Amsterdam on the 28th February had a record number of exhibitors, 22 in total; 167 people attended the event which was once again a great success. The 230 materials presented were the most interesting collection seen to date with some very novel and innovative products on display. Readers interested in receiving samples can contact the companies directly.

Exhibitors:
Advanced Biotech Europe , Agrumaria Corleone , Axxence Aromatics, Biolandes, David Michael Europe, Destilla Flavours & Extracts, De Monchy Aromatics, Döhler, DSM Food Specialities, Elixarome, Firmenich, Frutarom F&F Ingredients, Lionel Hitchen Essential Oils, Omega Ingredients, Prova SAS, Riverside Aromatics, SAFC, Sensient, Simone Gatto, Symrise, R.C. Treatt, V. Mane Fils.

Table Top Presenters:
Allured - Perfumer & Flavourist Magazine, Besmoke, Flavour Horizons, Flavortech, Leffingwell, Streatly Software Solutions, Nizo Food Research

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Sweeteners: Natural or Artificial? The Answer is 50 Shades of Grey

by Lindsey Bagley

As we have previously discussed a liking for sweet tastes is founded in our need to select carbohydrates in food sources for energy but is also considered to be the result of the evolutionary advantage of avoiding bitter tastes, which could be poisonous. Many mammalian meat-eating species have lost the ability to taste sweetness, indicating an evolutionary trend towards diet specialisation. As a species we humans find sweet taste very pleasing and we indulge in a wide variety of attractive sweet tasting food forms.

The sweetener systems in food and beverage products are rarely selected on the basis of simply the best sweet-tasting composition. There are a number of associated aspects to deliberate; it is a multi-factorial consideration. Technological considerations may certainly start with taste but include bulking, texture and structure, freezing point depression, crystalinity, glass formation, hygroscopisity, glycaemic index (GI), fermentability, preservation and not least process & product stability. Marketing considerations of positionings include natural, organic, non-cariogenic, sugar-free, diet, calorie-free, low GI, and sweeteners regarded highly by consumers. As a part of the overall selection matrix there will also be commercial considerations of cost and availability.

There is no single definition of natural when it comes to sweetener choices. There are several factors that manufacturers need to assess before defining the choices they make. Marketing choices, legislative choices and consumer values will all result in different rationalisation of the final selection.

Sugars

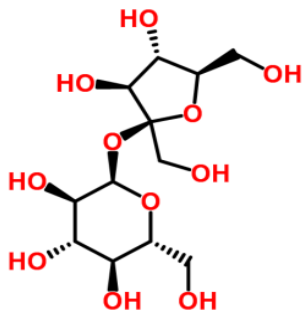
The disaccharide sucrose is made by some plants as their preferred storage carbohydrate. Sugar cane and beet sugar are the two main crops grown commercially for sucrose which is extracted by simple water solubility techniques, without chemical intervention and so is the ultimate natural sweetener. It has a taste which is recognised as the gold standard of sweet tastes, being full-bodied and having fast impact and no aftertaste with associated caramel notes we find distinctly pleasurable. At 67 its glycaemic index is median; it has 4 calories per gram and is completely safe. Yet we have come to undervalue its benefits and focus on the negative attributes of this king of the carbohydrate sweeteners. Simply because it is so familiar to us we have lost an appreciation of its exceptional characteristics.

The systematic name for sucrose is β-D-Fructofuranosyl α-D-glucopyranosideis; glucose and fructose molecules are linked in a 1, 4 configuration. These are the two main sugars found in the plant world in different configurations for energy storage.

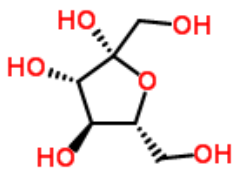
Sucrose can also be chemically treated to create a mixture of glucose and fructose in syrup referred to as Invert syrup.

Starch is an energy storage system based on multiple glucose units and is the storage carbohydrate of many grains (maize (corn), wheat, rice) and vegetables (potato). Inulin is the storage carbohydrate of chicory, artichokes and agave and is based on linked fructose units.

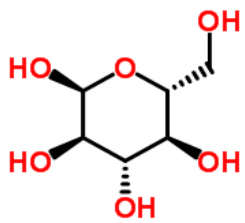
Commercially, glucose, glucose syrups, and high fructose corn syrups (HFCS), very commonly used in the US, are derived from starch by chemical interventions such as enzymatic treatment or acid hydrolysis of starch. Fructo-oligosaccarides (FOS) are produced by similar treatment of inulin and consequently all these sweeteners are chemically derived. Many fruits contain high levels of fructose when they are fully ripe which is why fructose is often referred to as fruit sugar. Some commercially available fructose is naturally derived from fruits, however it is most often chemically derived from starch.



Sucrose



Fructose



Glucose

Honey is a sweet food made by bees as their food-store, using nectar from flowers. They transform nectar into honey by a process of regurgitation and evaporation. It is principally fructose and glucose with a slightly higher proportion of fructose than glucose.

Agave Syrup is inulin extracted from agave plants and hydrolysed to produce a high fructose syrup.

Maple syrup is made from the xylem sap of maple trees. Starch stored in their roots in the winter is converted to sugar that rises in the sap in the spring. Maple trees can be tapped by boring holes into their trunks and collecting the exuded sap. The sap is processed by heating to evaporate much of the water, leaving the concentrated syrup. The syrup consists mainly of sucrose with some naturally occurring organic acids, creating some invert sugars (fructose and glucose), making it slightly acidic.

It can be seen from this brief discussion that it becomes more difficult to truly define 'natural' compared to 'chemically derived' or 'nature identical' in the commercially available carbohydrates.

Sugar alcohols

Sugar Alcohols, also known as a polyols, are a hydrogenated form of carbohydrate. The polyols generally permitted for use in foods are isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol, and more recently erythritol. They are not sugars, so can be used in sugar-free food forms but they are generally less sweet than carbohydrates. They are also non-cariogenic. In fact xylitol has found particular favour in sugar-free confectionery, particularly gum, as it is anti-cariogenic. Scientifically they have variable caloric contributions but in the EU they have been legally defined as contributing 2.4 calories per gram (relative to 4.0 calories per gram for carbohydrates). Erythritol has been accepted as being non-metabolised and therefore does not contribute any calories. It is actually absorbed in the small intestine and excreted unchanged through urine, so it has no side effects at typical levels of consumption.

	Relative sweetness	Calories in EU Legislation	Calories scientifically defined
Sucrose	1.0	4	4
Erythritol	0.8	0	0.2
Isomalt	0.5	2.4	2.0
Lactitol	0.4	2.4	2.0
Maltitol	0.9	2.4	2.1
Mannitol	0.5	2.4	1.6
Sorbitol	0.6	2.4	2.6
Xylitol	1.0	2.4	2.4

Erythritol occurs naturally in some fruits and fermented foods; Isomalt is produced in beetroots; Sorbitol is found in apples, pears, peaches, and prunes and Xylitol is found in the fibres of many fruits and vegetables.

Whilst erythritol, isomalt, sorbitol and xylitol are all naturally occurring materials, none of them are extracted naturally as they occur in small quantities. For commercial viability they are chemically synthesised. Again we see a distinction between 'naturally occurring' and 'natural' and also that science and legislation can disagree.

Sweetness perception

It is also important to consider sweetness profiles of ingredients being selected and in issue 4 we discussed the complexity of sweet taste perception.

It is known that some people have tongues that are more sensitive to sweetness than others. Investigations have shown that the more densely packed the taste buds containing the taste receptor cells on the tongue are, the more intensity of sensation a person perceives from a fixed concentration of sugar. Recent studies have also indicated that there are multiple cells involved with the detection of different carbohydrates and their sweetness, a complex multi-faceted process resulting in a simplified perception of 'sweet' taste. Knowing this makes it easier to understand why our perceptions of sweetness vary so greatly. All sweeteners have different taste profiles and some individuals are more sensitive to certain taste characteristics of sweeteners than others.

Generalisations summarising the overall sweetness profiles must take these varying sensitivities into account. Sucrose is generally accepted as having the preferred sweetness profile. Relative to sucrose, fructose is slightly sweeter and glucose less sweet, so different blends of these two sugars will show varying sweetness characteristics. HFCS has become accepted as the sweetener of choice in beverages in the US as it is commercially attractive to use; however it delivers a distinctly different sweetness profile to sucrose. It lacks the warm caramelised flavours of sucrose. The sugar alcohols are associated with a cooling aftertaste that is incompatible with some applications/ flavour types and so restricts their acceptability.

High Potency Sweeteners (HPS)

This group of sweeteners are ingredients used in tiny amounts as they are intensely sweet. Therefore where they are caloric, they have negligible impact on a product's overall calorie content. The particular value of these sweeteners is that they disconnect sweetness from calories and so enable sugar free, and no-added-sugar food options. Their proliferation has been the life blood of diet and zero calorie beverages. In the EU they are restricted by use level and category, and where they are permitted they must be used in products with at least 30% calorie reduction with reference to a standard product.

All these sweeteners have different taste characteristics; none mirror the taste profile of sucrose, the gold standard for taste, so all need careful formulation into foods and beverages to achieve an acceptable taste.

The most commonly used sweeteners are shown in the table:

Sweetener	Sweetness Multiple relative to Sucrose	Sweetness Quality	Stability
Acesulfame K	x 200	☹ Metallic aftertaste	☺
Aspartame	x 200	☺ Slight lingering aftertaste	☹
Cyclamate	x 30	😐 Slight lingering aftertaste	☺
Neotame	x 8000	😐 Lingering sweetness	😐
Saccharin	x 400	☹ Aspirin aftertastes	☺
Sucralose	x 600	☺ Very slight lingering aftertaste	☺
Stevia	x 250 (as Reb A)	☹ Harsh side tastes	☺

These sweeteners all have different sweetness profiles, handling characteristics and stability profiles. Acesulfame K has a metallic aftertaste and is rarely used as a sole sweetener but normally in blends with aspartame. Aspartame is used as a sole sweetener, albeit having a lingering sweet aftertaste and relatively poor stability. It blends well with acesulfame K to deliver a good taste, sweetness synergy and improved in-product stability. Cyclamate has had a chequered safety history and has limited sweetness at its permitted use levels but provides good stable sweetness and a good sweetness profile where it is used. Neotame has an intensely sweet aftertaste and must be used in blends but offers a very cost effective sweetener solution but with unique handling issues. Saccharin has a bitter aftertaste which limits its acceptability but it is very cost effective and blends well. Sucralose is also often used on its own but has a lingeringly sweet aftertaste. Stevia has a lingering bitterness and harsh liquorice side tastes which limits its taste acceptability.

These sweeteners are also often used to reduce the cost of sweetness as they are less expensive at an equivalent sweetness to sucrose and the other carbohydrate sweeteners. However, they do not provide bulk so work best where water can fill the space left when bulk sweeteners are removed.

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Blending these various sweeteners has become standard practise particularly within the beverage industry to achieve:

- the best sweetness profile
- a desirable cost
- a desirable stability

All except stevia are chemically synthesised. Stevia sweetener is extracted from the stevia plant and is a mixture of steviol glycosides. The permission to use this sweetener across the EU is defined by category and addition rates are limited by steviol equivalence. As the side tastes of this extract, along with regulatory limitations, restrict its use and as it is the only natural sweetener in the HPS category, it is mostly blended with carbohydrate sweeteners.

Theoretical Relative cost of sweetening a beverage @ 10 % sucrose equivalence

Sweetener	Relative cost
Sucrose	100.0
Acesulfame K	2.5
Aspartame	5.6
Cyclamate	12.5
Neotame	4.3
Saccharin	1.4
Sucralose	13.5
Stevia	60

Conclusions

It is not possible to categorise sweeteners as either 'natural' or 'artificial' as their presence in nature is not necessarily their commercially manufactured route and also their status with consumers is much more complex.

If the definition of natural used in the flavouring regulations 1334/2008 was applied to sugars, very few could be called natural because synthetic processes are used in their manufacture and hence they have not been produced using 'traditional food preparation processes' defined in Annex II of this regulation, which is one of the key determinants for a flavouring or flavouring substance to qualify as natural.

Naturally derived sweeteners such as agave and maple syrups are chemically similar to invert sugar syrups but are more kindly viewed by consumers.

Sugar alcohols may be present in nature, but those available for commercial use are all chemically manufactured so are 'nature identical' rather than 'natural'.

The various synthetic High Potency Sweeteners have all been proven safe to be included in our diets, but consumers view them differently. Some consumers will define the taste of anything sweetened with these components as synthetic, regardless of their actual taste.

Natural stevia sweeteners can be simple water extracts from stevia leaf, but legislation limits their application and demands that they can only be referred to as 'naturally derived' and declared as 'steviol glycosides'; this is a molecule which does not exist as an independent chemical entity.

Certainly for now, the world of ingredients still awaits the natural sweetener which delivers the taste, sweetness and texture of sucrose, without the calories.

Flavoured Beers offer Growth Potential

by Melanie Brown

Traditional beer flavours

Flavoured beers are not a new concept. Prior to the widespread adoption of hops for brewing in the Middle Ages, beers were flavoured with a range of different botanicals, such as chamomile, dandelion, mugwort and nettle. Since then traditional brewing has centred on the four main ingredients water, hops, malt and yeast. In addition, certain fruit flavours have traditionally been used for specialist fruit beers, such as the classic Belgian lambic beers, which are fermented with yeast, bacteria and Morello cherries to give a distinctive tart taste. In recent years there has been a growing interest in flavoured beers which currently represent one of the growth areas in the brewing market.

Many breweries add hop extracts to their beers to enhance flavour, as the aromatic volatiles, crucial for beer's

characteristic flavour, can be lost during brewing and fermentation. For example, Treatt has just launched a new, natural hop distillate[1] with a high level of volatiles, which can be incorporated into the brewing process at the end of fermentation to improve the flavour profile and to confer a strong, hoppy aroma and taste to beer. Symrise has developed a beer flavour 'portfolio' (BrewTopia) for the traditional brewing market incorporating hop, malt and yeast flavours. The modular flavour toolbox can create tailor-made beer profiles (such as lager, stout or pilsner) in a single brew.[2]

In the last decade, the craft beer movement has grown in the US and around the world and the craft brewers have begun to experiment with a wide range of new, exotic flavours, many of them quite unexpected, for example cucumber, tomatoes, chillies, algae, oysters, chocolate, elderflower and a wide range of herbs and spices (Table 1). Most of these combine the addition of a flavour product to the mash and the addition of natural essences and extracts post brewing. This trend has resulted in significant growth in the flavoured beer sector in an industry where sales have otherwise been flat. The big brewers have recognised the opportunity and have begun to cash in on the demand for flavoured beers.

North American Market

Today the US boasts more than 2,000 breweries - up from only 50 in 1980. Craft beer sales are booming in the US and seasonal beer is one of the top selling craft beer categories. In 2012, craft surpassed 6% of the total US beer market.[3] Exports of US craft beer rose by 72% in 2012, with Canada, the UK and Sweden making up the largest international markets. While overall beer sales in the US fell by 1.3% in 2011, the craft brewing industry grew 13% by volume and 15% by sales in the same period, according to the Brewers' Association.[4]

The big North American brewers are responding to this growth in specialist beers by diversifying into flavoured beers with added citrus and other fruit flavours, tea and even mint in an attempt to lure new consumers into the fold and to protect their market share from the growing wine market and the expanding craft breweries (Table 2).

Flavoured beers are increasingly going mainstream. Anheuser-Busch has recently introduced Bud Light Lime with a $35 million marketing push. Its decision to flavour a flagship brand and not to create a new label signals a change in attitude by the large beer makers. SAB Miller has also decided to market its flavoured light beers, Miller Chill (flavoured with lime and salt) and Miller Chill Lemon, under its own brand name. Coors Brewing offers seasonal flavours for its Belgian-style Blue Moon brand which includes pumpkin for autumn, lime for spring, honey for summer and dark Belgian sugar for winter.[5] About 10% of Molson Coors (part of SAB Miller) business is from brands it did not have three years ago, such as Molson Canadian 67 (lemon and lime) and Miller Chill.[6]

[1] http://www.foodingredientsfirst.com/news/Treatt-Introduces-New-Natural-Distillates-for-Beer.html
[2] http://www.symrise.com/en/flavor-nutrition/our-brands/brewtopiar.html
[3] http://www.thedrinksbusiness.com/2013/04/top-10-biggest-us-craft-brewers/
[4] http://www.bbc.co.uk/news/magazine-21541887
[5] http://abcnews.go.com/Business/IndustryInfo/story?id=4375714&page=2#.UZEchrWTh_Q
[6] http://business.financialpost.com/2012/06/29/beermakers-add-flavours-to-juice-up-their-sales/

UK Market

Strawberry, raspberry and cherry beers have become very popular and are now the fastest-growing area of the UK beer market predicted to expand further over the next few years according to market research group AC Nielsen. Spirit-flavoured brews such as rum, bourbon and tequila beers are adding to the trend. In recent years sales of flavoured beers have grown by 80%.[1] Many British breweries now have flavoured beers among their brands, for example, Wells & Young's (Young's Double Chocolate Stout and Wells Banana Bread Beer) and Hall & Woodhouse (Golden Champion, flavoured with elderflower, Golden Glory, flavoured with peach blossom and Old Glory, flavoured with peach and melon).

Flavoured beers, such as Crabbie's Alcoholic Ginger Beer, have grown to build a share equivalent to 12% of the traditional Premium Bottled Ale market (worth about £470m in the UK). They continue to grow at 57% year on year through attracting younger drinkers and more female consumers with a sweeter product served over ice. This is in line with similar growth seen in the cider category where fruit flavoured ciders have been growing at 64% annually.[2] Ciders with flavours such as elderflower and berry have become the UK's fastest growing alcoholic drink sector with a market worth £113m. The arrival of pear and fruit ciders has doubled the value of the total UK cider market in four years.[3]

The market is still in its relative infancy but UK brewers are recognising the potential to increase their ranges for drinking at home. Two years ago Tesco stocked four flavoured beers but now it sells 16 with sales trebling during that period. According to Tesco, flavoured beers appeal to foodie customers who are also more likely to cook from scratch and buy premium brands or products.[4] Sainsbury's sales figures show that young women are buying more premium bottled real ale than ever before, and favour not only flavoured beers but also golden ales.[5]

Craft breweries trade heavily on the provenance of their ingredients and are invariably looking for natural or locally sourced raw materials. For example, Edinburgh-based Innis and Gunn launched a range of strawberry and raspberry beers made from 100% malted barley, hops, yeast and water, and blended with cold-pressed juice made from berries grown in Perthshire, Fife and Angus. Oxfordshire-based Wychwood also recently introduced Snake's Bite (made with cider apples) and Forest Fruits (made with mixed berries), following growing customer demand for fruit-flavoured and thirst-quenching drinks.[6]

Future trends

The use of modifying flavours can improve the overall flavour of a beer and enhance consumer perception of uniqueness and premium quality. They can also be used to enhance specific notes within a beer. The growing demand for flavoured beers seems set to continue as more young people, in particular women, seek refreshing seasonal alternatives to traditional beers. This trend could represent a significant opportunity for the flavour industry, particularly to supply the big brewing companies. Beverages already dominate the global flavours market. It will be interesting to see whether the demand for flavoured beers follows the pattern of flavoured alcoholic beverages, which exploded into the marketplace 20 years ago.

[1] http://www.guardian.co.uk/lifeandstyle/2012/jul/29/flavoured-beers-popularity-food-pairing
[2] http://www.marstons.co.uk/docs/8010_PBA_REPORT_2012_A4_V10.pdf
[3] http://www.guardian.co.uk/lifeandstyle/2012/nov/11/fruit-flavoured-cider-sales-grow
[4] http://www.guardian.co.uk/lifeandstyle/2012/jul/29/flavoured-beers-popularity-food-pairing
[5] http://www.mintel.com/blog/flavoured-alcoholic-beverages-surging-but-do-really-need-lady-booze
[6] http://www.guardian.co.uk/lifeandstyle/2012/jul/29/flavoured-beers-popularity-food-pairing

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Table 1 Some examples of exotic flavours in beers from North American craft breweries

Brewery	Beer	Flavours/ingredients	Comments
Short's Brewing Company, Bellair, Michigan	Bloody Beer	Roma tomatoes, spiced with dill, horseradish, peppercorns, and celery seed	Bloody Mary experience in a beery format
	PB & J Stout	Peanut puree, strawberries, blueberries, raspberries and blackberries	Adult version of the popular childhood sandwich
	Key Lime Pie	Graham crackers, marshmallow and fresh limes	Tart-and-sweet flavour that won gold at 2010's Great American Beer Festival.
Cigar City, Tampa, Fla	Cucumber Saison	Cucumber	Citrusy, fruity, hoppy and 'cucumbery' flavours
Twisted Pine, Boulder, Colo.	Ghost Face Killah	Anaheim, Fresno, Jalapeno, Serrano and Habanero chillies	Blast of peppery heat
Midnight Sun, Ankorage, Alaska	Berserker Imperial Stout	Maple syrup and molasses	Rich, decadent flavour
Mamma Mia, Campton Township, Ill.	Pizza Beer	Basil, oregano, tomato and garlic	
Hardywood Park Craft Brewery, Richmond, Va.	Gingerbread Stout	Madagascar bourbon vanilla beans, Vietnamese cinnamon and milk sugar, baby ginger and wildflower honey	Notes of chocolate, vanilla, gingery spice and warmth
The Bruery / Dogfish Head, Placentia, Calif.	Faster, Bigger, Better, Bolder	Japanese spice blend containing ginger, cayenne, white sesame seeds, black sesame seeds, poppy seeds, nori, kumquats	
Pipeworks Brewing Company, Chicago	Pastrami on Rye	Mustard seed, bay leaf, red pepper, coriander, ginger, allspice, clove, caraway seed, Tellicherry black peppercorn, cinnamon, nutmeg, rye, dark candi sugar and smoked malt	Potent strong dark ale with a complex profile
Freetail Brewing Company, San Antonio, Texas	Spirulina Wit	Spirulina	Algae add notes of tropical fruit
Dogfish Head Craft Brewed Ales, Delaware	Noble Rot	Unfermented grape juice, including Viognier grapes infected with botrytis fungus	Tart, lightly spicy, and subtly sweet, with a dry finish
Flying Dog Brewery, Maryland	Pearl Necklace Oyster Stout	River oysters	
Flying Monkeys, Barrie, Ontario	38 Dark chocolate Birthday Cake	Chocolate	Sales have grown by 70% in last 2 years
	Netherworld Pumpkin Spiced Ale	Pumpkin	
	Orange Mungus	Orange	
Mill Street Brewery, Toronto	Lemon Tea Beer	Tea & lemon	Won 2 gold medals at Ontario Brewing Awards
Yards Brewing Company, Philadelphia	Poor Richard's Tavern Spruce	Spruce tips & molasses	Sweet stroll through a forest.
Twisted Pine Brewery, Colorado	Ghost Face Killa	Bhut jolokia (chilli pepper)	Crisp and fiery
Uncommon Brewers, California	Bacon Brown Ale	Toasted buckwheat and bacon	Smokey, salty curiosity
Willoughby Brewing Co. , Cleveland, Ohio	Peanut Butter Cup Coffee Porter	Peanuts	

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Table 2 Some examples of flavoured beers from the big brewers

Brewery	Beer	Flavours/ingredients	Comments
Anheuser-Busch InBev	Bud Light Lime	Lime juice	
	Bud Light Lime Mojito	Lime & mint	
	Bud Light Lime Straw-Ber-Rita	Lime & strawberry	
	Michelob Ultra Pomegranate & Raspberry	Pomegranate & raspberry	Berry aroma that finishes with a hint of pomegranate.
	Michelob Ultra Lime Cactus	Lime cactus	
	Michelob Ultra Tuscan Orange Grapefruit	Orange & grapefruit	
	Budweiser & Clamato Chelada Bud Light & Clamato Chelada	Clamato Tomato Cocktail (a clam-juice-flavoured, Bloody Mary-type mixer)	Clamato, spices and a hint of lime
SAB Miller	Miller Chill	Lime and salt	Market leader in flavoured beer with over 50% market share and about 1.4% of the total beer market in Poland
	Miller Chill Lemon	Lemon	
	Redd's Apple Ale	Apple	
	Redd's Red	Raspberry	
	Redd's Sun	Exotic fruits	
	Redd's Cranberry	Cranberry	
	Blue Moon	Spiced with coriander & orange peel	Unfiltered Belgian-style wheat ale
	Blue Moon Honey Moon Summer Ale,	Honey	
	Blue Moon Rising Moon Spring Ale,	Lime	
	Blue Moon Harvest Moon Pumpkin Ale,	Pumpkin	
	Blue Moon Full Moon Winter Ale	Dark sugar	
Molson Coors (owned by SAB Miller)	Canadian 67 Sublime	Lemon & lime	
	Coors Light Iced Tea	Tea and citrus	
	Rickards Dark	Maple syrup	
SAB Miller India	Indus Pride	Citrusy Coriander, Citrusy Cardamom, Spicy Fennel and Fiery Cinnamon	Pairing with Indian gourmet cuisine
SHS Drinks	Dead Crow	Bourbon	Aromatic bourbon aroma
	Cuvana	Light rum and lime	Latin America and Cuban culture and heritage.
Diageo	Harp Lime	Lime juice	Launched in Africa
Heineken	Foster's Radler	Malt and cloudy lemon	Launched in Africa and UK
Carlsberg	Eve	Lychee	Brewed with malt and rice

Flavour Company Innovations 2012-13

by Melanie Brown

The tables on the following pages identify investments made in innovation and acquisition by leading flavour companies in 2012-13. Acquisitions in the flavour sector moved at a slightly slower pace in 2012 than in 2011. This was principally because Frutarom and Kerry slowed down the rate at which they acquired new companies last year. Frutarom made five acquisitions in 2011 and three in 2012,[1] while Kerry made seven in 2011 and five in 2012.[2] Both companies have put in good trading performances in 2012, especially in the Asia-Pacific markets. Kerry will have a war chest of up to €250m to spend on acquisitions this year after the company generated annual profits for 2012 that exceeded expectations.[3] Growth was driven by the ingredients and flavours side of the business. A "very active" pipeline of acquisition deals is reported for the coming year. Similarly, flavour was among the most profitable of Frutarom's activities in 2012, showing the highest growth and accounting for 74% of sales. The company continues to seek new, bolt-on acquisitions as a part of its growth strategy.

A number of joint ventures and collaborations were announced in 2012. Two of these involve the company Evolva, which specialises in the use of fermentation to produce flavours. Evolva is working with Cargill to produce steviol glucosides as sweeteners and IFF to produce a natural vanillin flavour. Another strategic joint venture between Ramanandraibe Export Co., the biggest vanilla producer in Madagascar, and Takasago International was signed in September, 2012. This brings Takasago in direct contact with the farmers in Madagascar, the world's leading vanilla bean exporting country, and provides a competitive advantage in securing vanilla, while achieving price stability.[4]

Despite the recession, investment in new flavour production and research facilities has proceeded at locations all around the world. The majority of investment projects have expanded facilities in Europe (12 developments). Four new flavour facilities are based in Brazil, four in South East Asia, five in India, three in Africa and two in China. Flavour companies are making strategic investments and acquisitions in locations that provide improved access to the expanding South East Asian, South American, Indian and Chinese markets.

Many of the new facilities are focused on savoury flavour development and manufacture in response to the increasing demand for savoury flavours and seasonings in China and other parts of SE Asia as meat consumption rises. Some new facilities are providing specialist plant for new flavour technologies, such as filtration and encapsulation.

Givaudan, Firmenich, Frutarom and Symrise have all announced new collaborative developments in 2012-13. Givaudan is collaborating with AkzoNobel Salt Specialties to address sodium reduction in processed meat. It is also collaborating with MIT to develop the use of mathematical modelling to analyse taste test results with the aim of reducing the time and cost of taste testing. Firmenich continues its close collaboration with Senomyx on the development of sweet tastes and has launched a new project with Amyris on the development of renewable ingredients for flavours. It has also established a flavour applications laboratory in a Nigerian college in Lagos to tap into local expertise and to improve links with local customers. Its commitment to sustainable development has led Firmenich to become the first flavour house to offer Rain Forest Alliance certified vanilla.[5]

In addition to Frutarom's focus on flavours and emerging markets, it also seeks competitive advantage by combining taste with health, health supplements, anti-aging products and food targeting specific population and age groups. It has recently announced a collaboration with Novel Creation on a new line of health supplements. In addition it is working with academics in the UK to identify new flavours in fish processing waste. Symrise has signed a joint R&D agreement with Probi to develop oral health applications to help meet the growing demand for functional consumer health products. Symrise has obtained a loan of €125 million from the European Investment Bank to fund research and development activities in the field of functional ingredients for cosmetics and healthy nutrition.[6]

Prospects for flavour companies appear promising over the next 12 months, particularly in South East Asian and South American markets.

Symrise and Kerry have been tipped as good investments for 2013 by Randeep Somel, the deputy manager of the M & G Global Basics fund. He said "The emerging middle classes of developing nations, forecast to rise threefold over the next two decades, will stoke increased demand for Western-style foods. Flavour and fragrance suppliers would benefit from this."[7]

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[1] http://www.frutarom.com/FrutaromNew/Templates/showpage.asp?DBID=1&LNGID=1&TMID=178&FID=545
[2] http://www.kerrygroup.com/
[3] http://www.independent.ie/business/irish/kerry-amasses-250m-war-chest-for-acquisitions-as-profits-soar-29096774.html
[4] http://pdf.irpocket.com/C4914/JA1b/BJsv/Zzkr.pdf
[5] http://www.firmenich.com/m/company/news/index.lbl
[6] http://www.symrise.com/en/news-media/press-releases/2013/detail/article/symrise-ag-obtains-research-loan-from-european-investment-bank.html
[7] http://www.telegraph.co.uk/finance/personalfinance/investing/9769761/2013-a-look-into-your-financial-future.html

Flavour Company Activities 2012-13

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Company	Investment in new facilities	Refs
Ajinomoto	Expansion of flavour seasoning plant in San Paulo, Brazil. Constructing a new factory dedicated to SAORI liquid seasoning in West Java, Indonesia. Opening new MSG plant in Ayutthaya's Nakhon Luang district, Thailand. Establishment of a repacking plant for umami seasoning in Abidjan, Ivory Coast. Expansion of capacity at WASCO's packaging plant in Nigeria, construction of a distribution warehouse for WASCO in Northern Nigeria and expansion of its sales network in Nigeria.	http://www.foodprocessing-technology.com/news/newsajinomoto-to-boost-flavour-seasoning-production-in-brazil http://www.foodingredientsfirst.com/news/Ajinomoto-Co-Inc-Constructing-a-New-Factory-for-Liquid-Seasoning-In-Indonesia.html http://www.nationmultimedia.com/business/Ajinomoto-MSG-plant-to-start-operating-in-May-30197371.html http://www.foodingredientsfirst.com/news/Ajinomoto-Co-Announces-Full-Scale-Operation-of-New-Umami-Seasonings-Repacking-Plant-in-Cte-DIvoire.html

Company	Collaborative agreements	Refs
Azelis	Partnership with Sensus to distribute Frutafit inulin and Frutalose oligofructose, natural ingredients from chicory roots with positive impact on taste and texture.	http://www.nutritionhorizon.com/news/Sensus-Announces-Partnership-with-Azelis-France.html

Company	Acquisitions/Joint ventures	Investment in new facilities	Refs
Cargill	Cargill and Arasco are creating a new starches and sweeteners joint venture in Saudi Arabia. Evolva Holding SA and Cargill have agreed to jointly develop and commercialise fermentation-derived steviol glycosides. Evolva has the right to a 45% stake in final business.	Upgrading and expanding the cocoa pressing capacity of its Ilhéus plant in Brazil by 25%.	http://www.foodingredientsfirst.com/headlines/Cargill-Enters-Starch-and-Sweeteners-Joint-Venture-in-Gulf-Region.html http://www.foodingredientsfirst.com/news/Evolva-And-Cargill-In-Deal-To-Co-develop-Steviol-Glycosides.html http://www.foodingredientsfirst.com/news/Cargill-Expands-Cocoa-Pressing-Capacity-at-Ilhus.html

Company	Acquisitions/Joint ventures	Refs
Döhler	Acquired the Fruit Processing and Flavour Unit of Delta Aromatic (DELRO), the Egyptian specialist for fruit and vegetable ingredients.	http://www.foodingredientsfirst.com/headlines/Dhler-Expands-Fruit-Processing-and-Flavor-Capabilities-Through-Egyptian-Acquisition.html

Company	Investment in new facilities	Collaborative agreements	Refs
Firmenich	Opened new Culinary Centre of Excellence in Vienna, Austria focused on savoury flavours. New flavour manufacturing facility in Indonesia for encapsulation technology (Durarome).	Extended the Sweet Taste Program collaboration agreement with Senomyx. Expanded collaboration with Amyris to develop and commercialise renewable ingredients for the flavours and fragrances market. Collaboration with Yaba College of Technology in Lagos, Nigeria to establish a Firmenich flavour applications lab in the Food Technology Dept.	http://www.foodnavigator.com/Financial-Industry/Firmenich-opens-Austrian-centre-to-drive-savoury-flavour-development http://www.foodnavigator-asia.com/Business/Swiss-flavour-house-builds-Southeast-Asian-presence http://www.foodingredientsfirst.com/news/Firmenich-Extends-Period-of-Research-Funding-for-Senomyx-Sweet-Taste-Program.html http://www.foodingredientsfirst.com/headlines/Amyris-and-Firmenich-Announce-Expanded-Collaboration.html http://www.foodnavigator.com/Financial-Industry/Firmenich-invests-in-strategic-partnership-with-West-African-college

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Company	Acquisitions/Joint ventures	Investment in new facilities	Collaborative agreements	Refs
Frutarom	Acquired Savoury Flavours, Mannningtree, UK. Acquired Mylner, Brazil. Acquired Etol, Slovenia. Acquired JannDeRee, South Africa, which specialises in savoury flavours and sweet flavour solutions.	New flavour manufacturing facility in Shanghai, China focused on savoury flavours. Expansion of North Bergen, New Jersey plant in US for new filtration technology, HyperPure. Expanding facilities at Sittensen and Bramstedt in Germany for spice blends & seasonings, while closing its Loxstedt-Nesse spice refining facility where expansion was not possible.	Collaborating with University of Northumbria, UK, to identify new ingredients and flavour extracts from fish processing waste. Teamed up with Novel Creation to develop a new line of liquid supplements for health combining flavour and supplement expertise.	Flavour Horizons Issue 2, Summer 2012 http://www.foodnavigator-asia.com/Business/Frutarom-s-savoury-sway-for-China-and-SE-Asia http://www.nutraingredients-usa.com/Suppliers2/Frutarom-expands-capabilities-at-New-Jersey-plant http://www.foodnavigator.com/Science-Nutrition/Frutarom-fishing-around-for-flavours-with-UK-academics http://www.foodnavigator.com/Science-Nutrition/Frutarom-partners-Novel-Creation-on-liquid-supplements/?c=bMed5Lkp8p%252FLg77Z3s4wJFMvPjx0qFKX&utm_source=Newsletter_Subject&utm_medium=email&utm_campaign=Newsletter%252BSubject http://www.just-food.com/flavourings/Frutarom-to-create-future-proof-spice-refining-facility_c617.aspx http://www.foodingredientsfirst.com/news/Frutarom-Acquires-South-African-Flavor-Company-JannDeRee.html

Company	Investment in new facilities	Collaborative agreements	Refs
Givaudan	New production facility for savoury flavours in Mako, Hungary. New manufacturing facility dedicated to savoury flavours, in Nantong, China. Opened new Innovation Centre in Mumbai, India, expanding local capabilities and resources for creative flavour and taste solutions for Indian customers.	Collaborating with AkzoNobel Salt Specialties to address sodium reduction for processed meat. Collaboration with MIT on mathematical modelling for analysis of taste tests. Is financing the supply of certified healthy lavender plants from CRIEPPAM (a French fragrant plants research organisation) to the cooperative members of France Lavande.	http://www.foodnavigator.com/Financial-Industry/Givaudan-opens-130m-savoury-flavour-plant-in-Hungary http://www.foodingredientsfirst.com/headlines/Givaudan-Lays-Foundation-For-New-Savory-Facility-in-China.html http://www.givaudan.com/webcom/v/index.jsp?vgnextoid=b4f787bc4951d310VgnVCM1000004a53410aRCRD&vgnextchannel=c2391877c3917210VgnVCM1000005b53410aRCRD http://www.foodingredientsfirst.com/headlines/Givaudan-and-AkzoNobel-Salt-Specialties-Partner-on-Sodium-Reduction-Solution-for-Processed-Meat.html http://www.foodnavigator-usa.com/R-D/Givaudan-to-work-with-MIT-researchers-on-flavor-algorithms http://www.saaffi.co.za/index.php?page=newsletter129#Giv

Company	Investment in new facilities	Collaborative agreements	Refs
IFF	Opened liquid flavour and fragrance compounding site in Singapore and a sales facility in Delhi, India in 2012 and a new flavours manufacturing facility at Guangzhou, China in 2013. Expansion of manufacturing plant at Gebze, Turkey and a new creative flavour centre. Closure of fragrances ingredients manufacturing plant in Augusta, Georgia to consolidate production at other sites.	Collaboration with Amyris to develop and commercialise a specific set of renewable fragrance ingredients. Entered pre-production phase agreement with Evolva for a natural vanillin flavour produced through fermentation. IFF will commercialise the product and Evolva will receive royalties.	http://www.foodnavigator.com/Financial-Industry/IFF-and-Evolva-step-closer-to-commercialising-new-natural-vanillin http://phx.corporate-ir.net/phoenix.zhtml?c=65743&p=irol-newscenterArticle&ID=1792565&highlight= http://phx.corporate-ir.net/phoenix.zhtml?c=65743&p=irol-newsArticle&ID=1706787&highlight=shanghai http://www.foodnavigator.com/Financial-Industry/IFF-to-invest-50m-in-Turkish-plant-expansion http://www.foodingredientsfirst.com/headlines/IFF-and-Amyris-Form-Multi-Year-Collaboration-to-Commercialize-Sustainable-Ingredients.html http://www.foodingredientsfirst.com/news/IFF-Announces-Closure-of-Fragrances-Ingredients-Plant-in-Augusta-Georgia.html

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Company	Acquisitions/Joint ventures	Investment in new facilities	Refs
Kerry	Acquired Orley Foods in South Africa, the Cape Town-based sweet ingredient solutions supplier. Acquired Angsana Food Industries, Malaysia (which has a factory in Shanghai) a producer of meat marinades, seasoning mixes, spices etc. Acquired Food Spectrum Group in Brisbane, Australia, a specialist in aseptic fruit preparations, syrups/ toppings and formulated pre-mixes. Acquired Millenium Foods, Indianapolis, Indiana, a specialty dry ingredients and formulations supplier. Griffith do Brasil in Mogi das Cruzes, Brazil, a specialist manufacturer of meat systems, flavours and texturant systems was acquired. Acquired Big Train in Lake Forest CA, a specialist in liquid and powdered beverage concentrates.	Investing in technology and innovation centre in Naas, Co Kildare, Ireland, which will also be the regional HQ for Kerry Ingredients and Flavours. Opened a new emulsifier plant in Zwijndrecht, the Netherlands, to free capacity at its Asian emulsifier facility. Expanding Center of Excellence in Beloit, Wisconsin with New Cell Science Laboratory Serving the bio-pharma sector.	http://www.foodingredientsfirst.com/news/Kerry-Acquires-South-African-Sweet-Ingredient-Supplier-Orley-Foods.html www.kerrygroup.com/download.asp?id=194 http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=215572771 http://www.foodnavigator.com/Financial-Industry/Kerry-Group-to-invest-100m-in-new-innovation-centre-in-Ireland http://www.foodnavigator.com/Financial-Industry/Kerry-s-new-European-emulsifier-plant-opens-doors-in-Asia http://www.wmblair.com/News/William-Blair-News/2012/September/19/Millennium-Foods-LLC-Acquired-by-Kerry-Group-plc.aspx?overlay=1 http://finance.yahoo.com/news/nautic-partners-sells-big-train-120000335.html http://www.kerrygroup.com/page.asp?pid=93

Company	Acquisitions/Joint ventures	Investment in new facilities	Refs
Mane	JV with France Protéines Services has created a Meat Centre of Excellence.	Opened flavour production extension at la Sarrée in France. New creative centre in Accra, Ghana. New production plant in Sable-sur-sarthe, France for flavour, ingredients and additive blends.	http://www.mane.com/news

Company	Investment in new facilities	Refs
Robertet	Investing in Grasse manufacturing site in France, which includes food flavourings.	http://investincotedazur.com/en/newsletter/grasse-robertet-group-to-invest-several-million-euros-on-its-grasse-site&artid=act11015

Company	Investment in new facilities	Refs
Sensient	Opened new colour and flavour factory in San Paulo, Brazil. Investing in improved UK natural flavour and aroma production facilities at Bletchley, UK.	http://www.foodnavigator-usa.com/Suppliers2/Sensient-opens-new-color-and-flavor-factory-in-Sao-Paulo-Brazil http://www.foodmanufacture.co.uk/Manufacturing/Sensient-invests-13M-in-UK-flavour-facilities

Company	Investment in new facilities	Refs
Silesia	Opened Turkish subsidiary in Istanbul to service Turkish market.	http://www.silesia-aroma.com/en/establishment-silesia-turkey

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Company	Acquisitions/Joint ventures	Investment in new facilities	Collaborative agreements	Refs
Symrise	Acquired the global fragrance business of the Belmay Group in the US, an international developer and manufacturer of fragrances and perfume oils.	Opened a new flavour and fragrances centre in San Paulo, Brazil. Opened a new €10 m research centre in Holzminden, Germany for interdisciplinary exchange.	Signed joint Research and Development Agreement with Probi, a specialist in probiotics, on oral health applications.	http://www.foodingredientsfirst.com/news/Symrise-Acquires-American-Fragrance-Manufacturer-Belmay.html http://www.foodnavigator.com/Financial-Industry/Symrise-opens-Latin-America-facility http://www.symrise.com/en/news-media/press-releases/2013/detail/article/symrise-opens-new-research-center-in-holzminden.html http://www.foodingredientsfirst.com/news/Symrise-and-Probi-Sign-Joint-Research-and-Development-Agreement.html

Company	Investment in new facilities	Refs
Synergy Flavors	Plans to move into new flavour innovation and manufacturing campus in Wauconda, Illinois, US to expand production and accommodate recent acquisitions.	http://www.foodnavigator-usa.com/Suppliers2/Synergy-Flavors-plans-move-into-new-innovation-facility

Company	Acquisitions/Joint ventures	Investment in new facilities	Refs
Takasago	Announced JV with Ramanandraibe Export Co., the biggest Vanilla producer in Madagascar.	Set up a manufacturing and research facility at a new site in Poonamallee, Chennai, Tamil Nadu, India.	http://pdf.irpocket.com/C4914/JA1b/BJsv/Zzkr.pdf http://www.foodingredientsfirst.com/news/Takasago-Jumpstarts-Production-RD-Operations-in-India.html

Company	Acquisitions/Joint ventures	Refs
Virginia Dare	Established a JV (Wei yi wei de) with We-e Flavors of China for a new flavour company based in Shanghai with flavour creation, product application and production capabilities.	http://newhope360.com/mergers-amp-acquisitions/shanghai-gets-new-flavor-company

Company	Acquisitions/Joint ventures	Investment in new facilities	Refs
Wild	Has acquired Cargill's global juice blends and compounds business. Production & storage facilities are located in Amsterdam, Holland, Port Elizabeth, US and Chiba & Kashima in Japan.	Launched new Global Research & Innovation Group in Zug, Switzerland. New facility in Mumbai will feature a lab for beverage applications. Expanded presence at its mint manufacturing site at Tarapur in Maharashtra with new production unit for fruit flavours. Opened its first sales office in Singapore.	http://www.wildflavors.com/?fuseaction=news.item&newsCategoryID=CEC1FDC1-E081-2F43-D489C80083CB50A1&newsItemID=E5E905A7-0B48-B6EF-16702CAFF64BC87C http://www.foodingredientsfirst.com/headlines/WILD-Progressing-on-Emerging-Markets-Strategy.html http://www.beveragedaily.com/Manufacturers/Cargill-agrees-sale-of-juice-blends-and-compounds-business-to-Wild-Flavors

Company	Acquisitions/Joint ventures	Refs
Wilmar International	Acquired strategic investment in Blue Pacific Flavours in the US, a fruit flavours specialist.	http://www.prnewswire.com/news-releases-test/blue-pacific-flavors-announces-strategic-investment-by-wilmar-international-limited-138557679.html