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# Developments in Flavors and Flavorings

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**T**he flavor industry is a service industry directly relying on the food, beverage and related consumer product manufacturers for its outlets. The products themselves are dictated by the needs of the users. Although these industries have been somewhat less affected by the recent recession, there has been a significant cutback in development activities and an even greater reduction in the financing of longer-term research projects. The cost of introducing a new product onto the market is now more expensive and the potential for successful sales is much less secure than it was five years ago.

In line with other aspects of business, many manufacturers have computerized their product formulations and material stock controls so that the introduction of a new flavoring material or product is not received enthusiastically unless it shows outstanding quality attributes. It can not merely match something that already exists from another supplier. New flavor products have to be unusual in their profiles. They must have highly desirable technological advantages and unrestricted availability at a cost saving to offset the expense of administrative change of existing computer data and to offer economic advantages in real terms. This is asking a lot of any new flavoring and is why the flavor industry is not making as much headway as it would like.

The indications are that it will take an enormous upturn in the economy before the marketing attitudes for new food products change; until this happens the flavor industry must patiently improve its products and continue to work in close harmony with the development departments of the user industries.

Anyone with a knowledge of the flavor indus-

try agrees that its members are not renowned for trumpeting their achievements from the rooftops. Rather they beaver away steadily, yet positively, to provide their customers with constantly better flavorings designed to satisfy a particular customer or technological need.

A comparison of flavorings currently available with those being offered a decade ago show enormous advances in flavor profiles. Over the years there has been a significant move towards more 'true to nature' products and also the introduction of many new flavorings based on unusual natural materials. There will continue to be a large demand for the traditional flavors, but as the food industry tries to stimulate new interest, particularly in convenience foods, there will be an even greater need for new flavoring experiences.

The flavor industry is composed of a few giants, a somewhat larger number of medium-sized companies and numerous smaller companies which may serve only a region or particular type of manufacturer. Although the major international companies have many advantages in running their often complex operations, it is the company which provides the best and most reliable service to its customers that will ultimately succeed. Confidence is of the greatest significance in the supplier-user relationships of the flavor industry.

Whatever the size of the company, all depend on progressive product development. The bigger companies have their own R & D laboratories fully equipped with all the latest instrumental means for advanced research into flavor chemistry, and a highly trained staff. Others have only a limited R & D capability and

prefer to invest in technological applications using the published results of university research, patents and other such sources for their essential data.

Whether the effort be long- or short-term the objective is the same—to create flavorings that will capture the imagination of the development and marketing staffs of food manufacturing companies, offer technological advantages in use either to improve existing end products or enable the creation of new ones, yet be more cost effective than existing flavoring materials. This calls for a considerable awareness of the state of the art in flavor chemistry. A real understanding and preferably first-hand experience of the user technologies affect flavoring applications. A feeling for consumer preferences and attitudes for the safety of synthetic chemicals in foods is also required.

### Technological Parameters

So much of the flavor industry's efforts are geared to the user technologies. It is reasonable to examine these to see what developments have taken place and what further changes may arise over the next decade. Even in the United States, where throughput is so much bigger than in the European food processing plants, many manufacturers have re-equipped to handle large-scale batch processing or in some cases continuous or automated processing wherever a product line warrants it.

With the exception of localized manufacturers the practice of making innumerable relatively small batches of specialized products to satisfy a limited market demand is now being progressively rejected in favour of a shorter product list, wider marketing of 'standard' products coupled with streamlined and computerized handling of production, stock and cost data. With a cutback in available money to the consumer there is now much less chance of another new product finding space on the supermarket shelves, let alone 'taking off,' unless it is very expensively promoted by TV and other forms of advertising. In consequence, new product ideas are now much less likely to survive the hypercritical reviews, trials and test markets through which such developments are now subjected as a matter of routine.

When the long-awaited upturn in the economy does arrive it is not likely to result in any significant change in attitudes towards new product launches. Inevitably, the flavor industry, in order to remain in a growth situation, will find it

progressively necessary to develop flavoring systems purpose-designed to create optimum flavoring effects within given processing parameters. Some of these have proved particularly troublesome in the past, e.g., extrusion, UHT sterilization.

Alternatively flavorists must make better and more imaginative use of the enormous amount of research data being published on flavoring components of a wide spectrum of natural flavouring materials. New imitation flavorings will need to be really 'true to nature' and possess the often undefinable characters of the natural product even if this does mean complicated formulations and the use of unfamiliar synthetic chemicals.

Where then have the main technological advances been made? Briefly, in the following areas:

- better utilization of otherwise neglected but nutritious food materials, the flavor of which may require modification to make them acceptable to consumers (e.g., fish)
- the employment of enzyme systems to convert unwanted by-products (e.g. milk whey) into desirable food ingredients
- continuous development of novel sources of vegetable protein
- improved plant hygiene and aseptic packaging to reduce heat damage using continuous-formed and other novel containers
- production of materials aimed at improving the textural attributes of processed foods, particularly those sold in dehydrated forms for consumer convenience
- use of microwave cooking in place of traditional high temperature cooking in the home or service restaurant
- product reformulation for dietary requirements, particularly reduction in salt and sugar contents

These reflect a growing concern by manufacturers:

- the high cost of energy and the need to reduce its use wherever possible
- the deleterious effects of certain processing techniques on the nutritional value of foods
- the need to appraise new forms of end-product packaging and distribution to reduce costs and increase consumer convenience in storage and preparation
- the increasing intrusion of legislation into food formulation and labeling and the no-doubt well-intentioned but unproductive

proliferation of restrictive legislation aimed at consumer protection

All of the above considerations offer a challenge to creative flavorists and applications technologists. Even though there are no specific positive listings of synthetic flavoring materials in most developed countries, there is an increasing demand by food manufacturers for flavorings containing only chemicals included in one or other of the various 'GRAS' listings, e.g., FEMA, Council of Europe, IOFI. In Europe the trend is towards a wider acceptance and rational use of flavorants which can be classified as 'nature-identical' and to restrict the use of those which are as yet not found in nature under the classification 'artificial.' Unfortunately several other views are currently held. Until some basis for agreement is reached by law-makers, flavor industry, food manufacturers, informed consumer interests and even, possibly, the media, the problems of creating internationally acceptable flavorings will persist to the detriment of producers and consumers alike.

The food and flavor industries are not unanimous in their opinions on future trends. Dis-

cussions with technical and commercial staffs involved in many different branches of food processing agree that basically there has been very limited technological change on the factory floor over the last five years although theoretical knowledge and plant design has improved. Most admit that they now know much better the underlying reasons for certain procedures which until recently have been carried out by 'rule of thumb.' A scientific understanding of process technology and the implications of computerized control systems have greatly improved cost effectiveness. Coupled with a direct and close collaboration with the flavor industry to resolve problems of flavoring applications, this has inevitably resulted in end products having a better flavor quality, increased shelf life, more convenience for the consumer and improved marketing prospects.

#### Flavor Industry R & D

The flavor and fragrance industries (the two being so frequently associated) are recognized for the high quality of their R & D efforts. Without doubt the food, beverage, cosmetic and toiletries industries have benefited to a consid-

Chemical or Type of Chemical Covered	Patentee or Assignee	Country	Patent Number	Usage Claim
Acetals of 2-methyl-2-pentenal	IFF Inc.	USA	4,198,393	flavor modifier
Acetals of 2-nonenol or 2-nonenal	—	Japan	39463/79	coffee flavor enhancer
Linear acetals	IFF Inc.	Japan	37784/81	green, sharp strawberry flavor
Acetolactic acid	Svenska Mejeriemas	Germany	3,021,379	edible fats & butter improver
2-Acetyl pyrazines	Firmenich SA	Germany	1,793,846	coffee flavor modifier
3-Acetyl-2,5-dialkyl furans or thiphenes	IFF Inc.	Japan	25824/80	nut-like flavors
Acetyl hydrindacenes	IFF Inc.	USA	4,209,543	pear, peach & apricot flavors
		USA	4,305,967	
Acetyl indanes	IFF Inc.	USA	4,305,967	pear, peach & apricot flavors
2-Acetyl pyrazines	Firmenich SA	Germany	1,793,846	coffee flavor modifier
Acetyl pyridine compounds (specified)	Firmenich SA	Germany	1,793,847	coffee aromatization
$\alpha$ , $\beta$ -unsatd. aldehydes (2-methyl-oct-2-ene aldehyde)	Firmenich SA	UK	2,025,198	fried meat flavors
$\beta$ -unsatd. aldehydes (specified)	Firmenich SA	USA	4,324,809	meaty flavors with oily-green notes
Pyridine aldehyde compounds (specified)	Firmenich SA	Germany	1,793,847	coffee aromatization
4-Acyl-pyrimidine derivatives	Firmenich SA	UK	1,561,121	meat flavor modifier
Polyunsatd. aliphatic esters	Firmenich SA	USA	4,304,794	feedstuff flavor modifier
2-Alkenyl-cyclopentenones	Takasago Perfumery KK	Japan	21171/82	flavor modifier
Synthetic alkylamines (mixtures)	Unilever NV	Japan	24873/80	ripened cheese aroma
2-Alkyl-4,5-dialkyl- $\Delta^2$ -thiazolines	IFF Inc.	USA	4,256,776	walnut-like flavors
Alkylcyclohexenones and their exo-cyclic hydrogenation products	Givaudan & Cie SA	UK	1,566,092	spice-like and fruity flavors
Alkyl esters of 3,5-hexadien-1-ol	Firmenich SA	UK	2,035,799	fruit-like flavors
9—12C alkyl-hydroxy acids (heated)	Soda Sangyo Co.	Japan	31/80	milk-like flavors
$\alpha$ -substd. alkylidene methionals	IFF Inc.	USA	4,179,526	flavor enhancer

## Developments in Flavors

Chemical or Type of Chemical Covered	Patentee or Assignee	Country	Patent Number	Usage Claim
Lower alkylquinoxalines	Firmenich SA	Germany	1,793,845	coffee flavor modifier
Allyl thiobenzoate	IFF Inc.	USA reissue	30,370	flavor enhancer
Allyl thiopropionate	IFF Inc.	USA reissue	30,370	flavor enhancer
trans-Anethole	Unilever NV	Germany	2,331,522	Gouda cheese aromatization
L-Asparagyl-L-phenyl alanine methyl ester	General Foods	Japan	49542/81	fruity taste and aroma
Benzenethiol and aromatic sulfur compds.	Firmenich SA	Germany	1,793,848	coffee flavor modifier
Benzdionone compds.	IFF Inc.	USA	4,241,097	flavor and aroma enhancer
Benzofuran derivatives (specified)	Firmenich SA	Germany	1,793,842	soluble coffee aromatization
Bornyl ethyl ether	IFF Inc.	USA	4,252,828	woody, eucalyptol-like flavors
6-n-Butyl-5,6-dihydro-(2H) pyran-2-one	Firmenich SA	UK	2,035,083	fruit-like flavors
transesters of Caproic acid with specified fats or oils	Fuji Oil KK	Japan	39300/80	fruit-like flavors
Carboalkoxy alkyl norbornanes	IFF Inc.	USA	4,312,888	flavor enhancer in chewing gum
Carboamidoalkyl norbornanes (specified)	IFF Inc.	USA	4,329,373	grapefruit flavor enhancer
Carvyl methyl ether	IFF Inc.	USA	4,223,046	root beer flavor enhancer
Caryophyllene alcohols (mixed)	IFF Inc.	USA	4,250,201	flavor enhancer
cis and trans-Cinnamaldehyde isomers	Firmenich SA	UK	2,045,076	replacement for cassis, woody flavors
Cycloaliphatic unsatd. ketones (specified)	Firmenich SA	USA	4,226,892	fruity, herb-like, winey flavors
Cyclohexene methanol lower alkyl esters	IFF Inc.	USA	4,217,371	flavor enhancer
Cyclopentanone derivatives	Firmenich SA	USA	4,173,584	flavor modifier
Cyclopentyl thiopropionate	IFF Inc.	USA reissue	30,370	flavor enhancer
2- and 3-Cyclotetradecen-1-one derivatives	IFF Inc.	USA	4,183,965	bitterness depressant
2- and 3-Cyclotetradecen-1-ones	IFF Inc.	USA	4,224,352	pear flavors
8-p-Cymenyl ethyl ether	IFF Inc.	USA	4,275,080	herbal flavors
6-Deoxyaldohexoses and $\alpha$ -amino acids	Unilever NV	Japan	51538/80	flavoring for margarine
2,5-Dialkyl-dihydro-furanones	IFF Inc.	UK	2,026,482	variety of flavor effects
2,4-Dialkyl-dihydro-furanones	IFF Inc.	USA	4,234,616	flavor enhancer
Dialkyl- $\alpha$ - $\beta$ -diacyl succinates	Fritzsche Dodge & Olcott	USA	4,200,659	flavor modifier
2,5-Dialkyl-2,5-dihydroxy-1,4-dithianes	IFF Inc.	Japan	29986/81	meat-like flavors
Dihydrochalcone	Torey Co.	Japan	27790/80	improvement of flavor of brine salts
$\alpha$ -Dihydroionone	Firmenich SA	UK	2,024,600	raspberry & strawberry flavors
Dihydronormethyl jasmonate	IFF Inc.	USA	4,294,863	Guava flavor improver
4,7-Dihydro-2-(3-pentyl)-1,3-dioxepin	IFF Inc.	UK	1,605,049	} Chocolate-like flavors
		UK	1,605,050	
2,5-Dimethyl-3-acetylfuran	IFF Inc.	USA	4,263,331	hazelnut flavor
Dimethylcyclohex-3-enyl-methyl ketones	Firmenich SA	Japan	22066/80	flavor modifier
2,5-Dimethyl-4-hydroxy-3-(2H) furanone	Unilever NV	Germany	2,335,469	flavor enhancer for heated foods
2-subst. 4,5-Dimethyl- $\Delta^3$ -thiazoles	IFF Inc.	USA	4,243,688	nut-like flavors in chocolate
3,3-Dimethyl-2-norbornane-methanol compds.	IFF Inc.	UK	1,596,309	piney notes
3,5-Di-(2-methylpropyl) 1,2,4-trithiolane	IFF Inc.	USA	4,263,331	hazelnut-like flavors
		USA	4,293,579	flavor modifier
		USA	4,307,122	flavor modifier
cis-10,10-Dimethyl-tricyclo [7,1,1,0]-undec-2-en-4-one	Firmenich SA	USA	4,307,122	
Dioxolan derivatives (specified)	Givaudan & Cie SA	Japan	12908/80	butter & fruit-like aromas
Dioxolanes (specified)	IFF Inc.	USA	4,315,952	flavor enhancer
2,4-Dithiopentane	Unilever NV	Germany	2,331,522	Gouda cheese aromatization
1,2- and 1,3-Dithiolanes and dithianes	IFF Inc.	Japan	20664/80	flavoring agent
1,4-Epoxy-1,3,3-trimethyl-2(2-buten-1-ylidene) cyclohexanes	IFF Inc.	USA	4,256,776	walnut-like flavors
1-Ethoxy-1-ethanyl acetate-aldehyde mixtures	IFF Inc.	USA	4,348,416	flavor enhancer
6-Ethyl-5,6-dihydro-(2H) pyran-2-one	Firmenich SA	UK	2,035,083	fruit-like flavors
Ethyl 3-mercaptopropionate	General Foods	USA	4,329,372	Concord grape flavor
Ethylidene cyclopentanol compds.	Firmenich SA	UK	2,071,101	woody flavors

Chemical or Type of Chemical Covered	Patentee or Assignee	Country	Patent Number	Usage Claim
Fenchyl ethyl ether	IFF Inc.	USA	4,246,287	lemon flavor enhancer
2-Formyl pyrazines	Firmenich SA	Germany	1,793,846	coffee flavor modifier
Geranyl butyl ether	IFF Inc.	USA	4,250,194	citrus, floral & rose-like characters
Heptanone ether derivatives	IFF Inc.	UK	1,596,251	flavor enhancer
cis-3-Hexenal; trans-2-hexenal; cis-3-hexenyl formate; cis-3-hexenyl; cis-3-hexenoate	IFF Inc.	USA	4,241,098	flavor enhancer
cis-3-Hexenol derivatives	Hasegawa Co.	Japan	16781/81	flavoring agent
3-Hydroxy-(4H) pyranone-4 derivatives	Otsuka Kagaku Yakuhin	Japan	40551/79	flavoring agent
1-Hydroxy-1-ethynyl-2,2,6-trimethyl cyclohexane	IFF Inc.	USA	4,284,654	aroma and taste augmentation
Indane alkanols	IFF Inc.	USA	4,315,951	flavor enhancer
Ionone mixtures	Firmenich SA	USA	4,247,572	fruit-like flavor enhancers
Ionone-cyclohexene derivatives	Givaudan & Cie SA	UK	2,001,055	flavoring agent
2-Isobuty-dialkyl oxazolines	IFF Inc.	USA	4,191,785	flavor enhancer
2,4,6-Tri-isobutyl-1,3,5-trioxane	IFF Inc.	UK	1,605,049	chocolate-like aroma
		UK	1,605,050	
$\alpha$ -Isogeranyl alkyl or aryl esters	Hasegawa Co.	Japan	4735/80	flavor modifier
2-Isopropyl-4-methyl-thiazole	PFW	UK	1,557,382	peach flavor
Ketones (specified)	IFF Inc.	USA	4,321,255	flavor augmentation in chewing gum
Maltol-2-methyl pentenoates	IFF Inc.	USA	4,168,900	flavor enhancer
8-Mercapto-p-menthan-3-ol	Givaudan & Cie SA	Germany	2,152,015	flavor modifier
2-Methoxy-3-ethyl piperazine and 2-methoxy-3-alkyl piperazine compds.	BBA	UK	1,571,005	parsley flavors
2-Methyl-4-acyl-pyrimidine derivatives	Firmenich SA	UK	1,561,121	meat flavor modifier
2-Methyl-6-ethoxypyrazine	General Foods	Japan	1063/81	pineapple-like flavor
4-Methyl-4-furfurylthio-pentanone-2	Naarden Intl. NV	USA	4,230,734	flavor modifier and enhancer
Methyl-3(methylthio)thiopropionate	IFF Inc.	USA reissue	30,370	flavor enhancer
Methyl-(methylthio)methyl furan acrolein compds.	Firmenich SA	Germany	2,614,797	flavor modifier
2-Methyl-oct-2-ene aldehyde	Firmenich SA	UK	2,025,198	fried meat flavor improver
5-Methyl-3,5-octadien-2-one	IFF Inc.	USA	4,301,184	flavor modifier
7-Methyl-oct-3-en-2-one	Firmenich SA	USA	4,337,277	flavor modifier
unsatd. 2-Methylpentanoic acids and esters	IFF Inc.	Germany	2,530,227	flavoring agents
2-Methyl-2-pentenal cyclic acetals	IFF Inc.	USA	4,198,393	flavor modifiers
2-Methyl-2-pentenoic acid	IFF Inc.	USA reissue	30,363	flavor enhancer
cis-2-Methyl-3-pentenoic acid	IFF Inc.	Japan	37784/81	green, sharp, strawberry flavor
2-Methyl-4-n-propyl-1,3-oxathiane or its sulfoxide	Firmenich SA	USA	4,262,030	flavor modifier
Methyl substd. norbornane carboxaldehydes	IFF Inc.	USA	4,335,152	flavor enhancer
3-Methyl-1,2,4-thiane	Firmenich SA	UK	2,010,263	flavor modifier
Methyl-thiobutyl-trimethyl-cyclohexene or its cyclo hexidene analog	IFF Inc.	Germany	2,808,710	flavor modifiers
3-Methyl-1,2,4-trithiane	Firmenich SA	USA	4,247,571	roasted and grilled flavor notes
2-Methyl derivatives of thiopanone-3	Firmenich SA	Germany	1,793,848	coffee flavor modifier
Methyl thiomethyl esters (specified)	PFW BV	USA	4,332,829	flavor modifiers
Musk isochroman compds.	IFF Inc.	USA	4,250,200	pear flavor enhancer
2-N-alkyl-cyclopentanone derivatives	Firmenich SA	Germany	2,721,002	peach and apricot-like flavors
2-Nonenol and 2-nonenal acetals or esters	—	Japan	39463/79	coffee flavor enhancers
Normethyl jasmonate	IFF Inc.	USA	4,294,863	guava flavor enhancer
Norbornane carboxaldehyde derivatives	IFF Inc.	USA	4,335,152	flavor enhancers

## Developments in Flavors

Chemical or Type of Chemical Covered	Patentee or Assignee	Country	Patent Number	Usage Claim
2-Oxabicyclooctane derivatives	IFF Inc.	USA	4,195,099	} flavor enhancers
		USA	4,195,100	
		USA	4,197,328	
1-Oxa-spiro-4,5-decan-6-ol and esters	Firmenich SA	Germany	2,559,751	flavor modifiers
		Japan	23062/80	flavor modifiers
Oxathiolanes	Firmenich SA	Japan	48778/80	flavor modifiers
2-Phenylethyl-ethyl-disulfide	Givaudan & Cie SA	UK	1,552,857	flavor modifier
2-Phenyl-3-(furfur-2-yl)-prop-2-en-1-al Propylthiobenzoate; propylthiopropionate	Firmenich SA	Germany	2,614,797	flavor modifier
	IFF Inc.	USA reissue	30,370	flavor enhancer
Pyrazine compds. (specified)	Firmenich SA	Germany	1,793,844	coffee flavor modifier
Pyrazine derivatives (specified)	IFF Inc.	Japan	6633/80	flavor modifiers
Pyrazine derivatives (specified)	Firmenich SA	USA	4,303,689	flavor modifiers
2-Pyrazinyl-3-furyl sulfides	IFF Inc.	UK	1,551,326	meat flavor enhancers
Pyridine derivatives (specified)	Firmenich SA	Germany	1,793,843	coffee flavor modifier
Pyridine aldehyde compds. (specified)	Firmenich SA	Germany	1,793,847	soluble coffee aromatization
Quinic acid	Takasago Perfumery KK	Japan	50555/81	improved flavor in acid foods
Spirane derivatives (specified)	Firmenich SA	USA	4,218,488	woody, amber-like, earthy flavors
Stevioside mother liquors from crystallization	Sanyo Kokusaku Pulp	Japan	35090/80	astringent flavor improvement
Aromatic Sulfide compds.	Firmenich SA	Germany	1,793,843	coffee flavor modifiers
Aromatic Sulfur compds. of stated structures	Firmenich SA	USA	4,220,660	flavor modifiers
$\alpha$ -Terpinyl methyl ether	IFF Inc.	USA	4,255,155	sweet, vegetable, celery-like flavors
2,6,1',6'-Tetrachloro-2,6,1',6'-tetra-deoxy-mannosucrose	Tate & Lyle	UK	2,036,007	bittering agent
Tetra-hydrobenzofuranone derivatives (specified)	Haarmann & Reimer GmbH	Germany	3,017,068	coumarin substitute
Tetramethyl-oxaspiro-decadiene compds.	Firmenich SA	UK	1,561,121	flavor modifiers
Tetramethyl-2-oxabicyclo(2,2,2)octane	IFF Inc.	USA	4,269,862	flavor enhancer
3,7,11,11-Tetramethyl-spiro (5,5)undeca-8-en-1-one	Takasago Perfumery KK	Japan	21170/82	flavor modifier
Thiaalkane-thiols	Unilever NV	Germany	2,149,682	meat-like flavors
Thiazole compds. (specified)	Firmenich SA	Germany	1,793,852	coffee flavor modifiers
2,4,5-Trialkyl-dihydro-furanones	IFF Inc.	UK	2,026,482	} flavor enhancers
		USA	4,234,616	
2,4,6-Triisobutyl-1,3,5-trioxane	IFF Inc.	USA	4,191,785	} flavor enhancer
		USA	4,260,641	
		USA	4,235,938	
2,4,6-Triisobutyl-dihydro-1,3,5-trithiazine	IFF Inc.	USA	4,235,938	bacon and caramel flavors
2,4,4-Trimethyl-3-(buta-1,3-dienyl)cyclohex-2-en-one	Givaudan	USA	4,311,718	flavor enhancer
2,5,5-Trimethyl-hepta-2,6-dienal or its lower alkyl acetals	General Foods	Japan	22538/82	coffee flavor enhancer
2(2,2,6-Trimethyl-1-cyclohexen-1-yl)ethen-1-ol esters	IFF Inc.	UK	1,549,731	flavor modifier
2,2,6-Trimethyl-1-cyclohexen-1-vinyl alkanoates	IFF Inc.	Japan	45902/81	damascenone-like flavors
Trimethylcyclopentenyl ethyl and ethylidene cyclopentanol compds.	Firmenich SA	UK	2,071,101	} woody flavors
		Germany	3,049,802	
2,6,6-Trimethyl-3-oxacyclohex-1-ene carboxaldehyde	Firmenich SA	UK	1,570,539	sweet, woody flavor notes
2,6,6-Trimethyl- $\alpha$ -propenyl-1,3-cyclohexadiene-1-methanol compds.	IFF Inc.	USA	4,275,087	flavor enhancers
Thiophanone or its 2-methyl derivatives	Firmenich SA	Germany	1,793,850	coffee flavor modifier
Thiosulfonates (specified)	Naarden Intl. NV	Germany	2,145,177	onion-like aromas
Vinyl ethers	Hercules Inc.	UK	1,595,141	citrus juice flavor enhancer

**Table I. Flavor Related Patents**

<u>Patents</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
Flavor chemical applications	36	30	31
Reaction flavors	8	6	3
Processes	12	13	5
Seasoning compositions	6	13	12
Sweeteners	26	18	19
Other flavors and applications	3	8	14
Food colorants	9	12	16
<b>Total</b>	<b>147</b>	<b>148</b>	<b>127</b>

Patentees

Major flavor manufacturers

International Flavors & Fragrances	13%	16%	16%
Firmenich SA	16%	9%	6%
Givaudan	3%	0.7%	5%

Major food manufacturers

Nestle SA	6%	3%	0.8%
General Foods	2%	2%	6%

Source: Food Technology, 1980/81/82. "Food Patents under Flavors and Colors."

erable extent. But, unlike the universities, industry is not anxious to place the results of its research into the hands of competitors and hence the level of published information from this source is necessarily low. In many industries the exploitation of R & D effort is safeguarded by the publication of easily controllable patents. But, from the plethora of closely similar imitation flavorings which are currently being offered, one wonders just how secure this view may be for the flavor and fragrance industries.

It is interesting that one does not read of any major patentee pursuing undoubted rights through the courts; perhaps the burden of proof is too costly and not really worth the hassle involved. To most members of the industry the patent approach to safeguarding novel applications of flavorants is much less acceptable than unpublished secrecy. The difficulties of proving that any particular aromatic chemical has been used in a highly complex mixture commonplace in compounded flavorings and fragrances are apparent.

A review of the patents published on flavoring topics from 1980 through 1983 reveals that the patenting of flavor applications accounts for more than 30% of the total and that the patent process is employed by relatively few major flavor and fragrance houses. A summary of the data is given in Table I.

Out of the very large number of major chemical companies known to be actively involved in R & D these low figures clearly indicate that there are mixed views about the value and practicability of patenting new chemicals for use in flavorings and/or fragrances or for their specific applications. Most prefer to retain their acquired knowledge making use of specialty chemicals without the publicity associated with patenting. Perhaps those who do patent are looking further ahead when advancing instrumental techniques will made policing easy and worthwhile.

Salvadori (1982), reviewing the effects of patenting in the fragrance industry, concluded that the judicious use of patents offered many advantages to the patentee, did not repress research activities and was still the best way of establishing legal proprietary rights for new chemicals, novel applications and new demonstrable sensory effects. Only time will tell whether the industry will fundamentally change its attitude and be prepared to contest through the courts its rights established by patent.

Obviously, patents only provide a limited selection of industrial research results but there is sufficient evidence to give one a clear indication that the search for new methods of synthesizing aromatic chemicals, whether these be nature-identical or artificial, is still being actively pursued. The flavor industry is constantly seeking to achieve better flavoring effects and more 'true to nature' flavorings. Heath (1981) listed the patents for flavoring substances published between the years 1970 and 1979 and since then the list has been extended. Presently, there is no legal restriction in Britain to the use of new flavoring substances in food flavoring compositions, but the industry is its own watchdog and well aware of the need to ensure safety in use even at the very low ADI levels normally associated with compounded flavorings.

### Academic Research

The last three years have seen a continuation of research into the aromatic and non-volatile constituents not only of the well recognized plant materials but of an increasingly wide range of other less well known species of flavoring and fragrance materials. These will be the subject of specific reviews in future articles.

### References

- H. B. Heath, *Source Book of Flavors*. AVI Publishing Company, Westport, CT, 1981 Chapter 12, pp 436-457
- G. Salvadori, Patents and fragrance formulations: Are they compatible? *Perf. Flavor.* 7(2), 51-56 (Apr/May 1982)

