Vol. 7 No.1 December 2004

Chemo Sense

EDITORIAL: OUR 25TH ISSUE

Nobel Prize for Chemical Senses

By Graham Bell

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A palpable ripple of excitement spread through the chemosensory community in 1991. It was caused by the publication in *Cell* (65, 175-187) of Linda Buck's and Richard Axel's paper on "a multigene family [that] may encode odorant receptors: a molecular basis for odor recognition". The olfactory receptor molecule had been discovered.

I was on my way to AChemS, from Australia via Japan, and heard about it on the phone from an excited Kensaku Mori. A couple of days later, I reached Atlanta and found that at Emory University (John Scott, et al), a special seminar had already been held attended by many physiologists, anatomists and

cont. pg 8

Global 'Sensory-Based' Segmentation

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Summary

Global segmentation reveals groups of like-minded people around the world, with these segments transcending political boundaries. The same segments exist country to country, albeit in different proportions. Sensory segmentation at the actual taste/ingestion level guides the development of actual products. 'Sensory' segmentation at the cognitive level revealed through concepts, guides the development of product ideas world-wide. Proper use of segment information creates world brands targeted to the segments, with the world brands appropriately and modestly particularized to the consumer needs in each particular country.

The Emerging World Market

As the new century develops our international marketing and research communities announce with increasing frequency a single world of consumers, divided by geo-political boundaries, but sharing product and service preferences. Boundaries for products and services exist, but transcend the traditional political ones. These preference groups constitute global segments. One can easily recognize political boundaries, but not as easily recognize and then profit from 'preference boundaries'.

cont. pg 2

INSIDE:

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ISSN 1442-9098

Global 'Sensory-Based' Segmentation continued

At a practical level we have not yet reached the stage where we can easily customize a product for a single person, no matter what the business books preach, and no matter how much we pay our business pundits and wise men to prophesy. Yet, the time when Henry Ford could dictate that all car colors must be black has also long passed. Marketers now face a dilemma - everyone wants a customized product, but good business senses prevents most motivated marketers from succumbing to the temptation to create and market such a product.

One feasible alternative creates a set of products to fit a limited group of people. Each different group of people constitutes a segment. The researcher must discover these segments in the population, guide the developer how to create the product, and counsel the marketer how to sell it. To the degree that these limited groups exist worldwide, albeit in different proportions across countries, the researcher, developer and marketer will have uncovered global segmentation. The next natural step uses this global segmentation to create targeted services and products.

Segmenting consumers on the basis of sensory preferences presents a useful organizing principle by which to divide people. Rather than looking at lifestyles and psychographic differences, which is a popular method among marketers, sensory segmentation divides people by the features they like in products. A cursory review of the psychophysics literature reveals that researchers have long known that people differ in what they like or dislikes. This observation by itself simply extends our knowledge of individual differences. Engel in Germany almost 80 years ago (1928), Ekman in Sweden forty years ago (1964), and Pangborn in the US almost thirty five years ago (Pangborn, 1970) all reported that individuals differed in liking of sweet and salt tastants. These individual differences are just as marked when it comes to food acceptance, exhibited ether in surveys or demonstrated far more clearly in the array of different products in any local supermarket.

The best way to understand global segmentation uses case histories. Case histories reveal the marketer's mind, the product developer's creativity, and the market researcher's toolbox. We deal here with two cases: orange juice and coffee. For orange juice we will see how the researcher can identify different segments based upon actual responses to products For coffee we will see how the researcher can identify different segments based upon the response to concepts.. The segmentation exercise provides interesting insights for both science and business. For the chemosensory science segmentation provides a tool that links together organizing principles from basic research with practical industrial application.

Underlying rules of segmentation

It's not sufficient to observe individual differences and record the patterns without an organizing principle, as Pangborn, Ekman and Engel did in their pioneering work. It's critical now to have an organizing principle which goes beyond the data to suggest rules by which nature works. Segmentation into groups of individuals is certainly one way to do this, but the segmentation must be governed by scientific principles, not by mere expediency..

Hedonics, the study of likes and dislikes, provides the researcher with a key dimension of human behavior on which to create a segmentation scheme. We know from basic research that as a stimulus increases in intensity liking first increases, peaks at an optimum sensory level, and then decreases with further sensory increase. This inverted U (or occasionally V) shaped function emerges most clearly for simple stimuli like sugar, but it also appears in foods. Indeed, product developers attempt to identify that optimal spot to ensure consumer acceptance. We see this average inverted U shaped function schematically portrayed by Figure 1 (left panel). However, if we were to run individual respondents we would find that the nicely behaved function really

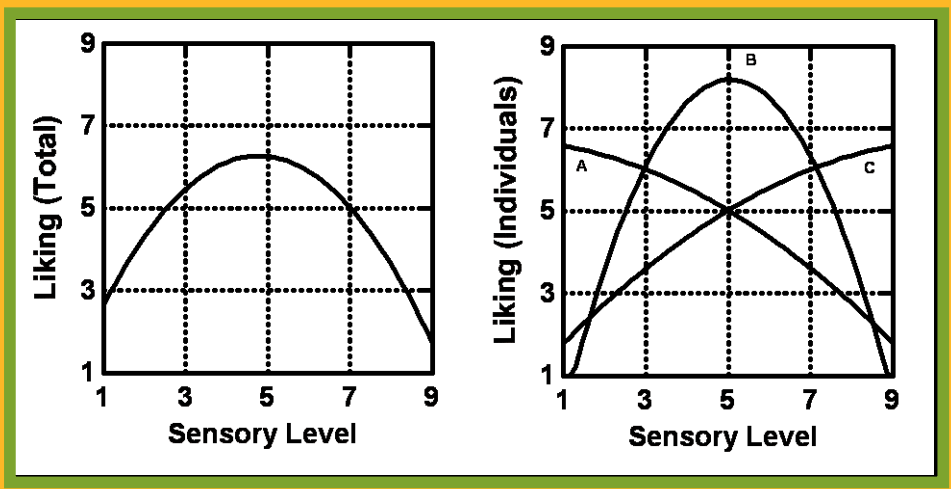

Figure 1: Schematic of the inverted U shaped curve for total panel and for individuals

cont. pg 3

Global 'Sensory-Based' Segmentation continued

becomes the average of a distribution of different functions, shown schematically by Figure 1 (right panel).

Psychophysicists look for generalities. It is not surprising that our psychophysicists were content to report the average and then to look at individual differences. Those differences were curiosities, to be reported, just as scientists report the variability and speculate on the cause of variability without pursuing the matter any deeper. In fact, it would take the commercial application of hedonic scaling to drive the notion of segmentation forward to its application.

Continuing the analysis we might find that it is possible to locate the observers in different groups based upon the patterns of their curves. The initial attempts at sensory segmentation attempted to classify the observers by the shapes of their patterns. These attempts were unsuccessful because there were no simple rules to define the patterns. A more tractable approach was to identify the sensory level (or ingredient) level for each individual corresponding to that individual's optimum level of liking. This single number could then be used to define each person as a location along the sensory scale, shown in Figure 2.

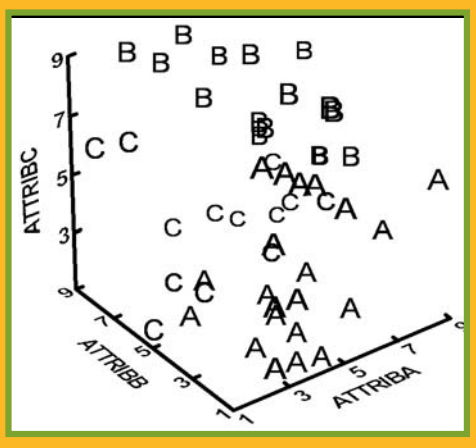

Figure 2: Distribution of optimal levels and segments. Each person, corresponding to a letter, is located in a region of the three dimensional space corresponding to his 'optimal sensory level'. Respondents in the same segment have the same letter.

From there it became very simple to cluster the individuals. For the more complicated stimuli in the food world, one could identify optimal levels for different sensory continua. Each person would have a vector of numbers, with those numbers representing the person's optimum level on a series of numbers. The same mathematical clustering (k-means; Systat, 1997) could then be used to assign people to the appropriate segments. In the case of a multiple sensory attributes, for which each person has an optimum, the researcher might wish to use some data reduction technique such as principal components in order to ensure that all sensory inputs are equally represented.

Application #1 Grovestand® Orange Juice.

At a very basic level, orange juice has become a commodity worldwide. The Tropicana Company, a leader in the fruit juice business, wanted to grow the juice business by rethinking the concept of basic orange juice. Sensory preference segmentation comprised a cornerstone of the strategy. Through sensory analysis of many different juices, Tropicana discovered that a variety of product features 'drive liking', so that changes in these features correlated with changes in liking. People differed, however, worldwide. Sweeter orange juices generated higher liking scores for some consumers, but not for others. Sometimes pulp, hitherto an unwanted byproduct in the juice, generated higher liking scores. Through systematic exploration of different orange juice formulations worldwide, it soon became clear that two different types of consumers drank orange juice. One group, the '*low impact*' consumers, liked sweeter juice (up to an optimum level), but did not like increasing amounts of juice pulp (made from the flavorless inside of the orange rind). Another group, the '*high impact*' group, like sweet juice, but also loved increasing amounts of pulp. These segments, appearing in country after country, suggested a very big pair of product opportunities - products with low pulp and high sweetness, versus products with moderate sweetness and high pulp. The latter product, new to the world, became Tropicana's best selling "Grovestand® Orange Juice". Just as importantly, the global segmentation by flavor and pulp revealed specific, actionable organizing principles. Those principles would drive strategic product development and marketing for years to come.

One of the important results to emerge from the orange juice study was that consumers were only modestly able to identify their optimal product if asked directly. That is, the range of acceptance of products was greater than one might think on the basis of the self-designed ideal. The self-designed ideal, often used in product development, assumes that the consumer knows the sensory level at which liking will optimize. This was demonstrated not to be the case. It took the actual experiment itself to identify the optimal formulation, to reveal the two clearly distinct segments, and then to determine the best product for each.

Application #2: Segmentation based upon response to concepts: The case of coffee

Coffee is one of the world's leading beverages. Coffee, however, really stands for a universe of different products, ranging from simply a 'wake-up' drink to a more exotic product served in a European *konditorei*. We know that consumers in different countries are exposed to a variety of coffee experiences. The practical question that emerged was whether there were any different 'mind-sets' about coffee. For this exercise we worked with concepts, rather than actual physical prototypes.

Concepts are short paragraphs about

cont. pg 4

Global 'Sensory-Based' Segmentation continued

products or services. There isn't much written about concept research in the basic chemo-sensory literature, primarily because concepts are about things to be sold in the marketplace, and the literature is about knowledge rather than about products. Nonetheless, understanding how people segment in their responses to concepts can be enlightening for the researcher because this knowledge tells us about cognitive processes in the chemical senses. Furthermore, when the researcher works with product-related concepts rather than simple statements about sensory experience the research has much greater ecological validity. People respond more meaningfully to things they know about (food and drink).

Working with concepts using psychophysical principles need not be any different than working with products. The psychophysical approach systematically varies the coffee concepts, which we did, using experimental design, and a technology known as conjoint analysis, specifically IdeaMap® (Moskowitz, Porretta & Silcher, 2004). Across eight countries, approximately 100 respondents in each country responded to systematically varied concepts about coffee. These concepts comprised sensory messages, usage messages, emotion statements, brands, and pictures, with each test concept comprising 2-5 concept elements. The output of the exercise, at the individual respondent level, as a set of utilities or 'impacts', one for each concept element, showing the conditional probability that the consumer would be interested in a concept containing that particular element.. At the end of concept exercise another group of respondents profiled each of the concept elements on a set of semantic scales. Thus the exercise generated numbers that could be treated like product data - liking ratings for products became utility values for concept elements; sensory attributes for products became semantic profiles of concept elements; segments became groups of individuals, independent of country, whose utilities maximized in the same location in the semantic space.

	Tot	S1	S2	S3	S4
Total					
Show your good taste by serving your guests the very best coffee	4	-4	0	6	10
The rich aroma is followed by great taste	4	-9	1	8	8
Delicately roasted beans result in the ultimate drinking experience	4	-7	1	7	9
Pure coffee enjoyment	4	-3	2	4	8
Segment 1…Indifferent					
Visual..Cup of coffee from above	1	***0***	1	2	2
The perfect way to welcome friends and family	3	***-1***	0	4	6
Coffee Beans	2	***-1***	-2	3	5
Coffee and the morning paper	3	***-1***	5	8	0
Segment 2… Relaxer					
Put your feet up and enjoy a cup of coffee	3	-5	***6***	6	0
The coffee you can drink all day	2	-3	***6***	0	4
Hot coffee and a good book	2	-2	***6***	5	0
Sit by the fireplace with a cup of coffee	3	-2	***6***	3	5
Segment 3… Waker Upper					
Picks you up when you're feeling down	2	-7	0	***14***	-3
Wake-up taste	2	-9	1	***14***	-3
Makes you feel invigorated	1	-13	1	***13***	-4
Boost your energy	2	-10	2	***13***	-4
Segment 4 … Flavor Seeker					
Available in Orange Brandy	-6	-11	-12	-17	***12***
Served at the finest coffee shops	2	-8	-2	1	***11***
Top quality for the gourmet and connoisseur	2	-11	-4	5	***11***
Available in Irish Cream	-1	-5	-4	-10	***11***

Table 1: Results of the coffee concept study. Data show utilities for total panel and for the four segments. The table shows the four best performing elements, using the utility value as the measure of performance.

The outcome of this exercise was four segments of respondents, reacting to different types of messages (see Table 1). Only one group, the flavor seekers (Segment 4) was interested in product features and sensory messages. The remaining three segments were interested in other types of messages. Furthermore, the segments were present in all countries, just as the sensory preference segments for orange juice were present in all countries, albeit in different proportions.

Principles Uncovered, Lessons Learned

We all know that segmentation exists. We need only use the Internet to list the specifications of the many variations of product and service offered by each company. We quickly realize that marketers know a lot about segments. But how do the marketer and product developer *systematically* uncover promising worldwide segments that are actionable, rather than leave such discovery to chance? The principles below provide an 'algorithm' or defined set of steps to discover and to use global segmentation.

cont. pg 5

Global 'Sensory-Based' Segmentation continued

1. **Develop an organizing principle.** For meaningful global segmentation, not just statistical exercise, the segmentation must embody an easily understood and intuitively meaningful, organizing principle. At the level of product, the organizing principle comprises two clearly defined sensory profiles. Thus, for Tropicana the organizing principle for orange juice consists of juice products having pulp versus no pulp. For concept the organizing principle emerges from the common elements that 'float to the top' in a conjoint exercise.
2. **Make sure the segments tell a story to the audience, for stories embed themselves in the corporate culture far more easily than do never-ending data tables.** If at the end of the meeting the marketers and product developers talk about the segments as 'real people' who can be approached, convinced, and sold to, then the researcher has succeeded. The segmentation has become a real and useful guide. Nothing so frustrates as segmentation that simply demonstrates the researcher's statistical prowess, without telling a coherent, useful, actionable story. More than likely, if the segmentation makes sense, then it portrays the different consumers in the form of a story or at least a vignette. That story or short description will, no doubt, inspire further new products and services, and form the basis of marketing strategies. Such segmentation quickly embeds itself into the corporate knowledge base.
3. **To make the segmentation 'actionable' explore a wide range of stimuli, and let the segments emerge from the response patterns to these stimuli.** A lot of global, overarching segmentation works with general statements in questionnaires. After the statistical analysis, the appropriate statements defining each newly uncovered segment demand yet another step - conversion into specific, concrete communications and product formulations. A better way tests many stimuli that represent the end communication or actual product, whether language to incorporate into credit card offers or prototypes that become the basis of new juice products. Testing with the actual stimuli that marketers and product developers can immediately apply makes the segmentation instantly actionable, far more compelling, and ultimately far more relevant to the business.
4. **Generalities first and then specifics – Before looking at a country-by-country segmentation, identify general segments worldwide.** At the start of the research, treat the whole world as one population, cluster the consumers worldwide into the segments independent of country, and then afterwards determine how these segments occur in the different countries. Start with world-principles at the beginning, before getting involved in the details. Then drill down to the country level. The global segmentation should take precedence, for it presents the marketer and developer with the first-order opportunity. Only afterwards should one get involved in country details, for they have a way of marring the clarity of the segmentation.
5. **Particularize the product to a segment, in a country.** Once the marketer identifies the optimum product or service for a segment, the developer can then fine-tune or particularize the particular product for an individual country. Particularization takes into account both the global segmentation (efficient development, targeted product), and the local, individual nature of the country.

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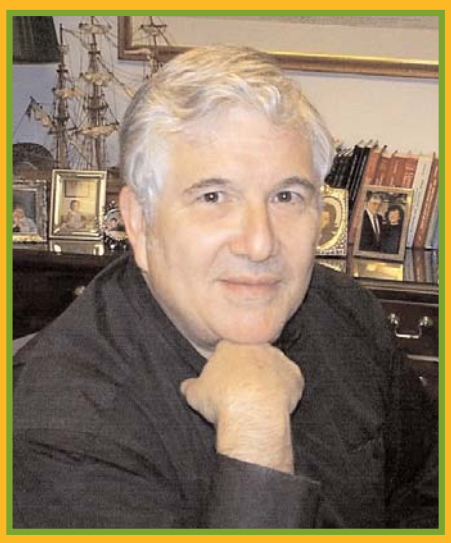

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Vol. 7 No.1 December 2004

Abstracts of the 2004 Australasian Association for the ChemoSensory Science (AACSS) Annual Scientific Meeting

ABSTRACTS:

Held at Noosa Blue Resort, Noosa, Queensland

October 1-3, 2004 Sponsored by Goodman Fielder

OLFACTION AND MEMORY: LESSONS FROM THE HONEYBEE

J. Reinhard, M.V. Srinivasan, S.W. Zhang

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Honeybees have an impressive capacity for discriminating and learning odours. They are also capable of forming complex associative memories. E.g. during foraging flights honeybees learn to associate the chemical stimuli of a flower patch, such as the scent and the taste of the nectar, with the flower's visual appearance, its colour and shape, and its location in the field.

We investigated how the honeybee's capacity for olfactory discrimination and associative learning assists her in navigating back to a known food source. In a series of experiments, we trained marked bees to forage on sugar feeders at different locations, equidistant from the hive. The feeders were scented with different floral odours, such as rose, lemon, or almond scent. In subsequent tests the feeders were replaced by dummies that were empty and unscented, but had the identical visual appearance. The training scents were then offered alone or in combination to the bees by blowing them into the hive for brief periods. Blowing the scents caused the trained bees to fly to the respective feeder locations, although the feeders were empty and unscented. The specific olfactory memories the bees had of the food sites triggered recall of the visual memories associated with the feeders, leading the bees to the respective locations.

In nature, when a bee returns to the hive after visiting an attractive food site, she often distributes nectar samples to potential recruits. Our findings suggest that the odour and taste of the nectar may facilitate and expedite foraging in the recruits by triggering recall of visual memories such as direction and distance of the site, as well as the landmarks and colours at the destination.

This work was partially supported by grants from the Humboldt Foundation to J. Reinhard, and from the Australian Research Council to M.V. Srinivasan and S.W. Zhang.

RELATIONSHIPS BETWEEN ODOUR SENSITIVITY AND PERCEIVED INTENSITY AND QUALITY OF RETRONASALLY PRESENTED BINARY ODOUR MIXTURES

C.M. Delahunty[1] and M.D. Geary[2]

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[2]*Reading Scientific Services Ltd., The Lord Zuckerman Research Centre, Whiteknights, Reading RG6 6LA, UK*

This study was undertaken to gain an understanding of the relationship between a person's odour sensitivity and their ability to perceive odour intensity and quality during consumption.

Sixteen participants between the ages of 20 and 35 were recruited. Individual orthonasal odour detection thresholds for diacetyl and ethyl butyrate were determined using an ascending three-alternative forced-choice test. The compounds were prepared in gelatine gels (25% w/w) and presented in 5g pieces via 250ml polypropylene squeeze-bottles. In a further study, perceived retronasal odour intensity for 3 concentrations of each compound for each participant was measured during consumption of the 5g gels. In addition, retronasal odour intensity and quality was measured during consumption of the 5g gels containing the two compounds in equi-intense mixtures, but which also varied in 3 concentrations by dilution. Measurements were made on unstructured 100mm line scales for the attributes "fruity" and "buttery".

Significant differences between participants in threshold concentration were found for diacetyl [$F(15,47) = 3.65$, $p = 0.001$] and ethyl butyrate [$F(15,47) = 138.90$, $p = 0.000$]. Mean individual thresholds for diacetyl varied over 500-fold from 0.0063 ppm in the gel to 3.1854 ppm in the gel across the group. For ethyl butyrate, the mean individual thresholds varied over 750-fold from 0.0002 ppm in the gel to 0.15 ppm in the gel across the group.

Individual participant concentration response functions were determined for the attributes "fruity" and "buttery", perceived when compounds were unmixed and mixed. Hierarchical Cluster Analysis was used to cluster

participants. Concentration-response functions demonstrated relationships between odourant sensitivity and perceived intensity for both single compounds and compounds in mixtures. In mixtures, the extent of odour suppression was dependent on the relative sensitivity to each of the two compounds in the mixture. These results suggest that there are individual differences in the quality of odour mixtures perceived, and that these differences are related to individual differences in odour thresholds.

STRUCTURE-ODOUR-ACTIVITY-RELATIONSHIPS OF BENZODIOXEPINONE HOMOLOGUES

B. Drevermann, A. Lingham, H. Hügel, P. Marriott

Department of Applied Chemistry, School of Applied Sciences, RMIT University, Melbourne, VIC.

The fragrance compound Calone 1951® (7-methyl benzo[b][1,4]dioxepine-3-one) possesses a marine fragrance with floral nuances. It is used in a range of popular perfume compositions, including "Escape" (1991), "Cool Water" (1996) and "Polo Sport" (1996). It's structural features: polar, semi-polar and hydrophobic, make it a particularly intriguing and applicable molecule for analysis. Changing the chemical constituents may alter the recognition of the molecule by the receptor site, and demonstrate how this interaction impacts on the odour. The demand for new and interesting compounds with fragrant accords is constant, which is one reason for our motivation to delve into benzodioxepinone chemistry. Our

cont. pg 11

NEWS

AACSS to meet at Heron Island in December 2005

See page 9 for details.

EDITORIAL

Nobel Prize for Chemical Senses continued

molecular biologists from the university. The next night, I joined the late stayers at the "Boathouse" bar at the AChemS venue (Sarasota Hyatt) and noticed a huddle of AChemS "celebrities" including Doron Lancet, Stuart Firestein, Dick Vogt and John Prescott, around a "beautiful stranger". It was the now famous Linda Buck, making her first "command appearance" in the chemical senses scientific community. There I learned that Linda had turned her molecular biological skills and attention (previously devoted to other medical issues) to the olfactory receptor question. After a couple of years, and with much late night work, she and Richard Axel had "nailed the big one" - the structure and genetic basis of the olfactory receptor molecule. And so the excitement grew and grew, at Sarasota and thereafter. And so did chemosensory science and more broadly, cellular neurophysiology and genetics, grow and thrive on their discoveries.

Now we are again flushed with the thrill of learning that Buck and Axel have won the $1.3 million Nobel Prize for medicine/physiology for their discovery of the receptor gene family and their subsequent independent work that has extended and consolidated the discovery. Congratulations to you both and to all those who supported your efforts!

This great event has brought a sharp and welcome focus to bear on the science of the chemical senses: the subject of this quarterly bulletin, *ChemoSense*, which is now in its 25th issue and 7th year. The purpose of *ChemoSense* is to communicate the achievements of the field, particularly to educate funding agencies and industry, that they may realise the value of investment in it. Yet, chemosensory science remains relatively unexplored. There should be more prizes, even Nobel Prizes, to be won in this broad and fertile field. We can also look forward to a considerable yield from the technologies it produces ■

AACSS at Heron Island 2005

First Announcement

The Australasian Association for ChemoSensory Science (AACSS) will hold its 8th Scientific meeting at Heron Island, Queensland from 2-6 December, 2005.

All members of the Australasian and International Chemical Senses communities are cordially invited to participate. Booking is now open and important information is given below.

Who should attend?

Researchers and applied scientists in the chemical senses from research institutions and academia, as well as industrial delegates are welcome. A contingent of Australian and international representatives of the food, wine, beverage, perfume, pharmaceutical, flavour, air & water quality industries are expected to attend. The AACSS meeting is open to the international chemosensory community (AACSS, AChemS, ECRO, JASTS, Pangborn, Chemometrics) as well as accompanying families/guests, who may stay at the Island at AACSS accommodation rates. Admission to the meeting will be at the discretion of the AACSS Organisers.

PROGRAM

Call for Volunteer Papers:

Submissions of abstracts for symposium, oral and poster papers must be sent to the Programme Chair, John Prescott, john.prescott@jcu.edu.au by the **Abstract Deadline: 31st August 2005.** All abstracts will be refereed by the Program Committee.

Symposia / Special Sessions

A number of symposia will be organised around core topics. If you wish to organise a symposium or special session please contact the Program Chair.

Why Heron Island? The AACSS meeting of 2002 showed that we have something unique to offer our members and international chemosensory community by hosting a meeting on Heron Island. This rare geographical jewel in the Coral Sea is two hours by boat from Gladstone, Queensland, or 30 mins by helicopter. Heron Island offers you one of the most exciting conference venues imaginable. Built on a tiny coral atoll, surrounded by rich coral and marine life, it consists of a solitary luxury, low-built resort, and a marine research station. It is, without any argument, one of the most beautiful, exciting, yet relaxing places on Earth. Just do a web-search and see how many people around the world have raved about it. Over 60% of people on Heron Island, at any time, are from abroad.

A confirmed booking at the Heron Island Resort is essential to attending the meeting.

HERON ISLAND RESORT BOOKINGS

A confirmed resort booking (Heron Island Resort and transfers to and from the island) is essential for registration at the Meeting, as this is the only accommodation available. Rates quoted here are at a special 20% discount exclusive to AACSS Meeting participants and their parties. Stays may be extended at these rates before and/or after the Meeting, depending on room availability. *The Resort provides three meals inclusive in the room rates.*

Please make your hotel and island transfer bookings as early as possible. Room numbers are limited and will available on a first-come first-served basis. AACSS accepts no responsibility for attendees' hotel, transfers or travel bookings or any matters arising therefrom. Attendees must see to their own accommodation and travel arrangements. All bookings must be finalised by the **Hotel Deadline: 31st August 2005.**

All your accommodation on Heron Island and launch/helicopter transfers must be made directly by you through Wendy Burchmore of Tourism Queensland Groups and Conferences (see contact details below). Once you have a confirmed booking the AACSS Organisers will contact you regarding registration.

Wendy.Burchmore@tq.com.au

Phone +61 7 3535 5837
Fax: +61 7 3535 5045

ACCOMMODATION RATES

Per person, per night including full buffet breakfast, smorgasboard lunch, 3 course table de hote or themed buffet dinner daily including Saturday night seafood buffet, and many island activities.

All prices quoted in Australian dollars and inclusive of 10% GST.

The below group rates represent a discount of 20% on nightly tariffs.

TRANSFERS (table below)

The courtesy coach transfer departs Gladstone airport at 10.15 am and the launch departs the Marina **at 11.00 am**. The launch returns to the Marina **at 3.45 pm** with an immediate courtesy coach connection to the airport. **Flights departing Gladstone must depart no earlier than 4.20 pm.**

Helicopter transfers are operated on demand during daylight hours. The above timings are subject to change.

Conference Registration Fees: AUD$300.00 per attendee. Students AUD$150.00. *Take up the 10% Early Bird Discount if fees are paid by 1 July 2005.*

IMPORTANT DATES:

Heron Island Resort Bookings OPEN 1 December 2004

Booking Finalisation & Abstract Deadline: 31 August 2005

Meeting: 2-6 December 2005

IMPORTANT CONTACTS:

Book your Heron Island Accommodation through Wendy Burchmore: Wendy.Burchmore@tq.com.au

Send Abstracts and Symposium proposals to Program Chair, John Prescott: john.prescott@jcu.edu.au

Other inquiries to The Conference Organiser, Graham Bell: g.bell@atp.com.au

FIRST STEP: Contact Wendy Burchmore and make your Heron Island Accommodation Booking.

SECOND STEP: Submit your abstract

THIRD STEP: The Conference Organiser will contact you when you have a confirmed booking, with registration payment information

FOURTH STEP: Pay conference fees

SEE YOU (again) IN PARADISE!

Accommodation and all meals	Per person per night TWIN SHARE	Per room per night SOLE USE	Extra Adult*	Extra Child* (3-14 years)
Turtle Room	$200.00	$292.00	$128.00	$80.00
Reef Suite	$228.00	$320.00	$128.00	$80.00
Heron Beachside Suite	$288.00	$380.00	$128.00	$80.00
Point Suite/Beach House/Wistari Suites	$384.00	$476.00	$128.00	$80.00

TRANSFER RATES All prices quoted in Australian dollars and inclusive of 10% GST.

Transfer ex Gladstone	Adult One Way	Adult Return	Child One Way (3-14 years)	Child Return (3-14 years)
Launch	74.40	$148.80	$37.60	$75.20
Helicopter	$291.00	$495.00	$146.00	$248.00

Useful Chemical Senses Book

Tastes and Aromas: The Chemical Senses in Science and Industry, Edited by Graham Bell and Annesley J. Watson. 214 pages. Published by UNSW Press and Blackwell Science, 1999. ISBN: 0-86840 769 0. Hard Cover. Price: US$ 30 / AUD$ 40 (includes tax if applicable, postage and handling). Order from: g.bell@atp.com.au

A limited number of this extremely useful volume are, for a short time only, available at a 50% discount. *Tastes and Aromas* has been hailed as a great teaching aid and resource for the practicing sensory scientist. Written by leaders in their fields as fundamental information, the volume retains its value and is rich in scientific and practical quality. Beautifully packaged in hard cover, it will continue to be a durable reference for many years to come.

Chapters include mini-reviews by (first authors) Stoddart; Bartoshuk; Youngentob; Prescott; Lyon; Weller; Bell; Saito; Lambeth; Noble; Morgan; Best; Barry; Sullivan; Key; Mackay-Sim; Atema; Hibbert; Barnett; and Levy.

Content covers the chemical senses in human culture; fundamentals of smell; taste; pungency; oral touch and pain; applied sensory evaluation; cross-cultural studies; perfumery and flavour chemistry; wine preference; psychophysics; sensory mapping; physiology of odour encoding; anatomy, growth and aging; emerging chemosensory technologies; sensors; marine chemical signals; electronic noses and chemosensory machines.

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ABSTRACTS: continued

aim was to synthesise a range of benzo[b][1,4]dioxepinones to research the structure-odour-activity-relationships of these compounds. Analysis performed utilises gas-chromatography-olfactometry (GCO), computational molecular modelling and olfactory analysis.

SOAR aims to find a relationship between psychological/sensory impressions and experimental physiological data in order to discriminate between fragrances. SOAR is used in an attempt to highlight relationship trends linking structural features of fragrant molecules with the compounds corresponding fragrance. By systematically changing a chemical region of the molecular structure, the resultant odour change can be monitored. These transformations will assist in analysis and development of SOAR with the objective of leading to the discovery of novel fragrance compounds. Achieving a predictive template for associating a molecule's structure and odour would be ideal. This research will contribute towards the rational design of odour molecules by being able to predict the structural requirements for odour, and successfully linking *in vivo* receptive olfaction with *in vitro* research on odour molecules.

ODOUR, IRRITATION AND THE PRESENCE OF S-COMPOUNDS, FROM INDUSTRIAL OPERATIONS IN GLADSTONE

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In January 2001, in response to community health concerns associated with the operation of an industrial project in Gladstone, the Queensland Government underwrote an independent technical review of the project. An investigative work plan included a health risk assessment that evaluated the likelihood of emissions causing toxicity and organ damage to an exposed population.

The assessment was conducted in accordance with Australian guidelines and was heavily biased towards finding toxicity if possible. Concentrations of emissions in the local community area were extremely small. There was negligible risk of organ damage or cancer with either short term (acute) or long term (chronic) exposure. The studies suggested there might be occasions when irritation was experienced. This did not correlate with the reported incidence of irritation by the community. In contrast a predicted high likelihood for odour to be experienced by the surrounding community was supported by community experience. Some sulphur containing compounds such as carbonyl sulphide and thiophene, appeared to be primarily responsible for the majority of the smell.

Although specific emission components could not be identified as being causative of community reported acute health effects these anecdotally coincided with episodes of bad smell. Studies of other communities around the world that are impacted by odorous emissions arising from a range of industries show similar health effects. It is not possible to state that the odour itself is causative of irritation complaints and/or the lower wellbeing of the community, or whether the odour is acting as an indicator for some other causative emission components. Nonetheless it wass concluded there was a strong association between malodour and health and well-being. Odour is a significant contributor to community stress and mitigation of odour will be beneficial for the overall well being of the community.

AIR QUALITY AND ITS IMPACT ON HUMAN HEALTH AND THE ENVIRONMENT

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Over the last two or three decades the need for good air quality has been established at national and international levels. A large number of epidemiological studies conducted worldwide have conclusively demonstrated strong links between air pollution and human mortality and morbidity. With the emergence of new exposure and epidemiological data as well as environmental data, most countries have introduced legislation to regulate concentrations of a range of air contaminants that have been linked to human health or environmental risks. However, in recent years there has been growing concern that there are other pollutants, not regulated by any legislation but that are responsible for a considerable increase in health and environmental risks. Where are those pollutants coming from? What are their physical and chemical characteristics? Can smell warn us about air pollution? This presentation will explore what we know and what we do not know about air pollution and what is the way forward towards better air quality.

AGING, ETHNICITY, AND LIKING FOR CARBONATED BEVERAGES.

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Elderly individuals often report dissatisfaction with the taste and smell of their food, and numerous studies have demonstrated age-related declines in the function of two of the chemical senses, gustation and olfaction. Taste and olfaction are obviously major components of flavor, and age-related deficits in these functions play a role in decreasing dietary pleasure. However, taste and olfactory sensitivity may not be the only factors of importance. It is possible that age-related deficits in chemesthesis - the desirable sensory experience of the irritation produced by carbonation and spices (commonly termed "irritants") - also plays a role in decreasing dietary pleasure. We are interested in age-related changes in the oral perception of trigeminal stimuli, namely the desirable irritation produced by carbonation. Moreover, the typical diets of different cultural groups vary in patterns of use of carbonated beverages and irritant spices making it important to examine an ethnically diverse group of participants in this work. In the present study, we assessed liking for and oral perception of different levels of carbonation in commercially available carbonated beverages as a function of age (young vs. elderly) and ethnicity (Jewish, African

cont. pg 12

ABSTRACTS: continued

American, and Indian). In general, there were no differences in perceived intensity of the carbonation or overall liking for each beverage, as a function of age, ethnicity or their interaction. Results did reveal, however, that elderly Indian participants typically reported liking the level of carbonation more than participants in the other groups. These data are consistent with previous research examining age-related changes in perception of carbonation (Pelchat, 1999) and are discussed with respect to individual differences such as frequency of consumption and familiarity.

CORRELATION BETWEEN SENSORY ASSESSMENT OF TRAINED PANELISTS WITH HPLC ANALYSIS FOR A SERIES OF SWEET, BITTER AND MIXED SOLUTIONS

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A short collaborative project between Food Science Australia (FSA) and Victoria University was carried out where trained panelists from FSA were assessed for their recognition and threshold levels for sucrose and caffeine solutions. The panelists were then presented with solutions to test if sweetness, sucrose, is suppressed by bitterness, caffeine, and if bitterness is suppressed by sweetness. The intensity, basic taste solutions and taste mixture results from the panelists were compared with HPLC data. Statistical analysis of the results indicated that the trained panelists were able to detect suppression of caffeine and to a lesser degree suppression of sucrose. Small changes in concentration of the solutions could be determined by HPLC analysis but the panelists, however, could not detect these small concentration differences. Both panelists and instrumental analysis could be correlated in this sensory evaluation but different information was obtained on the same solutions. The preliminary work done in this project is intended to be the basis of a larger study in the future.

THE GROWING USE OF ODOUR INTENSITY TESTING IN AUSTRALIA

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An odour consists of a mixture of individual chemical compounds. For the most part odours are unpleasant and cause loss of amenity or nuisance to those exposed to them, although pleasant odours, typically from food processing operations, can also cause nuisance. At the present time environmental regulators struggle to deal with odours of different types and character.

The presentation examines a range of developments in the odour measurement field, including the measurement of odour concentration, intensity and hedonic tone. Quantitative odour impact assessment is a relatively new science in Australia, made possible by the introduction of European-style dynamic olfactometry in the early 1990s which culminated in a new Australian Standard for odour measurement in 2001 (AS/NZS4323.3:2001). The presentation discusses the extent to which the improvements in the odour measurement method resulted in the adoption of quantitative odour standards by the State EPAs. It briefly gives examples of these policies, and their impact on industry.

A method for measuring odour intensity is presented, based upon a modification to the German VDI method designed to make it compatible with Australia olfactometry. The results of intensity testing using this method show that the Weber-Fechner law applies equally well to mixtures odorants as with pure compounds.

The presentation also shows olfactometry data suggesting substantial odour decay in the hours between sampling in Nalophan sampling bags and testing. For reactive samples odour concentration reductions of up to 75% have been found within a 30-hour delay period.

Preliminary hedonic tone testing results are also presented. The environmental management industry is yet to embrace this odour assessment tool

The presentation concludes with examples of how quantitative odour emission assessment is used in the development of odour emission reduction programs.

THE ROLE OF EXPECTATION IN PERCEPTION OF ODOURS IN A CONTEXT OF AIR POLLUTION.

Nobuyuki Sakai[1], Sumio Imada[2], Sachiko Saito[3], Tatsu Kobayakawa[3], and Yuichi Deguchi[4]

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In our daily lives, we usually recognize odours using visual images of objects from which the odours may come. If some visual stimuli are presented with an odour, the perception of the odour may be changed or distorted. In this presentation, we would like to show an experiment approaching this phenomenon. The first experiment was aimed to investigate the effect of description about odour on perception of the odour. In this experiment, unfamiliar odour stimulus (anethol; anis odour) was presented with a description about the odour to participants. Half of the participants received a positive description about odour, and the other half received a negative description about the odour. As a positive description, the experimenter sharpened a positive aspect of the odour description, such as used as spice and used in aromatherapy. On the other hand, as a negative description, the experimenter sharpened a negative aspect of the odour description, such as used as pesticide and had a harmful for organisms. Then participants smelled anethol for 20 minutes, and were asked to evaluate intensity for the odour using an apparatus which had real time recorder. There were no significant differences in averaged intensity ratings in every 5 minutes between the groups. However, there were differences among intensity curves which were made on real-time recordings of intensity ratings. Significant differences in hedonic ratings were found between the groups. Thus, participants in the positive group rated the odour as more pleasant than those in the negative group. In the second

cont. pg 13

ABSTRACTS: continued

experiment, participants were asked to evaluate the intensity of and the preference for an odour presented with pictures, one of which (X) was congruent with that odour and the other (Y) was incongruent with that odour. When the odour presented with X, the evaluated intensity was significantly higher than those presented with Y. Preference ratings for odours, which rated as palatable in preceding study, were significantly higher when they were presented with picture X than those with picture Y. On the other hand, preference ratings for odours, which rated as unpalatable in preceding study, were significantly lower when they were presented with picture X than those with picture Y. In conclusion, evaluations of preference for odours were enhanced (both positively and negatively) by presentation of visual stimuli that were congruent with the odours. Thus, the results seemed to indicate that visual stimulus had evoked objects' image, and which evoked expectation for the following odour, and then the expectation enhanced perceived odour intensity. These studies suggest that our odour perception is affected by expectations for the odours, which are developed by the experience through our daily lives. This phenomenon seems to support the individual differences in odour pollution.

THE CHEMSENSOR II AND THE MEASUREMENT OF THE COLOUR OF ODOUR

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The development of objective methods to classify and measure odours using instrumentation has been an active and rapidly advancing area of research and development for well over a decade. While substantial progress has been made in devices that are classified generically as "electronic noses", the goal of an instrument with the potential to discriminate as well as the human nose, but as objective as, say, a spectrophotometer, remains elusive.

A number of technologies have been used to measure odours including chemoresistance (MOS and polymer sensors), gravimetry (quartz crystal microbalance and surface acoustic wave), potentiometry (MOSFET transistors) and optical (surface plasmon resonance). Some of these technologies have been shown to be capable of modification to allow field deployment into instruments such as the Cyranose and the Z-nose.

Each of these technologies has features which, in certain situations, become limitations. Sensitivity to water activity, degradation of polymer sensors, complex hydraulic and sensor electromechanics, chemical selectivity and a range of other features may all influence the performance in a given application. Depending on the application, a sensing technology may be completely unsuitable for the measurement of a particular odour. It is therefore prudent to evaluate new alternative approaches for the measurement of odour for their strengths and weaknesses.

We describe a device that is based on the principle that certain porphyrin-based dyes are intrinsically coloured (Rakow and Suslick, 2000). This colour, the absorption spectrum, can be influenced by the binding of small volatile molecules. The changes in the absorption pattern will also differ for different chemicals. A further level of discrimination can be introduced by varying the metal ion in the porphyrin and fine structure of the porphyrin-dye, and each dye molecule can have a different absorption spectrum and chemical reactivity. This multi-factor variability is well suited to adaptation into a matrix-type odour sensor. The ChemSensor II has a chip which contains a 6 x 6 array of different porphyrin dye spots which are visualised at the start of a sensing event. The chip is then exposed to the odour sample and re-imaged. The differences in the absorption spectra of sensitive dots is then measured and the colour, intensity and matrix forms a fingerprint of the odour.

The instrument has the potential features of simplicity as it only requires a pump, light source and imaging sensor. This allows it to be compact and potentially portable. The chip is a disposable item reducing the potential for carry-over and contamination of the device. The chemicals are also relatively insensitive to humidity.

In this presentation we will describe our very preliminary experience with the ChemSensor II, a novel e-nose which operates by measuring changes in colour in response to exposure to odour.

Rakow, N. A.; Suslick, K. S. (2000) *A Colorimetric Sensor Array for Odour Visualization* Nature, 406, 710-714

NEW GENERATION E-NOSES FOR ENVIRONMENTAL ODOUR MONITORING

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Many industries depend on the use of volatile chemicals or they produce them as by-products or waste. Plants and facilities once located out of town, become encroached upon and subject to costly complaints and restrictions on growth. At a national level, the cost adds up to billions of dollars. The current and accepted method of measuring environmental odour is by "dynamic olfactometry." It involves bagging air samples on site and sending them to be assessed by a trained human panel, which determines how many times a unit volume of the air has to be diluted before it can no longer be detected. These dilution factors, or "odour units" (OUs) are assumed to represent the strength of the odour, based on a linear and common psychophysical relationship for all industrial odours. Nevertheless, sufficient data is difficult to obtain, and timely action to minimise a possible complaint is practically impossible.

What is needed is a continuous monitoring technology with sufficient sensitivity, reliability and validity within constraints imposed by likely concentration range of pollutants; background emissions from other sources; meteorological and geographic conditions; and sampling and calibration frequency of the system. It should be affordable, of convenient size, draw minimal power, and communicate efficiently with its operator. This paper describes the development and deployment in an abattoir, over several months, of one of a new generation of electronic nose (e-nose). The array has fewer sensors than commercial e-noses, such as

cont. pg 14

ABSTRACTS: continued

Cyranose or Aroma Scan. It uses metal oxide-based sensors that run at high temperature and are highly durable and reliable, even when subjected to a wide range of temperatures and humidity.

The kind of odour produced at various parts of the site, and their chemical composition was studied first, lab trials with mixtures of the key components and various combinations of sensors were conducted, and then an array was specified. The "red meat" e-nose responded at low levels that give rise to complaints (calibrated against duplicate samples assessed as OUs at ten places on the site). Data was recorded remotely via the internet, and continuously "24/7", from high and low odour areas. A predictive alarm system was developed, as well as an "automatic" calibration and cleaning system for the sensors. The daily records produced a useful profile of when and where problem-level odours were occurring. The new e-nose can be readily combined as a multi-unit network to provide wide area or very long perimeter monitoring. The data obtained provides the company with a continuous record of the odour status of its sites and allows timely action to be taken to avert costly complaints.

Acknowledgements: *The work was supported by Meat and Livestock Australia (MLA). The research team included: Donald Barnett, Brian Crowley, Brynn Hibbert, David Levy, Arvind Srivastava and Winston Wu. Thanks are expressed to the cooperation of Southern Meats Ltd and to Mr. Jonathan Lawson. Prof. Mike Johns and Mr Duncan Furgusson of MLA provided project management support.*

COMPARISON OF AN ELECTRONIC NOSE AND A TRAINED SENSORY PANEL FOR DETECTION AND QUANTIFICATION AT THE PPT LEVEL OF THE CORK TAINT COMPOUND TCA (TRICHLOROANISOLE)

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Tricholoranisole is one of the compounds responsible for cork taint in wines and produces a musty off-odour at levels as low as 2-3 parts per trillion (ppt). Electronic gas sensing devices or electronic noses, as they are often referred to, use sensitive mass detectors to quantify odour compounds at the ppm and ppb level in air or the gaseous head-space above liquids and solids. To obtain the higher sensitivity required to measure odour compounds at the ppt level the EST ZNose Model 7100 gas sensing device, the instrument used in this study, utilizes a purge and trap concentrating system prior to mass measurement. The purpose of this study was to compare the EST Znose Model 7100 with a trained sensory panel for detection and quantification of the cork taint compound TCA (trichloroanisole) at the ppt level. The results showed that although the EST Znose Model 7100 could detect TCA in standard solutions at the ppt level, the accuracy and repeatability of the measurements was poor. This lack of accuracy and repeatability was most likely due to the ease with which the system became contaminated with TCA, the difficult of completely removing the TCA from the instrument prior to subsequent analysis and the inability of the gas sensing system to differentiation between TCA and other compounds present in the samples most likely contaminants from the septums used for sample analysis. The trained panel could also detect TCA at the ppt level but there was extreme variation between panelists.

EXPRESSION OF GDNF, NEURTURIN AND THEIR RECEPTOR COMPONENTS IN THE OLFACTORY SYSTEM

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The GDNF family of trophic factors, including neurturin (NTN), persephin and artemin, are known to support survival and regulate differentiation of many peripheral neuronal populations, including sensory and enteric neurons. They bind GDNF family receptors (GFRa1-4), predominantly signaling through Ret receptor tyrosine kinase. The biology of GDNF signaling is complicated and these ligands can also signal via NCAM.

The role of this trophic family in the olfactory system is as yet undefined. We showed previously that GDNF protein was detectable in olfactory sensory neurons (OSNs) in the adult rat olfactory neuroepithelium (ON), and was depleted in the ON post-bulbectomy (Buckland and Cunningham, 1999). Published data to date, has not yet supported the finding of Ret receptor component expression in the ON, so the functional implications of the GDNF expression have remained uncertain.

Using immunohistochemistry we have defined and contrasted the localisation of GDNF, NTN, Ret, GFRa1 and GFRa2 in the adult rat ON and olfactory bulb. In the ON, we confirmed GDNF and Ret co-expression in mature and immature OSNs and the GBC layer. In contrast, NTN was selectively and highly expressed in mature OSNs. The GFRs had differential expression, with mature OSNs preferentially expressing GFRa1, while immature neurones and progenitors expressed GFRa2.

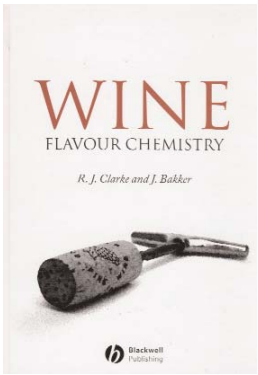
In the bulb expression patterns of the five proteins were complex. GDNF was expressed by the projecting neurones, the mitral and tufted cells, and most periglomerular cells. NTN was entirely restricted to the incoming olfactory nerve fibre layer and the terminal processes of OSNs within glomeruli. Olfactory axons co-expressed significant amounts of NTN, Ret and GFRa1, a finding which may implicate them with a critical functional role in olfactory targeting. *In vitro* studies of expression in dissociated primary culture from ON are directed at defining these functional relationships.

Our data are supportive of two members of this neurotrophic family, GDNF and NTN, and their receptors playing important and different roles in the olfactory neuronal system. Based on our findings, by analogy with information from other neuronal systems, we can now make predictions about possible mechanisms of action.

Supported by the Garnett Passe and Rodney Williams Memorial Foundation

Vol. 7 No.1 December 2004

WineSense:
Wine flavour chemistry



R.J. Clarke and J.Bakker
pp 324.

Blackwell Publishing Ltd, Oxford, 2004
ISBN 1-4051-0530-5

Hard back $85.00

Wel loved he garleek, onions,
and eek leekes
And for to drynken strong
wyn, reed as blood.

Geoffrey Chaucer (c 1343 - 1400), The Canterbury Tales, 'The General Prologue, 1.634

Of course, Geoffrey Chaucer is not the first to mention wine; as we learn from this book, vines probably originated some 6000 years ago in Mesopotamia, and the Egyptians, Greeks and certainly Romans are well known to have imbibed. However, Chaucer seems appropriate for this rather United Kingdom-centric book. To quote, "... in the UK, wine has become a drink enjoyed by many consumers at numerous occasions, ..." might give an indication of the stilted nature of the writing. Luckily, the literary style of the authors is not a problem, as no one would have this book as bedside reading. What the readership might want, is to find out about flavour components of wine and their chemistry, and in this regard they will not be disappointed. In 300 pages, I am sure there is mention of all the known 400-odd odour compounds, along with all the other important chemicals in wine. Being an Antipodean wine buff, this is a fascinating exposition on the chemistry of wine from the grapes through to ageing in bottle, and how the changes affect the perception of the wine.

The first chapter is an introduction to wine. What beverages count as wine, how wine is made with details of treatment of grapes from picking through to bottling for red, white and sparkling wines as well as fortified ports and sherries.

In the second chapter, the main grape varieties and growing regions of the world are described. I found this interesting, but would not totally agree with the list of major producers in Australia. This may be a casualty of the time the book has been in preparation, as recent amalgamations in Australia appear not to have been taken into account. Different 'appellation' rules and conventions are well described for the major wine producers here.

The chemical meat of the book follows in two chapters on the basic taste and stimulant compounds, and on volatiles. There is a wealth of information, with quite deep physical chemistry along the way. Activity coefficients of compounds are explained, and no physical chemical stone is left unturned including redox potentials, partition coefficients and odour thresholds. There are many tables with useful data tying together chemical data and the role the compounds play in wines. For the flavour chemist this is an excellent resource. I thought there might have been some reference to quantitative structure activity relationships (QSAR), and multivariate analysis applied to wine data, but perhaps there is no so much work in this area. There is passing reference to data analysis, but whereas the chemistry in the book is explained in some detail, statistical analysis of the data produced, particularly in wine tasting, is something done 'by statisticians' with 'so-called multidimensional statistical analysis'.

Chapter five concerns tasting and wine flavour, explaining how wine is tasted and the kinds of descriptors of a taster's appreciation of a wine. Did you know that an average sniff of a wine lasts 0.4 s, at an inhalation rate of 30 L min-1 ? (Look out trivia buffs, and wine bores!) Different approaches to express the almost intangible impact the aroma of a wine makes are described. These include the 'aroma wheel' used for wine and a number of other sensory systems. There is detail about different wines, and different grape varieties and finally reference to off odours and taints.

Sherries and ports are described in the following chapter, and the last chapter has details on how different compounds are formed during the vinification process. The book ends with appendices, mostly of tables of useful information.

With each chapter is a comprehensive bibliography of monographs and scientific papers. The book has been in preparation for ten years, we read, and there is a lack of very up to date references which may be a consequence of this. Unfortunately with the present activity in the analytical chemistry and sensory aspects of wine, even the latest papers quoted (few after the year 2000) can no longer be termed 'recent'.

Despite some criticisms, I found this a useful text that will be a resource for wine chemists, food scientists and oenologists. Whether it would be anything but of passing interest to the wine-buff-in-the-street I am not sure.

Finally, although I am an analytical chemist whose life is spent in carefully dissecting nature to find out what is in it, this text clearly shows that even the most detailed analysis available to modern science of a wine cannot yield the essence of what makes this beverage elicit the lines:

All love at first, like generous wine,
Ferments and frets, until 'tis fine;
But when 'tis settled on the lee,
And from th'impurer matter free,
Becomes richer still, the older,
And proves the better, the colder.

Samuel ('Hudibras') Butler (1612 - 80), Genuine Remains (1759) 'Miscellaneous Thoughts'.

Professor D Brynn Hibbert,
School of Chemistry,
University of New South Wales

Upcoming Events

8-11 March 2005	**Foodex, Japan** (30th Anniversary) Tokyo Info: www.jma.or.jp/FOODEX
13-15 April 2005	**International Symposium on Electronic Noses (ISOEN)** Barcelona, Spain Info: www.isoen2005.org
April 2005	**AChemS** Sarasota, Florida, USA Info: www.achems.org
21-24 June 2005	**11th Weurman Flavour Research Symposium** Comwell Roskilde, Denmark Info: weurman2005@staff.kvl.dk www.weurman2005.kvl.dk
10-13 July 2005	**38th Annual AIFST Convention and FoodPro 2005** Sydney Convention & Exhibition Centre Info: www.aifst.asn.au
7-11 August 2005	**Pangborn Sensory Science Symposium** Harrogate, North Yorkshire, UK. Abstract Deadline 31 January 2005 Info: www.pangborn2005.com
12-16 November 2005	**Society for Neuroscience** Washington DC Info: www.sfn.org
2-6 December 2005	**AACSS on Heron Island** (Australian Great Barrier Reef) **Australasian Association for ChemoSensory Science** 8th Annual Meeting Accommodation: Wendy.Burchmore@tq.com.au Conference info: g.bell@atp.com.au Program info: john.prescott@jcu.edu.au
2-4 August 2006	**8th Sensometrics Meeting: Imagine the Senses** Ås, Norway. Contact: www.sensometric.org
21-25 October 2006	**Society for Neuroscience** New Orleans Info: www.sfn.org
October 2006	**AACSS** **Australasian Association for ChemoSensory Science** **9th Annual Meeting** Adelaide, South Australia

ChemoSense (ISSN 1442-9098)
Web: http://www.chemosensory.com
Published by **E-Nose Pty Ltd**
P.O. Box 488 Gladesville, NSW Australia 2111
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Production Team
Editor: Graham Bell, g.bell@atp.com.au
Advertising: Brian Crowley, b.crowley@atp.com.au
Design and Layout: Lawton Design Pty Ltd

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