Research Wire

An overview of recent F&F science

Chewing gum: R.V. Potineni and D.G. Peterson had a couple of interesting publications regarding flavor release in chewing gum.[1,2] First, the pair reported that the release of the sugar alcohol phase in sugar-free chewing gum was directly related to the release profile of cinnamaldehyde in the same product. The authors examined a number of flavor solvents in the study, including triacetin, propylene glycol and medium chained triglycerides. Specifically, they looked at the effect on texture, flavor release and sensory perception effects on sugar-free chewing gum. According to the paper:

> Time course analysis of the exhaled breath and saliva during chewing gum mastication indicated that flavor solvent addition or type did not influence the aroma release profile; however, the sorbitol release rate was statistically lower for the triacetin formulated sample in comparison to those with propylene glycol, medium chained triglycerides, or no flavor solvents. Sensory time-intensity analysis also indicated that the TA formulated sample was statistically lower in perceived sweetness intensity, in comparison with the other chewing gum samples, and also had lower cinnamon-like aroma intensity, presumably due to an interaction between sweetness intensity on aroma perception. Measurement of the chewing gum macroscopic texture by compression analysis during consumption was not correlated to the unique flavor release properties of the TA-chewing gum. However, a relationship between gum base plasticity and retention of sugar alcohol during mastication was proposed to explain the different flavor properties of the TA sample.

The authors followed up this report by looking into the "mechanisms of cinnamaldehyde release from a sugar-free chewing gum."[2] The study included 8 min breath analyses of chewing gum samples. The results showed that cinnamaldehyde concentrations in the breath were up to three times higher in the first stage of chewing than later phases. However, the p-cresol concentration remained constant throughout. On the other hand, the release of cinnamaldehyde and cresol from a flavored gum base containing no sugar alcohol phase was similar over an 8-min consumption period. The authors concluded:

> On the basis of tandem mass spectrometry, cinnamaldehyde was reported to react with sorbitol and generate hemiacetal reaction products that were not stable under slight alkaline conditions; it was suggested to revert back to free cinnamaldehyde and sugar alcohol in the oral cavity. The increased polarity of these transient cinnamaldehyde-sorbitol hemiacetal reaction products would result in a more rapid release rate of cinnamaldehyde than would be typically predicted based on the affinity of cinnamaldehyde for the gum base.

The Maillard reaction: C. Cerney recently worked to shed some light on the "minor pathways" of the Maillard reaction.[3] The author focused on the nitrogen- and sulfur-containing aroma compounds formed at low levels in reactions due to side reactions. "The elucidation of the relevant precursors in food and the identification of previously unknown intermediates can throw light on these minor pathways," the report states. Cerney also notes that formation mechanisms can be elucidated by studying model reactions with isotopically labeled precursors. The author's work examines the following:

- the role of glycerol in the formation of pyrazines
- the significance of 4-hydroxy-5-methyl-3(2H)-furanone as intermediate in the reaction between ribose and cysteine
- the proportional contribution of the precursors cysteine, xylose, and thiamine to the formation of the resulting aroma compounds in the thermal reaction

Case study of "popcorn lung": Authors from Westlake Hospital and Rush University Medical Center recently outlined a case of bronchiolitis obliterans, or popcorn lung, in a 41-year-old industry worker based in Missouri.[4] The report, which doesn't break new ground in this controversy, associates the worker's condition with a number of organic compounds used in the manufacture of butter flavors, and singles out diacetyl as a key culprit.

The link between olfaction and sex: Huh et al. take a novel approach to understanding sexual arousal in their

recent paper.[5] Using eight right-handed heterosexual males, the authors employed fMRI to map the areas of the brain affected by olfactory sexual stimulus. Exposed to women's perfume (not specified) under controlled conditions, the participants rated the scent's intensity and perceived arousal. Five of the subjects reported strong to moderate sexual arousal. The fMRI showed that the insula, inferior and middle frontal gyrus, and the hypothalamus were the most affected in subjects reporting strong arousal. Meanwhile, the median cingulate gyrus, thalamus, angular gyrus, lingual gyrus, and cerebellar cortex were stimulated in subjects who had moderate or strong sexual arousal response. The authors concluded:

> Olfactory stimulation with women's perfume produces the activation of specific brain areas in men. The brain areas activated differed according to the degree of perceived sexual arousal response. Further studies are needed to elucidate brain activation response according to the different kinds and intensities of olfactory stimulation.

Masculinity/femininity perceptions in fine fragrance: "Thinking of the masculinity/femininity of a fragrance influences the selection of colors that correspond to these odors," concludes a recent report from Montclair State University.[6] The authors conducted four experiments and concluded that the perception of a fragrance as masculine or feminine inherently affects the colors people choose to correspond with those scents. In an experiment involving three male and three female scents, the colors chosen for each category differed down "gender" lines. When it came to unisex scents, the colors chosen to correspond depended entirely on people's perception of the scents as either masculine or feminine. Similarly, when the authors labeled fragrances as male or female, respondents chose corresponding colors based on those genders, showing that perception is king.

Incense dangers: A new study looks into the potential dangers of incense burning.[7] A typical incense stick, according to the authors, consists of approximately 35% fragrance. While typical cigarettes each produce particulate levels around 10 mg/g burned, an incense stick can emit more than 45 mg/g burned. The authors also cite the release of volatile organic compounds such as benzene, toluene and xylenes, in addition to aldehydes and polycyclic aromatic hydrocarbons. The study notes previous data on air pollution in places such as temples, and highlights possible health effects, including respiratory system dysfunction and allergic contact dermatitis. The authors conclude by advising proper ventilation when using incense.

Why women use makeup: A recent report by LVMH researchers examines the psychology of women's personal care choices.[8] Aside from the pleasure derived via fragrance, beauty and "sensations from the body surface," the report finds deeper motivations behind these products' popularity. The authors interviewed women about their quality of life and makeup habits, and found two distinct groupings:

> "Our first results clearly showed that makeup could support two opposite "up" functions, i.e., 'camouflage' vs 'seduction.' Concerning their psychological profiles, results showed that women of the functional class 'camouflage' are more anxious, defensive, and emotionally unstable compared to those of the functional class 'seduction,' who appear to be more sociable, assertive, and extroverted.

Fragrance release and stability: Numanoğlu et al. examined the controlled release, stability, water solubility and liquid-powder conversion with cyclodextrins of fragrance materials.[9] The authors chose linalool and benxyl acetate as their fragrance materials, and β-cyclodextrin and 2-hydroxypropyl-β-cyclodextrin as solubility agents. According to the authors, "The results of the solubility studies showed that preparing the inclusion complex with 2-hydroxypropyl-β-cyclodextrin at a 1:1 molar ratio increased the solubility of linalool 5.9-fold and that of benzyl acetate 4.2-fold, whereas the complexes at a 1:2 molar ratio increased the solubility 6.4- and 4.5-fold for linalool and benzyl acetate, respectively." They summarized their stability findings as follows: "It was observed that the volatility of both fragrance materials was decreased by preparing the inclusion complexes with 2-hydroxypropyl-β-cyclodextrin. Also, in vitro release data

indicated that controlled release of fragrances could be possible if inclusion complexes were prepared."

Isoeugenol derivatives in perfumes: A recent report claims that, even though the fragrance industry has restricted isoeugenol to 200 ppm for the last 10 years, no corresponding decline in isoeugenol-related contact allergy has been observed. The authors sought to discover whether this is the result of the use of isoeugenol derivatives in fragrances, including isoeugenyl acetate. The authors performed GC/MS analyses on 29 international brand perfumes and aftershaves, with all samples analyzed in duplicate at detection levels of 1–5 ppm. The results showed that:

> "Sixteen products contained isoeugenol. The maximum concentration was 202 ppm. Ten products contained isoeugenyl acetate, which in nine cases occurred together with isoeugenol. The concentrations of isoeugenyl acetate ranged from 20 to 4,689 ppm. Thirteen products contained 64.9 to 1755.0 ppm isoeugenyl methyl ether. Isoeugenyl benzyl ether was not detected in any of the investigated products."

The authors conclude by theorizing that isoeugenyl acetate's presence in many perfumes and aftershaves is responsible for the lack of decline in consumers' isoeugenol sensitization.

References

RV Potineni and DG Peterson, Influence of Flavor Solvent on Flavor Release and Perception in Sugar-free Chewing Gum. *J Agric Food Chem* Apr 22 (2008)

RV Potineni and DG Peterson, Mechanisms of Flavor Release in Chewing Gum: Cinnamaldehyde. *J Agric Food Chem* Apr 22 (2008)

C Cerny, The aroma side of the Maillard reaction. *Ann N Y Acad Sci* 1126 66–71 (2008)

P Modi, V Yadava, R Sreedhar, F Khasawaneh and RA Balk, A Case of Flavor-Induced Lung Disease. *South Med J* Apr 10 (2008)

J Huh, K Park, IS Hwang, SI Jung, HJ Kim, TW Chung and GWJ Jeong, Brain activation areas of sexual arousal with olfactory stimulation in men: a preliminary study using functional MRI. *J Sex Med* 5 619–625 (2008)

DA Zellner, A McGarry, R Mattern-McClory and D Abreu, Masculinity/femininity of fine fragrances affects color-odor correspondences: a case for cognitions influencing cross-modal correspondences. *Chem Senses* 33 211–222 (2008)

TC Lin, G Krishnaswamy and DS Chi, Incense smoke: clinical, structural and molecular effects on airway disease. *Clin Mol Allergy* 6 (2008)

R Korichi, D Pelle-de-Queral, G Gazano and AJ Aubert, Why women use makeup: Implication of psychological traits in makeup functions. *Cosmet Sci* 59 127–137 (2008)

U Numanoğu, T Sen, N Tarimci, M Kartal and OM Koo, Use of cyclodextrins as a cosmetic delivery system for fragrance materials: linalool and benzyl acetate. *Onyüksel HAAPS PharmSciTech* 19 (2007)

SC Rastogi and JD Johansen, Significant exposures to isoeugenol derivatives in perfumes. *Contact Dermatitis* 58 278–281 (2008)