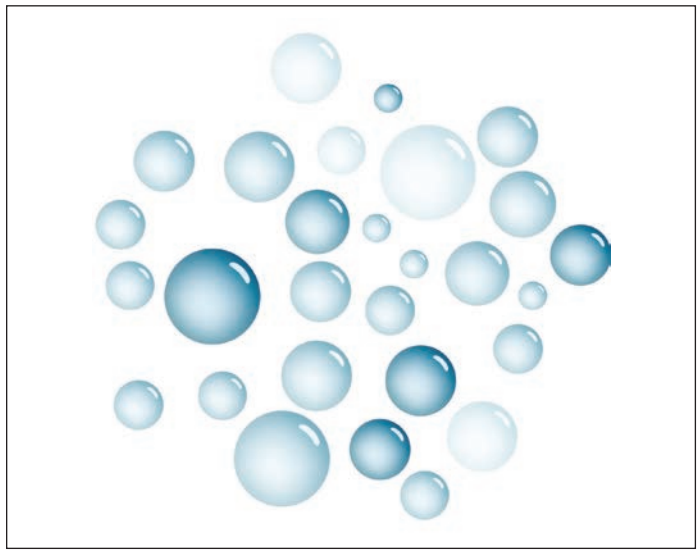
F&F Innovation and Brand Needs

A look at the innovation needs of food, beverage, and personal and home care brands, and a survey of recent F&F innovation literature.

It is no secret that relevant innovation is crucial to success in the home and personal care and food and beverage industries. According to a study conducted by AMR Research in 2008 and cited by Accenture (*www.accenture.com*), the ratio of ideas generated to actual launches in home and personal care was 21:1. That ratio was 13:1 in the food/beverage/alcohol segment. Furthermore, only 50% of product concepts moved from development to launch; of those, just two thirds generated the anticipated revenues. Among the reasons for failure, AMR Research found that 27% were impacted by not meeting consumer needs, while 23% suffered from a lack of clear differentiation.

What worked? The AMR Research study found that successful consumer product companies had three key traits: they launched 25 times more products than their bottom quartile counterparts, generated 20% more revenue from their new product introductions and had a speed to market that was nearly five times faster. In order to support new introductions, companies are looking for growing amounts of innovation from within and without their organizations.



In one demo formula, (1-methyl-2(5-methylhex-4-en-2y1)cyclopropyl)methanol contributed the characteristic, natural, rosy, floral odor to a detergent scent, "in particular in the wet and fresh rinsed phase of the washing process."

Innovation Needs

To support growing innovation needs, AMR identified a rapidly increasing trend of consumer product companies collaborating with external partners.

In the cleaning product segment, according to Smithers Apex (*www.smithersapex.com*), consumer product companies are looking for innovations that improve product efficiency and overall performance, as well as ease of use and cost-effectiveness. Companies are also seeking differentiating innovations, including via fragrance.

In addition, sustainability is key. Last autumn, a consortium of key stakeholders in retail (ex: Target and Walmart), consumer products (ex: P&G, L'Oreal, Unilever and Clorox) and ingredient/fragrance suppliers (ex: Firmenich and Givaudan) gathered in Chicago for The Beauty and Personal Care Products Sustainability Summit.

The event focused on sustainability issues impacting beauty and personal care products and identified areas that would benefit most from collaborative action across organizations and value chain stages. Among the highest concerns, the attendees listed "impact of chemicals (health & environment," "transparency," "waste & disposal of products," and "extraction of raw materials." And among the top concerns that could most benefit from cross-organizational collaboration, the forum participants highlighted "impact of chemicals (health & environment)," "transparency," "waste & disposal of products," and "extraction of raw materials." The results of this forum are forthcoming as of press time.

In the food and beverage sector, establishing "competitive differentiation" is critical, according to data from Sopheon (*www.sopheon.com*).

The innovation software company notes, "In a recent survey, over 60% of food and beverage executives stated that product innovation or portfolio adjustments to 'healthier' trends will be the key drivers they turn to for revenue growth over the next three years. While executives acknowledge that the achievement of strategic goals will be largely dependent on product innovation, many companies struggle with effectively delivering on innovation initiatives to meet those goals, with failure rates of new food and drinks products climbing as high as 70–80%."

Flavor companies' food and beverage clients are facing a growing range of challenges, according to Sopheon, including unstable raw material prices, regulatory pressures, pricing competition, an explosion of product launches against which to compete and a constantly shifting range of consumer demands. Given that more than 50% of many brands' revenues comes from products launched within the last five years, and that Accenture has found that top-quartile companies achieve about 20% more revenue from new product launches compared to their bottom quartile counterparts, it is no surprise that companies are focusing more and more on business-transforming technologies.

Herein, *P&F* presents a range of recent R&D, scientific publications and other work focused on innovation in flavors, fragrances and ingredients, particularly new ingredients, encapsulation technology, instrumentation and sensory science.

Flavor, Taste & Satiety

In a recent publication, Per Møller of the Department of Food Science at the University of Copenhagen explores the notion that overeating might "result from avoiding reward and sensory satisfaction."[1] Møller and a colleague carried out four experiments that suggest "quality can replace quantity." For example, the addition of chili to soup appeared to have a number of positive effects, aside from flavor enhancement, including speeding satiety despite increasing organoleptic preference.

Møller concludes, "The subjects liked better the spiced soup that satiated them faster. That is, eating a more rewarding food does not imply that normal subjects will eat more of it."

Meanwhile, a recent publication by Keast and Costanzo argues that not only is fat a "sixth taste," but that insensitivity to this taste is directly related to over consumption of "fatty food and energy."[2] According to the authors, the likely stimuli of so-called "fat taste" are fatty acids, the breakdown products of fat. They go on to acknowledge a data gap in determining fat taste as a perception independent of other taste stimuli such as salt, or aromatic senses. However, the authors conclude that emerging evidence of the sixth taste is "consistent." As mentioned, it is possible that insensitivity to fatty acids in the oral cavity and gastrointestinal tract leads to a lack of satiety, and thus to overconsumption and obesity.

Wearable E-fragrance Technology

Is Google dipping into the e-scent market? According to a recent patent application, potentially.[3] A recent Google patent describes a wearable smart device that "can detect physical activity of a user of a device." The gadget is designed detect malodors that result from physical activity and then emit a scent in response.

Comet Odor Detection Applied on Earth

In 2014, the European Space Agency's Rosetta space probe deployed its *Philae* lander module, which landed on the surface of comet 67P/Churyumov–Gerasimenko (67P). The lander will study the content and properties of the comet throughout the year. Back on earth, the Rosetta mission scientists have collaborated with Givaudan to apply deep space scent analysis technology in a commercial setting. Using the technology derived from the mission, Givaudan reportedly seeks to apply complex atmospheric analysis to determine which elements of fragrances are most impactful for consumers.

The Rosetta's Ptolemy "sniffing" instrument was originally developed to detect airborne molecular mixtures as they evolve in the atmosphere. The collaboration will run for three to five years and is expected to yield actionable information to be applied to consumer product fragrance technologies.

The Ptolemy comprises a mass spectrometer designed to collect compositional data for the comet, particularly organic molecules and minerals. The device is expected to elucidate the present organic compounds and their ratios, according to an official ESA blog (*http://blogs.esa.int/*), as well as the ways in which the composition changed over time.

Fragrance Encapsulation

Geffroy et al. have published a patent focused on core-shell capsules of 5–250 µm diameter for fragrance delivery.[4] In one example of application, the authors say that an encapsulated fragrance in a shower gel formulation boosted the intensity and overall performance. The authors pointed out, "In particular, it should be noted that the capsules remained on skin even after shower."

A recent patent publication highlights the application of 4-methyl-8- methylene-4,9-decadienal for aldehydic notes reminiscent of lily of the valley or cardamom.

Molecular Modeling

A recent publication argues that models act "as 'mediators' between theory and data."[5]

It also asks: what are the limits of a model to represent? Specifically, the author focuses on molecular modeling of odors and the utility of structure-odor relations.

Lily of the Valley/Cardamom Fragrance Notes

A recent patent publication highlights the application of 4-methyl-8-methylene-4,9-decadienal for aldehydic notes reminiscent of lily of the valley or cardamom.[6] In one composition, the addition of 300 parts by weight of the material "reinforced the clean aldehyde aspect of the original composition by pushing the herbaceous aspect, and imparted also a twist of the cardamom type." The material can perhaps be considered a reasonable one-to-one replacement for 3-(4-tert-butylphenyl)-2-methylpropanal, also known as Lilial,[a] which faces severe restrictions in the wake of the EU Scientific Committee on Consumer Safety (SCCS) opinion on fragrance allergens.

Novel Cashmeran Odorant Synthesis

Using molecular modeling, the authors of a recent paper were able to produce odorants with a Cashmeranlike[b] fragrance.[7] The process involved an enol activation catalysis that produced good yields. Cashmeran (1,2,3,5,6,7-hexahydro-1,2,3,3-pentamethyl-4h-inden-4-one) is a musk with woody and ambery impressions that has been applied in fine fragrances.

Rosy, Floral Notes for Fragrances

A recent patent publication focuses on the production and application of trimethyloctadienol and trimethyloctadienol derivatives for fragrance compositions.[8] The materials in question reportedly impart rosy and floral notes. According to the authors, "The closest analogues with a similar structure, one may

[a]Lilial is a trademark of Givaudan.
[b]Cashmeran is a trademark of IFF.

cite 3,7-dimethyloct-6-enol (citronellol) and 3,7-dimethyloct-2,6-dienol (geraniol)." They add that the trimethyloctadienol and derivative odors have a distinctly different odor strength and diffusivity. In fact, they say, "2,4,7-trimethylocta-2,6-dien-1-ol and derivatives thereof constitute a new, well-defined class of odorants possessing surprisingly low odor threshold concentrations compared to compounds with similar structures." As such, these materials can be applied at levels far lower than an ingredient such as citronellol or geraniol. In one demo formula, (1-methyl-2(5-methylhex-4-en-2y1)cyclopropyl)methanol contributed the characteristic, natural, rosy, floral odor to a detergent scent, "in particular in the wet and fresh rinsed phase of the washing process."

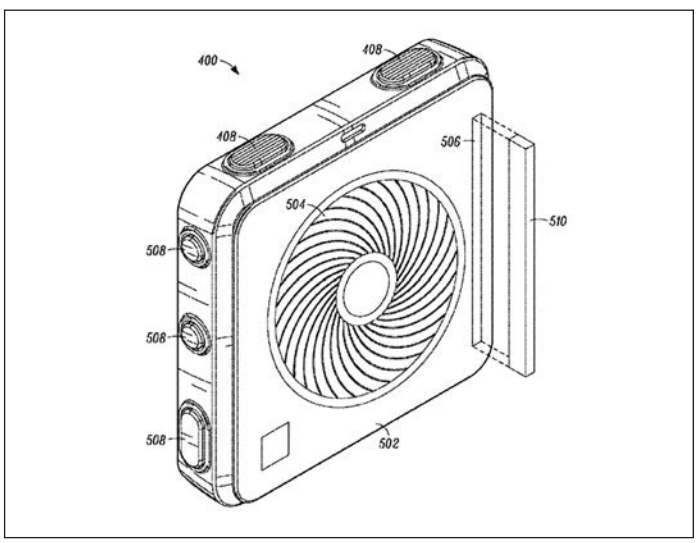
Animalic, Musky and Amber Compounds

Caroline Plessis has published a research review paper focused on animalic and musky/ambery compounds.[9] The author explains, "They possess very different structures, such as bicyclic pentanols, glycolates, or tricyclic ketones, and all show interesting notes in the animalic fragrant family: from costus, leathery to ambery and musky scents, making them all attractive for different purposes." Plessis adds, '[T]he molecules presented here, belonging to the broad animalic family, were discovered rather by serendipity while working on non-ambery-oriented projects, demonstrating again how amazing and exciting fragrance chemistry can be."

In the same publication, A.P. Narula focused on amber fragrance ingredients, notably the discovery of Amber Xtreme and Trisamber.[10,c] The author notes, "Not only do amber notes impart high performance and substantivity to fragrances, but they are paramount in the development of classic and legendary fragrances."

Finally, authors Maurice Roucel and Fanny Grau discussed the role of new molecules in perfumery, including "the violet odorant undecavertol, the floral nerolione and coumarone, the gourmand cappuccino levistamel, the sandalwood notes Sandranol or Bacdanol, the fruity top note magnolia flower oil, and finally the woody ambery Ambrocenide."[11,d] In classic scents, new materials have played a crucial role in creative breakthroughs. The authors offered the following examples: coumarin in *Jicky*, aldehydes in *Chanel No 5*, Calone[e] in *New West for Her* and ethyl maltol in *Angel*. In addition to new materials, the authors explained that overdoses of existing materials reveal new olfactive directions, as when Roucel applied 8% undecavertol to the formula of *DKNY Be Delicious*, injecting the fragrance with a strong violet facet that highlighted the green and fruity apple aspects.

[c]Amber Xtreme and Trisamber are trade names of IFF.
[d]Sandaranol is a trade name of Symrise; Bacdanol is a trade name of IFF; Ambrocenide is a trade name of Symrise.



Google's patent-pending fragrancing device will both detect and emit odors.

One study that focused on flavor and satiety examined whether the spicing of chili would increase consumer pleasure without inducing overeating.

Improving Fragrance Performance & Substantivity

A recent patent publication focuses on fragrance performance, particularly substantivity. The authors discuss a range of 94 fragrance molecules, including (S)-2,2-dimethyl-3-(4-(prop-1-en-2-yl)cyclohex-1-enyl)propanenitrile, 1-(1-(cyclopropyl-methyl) cyclopropyl)ethanone and 1-(3-methylbut-2-en-1-yl)cyclopropanecarbaldehyde, which possess a range of aromatic qualities, including woody, citrus, rose, peony, green, vegetative, earthy, terpeney, fruit, spicy and many others.[12] These odorants have a fragrance benefit when neat, or when present on wet and dry fabric, and dry hair, according to the authors. Performance is further boosted by a diminished leakage from microcapsules.

Another patent publication focuses on the use of neopentyl glycol diethylhexanoate as a "fragrance evaporation modulator" in formulations comprising ethanol and intended for application to skin or hair.[13] The use of the modulator has been found by the authors to increase fragrance substantivity.

Light-released Capsules

A recent publication by Paret et al. explores an encapsulation system with a light-induced release activation.[14] Using UVA light to irradiate microcapsules, the authors reported degradation of bioactive compounds, creating gas pressure that eventually expanded or broke the capsule walls, releasing the bioactive compound. UVA light intensity and capsule wall thickness were factors in the efficiency of the technology.

Linalyl Acetate Safety Assessment

A recent publication from the Research Institute of Fragrance Materials presents an ingredient safety assessment of linalyl acetate (CAS# 115-95-7).[15] The publication notes that the

[e]Calone is a trade name of Firmenich.

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material was assessed against seven human health endpoints, as well as environmental endpoints.

Citrus: Lemon Volatiles & Nootkatone Synthesis

A recent publication highlights the identification of "a series of branched aliphatic aldehydes and several novel sulfur-containing structures" in the peels of Lisbon lemons (*Citrus limon* L. Burm. F. cv. Lisbon).[16] The fruit was harvested from a California grove and underwent liquid-liquid extraction. The compounds found were odor-active, according to the authors, further elucidating the overall aroma of lemon fruit.

Another publication highlights the synthesis of (+)-nootkatone via an enzymatic process.[17] The sesquiterpenoid is sought-after for its grapefruit odor, but is harvested in low yields from natural sources and its traditional synthesis may involve environmentally unfriendly chemicals. The authors suggest a biocatalytic route that reportedly produces (+)-nootkatone in a concentration up to 360 mg L^{-1}.

Flavor Evaluation

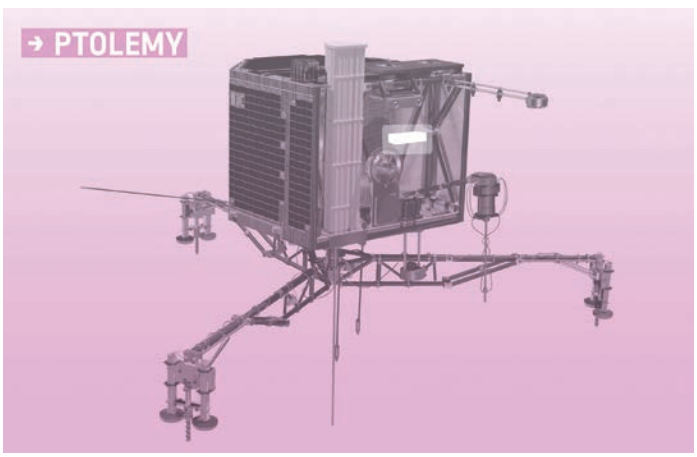
A recent patent publication focuses on an in vivo optical measurement system for assessing a subject's reaction to a known flavor-improving agent.[18] The challenge, the authors note, is that olfactory-stimulating materials do not directly impact salivary gland activity. As a result, objective measurements of impact are difficult. The authors' proposed system uses a device that makes an "in vivo optical measurement at a region including a periphery of the temple of the forehead of the subject."

Encapsulation Modeling

The authors of a recent publication suggest that the NetLogo (*https://ccl.northwestern.edu/netlogo/*) modeling platform is a useful tool in simulating flavor release in encapsulated systems.[19] In the study, the authors developed a model for the easy prediction of the release of encapsulated flavors (time, rate, etc.). The group built a model using NeLogo and then evaluated "flavor-release properties … dependent upon input parameters." The encapsulated material in this case was diacetyl, while the encapsulate was alginate-whey protein.

Mechanics of Taste Preference

A recent study has found that those rated as neophilics on the food neophobia scale, which "measures reluctance to try novel foods," were more likely to be accepting of novel foods and were much more likely to accept complex foods than their neophobic counterparts.[20] The authors suggest that a difference in expectations of foods may be to blame. In the case of neophobics, blander foods received a higher preference rate. The key factors involved in preference included "taste quality, novelty, expectation, and familiarity," according to the authors.



The ESA's Ptolemy can detect complex mixes of odors; photo courtesy of ESA.

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