Molecular Flavour Pairing of Foods & Drinks

by Danny Hodrien, F&F Projects Ltd

Flavourists have studied the molecular composition of the flavour of foods since the early days of the industry at the turn of the last century and the focus has been and always will be to unravel the mysteries of nature when it comes to flavour. However as a diversion we can play around with flavour combinations based on common molecules found in paired foods. Some are quite obvious, others not so obvious.

'Molecular' gastronomy

First let's talk about the new kid on the block in the most expensive and most creative restaurants, 'molecular gastronomy'. The term molecular gastronomy has found its way into food vocabulary in recent times through celebrity chefs and food scientists.

Hervé This is a great exponent of the quest to understand the chemistry, physics and technology of food cultivation, selection, preparation, tasting and digestion.

Heston Blumenthal (a recipient of the Bill Littlejohn award and owner of the Fat Duck) is of course a regular on TV through his magical and mystical feasts.

Tony Conigliaro is a bartender and mixologist who uses molecular mixology in cocktails.

From working at the top bars in London, including the award-winning Roka restaurant, he has now opened his own venue 'The bar with no name', where he has a laboratory upstairs and the bar downstairs. He also regularly holds master classes showcasing the latest and most progressive techniques in the bar industry.

Ferrán Adrià founded the el Bulli restaurant in Roses, Spain. The restaurant closed in 2011 but will be re-opening this year as a culinary think tank so watch this space!

In the summer of 2013 Somerset House hosted an exhibition dedicated to the food of Ferran Adrià and el Bulli. The exhibition looked back over the evolution of the restaurant's laboratory and kitchen. Multimedia displays examined the methods behind the creation of signature dishes and original sketches and hand written notes of the recipe creations were on display with plasticine models of the dishes that were served. I was fortunate to have been partly involved through a piece of work and seminar with Odette Toilette on 'lickable perfumes'.

But apparently we can all be molecular gastronomists through a selection of purchases from Amazon! Perhaps I should think about putting together a flavourist kit along similar lines?

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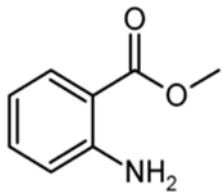
Is molecular gastronomy really molecular?

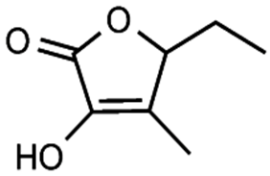
Food/flavour molecules look like this:



As an example, methyl anthranilate is the typical note of Concord grape. Its molecular weight of 151 and Avogadro's number (number of molecules in 1 mole) mean that there will be 5000 million, million, million molecules in 1g. If you could count 1 per second it would take you about 30 million years to count them. Can we taste 1 molecule?

If we take the strongest known flavour molecule – maple furanone – this has an odour threshold of 0.00005 parts per billion. 1 ppb equates to a sugar lump in an Olympic swimming pool so I am sure you will agree this is a very low threshold. In percentage terms this is 5e to the minus 12 %.

So can we taste 1 molecule in 100g of water? As we have seen, this very low threshold of maple furanone gives a % of not much really. 1 molecule in 100ml water gives an even smaller number of 2e to the minus 22 % so virtually nothing. So the answer is ….. no.



Maple Furanone

Returning to molecular gastronomy it tends to look like this – foams and spheres. The key elements here are of course taste (so millions of molecules), surprise and magic. Colour changing, explosions, dry ice smoke, liquid nitrogen frozen fruits and ingenious presentation.

Fad or serious?

As each decade comes and goes we see new fads also coming and going but I believe that a greater understanding of molecular flavour pairing will lead to some positive benefits in our society. There is a fun side to this type of flavour development but there is also a more serious angle.

One of the concerns we face in the world today is the rise of obesity due to incorrect nutrition, which starts at an early age through children's misguided eating habits

Obesity & nutrition

As we all know by now, obesity is caused by overeating combined with insufficient exercise. If we could design pairings of food that would reduce intake then we could go some way to reducing this significant health problem. For example, we know that carbohydrates, in particular sugar, and fats are very desirable in combination, such as in a burger or an ice cream, but we don't eat spoonfuls of sugar or scoops of fat. It is the combination which somehow brings about that acute desirability. If we can pair the flavour molecules found in say beef and burger buns and even maybe sesame we can perhaps simulate the taste experience of a burger without the need for the fat and calories.

Bread/beef common flavour molecules

Hexanol
Isovaleraldehyde
Methyl pyrazine
Ethyl pyrazine
2,3-Dimethyl pyrazine
2-Ethyl-3-methyl pyrazine

Could this then go some way towards satisfying our appetites? In my own experience of working with concentrated flavour molecules in the laboratory there is a definite effect on appetite.

Children's eating habits

It is a well-known fact that a child's last choice of food would be vegetables. If we compare the volatiles of cooked broccoli and strawberry jam we find that they have common flavour molecules, such as benzaldehyde, trans-2-hexenal, cis-3-hexenol, dimethyl sulphide and nonanal. These components could be used to create a fantasy flavour for, say, a quiche containing broccoli or a sauce for broccoli that would make a product more acceptable to children. How about sweet gravies or a kiwi and almond sauce for broccoli?

Traditional Food Pairings

For centuries we have known that certain foods go well together and chefs are always looking for the next magical combination. The following traditional pairings are still popular today but why do they work so well together? We could be convinced that it is because they have common flavour molecules so, in some way, they have a family connection.

Cheese & Onion:

16 molecules in common.

I have selected dimethyl sulphide (intense vegetable, tomato, seafood), methanethiol – (cabbagey) and ethyl butyrate (sweet, fruity, strawberry, mature cheese) as character impact compounds. It would be misleading to suggest that this is the only reason these two foods go well together as it is probable that the sharpness of the onion cuts through the fattiness of the cheese but the other flavour contributors, such as these named compounds, must also play a part in the marriage.

Gammon & Pineapple:

38 molecules in common.

I selected phenol with its smoky medicinal notes, gamma-hexalactone – (coconut, creamy), hexanal (green, leafy), ethyl acetate (sweet, fruity, ethereal) as the impact compounds here.

Lamb & mint

The flavour of lamb is attributed to branched chain fatty acids, such as 4-methyl octanoic acid, and we see that lamb & mint have 8 acids in common: 2-methyl butyric acid (sweet, fruity, strawberry, lamb fat), caproic acid (fatty, cheesy), capric acid (fatty, waxy, cheesy).

Gin & tonic:

32 molecules in common.

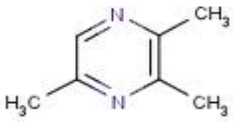
The presence of decanal, linalyl acetate, alpha-terpineol as distinctive character compounds is significant. Linalyl acetate in particular is interesting as it is the main flavour component of bergamot oil. So next time you have a g & t look out for the Earl Grey aroma caused by the addition of 2 sources of linalyl acetate.

Future Food Pairings

Beef & chocolate

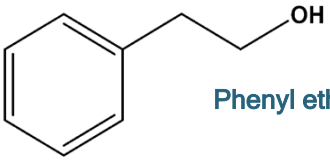
We know that beef & chocolate seem to go well together and they are now appearing on the menus of many high end restaurants.

Perhaps this successful pairing is based on the molecule 2,3,5-trimethyl pyrazine?



Tequila & rose

This combination works really well and the concept was used recently in a cocktail competition hosted by the Savoy Hotel in London. Phenyl ethyl alcohol possesses both rose and fermented notes depending on which other molecules are present. It is quite the chameleon among flavour molecules.



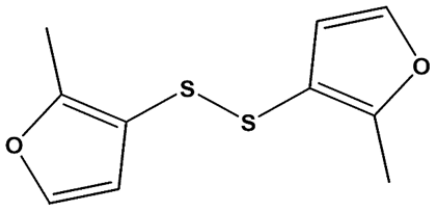
Phenyl ethyl alcohol

Shrimps & port wine

We are of course quite familiar with the combination of seafood and white wine. This is a tried and tested combination that works. Amines are typically produced when fish and seafood is less than fresh and the acidity of the white wine (more acidic than red) reacts with amines to produce odourless amides. However port wine and shrimps also have this molecule in common - phenol. With its smoky antiseptic character it bridges these two products very well.

Goat's cheese & grapefruit

A new combination using this approach that I particularly like is goat's cheese and grapefruit. I would propose that this in some way is down to the molecule bis(2-methyl-3-furyl) disulfide. In isolation this molecule is extremely powerful and has typical meaty notes that we can detect in the flavour of both goat's cheese and grapefruit.



bis(2-methyl-3-furyl)disulfide

Molecular foods & drinks?

Our food is undergoing a revolution. We are witnessing the arrival of 3D printed food, such as pasta, confectionery and other products already in development. US company 3D Systems partnered in January with The Hershey Company to create a 3D chocolate printer. This could give consumers the option of treating a 3D printer like a vending machine, which could print any chocolate combination they would like.

So we are building foods from the molecule up rather than breaking then down by analysis. Perhaps now is the time to build flavour from the molecule up using the molecular food pairings I have introduced.

To finish, I would make the very important point that a creative flavourist must never forget: analysis tells us what colours to use, it doesn't give us the final painting.

F&F Projects Ltd provides analytical and development services to the flavour and fragrance industry as well as to the users of flavours and fragrances. Recent work on Molecular Flavour Pairing has brought about some interesting results and may provide a pathway to future food and drink product development.