Food Pairing: Is It Really about Science?

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About the so-called “food pairing theory”, let’s tell the story, because it helps to understand the issue. At the second International Workshop on Molecular and Physical Gastronomy (1995) in Erice, there were representatives of the flavouring industry who discussed the idea that one could associate two ingredients in a dish if they had odorant compounds in common. Later, some cooks collaborated with this flavouring company and produced some dishes designed on the basis of odorant analysis of food ingredients.

At the third Workshop on Molecular and Physical Gastronomy (1997), when this question was discussed again, along with tasting of some dishes prepared according to this principle, two observations were made: (1) not all participants of the workshop agreed that the proposed associations “worked well”; (2) when it was observed that the probability of having two odorant compounds in common was almost 100% for any pair of food ingredients (for example, ethanol is present in most plant tissues, but also many compounds important for living systems are in all living cells), the promoters of the theory modified it to say that these compounds had to be “preponderant”. Moreover, some chefs attending the workshop claimed that talented cooks can make a “good” dish with any association of food ingredients.

Since then, some companies have been set up to sell advice about pairing, and some chefs use it for inspiration. However, the analysis should be as follows: if culinary activity includes an art component (and it does), the question of what is “good” is, in fact, the question of what is “beautiful to eat” (This, 2010). Also, the history of art shows clearly that all arts (music, painting, etc.) evolved in order to escape the rules. For example, in music, it was said in the Middle Ages that a tritone (a musical interval composed of three adjacent tones) was Diabolus in Musica (the interval of the devil), but many artists used it in order to produce beautiful music. Also, the classical rules of perspective are certainly not respected in painting by Picasso and other artists from the Cubism movement, while in theatre, the classic rule of unity of time, place and action was amply refuted by writers such as Aristotle (Aristotle, 335 BCE).

Refutation of the Food Pairing Theory: A Critical Look at the Literature

Food pairing is sometimes advertised as a scientific method to identify which foods and drinks go well together (The Food Pairing Company, 2020). Briefly, it starts with a GC-MS chemical analysis (gas chromatography coupled with mass spectrometry) of an ingredient to identify the main odorant compounds that a human will effectively smell. This enables the creation of a flavour profile of the ingredient, which can be compared with other profiles by screening a database to build a tree graph based on the so-called food pairing hypothesis; ingredients that have aromas in common are said to match in a dish. Or, to put it another way: “the more aromatic compounds two foods have in common, the better they taste together”. Now, the simplicity of this theory is as tempting and popular as it is scientifically unsound; indeed, as a “scientific theory”, food pairing has been refuted for many reasons.

First, on an individual basis, many chefs are able to pair food ingredients given to them at random (Pierre Gagnaire, among others, has played this game many times, in particular during TV shows). Of course, food pairing does not apply every time that only two ingredients are used, and this is fortunate, because dishes with only two ingredients on the basis of odour would probably lack interest in terms of consistency, taste, trigeminal sensation, calcium perception, fat perception, colour and so on. Then, when it is argued that “the major volatile molecules of two foods are the same”, this is ambiguous, because “major” could be about quantity (but the probability that two ingredients have the same compounds in equal quantity is almost nil) or quality (but the human diversity in olfactory receptors does not make this measurement possible).

For a more systematic and comprehensive criticism of food pairing theory, let’s have a closer look at some assumptions made and how the scientific literature addresses these issues.

Using a sensory test with different ingredients mixed in all combinations, the hypothesis that “if the major volatile molecules of two foods are the same, they might taste (and smell) nice when
the foods are eaten together” was tested and rejected (Kort et al., 2008). Other scientists interpreted this theory on the basis of cultural heritage (Ahn et al., 2011). By building aroma networks that linked and compared culinary ingredients, they claimed to show that there is a very slight tendency to pair ingredients that share compounds (hence matching the food pairing hypothesis) in Western cuisine (the North American corpus: USA, Canada), but that the effect was opposite (i.e., a slight tendency to avoid ingredients sharing compounds) in Eastern cuisine (East Asian corpus: Korea, China, Japan).

This “anti-pairing” effect was confirmed in another study addressing different regional cuisines in India; again, the authors showed that each regional cuisine follows a negative food pairing pattern. The greater the extent of flavour sharing between two ingredients, the less their co-occurrence in that cuisine (Jain et al., 2015). This clearly emphasizes the fact that, if there is any “rule”, it is cultural rather than physiological (de Klepper, 2011; Perkel, 2012) and also influenced by the culinary educational level (Traynor et al., 2020).

In a more “historical” but also methodological perspective, Varshney et al. (2013) tested the food pairing hypothesis on a collection of recipes from Medieval Europe. Although they did indeed find some pairing tendency (incidentally, stronger in the medieval period than in modern times) with a first dataset, they also showed that this result depended on methodological choices, in particular the quality of the raw data and of the data preparation. Hence, using a different (more complete) dataset drove them to the quite confusing opposite conclusion, that ingredients with shared compounds are not over-represented in recipes (Varshney et al., 2013).

Some studies worked the opposite way, through addressing the effectiveness of the theory in creating a new dish (Öztürk and Zeyrekçe, 2019; Traynor et al., 2013), but nothing can be concluded from so few trials.

Beyond artistic issues that might disrupt food pairing “rules”, there is a good chance that this pairing is also influenced by nutritional balance issues (sometimes referred to as “food combining”) as a whole, as well as more particular preservative effects of some ingredients, like spices (Ohtsubo, 2009).

Also, it should be noted that the pairing issue also concerns association of any food with a particular product, like olive oil (Cerretani et al., 2007) or, even more importantly, with drinks; food and wine pairing is quite a big issue in the scientific and gastronomic literature, since both the solid and the liquid should match key elements (texture, flavours and trigeminal sensations) along with traditions and other local/cultural aspects (Harrington, 2006). But considering that (1) both wine and dish are interacting with each other (the wine changes the taste of the dish, and the dish changes the taste of the wine), (2) the taste of wine evolves during the meal (due to oxidation, change in temperature, etc.) and (3) above all, taste is a personal matter, one can easily figure out how attempts to “rationalize” food/wine pairing are quite desperate.

**Conclusion**

Although it is always interesting to “play” with big culinary datasets and use systems and networks analysis tools, statistics or even non-equilibrium dynamics models (Kinouchi et al., 2008) to extract some information from these data, it should always be kept in mind that cooking contains artistic motivations, to which it is quite hazardous to attribute universal “rules”. Also, there is no need to look for the mechanisms of a phenomenon until this phenomenon is demonstrated to exist. So, before trying to explain the hypothetical mechanisms behind food pairing, one should demonstrate that there are indeed some food pairing rules, which is not clear so far!

Last but not least: when discussing a so-called “scientific theory”, one has to understand whether the sciences in question are natural sciences (physics, chemistry, biology and physiology) or sciences of humans and societies. The art and science (if any) of food pairing probably pertain to both.

**REFERENCES**


