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Editorial

The mayonnaise paradigm: An introduction to scientific gastronomy

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In June 1756, the Duke of Richelieu, leading an army of 12,000 men, embarked on the occupation of the island of Minorca, which was under English rule at the time. His military chef found himself having to satisfy the discerning tastes of a worldly man without access to the refined ingredients of the homeland. It was at this moment that, to celebrate the victorious advance of the French troops, he improvised a French-style sauce using local Minorcan ingredients: egg yolk, olive oil, lemon juice, and salt. We don't know if it was a stroke of luck or the chef's culinary skill, but the sauce gained increasing popularity and quickly spread, even in a version where vinegar replaced the lemon. It was christened "mahonnaise," from Mahon, the capital of Minorca, and later became "mayonnaise." Today, it can be found in supermarkets around the world.

At this point, the attentive reader cannot help but ask: why only then? The ingredients for mayonnaise were available millennia earlier. The ancient Romans could have easily prepared it with vinegar, and the same goes for the ancient populations of the Mediterranean region. The necessary equipment is elementary: a bowl and a fork, or any suitable tool for quick mixing. Archaeological excavations are filled with evidence of such tools. However, before the 18th century, there is no trace of such a preparation. Why?

The answers are multiple and interrelated, forming an organic view of the issue, typical of the science of gastronomy.

Let's start with a simple consideration. If the ingredients and tools were available earlier, but mayonnaise did not exist, it's clear that ingredients and tools alone are not enough to create a dish. Some might say, "Well, they lacked the idea; no one had thought of combining those ingredients in a bowl and mixing them with a fork." However, this answer isn't entirely accurate. If you pour oil, vinegar, salt, and yolk into a bowl and start mixing, you'll never get mayonnaise. And if you've never seen mayonnaise in your life, you could never imagine that those ingredients could result in that creamy, glossy, and clear sauce. Ingredients and tools alone are insufficient; a procedure is needed. The procedure for making mayonnaise is far from intuitive. First, you need to mix all the ingredients except the oil thoroughly, and then start vigorously beating the mixture while slowly adding the oil drop by drop. In doing so, the oil seems to be sucked up by the yolks and appears to disappear within the mixture. Meanwhile, the sauce increases in volume, thickens, and transforms from a liquid to a less fluid state, eventually reaching a well-defined, solid form, which is the final stage of whipped mayonnaise. If you pour the oil too quickly or pour too much of it, the yolks won't be able to incorporate it, resulting in an irrecoverable disaster: a broken mayonnaise.

We've understood something fundamental: a dish, even if it's not cooked, is something new and different from the sum of its ingredients. In other words, there are many ways to combine ingredients, and each produces a different result. The difference lies in the procedure or, in technical terms, the process.

Why is the process so important? Because it determines the structure.

This property, evident to common sense, was neglected by science for centuries. The reason is simple: when a microscopic structure depends on the process

by which it's prepared, it is necessarily far from thermodynamic equilibrium, hence unstable. Mayonnaise, indeed, is unstable and doesn't last forever. The key is that it lasts long enough to be eaten and be pleasing to the palate. The science of gastronomy is a science of the ephemeral.

So, let's take a look at the structure of mayonnaise.

When we pour the oil slowly while beating rapidly, we break it into numerous microscopic droplets. These droplets would re-coalesce into a single large drop upon contact, were it not for the lecithin molecules found in the yolk. Lecithin molecules arrange themselves around each droplet, forming a sort of molecular protective film that allows the droplet to navigate smoothly in the surrounding sea of water, which comes from the yolk itself and the lemon.

As more and more oil is poured, the droplets become plentiful and can't navigate freely anymore. Water is scarce, there's no space, and they collide with each other. The sauce becomes less fluid. In the end, there's no more room for them to move. The mayonnaise is stable; it's whipped.

To reach this stage, a substantial amount of oil is added. Escoffier prescribes a liter for six egg yolks. On average, mayonnaise consists of 70% to 80% oil. A sea of calories. Yet, it doesn't feel greasy in the mouth. You wouldn't say you're ingesting all that fat. In reality, the oil is hidden within the yolk. The mouth perceives primarily the watery, slightly acidic, and salty matrix supporting the myriad of oily droplets. The tongue divides the sauce into smaller and smaller portions, making it easier to swallow. But each time, you still find that watery matrix outside, so almost none of those oily droplets come into contact with your taste buds. You swallow fat and calories without sensing them in your mouth.

It might be a good way to fatten up an anorexic, but the chef of Richelieu had a different goal in mind. He wanted a creamy, sour, and salty sauce with a delicate flavor to use as a condiment. Olive oil was abundant in the Balearic Islands, which didn't quite match the taste of an 18th-century Parisian. French cuisine predominantly used butter, but fat, aside from its flavor, also serves a structural function. In mayonnaise, it provides volume and solidity to the sauce. It dilutes the strong flavors of lemon and salt. The key is to hide it well. It's likely that the idea of cautiously adding the oil drop by drop originated from an attempt to conceal the foreign ingredient within the yolk.

Why had no one tried this before? Because Mediterranean populations adored olive oil and would never think of hiding it. A Minorcan who had camouflaged this delicacy in an egg yolk would never have been taken seriously. It took a Northern palate, forced to use Mediterranean ingredients, to devise such a complex and non-intuitive procedure.

As you can see, gastronomy is a highly complex subject that encompasses every aspect of human knowledge. We eat for nourishment, of course. But we also eat for the sheer pleasure of the senses and the mind. These two aspects of eating must be harmonized; otherwise, the equation doesn't balance. Just as we can poison ourselves with delicacies, we can fall into deep depression by eating healthy but unappetizing foods. Assuming we can even ingest them. Those who seriously study nutrition cannot ignore these two facets of human nutrition. Food is also a daily ritual that fits into a complex and ever-changing personal and social context. Only by deeply understanding it can you determine what is the most suitable food for a given person on a specific occasion.

Above all, food is much more than a measured list of molecules. The dishes we eat are structures composed of bricks that are nutrients. Just as with the same bricks, you can build a villa or a warehouse, in the same way, you can create a delicacy or a disaster using the same nutrients. Food is a structure that the chef constructs, and the diner disassembles to assimilate its bricks. This act of deconstruction gives rise to sensory pleasure. The demolition begins in the mouth and is completed in the intestine, and the structure dictates the timing and manner of this deconstruction. The structure influences the kinetics of nutrient assimilation and requires energy to be disassembled. Even the caloric consumption required for eating is determined by the structure.

This is where the realization that we don't consume molecules but structures leads to the need for a scientific approach to gastronomy.

Scientific gastronomy is all of this and much more. It's a new discipline, officially established with the Barcelona Manifesto in 2019. It's a discipline that requires all other disciplines, but it cannot be reduced to the sum of physics, chemistry, biology, and so on. The analysis

of mayonnaise you've just read spans various fields, but it's the comprehensive view that makes it meaningful. To achieve this holistic perspective, it's not enough to know various diverse disciplines; it requires experience, reflection, comparison, research, and discussions.

The authors of the manifesto have devoted a significant portion of their lives to reach this synthesis and ask that the result becomes an officially taught discipline at universities. To this day, many degree programs include "gastronomy" in their titles, but there is no subject called gastronomy. There is no course that isn't reduced to the usual traditional disciplines. In practice, we are asking inexperienced students to perform the immense synthesis effort that took years for those who were much more experienced.

We will discuss the Barcelona Manifesto in detail in an upcoming article. For now, I want to tell you that scientific gastronomy naturally leads to innovative creations as well. For instance, a mayonnaise without eggs, made only with oil, vinegar, and salt. A vegan sauce, cholesterol-free, yet tasty and creamy. How? By using an ultrasonic agitator instead of a fork. Occasionally, even the tools make a difference...

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