



On how some discoveries in various fields of science sooner or later found practical applications (often in very unexpected ways), we wrote in issue Δ_{19}^{11} .



Raw



Hard-boiled



Soft-boiled



Sous vide



Periodic

[*] Di Lorenzo, E., Romano, F., Ciriaco, L. et al., 'Periodic cooking of eggs,' *Communications Engineering* 4, 5 (2025).
doi.org/10.1038/s44172-024-00334-w.

Soft-boiled, hard-boiled... and just right

Scientists engaged in fundamental research are occasionally faced with the necessity of answering questions about how the results of their studies will be applied in so-called 'everyday life.' It is well known that not all research yields results that can be immediately applied in industry, gastronomy, or entertainment.

One may wonder whether the goal of a certain group of researchers from Naples, Italy, was indeed to find an application for mathematical modeling methods and advanced imaging techniques in everyday life, or whether the inspiration came from an entirely different source. Regardless of their motivation, there is no doubt that the task they set for themselves was very ambitious. It might seem that the topic of cooking eggs has already been thoroughly and exhaustively explored by humanity through experiments repeated billions of times, leaving nothing new to be discovered. Everyone knows hard-boiled and soft-boiled eggs. It is common knowledge that for a hard-boiled egg, it should remain in boiling water longer, whereas for a soft-boiled egg, it should be cooked for a shorter time. Exactly how long this 'shorter' duration should be depends on personal preferences, and acquiring this knowledge requires some practice, but determining the optimal cooking time is relatively straightforward after a few trials.

It turns out that sometimes reading a scientific article can expand our culinary horizons. In the paper [***], the aforementioned group from Naples compares a new egg cooking method proposed by them with three previously known methods. What is this third method (apart from *hard-boiled* and *soft-boiled*)? Perhaps some Readers are already familiar with it, but no one in the *Delta* editorial team had heard of it before. It is called *sous vide* or $6X^\circ\text{C}$ and involves cooking eggs at a temperature between 60°C and 70°C for at least an hour. This relatively new but apparently increasingly popular method produces a very specific result—both the egg white and the yolk acquire the same creamy consistency.

This form of egg preparation likely has its enthusiasts; however, not everyone appreciates that albumen in this method does not fully set, as some proteins in the white solidify at temperatures higher than 70°C . The albumen and yolk have two very different compositions and consequently require different temperatures to reach their optimal states. The white would ideally cook at 85°C , while the yolk at 65°C .

A solution to the problem of different optimal temperatures could be to break the egg and prepare the white and yolk separately. But what if we insist on cooking the egg whole, in its intact shell? This is where the proposal from the Naples researchers comes in: the egg should be alternately placed in boiling (100°C) and cold (30°C) water. The switching should occur every 2 minutes, and a total of 8 cycles should be performed, meaning the entire process should last 32 minutes. The authors have named this method *periodic cooking*. The cooking time and switching frequency were determined through numerical simulations, taking into account heat conduction and the energy required for protein denaturation in both the egg white and yolk. In these conditions, the temperature at the egg's center changes slowly and approaches the optimal temperature for cooking the yolk without exceeding it. Meanwhile, closer to the shell, the temperature fluctuations are greater but oscillate around a higher value, optimal for cooking the white.

The numerical simulation predictions were tested experimentally, and according to the authors, they were fully confirmed. Periodically cooked eggs supposedly have an optimal consistency throughout their entire volume. Anyone with 32 minutes to spare can switch an egg between warm and cold water 8 times and then taste it to form their own opinion on whether modern scientific methods truly have applications in gastronomy.

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