

# Physics of food shows secrets of popcorn

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Credit: Petr Kratochvil/public domain

To most people, it may be just a fun food to munch while watching a movie. But to a couple of French investigators, popcorn is a biomechanical enigma waiting to be explained.

In an unusual study published on Wednesday, engineers Emmanuel Virost and Alexandre Ponomarenko carried out experiments into what makes popcorn, well, pop.

Cameras recording at 2,900 frames per second helped show what happened when a kernel of corn strutted its stuff.

When the temperature reached 100 degrees Celsius (180 degrees Fahrenheit), some of the moisture inside the corn started to turn into steam, the researchers found.

As the [temperature](#) rose to around 180 C (356 F), pressure built to around 10 bar, or 10 times the atmosphere at sea level.

Unable to withstand the stress, the outer shell broke open, causing a dramatic drop in pressure that forced the kernel's starchy innards to expand and protrude.

"We found that the [critical temperature](#) is about 180 C (356 F), regardless of the size or shape of the grain," said Virost, an aeronautical engineer at the elite Ecole Polytechnique.

The first thing to emerge from the fractured shell is a limb-shaped structure—a "leg"—that comes into contact with the surface of the pan and starts to compress under the heat.

Tensed and then released, the "leg" causes the corn to leap up—a height ranging from a few millimetres to centimetres (tenths of an inch to several inches)— and emit a "pop" from the sudden release of water vapour.

A few milliseconds later, the granules spewing from inside expand to form a spongy flake.

Evolution from fracture to flake takes less than 90 milliseconds—0.09 of a second.

The popcorn's leap results from an intriguing combination of thermodynamics and fracture mechanics, rather than just the blast of pent-up gases.

"A piece of [popcorn](#) has a singular way of jumping, midway between explosive plants such as impatiens, and muscle-based animals such as human beings," the researchers said.

The study appears in a British journal, the Royal Society *Interface*.

**More information:** Popcorn: critical temperature, jump and sound, [rsif.royalsocietypublishing.org/... .1098/rsif.2014.1247](http://rsif.royalsocietypublishing.org/doi/10.1098/rsif.2014.1247)

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