Microwaved exploding eggs make for an unusual acoustic experiment

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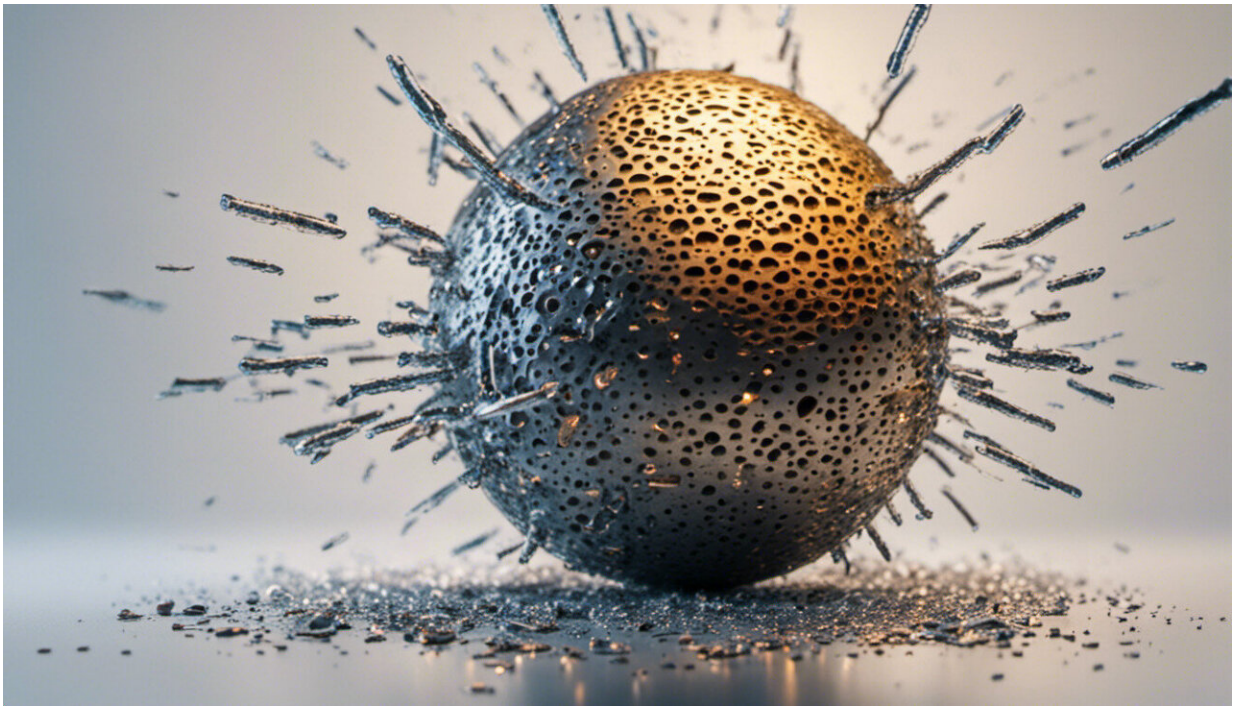

Credit: AI-generated image (disclaimer)

Microwave ovens are often a fast way of warming food and have become a staple cooking appliance in both household kitchens and restaurants alike. If you have looked closely at the microwave's warnings or have experienced an accidental explosion, you know that certain foods pose a risk due to an increase in their internal pressure. Potatoes

and hard-boiled eggs are among the most common culprits of potentially dangerous explosions. While both potatoes and eggs might explode, their mechanisms of bursting are different.

Anthony Nash and Lauren von Blohn, from Charles M. Salter Associates, will present their research on the sound pressures generated by exploding eggs at the 174th Meeting of the Acoustical Society of America, being held Dec. 4-8, 2017, in New Orleans, Louisiana.

Nash and von Blohn explored the mechanism of exploding eggs as part of expert witness testimony for litigation where a plaintiff allegedly suffered severe burns and hearing damage at a restaurant after a microwaved hard-boiled egg exploded in his mouth.

"We needed to quantify the peak sound pressures from an exploding egg so we could compare it to hearing damage risk criteria," said Nash. "At one foot away, the peak sound pressure levels from microwaved eggs covered a wide range from 86 up to 133 decibels. Only 30% of the tested eggs survived the microwave heating cycle and exploded when pierced by a sharp object. On a statistical basis, the likelihood of an egg exploding and damaging someone's hearing is quite remote. It's a little bit like playing egg roulette."

Because there was little scientific literature on the subject, the investigators initially took an unorthodox approach by reviewing YouTube's collection of microwave explosions.

"Those experiments had been done by non-scientists who were casually detonating eggs in a microwave," said Nash. Since their experiments seemed to be more for personal entertainment than for scientific exploration, they did not control for a number of important variables, including measurement of sound levels or internal temperatures, or documentation of the various kinds and sizes of eggs.

For Nash and von Blohn's experiments, they did account for these variables, which were highly controlled. First, selected hard-boiled eggs were placed in a water bath and heated for three minutes, and the temperature of the water bath was then measured both at the middle and end of the heating cycle. Finally, the eggs were removed from the water bath, placed on the floor and pierced with a fast-acting meat thermometer to induce an explosion.

"For both the exploded eggs and eggs that didn't explode, we would probe the inside of the yolk with the thermometer," said Nash. "We discovered that the yolk's temperature was consistently higher than the surrounding water bath."

The implication is that the egg yolk is more receptive to microwave radiation than is pure water (water constitutes about half the weight of an egg yolk). The duo hypothesized that the egg's protein matrix traps small pockets of water within the yolk, causing the pockets to superheat well above the nominal boiling temperature of ordinary tap water. When these superheated pockets are disturbed by a penetrating device, or if one attempts to bite into the egg yolk, the water pockets all boil in a furious chain reaction leading to an explosion-like phenomenon.

Applications of this research may extend past the obvious warnings by manufacturers of microwave ovens and contribute to the growing understanding of impulsive sound sources that cause hearing damage.

More information: Abstract: 3aAA11: "Sound pressures generated by exploding eggs," by Anthony Nash and Lauren von Blohn, Dec. 6, 2017 in Studio 9 in the New Orleans Marriott. asa2017fall.abstractcentral.com/s/u/3Cw0kpJV_I4