How are rice cakes made? Heat, pressure and a fifth of a second

From the crackers.biz wiki

A measured scoop of slightly damp rice goes into a hot mould, where a piston squeezes it hard. The heat works on the water inside each grain; when the piston pulls back and the pressure vanishes, that water flashes into steam, the grains burst open and they fuse into one cake. A patent filed by Mars describes the mould widening from roughly 0.5mm to roughly 10mm within about 200 milliseconds, with the whole cycle done in under five seconds.

From rice to cake in seconds

Most crackers take their time. A cream cracker dough ferments for most of a day before it is rolled, layered and baked, as our article on how cream crackers are made explains. A rice cake is the opposite. There is no dough, no rolling and no oven. Loose grains of rice go into a hot metal mould, and a few seconds later a finished cake comes out, puffed, crisp and holding together on its own.

The whole trick is heat, pressure and a very sudden release. A clear description of it appears in a patent filed by Mars in November 1996 and published in February 1999, which sets out how rice cakes were being made at the time and how the company proposed to make them faster.

Inside the machine

The patent describes the usual process in six steps:

1. The machine has a mould made of several parts, one of them a piston that can move up and down to squeeze the grains inside.
2. A measured quantity of plain, unpuffed rice goes in. It can be parboiled or not, and its moisture is typically about 16 per cent of its weight.
3. The piston compresses the grains to a pressure of about 6 MPa, or 60 bar: roughly sixty times the pressure of the air around us.
4. The mould heats the rice to between 230 and 280C.
5. The piston moves back to open the mould by a set amount. The hot grains expand into the space and bond together to form the cake.
6. The finished cake is taken out of the mould.

That is all. No binding syrup is added: in the patent's words, rice cakes are made from puffed grains bonded together without a binding matrix. The same patent notes that the rice cakes of the day generally contained only rice and salt, with any flavouring added to the surface once the cake was formed.

Why the grains burst

The pop comes from the water in the grain. While the mould is shut, the grains are heated far beyond 100C, but the pressure holds the water inside them in check, just as a pressure cooker lets water get hotter than it could in an open pan. When the piston pulls back, the pressure disappears in an instant, and the water flash boils into steam inside every grain. Wikipedia describes puffed rice forming through a reaction of starch and moisture heated inside the shell of the grain, with the moisture flash boiling and puffing the rice up. Each grain swells and sticks to its neighbours, and in a blink the loose scoop of rice has become a single light disc.

Moisture has to be right for this to work. Wikipedia notes that rice kernels are naturally short of moisture and must first be conditioned with steam before they will puff.

The Mars design: under five seconds

The Mars patent was about speed. It says conventional machines needed at least 6 seconds for each cycle of compressing, heating, expanding and removing the cake, and usually 10 to 12 seconds. In the new design the rice, preferably at 16 to 28 per cent moisture, reaches a puffing temperature of 210 to 270C in about two seconds. The mould then opens in steps from a thickness of about 0.5mm to about 10mm, so the cake ends up around twenty times thicker than the compressed rice, and that expansion takes roughly 200 milliseconds, a fifth of a second. The whole cycle of compressing, heating and expanding can be completed in under five seconds.

An old idea in a new mould

Rice cakes borrow the principle behind puffed rice, which is older. Wikipedia credits the American botanist Alexander P. Anderson with developing commercial popped rice while he was studying the moisture in starch granules, and says he showed the first puffing machine at the World's Fair in St Louis in 1904. In the method known as gun puffing, grain with the right moisture is pressurised to around 200 psi, about 1,400 kPa, and when the pressure is suddenly released, the pressure stored inside each kernel makes it puff out. A rice cake machine does much the same thing, but inside a mould that presses the puffing grains into a disc.

Traditional methods puff rice by frying it in oil or in hot salt, and Wikipedia notes that parboiled rice, steamed and then dried, can be puffed in preheated salt.

Another way: hot air

Pressure is not the only route. A different process appears in a 2010 patent application from CJ CheilJedang, a food company based in South Korea. The rice is brought to a moisture of 20 to 40 per cent, milled to a fine powder of 100 to 200 micrometres, steamed, and rolled into a sheet 1.3 to 2.5mm thick. Finally hot air at 240 to 280C puffs the sheet in a roaster, over 20 to 60 seconds. The applicants say snacks

puffed by the usual pressure method are very brittle, and that the hot air method gives a better texture.

Rice cakes on the cracker shelf

In Wikipedia's words they are flat, hard discs of puffed rice. People eat them on their own or put something on top, which is why they sit so comfortably next to crackers. Most are round, though square ones exist, and flavours run from cheese and sweet chilli to chocolate, caramel and salt and vinegar.

Our rice cakes shelf has the Snack a Jacks Jumbo Salt and Vinegar, which the label describes as rice and corn cakes, made with wholegrain rice and maize. Kallo Lentil Cakes take the idea beyond grains altogether: the label gives 85 per cent lentil flour, plus corn flour and buckwheat.

If you avoid gluten, rice cakes are worth a look, but always read the pack, because some carry warnings about wheat, gluten and barley. Our guide to gluten free crackers covers the wider choice, and our article on rice cakes compares them with oatcakes and crispbread. For everything else that snaps and crunches, see our guide to every kind of cracker.

Quick facts

Goes in	Plain rice, typically about 16 per cent water by weight
Squeezed to	About 6 MPa, or 60 bar
Heated to	230 to 280C in a conventional machine
The puff	A thickness roughly twenty times greater in about a fifth of a second
Time per cake	Usually 10 to 12 seconds in older machines; under 5 in the Mars design
Glue	None; the puffed grains bond to one another
Other grains	Wheat, millet, buckwheat, barley and corn can be puffed the same way

Questions people ask

What makes the pop when a rice cake is made?

The sudden release. The grains are heated while held under great pressure, so the water inside them cannot boil off as it would in an open pan. When the mould opens the pressure disappears at once, the water flash boils into steam and the grains burst outwards.

Is there anything holding a rice cake together?

Nothing added. The Mars patent describes rice cakes as puffed grains bonded to each other without a binding matrix: the heat and pressure fuse them as they expand.

Are rice cakes baked in an oven like crackers?

Not in the usual method. The cake cooks inside the hot mould in a few seconds, whereas a cream cracker dough ferments for most of a day and then bakes for a few minutes.

How do flavoured rice cakes get their flavour?

The Mars patent says rice cakes generally contain only rice and salt, and that any flavour goes on the outside once the cake has been made. Flavoured cakes list their seasonings or coatings on the pack.

Can I eat rice cakes if I avoid gluten?

Rice contains no gluten, but read the pack. Snack a Jacks mix rice with maize, and their caramel and chocolate chip cakes warn on the label about possible traces of wheat, barley and gluten.

Can rice cakes be made from other grains?

Yes. The Mars patent lists wheat, millet, buckwheat, barley and corn. Snack a Jacks combine wholegrain rice with maize, and Kallo's lentil cakes are mostly lentil flour.

Sources

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