Ammonium bicarbonate: the raising agent behind Ritz, TUC and Mini Cheddars

From the crackers.biz wiki

A raising agent that works on heat alone, ammonium bicarbonate is covered on UK labels by E503, the ammonium carbonates. Heat breaks it down above about 36C into ammonia, carbon dioxide and water, and in a thin, dry cracker all of it escapes in the oven, leaving no salty or soapy taste behind. It is the modern baker's ammonia, once made from deer horn and called hartshorn. On our shelf Ritz, TUC and Mini Cheddars use it, while Carr's Table Water uses no raising agent at all.

A raising agent for thin things

Crackers get their texture in different ways. Some rely on a long yeast ferment, some on bicarbonate of soda, and some on nothing but thin rolling and a hot oven. Several familiar snack crackers use an older and odder ingredient: ammonium bicarbonate, the raising agent bakers once called hartshorn. Read the small print on a box of Ritz, a packet of TUC or a bag of Mini Cheddars and you will find it, or its close relatives, among the raising agents.

It sounds alarming on a label. It is not ammonia in the cracker, though, and the reason why comes down to what heat does to it.

The chemistry in one line

Chemically it is a simple ammonium salt, (NH4)HCO3. It is colourless, and Wikipedia notes that it readily falls apart into carbon dioxide, water and ammonia. That instability is the whole point. A raising agent is any ingredient that makes gas inside a dough, and ammonium bicarbonate makes its gas with nothing more than warmth. Bicarbonate of soda works best with an acid alongside it; BAKERpedia notes that ammonium bicarbonate releases carbon dioxide without needing one.

What happens in the oven

Wikipedia puts the turning point at about 36C, and BAKERpedia at 34C: either way, far below any oven. As the dough heats, the powder breaks down into ammonia, carbon dioxide and water, all of which are gases at baking heat. The gas opens up tiny pockets in the dough and lifts it. Then, in something as thin as a cracker, it simply leaves. Wikipedia says the compound decomposes completely into water and gases that evaporate during baking, so none of it is left in the finished cracker.

That is also why it only suits thin, dry bakes. In a thick, moist bake some of the ammonia gets trapped, and Wikipedia warns that the result tastes unpleasant, which rules it out for ordinary bread and cake.

BAKERpedia draws the line at 5 per cent moisture: above that an ammonia flavour can develop, so it names biscuits, crackers, cookies and waffle cones as the natural home for this raising agent.

A cracker sits well inside that limit. BAKERpedia's figures for cracker baking give a finished moisture of just 1.5 to 2.5 per cent, from a sheet of dough only a few millimetres thick, as our article on how cream crackers are made describes. The small holes pressed into most crackers help too, letting steam and gas out so the sheet bakes flat; see why crackers have holes.

Why cracker makers like it

Wikipedia gives two advantages over bicarbonate of soda or potash. Gram for gram it gives off more gas, so a little goes a long way, and because it breaks down completely it leaves no salty or soapy taste. BAKERpedia adds that it leaves no alkaline residue behind and does not shift the pH of the bake.

It rarely works alone, though. Ritz Original lists four raising agents: calcium phosphates, ammonium carbonates, sodium carbonates and potassium carbonates. TUC Original and Mini Cheddars both list ammonium bicarbonate with sodium bicarbonate. All three pair it with at least one other raising agent, and the baker balances the mixture to get the texture they want.

What the labels on our shelf say

We checked the Open Food Facts records for crackers on our shelf, and they fall into clear groups:

- Ritz Original: calcium phosphates, ammonium carbonates, sodium carbonates and potassium carbonates.
- Ritz Cheese: ammonium carbonates and potassium carbonates.
- TUC Original: ammonium bicarbonate and sodium bicarbonate.
- Mini Cheddars: ammonium bicarbonate and sodium bicarbonate.
- Jacob's Cream Crackers: yeast, with sodium bicarbonate.
- Krackawheat: sodium bicarbonate, with lactic acid.
- Carr's Table Water: no raising agent at all.
- Cornish Wafers: no raising agent at all.

The ammonium users are the snack crackers, and their doughs are richer: Ritz lists sugar and glucose fructose syrup, TUC glucose syrup, and Mini Cheddars sugar, glucose syrup and dried cheese. The plain cheese board crackers are the opposite. Carr's water biscuits contain just flour, salt and palm oil, and our article on Carr's water biscuits tells their story. The cream cracker gets its lift from a long yeast ferment. For more on the snack crackers themselves, see Ritz, TUC and our guide to cheese biscuits. Recipes do change, so always trust the pack over any list, ours included.

Ammonium bicarbonate or ammonium carbonates?

Labels name it in different ways. Jacob's writes ammonium bicarbonate; the Ritz box says ammonium carbonates. The GOV.UK list of approved additives groups them together as E503, ammonium carbonates, next to E500 for sodium carbonates and E501 for potassium carbonates. Wikipedia explains that ammonium

carbonate itself breaks down into ammonium bicarbonate and ammonia, and both do the same job in the oven: they turn into gas and bake away.

From deer horn to cracker factory

Long before factories, this raising agent came from animals. Wikipedia says baker's ammonia was originally made from ground deer horn, which is why it was called hartshorn; a hart is a male deer. It came before bicarbonate of soda and baking powder, and under the old name sal volatile it was part of smelling salts. Ammonium carbonate is still the main component of smelling salts today.

The old names survive. In Norway it can still be called hornsalt, and Wikipedia lists it in traditional northern European bakes: Swedish drömmar, Danish klejner at Christmas, German Lebkuchen, speculoos, and tunnbröd, a thin Swedish bread. For Sweden's rye crispbread, see our crispbread article. BAKERpedia adds Scandinavian gingerbread and German Spekulatius.

There are no deer in it now. Wikipedia describes it being made by combining carbon dioxide with ammonia, and records around 100,000 tons of ammonium bicarbonate produced that way in 1997.

Baking with it at home

Some old Scandinavian and German recipes still ask for baker's ammonia. If you try one, treat the raw powder with care. Wikipedia notes that ammonium bicarbonate irritates the skin, eyes and airways, and that breathing it in can cause coughing. Keep the tub tightly sealed, since it breaks down readily, and expect a strong smell of ammonia when the tray first goes in. Wikipedia's advice is to keep it for crackers, cookies and other thin, dry bakes, so that the smell bakes out.

For the bigger picture of how crackers are raised, flaked and baked, see our guide to every kind of cracker.

Quick facts

Chemical formula	(NH4)HCO3
On a UK label	E503, the ammonium carbonates
Starts to break down	Above about 36C
Turns into	Carbon dioxide, water and ammonia
Old names	Hartshorn, salt of hartshorn, baker's ammonia
Works best in	Thin, dry bakes under 5 per cent moisture
On our shelf	Ritz, TUC and Mini Cheddars list it

Questions people ask

Is there ammonia in Ritz crackers?

Ammonium carbonates are on the Ritz ingredient list, but only as a raising agent. In the oven they break down into gases and water, and Wikipedia explains that in a thin bake like a cracker this happens completely, so it all evaporates rather than staying in the cracker.

Why not just use bicarbonate of soda?

Wikipedia gives two reasons: ammonium bicarbonate releases more gas per spoonful, and it leaves no salty or soapy aftertaste because nothing solid is left behind. BAKERpedia adds that it needs no acid to work and does not change the pH of the finished bake.

Why do bread and cakes not use it?

They are too thick and too moist. Some of the ammonia would be trapped inside and spoil the flavour, Wikipedia says. BAKERpedia puts the limit at about 5 per cent moisture in the finished product, and a cracker leaves the oven far drier than that.

What does E503 mean on an ingredients list?

It is the number for ammonium carbonates on the UK list of approved additives, and ammonium bicarbonate sits under it. Sodium carbonates are E500 and potassium carbonates E501; the Ritz Original label names all three groups.

Why was it called hartshorn?

Because it was first made from deer. Wikipedia says baker's ammonia was originally made from ground deer horn, hence hartshorn, a hart being a male deer.

Do all crackers use a raising agent?

No. The labels of Carr's Table Water and Jacob's Cornish Wafers list none at all: just flour, palm oil and salt, with wheat starch in the wafers. Jacob's Cream Crackers rise with yeast and bicarbonate of soda.

Sources

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