

## No LFS, no cry

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**W**hile for many, shedding a few tears as they cut an onion is a fair price to pay considering the improvement it can make to a dish, there are some who would gladly do without. Cooks for one. Until recently, it was thought that what made the distinct flavour and aroma of onions was also what made you cry. So if you tampered with the lachrymatory factor, the onion's flavour and aroma would be dulled - which would not do. A small revolution has occurred, however. A team of Japanese scientists discovered, quite by chance, an enzyme which catalyses only the lachrymatory factor, and has been named lachrymatory factor synthase (LFS). Tampering with LFS may allow us to dry up the tears while preserving the taste.

Does this mean that the biochemical pathways of onion flavour and aroma are separate from the tear-luring one? No. Which is why it has always been thought that these three sensations were by-products of the same process. Organosulfur compounds are the chemicals which are guilty for all the sensations an onion has to offer. Sitting on a shop shelf, an onion is harmless – it gives off no smell, it lures no tears – because the enzymes which trigger off the flavour and lachrymatory biosyntheses are trapped in cytoplasmic vacuoles while the sulfur compounds are free in the cell's cytoplasm. When you cut an onion, you disrupt the vacuoles, freeing the enzymes which make a beeline for their sulfur substrates. An initial enzymatic reaction generates 1-propenylsulphenic acid. Most flavour compounds result from spontaneous reactions of sulphenic acids. The result is a mixture of over 50 sulfur-containing compounds which are for the great majority volatile.

Propanthial S-oxide – the lachrymatory factor – was also believed to be part of this chemical firework. However, it has been discovered that lachrymatory factor synthase actually uses the first enzymatic product – 1-propenylsulphenic acid – to make the lachrymatory factor. So although the tear component is an integral part of the flavour/aroma biochemical pathway, it is produced independently of the other sulfur components. Once synthesized, the lachrymatory factor is particularly volatile and when it reaches our eyes, it reacts with the ocular fluids to form....sulfuric acid. Which is

enough to cry for. In fact, it is believed that the whole point of the release of onion lachrymatory factor is to ward off predators. One bite and a pungent odour coupled with an eye stinger are released. In some respect, an onion has found the same strategy as a skunk.



'Onion', Evan Nabrit

Courtesy of the artist

The onion (*Allium cepa*) probably originated in central Asia and spread east towards Europe to be shipped to the Americas by Christopher Columbus. There are traces of onion cultivation on the edge of the Mediterranean, which reach as far back as 5'000 BC. The Egyptians left

onions in the tombs of their dead; small onions were found in the eye sockets of the mummy of King Ramses IV, who died in 1160 BC. Onions have been part of the European diet for centuries and revered for their medicinal properties. Olympic athletes are said to have fed on onions to improve their performance. Blood clots in horses have been treated with onion for centuries. Greek physicians applied onion-based salves on wounds. And today, onions are claimed to have a variety of health benefits ranging from anticarcinogenic properties, antiplatelet activity, antiasthmatic and antibiotic effects.

So what would the benefits of tearless onions be? Economical say some. The world production has increased by 25% over the past decade. Currently, around 44 million tons are produced on a yearly basis. That is a lot of tears... Onions are grown and appreciated in cooking worldwide; tearless onions could sell better. The Japanese scientists who discovered

LFS suggest that the onion's flavour could be enhanced if the enzyme is withdrawn from the onion. Others say that things are not quite so simple. The chemicals which participate in an onion's flavour, and its health benefits, are so diverse that extracting the tear factor reaction may well tamper not only with the overall taste but also with the health benefits.

It really is too early to say. Some even go so far as to suggest that an organism in which a gene has been inactivated – rather than added – to make it more suitable for human consumption could ease the idea of genetically engineered organisms on the layman. Much ado about not much it seems. In the meantime, before you chop an onion, cut it in half and stick it in the freezer for a moment. This chills the lachrymatory factor synthase and, once you have taken it out of the freezer, if you chop your onion fast enough, LFS will have no time to react and no tears will be shed.

## Cross-references to Swiss-Prot

Lachrymatory factor synthase, *Allium cepa* (Onion) : P59082

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