

Science at the Seder

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SCIENCE OF THE SEDER BY POPULAR SCIENCE

MAROR AND CHAZERET

Horseradish is generally used as maror, and it is by far the most spicy and most bitter herb of them all. One good spoonful is more than enough to clear out the sinuses, but only if the plant is damaged. According to Harold McGee's *On Food and Cooking* horseradish stores its spicy chemical, theocyanate, by combining it with a sugar molecule. "When [horseradish] cells are damaged, special enzymes reach the storage form and break it apart, liberating the irritant molecules," McGee writes. So *grating* the horseradish is what gives a Hillel sandwich its famous kick.

HAROSET

This sweet mixture symbolizes the bricks that the Israelites made during their captivity in Egypt. Those bricks, composed primarily of reeds and gypsum-rich mud, may have been a pain for the Israelites to make, but they are a boon to modern scientists. In 2005, University of Chicago graduate student Virginia Emery published a paper in *The Journal of Archaeological Science* detailing how she figured out the organization of Egyptian work gangs based solely on the chemical composition of the bricks they used to build a house. And, according to Nadine Moeller, an assistant professor of Near Eastern Language and Civilization at the University of Chicago, that's just the tip of the iceberg. "Brick chemistry is something that's completely understudied in Egyptology," said Moeller. "We can really accurately trace which source the clay came from; it is actually very useful."

BEITZAH

The hard-boiled (or roasted) egg wouldn't take on that solid consistency we all know and love without the protein ovotransferrin. While ovalbumin makes up the majority of the egg white, ovotransferrin coagulates at lower temperatures. That's important when cooking eggs, as temperatures above 140 degrees Fahrenheit result in the release of hydrogen sulfide, which gives off that terrible, rotten egg smell. Ovotransferrin sets at 145 degrees Fahrenheit, while ovalbumin doesn't coagulate until it reaches a much higher temperature.

KARPAS

Most people use celery or lettuce for karpas. According to Rabbi Ari Zivotofsky, however, the original karpas was actually wild Israeli lettuce, or *Lactuca serriola*, and that plant may explain why you recline while eating on Passover. *Lactuca serriola* contains both lactucopicrin and lactucin, opiate-like sedatives and analgesics. Much like the famed tryptophan-coma that accompanies Thanksgiving meals, a hearty helping of lactucopicrin and lactucin would leave anyone sideways.

Z'ROA

The lamb shank symbolizes the tenth plague in particular, and all the plagues in general. Plagues that, according to Siro Trevisanato's book *The Plagues of Egypt: Archaeology, History, and Science Look at the Bible*, were caused by the eruption of the volcano Thera (now known as Santorini, and [covered more thoroughly](#) in a previous [PopSci.com](#) gallery). As Trevisanato tells it, fallout from the volcano rained down as flaming chunks of rock, blotted out the sun and filled up the river, turning it blood red. The ash polluted the river, driving the frogs onto land, where they died. Without the frogs to control the insect population, locusts and fleas had a field day. That more or less takes care of plagues one, two, three, seven and nine.

MATZOH

While not technically part of the seder plate, matzoh is too important a part of Passover to pass over here. If you believe Martin Blaser, the Frederick H. King Professor of Internal Medicine at New York University Medical Center, however, matzoh actually predates Passover and its affiliated Exodus. Blaser thinks that matzoh, which relates to the traditional disposal of yeast and bread products from the house during Passover, actually originated as a defense against plague-spreading rats. "This festival of the unleavened bread goes back thousands of years in Palestine," said Blaser. "Whoever wrote the Bible, human or otherwise, knew the ecology of plague." In his view, residents of the Middle East learned early on that grain attracted rats, and that rats carried the deadly bubonic plague. Thus, the holiday where grain is cleared out of the house coincides with the time of the year when the rats would emerge from their winter burrows, plague-infested and hungry. Blaser says his theory is corroborated by the relatively low mortality rates among Jews during a 16th century plague outbreak in Venice, Italy. Matzoh may be flavorless, but Blaser claims the tradition of eating it has saved thousands of lives.