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Evolution & Behaviour

The oldest beer in central Europe? Take it with a pinch of… malt!

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Ancient beer is hard to find, and new methods for identifying its remains are constantly being sought for. During their search for new ways of unlocking the secrets of charred prehistoric food crusts, an international team of archaeologists uncovered a new identification trait for foodstuffs made of malted grain. They also discovered the possibly oldest traces of brewing in central Europe.

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Beer making is based on the conversion of starch into alcohol by saccharification and fermentation. While ethanol fermentation is usually carried out by single-celled yeasts, saccharification is one of the few processes in food production that requires the processed organism to, well… process itself.

When a cereal kernel begins to sprout, the awakening seedling sends signals to a particular part of the grain, the aleurone layer. The aleurone then begins to produce large amounts of enzymes, which start breaking down the starch depots of the grain. They also decompose the grain's cell walls, continuously thinning them out. The released sugar units provide the growing seedling with energy. Malting makes use of these processes to have the grain produce the required enzymes, but kills the seedling before it consumes the free sugars. Instead, yeasts will feed on them to produce the desired alcohol.

Why this lengthy introduction on brewing when this is actually meant to be an archaeology article? Short answer: The archaeology of beer is a promising, but very difficult endeavour.

Long answer: Because of the crucial roles that food plays in social life, the analysis of archaeo-logical food remains – and thus, of ancient cuisine – can contribute a lot to the knowledge of how past societies actually worked (see an earlier TheScienceBreaker article). While this is certainly true for eating, it is even truer for drinking – especially if the drink is booze. Alcoholic drinks call

forth associations to complicity, feasting, even to ecstatic rituals. Today, most archaeological researchers are convinced that brewing beer is probably as old as agriculture itself (maybe even older), and that the habit probably already spread with Neolithisation.

Evidence for this hypothesis is however scarce, as ancient beer is quite elusive. The reason behind the uncertainties is that each indicator for beer-making has its ambiguities. Installations can be related to brewing, but few of them are unequivocally not just meant for cooking. Explicit decorations on drinking vessels can indicate feasts fuelled by beer, but they could also refer to wine or mead. Calcium oxalate crystals can derive from mashing and fermenting, but just as likely from some random plant. A grain cell's starch granules do display traces from the enzyme attack during sprouting, but they are only preserved in dry desert environments. Large amounts of charred sprouted grains can document malting, but the grains need to be intact and identifiable (not crushed or ground). Ancient beer research is therefore constantly searching for new sources of information, direct or indirect.

Our research within the ERC project PlantCult has now resulted in such a new marker for brewing – for malting, to be precise – applicable to charred food crusts made from ground up grains. Such food crusts are very common remains in archaeological excavations, and they are some-times still attached to the inside of vessels. Charring happens if food accidentally burns during cooking, or – even more fortunate for archaeologists – if an entire house burns down.

A few food crusts we analysed in the project, deriving from 4th millennium BCE Late Neolithic pile dwellings (see models of the Hornstaad and the Sipplingen objects), showed aleurone tissue with unusually thin cell walls under the scanning electron microscope (SEM).

This brings us back to the initially explained microstructural changes: As you know by now, a grain's cell walls get thinner during sprouting. Could "our" crusts be the remains of such sprout-ed grain? In order to verify our hypothesis, we looked at artificially charred barley malt in different stages of sprouting. We wanted to check if observable thin aleurone cell walls would survive charring. Several hundred measurements on SEM images later, we knew for sure. Then, we cross-checked with charred crusts from the oldest brewing installations (4th millennium BCE) in Egypt, from Tell el-Farkha and Hierakonpolis. We expected these brewing remains to display thin-walled aleurone tissue under the SEM. They did, and we were overjoyed!

Now we can safely claim that the inhabitants of some lakeshore dwellings produced food from ground malted barley. The structure of the Hornstaad find even suggests the malt meal had been dissolved in a liquid before it was accidentally charred by fire. Whether this "malt drink" had been intended as a mash for brewing remains unknown, as we lack markers for the alcoholic fermentation. Nevertheless, it is at least very likely. Given the dangers of the parasite-infested water at the lakeshore dwellings, beer from boiled mash may even have been the only liquid safe for drinking – and for being merry at the same time.