

Oldest evidence for processing of wild cereals: starch grains from barley, wheat, on Paleolithic grinding stone

When the water level in the Sea of Galilee dropped in 1989, archaeologists rushed to excavate Ohalo II, an ancient human settlement. On the floor of one hut they found a large, flat, basaltic stone. The stone's uneven surface yielded starch grains of grass seeds, mostly from wild barley and possibly also from wheat. This evidence presented in the journal *Nature* (August 5, 2004), pushes back the date for the processing of close wild relatives of domesticated wheat and barley, a key step in cultural development, to 23,000 years before the present era. "Ten thousand years before people were cultivating cereals, they were processing wild barley: starch grain analysis establishes a clear link between an intensive exploitation of wild cereals and the subsequent development of plant cultivation and domestication in the region " explains Dolores Piperno, lead author.

"We were very surprised by the abundance of seed remains we found on the stone and how the evidence pointed to the processing of just a few types of grass seeds. We could identify barley and there was no evidence for the processing of roots or tubers, underground plant organs."

Piperno, from the Smithsonian Tropical Research Institute and the Archaeobiology Program at the National Museum of Natural History, and her STRI colleague Irene Holst, had used starch analysis to chronicle plant domestication in the New World tropics [see references, below].

Harvard University archaeologist, Ehud Weiss and Dani Nadel, at the University of Haifa, had excavated a well-known paleo site in Israel, Ohalo II and carried out analysis of the numerous macroscopic remains of seeds and fruits found there. When Piperno and Weiss met for the first time a few years ago at a conference luncheon, they discussed the possibilities of applying starch grain analysis to artifacts from this Old World site.

Starch grain analysis is painstaking work. First, a fine needle is used to dislodge minute particles from the face of a grinding stone. Then, the entire stone is placed in a sonicator, a water bath in which sound waves vibrate the artifact until smaller particles float free. Each microscopic starch grain is compared to starch grains from hundreds of species maintained in a modern reference collection of plants. "We had used starch grain analysis to study the development of agriculture in the tropics, where plant materials are poorly preserved," explained Piperno. Significant and consistent differences in shape, size, and other features make it possible to distinguish starch grains from different plant species.

Evidence associated with an oven-like hearth also found at the site suggests that dough may have been baked in much the same way that modern nomadic tribes in the region still prepare seed cakes. Grinding and baking cereal grains was an important nutritional advancement, making carbohydrates more readily available for uptake into the bloodstream.

Grinding stones like the one found at Ohalo II have been excavated from other Old World sites dated to 13,000 – 45,000 years before present, but there has never been conclusive evidence to show that they were used to grind cereal grains or other types of plants, and not pigments. “It will be exciting to continue to analyze some of these older artifacts, to see if we can find evidence that they were used to process plants. We’re trying to find answers to two big questions: When were the first wild grains systematically collected as food and when did people begin to process seeds and underground plant organs to turn them into more digestible and nutritious dietary elements”

#### References:

This article: Piperno, D.R., Weiss, E., Holst, I., and Nabel, D. 2004. Processing of wild cereal grains in the Upper Paleolithic revealed by starch grain analysis. *Nature* (to appear in August 5, 2004 edition).

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Evidence presented in the journal *Nature* (August 5, 2004), by archaeologists from the Smithsonian Institution, Harvard University and the University of Haifa, pushes back the date for the processing of close wild relatives of domesticated wheat and barley--a key step in cultural development-- to 23,000 years before the present era.