Phytoliths from food residues provide the oldest date for use of wild rice in Minnesota

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Introduction:

The Anishinaabeg (Ojibwe) people have lived in what is now Minnesota and the Great Lakes region for generations. Anishinaabeg prophecies said that they must move their families westward until they find the food that floats on water, food given to them by the Creator. This sacred food is wild rice (*Zizania palustris*), “Manoomin” in the Ojibwe language.

The Ojibwe people are known to have harvested wild rice at Ogema-Geshik area for many years. Previously reported archaeological evidence for wild rice use dates back about 2,000 years ago. This study, based on radiocarbon dating of food residues in Brainerdware pottery from the Ogema-Geshik archeological site in Cass County, Minnesota, pushes the age of wild rice usage beyond 3000 years ago (Thompson, personal comm.).

In the past, it was common for the Ojibwe and other indigenous Nations to use unglazed pottery to prepare food, like corn and wild rice. Over time the cooked food is absorbed into the pore spaces within the vessel wall. Often times the food residue was left behind to waterproof the pot’s interior. The residue left behind contains phytoliths, microscopic opaline silica particles.

Phytoliths are plant remains made of silicon dioxide, more commonly known as glass. During their lifetime, plants absorb soluble silica within ground water but cannot excrete it fast enough, so it is transported and deposited throughout their cell walls and epidermal tissue. Different plants produce different shapes of phytoliths, which can be used as identifiers. Phytoliths also act as structural support and can trap organic matter inside (bits of nucleus with possible DNA).

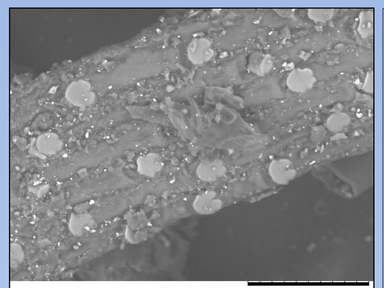
Wild rice and corn are foods common to the Ojbwe, and it can be expected that pottery from Ojibwe land will contain food residues from both types of plants. Both wild rice and corn produce a rondel-shaped phytolith in the chaff of the plant. The chaff is a small percentage of food that is cooked; however, it produces abundant silica bodies, which form a large percentage of what remains in the food residues.

Methods:

Phytoliths can withstand chemical dissolution and high temperatures. The charred remains from cooking vessels and vegetation samples were prepared through a chemical process to remove organic material. The remaining sample containing phytoliths is pipetted upon a glass microslide and allowed to dry; a cover slip is placed over the material and secured with optical cement. A Leica light microscope and camera were used to record and view the slides at 400X magnification in most cases. Additional photos were obtained with a Scanning Electron Microscope (SEM).

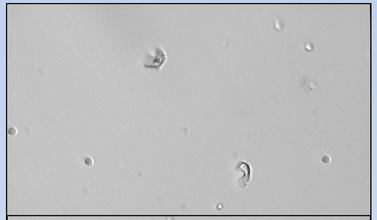
Phytoliths viewed on a microscope slide are essentially3-dimensional objects being forced into a 2-dimensional plane. A rondel is a cylinder shaped phytolith. When it is in an upright position on a microscope slide, its planar face is visible. The planar view shows a thinner (larger) and thicker (smaller) face. Phytoliths can be seen from any angle, however, the rondel phytolith’s planar view is the one employed in this study. The face can be circular or oval shaped, and can include one or more indentations. The face can also show decorations, or projections. Wild rice and corn rondels can be distinguished by their patterns of projections and indentations. These variations in rondel face shapes are categorized into a system created by Dr. Robert Thompson.

A variety of 100 rondel phytoliths in planar view were recorded from each food residue or plant sample. These were entered into a database such that statistical analysis could be performed. Palentological Statistics (PAST) program was used to configure the database so it could be used with DISSIM32, a program used to calculate the squared-chord distance ($d_{ij} = \Sigma_k (p_{ik}^{.5} - p_{jk}^{.5})^2$). The distance between phytolith features is used to identify the difference between corn and wild rice. DISSIM32 results were used to create both cluster analysis and principal components images.

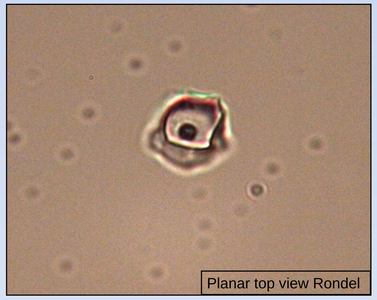


Wild rice food residue from modern parching vessel.

Ohio *Zizania aquatica* Rondel



Ogema Point Brainerdware Rondels

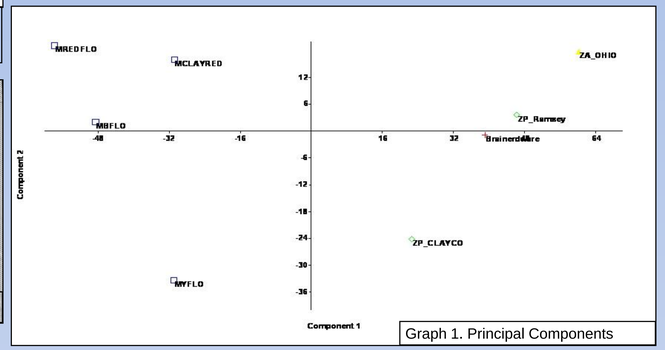


Planar top view Rondel

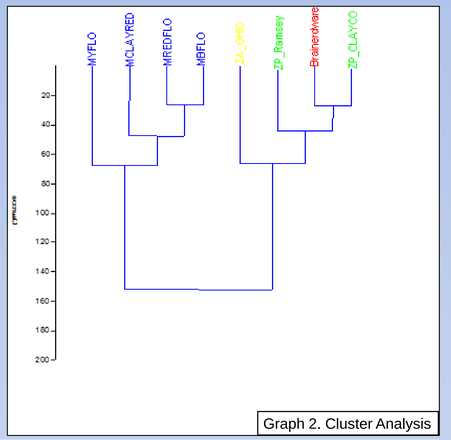
Results:

Principal components analysis shows that the assemblage of phytoliths from the Brainerdware pot represents wild rice. The phytoliths from the Brainerdware food residue are similar to the rondel assemblages produced by the chaff(hardy seed coat in wild rice, cob in maize). This result can be expected as it occurs in modern day wild rice parching vessels. There is enough data to statistically compare rondel assemblages with plant inflorescence assemblages.

Each of the chaff maize samples, Mandan Clay Red, Mandan Red Flower, Mandan Yellow Flower, and Mandan Blue Flower are visibly and numerically distinguished from the assemblages of wild rice chaff samples, Clay County *Zizania palustris*, Ramsey County *Zizania palustris*, Brainerdware, and the Ohio *Zizania aquatica*. Brainerdware statistics place it with the assemblages that the wild rice chaff has produced, and is different than that of the maize chaff samples.



Graph 1. Principal Components



Graph 2. Cluster Analysis

Table 1. Square chord distance dissimilarity matrix

	Brainerdware	MCLAYRED	MREDFLO	MYFLO	MBFLO	ZP_CLAYCO	ZA_OHIO	ZP_Ramsey
Brainerdware	0	139	408	315	307	75	61	49
MCLAYRED	139	0	214	186	151	127	263	181
MREDFLO	408	214	0	175	99	338	558	465
MYFLO	315	186	175	0	108	234	451	397
MBFLO	307	151	99	108	0	260	452	381
ZP_CLAYCO	75	127	338	234	260	0	192	106
ZA_OHIO	61	263	558	451	452	192	0	71
ZP_Ramsey	49	181	465	397	381	106	71	0

Conclusion:

The Ohio *Zizania aquatica* sample was named during a period of time when all *Zizania* species were named *Zizania aquatica*. This sample was collected over 100 years ago. Our data show that it is likely mislabeled and is in fact *Zizania palustris*. Ohio *Zizania aquatica* phytoliths are different from the two Minnesota samples, however, it may not represent another species. The results of both the PCA and cluster analysis clearly show wild rice present in the Brainerdware pottery. These samples have been AMS dated to over 3000 years B.P. The study demonstrates wild rice usage in the Minnesota region from that time, however, it does not help to determine whether wild rice was growing there or was brought from another location.

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