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## **Investigating the Sacred Cacao Groves of the Maya**



**Research Year:** 2003

**Culture:** Maya

**Chronology:** Classic

**Location:** Zapotitan Valley

**Site:** El Cerén

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### **Introduction**

The Cerén archaeological site is located in the Zapotitan Valley alongside the Rio Sucio in El Salvador. The site was discovered in 1976 by a bulldozer operator. The archaeological studies started in 1978 by Pason Sheets (Sheets, 2002, 2006). El Cerén is described as a village that was buried by volcanic ash about 1,400 years ago after the eruption of the Loma Caldera Volcano. The village was suddenly abandoned leaving all inhabitants possessions very well preserved. According to Sheets (1992) the seasonality of plants suggests that the eruption occurred in August, after dinner was served but before the dishes were washed, between 6 and 7 P.M. The area excavated to date is about 900 m<sup>2</sup> where four households have been described, one fully

excavated and the others in different stages of excavation. The buildings at El Cerén include a civic complex, a sweat bath, a religious association, and a structure in which Sheets (1992) believes a woman shaman practiced.



**The Sauna**



**The Sauna**



**The Sauna**



**The Sauna**



**The Sauna**



**Maize Plants**



**Maize Plants**



**Maize Plants**



**Maize Plants**



**Maize Plants**



**Maize Field**



**Maize Field**



**Shaman House**



**Shaman House**





**Shaman House**



**Shaman House**



**Shaman House**



**Shaman House**



**Shaman House**



**Kitchen**



**Kitchen**

## **Report of Activities**

I want to thank FAMSI for all the support and patience throughout the development of my work. After a series of unforeseen delays, the analysis of materials from the site of el Cerén is underway. All necessary permits and authorizations from the government of El Salvador were obtained by December 5, 2005. On January 15, 2006 I began collecting cacao samples in El Salvador.

During the course of my investigation, I was informed that the cacao seeds from El Cerén reported by Payson Sheets were located at the Museo Nacional de Antropología “Dr. David J. Guzmán”. Upon examining the organic materials stored in the museum warehouse, I found three cacao seeds that had no corresponding catalogue information. Lic. Fabricio Valdivieso, Director of the Department of Archaeology of El Salvador, confirmed this lack of documentation.

The seeds reported by Payson Sheets were actually located in the Museum at El Cerén archaeological site. With the authorization of the Salvadoran government, Dr. Paul Amarolli, the Museum curator, kindly helped me to collect a sample from the showcase.

In summary, the government of El Salvador gave me the opportunity to analyze three seeds from the Museo Nacional de Antropología and one from the Museum at El Cerén archaeological site.

## Methods

Current techniques utilized in molecular biology permit rapid sequencing of DNA. Such techniques thus represent a good strategy for the recovery of DNA from archaeological and palaeontological remains, thereby permitting reconstruction of the genetic relationships among extinct organisms and their contemporary relatives. As DNA sequences from living organisms provide only indirect evidence of the historical processes that have formed them, the study of DNA from dead organisms offers complementary information necessary for correlating the evolutionary patterns of change with descent between extinct and contemporary organisms.

However, the research of ancient DNA is fraught with extreme technical difficulties due primarily to the small amount and degraded nature of any present DNA, and as a result of the high probability of contamination. When an organism dies, its DNA normally becomes degraded by endogenous nucleases. These enzymes can be inactivated or destroyed by sudden desiccation, low temperature, or high salt concentration in the dead material. However, a slower but relentless process degrades the DNA molecules. In terms of "optimal conditions" such as adequate physiological salt concentrations, neutral pH, and a temperature of around 15° C, it would take about 100,000 years for hydrolytic damage to destroy all DNA that could reasonably be retrieved (Hofreiter et al., 2001). The variation of these conditions can either reduce or increase this range DNA degradation. However, the amplification of DNA molecules older than one million years of age is unduly optimistic. For example, DNA reputed to come from a dinosaur was found to be contaminated by the insertion of a human mitochondrial gene within the nucleus (Zischler et al., 1995).

The use of the Polymerase Chain Reaction (PCR) to recover DNA sequences from 200 year-old specimens stored in herbaria and museums has become routine.

However in the case of archaeological or palaeontological specimens, the retrieval of DNA sequences requires a great amount of effort, especially to prove that the DNA recovered is in fact ancient. Several criteria have been published in order to authenticate results especially after the publication of a series of papers that were shown unrepeatably (Austin et al., 1997). These criteria are 1) Physically isolated work area 2) Control amplifications 3) Appropriate molecular behavior 4) Reproducibility 5) Cloning 6) Independent replication 7) Biochemical preservation 8) Quantitation 9) Associated remains.

Following these criteria, I will try to recover ancient DNA from seeds of cacao found in a vase buried with volcanic ashes in the Cerén archaeological site. I will follow the protocol as described above using a laboratory where no DNA has previously been extracted. The experiment will be duplicated in another laboratory in the Universidad Autonoma del Estado de Morelos.

## Seeds found at the El Cerén Museum

The eight oldest cacao seeds in the world are on display in the Museum of El Cerén in El Salvador. From this group of eight, one seed was taken for the purpose of DNA analyses. The video and photographs document this process. The photographs include images of the vessel in which the Cacao seeds were originally found.



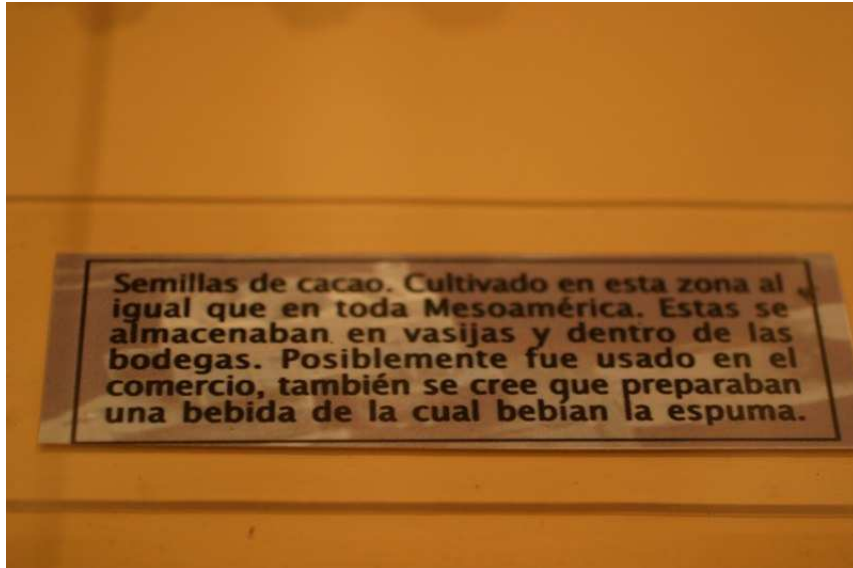
Vase where cacao seeds were found



**Showcase at the Cerén Museum**



**Cacao seeds at the Cerén Museum**



**Showcase Label at the Museum**



**Cacao seeds at the Cerén Museum**





**Cacao seeds at the Cerén Museum**



**Cacao seeds at the Cerén Museum**



**Cacao seeds at the Cerén Museum**



**Cacao seeds at the Cerén Museum**



**Cacao seeds at the Cerén Museum**

### **Seeds found at the Museo Nacional de Antropología**

A group of three Cacao seeds apparently not reported were found in one of the boxes labeled as “organic material”, in the Museo Nacional de Antropología. The material was poorly described with basically no information besides the notes that can be seen in the video and photographs. The three seeds were donated for later DNA analyses.



**Boxes sampled**



**No cacao was found**



**No cacao was found**



**The only box with cacao**



**Cacao seeds**



**Cacao seeds**



**Cacao seeds**



**Cacao seeds**



**Cacao seeds**



**Cacao seeds**



**Cacao seeds**





Cacao seeds

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