Testing for Theobromine in Southeastern Utah Ancestral Puebloan Ceramics

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Project Description

Recently, the finding of theobromine, biomarker for Theobroma cacao, was reported from analysis of ceramics from Alkali Ridge, Utah, Site 13, dating to the Pueblo I period (Washburn et al. 2013). This evidence is centuries earlier than the finding of theobromine in sherds from a trash mound associated with Pueblo Bonito in Chaco Canyon, New Mexico (Crown and Hurst 2009), and in vessels (non-local forms) from Chaco Canyon, New Mexico, four other sites in the Four Corners area, and the late Classic period Hohokam site of Los Muertos (Washburn et al. 2011).

Washburn et al. (2013) suggest that cacao may have been brought into the Alkali Ridge area by migrating groups, perhaps related to a number of migrations linked to the south and Mesoamerica where cacao was cultivated. They also point out the “stunningly different Abajo R/O ceramic technology and design system” that appeared during the late Basketmaker III period (Washburn et al. 2013:2012) as evidence of the entry of a new group. Testing Abajo R/O bowls from Alkali Site 13 showed positive results from a number of them for theobromine and caffeine (two of the biomarkers for *T. cacao* - the third biomarker is theophylline which was not detected). In addition to the Abajo R/O bowls, theobromine and caffeine were detected in vessels from the local ceramic assemblage-corrugated jars, PI Black-on-gray (B/G) bowls, and later Pueblo II Black-on-white (B/W) vessels (shallow bowls, vertical sided pitchers, a ladle) from other sites on Alkali Ridge (Sites 1, 5, 8, and 12), as well as two localities in La Plata County, southwestern Colorado.

We determined to test the findings and procedures used by Washburn et al. using sherds and whole vessels from Cave Canyon Village (Site 42Sa2096) and Monument Village (42Sa971) both in Montezuma Canyon, Utah (Museum of Peoples and Cultures, Brigham Young University), and from an early collection of whole vessels from the 1908 Wall Alkali Ridge Expedition (Natural History Museum of Utah, University of Utah).

Materials and Methods

Procedure for theobromine, theophylline, and caffeine extraction

HPLC grade organic free water and methanol were used. Extraction methods:

1. **Sherds** were placed in a beaker and just sufficient hot water (94°C) was added to partially cover the sherds (approximately 30 ml). The beaker and sherds were placed in a 70°C shaking water bath. The water was gently agitated in the reciprocating shaker (approximately 100 rpm) for one hour. The sherds were removed and the water was evaporated from the beakers in the 70°C bath.

2. **Pots** were rinsed with hot water in a similar manner suggested by Washburn et al. Boiling water (approximately 94°C) was pipetted 5 ml at a time to the sides of the interiors walls, until 30 ml were added. The hot water was swirled for approximately 2 minutes and poured into a cleaned beaker. The water was evaporated to dryness in the 70°C water bath. The methylxanthines were extracted from the dry residue with 1 ml of methanol. The beaker was placed in an ultrasonic bath for three minutes and the extract was filtered and prepared for HPLC-MS analysis.

Initial Results

In our first test, 6 of 7 sherds from Cave Canyon Village and Monument Village were positive for theobromine and caffeine. Five Abajo R/O, 1 B/R and 1 PII B/W sherds were tested. All of the sherds came from BYU field school projects and had been cleaned and previously studied.

With positive results, we proceeded to extend our testing procedures to whole vessels from Cave Canyon Village, as well as to a collection of whole vessels recovered from Alkali Ridge in 1908, and 2 recently excavated sherd from Alkali Ridge Site 13.

Discussion

Positive results for theobromine and caffeine from 6 of the 7 initial sherds were encouraging, and the next round of vessels and sherds that were tested included a wider geographical and temporal range. We selected a miniature BMIII gray ware bowl as a control – not expecting to find evidence of theobromine or caffeine. Future specimens to be tested will include other early ceramics. Modern vessels known not to have cacao or coffee residue were also tested as secondary controls. Whole vessels dating to Pili and PIII periods at Alkali Ridge were also included in the tests.

We are concerned about possible contamination sources that would need to be discounted and are researching those. Also, the possibility of another beverage made from plants that could account for the presence of theobromine and caffeine in residues must be considered, although none are currently known in the American Southwest. In the American Southeast the so-called “Black Drink” was made from holly plants and used in prehistoric and historic times. It contains theobromine, caffeine and uricosic acid. We plan to test for uricosic acid.

Literature Cited


Acknowledgements

The Natural History Museum of Utah (University of Utah) provided the funding for this project. Materials from Montezuma Canyon, Utah, were made available by the Museum of Peoples and Cultures, Brigham Young University. Vessels from the 1908 Wall Expedition to Alkali Ridge were made available by the Natural History Museum of Utah, University of Utah. Cultural maps created by Dawn Farkas Prasad. Source of the area map is Google Maps (with additions).