Interpreting Isotopic and Macrobotanical Evidence for Early Maize in the Eastern Woodlands: A Response to Hart and Colleagues

Mary L. Simon, Kristin M. Hedman, and Thomas E. Emerson

In the following response to Hart and colleagues (2021) we clarify our interpretations of the archaeological record for maize use from western Illinois. The robust archaeological record, newly obtained AMS dates, and evaluations of enamel apatite combine to support a late date for maize cultivation in this region. We reiterate that maize histories in the Eastern Woodlands may vary among different regions.

Keywords: maize, carbon isotope assays, American Bottom of Illinois

En la siguiente respuesta a Harty colaboradores (2021), aclaramos nuestras interpretaciones del registro arqueológico del uso de maíz en el oeste de Illinois. El sólido registro arqueológico, las fechas AMS recién obtenidas y las evaluaciones de la apatita del esmalte se combinan para respaldar una fecha tardía para el cultivo de maíz en esta región. Reiteramos que la historia del maíz en Eastern Woodlands puede variar entre diferentes regiones.

Palabras clave: maíz, ensayos de isótopos de carbono, fondo americano de Illinois

In their critique of Emerson and colleagues (2020), Hart and colleagues (2021) imply that we question their microbotanical and isotope research identifying early maize in the northern Eastern Woodlands. We do not. We accept their findings and cite their work as an example of the diverse regional and chronological variation that marks the history of maize in the Eastern Woodlands.

However, we take this opportunity to clarify several issues raised. Hart and colleagues cite the Icehouse Bottom and Edwin Harness sites as evidence for Middle Woodland maize. As noted in our article (Footnote 3, p. 224), reanalysis of these archaeobotanical samples was ongoing. Simon (2019), however, had reported preliminary results at the Plains Anthropological Conference as follows: two alleged maize samples from the Edwin Harness site returned $\delta^{13}C$ values of <−21.0, indicating they were not maize, and two Icehouse Bottom samples returned $\delta^{13}C$ >−10, but postdated AD 1000 in age. We would have been glad to share this information.

Hart and colleagues criticized us for ignoring the Ellege site sample date (1520 ± 70 RCYBP; Simon 2014). We rejected this sample as being maize because the radiocarbon laboratory did not return a carbon isotope assay for it. A second alleged maize sample from the same feature returned a $\delta^{13}C$ value of −25.3‰, indicating that it was not maize. We discount wood dates from associated contexts as unreliable. Simon (2014) demonstrated that with one exception, maize samples from early Late Woodland contexts (ca. AD 500–750) from western Illinois

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American Antiquity 86(2), 2021, pp. 428–430

Published by Cambridge University Press on behalf of the Society for American Archaeology
doi:10.1017/aaq.2020.83

postdated standard dates obtained on associated materials by hundreds of years, suggesting that maize was intrusive in these feature contexts.

Compared to other Illinois data, the Late Woodland date (ca. AD 700) obtained on the Edgar Hoener site sample is "aberrant"—a conclusion corroborated by our extensive macrobotanical record (Simon 2014:Table 5). We accept this date, however, and cite this as an example of early maize.

The application of stable isotope analysis to questions of maize consumption is particularly applicable where the pre-maize diet is almost exclusively C_3 based and addition of maize, a C_4 grass, would be evident in the $\delta^{13}C$ values of skeletal tissues. Furthermore, because maize displays minimal geographic or landrace differences in isotopic values, comparisons are possible among different regions (Bender 1968; Lowden 1969; Tieszen and Fagre 1993). The isotopic datasets available for the northeast; comparable methodology in sample preparation and analysis; and long-established, multifaceted research programs aimed at identifying early maize make the work of Hart and colleagues (Hart and Lovis 2013; Katzenberg 2006) a particularly appropriate and valuable point of comparison to our own work.

Hart and colleagues took issue with our questioning bone carbonate data as reliable evidence for minimal maize consumption in southern Ontario. As summarized in Emerson and colleagues (2020:245–246) and presented in detail by Harrison and Katzenberg (2003:228–230), the use of bone or enamel carbonate data for dietary reconstruction has been demonstrated, and lab pretreatment procedures have been developed and implemented to address concerns about diagenetic effects on bone carbonate (Harrison and Katzenberg 2003:228). The (organic) bone collagen primarily reflects the isotope values of dietary protein, whereas (inorganic) bone and enamel carbonate reflect those of the whole diet. Because maize is a low-protein food, its consumption in small amounts would not be reflected in bone collagen but would be first reflected in bone or enamel carbonate (Ambrose and Norr 1993; Harrison and Katzenberg 2003; Hedman et al. 2002; Tieszen and Fagre 1993). As in our study area, Harrison and Katzenberg found that the C_4 isotopic signature of maize is reflected in bone collagen at around AD 1000 in southern Ontario but not earlier (Harrison and Katzenberg 2003:236). Also, as in our study area, the $\delta^{13}C$ values of bone carbonate for some individuals who predate AD 1000 are slightly enriched in heavy carbon, but corresponding $\delta^{13}C$ values of collagen are not (Harrison and Katzenberg 2003:234, Table 2). This pattern is consistent with a mixed C_3/C_4 diet consisting primarily of C_3 resources supplemented with a small amount of a C_4 resource (e.g., maize). In the Northeast, this interpretation is supported by maize phytoliths and starch grains recovered from dated pot residues. Although, as Hart and colleagues have noted, we lack microbotanical data, we have an exceptionally robust macrobotanical record essentially lacking maize from pre-AD 900 contexts. Therefore, we are cautious about interpreting slightly enriched apatite $\delta^{13}C$ values as evidence of maize consumption.

To address this concern, we analyzed enamel apatite carbonate $\delta^{13}C$ for Middle Archaic and Middle Woodland individuals from several sites in Illinois. In nearly all cases, the enamel $\delta^{13}C$ values are less enriched than that of bone carbonate for the same individuals, which both reflects a C_3 diet and is consistent with the diet suggested by bone collagen $\delta^{13}C$ results (Emerson et al. 2020:Supplemental Figure 2.3, Supplemental Table 2.3). If we accept Harrison and Katzenberg's interpretation of their bone carbonate $\delta^{13}C$ levels as indicating maize consumption, then we might conclude that Middle Archaic people in Illinois consumed maize. We think that is unlikely. The divergence between bone carbonate $\delta^{13}C$ and enamel carbonate $\delta^{13}C$ from the same individuals, when preservation criteria for both collagen and apatite carbonate are met, raises the question of bone carbonate $\delta^{13}C$ as a reliable indicator of slight maize consumption, particularly when quality of bone carbonate cannot be confirmed.

We recognize from macrobotanical and microbotanical evidence that the history of maize's chronological appearance as well as cultural and economic impact east of the Mississippi River varies dramatically. The seeming discrepancies between the Eastern Woodland macrobotanical and Great Lakes–Northeastern microbotanical evidence calls for additional research to help us understand the role that maize played in Native subsistence practices. We interpret the current evidence as an example of the tremendous variation in the history of maize among Native peoples across this region, and we call for our colleagues to continue to explore this variation.

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Submitted June 22, 2020; Revised July 20, 2020; Accepted July 21, 2020