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ISOTOPIC FRACTIONATION IN CORN

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This study was started during the summer of 1965 because of the discrepancy observed between dates obtained from wood charcoal and charred corn samples collected from the same archaeologic sites. These results are listed in Table 1.

TABLE 1

Corn vs. Wood Dates

Sample no.	Sample type, McIvor site, Ontario	Age (Yr B.P.)
a) GSC-457	Charred corn (kernels & cob fragment)	140 ± 130
GSC-441	Wood charcoal	320 ± 130
b) GSC-460	Charred (corn kernels)	90 ± 130
GSC-442	Wood charcoal	280 ± 140

Detailed descriptions of these samples appear in (Lowdon *et al.*, GSC VIII, Radiocarbon, 1969, v. 11, no. 1, p. 22-42). In both cases the wood charcoal gave the more acceptable archaeologic age, accepting the assumption made by the collector that the different materials dated were living contemporaneously. Isotopic fractionation was thought to be a plausible explanation for the cause of the young corn dates. Unfortunately, C^{13}/C^{12} ratios were not obtained for the corn or wood samples. However, a study of isotopic fractionation in modern corn was undertaken. Results of this study are shown in Table 2.

TABLE 2

Mass Spectrometric Analyses of Modern Corn Samples

Sample	Location	Date collected	δC^{13} ‰ (Relative to PDB standard)
Corn kernels*	Ottawa, Ontario	Sept. 1965	−9.5
Corn kernels	Morden, Manitoba	Sept. 1966	−9.3
Corn leaves	Morden, Manitoba	Sept. 1966	−10.9
Corn leaves	Ottawa, Ontario	Sept. 1966	−11.1
Corn kernels	Ottawa, Ontario	Sept. 1967	−9.7
Corn leaves	Ottawa, Ontario	Sept. 1967	−11.1
Corn kernels	Morden, Manitoba	Sept. 1967	−9.5
Corn leaves	Morden, Manitoba	Sept. 1967	−10.9
		Average	−10.3‰

* All samples are of *Zea mays*, Panicoideae sub-group Maydeae.

The samples were obtained from two different localities: The Dominion Experimental Farm, Ottawa, Ontario, and the Experimental Farm, Morden, Manitoba. Both corn kernels and leaves from the corn plant were analyzed. The results are quoted as $\delta\ C^{13}$ values in per mil relative to the PDB standard (Craig, 1953, 1957). The term $\delta\ C^{13}$ expresses C^{13}/C^{12} variations and is defined as:

$$\delta\ C^{13} = \frac{(C^{13}/C^{12})_{\text{sample}} - (C^{13}/C^{12})_{\text{standard}}}{(C^{13}/C^{12})_{\text{standard}}} \times 100$$

where C^{13}/C^{12} is the isotopic ratio obtained from mass-spectrometric analyses.

Maple leaves from the Experimental Farm, Ottawa, were also analyzed in 1966 and 1967 and gave $\delta\ C^{13}$ values of -24.8 and $-26.1‰$, respectively. These values are in accord with the $-25.0‰$ value for oak which is the accepted terrestrial standard with respect to the PDB standard. Also, four different NBS oxalic-acid preparations were measured and gave an average $\delta\ C^{13}$ of $-19.2‰$, which agrees with the $-19.0‰$ deviation observed by Craig (1961) and shows that no fractionation has been introduced in the preparation of CO_2 gas in the laboratory. The C^{13}/C^{12} ratios were determined by Isotopes, Inc. on aliquots of the same gas sample used for C^{14} activity measurements. The results obtained show a definite isotopic fractionation in corn and agree with the recently published and unpublished work of Hall (1967a, 1967b) and Bender (1968).

The $\delta\ C^{13}$ average of the results in Table 2 is $-10.3‰$ relative to PDB standard. This gives a $\delta\ C^{13}$ of $+14.7‰$ from the oak standard. By doubling this, a figure of $29.4‰$ (or 2.94%) for the estimated C^{14} enrichment of the sample is obtained. As a 1% C^{14} enrichment reduces the apparent age by 80 yr, 2.94% enrichment will reduce an age by 235 yr.

Applying this average correction of 2.94% to the corn dates shown in Table 1, the charred corn and wood charcoal dates are in close agreement.

It should be noted that the $\delta\ C^{13}$ values for the corn kernels (average $-9.5‰$) indicate a slightly higher degree of fractionation than the associated corn leaves (average $-11.0‰$). The reason for this is not yet apparent.

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