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PREHISTORIC MEDICINAL PLANT USAGE: A CASE STUDY FROM COPROLITES

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ABSTRACT.—Identifying medicinal plant usage from the prehistoric record is problematic due to the preservation of such information, and the lack of conclusive evidence provided through dietary and non-dietary assemblages. One of the most direct methods of determining prehistoric medicinal plant usage is through the analysis of coprolites. This paper presents data gained through an analysis of 32 Archaic coprolites from Caldwell Cave, Culberson County, in west Texas. The coprolites were analyzed for their pollen content in an attempt to identify flowers and/or inflorescences ingested purely for their medicinal value. High frequencies of *Ephedra* (Mormon tea) and *Prosopis* (mesquite) pollen were observed in the coprolites, and since these plants are known as diarrhetics, it is postulated that the Archaic peoples of Caldwell Cave probably used these plants as medicinal diarrhetics.

RESUMEN.—La identificación del uso de plantas con fines medicinales en el registro prehistórico es problemática dada la preservación de tal información y la carencia de evidencia concluyente proporcionada por colecciones dietéticas y no dietéticas. Uno de los métodos más directos para verificar el uso prehistórico de plantas medicinales es el análisis de coprolitos. Este trabajo presenta información generada a través del análisis de 32 coprolitos arcaicos de la cueva Caldwell, condado de Culbertson, en el occidente de Texas. Los coprolitos fueron analizados por su contenido de polen, en un intento de verificar la presencia de flores y/o inflorescenias ingeridas puramente por su valor medicinal. Se observaron frecuencias altas de polen de *Ephedra* (canutillo o tepopote) y *Prosopis* (mezquite). Puesto que estas plantas son conocidas como diarreicas, se postula que las gentes del período arcaico de la cueva Caldwell probablemente usaron estas plantas como diarreicas medicinales.

RÉSUMÉ.—À cause de la rareté de leur conservation et l'absence d'évidence conclusive à partir d'assemblages alimentaires et non-alimentaires, il est difficile de fournir témoignage sur l'emploi des herbes pharmaceutiques dans la préhistoire. L'analyse des coprolithes humains est une des méthodes les plus directes pour déterminer l'usage préhistoriques des herbes médicinales. Cette étude présente des résultats obtenus par l'analyse d'un échantillon de 32 coprolithes humains découverts dans la Caverne de Caldwell, un gisement préhistorique datant de la période Archaïque et situé dans le Département de Culberson au Texas Occidental (États Unis). Le pollen trouvé dans les coprolithes a été étudié de facon à déterminer la présence de fleurs ou d'inflorescences consommées seulement pour leur valeur médicinale. Des pollens de genres *Ephedra* (thé des Mormons) et *Prosopis* (mesquite) ont été observés fréquemment dans les coprolithes. Ces herbes sont connues actuellement comme médicaments contre la diarrhée. Par consequence, il est suggéré que les peuples Archaïques de la Caverne de Caldwell ont probablement consommé ces herbes comme médicaments contre la diarrhée.

INTRODUCTION

Documenting prehistoric medicinal plant usage is problematic because it is difficult to distinguish between plants that were consumed for dietary purposes and those consumed for medicinal purposes only. Many times plants were probably used both as foods and as medicines. The analysis of plant remains from archaeological sites is often used to reveal dietary and medicinal intake, although such data are actually an indirect estimation of subsistence. Plant remains in archaeological sites can be deposited through a number of channels, most significantly through contamination from outside sources (i.e., water, wind, matrix shifts, and animals). Prehistoric people used plants to produce clothing, shelter, basketry, and twining. Plants used for these purposes become deposited into archaeological contexts and can be mistaken for food or medicinal items.

One of the best methods to determine prehistoric medicinal and dietary consumption directly is through the analysis of human coprolites (dessicated human feces)(Bryant 1974). The analysis of coprolites can provide information on prehistoric medicinal usage (Reinhard 1991), because coprolites contain the undigested remains of meals that were consumed either a few days before (i.e., macroremains) or up to one month before (i.e., pollen)(Kelso 1976; Williams-Dean 1978; Sobolik 1988).

In this paper we present information gained from the analysis of the pollen content of 32 coprolites recovered from Caldwell Cave, Culberson County, western Texas. Analysis of the coprolites reveals a direct correlation between the presence of plants useful for alleviating diarrhea and coprolites which were diarrhetic. This correlation suggests that the prehistoric population of Caldwell Cave was ingesting medicinal plants to help alleviate chronic diarrhea. These plants include *Ephedra* (Mormon tea) and *Prosopis* (mesquite). This analysis confirms the inconclusive evidence provided through the study conducted by Holloway (1983) which indicated that the Caldwell Cave occupants were possibly using *Ephedra* and *Larrea* (creosote bush) in medicinal teas to help cure chronic diarrhea.

BACKGROUND

Caldwell Cave (41CU1) is a sink-hole located in the east central portion of Culberson County (Fig. 1). Caldwell Cave was occupied from approximately A.D. 1200-1450 (Tanner 1949). The prehistoric peoples occupying Caldwell Cave

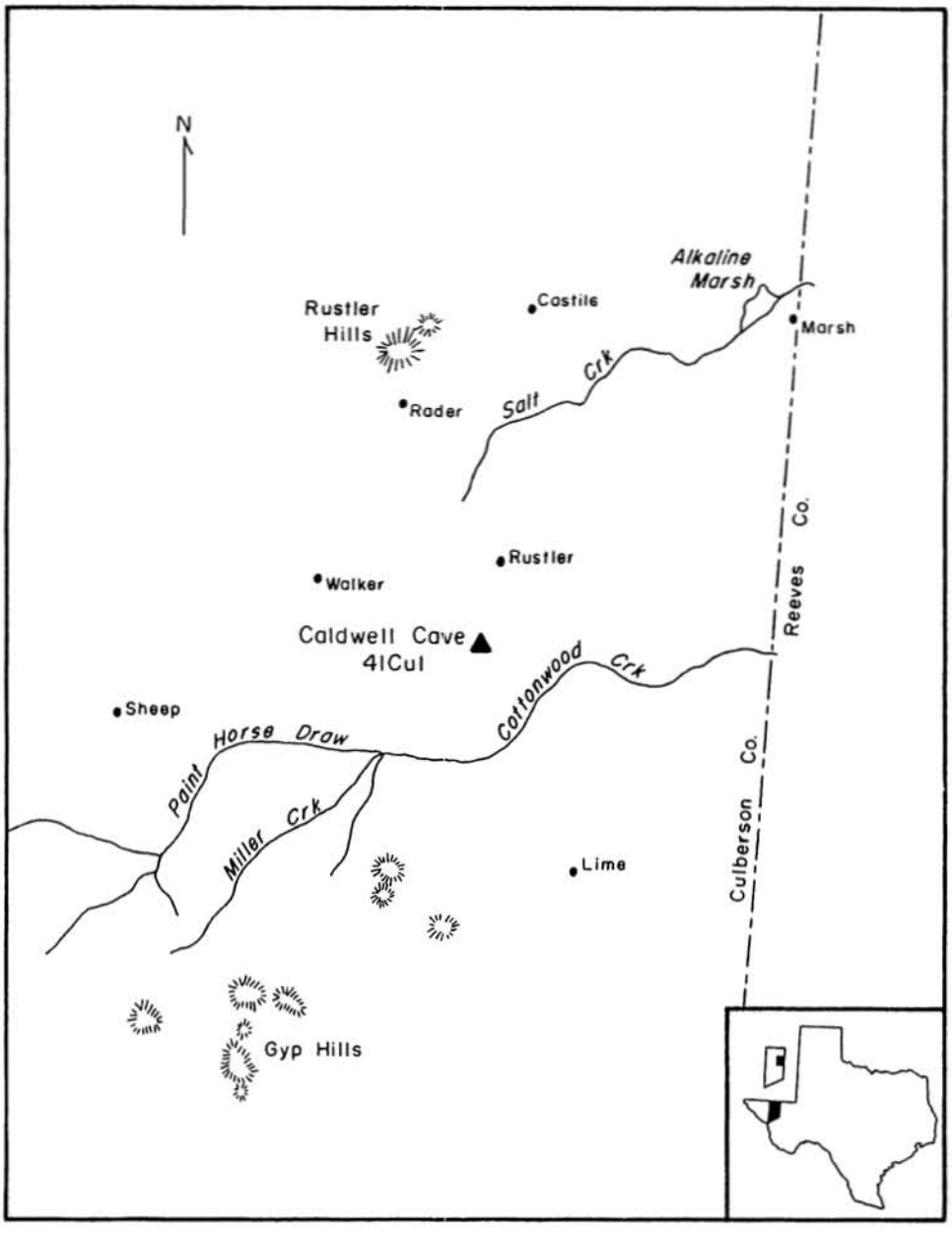

FIG. 1.—Location of Caldwell Cave, Culberson County, Texas.

and the surrounding area were hunter-gatherers throughout this time period (Jackson 1937; Tanner 1949).

Past and present observations of the coprolite samples indicate that chronic diarrhea was a prevalent health problem for the Caldwell Cave occupants. Chronic diarrhea may have been caused by high gypsum content in the local water supply—there is a gypsum stratum underlying the limestone surface of the area (Sayles 1941). Chemical analysis of a local spring revealed a high content of magnesium, which is a common ingredient in laxatives (Holloway 1983:Table 5).

Although analyses of coprolites from Culberson County are scarce, a few studies have been conducted: Holloway (1983) analyzed eight coprolites from Caldwell Cave, and Caldwell and Murry (Murry 1980) analyzed 16 coprolites and the colon contents of a mummified child from Granado Cave (41CU8). Holloway (1983) suggested that Mormon tea and creosote bush pollen were ingested as medicinal diarrhetics. However, Mormon tea pollen was observed in this study at a low frequency (10.7%), indicating that *Ephedra* pollen may not have been intentionally ingested. The sample which contained *Ephedra* pollen was not diarrhetic. One sample also contained *Larrea* pollen at a frequency of 18.7% indicating that this plant may have been ingested intentionally. The sample which contained *Larrea* pollen was diarrhetic. Holloway (1983) also observed high frequencies of grass pollen and seeds in most of the samples, high percentages of sagebrush pollen in two samples, and a high percentage of Hydrophyllaceae (water leaf) pollen in one sample. Murry (1980) also observed high frequencies of Mormon tea pollen (above 95%) in two of the samples he analyzed.

METHODS AND MATERIALS

The 32 coprolites used in this study were recovered by D.L. Hamilton and were analyzed for pollen and macroremain content. The samples were initially divided into four morphological categories following the methodology instigated by Holloway (1983:Table 1): type I, solid, firm, well-formed; type II, soft, well-formed; type III, soft, not well-formed; and type IV, soft, paddy-like, apparently runny. Because it proved difficult to distinguish morphological categories II and III, they were combined into one category, II/III. These categories were useful in determining general health (Holloway 1983), and in indicating which coprolites were diarrhetic.

The coprolites were processed following standard techniques (Fry 1985) and exotic *Lycopodium* tracers (11,300 ± 400 spores) were added to the samples in order to calculate overall pollen concentration (Table 1). Pollen concentration values (number of pollen grains/gram of material) for each coprolite were calculated by multiplying the number of tracer grains added by the number of fossil grains counted and dividing that product by the product of the number of tracer grains counted times the amount of sediment processed.

Calculating pollen concentration values from coprolites is important to determine which pollen types were most likely intentionally ingested (Sobolik 1988) and possibly used as medicines. Modern fecal studies have shown that the more

recently a pollen type was ingested the higher concentration value a fecal sample will have (Kelso 1976; Williams-Dean 1978). As the time from ingestion of a pollen type lengthens, the pollen concentration value for that sample decreases. The reason for this decrease is that pollen tends to become caught in the intestinal luminal folds and can be excreted many days after initial ingestion. Some pollen types can be excreted for up to one month after ingestion (Williams-Dean 1978).

Presence of high pollen concentration values in coprolites therefore indicate that the economic pollen types observed in the samples were ingested recently. Concentration values of over 100,000 pollen grains/gram of material usually indicate that pollen was recently ingested (Sobolik 1988). Samples which contain less than this amount may contain economic pollen types that were intentionally ingested many days before the sample was deposited (Sobolik 1988, 1991). Such samples will also contain a wide variety of unintentionally ingested, background pollen types. Therefore it is harder to recognize intentionally ingested pollen types in samples which contain less than 100,000 pollen grains/gram of material. Other factors influencing pollen abundance, such as the amount of pollen a plant produces and dispersal method, should also be considered in assessing the significance of the pollen.

DISCUSSION

The prehistoric Caldwell Cave population intentionally ingested at least four pollen types (Table 1). These pollen types are considered economic because they occur in high frequencies in the samples and most likely do not indicate accidental ingestion of pollen through contamination on food, in water supplies, and through breathing. The four economic pollen types are grass (Poaceae), Mormon tea *(Ephedra)*, mesquite *(Prosopis)*, and cactus (Cactaceae of the non-*Opuntia* type).

Twelve of the Caldwell Cave coprolites had concentration values of over 100,000 pollen grains/gram of material; ten samples contained extremely high percentages of grass pollen and aggregates; one sample contained a high frequency of cactus pollen; one sample contained a high frequency of Mormon tea pollen (Table 1). The high concentration values of these samples suggest that grass, Morman tea, and cactus flowers or inforescences were most likely intentionally ingested only a few days before the samples were deposited.

Grass pollen is particularly prevalent in the coprolite samples. Grass pollen, which is wind-pollinated, was found at high frequencies in 29 of the 30 samples which contained a statistically valid pollen count. A majority of the samples with abundant grass pollen also contained aggregates of grass pollen, possibly indicating the ingestion of anthers. The presence of pollen aggregates in non-coprolitic samples may, however, indicate a variety of depositional patterns (Gish 1991). The one coprolite sample which did not contain a high frequency of grass pollen, sample 28, contained a high frequency of Cactaceae pollen and aggregates of this type. Grass pollen was observed in samples which had high, intermediate, and low concentration values indicating variation in the length of time from

TABLE 1.— Major pollen frequencies from the Caldwell Cave coprolites.

Sample Number	Morph. Category	*Ephedra* %	*Prosopis* %	Cactaceae %	Poaceae %	Concentration Values	Count Totals
1	I	0	0	1	91 a	105,805.2	250
2	I	1	0	0	98 a	240,125.0	238
3	II/III	0	0	0	98 a	283,233.8	386
4	II/III	0	0	1	85 a	120,860.9	246
6	II/III	0	0	0	45	4,731.5	204
7	II/III	2	0	0	37	15,281.9	213
8	II/III	0	0	0	20	9,746.3	207
10	II/III	4	0	18	24	5,244.8	200
11	II/III	0	0	0	80 a	77,549.0	210
12	II/III	0	0	0	92 a	154,433.3	205
13	II/III	0	0	0	31	35,123.7	221
14	II/III	0	0	0	91 a	80,440.7	210
15	II/III	0	0	0	98 a	700,376.2	313
16	II/III	0	1	0	93 a	254,684.6	293
17	II/III	0	0	0	87 a	110,684.4	239
18	II/III	0	1	0	89 a	27,775.2	234
19	II/III	4	47	0	18	21,375.8	227
20	IV	0	1	0	96 a	96,857.1	216
21	IV	0	0	2	36	3,550.7	200
22	IV	0	3	1	38	8,999.6	205
23	IV	4	6	2	43	9,658.1	200
24	IV	2	0	0	49	9,783.5	200
25	IV	0	0	0	98 a	300,923.9	245
26	IV	47	0	0	23	67,261.9	200
27	IV	75	1	0	12	303,277.4	416
28	IV	0	2	91 a	2	128,866.4	222
29	IV	0	0	0	86 a	113,758.4	200
30	IV	1	1	0	47	3,705.7	223
31	IV	5	41	1	25 a	67,472.5	206
32	IV	51	0	1	22	96,660.8	211

a = aggregates

ingestion of grass pollen to sample deposition. Grass pollen may become ingested by eating grass seeds, which, due to their small size, are difficult to separate from grass inflorescences. Holloway (1983) also observed high percentages of grass pollen in the eight samples he analyzed, and Murry (1980) observed grass pollen in one sample, although he states that the sample may not be human.

Ephedra pollen was found at high frequencies in three of the Caldwell Cave coprolite samples (samples 26, 27, and 32), although only one sample contained a pollen concentration value above 100,000 grains/gram of material. All samples containing a high frequency of *Ephedra* pollen were in morphological category IV, indicating that the coprolites were diarrhetic. This suggests that only people with diarrheal problems ingested Mormon tea, possibly in medicinal teas to help cure their problem.

Mormon tea pollen, leaves, and stems are widely used as a diarrhetic; *Ephedra* is considered one of the most prevalent medicinal remedies for diarrhea both prehistorically and historically (Burlage 1968; Niethammer 1974; Moore 1979; Moerman 1986). Mormon tea was also used as a cure for syphilis (Burlage 1968; Niethammer 1974), and the ephedrine-related alkaloid in Mormon tea is a decongestant (Moore 1979).

Holloway (1983) observed *Ephedra* at a frequency of 10.7% in one coprolite (morphological type I). This frequency is relatively low, too low to conclude that *Ephedra* was definitely an economic pollen type in this sample, especially considering that *Ephedra* is wind-pollinated—its pollen occurs in the environment at higher frequencies than insect-pollinated types. *Ephedra* may be economic in this case, however, if it was ingested some time before the sample was deposited (Sobolik 1988). Murry (1980) observed *Ephedra* at high frequencies (92%, 86%) in two of the samples he analyzed.

Cactaceae pollen (of the non-*Opuntia* variety) was observed at high frequencies in sample 28 (morphological category IV). This sample also had a high pollen concentration value (Table 1). Pollen of Cactaceae, which are insect-pollinated plants, was also observed at a high frequency (79.3%) in the colon contents of a mummified child, which also contained tiny non-*Opuntia* cactus seeds (Murry 1980). Cactaceae pollen was not observed in other coprolites analyzed from the area.

The coprolite samples which exhibited pollen concentration values less than 100,000 pollen grains/gram of material contained high frequencies of pollen types which may also be economic. Grass pollen was again observed in a large number of these samples, indicating that it was ingested many days before the sample was deposited. The high frequencies of grass pollen present suggest that this pollen type was most likely intentionally ingested. Mormon tea and mesquite pollen were also observed in two of the samples with concentration values less than 100,000 pollen grains/gram of material at frequencies suggesting that they were most likely intentionally ingested.

Samples 19 and 31 contain high frequencies of insect-pollinated *Prosopis* (mesquite) pollen but have only intermediate pollen concentration values (Table 1). One of the coprolites with abundant mesquite pollen was in morphological

category IV and one in morphological category II/III. This indicates that mesquite may have been used to help cure diarrhea, although other uses are also possible. For example, mesquite leaves are useful as a medicinal tea for stomach ailments and to cleanse the system (Neithammer 1974). In the process of preparing mesquite leaves for a medicinal tea, pollen could also become incorporated into the tea, either intentionally or unintentionally. Mesquite also may have been ingested as a food source, rather than for purely medicinal advantages. The Cahuilla used mesquite catkins as a food (Bean and Saubel 1972), and the Pima sucked the catkins as a sweet (Curtin 1949). Mesquite pollen was not observed in other coprolite studies in the area.

CONCLUSION

Analysis of the pollen content of Caldwell Cave coprolites indicates the probable ingestion of Mormon tea *(Ephedra)* and the possible ingestion of mesquite *(Prosopis)* pollen in medicinal teas to help cure diarrhea. There is a strong correlation of diarrhetic coprolites with high frequencies of Mormon tea pollen; one diarrhetic coprolite contained a high frequency of mesquite pollen.

The addition of the present study of 32 coprolites to the previous study of eight coprolites from Caldwell Cave (Holloway 1983), strengthens the conclusion that the prehistoric inhabitants of the area used *Ephedra* pollen in medicinal teas to cure diarrhea. *Prosopis* and *Larrea* pollen may also have been used for the same purpose.

Determining prehistoric medicinal plant usage is difficult, since plants were also used extensively as foods and for other purposes. The best indications of medicinal plant usage are provided through the analysis of coprolites, particularly pollen content. Analysis of the Caldwell Cave coprolites demonstrates that it is possible to determine prehistoric medicinal plant use through careful analysis of the pollen preserved in coprolites.

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BOOK REVIEW

Traditional Plant Foods of Canadian Indigenous Peoples: Nutrition, Botany, and Use. Harriet V. Kuhnlein and Nancy J. Turner. Volume 8 in the Food and Nutrition in History and Anthropology Series, edited by Solomon Katz. New York and Philadelphia: Gordon and Breach Science Publishers, 1991. Pp. xi, 620. 48 figures, 3 maps. $88.00 (hardbound), $38.00 for individuals who are members of Science and Arts Society. ISBN 2-88124-465-3.

Ethnobotanical studies amongst Aboriginal Peoples in most parts of North America are "few and far between." It is indeed encouraging that such a highly