CASE REPORT

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Use of Fecal Material to Associate a Suspect with a Crime Scene: Report of Two Cases

REFERENCE: Norris DO, Bock JH. Use of fecal material to associate a suspect with a crime scene: Report of two cases. J Forensic Sci 2000;45(1):184–187.

ABSTRACT: Fecal matter analyses were applied to two cases: a homicide and a robbery. Scrapings of fecal matter removed from samples of clothing obtained from a homicide suspect were examined for their plant cell and cell fragment content and compared with fecal matter from a rape-homicide victim and scrapings from her clothing. Scrapings were hydrated and examined microscopically. Types of food plants were identified from the observed cells by comparison with known food plants. A similar analysis was conducted on the clothing of a robbery suspect and compared with fecal material left at the crime scene. The results showed that, respectively in the two cases, the reference samples were remarkably similar, if not identical, to those from the suspects' clothing.

KEYWORDS: forensic science, forensic botany, feces, plant cells, companion

The use of plant materials in modern homicide investigations was brought into focus by the 1935 trial of Bruno Richard Hauptmann for the kidnapping and murder of the 20-month-old son of Charles A. Lindberg, the famous American aviator (1). In recent years, evidence from plant materials and identification of plant species has been used in a number of ways in homicide investigations (2,3) and in other criminal cases and lawsuits (4–7). We have developed procedures for using plant cell identification techniques specifically to characterize vomit or gastric contents with respect to their composition and relating that to last known meals of homicide victims (8). This information has proven useful in a number of homicide cases to help determine time of death, and in one case led to a confession of guilt. Recently, we have expanded our analyses of gastrointestinal materials to include fecal matter.

In Case 1, a young woman was raped and murdered. We were asked to determine whether or not fecal stains on the clothing of the suspect in this case matched a fecal sample from the victim. This information was critical to link the suspect to the crime scene. In Case 2, we were asked to compare fecal material recovered from the bathroom of a church in which the robbery took place with fecal matter present in an article of the suspect's clothing. This suspect was known to exhibit a gastrointestinal disorder (Crohn's disease) that could trigger defecation in an unpredictable manner. He denied the charges and the fecal material represented the way to link him to the crime scene.

Microscopy has been used more than 100 years to identify fecal material per se although the emphasis often was on chemical components or animal parasites rather than on plant cells (see 9). In 1948, a single case was reported using fecal matter identified in part by its plant constituents to link the shoes of a suspect to a crime scene (10), but this use of fecal analysis apparently has seen little use since then. We developed a simple microscopic procedure modified from our protocol for gastric contents for analyzing fecal material for comparative purposes.

Materials and Methods

Case 1—Materials were shipped to our laboratory by law enforcement personnel and consisted of a fecal sample (F1) from the victim, three pieces of cloth cut from the suspect's clothing (S1–S3), and one piece of cloth cut from the victim's clothing (V1). One centimeter areas of cloth were cut from each clothing sample and placed in a small test tube containing 6% formalin. These samples were allowed to sit for 24 to 48 h to allow the fecal material to soften and separate from the cloth. Additional material was separated from the cloth by scraping with a clean, stainless steel spatula. Formalin also was added to the fecal sample (F1) prior to removing three random subsamples. Fluid containing materials from each soaked/scraped piece of cloth were placed on a glass microscope slide. After the addition of a cover slip to the slide, the slides were subjected to observation using the light microscope. All plant cells and plant cell fragments were identified using our laboratory manual (8) and comparing these materials with known standards of common plant foods prepared in our laboratory. All plant cells and fragments were photographed and/or saved as computer images to retain a permanent record of the materials present. One of us (Norris) did all the preparations and initial identifications and the other (Bock) independently verified the identifications.

Case 2—A similar procedure was followed with the suspect's clothing as for Case 1. However, because the fecal material recovered from the church was extremely hard and dry, this material first was ground in formalin using a clean porcelain mortar and pestle. The scrapings from the clothing were treated in the same fashion.

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Received 4 Mar. 1999; and in revised form 14 May 1999; accepted 17 May 1999.

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TABLE 1—*Presence* of plant materials in samples prepared from Case 1.*

Plant Type	Victim's Fecal Sample (F1)	Victim's Clothing (V1)	Suspect's Clothing (S1)	Suspect's Clothing (S2)	Suspect's Clothing (S3)
Bean seed coat	X	X		X	X
Bean pulp	X	X	X	X	X
Pepper seed coat	X	X			X
Onion epidermis	X				X
Spines (trichromes)	X			X	X
Vascular tissue fragments	X	X			X

* X = present, Blank = absent.

Results

Case 1

A summary of the major items observed in each sample is provided in Table 1. The most common items observed in all samples were clusters of cells that characterize the pulp of all types of beans (Fig. 1*a*) but which have different features for different bean types. Uniformly-sized epidermal spines (trichromes, Fig. 1*b*) that were dissociated from the cell walls to which they typically would be attached were common. Samples from all three sources exhibited fragments of similar bean seed coat (the covering of the bean) which was composed of a layer of many, small thick-walled cells (Fig. 2). The nature of the seed coat compared favorably with that of black beans and was unlike other common bean seed coats (e.g., lima, garbanzo, pinto). We also identified fragments of pepper seed coats (Fig. 3), fragments of vascular tissue (Fig. 4), and onion cells (see 8). In addition, there were other masses of plant material that we could not identify specifically but which appeared in samples from the victim's clothing, the victim's fecal sample, and the suspect's clothing. One such item appears in Fig. 1*a*. We found no items that were unique to either the clothing scrappings or the fecal sample, suggesting all could have been from the same sample.

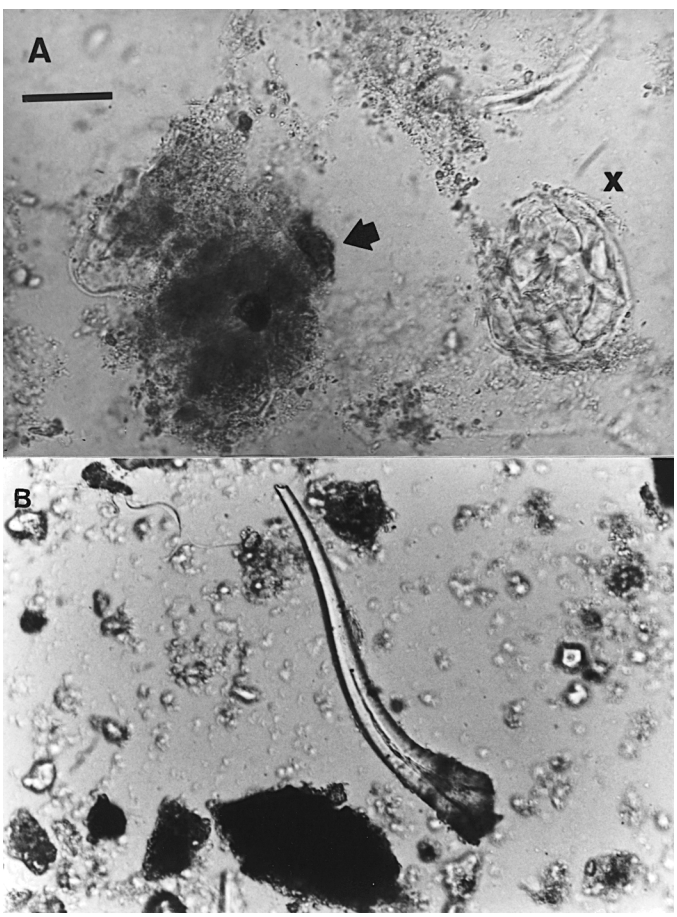

FIG. 1—*Case 1: Plant materials found in fecal samples from victim and suspect.* (A) *Bean pulp consists of hundreds of small clusters of cells. One such cluster is indicated* (X). *The arrow indicates a mass of unidentified plant material common to all samples. The bar represents 0.05 mm.* (B) *A small epidermal spine (trichrome) typical of the samples. Magnification is the same as for* (A).

Case 2

In this case, we observed numerous distinct items which matched in occurrence and frequency in both the church and clothing samples. The fragments tended to be smaller due to the additional grinding of the sample with the mortar and pestle. Again, some fragments were clearly identifiable (e.g., green bean seed pods) and others were identical but from unknown sources.

Discussion

An examination of Table 1 shows that all of the materials present in the fecal sample (F1) were present in one or more of the clothing samples. Only one of the suspect's clothing samples (S-3) contained all of the features found in the fecal sample, and the single sample from the victim's clothing did not exhibit all of the items in the fecal sample. The absence of certain items on some clothing samples were probably a consequence of the small amount of fecal material present on the clothing of which some was removed and examined. Similar differences would be expected in very small subsamples of F1. However, the observation that there were no items found that were unique to one source emphasizes that there were no real differences among the samples. Although this does not prove the samples were the same, there was no evidence found to suggest they were different.

Healthy humans tend to eat three major meals each day. The following digestion scenario is based on a composite of a variety of references (11–15). These processes are known to vary in time based on the composition and size of the meal, the health of the person, exercise, and other factors. Each meal spends roughly 2 to 6 h in the stomach before entering the small intestine. Digestive and absorptive processes in the small intestine take an additional 3 to 5 h before the remains are passed to the large intestine. Defecation occurs on the average every 1.1 days (12), resulting in a mixture of meals appearing in the feces. In our case, we learned that the victim had not been feeling well and had eaten very little since the previous evening. We assume that the small fecal sample from this victim probably repre-

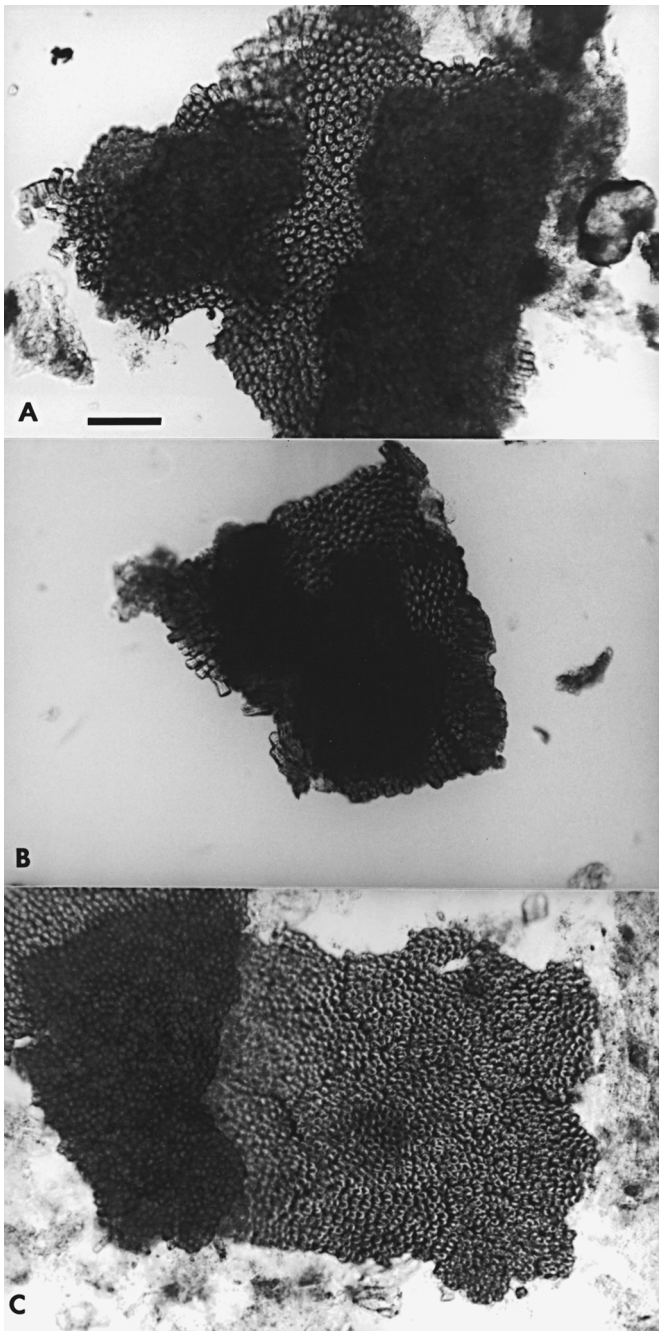

FIG. 2—*Case 1: Bean seed coat recovered from* (A) *the victim's fecal sample,* (B) *the victim's clothing, and* (C) *the suspect's clothing. The bar in* (A) *represents 0.1 mm. All samples are at the same magnification.*

sented largely the remains of a single meal eaten approximately 24 h prior to her death. Consequently, the similarity of plant cells present in the victim's and suspect's samples were limited to a relatively small number of plants eaten and probably to a single meal.

In the case of the robbery suspect, there was a much greater variety of plant material present in both the clothing sample and the deposit left at the robbery site. In comparison to a number of unrelated fecal samples we have examined, there were no items in common for most of these comparisons, a few with one item common, and one sample with two items overlapping with the suspect's clothing or the robbery deposit.

In conclusion, the comparison of plant cells in fecal samples can be a useful method for connecting a suspect to a crime scene. Furthermore, the analytical procedures employed do not alter the evidence in any way because plant cell walls are not damaged by any of the treatments employed. Finally, the method of observation of plant cells with a microscope and the comparison of unknown cells with known specimens in itself is not novel, and this identification technique for plant cells has been employed successfully by botanical scientists for hundreds of years. Anthropologists have used plant materials in fecal samples to reconstruct diets of ancient peoples. The uniqueness of our work is in its application to criminal cases.

We have testified concerning our use of this general methodology for plant identification and reconstruction of last meals in nu-

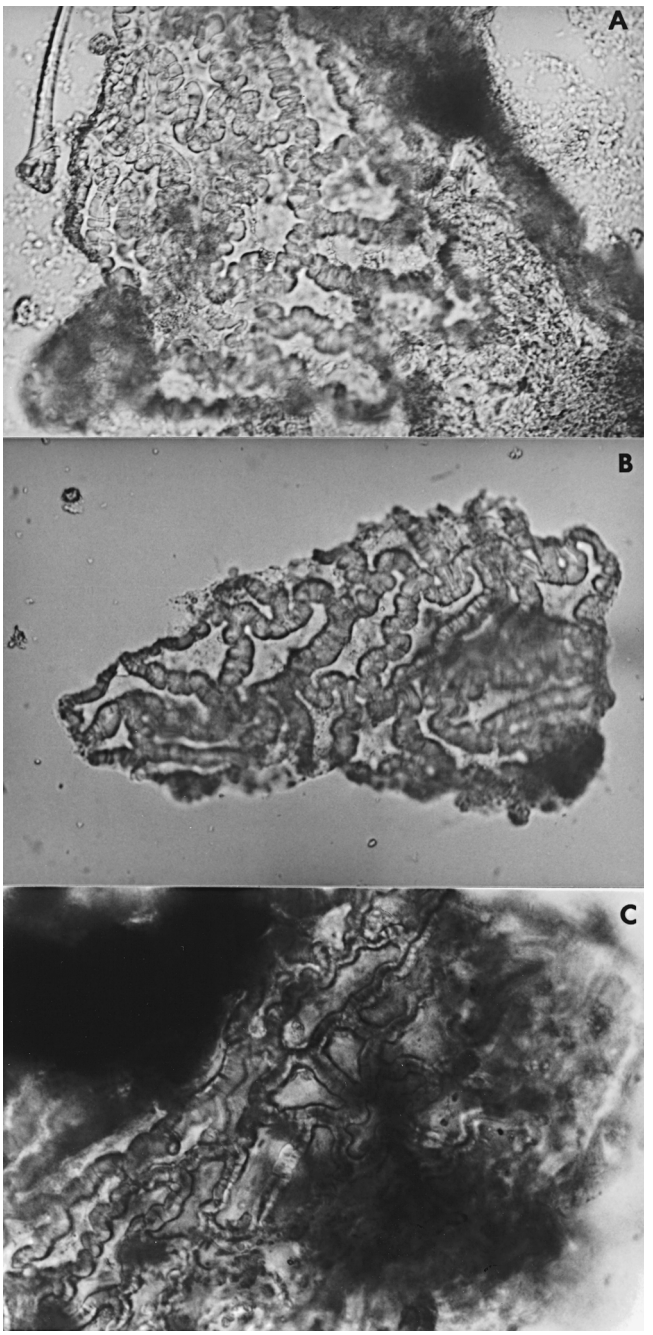

FIG. 3—*Case 1: Epidermal cells characteristic of pepper seeds from* (A) *the victim's fecal sample,* (B) *the victim's clothing, and* (C) *the suspect's clothing. Magnification is the same as Fig. 1.*

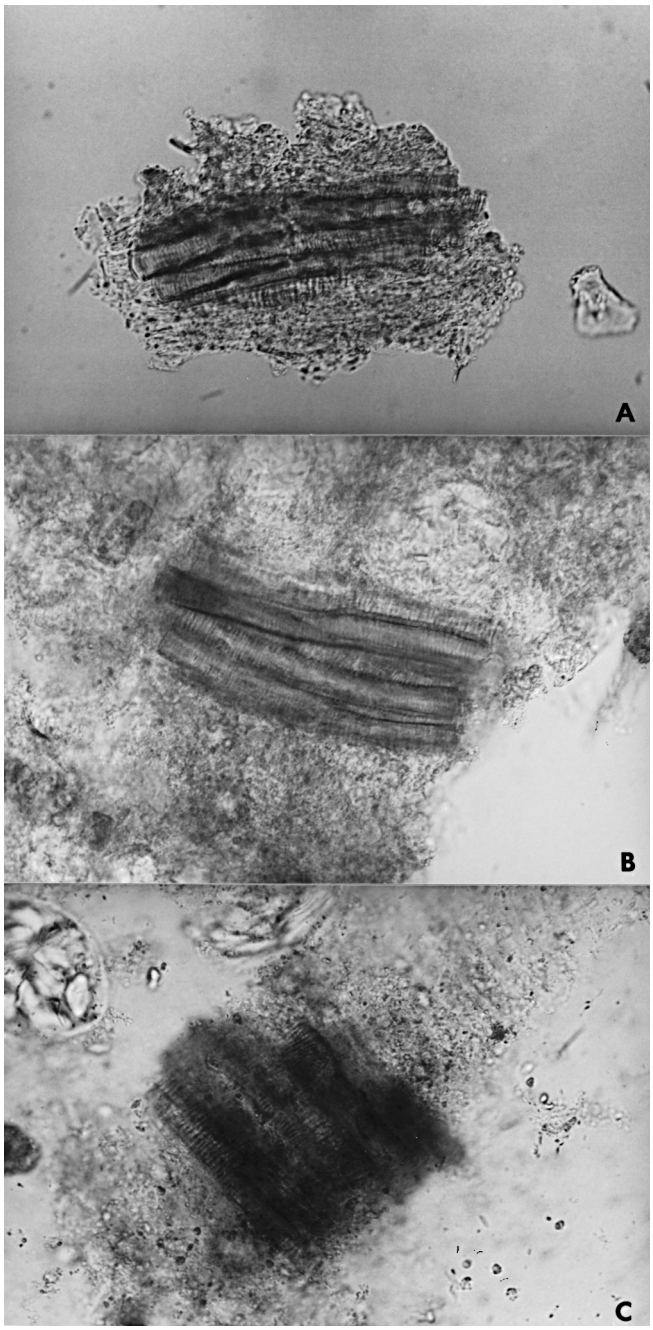

FIG. 4—*Case 1: Uniform fragments of plant vascular tissue recovered from* (A) *the victim's fecal sample,* (B) *the victim's clothing, and* (C) *the suspect's clothing. Magnification is the same as Fig. 1.*

merous court cases and it always has been accepted. Our testimony in Case 1 led to a guilty conviction. In Case 2, when the suspect was confronted with the fecal evidence, he changed his plea from "not guilty" to "guilty."

Acknowledgments

The authors wish to acknowledge Mr. Scott Epstein and Ms. Kathleen Eberling because it was their inspiration to see the possibility of using such evidence and to ask us to make the comparison in Case 1 and 2. We also wish to thank Lara Meyer for her analyses of some reference fecal samples unrelated to these two cases.

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