



G7 Analysis of Human Bitemarks in Food and Beverages Using Metric and Biological Analysis

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After attending this presentation, attendees will understand the importance of analyzing bitemarks by both physical and biological methods in criminal cases involving forensic odontology.

This presentation will impact the forensic science community by presenting different tests which will achieve human identification in simulated cases involving bitemarks and evidence found at crime scenes.

Multiple methods can be used for the comparison analysis of a suspect dentition to a suspected bitemark injury. The two most common are metric or biological analysis. Metric analysis involves the overlaying of a replica suspect's dentition above the pattern injury. This can be done physically, via caliper measurements, or virtually, using computer software. Biological analysis involves the comparison of the deposited salivary cell's DNA with a reference sample; however, the effectiveness of these methods can vary greatly depending on the impression substrate.

Study Goal: The goal of this study is to compare the effectiveness of four metric analysis methods on bitemarks produced in cheese and chocolate. A second goal was to determine if a biological method using DNA extracted from the saliva residue left on bitten food or water consumed from a bottle could also be used for comparison. Additional variables, such as the storage temperature of the substrate following the biting, as well as the time interval between the time of biting and time of analysis would have an effect on the analysis.

Study Design: The study consisted of 20 volunteers, ten males and ten females. The subjects were asked to bite into five samples of soft cheese, five samples of chocolate, and to drink from five bottles of water. This produced 15 samples from each of the 20 participants. One sample of each type was analyzed immediately while the remaining were stored at either room temperature (25°C) or in a refrigerator (4-8°C). Those samples were later divided so that one set was analyzed at three days and the other at seven days. Impressions were made of the bitten foods as well as the maxilla and mandible of all the participants utilizing alginate. Plaster casts were fabricated from all the impressions. Finally, reference DNA sample were obtained from each subject by collecting 2mL of saliva *in natura*.

Analysis: Four different metric analyses were performed on the food, one using a digital caliper, one using a manual overlay of the dental casts opposing the casts of foods, and two using a digital imaging overlay method and Adobe® Photoshop®. Metric comparisons were performed by a single forensic odontologist. For the biological analysis, a sample of the DNA was collected from cheese, chocolate, and water using the double-swab technique. The DNA was extracted according to the protocol of the QIAGEN® QIAamp® kit, quantification of the recovered DNA was performed using a NanoDrop™ spectrophotometer. Amplification was then performed using Identifiler® PCR Amplification AmpFISTR® kit (CSF1P0, D2S1338, D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539, D18S51, D19S433, D21S11, FGA, TH01, TPOX, VWA, and amelogenin) and agarose gel electrophoresis.

Results: The results showed that there was no significant difference between the four metric methods used. Manual overlay comparison yielded the highest number of matched subjects with 58% for both sexes. The Adobe® Photoshop® method yielded the lowest number with only 32% of the female samples matching and 44% of the males. For the biological analysis, DNA samples from saliva deposited in water, cheese, and chocolate had concentration values ranging from 26.66±12.32 to 9.38±3.42, showing that there was sufficient DNA present for amplification and later comparison. Thus, it was concluded that the sampling of food products at crime scenes can be important to investigators in identifying a suspect by utilizing metric and biological analysis.

Bitemarks, DNA, Saliva