ABSTRACT

Introduction: Saliva is a complex body fluid, which is emerging as a popular source of forensic evidence. They act as a source of valuable deoxyribonucleic acid (DNA) samples. This, along with its ease of collection and handling, has increased its popularity as a forensic tool for crime detection, in cases of poisoning, animal bites, drug and alcohol abuse, and hormone identification.

Objectives: To assess the different methods used for detection and recovery of saliva, and to analyze the various applications of saliva in forensics.

Materials and methods: In this review, PubMed was searched for relevant English papers from 1981 to 2017.

Conclusion: Saliva has recently attracted much attention among researchers, particularly in the branch of forensic sciences. More research should be dedicated for this innocuous body fluid for acquiring comprehensive information regarding its application in forensic sciences.

Keywords: Forensic odontology, Forensic tool, Saliva.

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INTRODUCTION

Recovery of traces of body fluids is one of the most important types of forensic evidence. They contain valuable DNA samples which may help in identifying an accused or a victim. Saliva is a complex body fluid which plays a critical role in forensic evidence. Saliva may get deposited on skin in instances of biting, sucking, or licking and can act as a significant source of forensic evidence. In recent years, saliva is attaining popularity because of the easiness in collection, safety in handling, and its close similarity with plasma.

The current article is intended at emphasizing the application of saliva in forensic odontology.
Salivary amylase contains an aromatic amino acid component called tryptophan. Tryptophan, when excited with radiations of 282 nm wavelength, gives a unique emission spectrum of 345 to 355 nm. It possesses good sensitivity in identifying dried saliva stains on the skin.

Recovery of Saliva from Skin

Traces of salivary evidence should be recovered since it is useful for identity testing. Only a very minute amount of saliva will be deposited on the skin with bite marks. Proper collection methods will help in the revival of the maximum attainable quantity of cells in the saliva.

Also any potential contamination of the cells from the victim’s skin will be reduced. Due to exposure to air, the saliva is dried out and most of the desquamated epithelial cells and leukocytes in the saliva are desiccated. Following are the techniques used for recovering saliva from the skin.

Single Swab Technique

This is the classical method. In the single swab technique, a wet cotton swab or a wet filter paper is used to retrieve saliva traces from the skin.

Double Swab Technique

Two sterile cotton swabs and 3 mL of sterile, distilled water is required for this technique. The procedure is as follows: (a) Soak the cotton swab in sterile distilled water. (b) Roll the cotton swab over the suspected area by applying slight pressure and by following a circular motion. (c) Allow this first swab to dry in a contamination-free environment for a minimum of 30 minutes. (d) Within 10 seconds after completing the first cotton swab, roll the second dry swab across the now moist area. (e) Apply moderate pressure to absorb the wetness from the skin into the second swab. (f) Allow the second swab to dry in a contamination-free environment for a minimum of 30 minutes. (g) After drying, pack and seal both swabs together, and mark with sample and case numbers. This study was conducted by Sweet et al. They found that the double swab technique is a better method for yielding saliva from the skin surface. This may be because moisture from the first swab will rehydrate and loosen majority of the epithelial cells dried within the saliva which will then adhere to fibers present in the cotton swab.

On the application of the second (dry) swab, the cells in the saliva adhere to the fibers more easily as they are rehydrated. Thus, this technique allows collection of a larger amount of DNA sample than the classical method.

Role of Saliva DNA Isolation

Salivary DNA can be recovered from different nonliving objects including clothing, foods, tobacco products, drink containers, oral hygiene devices, stamps, dental prostheses, envelopes, etc.

The ability to obtain forensic DNA data from salivary evidence was described in 1992, but the standard of practice for salivary DNA collection from skin was truly established when Sweet et al published the double swabbing technique. Deoxyribonucleic acid is isolated from the saliva sample using phenol–chloroform method. Phenol–chloroform extraction is a liquid–liquid extraction technique used for separating nucleic acids from proteins and lipids.

Aqueous samples, homogenized tissue, or lysed cells are mixed with equal volumes of phenol–chloroform mixture. The mixture is then centrifuged. Two distinct phases are formed since the mixture is immiscible in water. Phenol–chloroform mixture, which forms the organic phase, will sediment below the aqueous phase due to their higher density. Nucleic acids will remain in the aqueous phase, while the protein and hydrophobic lipid content will settle down into organic phase.

The upper aqueous phase is separated by pipetting it out.

Sex Determination

Saliva contains epithelial cells, which are exfoliated from oral mucosa, mostly buccal mucosa. These cells have increased the application of saliva for sex determination of the perpetrator. The duration of this line of inquiry is apparently possible for several weeks, post-deposition, depending on the materials containing the impressions and environmental factors. Based on successful results to identify the sex using blood stains, two parameters have been proposed.

The first one is the detection of sex chromatin: Barr bodies in females and F bodies in males. The second one is the determination of sex hormone levels. It is done based on the detectable quantities and ratios of 17 B-estradiol and testosterone.

Detection of Drug Abuse

Salivary concentrations of a particular drug can normally be directly correlated to the concentration of the same drug in blood. Drugs from the blood stream enter saliva through simple diffusion.

Drug wipe technique is a method used to monitor the presence of drug in saliva. Drug Wipe is a test used to wipe surfaces for recovering traces of drug residue. It may be used for testing both sweat and saliva of
Application of Saliva in Forensics

Saliva in Bitemark Analysis

Salivary animal bite mark analysis—Fletcher et al. suggested that salivary stains up to 16 months old can be used for species identification, with application of enzyme-linked immunosorbent assay technique using monoclonal antibody based on the presence of salivary immunoglobulin A. In cases with insufficient monoclonal antibody results, double gel diffusion techniques and crossover electrophoresis can be used for comparison. This technique is helpful in the examination of bitemarks from nonhumans when the biting animal is not known.

Salivary Biomarkers in Forensics

Salivary biomarkers in forensics Saliva biomarkers are also used in cases involving bitemarks for general identification of people and for victim identification in the instances of mass disasters. First, the hospital records of the victims are tracked down to check for the history of any particular disease. The salivary biomarkers for those particular diseases are then used for a positive identification from the traces of saliva samples obtained. These biomarkers may also be used to identify victims whose DNA data are not available on any existing DNA database.

CONCLUSION

Saliva has recently attracted much attention among researchers, particularly in the branch of forensic sciences. Serological testing and analysis of salivary cellular component are being increasingly applied in crime detection, hormone identification, drug and alcohol abuse, cases of animal bites, and poisoning.

Safe handling, along with the easy and noninvasive procedures of saliva collection, has increased its popularity in drug abuse tests. Sex determination and identification of the suspects in scenes of crime, with the help of cytological analysis and DNA profiling of saliva, are finding widespread applications in forensic investigations.

More research should be dedicated for this innocuous body fluid for acquiring comprehensive information regarding its application in forensic sciences.

REFERENCES