B112 Forensic Analysis of Flesh and Flavor Compounds in Stone Fruits

Chin-Chin Lim, MSc, MBA, Poh Ling Chia, BSc, Irene Tan, Wanjing Su, and Michael Ming Kiong Tay, PhD, Centre for Forensic Science, Health Sciences Authority, 11 Outram Road, Singapore, Singapore 169078, Singapore*

After attending this presentation, attendees will learn to select and apply appropriate analytical techniques to identify fruit pulp and juice stains and residues in a forensic context.

This presentation will impact the forensic community and/or humanity by drawing attention to the possibility of identifying fruit stains and residues in a crime scene, so as to reconstruct events and corroborate or refute allegations.

In forensic investigations, unknown stains are sometimes found on non-porous surfaces such as floor tiles, furniture, and utensils and on porous materials such as clothes, carpets, upholstery, and facial tissues. Techniques are readily available for stains of various organic and inorganic substances, and stains containing biological materials (blood, seminal and vaginal fluids, urine). The identification of fruit stain traces and residues has attracted little, if any attention in the forensic community.

The identification of a fruit residue or stain is useful to the forensic field as these substances may emerge as crucial evidence in understanding events surrounding the commission of a crime. They may be left at crime scenes and even in the stomach contents of murdered victims. The detection and identification of these substances could be vital in linking a suspect or victim to the crime scene or in establishing circumstances in the crime. The reconstruction of events provides valuable insights to the judge and jury of the mind, motive, and responsibility of the defendant.

The detection and identification of fruit stains and residues pose a significant analytical challenge due to the dynamic nature of the fruits and the complex environmental conditions. Whole fruit juices are usually 80-90% water. Juice expressed from fruit during cutting and squeezing contains natural sugars, vitamins, minerals, phytochemicals, organic acids, and aroma flavor compounds. Many fruit flavor and fragrance compounds are volatile or semi-volatile. Small volumes of juice leave little residue on drying. According to the literature, aroma volatile compounds are influenced by many factors including the species, cultivars, locations, seasons, fruit maturity at harvest, processing, and storage and ripening conditions. On exposure to air, cut or bruised fruit begins to darken and turn brown with oxidation, fermentation, and chemical reaction. Microbes, fungi and other microorganisms, ubiquitous in the environment, cause rapid spoilage in hot weather. Environmental conditions such as temperature and exposure effects also alter the chemical composition of the original fruit.

The aim of this research was to examine the usefulness of different analytical techniques and propose analytical schemes for the characterization of stone fruit pulps, residues, and stains. Seven different types of stone fruits were examined: mangoes, peaches, nectarines, cherries, plums, olives, and jujubes. The techniques used include screening with UV-VIS light, microscopy, Raman microscopy, Fourier Transform-Infrared (FT-IR) microscopy, and gas chromatography-mass spectrometry (GC-MS). Findings indicated that:

1. Fruit stains could be located by screening with light of 445 or 455 nm.
2. Microscopic examinations yielded information on the fibrous nature of the fruit pulps.
3. Raman microscopy and FT-IR microscopy were able to identify the non-volatile compounds (glycerol, sugars, oil, carotenoids) in the fruit pulps, residues, and stains but could not clearly differentiate different types of stone fruits.
4. GC/MS was useful for characterizing the volatile compounds in the fruit pulps and residues but it has its limitations for charac- terizing fruit stains, especially stains deposited on non-porous surfaces. The flavor and fragrance compounds of stone fruits were first extracted using either solvent extraction or passive headspace carbon strip adsorption techniques. The aroma volatile compounds detected using GC/MS include organic acids, alcohols, aldehydes, terpenes, esters, ketones and lactones. The comparison of chromatographic profiles (total ion chromatogram and extracted ion profile) of the unknown substance and the known cultivar would provide confirmatory information on the likely source of origin of the unknown substance.

Stone Fruits, Flesh and Flavor Compounds, Volatile and Non-Volatile

 ** Presenting Author*