

Hazardous Volatile Organic Compounds in E-Cigarette Liquids

ABSTRACT

The use of e-cigarettes continues to gain popularity, and there is concern for potential health risks from inhalation of aerosol and vapour produced by these devices, which are currently associated with millennial disease of E-Cigarette or Vaping product use -Associated Lung Injury (EVALI). In Malaysia, there has been little empirical studies on hazardous compounds in e-cigarette liquids (e-liquids) especially volatile organic compounds. The main objective of the study is to explore hazardous volatile constituents in e-cigarette liquids: Volatile organic compounds and flavouring chemicals. An analytical qualitative chemical characterization of volatile constituents of e-liquids using a static headspace technique was developed. Results of the study show that 85 % of the compounds identified are the flavoring chemicals listed as Generally Recognized as Safe (GRAS); applicable only to ingestion. In addition, carcinogenic benzene and nicotine were also detected. The research affirms that e-cigarette liquids may pose significant health risk, where the increasing current trend of adulterated product of e-liquids demands further investigation.

Key Words: E-Liquids, Volatile Organic Compounds, Flavouring Chemicals, Carcinogenic, GCMS-Headspace.

INTRODUCTION

The National Health and Morbidity Survey in 2019 shows there are 1.12 million vapers in Malaysia above 15 years old [1]. The vaping phenomenon against world's first treaty on public health which is the WHO Framework convention on Tobacco Control (WHO FCTC) signed by Malaysia since 2005 and the Sustainable Development Goals (SDGs) to reduce tobacco use. It is also not consistent with the National Fatwa Council that declared e-cigarettes to be haram (in 2015)[2] following their 1995 fatwa that smoking is haram. Evidently, we are far from fully understanding the potential hazards that they pose to respiratory health. However, in Budget 2022, Malaysia imposed an excise duty for e-cigarette products in order to compel Malaysians towards healthier lifestyle.

METHODOLOGY

Volatile organic compounds (VOCs) was screened from a batch of 3024 cartridge-type regular e-liquids seized by the enforcement body of Malaysia was chosen as a representative sample. The e-liquids are classified into flavour categories, including fruits, menthol, coffee, tobacco, nuts and beverages. 2 mL of each e-liquid is equilibrated in amber vials for 24 hours at room temperature. Headspace was transferred to an evacuated canister and qualitatively analyzed for 18 VOCs using a pre-concentrated gas chromatography/mass spectrometer system.

RESULT & DISCUSSION

- A total number of 3024 samples were received from National Pharmaceutical Regulatory Agency (NPRA) for nicotine analysis. Nicotine were detected for all representative samples by Gas Chromatography - Mass Spectrometry (GCMS). The same samples were used for volatile analysis by using GCMS-Headspace.

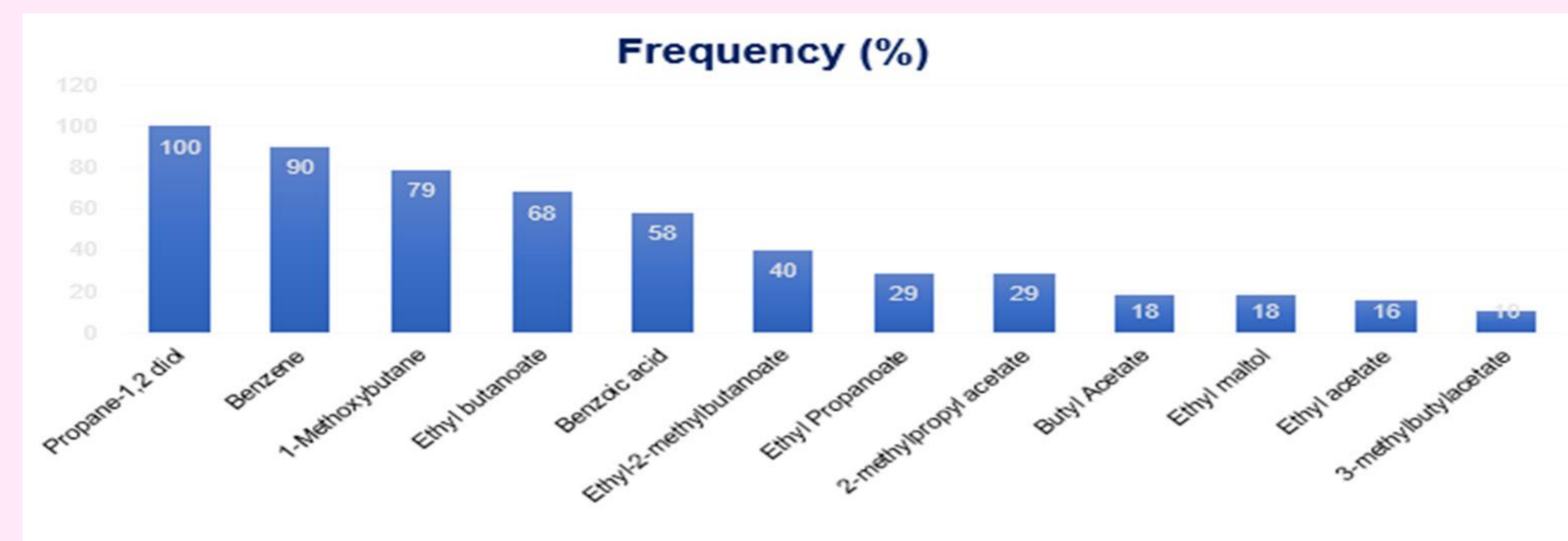


Figure 1 : Frequency of volatile constituents detected from e-cigarette liquids

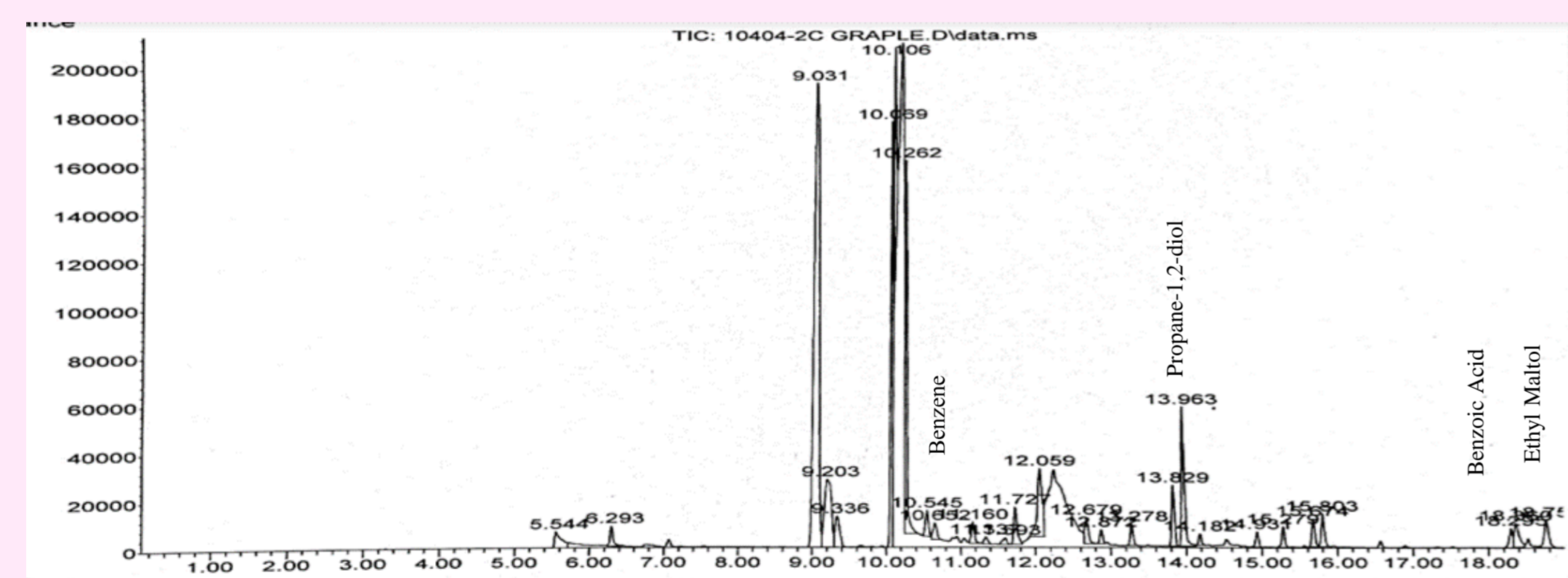


Figure 2 : Flavor type and its composition in e- cigarette liquids

- Figure 1 shows Propane 1,2- diol was the most prevalent compound in the e-liquids. Benzene was the second most frequent identified compound at 90% and followed by 1-methoxybutane at 79%.
- A typical GCMS-headspace chromatogram is shown in Figure 2; the resolved components of volatile constituents are identified from their characteristic retention times. The presence of benzene may be due to chemical reactions and transformations from other constituents including benzoic acid.

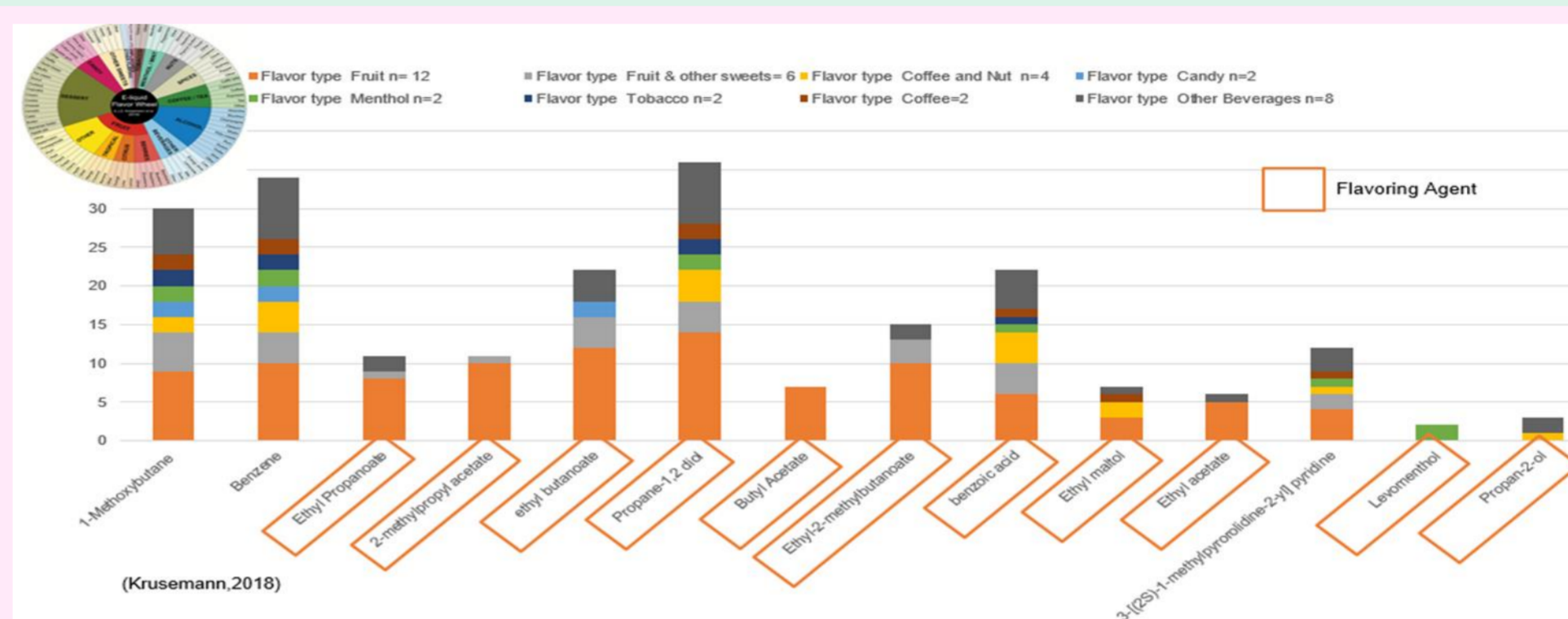


Figure 3 : Flavor type and its composition in e- cigarette liquids

- 85% of the identified compounds in Figure 3 are listed in the FEMA GRAS status. The FEMA expert panel evaluated only the safety of flavour ingredients under the conditions intended for use in food and did not evaluate flavour ingredients for use in vaping products or any other uses that are intended for inhalation [3].
- The statement made by manufacturers and marketers that suggests their vaping products are safe because they have FEMA GRAS status are false and misleading.

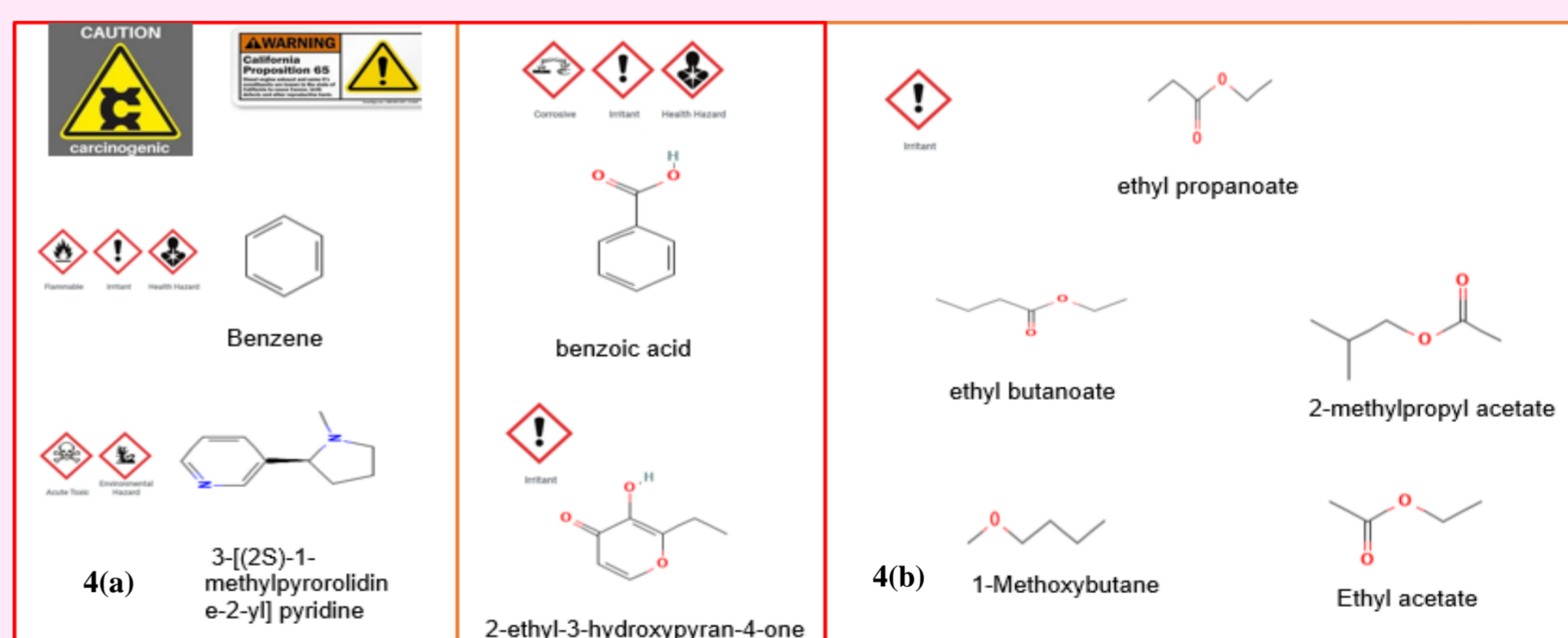


Figure 4 : (a) Compounds listed under California Proposition 65; (b) Flavoring Chemicals listed under Hazardous Substances Data Bank (HSDB).

- As shown in Figure 4(a), benzene and nicotine which are carcinogenic compounds have been detected.
- Evidently, based on the PubChem Chemical Database as shown in Figure 4(b), the flavoring chemicals pose significant health risk especially to the respiratory passages. The finding is supported by Lisa Miyashita and Gary Foley that highlighted the potential respiratory health effects is from using flavored e-liquids [4].

CONCLUSIONS

In Malaysia, leading medical groups, organizations and scientists are concerned about the lack of restrictions and regulation for E-Cigarette. The e-cigarette product is launched without knowing the harmful health effects. The research affirms that e-cigarette liquids may pose significant health risk, where the increasing current trend of adulterated product of e-liquids demands further investigation.



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