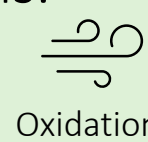


## Background

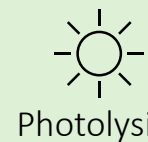
- E-cigarettes are electronic nicotine delivery systems (ENDS) that vaporize liquids and are inhaled.
  - Popular flavors include fruit, mint, and dessert.
  - Flavors comprise of many individual flavoring chemical compounds.
- The stability of flavoring chemicals in e-cigarettes is unknown.
  - Expiration dates are often arbitrarily listed and the amount of time from manufacture to purchase is usually unknown.
- NYS recently banned all flavored liquids due to their attractiveness to youth.
  - Users and stores may begin to purchase and store flavored e-cigarette liquid products.
  - This is concerning because the flavoring compounds could degrade into other chemicals with unknown health effects.
- Degradation may occur from oxidation, hydrolysis, or photolysis.



Oxidation



Hydrolysis



Photolysis



Electronic Cigarette 101 - What You Need To Know - Vaper's Corner (vapercorner.co.za)



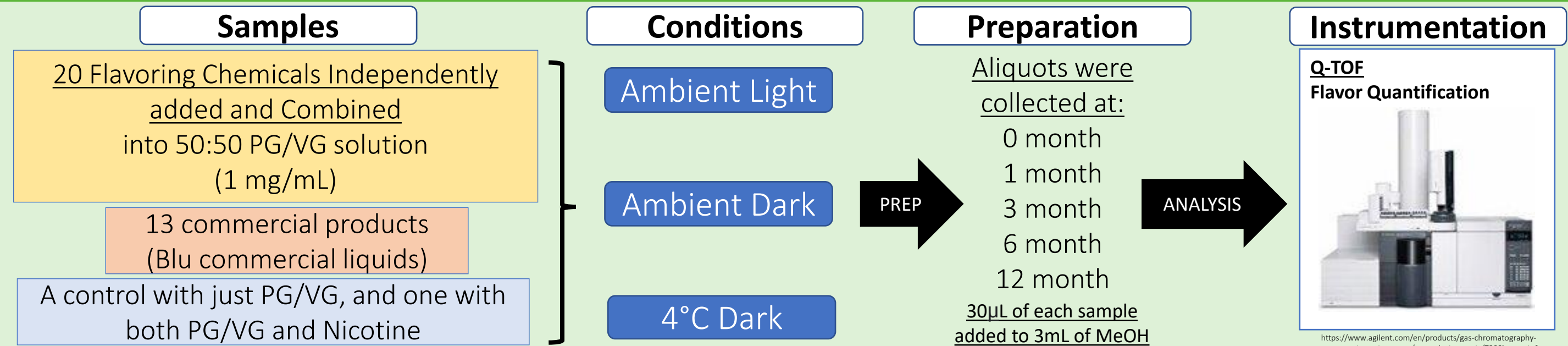
REBEK.CO.UK - Best E-liquids in UK (wordpress.com)

- Vanillin, a widely used flavoring chemical in food products, has been shown to degrade in various conditions (Weerawatanakorn, M. et al 2015).
  - Vanillin is also a popular additive to e-cigarette liquid flavors, and its stability in the liquids is currently unknown.
  - Though vanillin and other flavor compounds oxidize in food products, we still don't know what is occurring in e-cigarette products.

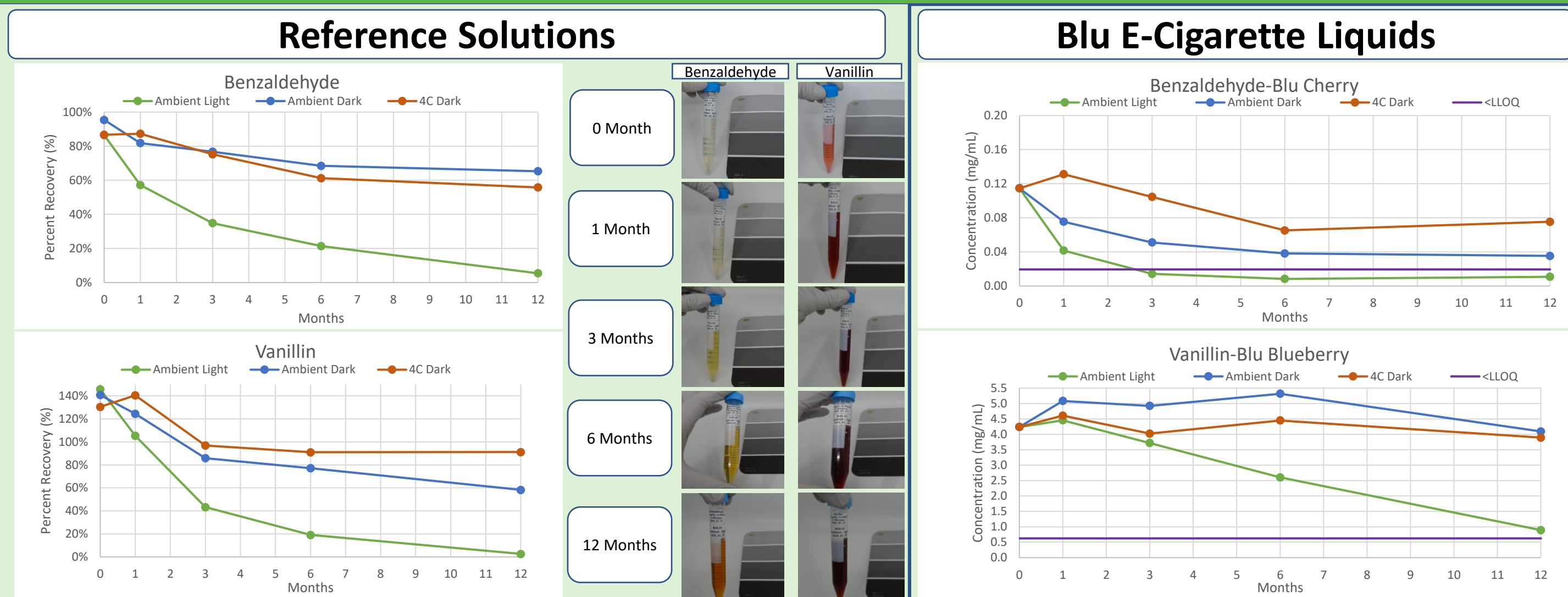
## Purpose/Hypothesis

- The purpose of this study was to determine if 20 chemical compounds added to flavored e-cigarettes degrade over the span of one year in three different light and temperature conditions.
- Hypothesis: If flavoring chemical compounds degrade in food products, then similar degradation effects will be observed in e-cigarette liquids.**

## Methods/Materials



## Results/Analysis



A study from Yale University has shown that flavor aldehydes rapidly reacted with PG (Erythropel, H. et al 2019).

After the mixing of PG/VG with flavor aldehydes, and after a storage period, it was found that:

- E-cigarette liquids are chemically unstable
- New compounds can form

**Acetals**  
Molecules formed from chemical reactions between aldehydes and PG/VG.

**Cytotoxic**  
PG flavor acetals are more cytotoxic than the parent aldehyde (Jabba, S., et al. 2020).

## Conclusions

- The flavoring chemical compounds Benzaldehyde and Vanillin in reference solutions and in commercial Blu liquids degraded over the span of one year.**
- The ambient light condition allowed for fastest decay in both the Blu liquids and the reference solutions.
- Degraded commercial liquids could possibly be exposing users to harmful toxic acetals.

## Disclosures

Dr. Goniewicz reports grants from Pfizer Inc. and served as an advisory board member to Johnson & Johnson, manufacturers of smoking cessation drugs, outside the submitted work.

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