

Evaluation of cigalike products with novel mouth-end configurations and novel e-liquids

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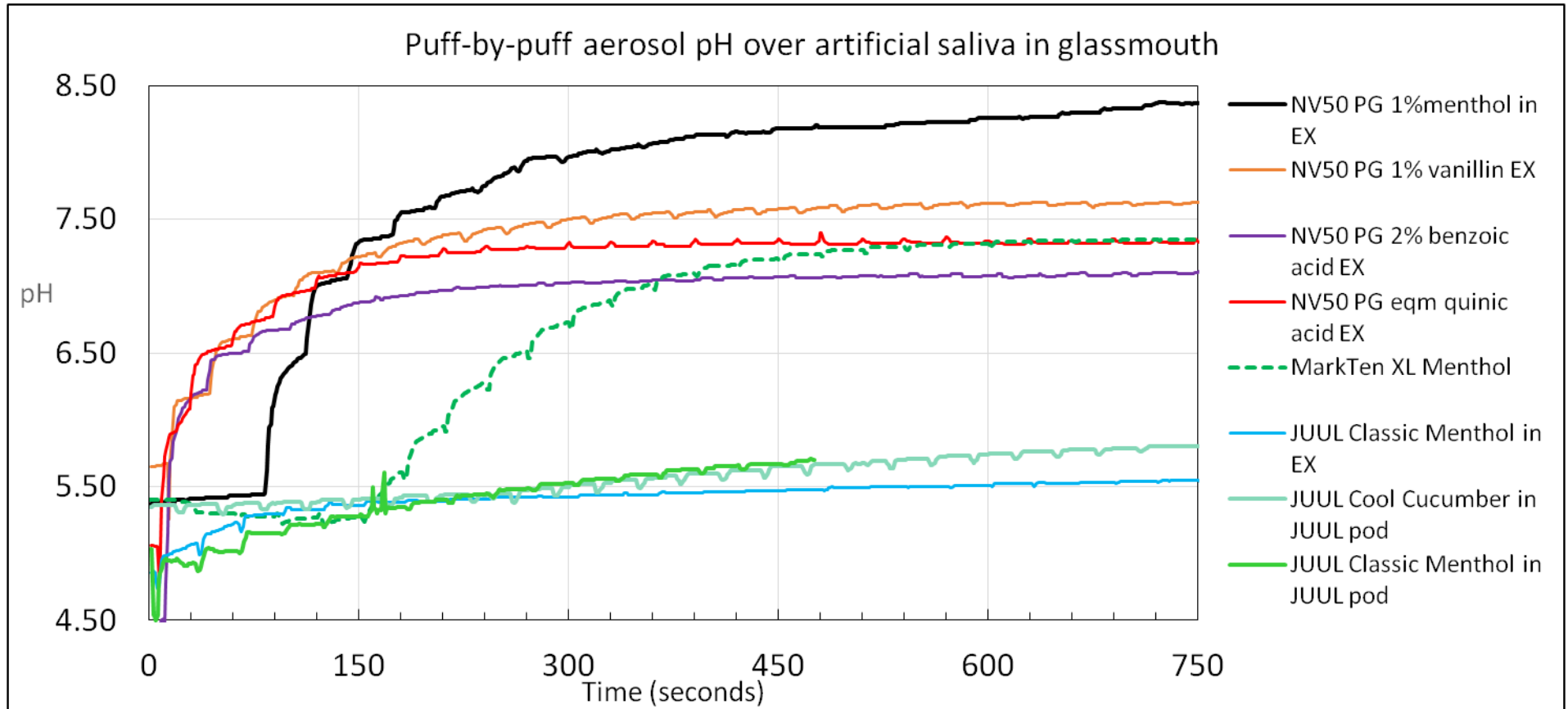
Outline for presentation

- Initial findings with glassmouth
 - Experimental
 - Results
 - Conclusions from use of glassmouth for aerosol pH
- Lost luggage and other laboratory tragedies
- Putting the pieces back together
 - Meeting needs of small e-liquid manufacturers [aka small tobacco product manufacturers (SMTP)] for analyses
 - Repurposing old work and adding a new spin
 - Product differentiation without pricey instrumentation
- Conclusions

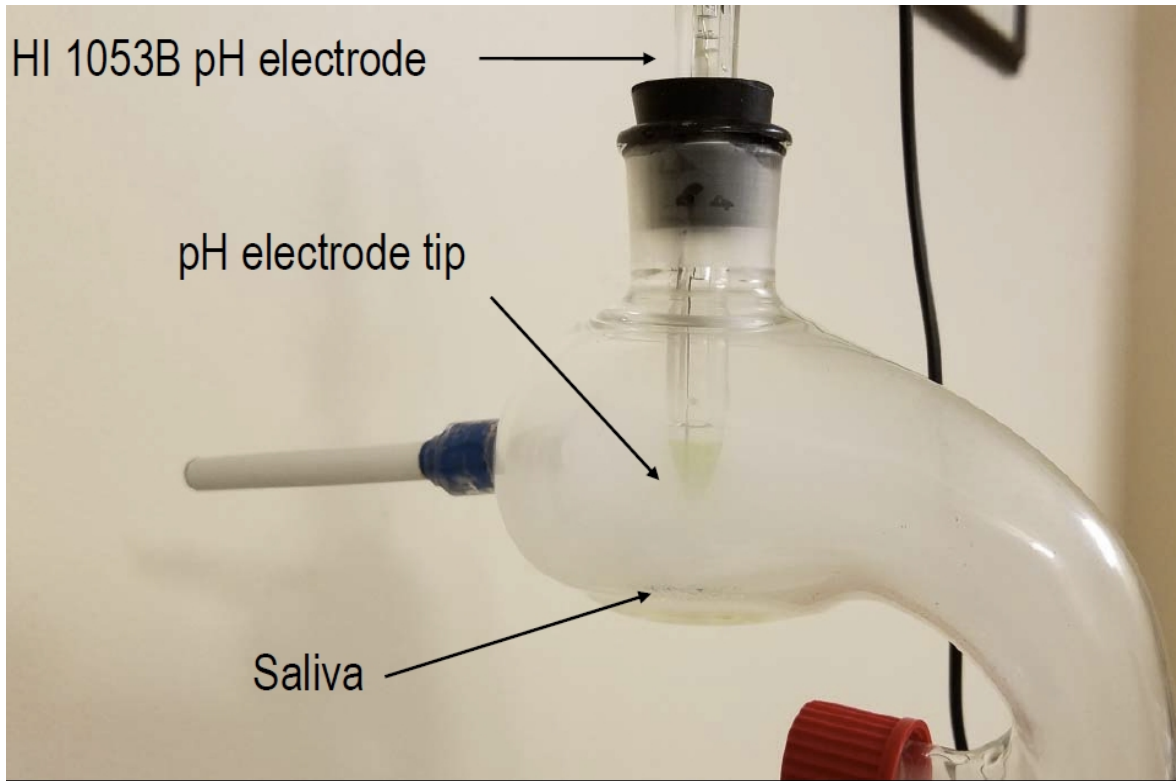
Experimental work with glassmouth

- Glassmouth used as previously reported
 - Novel devices obtained from Internet stores; convenience samples, not representative of marketplace
 - Novel e-liquids made from nicotine (50 mg/mL) in PG
 - Artificial saliva (10 mL) was Pickering Laboratories 1700-0304 (not stabilized, no preservative)
 - V2 EX blank cartomizers and V2 battery sections used for novel e-liquids and e-liquids taken from pods
 - Generally at least 25 puffs (CRM No. 81) are taken
 - Artificial saliva removed from glassmouth after exposure to aerosol and pH-value determined

Experimental results with glassmouth



Picture of glassmouth



Glassmouth trap with Conical tip electrode

Conclusions from work with glassmouth

- Menthol at 1% can raise observed aerosol pH
- Vanillin at 1% has little effect on aerosol pH
- Benzoic acid at 2% more effective at reducing pH than quinic acid at equimolar concentration with nicotine
- JUUL e-liquid performs in a similar manner whether in EX cartomizer or in JUUL pod used with JUUL device

Lost luggage and laboratory tragedies

- Initial presentation left behind in USA by the airlines
 - Had to start a fresh presentation on arrival in Kunming
 - A series of lab errors showed that saliva is apparently picking up flavors in addition to nicotine
 - Cannot ignore new findings and their importance to meeting regulatory needs; but they are preliminary



A new use for the glassmouth

- Numerous suppliers of e-liquids service US market
 - Are FDA “small tobacco product manufacturers” (STPM)
 - Many lack necessary instrumentation to show products formulated per recipe (likely FDA requirement)
- Question of commercial lab capacity and costs
 - Will there be capacity at any price?
 - Can STPM afford to send all testing to commercial labs?
- Answer may be to develop some simple methods
 - Must be able to differentiate similar products
 - Must be cost-effective – no pricey instrumentation
 - Examples shown on next slides

Major product changes in recent years

- Rectangularly-shaped devices/mouthpieces
 - Device and mouthpiece same shape
 - Device and mouthpiece different shape
 - Does it make a difference in the mouth?
- Use of nicotine salts
 - Much advertising, but what is really happening?
 - Other acids besides benzoic acid in commercial use?
 - Can users distinguish salt from non-salt?
 - How much of product is likely retained in mouth?

A three-product test

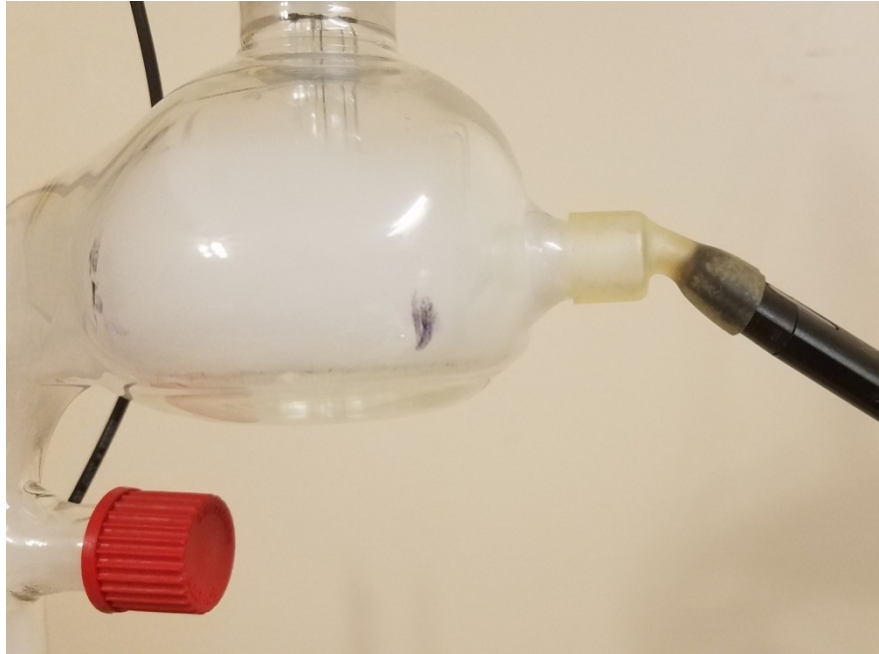
- A popular menthol e-liquid tested in a cigalike
 - nkd 100 salt menthol Brain Freeze, 50 mg/mL
 - Used with V2 EX Blank Cartomizer and V2 battery section
- Rectangularly-shaped disposable device
 - STIG Lush Ice (iced watermelon), 60 mg/mL
 - 75 mm-long with tapered plastic tip (like tipped cigar)
- Rectangularly-shaped reusable device with pods
 - my blu™ brand with rounded-mouthpiece pods
 - Polar Mist (menthol) at 24 mg/mL

How to test with available instruments

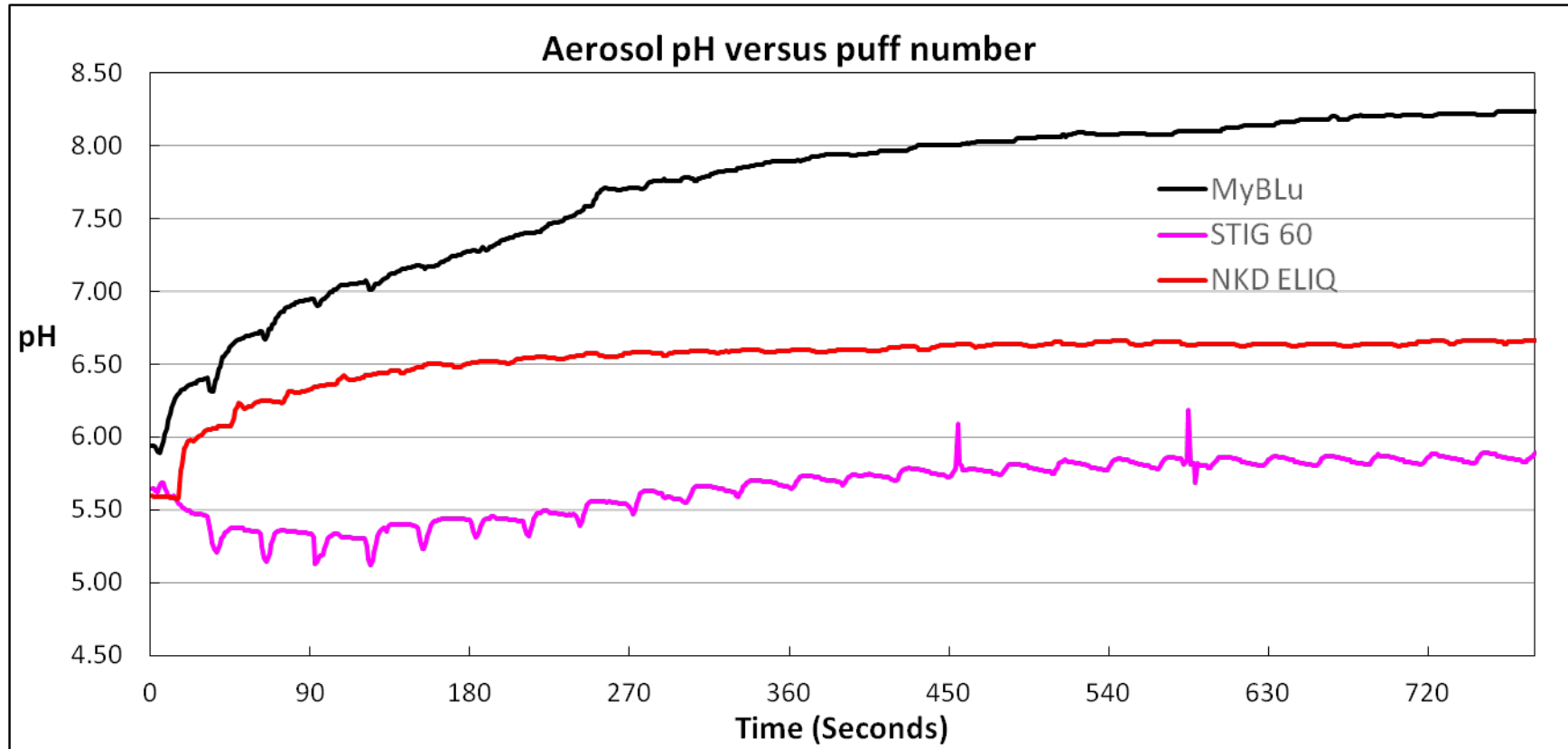
- Aerosol pH in glassmouth with artificial saliva
 - pH of aerosol and change in pH of artificial saliva
 - Weight loss from device (\approx aerosol collected matter)
 - Difficulty mating rectangularly-shaped devices with cylindrical opening on glassmouth (used latex tubing)
- LC of saliva or collected aerosol?
 - Used saliva is easier to sample than aerosol
 - May be related to transfer of flavors to taste receptors
 - Used LC as one already set up for reverse-phase LC using Cogent™ Phenyl Hydride column

Rectangular pegs in round holes?

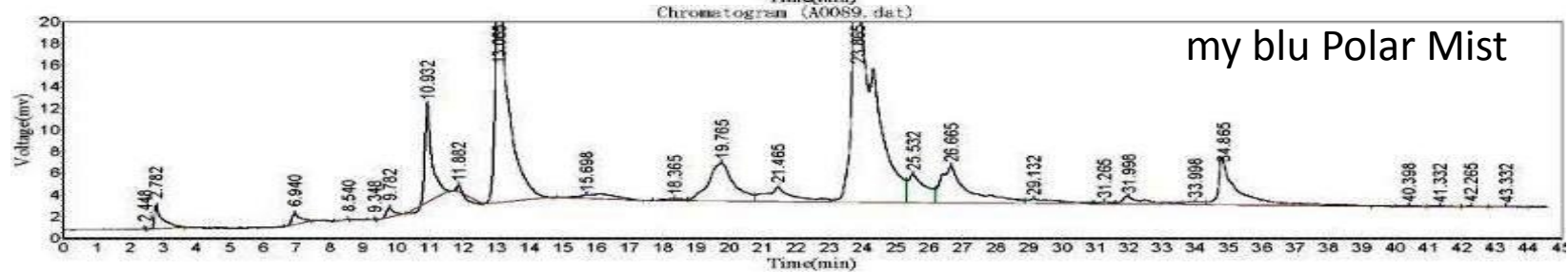
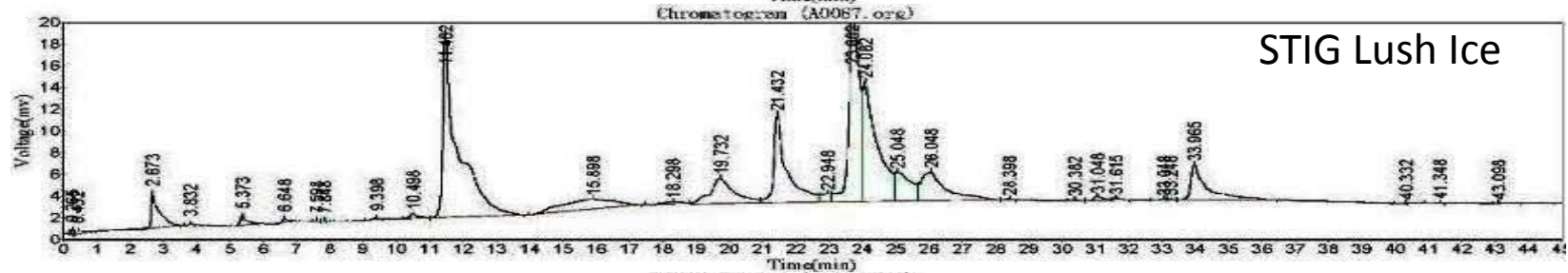
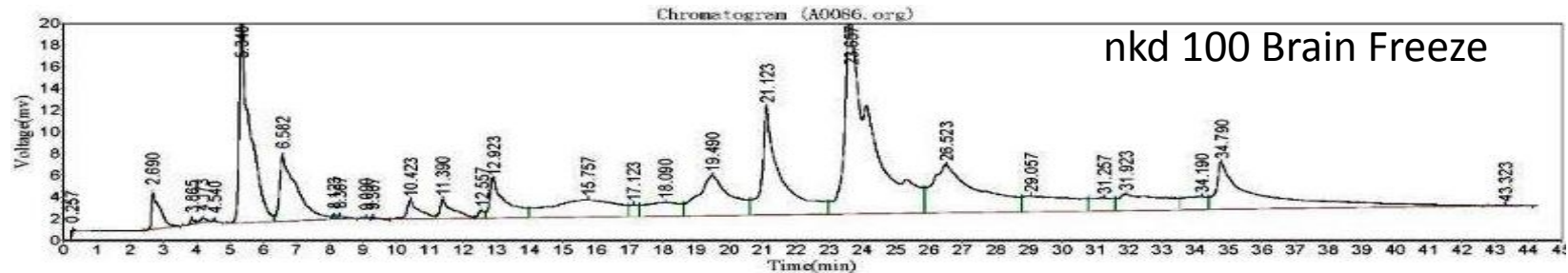
- Are the rectangular shapes more than a gimmick?



Maybe it is aerosol pH of the e-liquid?



Maybe it is what goes into the saliva?



Low-cost instrumentation used – 1

- Aerosol pH in glassmouth with artificial saliva
 - Hach H260G meter with Hach SmartLogger II software, Hanna Instruments 1053B pH electrode
 - Glassmouth (fabricated by laboratory glassblower)
 - Lenovo ThinkCentre PC, Arduino boards, and software
 - Solenoid valve, 10-turn metering valve
 - 500 mL bubble flow meter and timer
 - Automotive vacuum pump, copper tubing, and fittings
 - Latex tubing and miscellaneous laboratory glassware
 - 3-place balance, ring stands, and laboratory clamps
- System mounted on electronics workstation cart

Low-cost instrumentation used – 2

- LC system for saliva, collected aerosol, e-liquids
 - Waters 510 pumps (2), 680 gradient controller, 486 UV-VIS detector, Rheodyne 7725 injector, Surwit N2000 two-channel chromatography data system and PC
 - Cogent™ Phenyl Hydride column (250 mm x 4.6 mm)
 - Standards for nicotine, aromatic aldehydes, and PG acetals of benzaldehyde, vanillin, and Ethyl vanillin
- LC conditions
 - Gradient: 79 H₂O/21 ACN to 79 ACN/21 H₂O (32 min)
 - Flow rate: 1 mL/min; 280 nm detector wavelength

Conclusions

- Glassmouth not only provides data on aerosol pH and saliva pH, but also on compounds absorbed by saliva during exposure to e-vapor aerosols
 - Low cost to build and operate
 - Potential to show changes that occur when e-liquids or devices containing e-liquids are aged
 - May be the O/WP for e-vapor aerosols
- Low-cost LC system would provide STPM with
 - Capabilities to monitor products, raw materials
 - Capabilities to conduct informal aging studies