Quantifying Ethanol Interference in Ammonia Standard Solutions

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Impact Statement: Understanding how ethanol interferes with ammonia measurements will improve the accuracy and reliability of point-of-care ammonia sensors, enabling faster and more precise diagnosis of conditions like hyperammonemia.

Background:

- Accurate Ammonia measurement is critical in diagnosing metabolic disorders such as hyperammonemia
- Point of care ammonia sensors require reliable calibration using standard solutions
- Commercial grade standard solutions typically mix ethanol along with ammonia
- Ethanol is volatile and can introduce measurement error
- Interference is defined as any deviation greater than 10% (CLSI EP07)

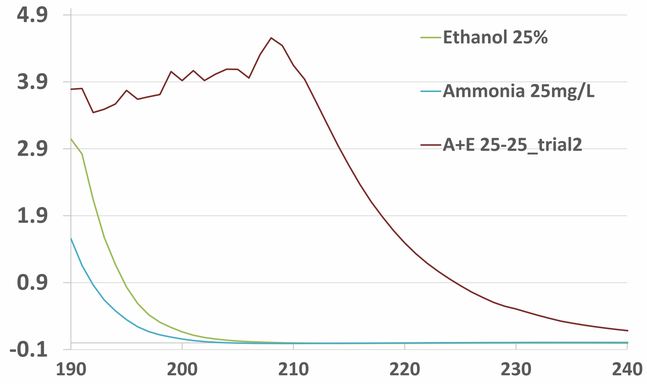
Methods:

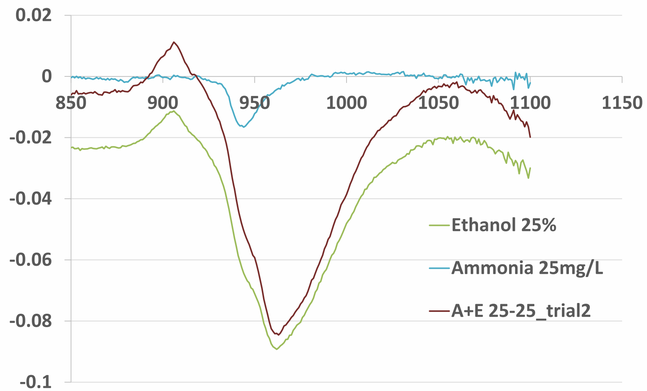
Prepared ammonia-only (AL2, AL3), ethanol-only (EL2, EL3), and mixed (AEL2, AEL3) solutions

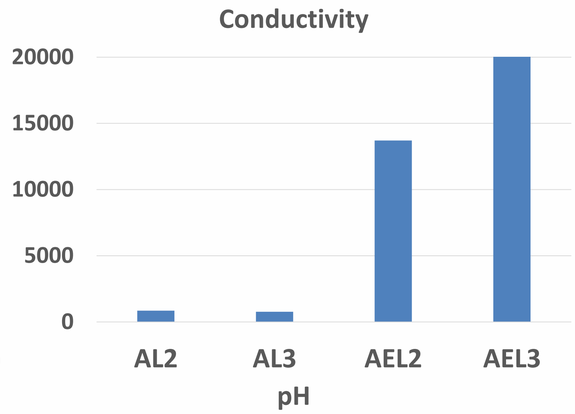
- Ammonia: 100 and 260 µg/dL
- Ethanol: 100 and 240 mg/dL
- Each sample tested in triplicate (n = 3)

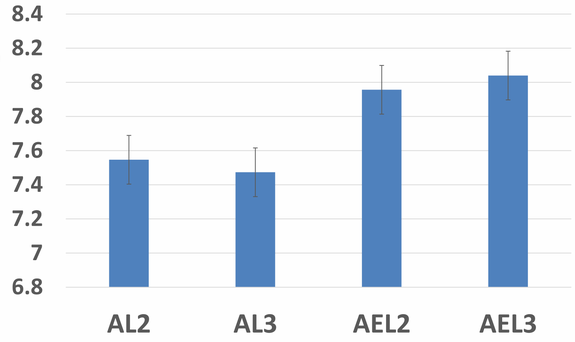
Data Collection & Analysis:

- Conductivity, pH, UV-Vis spectroscopy
- Data analyzed using Python (ANOVA, t-tests) and Excel (bar graphs)









Results:

- Welch t-tests between AL2–AEL2 and AL3–AEL3 show significant differences **($p \approx 0.000$),** confirming strong ethanol interference.
- pH also differs significantly **($p = 0.03$ and 0.0003),** indicating changes in solution chemistry.
- UV-Vis analysis identified two key regions:
- **190–240 nm:** Non-linear behavior between ammonia, ethanol, and mixtures (interference effect)
- **900–1000 nm**: Linear trend dominated by ethanol (signal masking effect)

Discussion

- **Conductivity:** Ethanol changes ion mobility in solution and its structure
- **pH-shift:** Ethanol affects ammonia equilibrium
- **190-240nm non-linearity:** Interactions and overlapping compound affects on AEL solution
- **900-1000nm masking:** ethanol dominates optical response leaving ammonia signal buried

Future Works:

- Develop calibration or correction models to account for ethanol interference in devices
- Produce alternative standard solution that is a better fit for device calibration
- Develop a compound interference curve to show factors and measurement error models
- Explore other sensing methods that are more sensitive to ammonia and not ethanol

Citations:

[1] M. Thomas, "At Home Ammonia Monitoring of Inborn Errors of Ammonia Metabolism," Clinicaltrials.gov, https://clinicaltrials.gov/study/NCT06953505 (accessed Oct. 14, 2025).

[2] D. R. Lide, Ed., *CRC Handbook of Chemistry and Physics*, 84th ed. Boca Raton, FL, USA: CRC Press, 2003

[3] Quantimetrix Corporation, *Ammonia alcohol (Lots 232801–232803)*. [Online]. Available: https://quantimetrix.com/wp-content/uploads/Ammonia-Alcohol-Lots-232801-232802-232803.pdf

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