# Nondestructive *E. coli* O157:H7 detection using a colorimetric sensor enabled by machine learning and non-toxic dyes

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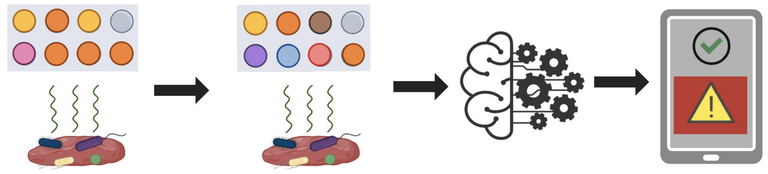
## Overview

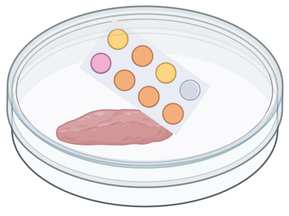
- Detection of foodborne pathogens can prevent foodborne illness
- Nondestructive detection may be used in smart food packaging for food safety monitoring along supply chain
- Aim to create a **nondestructive machine learning (ML)-enabled sensor to detect *E. coli* O157:H7 (*Ec*) in ground beef**
- Array of **non-toxic dyes** react with volatile organic compounds (VOCs) from foodborne pathogens



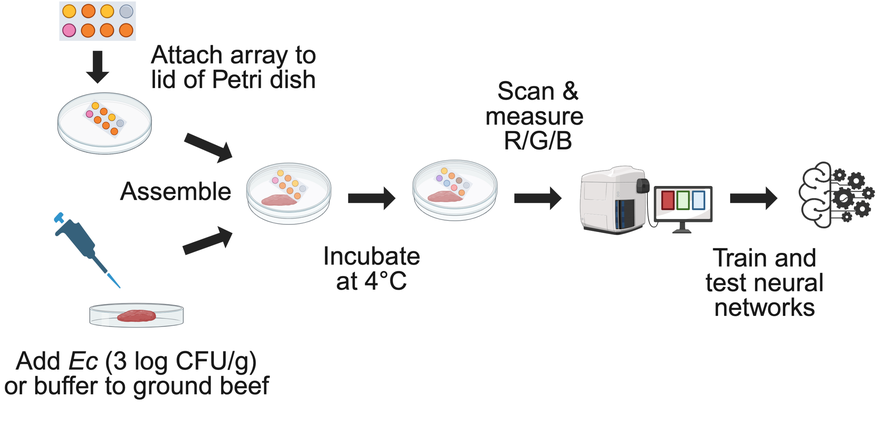
## Methods

**Reactivity testing:**

- To choose dyes & optimal application
- Tested reactivity of non-toxic dyes to:
  - Standard VOCs
  - *Listeria monocytogenes* (*Lm*), *Ec*, & *Salmonella enterica* (*Se*)
  - Various food models



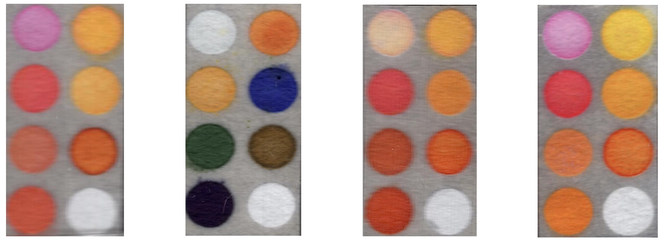
**Developing sensor for detecting *Ec* in ground beef:**




## Results & Discussion

### Reactivity testing

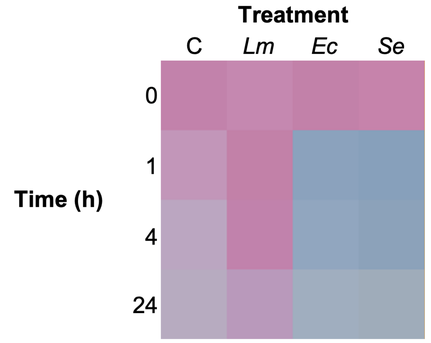
#### Reactivity to VOCs (4 h exposure)



Control | Morpholine | Indole | Ethanol

- Reactive to various VOCs, including amines and indole (*Ec* indicator)
- Showed potential for sensing microbially relevant VOCs

#### Reactivity to foodborne pathogens



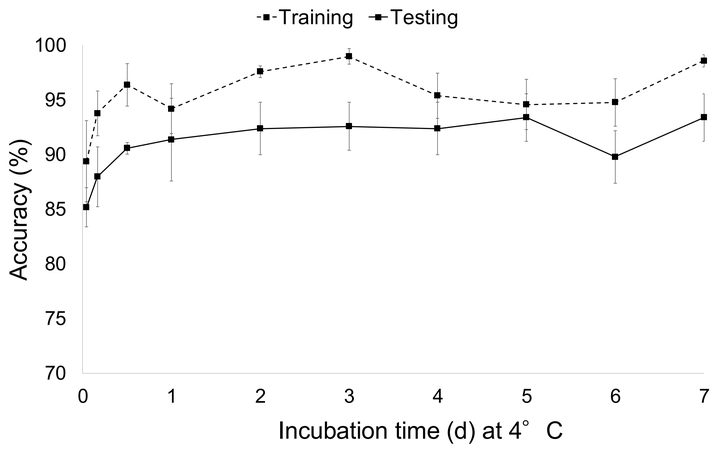

Average colors of Dye 1

*Ec* and *Se* caused more apparent color changes than *Lm*

- Likely more suitable for *Ec* or *Se* detection

Variations in color differences over time

### Neural network performance




- Varying accuracies over time
- Reached above 90% testing accuracy after 12 h
- Greatest testing accuracies were 93% after 5 d and 7 d

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## Conclusions

- Potential novel & nondestructive method for detecting *Ec* in ground beef for comprehensive monitoring
- Driven by differences in the dye colors in response to VOC profiles
- Suitable for **smart packaging** & testing same food sample at various time points in food supply chain
- Future research: selectivity, the limit of detection, & robustness
- Manuscript is under preparation

## Acknowledgements

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