

A survey of Enterobacteriaceae contamination and food safety awareness in Nigeria's informal markets

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Key messages

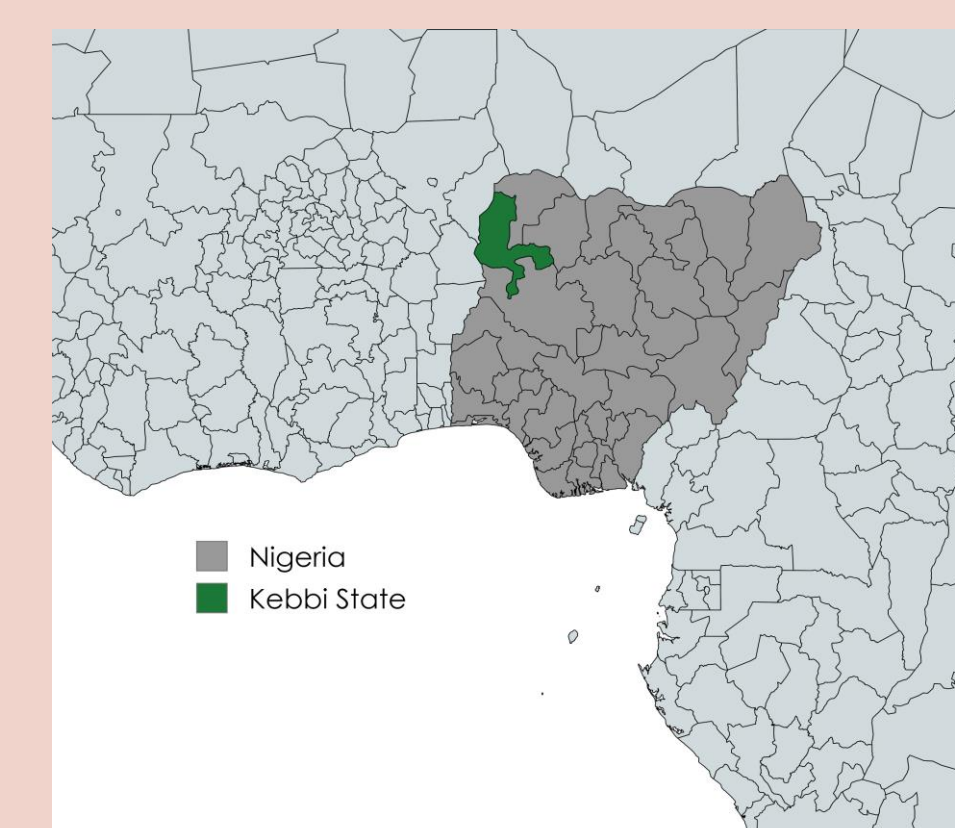
- **Hidden Hazards:** Fresh produce in Northern Nigeria reflects poor hygiene and potential contamination with health hazards.
- **Wet Markets- A Hazard Hotspot:** Traditional markets in low-income countries pose a significant threat to public health and demand immediate action.
- **A One-Health Solution:** A holistic approach is crucial to ensure the safety of food sold in these markets.

Context

- ❑ Africa carries the highest per capita burden of foodborne diseases, as reported by the World Health Organization (WHO, 2015). The primary source of concern for these diseases lies within domestic markets (GFSP, 2019).
- ❑ Microbes of the Enterobacteriaceae (EB) family, which encompasses pathogens such as *Escherichia coli*, *Shigella spp.*, *Salmonella spp.*, can serve as indicators of hygiene levels.
- ❑ This study estimates Enterobacteriaceae (EB) contamination in fresh produce and on vendor hands across informal markets of Birnin Kebbi, Kebbi State, Nigeria.



Image above: A vegetable seller on the central market of Birnin Kebbi (Credit: Mr. Sunday Yusuf)
Image below: Map showing location of Kebbi state in Nigeria (Source: www.mapchart.com)



Our approach

Central market, Birnin Kebbi
Tomato, Cucumber, Leafy Vegetable sellers (n= 80)

Neighbourhoods, Birnin Kebbi
Tomato, Cucumber, Leafy Vegetable sellers (n = 130)

Questionnaire and Observations

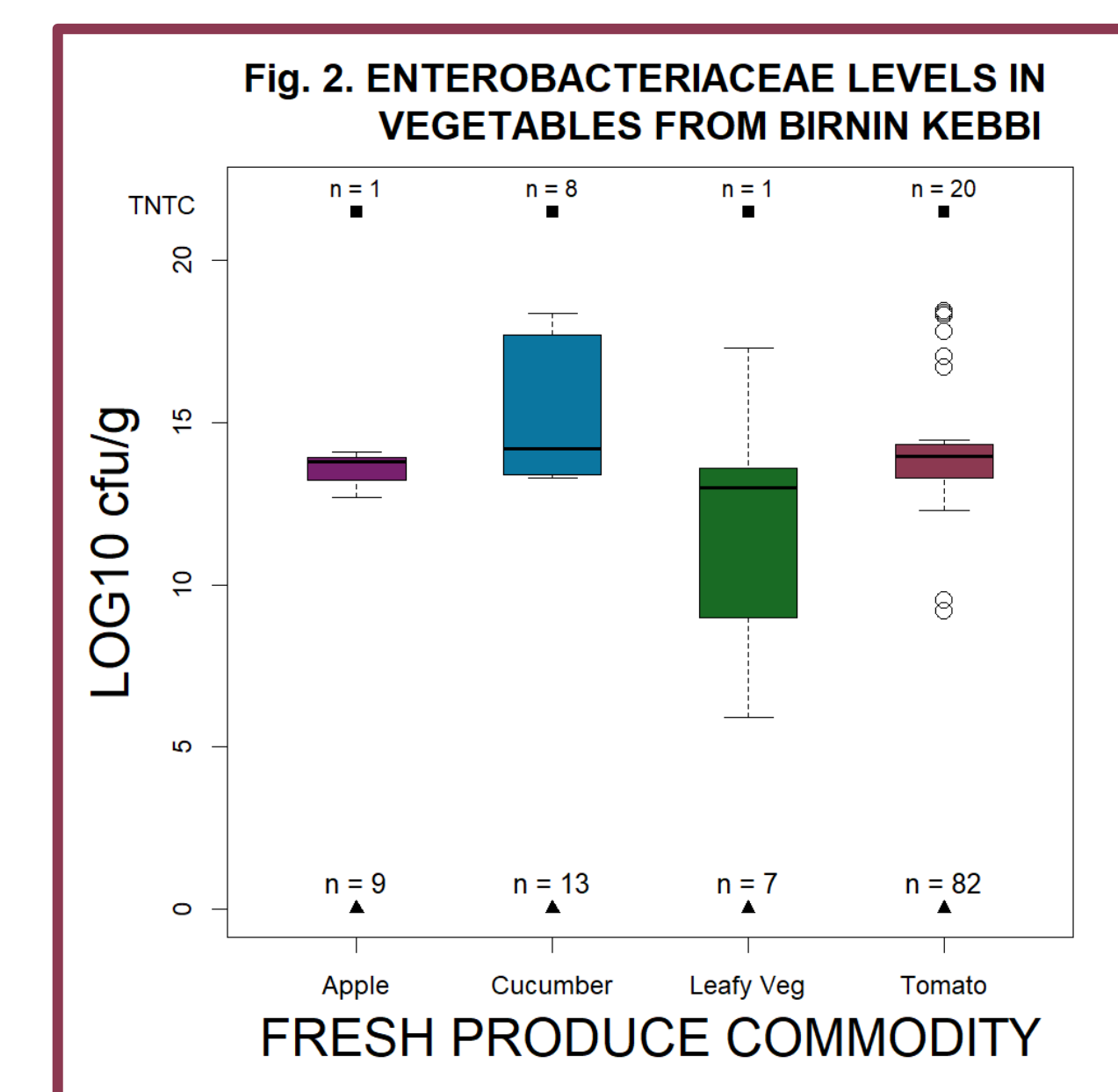
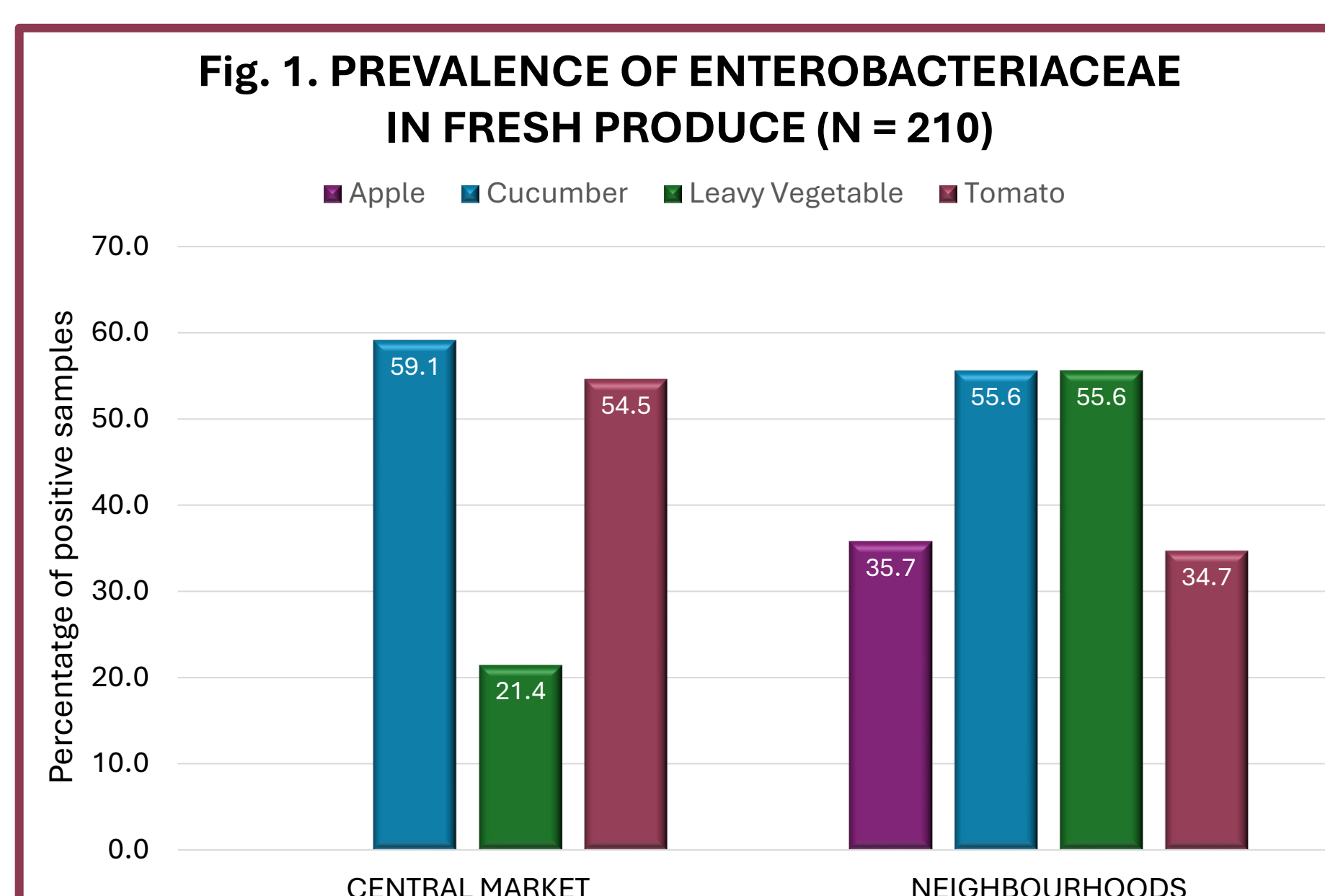
Microbial Sample Collection (Vegetables & Hand Swabs)

- Trained enumerators collected data in the local language, Hausa.
- 5 multiple choice questions assessing food safety knowledge.
- Observations made on 11 parameters covering shop, vendor and environment hygiene.
- Descriptive statistics used to analyse participant characteristics.

- Diluted homogenized vegetable samples used for analysis.
- Total bacterial counts (TBC) identified by inoculation on plate count agar and incubation at 30°C for 72 h.
- EB counts identified by inoculation on Violet Red Bile Glucose (VRBG) agar and incubation at 37°C for 24h.
- Confirmation of EB using biochemical tests (oxidase test & fermentation test)
- Statistical tests performed on microbial data.

Outcomes

- In all, 47.14% (n= 99) of vegetable samples tested positive for Enterobacteriaceae (EB) (Fig. 1).
- In 30.3% of positive samples, bacterial growth was too numerous to count, even when diluted 12-fold; whilst enumerable samples (n= 69) had high mean EB counts at 13.77 ± 6.87 log cfu/g (Fig. 2).



- Vendor hand EB counts revealed a lower mean value of 9.33 ± 4.65 log cfu/g. Vendors with dirty shops were more likely to have EB positive hand swabs (Odds Ratio = 2.06, 95% C.I. = 0.84, 5.07).
- Results of 5 questions on food safety knowledge and attitude revealed poor food safety awareness among vegetable vendors. It also indicated a wide range of perceived difficulty among respondents for the questions (Table 1 ↓).

S. No.	Food Safety Questions (True/False)	Expected answers	Vendors with correct answers
1	Presence of flies on the food is normal wherever food is sold.	False	10%
2	The vegetables I can't sell today or tomorrow, if they look good, I can take them home and consume with my family.	False	7.6%
3	Food that is clean, will be safe.	False	1.9%
4	Cooking food thoroughly does not mean it is safe.	True	83.8%
5	What are you most worried about in your food at home? (Germs/Chemicals)	Germs	68.1%

Conclusion

- ✓ Our findings demonstrate EB contamination of fresh produce and vendor hands far above recommended FAO limits (4 log cfu/g) for ready-to-eat foods.
- ✓ The informal markets lack basic hygiene levels and facilities.
- ✓ Vegetable vendors displayed negligible food safety awareness.
- ✓ There is an urgent need for targeted food safety interventions in the informal sector of low-resource countries such as Nigeria.

Fig. 3. SHOP HYGIENE LEVELS

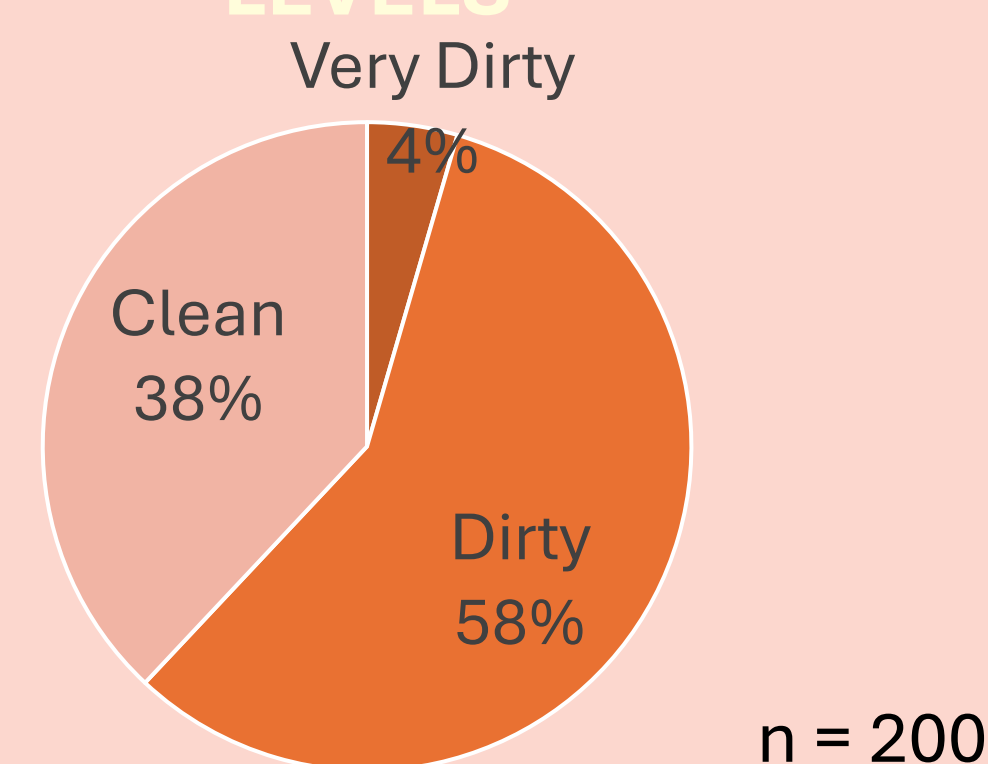
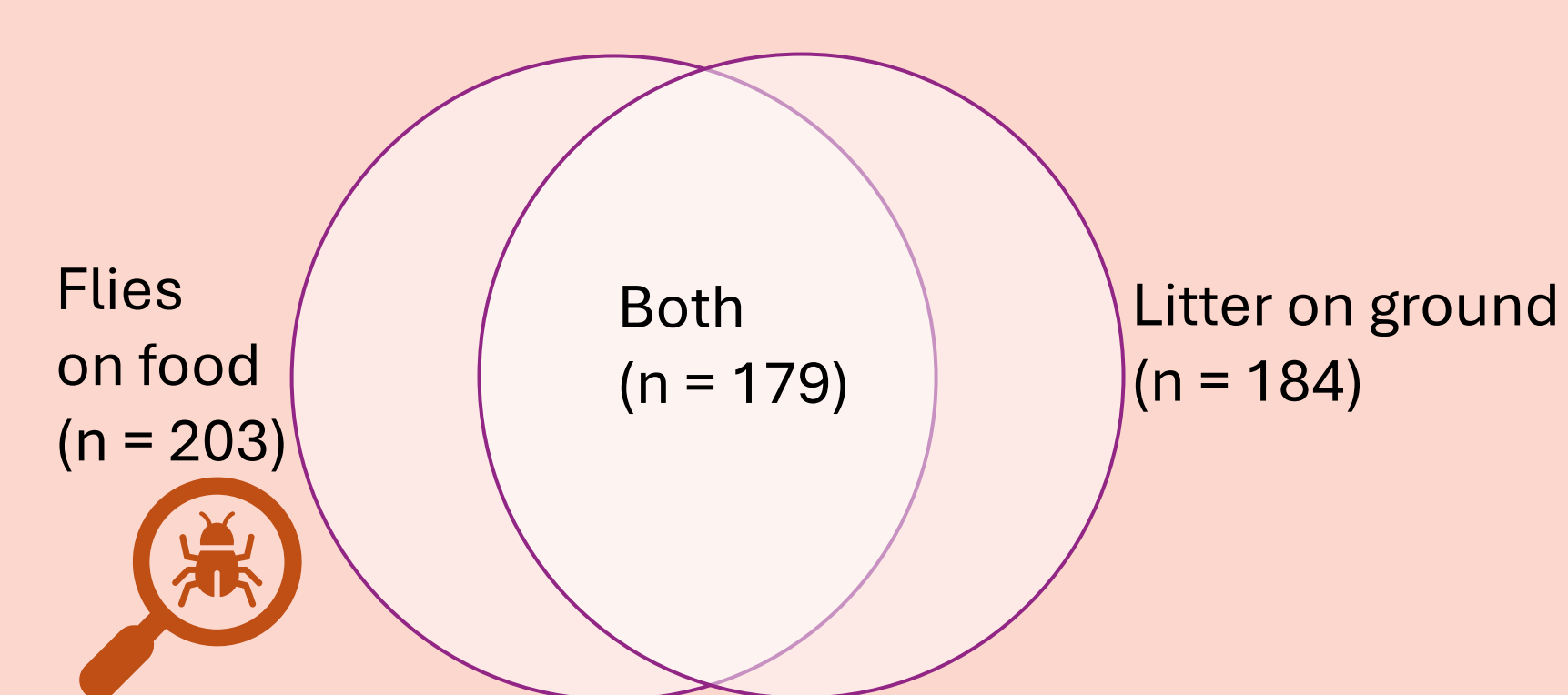
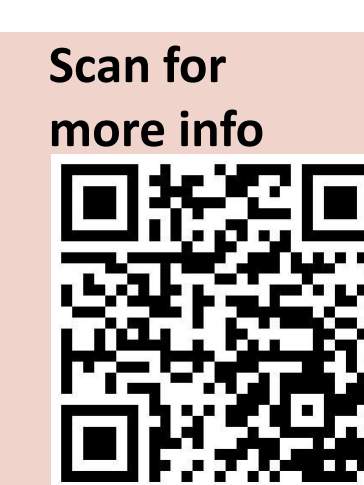


Fig. 4. PRESENCE OF FLIES & LITTER



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ACKNOWLEDGEMENTS



UK Research and Innovation

