

Detection of antimicrobial resistant Enterobacterales in dairy production areas of differing zinc concentration

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INTRODUCTION

Antimicrobial resistance (AMR) is a critical public health concern. However, limited information is available on the dissemination of AMR in the primary food production environment, where the presence of heavy metals may potentially influence AMR gene transmission. In Ireland, where agriculture is of key importance, soils are very well mapped in relation to the levels of heavy metals they contain. This includes zinc, which naturally occurs in low and high concentrations across the country.

The objective of this study was to evaluate the presence of antimicrobial resistant Enterobacterales in dairy pasture soil and bovine milk filters on farms in high and low zinc areas across Ireland.

METHODOLOGY

- A total of 50 soil samples and 12 bovine milk filters were collected from two distinct areas across Ireland, with varying zinc concentrations (Figure 1).
- Enterobacterales were enumerated and the presence of ESBL producing Enterobacterales (ESBL-PE), carbapenem resistant Enterobacterales (CRE), and ciprofloxacin resistant Enterobacterales (FQR-E) were assessed on selective agars.
- Suspect colonies were identified by MALDI-TOF, and antimicrobial susceptibility testing (AST) was performed on confirmed resistant Enterobacterales.
- Chemical analysis via Energy-dispersive X-ray fluorescence spectrometry (EDXRF) was conducted on soil samples to determine the zinc concentration.

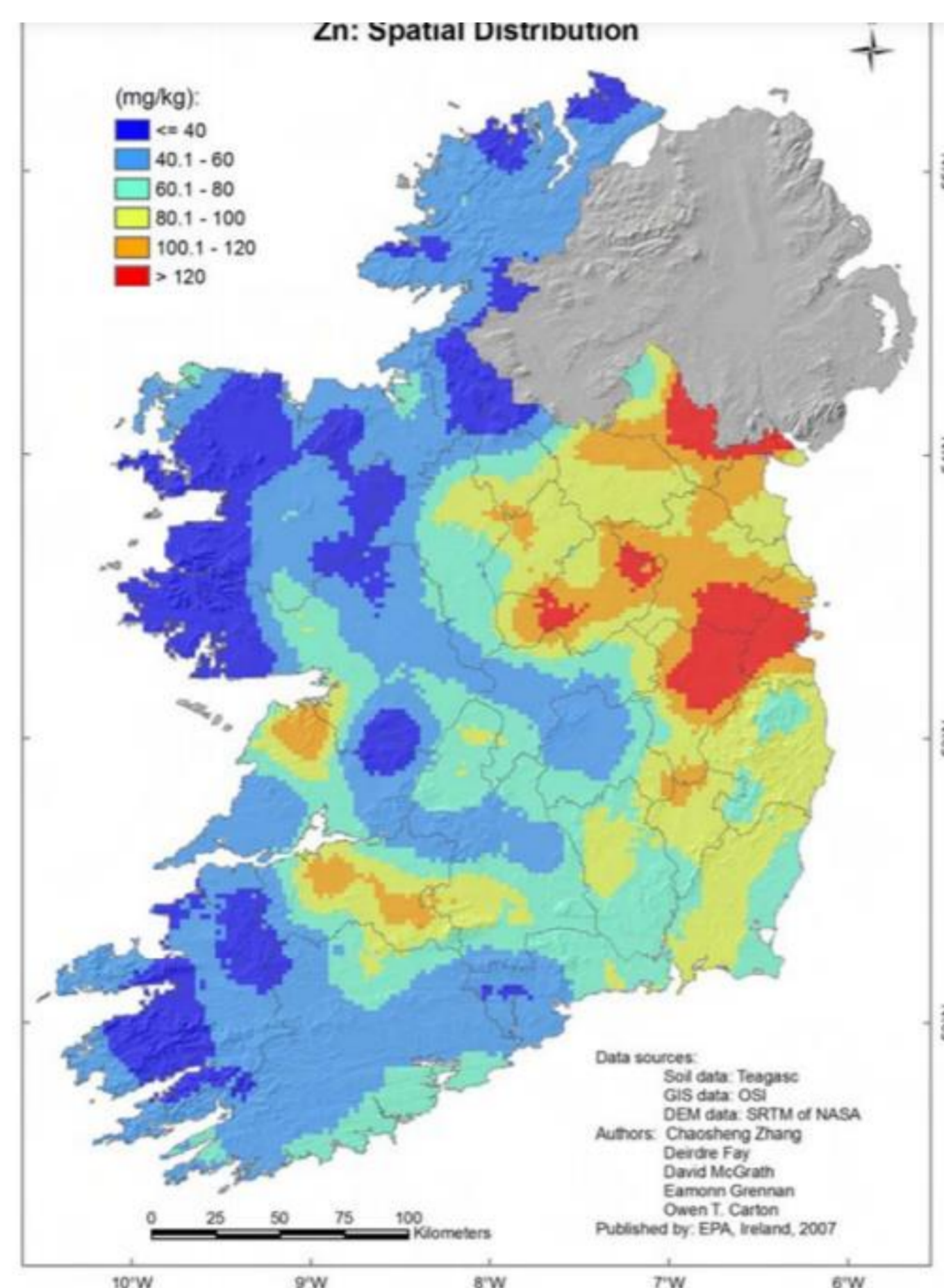


Figure 1. Zinc spatial distribution in the Republic of Ireland from "Soil Geochemical Atlas of Ireland".

RESULTS

- In total 39 antimicrobial resistant Enterobacterales isolates were identified (Figure 2).

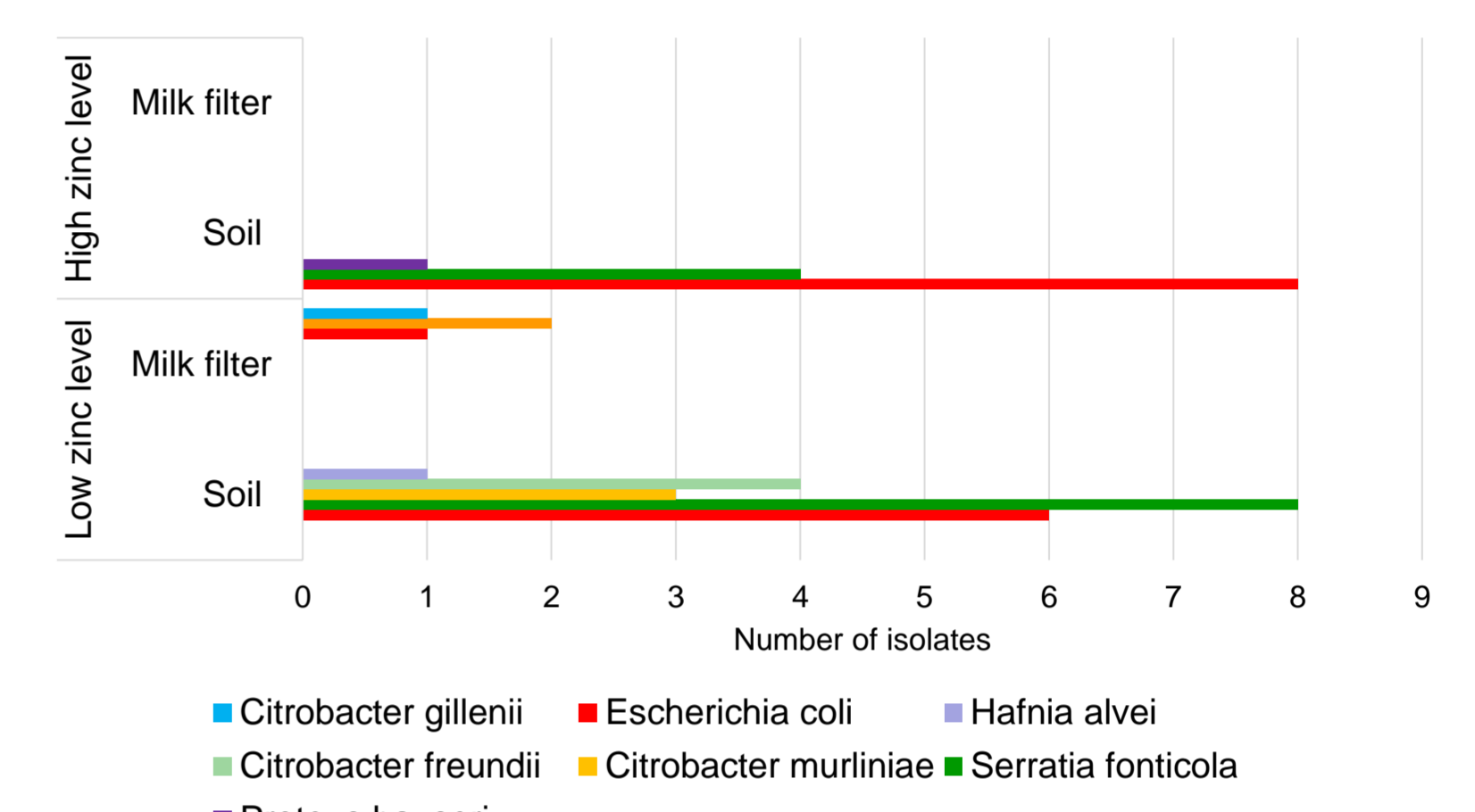


Figure 2. Number of antimicrobial resistant Enterobacterales isolated from soil and milk filters samples, from low and high zinc containing areas.

- Multidrug resistant Enterobacterales were isolated from a number of farms in areas of high zinc concentration (Figure 3).

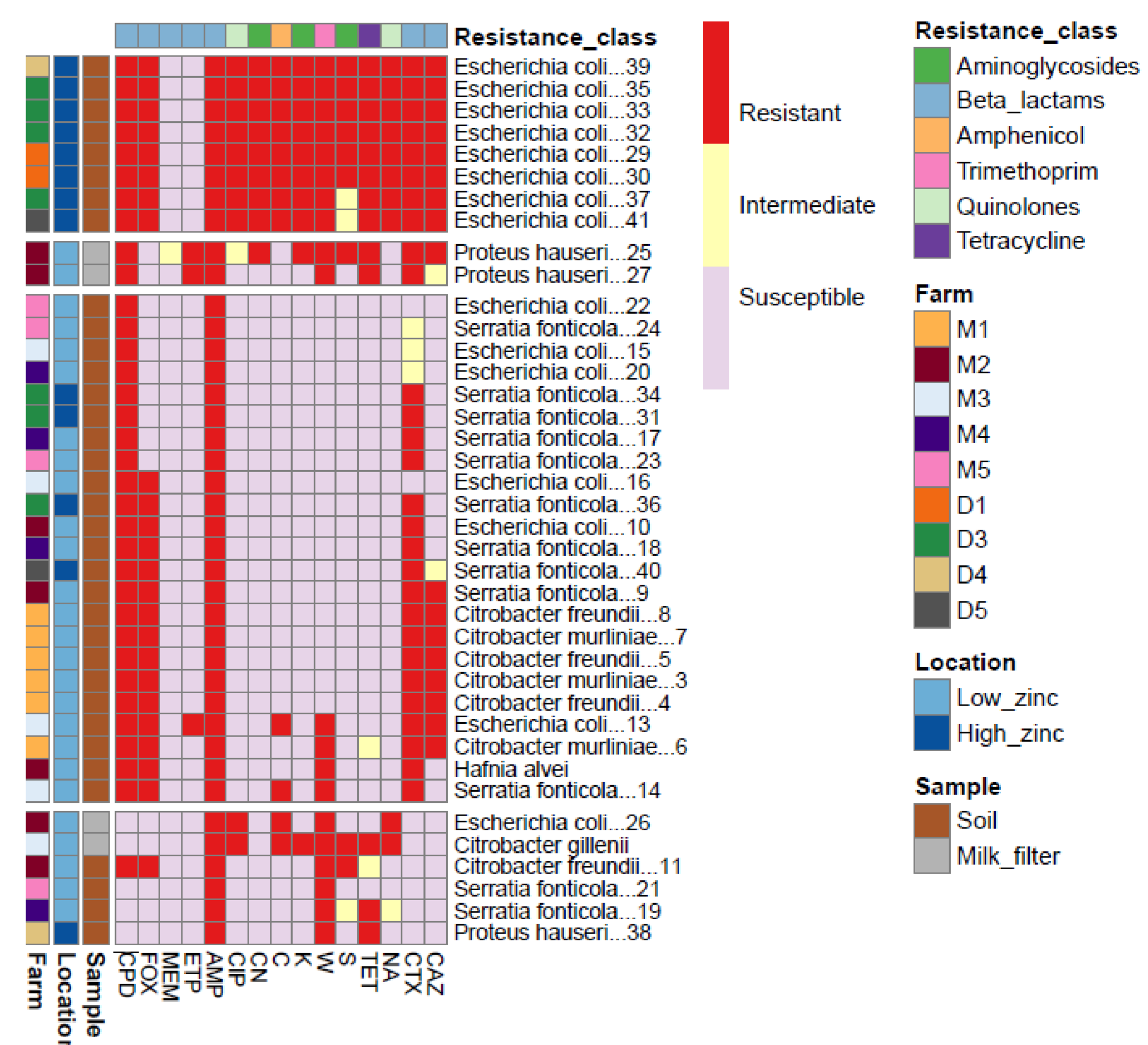


Figure 3. Heatmap showing the phenotypic antimicrobial resistance profiles of Enterobacterales from spinach and milk filters collected from different farms.

CONCLUSIONS

This study demonstrated that the dairy production environment can harbour Enterobacterales with diverse antimicrobial resistant profiles, which can confer resistance to a broad range of antimicrobial classes. However, further analysis are needed to determine the genotypic antimicrobial resistance profiles of these isolates, and to examine the role of zinc influencing the resistome in the dairy production environment.

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