Quantification of extended spectrum beta-lactamases producing *E. coli* in broilers manure

Nunzio Sarnino[1], Subhasish Basak[2], Lucie Collineau[2], Roswitha Merle[1]

Freie Universität Berlin[1]; French Agency for Food, Environmental and Occupational Health & Safety (ANSES)[2]

Introduction

- Chicken manure is commonly utilized as fertilizer in agriculture due to its rich nutrient content, which benefits plant growth.
- If the manure originates from a flock carrying bacteria resistant to antimicrobials, it can contribute to the spread of antimicrobial resistance (AMR) in agricultural produce, potentially affecting human health.
- This model quantifies the amount the extended spectrum beta-lactamases producing *Escherichia coli* (ESBL *E. coli*) in broiler manure and represents the first step of a broader Quantitative Microbial Risk Assessment model (QMRA) with the aim to estimate the human exposure to AMR from broiler production.

Materials and Methods

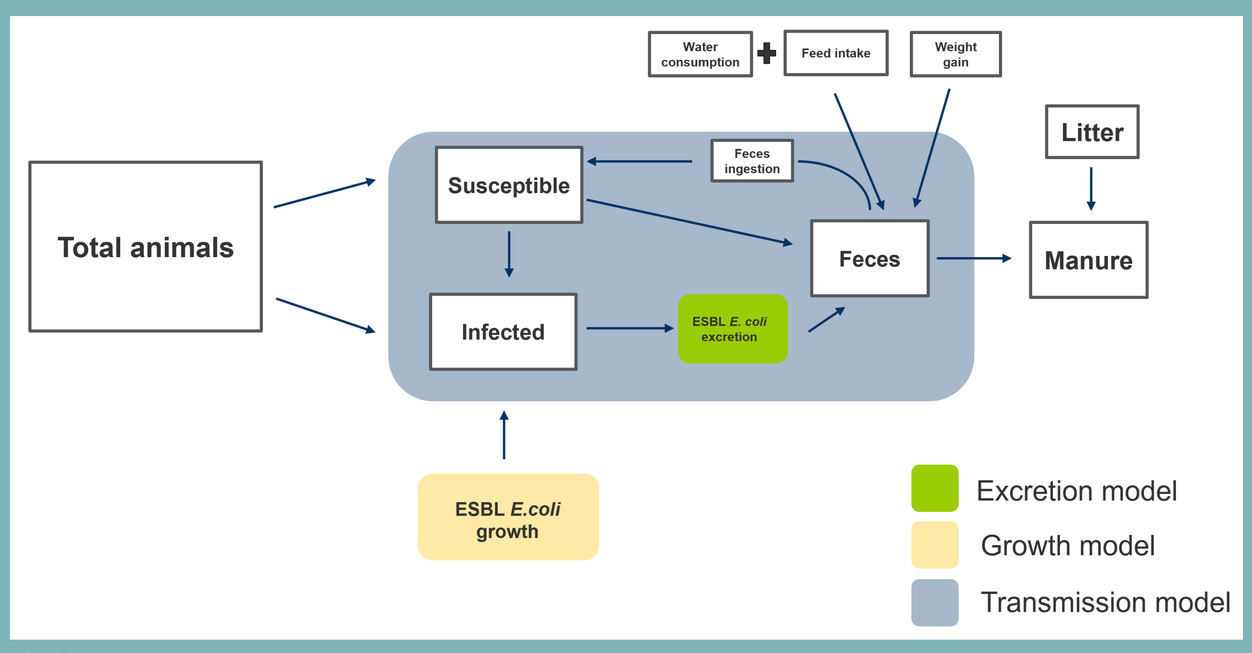

Fig 1. Quantitative model general scheme

Per each day of production, the model determines:

- The **feces** produced, excreted and ingested by a broiler
- The **amount of CFU** of ESBL producing *E. coli* excreted per broiler
- The **bacteria growth** in broilers gut
- The **number of positive animals** (>0 CFU) per each production day (fig 2 and fig 3)
- The **bacteria concentration** in the manure and the environmental decay

The model simulates a broiler flock during 36 days of production, from arrival to the farm to slaughter (fig 1).
In the **standard** baseline scenario, the simulated flock has a starting **prevalence** of **1%**, and an initial intestinal **bacteria concentration** of **100 CFU** per positive broiler.
In the alternative **thinning** scenario, the introduction of ESBL *E. coli* occurs at day 28, during partial depopulation.
The model employs a **stochastic** approach, conducting 1000 parallel iterations.

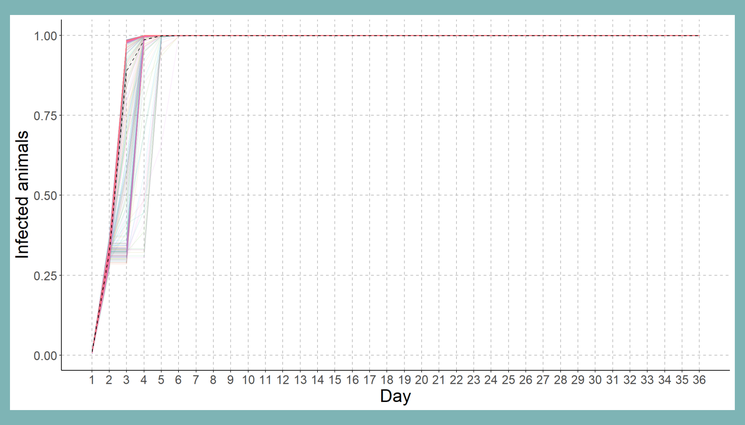

Fig 2. Proportion of positive animals (CFU >0) per day, standard scenario

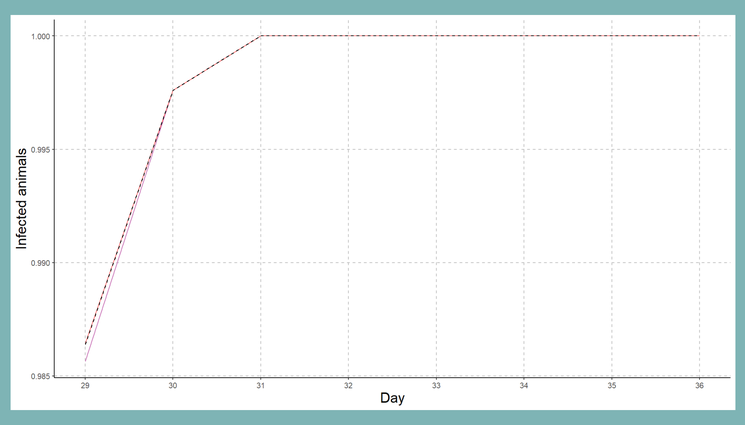

Fig 3. Proportion of positive animals (CFU >0) per day, thinning scenario

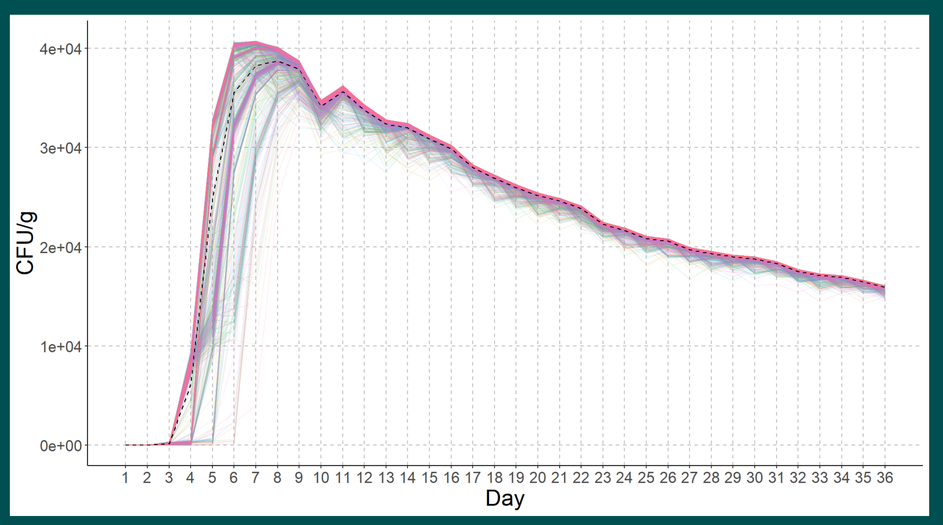

Fig 4. Colony-forming-unit of ESBL *E. coli* per gram of broiler manure, standard scenario

Results and Conclusion

- The model quantified an average ESBL *E. coli* concentration (CFU/g of manure) of **1.6 x 10^4** (sd 0.02 x 10^4) (fig 4) in the **standard** scenario, and **1.5 x 10^4** (sd 0.03 x 10^4) in the **thinning** scenario (fig 5).
- The **100% positivity** of the flock was obtained by day 5 in the standard scenario, and at day 31 in the thinning scenario.
- The model will be further developed, applying the interventional studies from the **ENVIRE project**, such as vaccination, phytotherapy, phage therapy, and manure treatment.

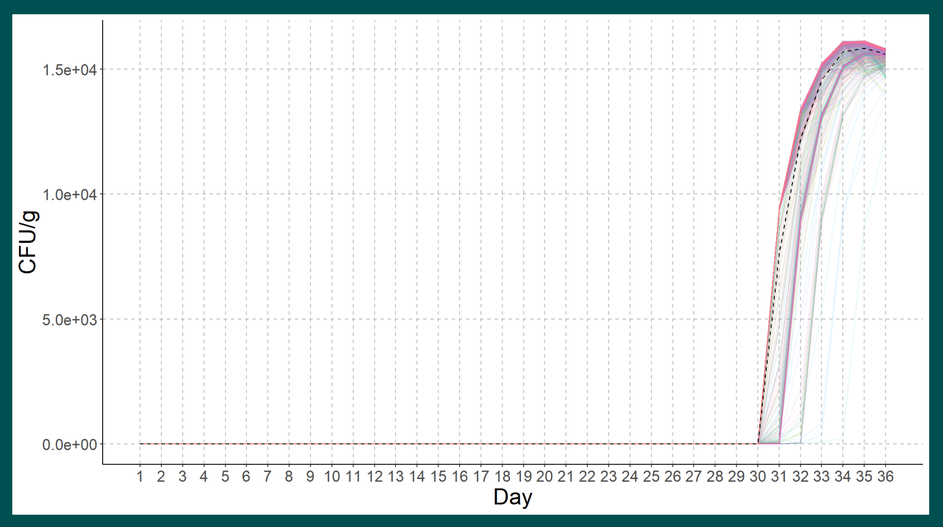

Fig 5. Colony-forming-unit of ESBL *E. coli* per gram of broiler manure, thinning scenario

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