Animal and anthropogenic pressures on agricultural soils from Shiga/Vero-Toxin producing E. coli (STEC/VTEC): impact on food safety and food security

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INTRODUCTION

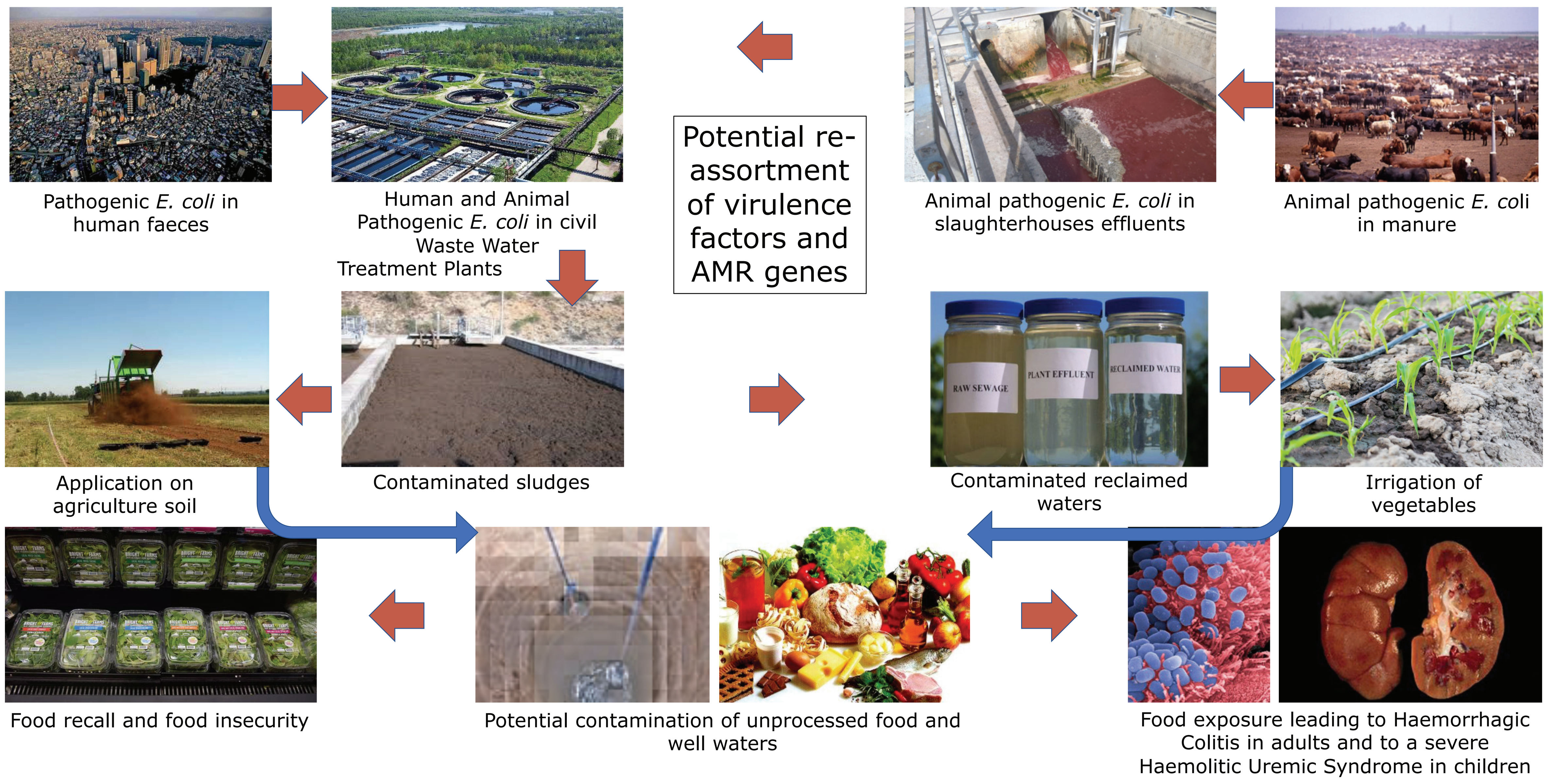
The use of biosolids and remediated water from civil wastewater treatment plants (WWTPs) in agriculture practices can represent a port of entry of pathogenetic E. coli strains including STEC in the food chain. The latter strains have been proven to cause severe Haemolitic Uremic Syndrome (HUS) outbreaks in children, Enterocolitis in adults and provoked food scandals that hampered food security.

Additional to the spreading of pathogens to soil, potential genetic re-assortment between strains of human, animal, and environmental origin, may determine the presence of emerging pathotypes showing different combinations of virulence and resistance factors:

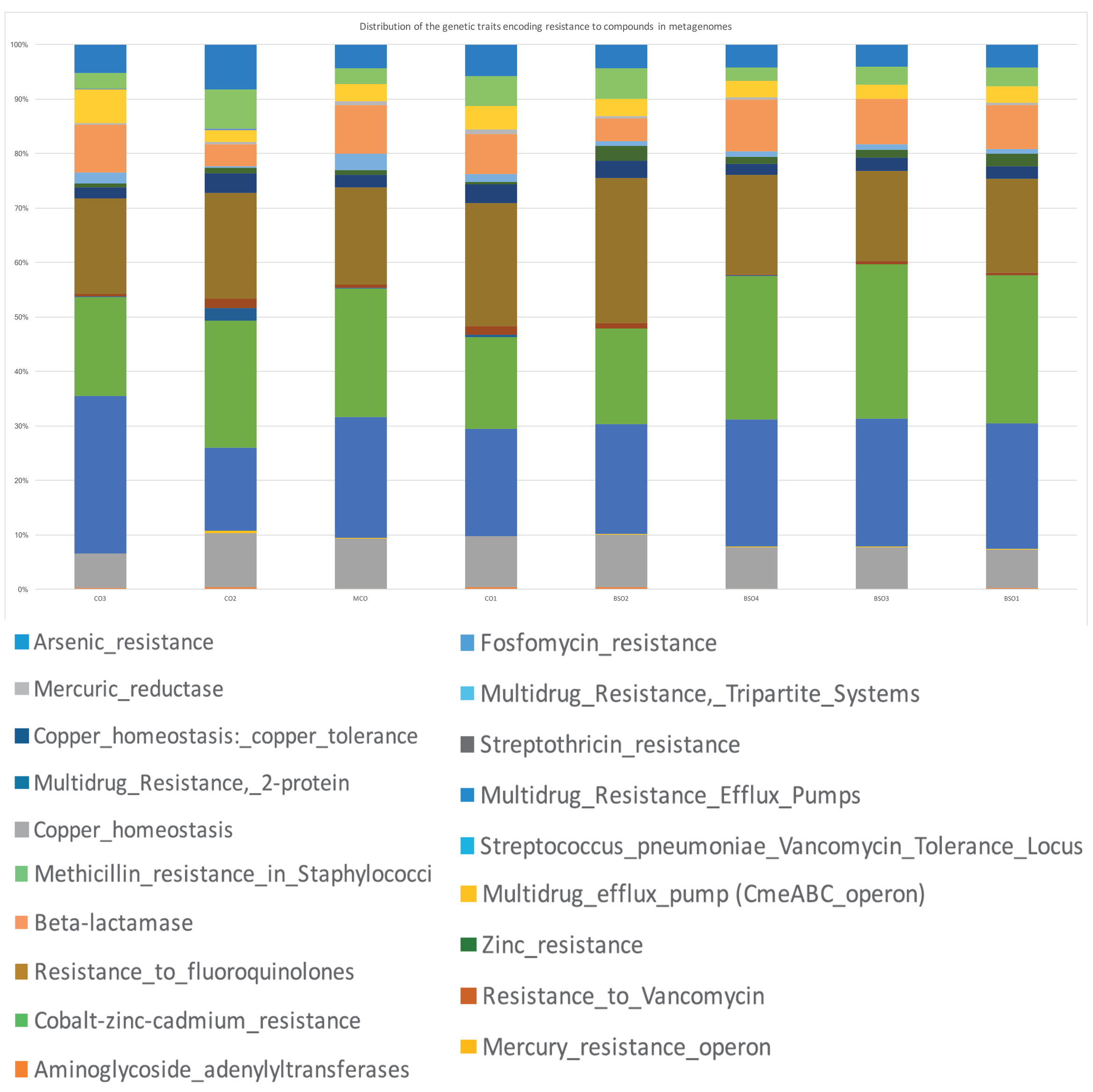
- *vtx1, vtx2, eae, aggR aaiC, lt, sth, stp, and ipaH*
- Antimicrobial Resistance - AMR

METHODOLOGY

Investigation of virulence factors associated with pathogenic *E. coli* strains and Antimicrobial resistance (AMR) genes in a set of different Biosolid samples originating from WWTPs in Italy, using a Real Time Polymerase Chain Reaction (RT-PCR) and Whole Metagenomic Sequencing approaches.

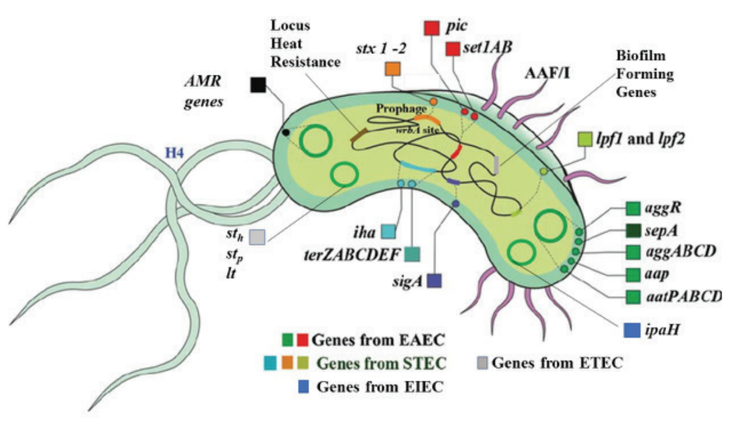


Genomic traits related to resistance to compounds, including resistance to heavy metals and antimicrobials



Genetic pool of virulence genes associated with all the pathotypes of Diarrheagenic *E. coli*.
Positive signals for some virulence genes in some cases appeared only after the enrichment of the samples, suggesting the presence of viable bacterial cells

	Nucleic acid extracted from enriched cultures								
Sample	***vtx1***	***vtx2***	***eae***	***aggR***	***aaiC***	***lt***	***sth***	***stp***	***ipaH***
MSS 13-0474	-	-	-	-	-	-	-	-	-
MSS 13-0475	-	-	-	-	-	-	-	-	-
MSS 13-0476	-	+	-	+	-	-	-	-	-
DIG 13-0477	-	-	-	-	-	-	-	-	-
MSS 13-0478	-	+	-	-	-	-	-	-	-
MSS 13-0479	-	-	-	-	-	-	-	-	-
MCO 13-0482	+	+	+	-	-	-	-	-	-
MCO 13-0483	-	-	+	-	-	-	-	-	-
MCO 13-0484	-	+	+	-	-	-	-	-	-
GCO 13-0485	-	-	-	-	-	-	-	-	-
MCO 13-0486	-	-	-	-	-	-	-	-	-
GCO 13-0487	-	+	-	-	-	-	-	-	-
MSS 13-0488	-	-	+	-	-	-	-	-	-
MSS 13-0489	-	+	+	-	-	-	-	-	-
MSS 13-0490	-	-	+	-	-	-	-	-	-
MSS 13-0492	-	+	+	-	-	-	-	-	-
MSS 13-0496b	-	+	-	-	-	-	-	-	-
MAN 13-0497	-	+	-	-	-	-	-	-	-
MSS 13-0480	-	-	-	-	-	-	-	-	+
MCO 13-0481	-	-	-	-	-	-	-	-	-
MSS 13-0493	-	-	-	-	-	-	-	-	-
MSS 13-0494	-	-	-	-	-	-	-	-	-
MSS 13-0495	-	-	-	-	-	-	-	-	+
MSS 13-0496	-	-	+	-	-	-	-	-	+



Representation of a potential super-pathogen *E. coli* due to the acquisition of virulence and resistance genes from different pathotypes. From Navarro-Garcia F. (2014), modified.

CONCLUSIONS

The sustainability policies for food production may impact on food safety/food security due to the recycle of former wastes of anthropogenic origin as soil improvers.

Pathogenic *E. coli* should be considered as priority emerging hazards, as far current aerobic/anaerobic fermentation to stabilize biosolids can be considered not effective in their abatement.

The set up of diagnostic tools based on genomic and metagenomic approaches would be able to identify emerging pathotypes, to design the end-of-waste criteria for the agriculture use of biosolids as well to evaluate the efficacy of the risk management .

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