ECCMID 2017-Vienna
25.04.2017 - Hall H 9:00-11:00
OS0870 - Session: OS175
Origin, dissemination and impact of *mcr* genes

Heterogeneous location of the *mcr-1* gene in Colistin-Resistant *Escherichia coli* strains of Human and Chicken Meat Origin

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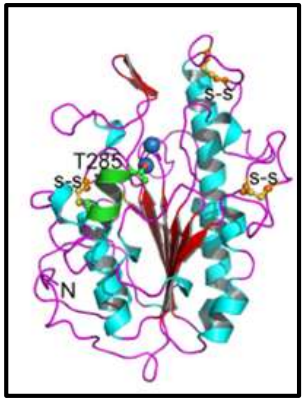
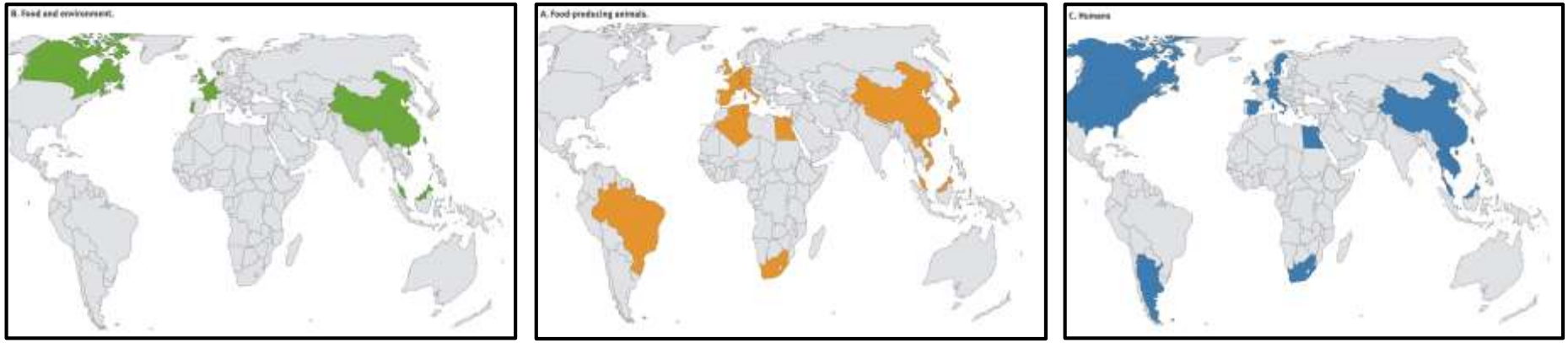
Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

Lancet, 2015

Yi-Yun Liu, Yang Wang*, Timothy R Walsh, Ling-Xian Yi, Rong Zhang, James Spencer, Yohei Doi, Guobao Tian, Baolei Dong, Xianhui Huang, Lin-Feng Yu, Danxia Gu, Hongwei Ren, Xiaojie Chen, Luchao Lv, Dandan He, Hongwei Zhou, Zisen Liang, Jian-Hua Liu, Jianzhong Shen*





Skov RL et al. Euro Surveill., March 2016

- *mcr-1* has been found in several different genetic backgrounds and in strains isolated from several reservoirs

- **Aim of the study**: characterization of the genetic environment of *mcr-1* in colistin-resistant *E. coli* strains of human, food and (food-producing) animal origin isolated in Switzerland

Methods

- ***mcr-1* carrying *E. coli*** isolated from: -**Swiss human faeces** (n=3) (Pires J et al. IJAA, April 2017) (Bernasconi OJ et al. AAC, July 2016)

  monitoring at ZOBA, Bern, Switzerland:
  - -**Swiss chicken caecum** (n=2)
  - -**Swiss calf caecum** (n=1)
  - -**Swiss chicken retail meat** (n=1)
  - -**Imported (GER) retail chicken meat** (n=2)

- **Whole-genome (WGS) and whole-plasmid sequencing (WPS)** with **MinION** (Oxford Nanopore); assembly with Canu followed by correction with mapped **Illumina** reads

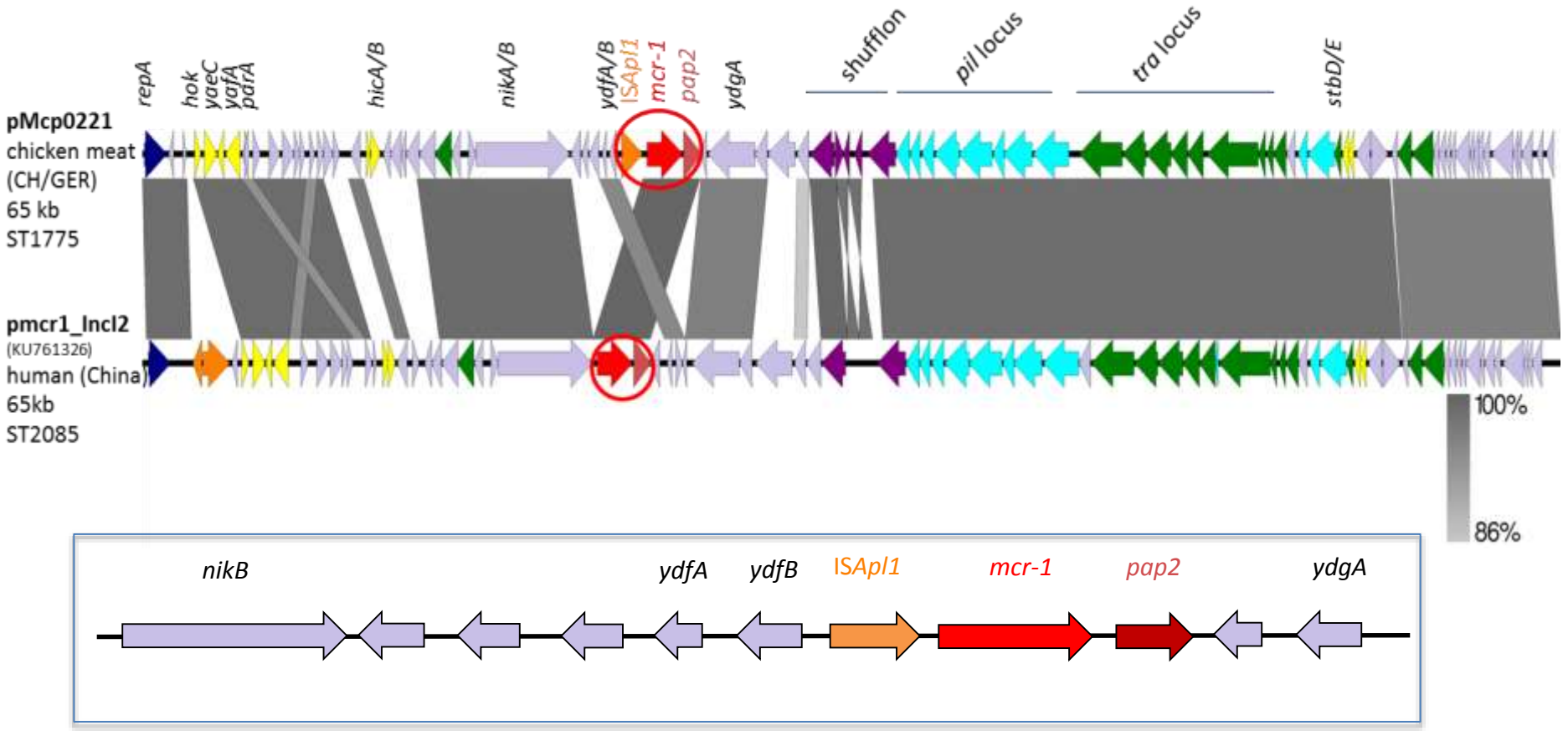
- **Plasmid-, resistance-, virulence gene-, and multilocus sequence-typing** with the online PlasmidFinder, ResFinder, VirulenceFinder, and MLST Tool platforms, respectively (http://www.genomicepidemiology.org/)

IncI2 plasmid

Colistin-resistant *mcr-1* positive *E. coli* isolate

ID	**Mcp0221**
Isolation source	**imported retail chicken meat (GER)**
MLST	**ST1175**
Colistin MIC (Etest)	4 mg/L
Plasmids (PlasmidFinder)	IncI2
***mcr-1* location**	**IncI2 plasmid (64 kb)**
Resistance genes (ResFinder)	colistin

IncI2 plasmid

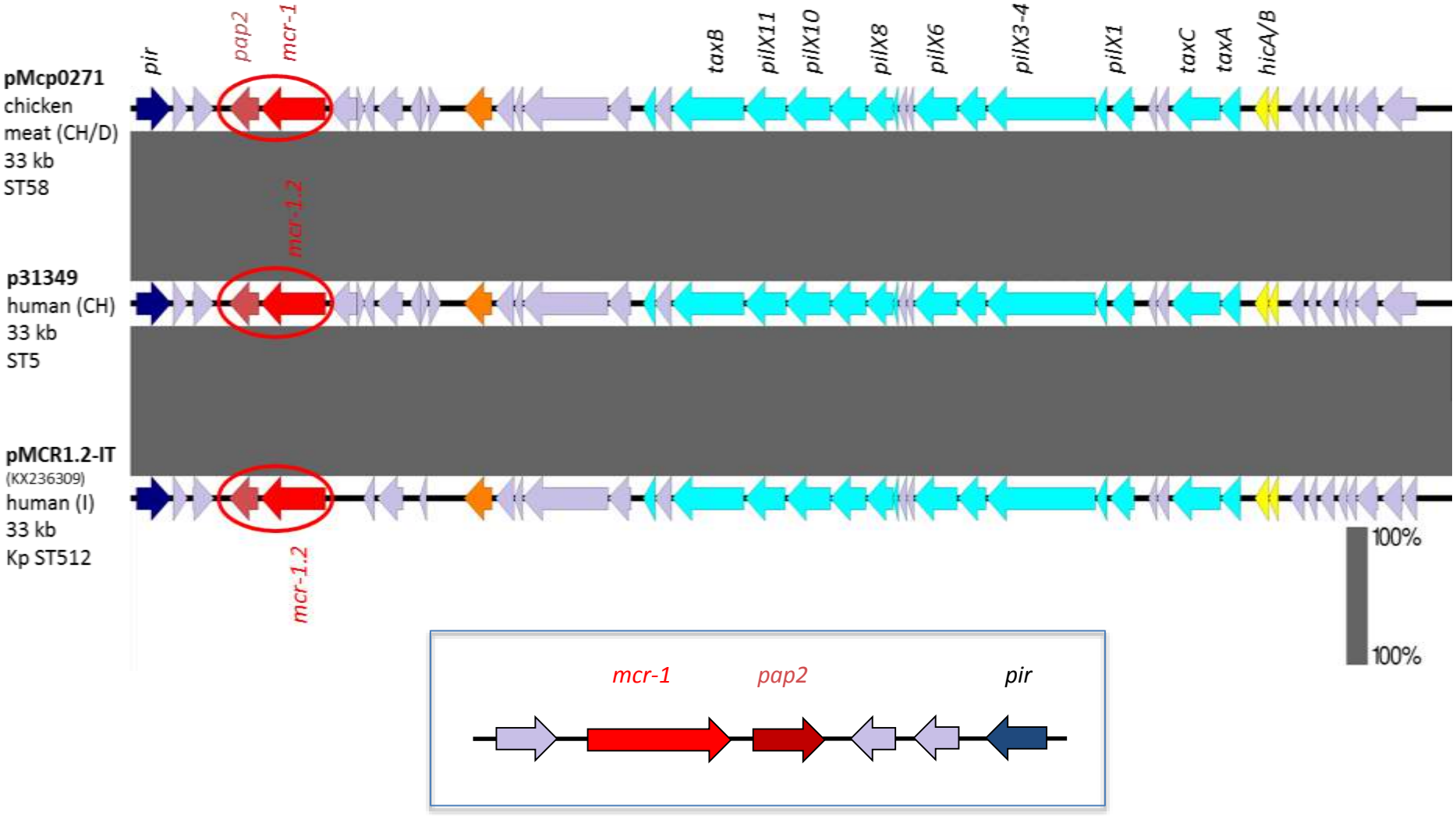


IncX4 plasmids

Colistin-resistant *mcr-1* positive *E. coli* isolates

ID	**31349**	**Mcp0271**
Isolation source	**human faeces, HIV+ (CH)**	**imported retail chicken meat (GER)**
MLST	**ST5**	**ST58**
Colistin MIC (Etest)	3 mg/L	4 mg/L
Plasmids (PlasmidFinder)	IncX4, IncL/M, IncFII and FIB	IncX4, IncFII/FIB/FIA,
***mcr-1* location**	**IncX4 plasmid (33 kb)**	**IncX4 plasmid (33 kb)**
Resistance genes (ResFinder)	colistin (*mcr-1.2*)	colistin (*β-lactams*)
Virulence genes (VirulenceFinder)	*espA, espJ, eae, tir, cif, sepA, nleB* (=indicative for EPEC)	

IncX4 plasmids

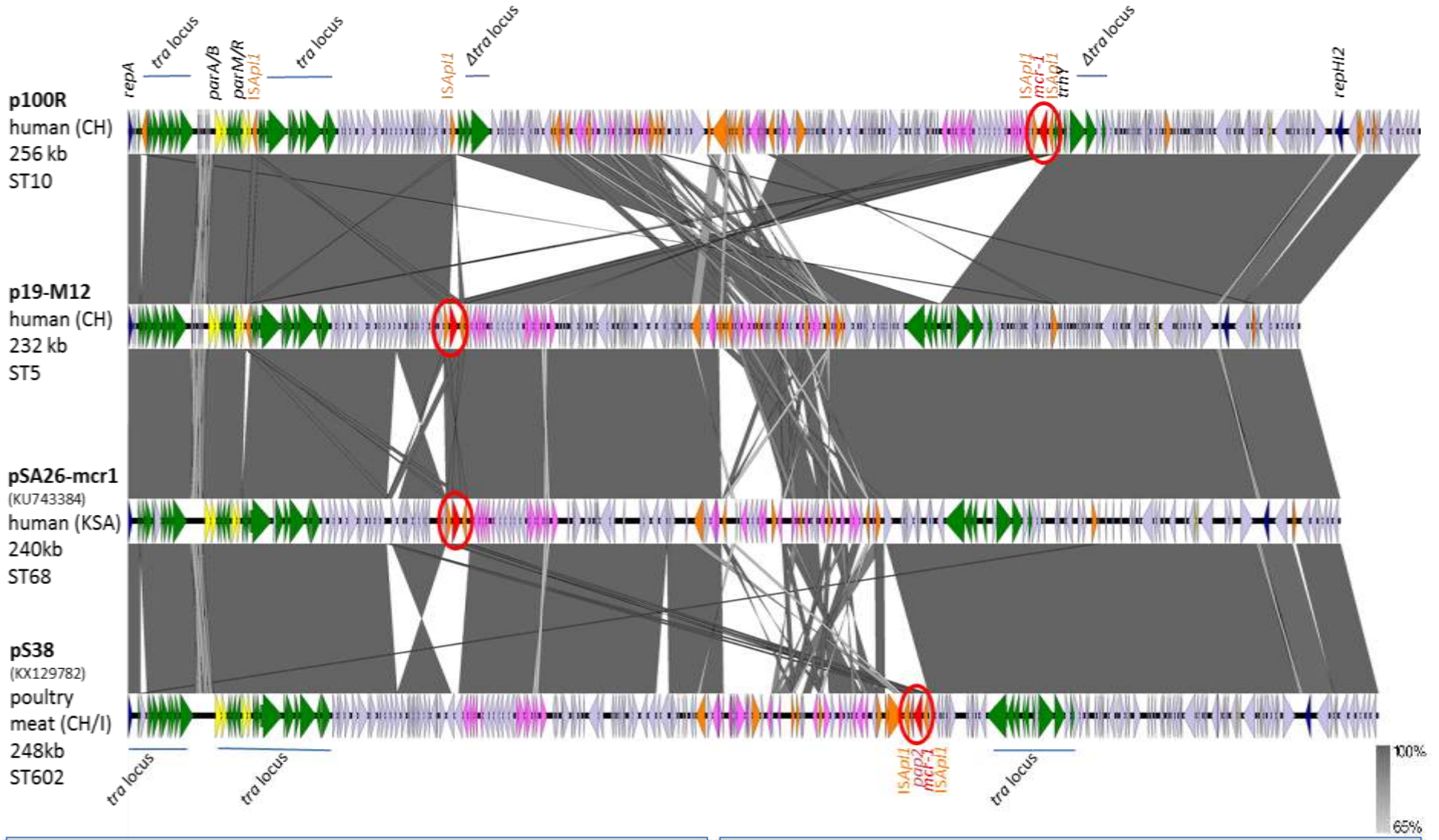


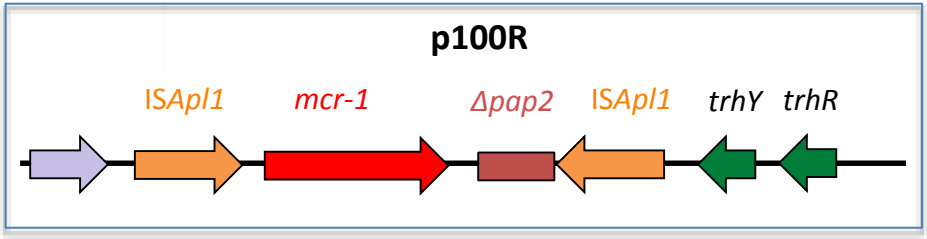
IncHI2 plasmids

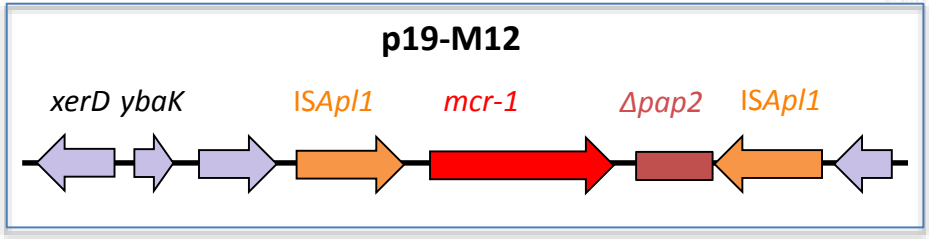
Colistin-resistant *mcr-1* positive *E. coli* isolates

ID	**19-M12**	**100-R**
Isolation source	**human faeces, traveler to India (CH)**	**human faeces, traveler to India (CH)**
MLST	**ST5**	**ST10**
Colistin MIC (Etest)	6 mg/L	12 mg/L
Plasmids (PlasmidFinder)	IncHI2, IncFII/FIB	IncHI2, IncFII, IncFIB, IncX1
***mcr-1* location**	**IncHI2 plasmid (230 kb)**	**IncHI2 plasmid (250 kb)**
Resistance genes (ResFinder)	colistin, trimethoprim-sulfamethoxazole, tetracycline, β-lactams, aminoglycosides, sulfonamides, macrolides (*chloramphenicol*, *quinolones*)	colistin, trimethoprim-sulfamethoxazole, tetracycline, β-lactams, aminoglycosides, sulphonamides, macrolides, chloramphenicol (*quinolones*)

IncHI2 plasmids





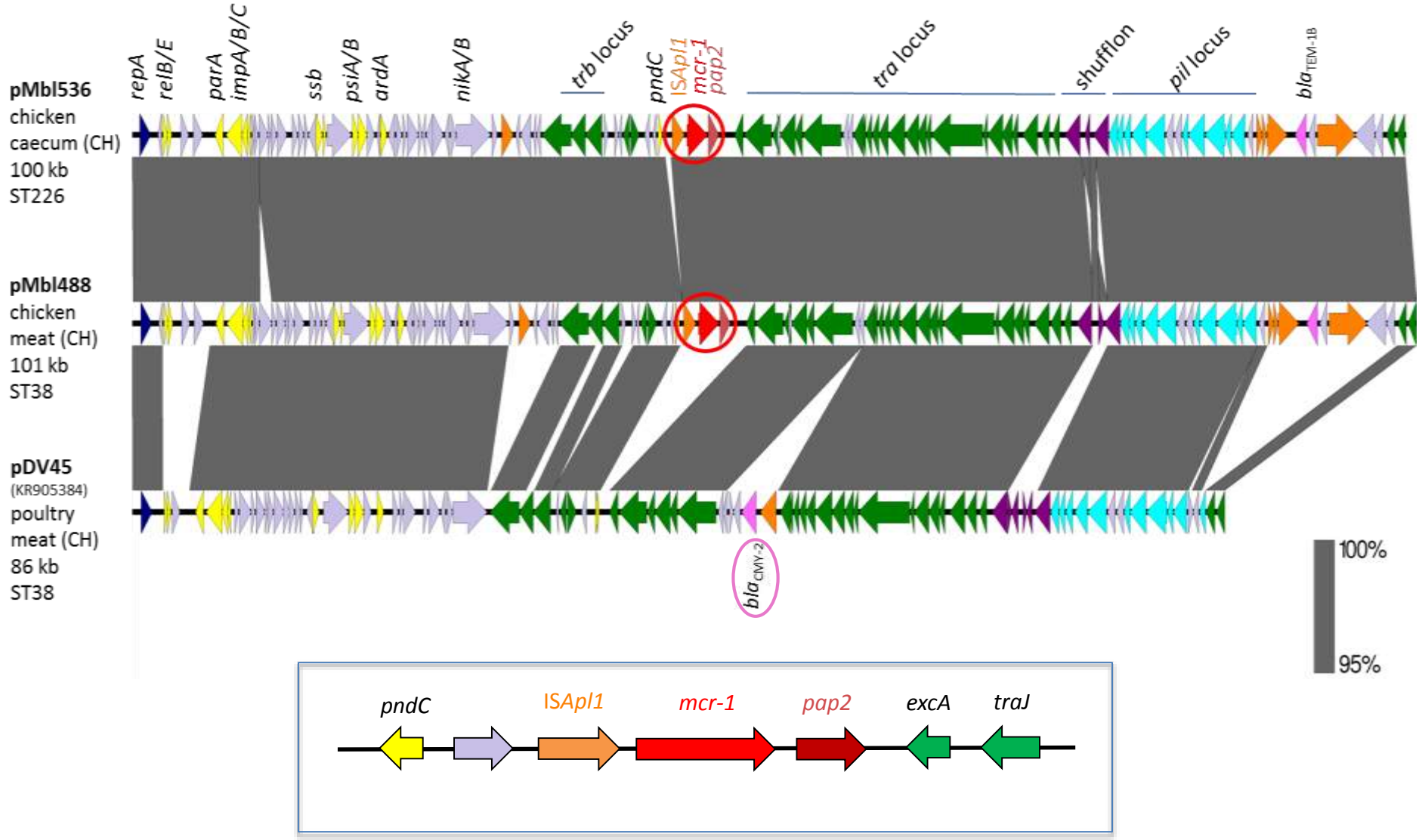


IncK2 plasmids

Colistin-resistant *mcr-1* positive *E. coli* isolates

ID	**Mbl488**	**Mbl536**
Isolation source	**retail chicken meat (CH)**	**chicken caecum (CH)**
MLST	**ST38**	**ST226**
Colistin MIC (Etest)	8 mg/L	4 mg/L
Plasmids (PlasmidFinder)	IncK2, IncFII/FIB, IncI2	IncK2, IncI1, IncX1
***mcr-1* location**	**IncK2 plasmid (100 kb)**	**IncK2 plasmid (100 kb)**
Resistance genes (ResFinder)	colistin, β-lactams (***bla*$_{\text{CTX-M-1}}$**), sulfonamides (*aminoglycosides, tetracycline, trimethoprim-sulfamethoxazole*)	colistin, β-lactams, sulfonamides (*tetracycline, trimethoprim-sulfamethoxazole*)

IncK2 plasmids

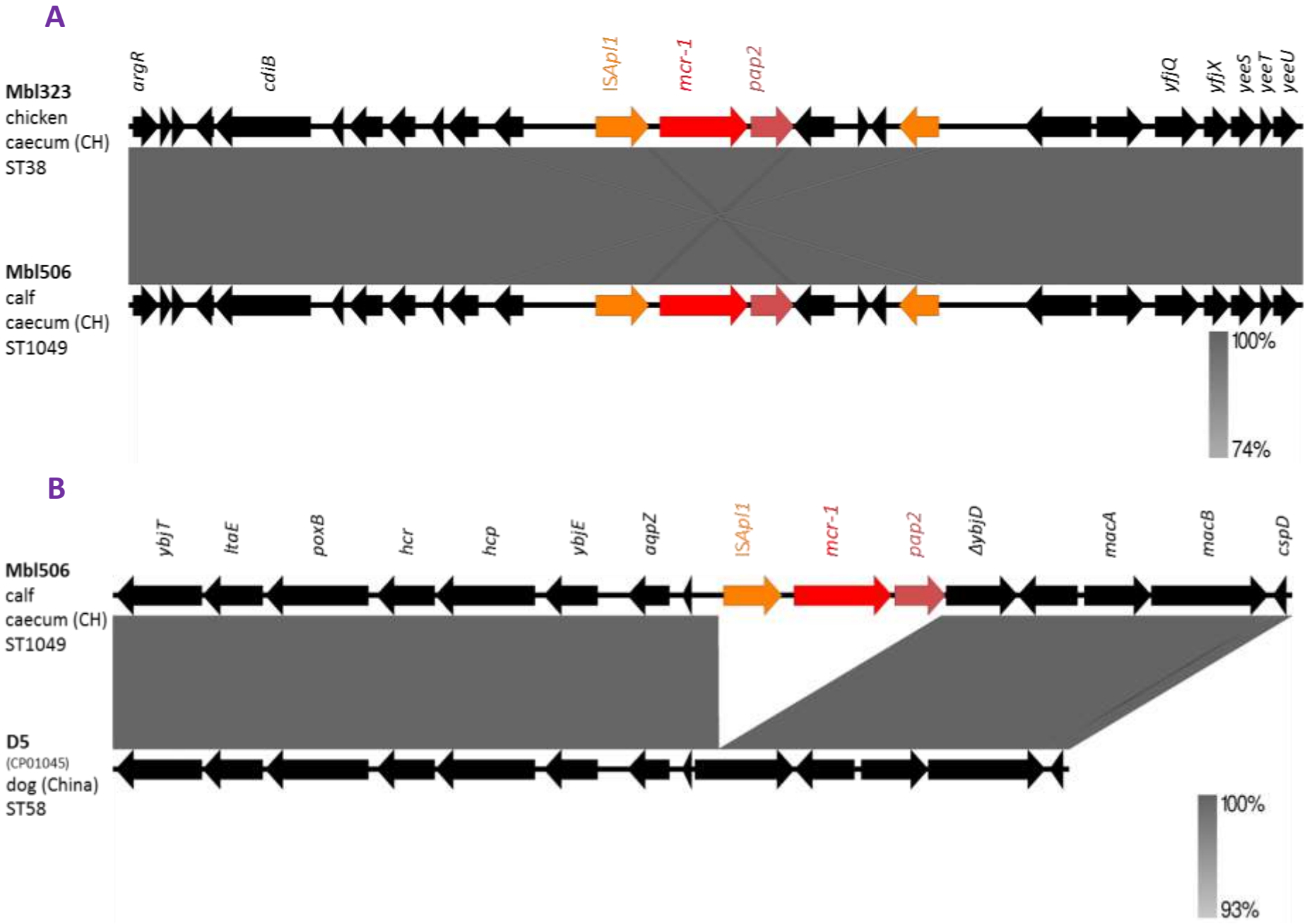


Chromosomal location

Colistin-resistant *mcr-1* positive *E. coli* isolates

ID	**Mbl323**	**Mbl506**
Isolation source	**chicken caecum (CH)**	**calf caecum (CH)**
MLST	**ST38**	**ST1049**
Colistin MIC (Etest)	8 mg/L	8 mg/L
Plasmids (Plasmidfinder)	**IncK2 (*bla*$_{CMY-2}$)**, IncFII/FIB, IncN and ColRNAI	IncFII/FIB, IncI1, IncI2, IncQ1
***mcr-1* location**	**chromosomal (1 copy)**	**chromosomal (2 copies, in different loci)**
Resistance genes (Resfinder)	colistin (*β-lactams, aminoglycosides, lincosamides*)	colistin (*β-lactams, tetracycline, aminoglycosides, macrolides, sulfonamides, trimethoprim-sulfamethoxazole*)

Chromosomal location



Conclusions

- ***mcr-1* location highly heterogeneous**
  - various plasmid types or integrated in different chromosomal loci

- **IncI2, IncX4 and IncHI2 plasmids were highly similar to others previously described**
  - common ecological niches worldwide

- **Novel IncK2 plasmids found in both Swiss chicken caecum and retail meat**
  - local spread of such *mcr-1*-carrying elements

- ***mcr-1* found in MDR plasmids**
  - even if colistin use in food-producing animals is restricted, other drugs (e.g., sulfonamides) may still select for colistin resistance

THANK YOU!

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