High Prevalence of Extended-Spectrum-Cephalosporin-Resistant Enterobacteriaceae in Poultry Meat in Switzerland: Emergence of CMY-2- and VEB-6-Possessing Proteus mirabilis

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The spread of extended-spectrum-cephalosporin-resistant (ESC-R) *Escherichia coli* in poultry meat is a serious concern (1–3). However, data regarding this problem in Switzerland are lacking. Moreover, the role played in this matter by other *Enterobacteriaceae* remains undetermined.

We explored the prevalence of extended-spectrum-β-lactamase (ESBL) - and plasmid-mediated-AmpC (pAmpC)-possessing *Enterobacteriaceae* as contaminants of raw poultry meat re-tailed in Bern, Switzerland. Twenty samples were purchased on various days during November and December 2012 in three grocery stores (Table 1). Ten grams of meat was incubated over-night in LB broth, and then 50 μl was plated on plates containing selective chromID ESBL agar, MacConkey agar plus cefazidime (2 μg/ml), and Drigalski agar plus cefotaxime (1.5 μg/ml) (bio-Mérieux). Colonies were identified by MALDI-TOF MS (matrix-assisted laser desorption ionization–time of flight mass spectrometry; Bruker). ESC-R *Enterobacteriaceae* were characterized using phenotypic and molecular methods as previously done (4–7) (see Table S1 in the supplemental material).

Fourteen samples (70%) contained ESC-R *E. coli* (n = 11), ESC-R *P. mirabilis* (n = 2), or both resistant species (n = 1) (Table 1). ESC-R *E. coli* strains found in meat originating from Switzerland possessed *blaCTX-M-1* and *blaCMY-2*, whereas those detected in meat imported from other countries harbored *blaSHV-12*, *blaTEM-52*, or *blaCMY-2*. Several ESC-R *E. coli* isolates belonged to the same sequence type (ST), but pandemic clones (e.g., ST131) often responsible for human infections were not found (8, 9). The recorded high prevalence of ESC-R *E. coli* (60%) was consistent with prevalences reported in other countries (1–3). However, we note that in Switzerland, CTX-M-1- and CMY-2-producing *E. coli* strains are common colonizers of food animals and may also cause human infections (4, 6, 10).

More intriguing was the detection of ESC-R *P. mirabilis* that grew in MacConkey-ćefazidime and Drigalski-ćefotaxime plates. In particular, one meat sample imported from Austria harbored *blaCMY-2*, whereas two from an unspecified European country carried *blaVEB-6*. These samples came from the same store and same packing plant but were wrapped on different dates. CMY-2-positive *P. mirabilis* isolates are commonly found in humans (11), but only unique VEB-6-possessing *P. mirabilis* isolates had been previously reported as responsible for infection in France, Oman, and Australia (7, 12, 13). In our isolates, *blaVEB-6* was situated in an ~17-kb class I integron which also carried *aacA4*, *aadB*, *dfra1*, *sul1*, *tet(A)*, and *qprA1* resistance genes and had a nucleotide sequence identical to that found in the human VEB-6-positive *P. mirabilis* isolate (VB1248) reported in France (12). Both VEB-6-positive *P. mirabilis* isolates also possessed a previously reported class II integron of ~4.6 kb containing *dfra1*, *sat2*, and *aadA1* resistance genes (GenBank no. DQ268533) and a single ~50-kb IncP plasmid. Electroporation experiments failed to transfer *blaVEB-6*, suggesting the chromosomal location of the integron. By repetitive extragenic palindromic PCR (rep-PCR), the two VEB-6-positive *P. mirabilis* isolates were identical to each other and showed 94% genomic identity with VB1248. Based on these results, we investigated the possible presence of VEB-6-positive *P. mirabilis* among 484 human isolates identified in Bern during 2011-2012, and we identified only four CMY-2-positive *P. mirabilis* isolates which were not clonally related to those found in poultry meat (see Fig. S1 in the supplemental material).

This is the first report of *blaVEB-6*-possessing *P. mirabilis* in a non-human clinical setting and the first description of ESBL- and pAmpC-positive *P. mirabilis* strains in the food chain. Our findings emphasize that not only ESC-R *E. coli* but also other species are responsible for the spread of multidrug-resistant mobile genetic elements in the raw meat. CMY-2- and VEB-6-positive *P. mirabilis* strains might represent an additional group of life-threatening pathogens that can be transmitted through the food chain to humans (8).
VEB was carried by the isolate. The isolate was found to carrybla, sul, andaadB genes. 

Antimicrobial agents tested include CRO, ceftriaxone (S, 0.125 g/ml); AMK, amikacin (S, 0.5 g/ml); ERT, ertapenem (S, 0.125 g/ml); FEP, cefepime (S, 1 g/ml); PNA, piperacillin (0.5 g/ml); GEN, gentamicin (0.5 g/ml); SXT, trimethoprim-sulfamethoxazole (8 g/ml); COL, colistin (0.125 g/ml); ATM, aztreonam (4 g/ml); TZP, piperacillin-tazobactam (0.5 g/ml); CAZ, ceftazidime (4 g/ml); P. mirabilis and E. coli isolates exhibited resistance to multiple antibiotics, including CRO, AMK, and SXT. 

Letter to the Editor

Phenotypic and molecular characteristics of the blaTEM-52/FI1304 CTX (16) gene were determined in poultry meat collected from different geographical areas in Turkey.

Table I: Phenotypic and molecular characteristics ofblaTEM-52/FI1304 CTX (16) gene in poultry meat collected from different geographical areas in Turkey.
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