Antibiotic resistance of bacteria along the food chain: A global challenge for food safety

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26 samples of which 61% contain resistant bacteria
- Conventional+, organic and « Red Label» products
- Resistance to critical antibiotics
Antibiotics hazards

- Antibiotics are the most therapeutic agents used in animal food producing

- Bacterial resistance: Spread along the food chain and the environment

- Pathogens (*Salmonella*, *Campylobacter*, *E.coli*, *Staphylococcus aureus*)

- Commensal bacteria (reservoir)
Routes of transmission of genes conferring antibiotic resistance.

Witte, IJAA 2000
Antibiotic resistance

- Microbiological resistance
- Epidemiological Cut-off (ECOFF) value
- MIC separating the wild-type population/resistant isolates (mutations, HGT)
Antibiotic resistance

- Health risks along the food chain
  - Zoonoses diseases

- Spread of resistance genes to other pathogens of diverse origins (mobile elements...)

Implications on animal and human health; and on the microbial ecology of the environment.
Growth

Sub-MIC Selective window

Selective window

Antibiotic concentration

Susceptible

Resistant

MSC

MICs

MICr

Andersson and Hugues, FEMS 2011.
Antibiotic resistance

- Mutants of *E. coli* and *Salmonella enterica* with resistance to AB (TET, FQ, AG)
  - Selection of R bacteria can occur at AB concentrations up to several hundred-fold below the MIC of the S strains

- Ultralow antibiotic concentrations found in many natural environments are sufficiently high to confer the selection and persistence of antibiotic resistance.
Food production systems

- Ab are used as growth promoters
- Ab could be bought w/o prescription
- Residus of forbidden Ab (Chl, NF)
  - Persistence of Ab in environment
  - Persistence and dissemination of resistant genes even if no use corresponding Ab
  - Lack of monitoring programmes
Food safety

**Salmonella spp.**

- Raw meat sold in market: Porc 39-64%; Chicken 42-53%; Beef 62%
- Resistance in meat: Porc 50-73% ; Chicken 45%
  - Tetracycline, sulphonamide, steptomycin, ampicillin, chloramphenicol, trimethoprim, nalidic acid
- Multiresistance: 21-56% of isolates
  - 7-9 antibiotics: 15% / 10-13 antibiotics: 8%

- Multiresistant *Salmonella* from food or food-producing animals are common in different countries:
  - Malaysia 49-75% (n=88)
  - Thailand 44-66% (n=342)
  - Vietnam 21-56% (n=180)

*Thi Thu Hao Van et al. IJFM 2012; Truong Ha Thai et al. IJFM 2012; Thi Thu Hao Van et al. AEM 2007; Thi Thu Hao Van et al. IJFM 2008.*
Food safety

**Campylobacter spp.**
- Chicken sold in market: 15.3%
- Chicken: 95% of strains are resistant to FQ

**Escherichia coli: a reservoir**
- Resistance: 84% of isolates of beef, poultry, porc
- Resistance to FQ: 52-63% in chicken
- Multiresistant *E. coli* (n=99) in raw meat:
  - 89.5% in chicken meat
  - 95% in chicken faeces
  - 75% in pork meat
- Chl-resistant *E. coli* in aquaculture (n=557)
  - Vietnam: 58.3%; Malaysia: 25%; Thaïlande: 31.8%

AMR dissemination

- Large conjugative plasmids and integrons containing many antibiotic determinants have been found in:
  - *Salmonella* (35% and 13% respectively)
  - *E. coli* (76% and 57% respectively)

in raw chicken and pork meats from the market place in Vietnam.

*Van et al. 2008; Van et al. 2007*
AMR dissemination

- China: Plasmid-mediated quinolone resistance in *E. coli* isolates from animals, farmworkers, and the farm environment in pig and chicken farms

- Transferable plasmid-mediated multidrug efflux pump gene *oqxAB* which was widespread in animal farms, was also detected in 30% of human commensal *E. coli* isolates from farmworkers without any previous antimicrobial treatment or hospital admission

Zhao, AAC 2010
AMR dissemination

- Comparison of AGP diet (2) and no AGP (28 d):
  - Similar prevalence *E. Coli* Amp<sup>r</sup>/Tet<sup>r</sup> (90%)

- Resistance patterns (n=25) were diverse from zero to resistance up to 9 different Ab

- Similar genetic profiles between meat/environment and hides/digesta isolates

- Contamination in slaughthering regardless the AGP administration

*Alexander, IJFM 2010*
Management system

Contamination Control
- Hygiene practices/BMP
- Microbial control

Proper use of AB
- Diagnostic
- Dose/length
- Molecules

Decrease AB use
- Health management
- Reduce diseases
- Alternatives

Surveillance
- AB use
- Resistance
- Detection

Monitoring/Compliance
- Knowledge/research
- Int. Collaborations

Management System
Need for global approaches because AMR is a global food safety hazard and a public health concern