Resistant bacteria to antibiotics in the food chain: A cause for global food safety concern

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Antibiotics

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

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

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

- Commensal bacteria (reservoir)
Antibiotic resistance

- Isolate that has a resistance mechanism rendering it less susceptible than other members of the same species lacking any resistance mechanism.
  - Different levels of resistance: low or high level of resistance

- Clinical resistance (pharmacokinetic/pharmacodynamic parameters; criteria of cure)
Antibiotics resistance

- Microbiological resistance
- Epidemiological Cut-off (ECOFF) value
- MIC separating the wild-type population/resistant isolates (mutations, HGT)
Routes of transmission of genes conferring antibiotic resistance.

Witte, IJAA 2000
Antibiotic resistance

- Health risks for food producing systems
  - Zoonoses diseases (overuse)

- 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

Susceptible

Resistant

Antibiotic concentration

Andersson and Hugues, FEMS 2011.
Antibiotics

- 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

- No frontier for bacterial resistance
- Persistence of AB in environment
- Once acquired, resistant genes are transferred among bacteria of different ecological niches (even if no use AB)
Antibiotic resistance

*Salmonella spp.*
- 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%

*Campylobacter spp.*
- Poulet : 95% des souches sont résistance aux fluoroquinolones (AB critiques)

*Escherichia coli : a reservoir*
- Resistance: 84% of isolates of beef, poultry, porc
- Multiresistance: Chicken 89%; Porc 75%
- Resistance to fluoroquinolones: 16-21% of isolates, mainly in chicken samples (52-63%)

Garin et al. IJFM 2012; 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.
Antibiotic resistance

- 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)

- Multiresistant *E. coli* (n=99) in raw meat (chicken, pork, beef), shellfish and chicken faeces:
  - 89.5% in chicken meat
  - 95% in chicken faeces
  - 75% in pork meat isolates

*Van et al. IJFM 2012; Van et al. AEM 2007; Vo et al. 2010*
Antibiotic resistance

- 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*
Antibiotic resistance

- 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
Conclusion

Contamination Control
- Hygiene practices
- Microbial control

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

Decrease AB use
- Health management
- Reduce disease

Surveillance
- AB use Resistance

Monitoring/Compliance
- Knowledge/Research
- Collaborations
Conclusion

- Research of new antimicrobials with new modes of action
- Rapid methods for detection
- Need for global approaches and strategies because AMR is a global problem