Assessment of human exposure to cephalosporin resistant E. coli (CREC) through consumption of chicken meat

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Introduction

•This study is the result of a self-tasking activity of the Scientific Committee of the FASFC (Advice SciCom 08-2011).

• Acquired resistance of *E.coli* against cephalosporin antimicrobial drugs through production of extended spectrum β-lactamases (ESBL) is becoming a major issue in intensive broiler farming (Smet *et al.*, 2008). In Belgium, about 36% of the *E. coli* strains isolated from broilers were resistant against cephalosporins (Persoons *et al.*, 2010).

•During slaughter, the carcass can become contaminated with resistant bacteria. Subsequently the food chain can act as a vector for the transfer of resistance to humans.

•The risk of consumption of CREC contaminated chicken meat consist mainly of the possible transfer of resistance genes to other, potentially pathogenic, bacteria in the digestive tract.

•A model was designed to estimate the exposure to CREC of the Belgian consumer via consumption of chicken meat produced in Belgium.

Objective: to gain insight, from a food safety point of view, into the possible human exposure to CREC through consumption of chicken meat.

Material and Methods

• A quantitative risk assessment model was constructed based on the models of Hartnett *et al.* (2001) for *Campylobacter* on chicken meat and the METZOON model of Bollaerts *et al.* (2009) for *Salmonella* in pig meat.

• The model consists of different modules which closely simulate the farm to fork chain starting from primary production, over slaughter, processing and distribution to storage, preparation and consumption of chicken meat.

•Data from primary production were gathered by Persoons *et al.* (2010), other data are coming from routine monitoring programs of the FASFC, while consumer behaviour data came from the Belgian Food Consumption Survey (IPH, 2006) and Halet *et al*. (2006).

•Because of insufficient data several important assumptions were made:

- There is no direct contact between humans and broilers
- There is no consumption of raw broiler meat
- There is no change in proportion of CREC (within total number of *E. coli*) in production chain after slaughterhouse
- There is no growth nor reduction of CREC during conservation between 0° and 10°C
- During heating all bacteria on the surface of meat are killed, hence insufficient heating only plays a role for chicken meat preparations since CREC can also be present at the inside of the meat
- Chicken meat is always eaten together with raw vegetables and all vegetables are consumed
- Because there is no data on the number of CREC that must be consumed to establish transfer of resistance to other bacteria in the human digestive tract, 4 infection doses were arbitrarily chosen (10, 100, 1000 and 10000 cfu/meal)

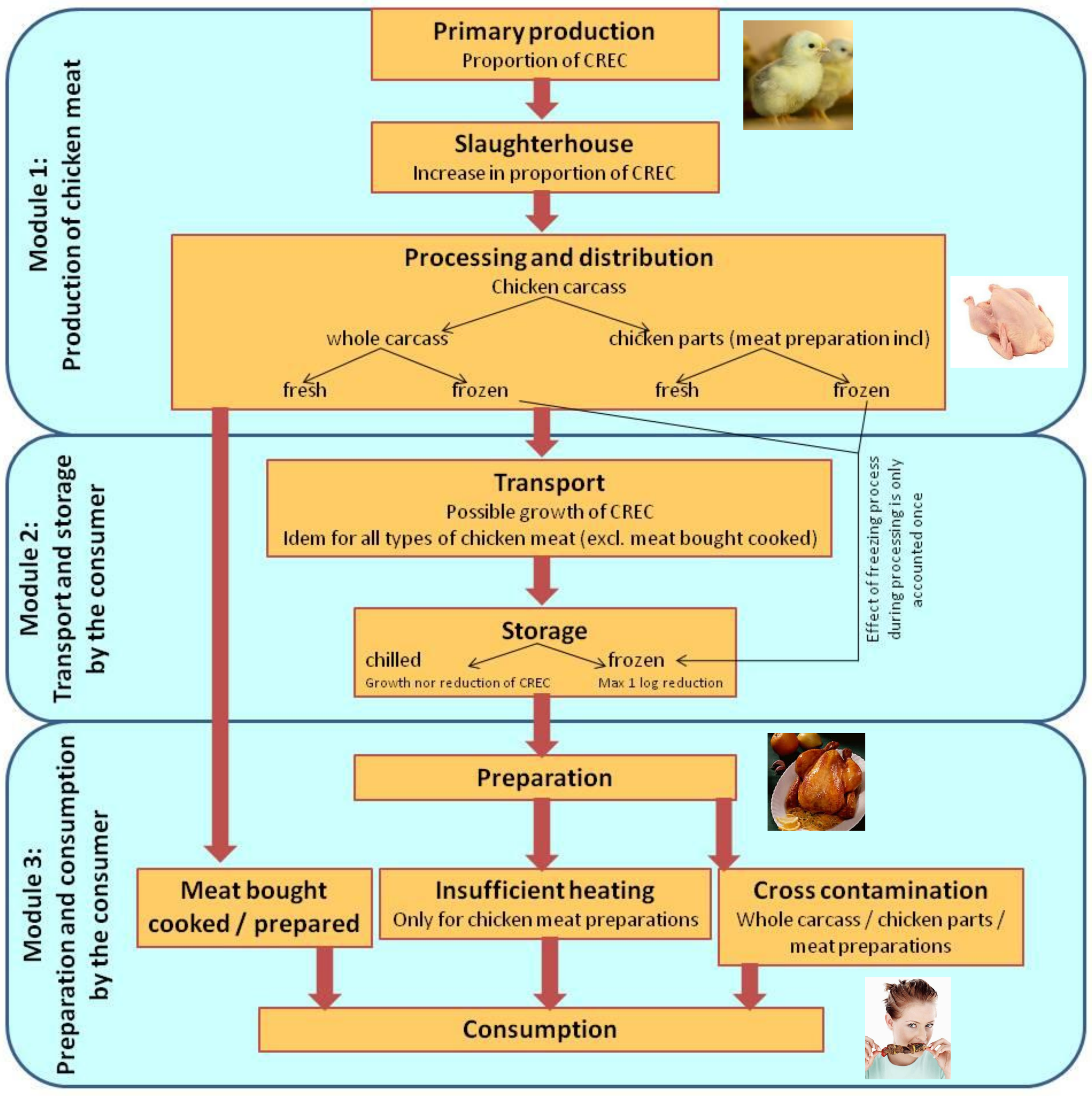

Figure 1: flowchart of the model

Results

Exposure to CREC through consumption of chicken meat

Table 1: Probability of the exposure to CREC through consumption of a meal containing chicken meat and in function of 4 arbitrarily chosen infection doses.

Infection doses (arbitrarily chosen)	10000 cfu	1000 cfu	100 cfu	10 cfu
Exposure through insufficient heating of chicken meat preparations	0%	0%	0%	0,03
Exposure through cross contamination (all types of chicken excl. chicken meat bought cooked / prepared)	0,39%	1,53%	3,26%	6,97%
Total exposure	**0,39%**	**1,53%**	**3,26%**	**7%**

The results indicate that about 1.5% of the meals with chicken meat contain more than 1000 colony forming units (cfu) of CREC. About 0,4% of the meals contain at least 10000 cfu.

The majority of exposures is caused by cross contamination in the kitchen

What if scenarios

Table 2: 'what if' scenario's and their impact on the total exposure to CREC by consumption of chicken meat.

Infection dosis (arbitrarily chosen)	10000 cfu	1000 cfu	100 cfu	10 cfu
What if proportion of CREC in primary production (within total number of *E. coli*) is at 0,75 (75% instead of 36%)	0,58%	1,93%	4,24%	9,26%
What if proportion of CREC in primary production (within total number of *E. coli*) is at 0,1 (10% instead of 36%)	0,14%	0,78%	2,24%	4,81%
What if total contamination with *E. coli* of chicken meat is maintained at maximum (4,15 log/g for carcasses and 3,41 log/g for chicken parts)	1,93%	4,27%	8,94%	16,65%
What if total contamination with *E. coli* of chicken meat is maintained at minimum (0,82 log/g for carcasses and 0,99 log/g for chicken parts)	0%	0,16%	1,05%	2,52%

The proportion of CREC (within the total number of E. coli) in primary production and the overall contamination of chicken meat with E. coli have a significant influence on the risk of consumer exposure to CREC.

Discussion and conclusions

•About 1,5% of the meals with chicken meat contain more than 1000 colony forming units (cfu) of CREC.

•The majority of exposures is caused by cross contamination in the kitchen, which is an argument to respect good hygiene measures during preparation of chicken meat.

•A sound antibiotic drug policy in primary production and respect of good hygiene practices in the slaughterhouse and cutting plant could reduce significantly the risk of exposure to CREC during consumption of chicken meat.

•The model describes only 1 route of transfer of CREC from chicken to men. More research is necessary to reveal the role of direct contact and indirect contact (via the environment) between poultry and men on the transfer of CREC.

•More research is needed to gain knowledge on the prevalence of CREC in the intestinal flora of the Belgian population and on the infection dosis to establish transfer of resistance genes to other, possibly pathogenic, bacteria in the human digestive tract.