

CAN ANTIBIOTIC USE IN PORK PRODUCTION REDUCE CONSUMER RISK?

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The risk of antibiotic use in food animals for purposes other than disease treatment is receiving renewed scrutiny. In the U.S. the question is being addressed with qualitative and quantitative risk assessments, in Scandinavia it has been addressed with prohibitions on the uses labeled as growth promotion (Cox and Popken, 2004, Hurd, *et al.*, 2004, US, FDA, 2002). However, every risk assessment is likely to calculate some level of risk, albeit extremely low. Society and regulators are not generally willing to permit or accept additional risk, unless there is some benefit. Is it possible that this perceived "risky activity" of food animal antibiotic use could decrease consumer risk? What if it reduced the burden of human illness associated with meat-borne bacteria such as *Salmonella* or *Campylobacter*? What if healthier animals resulted in healthier meat, milk and eggs? Clearly, society has a longstanding belief in the benefits of consuming healthy animals, demonstrated in meat hygiene inspection rules dating back to 1914 in the U.S.

How could the use of antibiotics decrease *Salmonella* and *Campylobacter* rates on carcasses and meat, thereby decreasing human risk? Risk is all about probabilities and dose; the probability of an event happening and the exposure dose if it does. Figure 1 shows the key processes that affect the probability and dose of *Salmonella* contamination in pork processing.

Figure 1 shows the many processes where the probability of contamination and dose can be impacted by animal health. For example, chronic stress of disease will increase the likelihood and degree of animal infection with pathogens such as *Salmonella*; disease control reduces risk. Additionally, animal health likely influences slaughter and evisceration quality; processes that affect the probability and amount of fecal contamination. Conditions that may increase the probability or amount of fecal contamination include:

- peritonitis (inflammation of the abdominal area)
- pleuritis (inflammation of the chest area)
- adhesions ("scar tissue" connecting viscera to the interior of body cavity)
- amount and fluidity of gut contents (increase probability of tears or spills)
- gut friability (increase probability of tears or spills)
- airsacculitis (inflammation and adhesions in the chest area of poultry)
- any health condition that leads to extra handling for trimming e.g. skin lesions, abscesses, arthritis

Meat inspectors will notice many of these issues and remove obviously unwholesome product; however, pathogens are invisible. The resulting feces from a gut spill are quickly cleaned up, but the unseen bacteria on hands, machinery or tools are not so easily detected. The extra handling required to trim contaminated surfaces or remove an arthritic joint has been shown to decrease shelf life due to extra bacterial load. Inflammation of the airsacs in a poultry flock has been associated with increased *Salmonella* and *Campylobacter* loads (Russel, 2003). Antibiotic free pigs tend to have more fluid gut contents. Any of these conditions may increase the probability and dose of pathogen contamination.

Many animal diseases produce the types of conditions just described. These diseases include *E. coli* infection (airsacculitis) and *Clostridium perfringens* infection producing necrotic enteritis in poultry. Pleuritis is common due to porcine respiratory disease of various bacterial causes at an early age. Inflammation of the small intestine in swine (ileitis) may increase gut friability. Liver abscesses in cattle and infectious arthritis in all animals lead to extra handling for trimming of unwholesome tissue.

Antibiotic use reduces or eliminates these diseases. Treatment with virginiamycin is effective in preventing necrotic enteritis in poultry. Prevention of porcine respiratory disease at an early age will avoid lesions such as chronic pleuritis or peritonitis and the resulting adhesions affecting evisceration quality. Lastly, uses labeled for improved performance have been shown to actually

reduce infections with *Clostridium perfringens* (Stutz and Lawton, 1984). Additionally, when avoparcin was removed from Norwegian poultry, necrotic enteritis reached “epidemic proportions” (Kaldhudsal, 2000). The loss of “growth promotion” antibiotics in all phases of Danish swine production (1999) has been followed by a 100% increase in the use of antibiotics labeled for treatment. To this point, there has been no decrease in *Salmonella* or *Campylobacter* illness or resistance levels in humans.

Could these disease-related conditions really affect public health? Based on available data the answer is “yes”. A simple calculation will demonstrate. A more sophisticated analysis for poultry was presented recently (Singer, *et al.* 2005, <http://www.ahc.umn.edu/news/releases/chick-ens110204/>). Say a pork processing plant, using antibiotic treated pigs, has about 5% of its carcasses *Salmonella* positive in the cooler. A large plant (15,000 head/day) would produce 750 *Salmonella* positive carcasses per day. But some research, based on quantification of *Salmonella* loads, shows that only about 4% of the resulting servings will be potentially infectious; computing to about 25,000 potentially infectious servings per day (Assumes: 110kg carcass weight, 20% of contaminated carcass is ground and potentially contaminated, 250g serving size) (Alban *et al.*, 2002).

If antibiotic free pigs are used and if they have slightly more disease which increases the *Salmonella* carcass positive rate only two percentage points to 7%, that plant is now producing 1,050 *Salmonella* positive carcasses per day; a 40% increase. Additionally, if the dose on those positive carcasses is increased two points so that 6% of the resulting servings will be potentially infectious, then the number of potentially infectious servings sold per day increases to 55,000; a 115% increase over the antibiotic treated pigs.

These calculations are based on the assumption that animal health conditions do impact the probability and dose of final product contamination. More data are needed on this topic, especially in cattle and swine. These types of studies should be fairly easy to conduct. It is useful, but not necessary that antibiotic free animals be used in these studies, as the key hypothesis is the relationship between conditions such as pleuritis, arthritis, etc. and carcass contamination with microbial load. Until these studies can prove there is no connection between animal health and pathogen load, we must assume that removal of antibiotics in food production would increase the human risk of generic *Salmonella*, *Campylobacter*, and *Yersinia* infection more than it would decrease risk from resistance.

Conclusion A quantitative risk assessment of the impact on human health relative to the continued use of virginiamycin has also been concluded. The report determined that the quantitative human health risk from continued use of virginiamycin in the U.S. is less than one statistical life saved in the entire U.S. population over the next 15 years (Cox and Popken, 2004). Consistent with the Cox/Popken study, the Food & Drug Administration in the U.S. draft risk assessment of virginiamycin, demonstrated a risk of virginiamycin use in the range of 0.7 to 14 chances in 100 million (US, FDA, 2004). Additionally, work by this author shows the risk of any adverse human effects (e.g. extra days of illness) of macrolide use in poultry, pork and beef cattle was less than 10 in 100 million per human year (Hurd *et al.*, 2004).

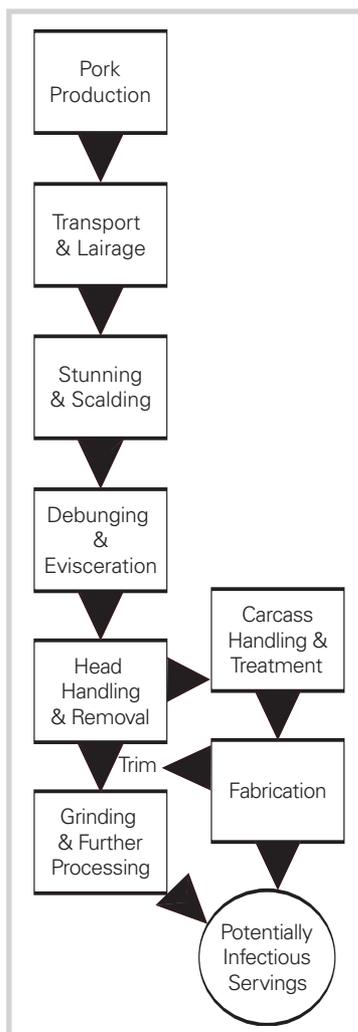


Figure 1. Processes affecting the probability and dose of *Salmonella* contamination of wholesale pork products resulting in potentially infectious servings.

Risk managers must compare the hypothetical risk of increased resistance to the thousands of excess *Campylobacter* and *Salmonella* cases expected if medicated feed additives were banned.

References

- Alban L., A.M. Olsen, B. Nielsen, R. Sorensen, and B. Jessen. 2002. Qualitative and quantitative risk assessment for human salmonellosis due to multi-resistant *Salmonella* Typhimurium DT104 from consumption of Danish dry-cured pork sausages. *Prev Vet Med.* 52:251-265.
- Cox, L. and Popken, D. 2004. Quantifying human health risks from virginiamycin use in chickens. *Risk Analysis*, vol. 24
- United States Food and Drug Administration. Center for Veterinary Medicine. 2002. Draft guidance for industry: evaluating the safety of antimicrobial new animal drugs with regard to their microbiological effects on bacteria of human health concern. Document no. 152. Available at: <http://www.fda.gov/cvm/guidance/fguide152.pdf>. Accessed 02 May 2005.
- United States Food and Drug Administration. Center for Veterinary Medicine. Draft Risk Assessment of Streptogramin Resistance in *Enterococcus faecium* Attributable to the Use of Streptogramins in Animals, Available at: http://www.fda.gov/cvm/Documents/SREF_RA_FinalDraft.pdf, Accessed 10, May 2005.
- Hurd, H.S., Doores, S., Hayes, D., Mathew, A., Mauer, J., Silley, P., Singer, R.S., Jones, R.N. 2004. The public health consequence of macrolide use in food animals: A deterministic risk assessment. *J. Food Prot.* 67:5 pp 980-992.
- Kaldhudsal, 2000. The economic impact of necrotic enteritis is greater than anticipated. *World Poultry* 16(8); 50-51.
- Russell, S.M. 2003. The effect of airsacculitis on bird weights, uniformity, fecal contamination, processing errors, and populations of *Campylobacter* spp. and *Escherichia coli*, *Poultry Science* 82: 1326-1331.
- Singer, R.S., Cox L.A., Dickson, J.S., Hurd, H.S., Phillips, I., Miller, G.Y. 2004. Potential Risks and Benefits of Tylosin Use in Poultry. Interscience conference on Antimicrobial Agents and Chemotherapy. Washington DC, November 2004. Session 211, Paper C2-1986, Poster #3011
- Stutz and Lawton., "Effects of Diet and Antimicrobials on Growth" *Poultry Science*, 1984.