Ban Antibiotics in Poultry?

[Why The Policymakers Have It Wrong]

Banning the use of certain antibiotics in poultry may increase the risk of foodborne illness. by Scott M. Russell

The National Advisory Committee on Microbiological Criteria for Foods (NACMCF, 1997) reported that because processing of raw broilers does not involve a lethal heat process, such as pasteurization, delivering live chickens to the processing plant with as few pathogens as possible is necessary to control contamination of carcasses with salmonella and campylobacter. Other scientists have supported this conclusion by stating that reducing C. jejuni colonization in live chickens should reduce the prevalence of C. jejuni infections in humans, presumably because of less exposure to the organism (Morishita et al., 1997). Controlling factors that contribute to colonization of the live bird during grow-out should significantly impact contamination of finished carcasses after processing.

At the processing plant, fecal contamination of carcasses can become a concern if the digestive tracts of chickens are cut or torn during venting, opening or evisceration because, if cut or torn, fecal material may be released onto the surface of the carcass (NACMCF, 1997). Intestinal damage is generally associated with improperly adjusted or worn-out evisceration equipment, variance among individual birds or birds with low body weight due to disease. These factors must be controlled because modern poultry processing plants are highly automated operations, and the equipment is set to receive carcasses of a specific size. Preventing contamination of carcasses from spillage of digestive tract contents or smearing of fecal material on edible meat surfaces is perhaps the single most important factor in sanitary poultry slaughter (Bilgili, 2001). If intestines are cut or torn during evisceration, feces can spread to equipment, workers and inspectors, and this can be a major source of cross-contamination with pathogenic bacteria (NACMCF, 1997).

Pilot studies conducted in 1997 by two vertically integrated broiler companies revealed a direct relation-
ship between air sacculitis infections in chickens and the presence of high numbers of *Escherichia coli* and salmonella. In the first study, carcasses that were removed from the line by USDA-FSIS inspectors for active air sacculitis infections, and carcasses that were not visibly infected were evaluated for *E. coli* counts over a one-week period (unpublished data). For carcasses with no visible signs of air sacculitis, 58 percent had pre-chill *E. coli* numbers in the acceptable range (0 to < 100 CFU/mL) according to the HACCP regulation (USDA-FSIS, 1996), 37 percent were found to be in the questionable range (100 to 1,000 CFU/mL), and only 5 percent were in the unacceptable range (> 1,000 CFU/mL). However, for carcasses removed from the line for air sacculitis infections, 4 percent, 46 percent and 50 percent of the pre-chill carcasses were in the acceptable, questionable and unacceptable ranges, respectively. Therefore, a total of 96 percent of air sacculitis-infected carcasses had questionable or unacceptable *E. coli* counts. In a second study conducted by another integrator, pre-chill *E. coli* counts for carcasses with air sacculitis were significantly higher (P ≤ 0.05) at 3.93 log$_{10}$ CFU/mL than air sacculitis-negative carcasses at 2.63 log$_{10}$ CFU/mL. Moreover, this company found that salmonella prevalence for carcasses with air sacculitis was significantly higher (P < 0.05) at 70 percent than for carcasses without air sacculitis at 40 percent (unpublished data). These studies demonstrate a link between the presence of air sacculitis in the flock and increases in indicator and pathogenic bacterial populations.

**Georgia Study**

We recently conducted a study to find out if air sacculitis infections in broiler chickens have an effect on carcass weights, percentage of carcasses with fecal contamination, the number of processing errors, and on populations of campylobacter and *E. coli*. We compared air sacculitis-positive flocks with air sacculitis-negative flocks for the factors listed above. In all cases, where differences in the age of the flocks were noted, adjustments were made to the individual carcass weights to account for age differences using the formula (weight for AS carcass + 27.24g x number of days).

Our study showed that air sacculitis-positive carcasses had significantly reduced weight averages in two of five repetitions (Figure 1).

Although not significantly different in three repetitions, the overall average weights were higher for air sacculitis-negative flocks. The net loss averaged over five repetitions was 84g/carcass. For one grow-out house, over a period of one year, the net loss would be approximately 32,379 lbs. as the result of the presence of air sac-
culitis at levels experienced in this study. Moreover, underweight birds are more difficult to process because the evisceration equipment cannot automatically adjust for smaller carcasses when a flock of air sacculitis-positive birds comes into the plant. Overall, air sacculitis had a negative impact on body weight, even though the carcasses selected from air sacculitis flocks in this study were not visibly infected and had already passed inspection. It is possible that the differences in carcass weights would be more pronounced if carcasses that had been removed from the line for visible air sacculitis infections had been weighed and compared to air sacculitis-negative flocks.

In our study, air sacculitis infections significantly increased fecal contamination in four of five repetitions (Figure 2). Thus, it is reasonable to conclude that air sacculitis in flocks of birds may contribute to increases in the risk for human foodborne infection.

We also found that air sacculitis-positive carcasses had a much higher number of processing errors. The combined results (five repetitions averaged) are presented in Figure 3.

Of particular interest is that the total combined cuts or tears were much higher on air sacculitis-positive carcasses at 49 percent as compared to 17 percent for negative carcasses. Low and non-uniform carcass weights may explain why more processing errors occurred in the air sacculitis-positive flocks because the automated equipment in the processing plant is set to receive carcasses of a certain size. Examples of processing errors seen at different locations on the digestive tract are shown in Figures 4-8.

**Campylobacter Counts**

*Campylobacter jejuni* is now considered worldwide as a leading cause of diarrheal disease and foodborne gastroenteritis (Solomon and Hoover, 1999). It is estimated that *C. jejuni* causes between 1 million to 7 million cases of enteritis per year in the United States, resulting in 100 to 500 deaths (Solomon and Hoover, 1999). Researchers have shown that the intestine of the chicken is the primary reservoir for campylobacter within a flock (Jeffrey et al., 2001). Thus, cut or torn digestive tracts may contribute to campylobacter contamination of the carcass, because if campylobacter is present and the intestines are damaged, the organism may be spread to the carcass.

In our study, campylobacter counts were significantly higher on carcasses from air sacculitis flocks in three of five reps (Figure 9).

In all cases where air sacculitis infections were present, campylobacter was present at levels greater than 1.5 log_{10}.
CFU/mL. In three of the reps, when air sacculitis was absent, campylobacter counts were absent or extremely low (< 0.05 log10 CFU/mL). Therefore, there was a relationship between the presence of air sacculitis-positive and campylobacter-positive carcasses.

The data collected in our study suggested that flocks of chickens with air sacculitis infections are more likely to: 1) weigh less than uninfected birds, 2) be contaminated with fecal material during processing, 3) have a processing error or multiple processing errors during venting, opening, and evisceration, and 4) have higher campylobacter counts.

**Industrial Data**

The results from our study led us to ask the question, if there is a relationship between air sacculitis infections, fecal contamination and indicator and pathogenic bacterial counts in a research study, does this relationship hold up when looking at commercial data from processing plants? To find out, we visited a commercial poultry processor who allowed us to review its records regarding specific processing parameters for 32,300,000 chickens processed over a two-year period. The data were analyzed by the Department of Statistics at the University of Georgia and we looked at the following:

- effects of the presence of air sacculitis infection of birds on fecal contamination of carcasses
- effects of the presence of infectious process on carcasses on fecal contamination of carcasses
- relationship between the number of condemned carcasses and fecal contamination of carcasses
- effect of air sacculitis infection of carcasses on Salmonella prevalence
- air sacculitis infection of carcasses and presence of infectious process on carcasses
- effect of air sacculitis infection of carcasses on carcass weight

The analyses showed that as the percentage of carcasses removed from the line by the USDA inspectors increased, the percentage of carcasses with fecal contamination increased as well. Increasing levels of infectious process also resulted in a significant increase in fecal contamination. The data revealed that when a high number of carcasses are condemned, an increased fecal contamination occurred. A significant finding was that as the number of carcasses removed from the line for active air sacculitis infection increased, the prevalence of salmonella on processed carcasses increased as well. The statistician concluded, “With samples of the size used in this investigation, these differences are quite significant; there is very convincing evidence that air sacculitis increase is associated with increasing probability of salmonella [contamination].” This conclusion strongly supports our research in which we found that the presence of air sacculitis increases campylobacter populations on carcasses and the research obtained from the previous pilot studies. As air sacculitis percentage increased, carcasses with infectious process also increased in a progressive manner. Moreover, carcasses with air sacculitis were significantly lower in weight than carcasses from healthy flocks. The statistician noted, “This analysis displays strong evidence that carcass weight is associated with air sacculitis.”

These industrial data show that flocks of chickens that enter the processing plant with air sacculitis infections are more likely to have the following negative parameters associated with processed carcasses arising from these birds: 1) higher fecal contamination, 2) higher salmonella prevalence, 3) higher infectious process, and 4) lower carcass weights.
Likewise, higher infectious process and condemned carcasses (indicating highly diseased flocks) resulted in higher fecal contamination on carcasses.

From the above studies, it becomes apparent that the reduction of air sacculitis in broiler flocks entering the processing plant is a food safety concern. The broiler industry does a good job of vaccinating for the common respiratory viruses that lead to air sacculitis, and there is great emphasis on air quality management, house temperature and feed and water delivery to optimize the broiler immune system. Flock visitations, post-mortem examinations, serology, virus isolation and the principles of epidemiology are employed by veterinarians who specialize in poultry disease control and prevention. However, as with all animal and human populations, disease will occasionally break through these management and vaccination barriers. When this occurs, as with air sacculitis, the last resort becomes antibiotic therapy.

**Effective Treatment Vs. Counterproductive Bans**

The next question arising from the study was, what is the most effective way to treat air sacculitis infections? A study was conducted at the University of Georgia in which flocks of chickens with active air sacculitis infections were treated with various commonly used antibiotics or no antibiotics (controls). The researchers found that enrofloxacin was the only antibiotic used in the study that was effective for eliminating air sacculitis infections in broiler chickens.

The fact that enrofloxacin is the most effective therapeutic drug for treating air sacculitis raises a number of issues. There is concern that enrofloxacin use in animal agriculture results in the development of antibiotic resistant campylobacter. The European Union was so concerned about the development of resistant forms of bacteria that in 1999 it placed a ban on the use of five growth-promoting antibiotics—avoparcin (a glycopeptide), bacitracin, spiramycin and tylosin (macrolides), and virginiamycin (a streptogramin combination). However, resistance to human analogues of these antibiotics, as well as to fluoroquinolones, has continued to increase in humans since the ban. Also, campylobacter and salmonella infection rates in humans are increasing in Europe (*Eurosurveillance Weekly*, 2002), while they are decreasing in the USA.
(CDC, 2002). Some have suggested that the European ban seems to have had a large negative net impact on both animal and human health (Casewell, et al. 2002), although the causes of the continuing rise in illness rates in Europe remain uncertain (Eurosurveillance Weekly, 2002).

Currently, the Food and Drug Administration is considering banning the use of enrofloxacin in poultry because of the concern over the development of enrofloxacin-resistant campylobacter in humans. Therefore, an in-depth risk analysis was conducted by Drs. Cox and Popken of Cox Associates, in which they looked at the health risks associated with the use of fluoroquinolones in chickens. They also computed the health benefits for several processing intervention strategies, including banning the use of enrofloxacin in chickens. They concluded that “perhaps surprisingly, the model predicts that a ban on enrofloxacin is expected to increase human health risks of campylobacteriosis by increasing the variance of microbial loads reaching people.” The authors found that a person is 9.1 times as likely to get a campylobacter infection if they eat chicken from an air sacculitis-positive flock as opposed to eating chicken from an air sacculitis-negative flock. These data strongly support our research findings, the findings of the pilot study and analyses of industrial processing plant data.

Additionally, another reason that the FDA is considering the ban on enrofloxacin is that a study by Marano (2000) indicated that when people become ill with campylobacter, if the campylobacter are resistant to treatment (antibiotic intervention), these people experience on average an extra two days of illness, resulting in additional health care cost, suffering, and lost work time. However, Cox and Popken found that in the Marano (2000) study, the researchers did not exclude from their analysis, illness associated with foreign travel. When this factor is excluded, the extra days of illness disappear. Therefore, it appears that domestically acquired resistant campylobacter infections pose no greater human health risk than susceptible campylobacter infections. It is also interesting to note that Smith (1999) found 70 percent of resistant campylobacter in Minnesota were associated with foreign travel. Cox and Popken calculated that a nationwide economic loss from increased chicken mortality if enrofloxacin is banned would be $11,692,000 a year. This figure does not include costs of additional air sacculitis condemnations of chickens that survive but do not pass inspection. Nor does it include losses due to smaller average bird weights among airsacculitis-positive flocks.

These studies collectively demonstrate that discontinuing the use of antimicrobials as therapy for air sacculitis (particularly enrofloxacin) may significantly and negatively impact foodborne illness rates in the USA. Moreover, the economic cost and animal welfare issues associated with discontinuing the use of these interventions are significant as well. Finally, the risks associated with the use of these treatments appear to have been miscalculated.

Scott M. Russell, Ph.D., is an associate professor at the Department of Poultry Science, Poultry Science Building, University of Georgia, Athens, GA 30602-2772; Phone (706) 542-1368; E-mail srussell@arches.uga.edu.

**References**


Turkeys were not alleviated by supplemental dietary vitamin E. Poultry Science, 76: 1682-1687.