Poultry on Antibiotics: Hazards to Human Health

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Poultry on Antibiotics:

Hazards to Human Health

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Founded in 1986, IATP works with family farm organizations around the country and the world, supporting policies and practices that result in healthy, profitable farms, greater public benefit, a safer food supply and flourishing rural communities.

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EXECUTIVE SUMMARY

Consumers expect the meat they purchase to be free of health-threatening bacteria. Increasingly, though, we've learned that food products, particularly meats, may be contaminated with bacteria that pose serious health risks.

In October 2002, the U.S. experienced the largest recall of meat in its history. It was associated with 13 deaths and 120 illnesses. Overall, the Centers for Disease Control and Prevention (CDC) estimates that bacteria cause nearly 5.2 million foodborne infections each year, resulting in 36,000 hospitalizations and almost 1300 deaths.

Most foodborne illness caused by bacteria gives victims a few days of intense discomfort and requires no treatment with antibiotics. But for patients whose infections spread beyond the intestine, antibiotics can be lifesaving.

For decades, antibiotics have dramatically reduced illness and death from bacterial infections. But recently, the effectiveness of these life-saving drugs has begun to wane because antibiotics are being overused.

Certainly antibiotics are overused in human medicine. Yet another major, and often overlooked, source of overuse is that factory farms routinely feed antibiotics to livestock to promote growth and to compensate for crowded, unsanitary conditions conducive to infection.

Scientific consensus now says that this antibiotic use in food animals contributes to antibiotic-resistant bacteria transferred to humans, mainly through contaminated food. The Union of Concerned Scientists estimates that 70 percent of *all* antibiotics in the U.S. are fed to pigs, poultry and cattle for reasons other than treating disease. The majority of such medicines are "medically important" – that is, identical, or nearly so to antibiotics used for humans.

Medical professionals are speaking out against this unnecessary use of antibiotics in food animals. If they can't rely upon effective antibiotics, it will become more difficult, and in some cases impossible, to treat bacterial illnesses. The American Medical Association (AMA) has gone on record opposing the use of antibiotics in farm animals that aren't sick.

Given the current interest in foodborne illness and antibiotic resistance, this study focuses on determining the prevalence of antibiotic-resistant bacteria on poultry products routinely purchased at grocery stores. Consumers should know what bacteria may contaminate their food and the potential dangers of eating certain food products.

This is the first study to examine brand-name poultry products at the retail level for the presence of antibiotic-resistant bacteria, including resistance to medicines relied upon to treat human infections. We chose brand-name poultry products that were prominent in the grocery stores we visited. Ours is also the first study to test for drug resistance among multiple bacteria found on poultry products at the same time, arguably a better measure of risk to the people actually eating the poultry.

We bought 200 fresh whole chickens and 200 packages of ground turkey from grocery stores in Des Moines, Iowa and Minneapolis-St. Paul, Minnesota. We contracted with a certified food-testing laboratory to test the products for the presence of three bacterial strains – *Salmonella*, *Enterococci* and *Campylobacter* – and for resistance to a number of antibiotics.

Campylobacter and *Salmonella* are the top two bacterial causes of foodborne illness in the U.S. Together, they account for an estimated 3.3 million foodborne infections and more than 650 deaths each year. Not everyone is at the same level of risk. Infants are ten times more likely than the general population to contract *Salmonella* infections, and twice as likely as older people to suffer a *Campylobacter* infection.

Contaminated meat is the dominant source of human *Salmonella* infections, while 50 percent or more of *Campylobacter* infections may come from eating contaminated chicken, according to Food and Drug Administration (FDA) estimates.

Disease-causing bacteria, *Salmonella* or *Campylobacter*, contaminated a large proportion of the whole chickens and ground turkey we purchased. The widespread resistance of bacteria in poultry samples to one or multiple antibiotics is perhaps an even greater cause for concern.

- Ninety-five percent of the 100 whole chickens we tested were positive for *Campylobacter*, the top cause of bacterial foodborne illness, or food poisoning, in the U.S. Nearly 62 percent of the *Campylobacter* bacteria tested for resistance were resistant to 1 or more antibiotics.

- More than 8 percent of *Campylobacter* tested for resistance were resistant to Cipro, the antibiotic of choice for presumptively treating severe bacterial food poisoning. The FDA's best estimate recently was that more than 153,000 people in 1999 alone contracted Cipro-resistant *Campylobacter*, just from eating contaminated chicken.

- Nearly 18 percent of whole chickens purchased were contaminated with *Salmonella*. Twenty percent of Country Pride chickens carried *Salmonella*, as did 15 percent of Gold'N Plump chickens. All 35 *Salmonella* isolated from whole chickens were analyzed for antibiotic resistance, and 6 percent were resistant to 4 or more antibiotics.

- Ground turkey purchased was more contaminated with *Salmonella* than was whole chicken, with an overall rate of 45 percent. Fifty-six percent of the Honeysuckle White ground turkey and 34 percent of the Jennie-O ground turkey carried *Salmonella*. Sixty-two percent of the *Salmonella* bacteria tested that were found in turkey were resistant to 1 or more antibiotics; a third of these *Salmonella* were resistant to 4 or more antibiotics.

- Both *Salmonella* and *Campylobacter* contaminated 32 percent of the Country Pride chickens and 14 percent of the Gold'N Plump chickens that we tested for both organisms (100 total), as well as 2 percent of the Jennie-O turkey we tested (1 of 51 packages)

- More than 90 percent of the *Enterococci* from chicken or turkey that was tested (101 total) for resistance was resistant to Synercid. Strains of resistant *Enterococci* are a growing cause of infections and deaths in hospitals, and Synercid is one of a few antibiotics still effective against them.

There are no good estimates of how many people overall suffer from foodborne infections resistant to antibiotics. As noted, more than 150,000 people may have developed fluoroquinolone-resistant *Campylobacter* infections just from eating contaminated chicken. Most antibiotic-resistant *Salmonella* in humans stems from eating contaminated food as well.

More people eating food contaminated with antibiotic-resistant *Salmonella* or *Campylobacter* will become ill than will people eating food with non-resistant organisms. One estimate is that the mere presence of *Salmonella* and *Campylobacter* strains resistant to at least one antibiotic could result in nearly 47,000 additional people getting foodborne illnesses, when compared to the expected number of sick following exposure to non-resistant strains.

In addition, people with antibiotic-resistant *Salmonella* and *Campylobacter* are likely to be sicker, for longer, than are people with non-resistant infections.

Recommendations

Consuming meat with antibiotic-resistant bacteria is not inevitable. Consumers, poultry producers and restaurants can all take steps to reduce or eliminate these health threats.

Poultry producers should reduce overall antibiotic use to a minimum. In addition, they should stop feeding antibiotics to birds or flocks that are not sick. Poultry producers also should stop using any antibiotic "cousins" of Cipro, which is simply too important to humans to risk its effectiveness by continuing the imprudent use of closely related drugs in poultry.

The good news is that some poultry producers are working hard to provide safer chickens and turkeys, by using better hygiene, by implementing growing or slaughter conditions to lower the levels of disease-causing bacteria on their meats, or by avoiding the use of antibiotics which increase the risk that meat will be contaminated with antibiotic-resistant bacteria.

Four of the top five top chicken producers already have sworn off any use of Cipro-like antibiotics, including ConAgra Poultry, producers of Country Pride chicken. Others, also including ConAgra, have made various claims to having stopped or greatly reduced the use of antibiotics for growth promotion or disease prophylaxis. We generally laud this approach, although there is no existing mechanism for verifying producers' claims.

Large-volume buyers should only purchase poultry from producers that use no antibiotics for animals that are not sick, such as for growth promotion, and that use no critically important human antibiotics, like Cipro, for any reason. McDonald's, Popeye's and Wendy's all now claim they refuse to buy chicken treated with Cipro-like antibiotics. Several other fast food companies, like Hardee's, Subway and Domino's, have similar policies, but also say they won't buy chickens fed important human antibiotics for non-therapeutic reasons, like growth promotion.

For consumers to be certain of buying poultry raised without antibiotics, they can buy certified organic chickens and turkeys.

Some poultry producers use U.S. Department of Agriculture (USDA)-defined terms like "raised without antibiotics" or "no antibiotics administered" on their meat labels. Consumers can derive some assurance from these claims, although no third party certifies them, as is the case with organic products.

Check out the **Eat Well Guide**, *www.iatp.org/EatWell*, for a state-by-state listing of meat and poultry producers using no antibiotics, or no routine antibiotics, in addition to restaurants and other places to buy these products. If they are not available, consumers should ask grocery store or restaurant managers to provide this option.

Consumers also should always cook meat thoroughly and carefully follow safe meat-handling procedures. Consumers can find practical advice and general information on food safety at *www.foodsafety.gov*.

CHAPTER 1

INTRODUCTION

Bacterial foodborne illness is a serious health problem in the United States. In October 2002, the U.S. experienced the largest recall of meat in its history.[1] It was associated with 13 deaths and 120 illnesses. Each year, foodborne bacteria result in nearly 5.2 million illnesses, 36,000 hospitalizations and almost 1300 deaths, according to Centers for Disease Control and Prevention (CDC) estimates.[2]

Campylobacter and *Salmonella* are the leading causes of foodborne bacterial infections. Together, they are responsible for an estimated 3.3 million foodborne infections and more than 650 deaths each year.[3] In rare cases, people infected with *Campylobacter* can later develop Guillain-Barré Syndrome, an acute paralytic condition that can sometimes be fatal.[4]

An estimated 80 percent of *Campylobacter* infections and 95 percent of *Salmonella* infections are contracted via contaminated food.[5] Contaminated meat is considered the dominant source of *Salmonella* infections.[6] Poultry is a major source of human *Campylobacter* infection, 48.5 to 66.7 percent may come from eating chicken, according to recent estimates by the U.S. Food and Drug Administration (FDA).[7,8]

U.S. poultry is significantly contaminated with *Campylobacter* and *Salmonella*. In 1994-95, the U.S. Department of Agriculture (USDA) surveyed whole chickens from slaughter facilities representative of the nation as a whole and found 88 percent were contaminated with *Campylobacter* bacteria, while 20 percent carried *Salmonella*.[9]

Antibiotics vs. Antimicrobials

Antibiotics are naturally occurring chemicals that kill or inhibit bacteria. But the term is often used more loosely to also include synthetic antibacterial agents, as well as compounds that affect other microorganisms, like parasites (technically "antimicrobials").

Salmonella and *Campylobacter* on meat have long been a problem. The escalating resistance of these and other foodborne bacteria to one or multiple antibiotics has raised more recent concerns.

Most foodborne illness caused by bacteria gives victims a few days of intense discomfort – diarrhea, fever, abdominal cramps, and requires no treatment with antibiotics. For patients whose infections become invasive, entering the bloodstream, brain or other organs outside the intestine, antibiotics may be life-saving. Around 40 percent of people with *Salmonella* infections who seek treatment receive antibiotics, according to surveys by the CDC.[10] Rising antibiotic resistance among foodborne pathogens therefore carries health consequences for humans, as well as for animals.[11,12,13]

Eating food that contains antibiotic-resistant pathogens can have a *direct* impact on health. Resistant strains of bacteria can cause more severe or more prolonged illnesses than will non-resistant bacteria.[14] Indirect health impacts are less obvious. Mounting evidence suggests that antibiotic-resistant bacteria on food, once ingested, may be able to pass their resistance onto other bacteria in the human intestine. If pathogenic, these newly resistant bacteria could go on to cause disease in the person eating the food, although perhaps long after the food was actually consumed.

Use of Antibiotics in Poultry and Other Food Animals

Ultimately, it is the use of antibiotics that drives bacteria to become resistant. Certainly, human uses are important. But the scientific consensus emerging is that antibiotic use in food animals also contributes to antibiotic-resistant bacteria transmitted to humans, typically through contaminated food.[15,16,17,18,19,20,21]

Bacteria found in the intestines of animals can be animal pathogens, human pathogens like *Salmonella* and *Campylobacter*, or "commensal" bacteria, which are part of the normal bacterial flora. Resistance can emerge and spread when these bacteria are exposed to non-lethal levels of antibiotics, such as those in animal feed or water for growth promotion. During slaughter or processing, these resistant bacteria can contaminate food.

Resistant bacteria, as well as the genetic material that makes them resistant, also can spread to human handlers, to other animals or to the broader environment – such as through manure, which can itself contaminate the surface waters, groundwater, and air that is next to, under or above livestock farms.

No government mechanism in the U.S. tracks antibiotic use, in humans or in food animals. Estimates by industry and advocacy groups agree that antibiotic use in food animals is huge, as much as 29.5 million pounds, dwarfing total human use by 4 to 10-fold.[22,23]

Antibiotic use is widespread in confined animal feeding operations (CAFOs) – more commonly, "factory farms" – that have come to dominate food animal production in the U.S. [24,25] Poultry factories now dominate U.S. production, accounting for more than 97% of U.S. sales of broiler chickens.[26] The EPA defines factory broiler chicken and turkey facilities as those containing at least 100,000 broilers or 55,000 turkeys.

Surveys of poultry plants in 2000 found that two-thirds were giving broiler chickens "grower" feeds containing antibiotics, while almost 65 percent were using antibiotic "starter" feeds – this, according to an industry database representing more than 90 percent of the broiler industry.[27] Arsenic compounds also were used in starter and grower feeds by almost 70 percent and 74 percent of broiler "plants" surveyed, respectively.[28]

Antibiotics generally are put into feed not as therapy for treating sick birds or flocks, but rather to promote growth or to prevent infections among flocks raised in cramped, stress-inducing, often unhygienic conditions conducive to infection. The Union of Concerned Scientists, using available data, recently estimated that 10.5 million pounds of antibiotics annually are put in poultry feed or water for these non-therapeutic reasons.[29]

Twenty-one percent (2.2 million pounds) are antibiotics identical or nearly so to ones used in human medicine. They include tetracyclines, erythromycin, penicillin, bacitracin, and virginiamycin (a close relative of the critical human medicine, Synercid). By comparison, all human antibiotic use may consist of just 3 million pounds each year.[30]

The balance of non-therapeutic poultry antibiotics – 8.3 million pounds – are arsenical compounds (like roxarsone) or other agents not considered important for human use.

By industry estimates (1999), around 38,000 pounds of fluoroquinolone antibiotics annually also are given in drinking water to poultry flocks when some birds become sick with respiratory disease.[31] Fluoroquinolones, such as ciprofloxacin (Cipro) are considered critical human medicines. When fluoroquinolone agents were first approved for use in poultry in 1995, therefore, it provoked much public health concern. When a 1999 Minnesota study found 20 percent of *Campylobacter* isolated from retail chickens to be Cipro-resistant, that concern only grew.

Purpose of this Report

No government testing to date, nor studies appearing in scientific journals, have tested specific poultry brands for both the presence of disease-causing bacteria *and* their resistance to antibiotics. No studies that we have identified have tested *multiple* bacteria found on poultry at the same time for their resistance to antibiotics, perhaps the best reflection of bacterial risk to people actually eating the meat.

In 1998, the magazine *Consumer Reports* did test 1,000 whole chickens purchased from grocery stores in 36 cities for levels of *Salmonella*, *Campylobacter* and generic *Escherichia coli* (an indicator of fecal contamination). The study included tests of four leading brands – Perdue, Tyson Holly Farms, Foster Farms and Country Pride, as well as several "premium" supermarket and kosher brands (of these, Country Pride is the only brand we also tested). The *Consumer Reports* study did not test turkey meat, and did not test for antibiotic resistance among any of the bacteria found on meat.

That study also preceded the U.S. Department of Agriculture's 1998 launch of its new HACCP (Hazard Analysis and Critical Control Point) slaughterhouse inspection program, specifically designed to reduce the levels of certain pathogens on meat and poultry. For poultry consumers, especially those in Minnesota and Iowa, therefore, our study gives new or updated information about the effectiveness of the program in ensuring lower pathogen levels on the specific poultry brands they buy.

The Sierra Club and the Institute for Agriculture & Trade Policy jointly commissioned this study, using funds from non-profit foundations or individual donors. We neither solicited nor used any money from corporations for this project.

CHAPTER 2

BACKGROUND INFORMATION ON BACTERIAL CONTAMINATION OF MEAT AND PUBLIC HEALTH CONCERNS

Government studies, as well as articles published in scientific journals, have long demonstrated that U.S. meats, including chicken and turkey, are significantly contaminated with disease-causing bacteria, including *Salmonella* and *Campylobacter*. More recent studies also demonstrate that *Salmonella*, *Campylobacter*, and other bacteria on meat individually often are resistant to antibiotics.

Government Testing for Bacteria in Meat

In 1994-95, the U.S. Department of Agriculture's Food Safety Inspection Service (FSIS) sampled nearly 1300 broiler chickens from slaughter facilities responsible for 99 percent of all slaughtered U.S. chickens. It found 88 percent were contaminated with *Campylobacter* bacteria, while 20 percent carried *Salmonella* bacteria.[32] Similarly, FSIS collected nearly 300 ground turkey samples in 1995 from 40 slaughterhouses, and found half (49.9 percent) carried *Salmonella*, and one in four samples (25.4 percent) was contaminated with *Campylobacter* species.[33]

For both broilers and ground turkey, the 1994-95 *Salmonella* data became the microbiological "baseline" or standard for the USDA's new HACCP system for slaughterhouse inspection, which began in 1998. Under HACCP, USDA collects hundreds or thousands of meat samples each year from large and small slaughterhouses and tests them for *Salmonella*.[34] To be in compliance, for example, no more than 20 percent of the 51 broilers tested in a plant (or 49.9 percent of the ground turkey) can carry *Salmonella*. Plants out of compliance must start corrective actions in order to meet the standard in follow-up testing. Strictly speaking, HACCP is simply an inspection program to monitor the cleanliness of slaughter facilities, and not a program for assuring consumers access to safe meat at the retail level.

In the years since HACCP began, USDA data (Table 1) show that in large plants meeting the *Salmonella* standards for either broilers or ground turkey, the prevalence of *Salmonella* has tended to fall. For 2001, the most recent data show *Salmonella* contamination of just 9.7 percent and 25.2 percent on broilers and ground turkey, respectively, for these same large plants – roughly half the levels found in USDA's "baseline" surveys in 1994-95.

Table 1: Prevalence of *Salmonella* and *Campylobacter* (in % of samples) on Raw Broiler Chickens and Ground Turkey Meat in Large U.S. Slaughterhouses Meeting USDA's Standards Under HACCP, 1998-2001, and Compared to Baseline.				
Year of Testing	**Salmonella**		**Campylobacter** (NT = not tested)	
	Whole Chicken	Ground Turkey	Whole Chicken	Ground Turkey
Baseline	20.0	49.9	88.2	25.4
1998	10.8	36.5	NT	NT
1999	9.3	33.1	NT	NT
2000	7.5	26.5	NT	NT
2001	9.7	25.2	NT	NT
Source: Food Safety Inspection Service, U.S. Department of Agriculture, Progress Report on Salmonella Testing of Raw Meat and Poultry Products, 1998-2001, Accessed 11/23/02 at *www.fsis.usda.gov/OPS/haccp/salm4year.htm.*				

By way of comparison, USDA (2001) recently tested whole turkeys in 38 slaughter plants throughout the U.S. for *Salmonella* contamination. The Center for Science in the Public Interest released the data to the public, including contamination levels for specific named plants, which ranged from 0 percent to more than 30 percent.[35] For example, Honeysuckle White brand whole turkeys tested in various Cargill plants were found to have *Salmonella* contamination ranging from 1.8 percent of tested birds (in California, MO) to 8.9% of birds (in Ozark, AR). Jennie-O brand whole turkeys tested in various Jennie-O plants were found to have *Salmonella* contamination ranging from 7.0 percent of tested birds (in Pelican Rapids, MN) to 14.3 percent of birds (in Faribault, MN plant).

Unlike for *Salmonella*, there is no performance standard for *Campylobacter* contamination under HACCP, nor does it require any testing of slaughter facilities for *Campylobacter* contamination of meat.

Other Select Studies of Bacteria in Meat

In Fall 1997, scientists at the Minnesota Department of Health purchased 91 "domestic chicken products" from retail supermarkets in the Minneapolis-St. Paul area, and found 88 percent contaminated with *Campylobacter* – the same prevalence as that found in USDA's 1994-95 baseline survey of broilers in slaughter facilities.

A study by White et al. (2001) purchased ground meats from supermarkets in the Washington, DC area and found 41 out of 200, or 20 percent, were contaminated with *Salmonella*.[36] Ground chicken (35%) and ground turkey (24%) were more frequently contaminated than were ground pork (16%) or ground beef (6%).

Recent surveys of U.S. retail meats also have found that an alarming percentage carry bacteria resistant to one or more important antibiotics. White et al. (2001), for example, analyzed 45 *Salmonella* from the 41 ground meat samples positive for *Salmonella* (some samples yielded multiple isolates). Eighty-four percent were resistant to at least one antibiotic, 53 percent were resistant to three or more antibiotics, and 27 percent were resistant to at least six antibiotics.[37]

In the Minnesota study just described, *Campylobacter* bacteria found on retail chicken products were also analyzed for antibiotic resistance. Twenty percent (18 of 91 products) of *Campylobacter* were resistant to ciprofloxacin. Eight of these Cipro-resistant isolates were also resistant to two other human fluoroquinolone medicines, grepafloxacin and trovafloxacin, as well as to two poultry fluoroquionolones, enrofloxacin (Baytril) and sarafloxacin. Six of the eight were also resistant to a fifth fluoroquinolone.[38]

As indicated by preliminary data from the Centers for Disease Control and Prevention, human *Campylobacter* infections resistant to fluoroquinolone (FQ) antibiotics rose from 13 percent in 1997 to 19 percent in 2001.[39] A decade ago, fluoroquinolone resistance was negligible. Human use of FQ antibiotics began in 1986. Yet FQ-resistant *Campylobacter* infections increased little until 1996-97, soon after the 1995 FDA approval of these drugs for use in poultry.[40] McDermott et al. (2002) have demonstrated that in poultry flocks given such fluoroquinolones, *Campylobacter* bacteria rapidly become less sensitive to these drugs, and the resistance persists long after the antibiotic is stopped.[41] In 2000, the FDA proposed banning these poultry fluoroquinolones, due to concern that their use has contributed to the dramatic rise in the prevalence of Cipro-resistant *Campylobacter* infections in humans.

Health Hazards from Resistant Bacteria on Retail Meats

There are no good estimates of how many people suffer from foodborne infections resistant to antibiotics. The Food and Drug Administration's best estimate using 1999 data is that 153,580 Americans developed FQ-resistant (Cipro-resistant) *Campylobacter* infections alone after eating contaminated chicken inside the U.S.[42] Most human infections with antibiotic-resistant *Salmonella* come from contaminated food, as well.[43,44,45,46,47]

While eating contaminated food may be the most obvious way to contract a resistant infection, bacteria in meat juices can also contaminate kitchen surfaces and utensils, indirectly leading to infection.

Though most infections do not require them, it is not uncommon for foodborne illness to be treated with antibiotics. Forty percent of patients with *Salmonella* seeking treatment received antibiotics, according to CDC surveys in 1990 and 1995. Rising antibiotic resistance among foodborne pathogens, like *Salmonella* and *Campylobacter*, therefore carries direct health consequences, a few of which are described.[48,49,50]

Less effective antibiotics, and fewer alternatives. Patients with bacterial infections respond poorly to an antibiotic given empirically (without a culture) if it turns out to be a medicine to which the bacteria are resistant.

Antibiotics work best at limiting the duration of a serious (bacterial) foodborne infection when taken early, even before cultures have confirmed exactly which microbe is the cause.[51,52] Yet, an infection caused by an actually resistant bacterial strain can mean that the initial, empirically-chosen antibiotic proves to be ineffective. Even a suspicion of resistance, therefore, can compel a health practitioner to choose a more toxic or expensive antibiotic than would otherwise be the case. The rising resistance of foodborne pathogens to fluoroquinolones, therefore, is particularly concerning.[53]

Fluoroquinolone antibiotics, like Cipro, are currently favored for empirically treating a severe foodborne infection of undetermined origin, because they work against most bacterial causes and have relatively few side effects. Rising resistance among foodborne bacteria means that previously used medicines are no longer favored. Macrolide antibiotics (like erythromycin) are also effective for treating *Campylobacter*, but not *Salmonella* or many other foodborne pathogens, so they are less useful as an empiric therapy.

A recent Minnesota study found that sixty-five percent of patients treated for *Campylobacter* received a fluoroquinolone antibiotic. Fluoroquinolones are not approved for use in children, however.

Ciprofloxacin also is the most-prescribed antibiotic for *Salmonella* infections, according to CDC surveys.[54] Expanded spectrum cephalosporins are the current antibiotic of choice for treating children with serious *Salmonella* infection, in part due to the low prevalence of resistance. In the past, ampicillin, chloramphenicol and trimethoprim-sulfamethoxazole (Bactrim) have all been the "drug of choice" for treating *Salmonella* infections.[55]

Increased resistance to any antibiotics used for treating severe foodborne infections is worrisome. Because they are the antibiotics of choice for serious infections in adults and children, however, increased *Campylobacter* resistance to erythromycin and fluoroquinolones, or *Salmonella* resistance to fluoroquinolones and cephalosporins, would have grave consequences for human health. Because of their beneficial properties, no clear and effective alternatives are available to these critical medicines.

Worse, more prolonged illness. For both *Salmonella* and *Campylobacter*, data suggest that antibiotic-resistant strains cause more severe or more prolonged illnesses than do non-resistant strains. For example, one recent study estimates that each year more than 400,000 additional days of diarrhea can be attributed to people in the U.S. contracting fluoroquinolone-resistant *Campylobacter* infections from domestically contaminated food.[56]

Not everyone is equally vulnerable to antibiotic-resistant infections. Children face higher risks, and more limited treatment options. Infants are ten times more likely than the general population to contract *Salmonella* infections, for example, and twice as likely as older people to suffer a *Campylobacter* infection.[57] Infants and toddlers also can become infected by lower levels of bacteria on food than do adults. In newborns and very young infants, such infections are more likely to invade the bloodstream.[58] With *Salmonella* and other foodborne pathogens becoming increasingly resistant to existing antibiotics, fewer medicines may be available to treat children with these infections.[59]

More infections. Foodborne pathogens need not be resistant to the antibiotics specifically used for treating foodborne disease for that resistance to be significant to public health.

The normal complement of bacteria in the human gut provides an important level of protection against intestinal infections by disease-causing bacteria. Even routine antibiotic use disrupts this protection, increasing a person's odds of getting an infection if exposed to a foodborne pathogen.

When that foodborne pathogen is resistant to an antibiotic (or more than one), however, studies suggest the person who happens to be taking that same medicine – even for an unrelated reason – has a more than 3-fold greater vulnerability to being infected.[60] In other words, antibiotic resistance among foodborne bacteria actually results in *more* people getting sick with foodborne infections than would have been the case without such resistance. In 2002, a published study estimates that the mere presence of *Salmonella* and *Campylobacter* strains resistant to at least one antibiotic will result in 29,300 additional human *Salmonella* infections and 17,600 additional *Campylobacter* infections each year.[61]

Concerns About "Opportunistic" Bacteria on Meat

The human intestine is colonized by around 500 commensal bacteria species.[62] Commensal bacteria typically cause no disease, but may do so opportunistically, when the immune system or other normal defenses against infection have been compromised – as in hospitalized patients, or patients undergoing chemotherapy for cancer. Some of these non-pathogenic bacteria are found on food, and are also becoming more and more resistant to antibiotics. They pose a health threat as well.

Enterococci bacteria are considered commensal. Retail meats are often contaminated with antibiotic-resistant *Enterococci*.[63,64,65] Danish researchers recently studied volunteers intentionally given chicken or pork contaminated with antibiotic-resistant *Enterococci*; these bacteria persisted in their intestines for at least two weeks.[66]

People whose intestines become colonized with drug-resistant *Enterococci* can later develop opportunistic infections in the hospital. Certain *Enterococci* strains, with resistance to vancomycin and with high-level resistance to gentamicin, have become important causes of illness and death in hospitals.[67] Gentamicin and vancomycin are important treatments for *Enterococci* infections; many strains resistant to these drugs may now only be treated with two newer human antibiotics, linezolid (Zyvox) and quinupristin/dalfopristin (Synercid). Synercid, a combination of two streptogramin antibiotics, was FDA-approved in 1999 specifically for treating these resistant infections. Resistance to Synercid is increasing however.

Gentamicin along with virginiamycin, a close cousin of Synercid, is frequently used non-therapeutically, for growth promotion and disease prevention in chickens. Research suggests the widespread use of virginiamycin and gentamicin in chickens has created a reservoir of Synercid-resistant and gentamicin-resistant *Enterococci* in the food supply.[68] This raises concerns that poultry contaminated with these bacteria may carry the "seeds" of resistance to these medicines from animals into the intestinal flora of the human populations, where *Enterococci* is also part of the normal bacterial flora.[69]

CHAPTER 3

PATHOGENS IN POULTRY: OUR TEST RESULTS

For this project, we bought and had tested chicken and turkey products routinely available to shoppers at large supermarket chains in Des Moines, Iowa and Minneapolis-St. Paul, Minnesota.

We tested 200 fresh whole chickens and 200 packages of fresh ground turkey in all, 100 of each from the two states. Iowa-purchased poultry products included Country Pride chicken and Honeysuckle White turkey; Minnesota-purchased brands were Gold'N Plump chicken and Jennie-O turkey. Each brand is commonly found in groceries, either regionally or nationally.

Gold'N Plump chicken is produced by Gold'N Plump Poultry (St. Cloud, MN). Country Pride is a brand of ConAgra Poultry Group (Duluth, GA). Ground turkey under the Jennie-O and Honeysuckle White labels are products of Jennie-O Turkey Store, Inc. (Willmar, MN) – a subsidiary of Austin, MN-based Hormel Foods, and Cargill, Inc. (Minneapolis, MN).

We contracted with a certified food-testing laboratory to test the products for the presence of three bacterial strains – *Salmonella, Campylobacter* and *Enterococci* – and for resistance to a number of antibiotics. For cost reasons, not every meat sample was tested for every type of bacteria (Table 2 and Tables A-2 and A-3 in Appendix A). Testing also was not done to determine the exact strain of certain bacteria present on the meat – *Salmonella typhimurium*, for example. Finally, not every bacteria actually isolated in these tests was itself tested for antibiotic resistance.

Table 2: Number of Whole Chickens and Ground Turkey Packages Tested for Prevalence of Bacteria

	Enterococcus	***Salmonella***	***Campylobacter***
Whole Chicken			
Gold'N Plump	50	100	50
Country Pride	50	100	50
Overall	100	200	100
Ground Turkey			
Jennie-O	50	100	50
Honeysuckle White	51	100	51
Overall	101	200	101

Appendix A describes in detail the methodology for collecting the meat samples, as well as the methodology for the actual testing of the meat samples. Appendix B summarizes the results of testing individual bacteria for resistance to antibiotics.

Whole Chicken Contamination

Laboratory testing found that, overall, nearly 18 percent of the fresh whole chickens purchased were contaminated with *Salmonella*, the second leading bacterial cause of foodborne illness in the U.S. (Table 3).

Table 3: Prevalence of Foodborne Pathogens on Whole Chicken, Ground Turkey Purchased in Minnesota and Iowa			
	Salmonella	***Campylobacter***	**Both**
Whole Chicken			
Gold'N Plump	15.0%	94.0%	14.0%
Country Pride	20.0%	96.0%	32.0%
Overall	17.5%	95.0%	23.0%
Ground Turkey			
Jennie-O	34.0%	2.0%	2.0%
Honeysuckle White	56.0%	2.0%	0.0%
Overall	45.0%	2.0%	1.0%

Twenty percent of Country Pride chickens carried *Salmonella*, as did 15 percent of Gold'N Plump chickens. By comparison, in 2001 the prevalence of *Salmonella* on whole chickens from large slaughter facilities passing the USDA's *Salmonella* "baseline" or standard under its HACCP inspection program was 9.7 percent – although this program tests chicken in the slaughterhouse, not at the retail level. The contamination rate in all slaughter facilities, large, small or very small, was 11.9 percent.[70] Both of the chicken brands we tested exceeded these levels.

All 35 *Salmonella* isolated from whole chickens were analyzed for antibiotic resistance. Nearly six percent (n=2) were resistant to 4 or more antibiotics (Table 4). One of these *Salmonella*, from a Gold'N Plump chicken, carried resistance to gentamicin, streptomycin, sulfamethoxazole, and tetracycline. The other, from a Country Pride chicken, was resistant to six antibiotics, including augmentin-clavulinic acid, ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline. Though no resistance to Cipro was observed in these *Salmonella* from chicken, there was some resistance to ampicillin and chloramphenicol, which – along with trimethoprim-sulfamethoxazole (Bactrim) – have been "treatments of choice" for Salmonella infections in the past.[71]

Table 4: *Salmonella* Resistance to One or Multiple Antibiotics (in % of isolates tested)					
	1 or more	**2 or more**	**3 or more**	**4 or more**	**5 or more**
Whole Chicken					
Gold'N Plump	6.7%	6.7%	6.7%	6.7%	0.0%
Country Pride	5.0%	5.0%	5.0%	5.0%	5.0%
Overall	5.7%	5.7%	5.7%	5.7%	2.9%
Ground Turkey					
Jennie-O	58.8%	58.8%	58.8%	58.8%	5.9%
Honeysuckle White	64.3%	42.9%	42.9%	14.3%	7.1%
Overall	62.2%	48.9%	48.9%	31.1%	6.7%

Campylobacter contaminated 95 percent of the whole chickens tested.

Forty-seven of the *Campylobacter* found on chicken were further tested for resistance. Nearly 62 percent (n=29) were found resistant to 1 or more antibiotics, and more than 6 percent (n=3) were resistant to 2 or more antibiotics (Table 5).

More than 6 percent of these chicken isolates overall were resistant to Cipro. By brand, 8.7 percent (2 isolates) of *Campylobacter* on Country Pride chickens, and 4.2 percent (1 isolate) on Gold'N Plump chickens, were Cipro-resistant (Appendix B).

Table 5: *Campylobacter* Resistance to One or Multiple Antibiotics (in % of isolates tested)

	1 or more	2 or more	4 or more
Whole Chicken			
Gold'N Plump	75.0%	4.2%	0.0%
Country Pride	47.8%	8.7%	4.3%
Overall	61.7%	6.4%	2.1%
Ground Turkey			
Jennie-O	100.0%	100.0%	100.0%
Honeysuckle White	100.0%	0.0%	0.0%
Overall	100.0%	50.0%	50.0%

Ground Turkey Contamination

Ground turkey tested was more contaminated with *Salmonella* than was whole chicken, with an overall rate of 45 percent. Fifty-six percent of Honeysuckle White turkey carried *Salmonella* bacteria, while contamination of Jennie-O turkey, at 34 percent, was somewhat lower.

By comparison, in 2001 the prevalence of *Salmonella* in ground turkey from large slaughter facilities passing the USDA's *Salmonella* "baseline" or standard under its HACCP inspection program was 25.2 percent. Again, ground turkey that we tested of either brand exceeded this level. *Salmonella* contamination of Honeysuckle White turkey was more than twice as high.

Of the 90 *Salmonella* isolated from ground turkey overall, half were tested for antibiotic resistance. Over 62 percent (28 of 45) of the latter were resistant to at least one antibiotic, almost half were resistant to 3 or more antibiotics, and roughly one-third to 4 or more antibiotics (Table 4). Resistant turkey isolates were most likely to carry resistance to the antibiotics streptomycin and tetracycline (48.9 percent), sulfamethoxazole (42.2 percent) and gentamicin (35.6 percent). Kanamycin resistance was 15.6 percent (Table 6).

While the Jennie-O products tested carried less *Salmonella* than did Honeysuckle White products, the resistant *Salmonella* in the Jennie-O products tended to be resistant to more antibiotics; nearly 59 percent of these isolates were resistant to four or more antibiotics, compared with just over 14 percent for Honeysuckle White.

Table 6: Antibiotic Resistance Summary for 35 *Salmonella* Isolates from Chicken, 45 Isolates from Turkey		
	Whole Chicken	Ground Turkey
Antibiotic	**% Resistant**	**% Resistant**
Amikacin	0.0%	0.0%
Amoxicillin-clavulanic acid	2.9%	2.2%
Ampicillin	2.9%	0.0%
Cefoxitin	0.0%	2.2%
Ceftiofur	0.0%	0.0%
Ceftriaxone	0.0%	0.0%
Cephalothin	0.0%	2.2%
Chloramphenicol	2.9%	0.0%
Ciprofloxacin	0.0%	0.0%
Gentamicin	2.9%	35.6%
Kanamycin	0.0%	15.6%
Nalidixic acid	0.0%	0.0%
Streptomycin	5.7%	48.9%
Sulfamethoxazole	5.7%	42.2%
Tetracycline	5.7%	48.9%
Trimethoprim-sulfamethoxazole	0.0%	0.0%

Of the two *Campylobacter* isolated from ground turkey packages, both were antibiotic resistant. One, from a Jennie-O package, was the most resistant of any *Campylobacter* bacteria identified, with resistance to six antibiotics including ciprofloxacin (Cipro), tetracycline and erythromycin. The same package also yielded a *Salmonella* bacterium resistant to four antibiotics.

Cipro and erythromycin are the two antibiotics of choice for treating severe *Campylobacter* infections in adults, so the presence of bacteria resistant to both of them raises concerns.

More than 8 percent of the *Campylobacter* isolated from chicken or turkey products and tested for resistance were resistant to Cipro (Table 7), while more than 61 percent were resistant to tetracycline. Only the turkey *Campylobacter* isolate mentioned above was fully resistant to erythromycin. In 22 percent of the *Campylobacter* bacteria tested, however, there was diminished susceptibility to erythromycin, meaning they were somewhat resistant. Whether or not this has implications for the likely evolution of full resistance to erythromycin in the future is unclear.

Table 7: Antibiotic Resistance Summary for 49 *Campylobacter* Isolates from Poultry		
Antibiotic	**% Resistant**	**% Intermediate**
Azithromycin	2.0	12.2
Chloramphenicol	0.0	0.0
Ciprofloxacin	8.2	0.0
Clindamycin	2.0	14.3
Erythromycin	2.0	22.4
Gentamicin	0.0	2.0
Nalidixic acid	8.2	0.0
Tetracycline	61.2	0.0

In 2001, the Union of Concerned Scientists estimated that 1.4 million pounds of a tetracycline antibiotic (chlortetracycline), and 380,000 pounds of erythromycin, annually are fed to poultry flocks for non-therapeutic purposes.[72]

***Enterococcus* Contamination**. *Enterococcus* was found on 100% of the chicken and turkey products we tested from Iowa and Minnesota. *Enterococcus* is a group of approximately twenty species of bacteria that are ubiquitous in man, animals and in the environment. In healthy persons, *Enterococci* are considered benign. In hospitals, however, antibiotic-resistant strains are becoming an important cause of serious, difficult-to-treat infections. We did not attempt to identify particular species of *Enterococci*.

Table 8: *Enterococci* Resistance to One or Multiple Antibiotics (in % of isolates tested)

	1 or more	2 or more	3 or more	4 or more	5 or more
Whole Chicken					
Gold'N Plump	100.0%	92.0%	60.0%	32.0%	4.0%
Country Pride	96.0%	56.0%	16.0%	4.0%	0.0%
Overall	98.0%	74.0%	38.0%	18.0%	2.0%
Ground Turkey					
Jennie-O	100.0%	88.0%	16.0%	0.0%	0.0%
Honeysuckle White	100.0%	100.0%	19.2%	0.0%	0.0%
Overall	100.0%	94.1%	17.6%	0.0%	0.0%

Of the 100 *Enterococci* bacteria isolated from whole chickens, half were tested for antibiotic resistance. Ninety-eight percent (n=49) of those were found resistant to one or more antibiotics, nearly 75 percent to two or more antibiotics (n=37), and 38 percent (n=19) to 3 or more antibiotics. Almost one in five *Enterococci* carried resistance to 4 or more antibiotics (Table 8). Gold'N Plump whole chickens carried a higher percentage of *Enterococci* bacteria resistant to 3 or more antibiotics at 60 percent (n=15), and to 4 or more antibiotics at 32 percent (n=8), than did other whole chicken or ground turkey brands.

Table 9: Antibiotic Resistance Summary for 101 Enterococci Isolates from All Whole Chicken and Ground Turkey Products

Antibiotic	% Resistant
Chloramphenicol	1.0
Ciprofloxacin	1.0
Erythromycin	19.8
Gentamicin	10.9
Linezolid	0.0
Nitrofurantoin	0.0
Penicillin	1.0
Quinupristin/dalfopristin	96.0
Streptomycin	8.9
Tetracylcine	81.2
Vancomycin	0.0

For all 101 *Enterococci* isolated from chicken or turkey products and subsequently tested for resistance (Table 9), resistance was most likely to quinupristin/dalfopristin (96 percent), tetracycline (81.2 percent), erythromycin (19.8 percent), and gentamicin (10.9 percent). Resistance to Synercid was somewhat higher for bacteria from turkey versus chicken (100% to 92%), as was also true for tetracycline (92% versus 70%). The reverse, higher resistance in chicken versus turkey isolates, was true for erythromycin (32% to 8%) and gentamicin (18% to 4%).

Chapter 4

Conclusion and Recommendations

For decades, antibiotics have dramatically reduced illness and death from bacterial infections. But recently, the effectiveness of these life-saving drugs has begun to wane because antibiotics are being overused.

Antibiotic overuse is the key factor in development of antibiotic resistance. Certainly, antibiotics are being overused in human medicine. But industrial-scale poultry producers also routinely put antibiotics in poultry feed, more than 10 million pounds a year by some estimates. More than 2 million pounds per year are antibiotics identical or closely related to important human medicines.

Evidence now links the widespread use of antibiotics in animal feed with the transmission to humans of antibiotic-resistant bacteria, and an increase in antibiotic-resistant infections that respond less well to treatment with these same, or similar, medicines.[73,74,75,76,77] In 1989, the Institute of Medicine estimated that as much as 90 percent of drug-resistant *Salmonella* in food stems from the practice of giving antibiotics to food animals at lower than therapeutic levels.[78]

The American Medical Association has gone on record opposing the use of antibiotics in farm animals that aren't sick. Other medical professionals are also speaking out. If they cannot rely upon these antibiotics, it will become more difficult and in some cases impossible to treat bacterial illnesses.

This report, based on testing of 400 poultry products purchased in Des Moines and Minneapolis-St. Paul, finds these products were frequently contaminated with bacteria that can cause infections. In this respect, our study confirms data available from previous government surveys and other studies (Table 10).

Table 10: *Campylobacter* and *Salmonella* on Retail and Slaughterhouse Whole Chicken and Ground Turkey: A Comparison of Findings from Several Studies

	Whole Chicken		Ground Turkey	
Study	*Campylobacter*	*Salmonella*	*Campylobacter*	*Salmonella*
FSIS, 1994-95	88.2%	20.0%	25.4%	49.9%
Smith et al. (MN) 1997*	87.9%			
White et al., 2001				24.0%
HACCP Baseline	NA	20.0%	NA	49.9%
HACCP 2001**	NA	9.7%	NA	25.2%
IATP/Sierra Club (MN & IA) 2002	96.0%	17.5%	2.0%	45.0%

* Tested "retail chicken products" and not whole chickens, necessarily.
** Prevalence of contamination in poultry from large facilities passing HACCP standards

Our tests also revealed, however that the bacteria on these products frequently were resistant to one or multiple antibiotics important to human medicine, like Cipro, gentamicin and Synercid. In one case, the same package of ground turkey carried multiple pathogenic bacteria, each resistant to multiple human antibiotics.

Among the *Campylobacter* found on poultry and tested, over 8 percent were resistant to Cipro – which, along with closely related drugs, are the antibiotics that doctors most rely upon for treating Campylobacter infections, as well as other severe, potentially life-threatening cases of food poisoning in adults. In 2000, the FDA concluded that continued use of the Cipro analog, Baytril (enrofloxacin) in poultry flocks makes Cipro less effective for treating people sick with severe cases of *Campylobacter* food poisoning. The agency estimated that in 1999, the eating of chickens contaminated with fluoroquinolone (FQ)-resistant *Campylobacter* bacteria led to 153,580 Americans developing a foodborne infection caused by FQ-resistant bacteria. FDA's best estimate was that 9,261 of these sick people subsequently were given Cipro, or a related medicine, to try and treat their infection.[79]

Subsequently, the FDA proposed banning the use of FQ antibiotics like Baytril on poultry. One manufacturer, Abbott Laboratories, complied with this request. Another, Bayer, has refused. Bayer continues to manufacture the drug, and poultry companies continue to use it. Bayer should voluntarily withdraw the use of this product to protect public health.

The widespread resistance of *Enterococci* found in our testing of both chicken and turkey products is another concern, especially the near universal resistance to Synercid. Synercid has only been used in people since 1999, while its close analog, virginiamycin, has been used non-therapeutically in poultry since 1974. Since resistant *Enterococci* from food can persist in the human intestine for weeks, there is grave concern that there will be rising Synercid-resistant infections in people, as rising human use of the medicine creates the conditions for these originally foodborne, Synercid-resistant bacteria to propagate and cause increased infections in humans.

Recommendations

Consumers expect the meat they purchase to be free of health-threatening bacteria. Increasingly, though, we have learned that food products, particularly meats, may be contaminated with bacteria that pose serious health risks.

The science clearly shows that raising animals with antibiotics results in antibiotic-resistant bacteria that get transmitted to people, typically via the eating of food contaminated with them. It stands to reason that chicken and turkeys raised without antibiotics are less likely to carry resistant bacteria.

Industry, consumers and government therefore all should act to reduce the threat of antibiotic-resistant bacteria in food.

<u>Consumers can help reduce the threat simply by buying chicken or turkey raised without antibiotics, or at the very least, without antibiotic growth promoters or other non-therapeutic antibiotics</u>. By choosing these products, consumers also are supporting producers who raise poultry using methods less likely to introduce resistant bacteria – and the genes that make them resistant – into the broader environment, including surface waters, groundwater and soil.

Poultry produced with little or no antibiotics is widely available throughout the U.S. One certain way of buying it is to purchase certified organic chickens and turkeys. Other producers, particularly smaller ones, may claim to use no antibiotics even if they have not gone through the expense of becoming certified organic.

Consumers can buy poultry products, for example, carrying "raised without antibiotics" or "no antibiotics administered" on the label, which the USDA defines as meaning meat from animals receiving no antibiotics over the course of their lifetime. Since USDA does define the terms, it has authority to hold producers responsible for the use of these labels. Unlike certified organic meats, however, neither USDA nor any independent, third party verifies the claims.[80]

Check the **Eat Well Guide**, *www.iatp.org/EatWell*, for a state-by-state listing of organic and other meat and poultry producers using either no antibiotics, or no routine antibiotics, in addition to restaurants and other places to buy these products.

Whatever meat products consumers purchase, they should always practice safe meat handling procedures. This will help avoid contamination between or on food items, cooking utensils, countertops, and other kitchen surfaces. Consumer advice is available at the website, *www.foodsafety.gov*.

Some industry groups also have begun to take some steps to address this problem. McDonald's, Popeye's and Wendy's all now state it is their policy not to buy chicken from producers using Cipro-like antibiotics.[81] Several other fast food companies, like Hardee's, Subway and Domino's, have similar policies, but also say they will not buy chickens fed important human antibiotics for non-therapeutic reasons, like growth promotion.[82]

Four of the top five top chicken producers also have sworn off any use of Cipro-like antibiotics, including ConAgra Poultry, producers of Country Pride chicken. Others, also including ConAgra, claim to have stopped using or to have greatly reduced the use of antibiotics for growth promotion or disease prophylaxis. We generally laud this approach, although there is no mechanism for verifying producers' claims.

While these are promising initial steps, all poultry producers should commit to reducing overall antibiotic use to a minimum, and to phasing out the use of antibiotics in animals that are not even sick. This especially includes ending the non-therapeutic use of antibiotics that are, or may become, important to human medicine.

Drug manufacturers also have a part to play in protecting the effectiveness of antibiotics for the benefit of everyone. And yet the failure of Bayer to act responsibly in withdrawing its Cipro-like product from the poultry market highlights the need for strong governmental action.

As a priority, the FDA should ban the use of fluoroquinolone antibiotics in poultry, as it has proposed. Two years have already passed since FDA first launched its proposal. Fluoroquinolones are critical antibiotics for treating many infections, including severe cases of food poisoning. FDA needs to act quickly lest this critical human drug lose any more of its effectiveness for treating seriously ill people.

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Appendix A: Methodology

Sampling Methodology

Overview. We bought 200 whole chickens and 200 packages of ground turkey, and prepared and shipped them to a certified laboratory where they were tested for the prevalence of two bacterial pathogens, *Salmonella* and *Campylobacter*, and one typically nonpathogenic bacterium, *Enterococcus*. Certain isolates of the three bacteria were then also tested for resistance to multiple antibiotics.

All testing was carried out by a full-service food-testing laboratory which has conducted hundreds of microbiological and chemical research projects for food and related industries over the last 35 years. The lab is ISO 25 compliant – according to the American Association for Laboratory Accreditation (AALA), AALA-accredited for biological testing, and meet ISO/IEC 17025 requirements.

Poultry collection and shipping. One hundred Country Pride brand whole chickens, and one hundred packages of Honeysuckle White brand ground turkey were purchased at several Hy-Vee and Dahl's supermarkets in or around Des Moines, Iowa over a two week period. A second hundred Gold'N Plump brand whole chickens and one hundred packages of Jennie-O brand ground turkey were bought from several Cub and Rainbow supermarkets in the Minneapolis-St. Paul, Minnesota metropolitan region, also over a period of two weeks. Table A-1 outlines the purchasing protocol followed.

All of the poultry products purchased were from the refrigerated section; no frozen meat was purchased. Also, after purchasing, the poultry products were kept refrigerated and were not frozen.

Poultry samples were collected over a 2-week time period, and at several grocery stores, to help ensure against anomalous results. The choice of where to buy the poultry was largely determined by the logistics of collecting, preparing and shipping several hundred meat samples. We also bought products from the supermarkets where people we know normally shop.

Poultry sample collection, preparation and shipping to the testing laboratory was conducted according to a written protocol. The only variance between the two cities was that poultry sample were purchased in Des Moines more frequently and in smaller batches.

Sample collectors picked up individual poultry packages from the meat counters in supermarkets using self-sealing plastic bags turned inside-out, to prevent contamination, as well as while wearing plastic gloves. Only one person handled each type of meat to avoid cross-contamination. Plastic bags were immediately sealed. Even before entering the store, the plastic bags had been numbered, labeled and sequentially ordered by codes that identified the meat type and state of purchase, e.g. M-C1 for Minnesota chicken. The labels/numbers were written directly onto the plastic bags with permanent waterproof marker; clear packing tape was placed over the label ensured visibility. Sampling data sheets were filled out completely after the sampling and collection effort to track the store of origin and brand for each meat product.

After purchase, poultry samples were immediately transported back to our offices in ice-filled coolers, although transit time was no more than 10 minutes for any given collection. Back at the office, label information was copied into the data sheets, poultry products were double-bagged and refrigerated until the entire day's collection was completed and ready for shipment.

Poultry products were packed in hard plastic shipping coolers, according to standards recommended by the testing laboratory, and kept refrigerated until pick-up by DHL courier.

Microbial Analysis & Antibiotic Assays:

Microbial Analysis: In the laboratory, whole chicken samples were received in the retail package, aseptically transferred from the store package to a sterile stomacher bag, and rinse sampled with 400 ml of sterile Butterfield's Phosphate diluent (BPD) per USDA methods.[1,2] The rinsate was microbiologically analyzed for *Salmonella*, *Campylobacter* and *Enterococci*. No attempt was made to determine individual strains of these bacteria.

For ground turkey samples, 25 g of product was aseptically transferred from the store package to a sterile stomacher bag, and stomached with 275 g of sterile Butterfield's Phosphate diluent (BPD). The sample homogenate was analyzed for *Salmonella*, *Campylobacter* and *Enterococci*.

Testing is not inexpensive, and so not every poultry sample was tested for the presence of all three bacteria. Every chicken and turkey sample was tested for the presence of *Salmonella*. Every other chicken and turkey sample was analyzed for the presence of *Campylobacter* and for *Enterococci*. Tables A-2 and A-3 summarize this information. The lab used a presence/absence method to obtain one isolate from each bacterium.

The following methods were used for the respective microbial analyses.

- *Salmonella* (AOAC, 989.14 presumptive ELISA screen)
- *Salmonella* (USDA LC-75/Chapter 4 MLG, incidence and confirmation)
- *Campylobacter* (USDA LC-69/Chapter 6 MLG, incidence and confirmation)
- *Enterococci* (CDC/NARMS Method for Enhanced Surveillance for Antimicrobial Resistance Among Enteric Bacteria: NARMS Retail Food Study)

Antibiotic Assays: Due to a limited budget, we decided to analyze *every Salmonella* isolate from whole chicken and *every other* isolate from ground turkey, as well as *every other Campylobacter* or *Enterococcal* bacteria isolated from either chicken or turkey, for sensitivity or resistance to various panels of antibiotics. On a few occasions, originally positive isolates would not grow out for resistance testing. In those cases, appropriate substitutions of other positive isolates were made. Please refer to Table B-1 in Appendix B for details.

Antibiotic resistance/sensitivity testing was carried out basically according to procedures described in the CDC publication, "CDC/NARMS Method for Enhanced Surveillance for Antimicrobial Resistance Among Enteric Bacteria: NARMS Retail Food Study".[3] *Salmonella* and *Enterococci* isolates were assayed for resistance to 16 and 17 antibiotics, respectively, using the Sensititre®

[1] USDA/FSIS Microbiology Laboratory Guidebook. 3rd Ed. 1998. Ch. 4
[2] USDA/FSIS Microbiology Laboratory Guidebook, 3rd Ed. 1998 Ch.6
[3] Enhanced Surveillance for Antimicrobial Resistance Among Enteric Bacteria: NARMS Retail Food Study

(TREK Diagnostic Systems, Westlake, Ohio) broth micro-dilution method, and *Campylobacter* isolates for resistance to 8 antibiotics using the E-Test® agar dilution method. Testing methods followed National Committee for Clinical Laboratory Standards where applicable.[4] The particular antibiotics tested are listed in Table A-4. Since NCCLS does not have *Enterococcus* MIC Interpretive standards for bacitracin, flavomycin, kanomycin, lincomycin, salinomycin, and tylosin, we did not get results indicating resistance or sensitivity of *Enterococcus* to these six.

Based on this testing regime, the last column of Table A-5 indicates the number of isolates of each bacteria tested for antibiotic resistance. Because there were so few, both *Campylobacter* isolated from turkey were analyzed for resistance.

[4] Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically; approved standard. Wayne, Pa: National Committee for Clinical Laboratory Standards, 2000 (NCCLS document M7-A5).

Table A-1: Poultry Purchasing Protocol

Date	Store Location	Brand Name	Product Purchased	Number of Packages
9/16/02	Cub #1	Jennie-O	GT	15
9/16/02	Cub #2	Jennie-O	GT	13
9/16/02	Cub #3	Jennie-O	GT	11
9/16/02	Cub #4	Jennie-O	GT	11
9/16/02	Cub #1	Gold N' Plump	WC	15
9/16/02	Cub #2	Gold N' Plump	WC	10
9/16/02	Cub #3	Gold N' Plump	WC	14
9/16/02	Cub #4	Gold N' Plump	WC	11
9/18/02	Hy-Vee #1	Country Pride	WC	4
9/18/02	Hy-Vee #2	Country Pride	WC	15
9/18/02	Hy-Vee #3	Country Pride	WC	6
9/18/02	Hy-Vee #1	Honeysuckle White	GT	7
9/18/02	Hy-Vee #2	Honeysuckle White	GT	10
9/18/02	Hy-Vee #3	Honeysuckle White	GT	8
9/30/02	Rainbow #1	Gold N' Plump	WC	12
9/30/02	Rainbow #2	Gold N' Plump	WC	14
9/30/02	Rainbow #3	Gold N' Plump	WC	11
9/30/02	Rainbow #4	Gold N' Plump	WC	13
9/30/02	Rainbow #1	Jennie-O	GT	14
9/30/02	Rainbow #2	Jennie-O	GT	12
9/30/02	Rainbow #4	Jennie-O	GT	16
9/30/02	Rainbow #3	Jennie-O	GT	8
9/30/02	Hy-Vee #1	Country Pride	WC	5
9/30/02	Hy-Vee #2	Country Pride	WC	9
9/30/02	Hy-Vee #3	Country Pride	WC	11
9/30/02	Hy-Vee #1	Honeysuckle White	GT	7
9/30/02	Hy-Vee #2	Honeysuckle White	GT	10
9/30/02	Hy-Vee #3	Honeysuckle White	GT	8
10/01/02	Hy-Vee #6	Country Pride	WC	8
10/01/02	Hy-Vee #7	Country Pride	WC	6
10/01/02	Hy-Vee #5	Country Pride	WC	11
10/01/02	Dahl's #1	Honeysuckle White	GT	4
10/01/02	Dahl's #2	Honeysuckle White	GT	6
10/01/02	Dahl's #3	Honeysuckle White	GT	3
10/01/02	Dahl's #4	Honeysuckle White	GT	12
10/02/02	Hy-Vee #4	Country Pride	WC	8
10/02/02	Hy-Vee #1	Country Pride	WC	4
10/02/02	Hy-Vee #5	Country Pride	WC	10
10/02/02	Hy-Vee #6	Country Pride	WC	3
10/02/02	Dahl's #5	Honeysuckle White	GT	6
10/02/02	Dahl's #4	Honeysuckle White	GT	6
10/02/02	Dahl's #3	Honeysuckle White	GT	6
10/02/02	Dahl's #1	Honeysuckle White	GT	7
				Total = 400

WC = Whole chicken
GT = Ground turkey

Table A-2: Results of Microbial Testing on Whole Chickens

Minnesota Samples (Gold'N Plump)				Iowa Samples (Country Pride)			
Sample #	*Enterococci*	*Salmonella*	*Campylobacter*	Sample #	*Enterococci*	*Salmonella*	*Campylobacter*
M-C1	positive	negative	positive	I-C1	positive	negative	positive
M-C2	not tested	negative	not tested	I-C2	not tested	negative	not tested
M-C3	positive	negative	positive	I-C3	positive	negative	positive
M-C4	not tested	negative	not tested	I-C4	not tested	negative	not tested
M-C5	positive	negative	positive	I-C5	positive	negative	positive
M-C6	not tested	negative	not tested	I-C6	not tested	negative	not tested
M-C7	positive	negative	positive	I-C7	positive	positive	positive
M-C8	not tested	negative	not tested	I-C8	not tested	negative	not tested
M-C9	positive	positive	positive	I-C9	positive	negative	positive
M-C10	not tested	positive	not tested	I-C10	not tested	negative	not tested
M-C11	positive	negative	positive	I-C11	positive	negative	positive
M-C12	not tested	negative	not tested	I-C12	not tested	positive	not tested
M-C13	positive	negative	positive	I-C13	positive	negative	positive
M-C14	not tested	negative	not tested	I-C14	not tested	negative	not tested
M-C15	positive	positive	positive	I-C15	positive	positive	positive
M-C16	not tested	positive	not tested	I-C16	not tested	negative	not tested
M-C17	positive	negative	positive	I-C17	positive	positive	positive
M-C18	not tested	positive	not tested	I-C18	not tested	negative	not tested
M-C19	positive	negative	positive	I-C19	positive	positive	positive
M-C20	not tested	positive	not tested	I-C20	not tested	negative	not tested
M-C21	positive	negative	negative	I-C21	positive	negative	positive
M-C22	not tested	negative	not tested	I-C22	not tested	negative	not tested
M-C23	positive	negative	positive	I-C23	positive	negative	positive
M-C24	not tested	negative	not tested	I-C24	not tested	negative	not tested
M-C25	positive	negative	positive	I-C25	positive	positive	positive
M-C26	not tested	negative	not tested	I-C26	not tested	positive	not tested
M-C27	positive	positive	positive	I-C27	positive	negative	positive
M-C28	not tested	negative	not tested	I-C28	not tested	positive	not tested
M-C29	positive	negative	positive	I-C29	positive	negative	positive
M-C30	not tested	negative	not tested	I-C30	not tested	negative	not tested
M-C31	positive	negative	positive	I-C31	positive	negative	positive
M-C32	not tested	negative	not tested	I-C32	not tested	negative	not tested
M-C33	positive	negative	negative	I-C33	positive	negative	positive
M-C34	not tested	negative	not tested	I-C34	not tested	negative	not tested
M-C35	positive	negative	negative	I-C35	positive	negative	positive
M-C36	not tested	positive	not tested	I-C36	not tested	negative	not tested
M-C37	positive	negative	positive	I-C37	positive	negative	positive
M-C38	not tested	negative	not tested	I-C38	not tested	negative	not tested
M-C39	positive	negative	positive	I-C39	positive	negative	positive
M-C40	not tested	negative	not tested	I-C40	not tested	negative	not tested
M-C41	positive	negative	positive	I-C41	positive	negative	positive
M-C42	not tested	negative	not tested	I-C42	not tested	negative	not tested
M-C43	positive	negative	positive	I-C43	positive	positive	positive
M-C44	not tested	negative	not tested	I-C44	not tested	negative	not tested
M-C45	positive	negative	positive	I-C45	positive	negative	positive
M-C46	not tested	negative	not tested	I-C46	not tested	negative	not tested
M-C47	positive	negative	positive	I-C47	positive	negative	positive
M-C48	not tested	negative	not tested	I-C48	not tested	negative	not tested
M-C49	positive	negative	positive	I-C49	positive	negative	positive
M-C50	not tested	negative	not tested	I-C50	not tested	negative	not tested
M-C51	positive	negative	positive	I-C51	positive	positive	positive

Table A-2: Results of Microbial Testing on Whole Chickens

Minnesota Samples (Gold'N Plump)				Iowa Samples (Country Pride)			
Sample #	*Enterococci*	*Salmonella*	*Campylobacter*	Sample #	*Enterococci*	*Salmonella*	*Campylobacter*
M-C52	not tested	negative	not tested	I-C52	not tested	negative	not tested
M-C53	positive	negative	positive	I-C53	positive	negative	positive
M-C54	not tested	negative	not tested	I-C54	not tested	negative	not tested
M-C55	positive	positive	positive	I-C55	positive	negative	positive
M-C56	not tested	negative	not tested	I-C56	not tested	negative	not tested
M-C57	positive	positive	positive	I-C57	positive	negative	positive
M-C58	not tested	negative	not tested	I-C58	not tested	negative	not tested
M-C59	positive	negative	positive	I-C59	positive	negative	positive
M-C60	not tested	negative	not tested	I-C60	not tested	negative	not tested
M-C61	positive	negative	positive	I-C61	positive	negative	positive
M-C62	not tested	negative	not tested	I-C62	not tested	negative	not tested
M-C63	positive	positive	positive	I-C63	positive	negative	positive
M-C64	not tested	positive	not tested	I-C64	not tested	negative	not tested
M-C65	positive	negative	positive	I-C65	positive	positive	positive
M-C66	not tested	negative	not tested	I-C66	not tested	negative	not tested
M-C67	positive	negative	positive	I-C67	positive	positive	positive
M-C68	not tested	negative	not tested	I-C68	not tested	negative	not tested
M-C69	positive	positive	positive	I-C69	positive	negative	positive
M-C70	not tested	negative	not tested	I-C70	not tested	negative	not tested
M-C71	positive	negative	positive	I-C71	positive	positive	positive
M-C72	not tested	negative	not tested	I-C72	not tested	negative	not tested
M-C73	positive	negative	positive	I-C73	positive	negative	positive
M-C74	not tested	negative	not tested	I-C74	not tested	positive	not tested
M-C75	positive	negative	positive	I-C75	positive	positive	positive
M-C76	not tested	negative	not tested	I-C76	not tested	negative	not tested
M-C77	positive	negative	positive	I-C77	positive	negative	positive
M-C78	not tested	negative	not tested	I-C78	not tested	negative	not tested
M-C79	positive	negative	positive	I-C79	positive	negative	positive
M-C80	not tested	negative	not tested	I-C80	not tested	negative	not tested
M-C81	positive	negative	positive	I-C81	positive	positive	positive
M-C82	not tested	negative	not tested	I-C82	not tested	negative	not tested
M-C83	positive	negative	positive	I-C83	positive	positive	positive
M-C84	not tested	positive	not tested	I-C84	not tested	negative	not tested
M-C85	positive	positive	positive	I-C85	positive	positive	positive
M-C86	not tested	negative	not tested	I-C86	not tested	negative	not tested
M-C87	positive	negative	positive	I-C87	positive	positive	positive
M-C88	not tested	negative	not tested	I-C88	not tested	negative	not tested
M-C89	positive	negative	positive	I-C89	positive	negative	negative
M-C90	not tested	negative	not tested	I-C90	not tested	negative	not tested
M-C91	positive	negative	positive	I-C91	positive	negative	positive
M-C92	not tested	negative	not tested	I-C92	not tested	negative	not tested
M-C93	positive	negative	positive	I-C93	positive	negative	positive
M-C94	not tested	negative	not tested	I-C94	not tested	negative	not tested
M-C95	positive	negative	positive	I-C95	positive	negative	negative
M-C96	not tested	negative	not tested	I-C96	not tested	negative	not tested
M-C97	positive	negative	positive	I-C97	positive	negative	positive
M-C98	not tested	negative	not tested	I-C98	not tested	negative	not tested
M-C99	positive	negative	positive	I-C99	positive	positive	positive
M-C100	not tested	negative	not tested	I-C100	not tested	negative	not tested

* Shaded cells indicate isolates tested for resistance to antibiotics

Table A-3: Results of Microbial Testing on Ground Turkey							
Minnesota Samples (Jennie-O)				**Iowa Samples (Honeysuckle White)**			
Sample #	*Enterococci*	*Salmonella*	*Campylobacter*	Sample #	*Enterococci*	*Salmonella*	*Campylobacter*
M-T1	positive	positive	positive	I-T1	positive	positive	negative
M-T2	not tested	positive	not tested	I-T2	not tested	positive	not tested
M-T3	positive	positive	negative	I-T3	positive	positive	negative
M-T4	not tested	negative	not tested	I-T4	not tested	positive	not tested
M-T5	positive	negative	negative	I-T5	positive	positive	negative
M-T6	not tested	positive	not tested	I-T6	not tested	positive	not tested
M-T7	positive	negative	negative	I-T7	positive	positive	negative
M-T8	not tested	positive	not tested	I-T8	not tested	positive	not tested
M-T9	positive	positive	negative	I-T9	positive	positive	negative
M-T10	not tested	negative	not tested	I-T10	not tested	negative	not tested
M-T11	positive	negative	negative	I-T11	positive	positive	negative
M-T12	not tested	positive	not tested	I-T12	not tested	positive	not tested
M-T13	positive	positive	negative	I-T13	positive	negative	negative
M-T14	not tested	negative	not tested	I-T14	not tested	positive	not tested
M-T15	positive	negative	negative	I-T15	positive	positive	negative
M-T16	not tested	positive	not tested	I-T16	not tested	negative	not tested
M-T17	positive	positive	negative	I-T17	positive	positive	negative
M-T18	not tested	negative	not tested	I-T18	not tested	positive	not tested
M-T19	positive	negative	negative	I-T19	positive	positive	negative
M-T20	not tested	positive	not tested	I-T20	not tested	positive	not tested
M-T21	positive	negative	negative	I-T21	positive	positive	negative
M-T22	not tested	positive	not tested	I-T22	not tested	positive	not tested
M-T23	positive	positive	negative	I-T23	positive	positive	negative
M-T24	not tested	positive	not tested	I-T24	not tested	positive	not tested
M-T25	positive	positive	negative	I-T25	positive	positive	negative
M-T26	not tested	negative	not tested	I-T26	positive	negative	negative
M-T27	positive	negative	negative	I-T27	not tested	negative	not tested
M-T28	not tested	negative	not tested	I-T28	positive	negative	negative
M-T29	positive	negative	negative	I-T29	not tested	negative	not tested
M-T30	not tested	negative	not tested	I-T30	positive	negative	negative
M-T31	positive	negative	negative	I-T31	not tested	negative	not tested
M-T32	not tested	negative	not tested	I-T32	positive	negative	negative
M-T33	positive	negative	negative	I-T33	not tested	negative	not tested
M-T34	not tested	negative	not tested	I-T34	positive	negative	negative
M-T35	positive	negative	negative	I-T35	not tested	negative	not tested
M-T36	not tested	negative	not tested	I-T36	positive	negative	negative
M-T37	positive	negative	negative	I-T37	not tested	negative	not tested
M-T38	not tested	negative	not tested	I-T38	positive	negative	negative
M-T39	positive	positive	negative	I-T39	not tested	negative	not tested
M-T40	not tested	positive	not tested	I-T40	positive	negative	negative
M-T41	positive	negative	negative	I-T41	not tested	negative	not tested
M-T42	not tested	negative	not tested	I-T42	positive	negative	negative
M-T43	positive	positive	negative	I-T43	not tested	negative	not tested
M-T44	not tested	positive	not tested	I-T44	positive	negative	negative
M-T45	positive	positive	negative	I-T45	not tested	negative	not tested
M-T46	not tested	negative	not tested	I-T46	positive	negative	negative
M-T47	positive	negative	negative	I-T47	not tested	negative	not tested
M-T48	not tested	positive	not tested	I-T48	positive	negative	negative
M-T49	positive	negative	negative	I-T49	not tested	negative	not tested
M-T50	not tested	positive	not tested	I-T50	positive	negative	negative
M-T51	not tested	negative	not tested	I-T51	not tested	positive	not tested
M-T52	positive	negative	negative	I-T52	positive	positive	negative
M-T53	not tested	negative	not tested	I-T53	not tested	positive	not tested
M-T54	positive	positive	negative	I-T54	positive	positive	negative

Table A-3: Results of Microbial Testing on Ground Turkey							
Minnesota Samples (Jennie-O)				**Iowa Samples (Honeysuckle White)**			
Sample #	*Enterococci*	*Salmonella*	*Campylobacter*	Sample #	*Enterococci*	*Salmonella*	*Campylobacter*
M-T55	not tested	negative	not tested	I-T55	not tested	positive	not tested
M-T56	positive	positive	negative	I-T56	positive	positive	negative
M-T57	not tested	negative	not tested	I-T57	not tested	positive	not tested
M-T58	positive	negative	negative	I-T58	positive	positive	negative
M-T59	not tested	negative	not tested	I-T59	not tested	positive	not tested
M-T60	positive	negative	negative	I-T60	positive	positive	negative
M-T61	not tested	negative	not tested	I-T61	not tested	positive	not tested
M-T62	positive	negative	negative	I-T62	positive	negative	negative
M-T63	not tested	negative	not tested	I-T63	not tested	negative	not tested
M-T64	positive	negative	negative	I-T64	positive	positive	negative
M-T65	not tested	negative	not tested	I-T65	not tested	positive	not tested
M-T66	positive	negative	negative	I-T66	positive	positive	negative
M-T67	not tested	positive	not tested	I-T67	not tested	positive	not tested
M-T68	positive	negative	negative	I-T68	positive	positive	negative
M-T69	not tested	negative	not tested	I-T69	not tested	positive	not tested
M-T70	positive	negative	negative	I-T70	positive	positive	negative
M-T71	not tested	negative	not tested	I-T71	not tested	positive	not tested
M-T72	positive	negative	negative	I-T72	positive	positive	negative
M-T73	not tested	negative	not tested	I-T73	not tested	positive	not tested
M-T74	positive	positive	negative	I-T74	positive	positive	negative
M-T75	not tested	positive	not tested	I-T75	not tested	positive	not tested
M-T76	positive	positive	negative	I-T76	positive	negative	negative
M-T77	not tested	negative	not tested	I-T77	not tested	negative	not tested
M-T78	positive	negative	negative	I-T78	positive	positive	negative
M-T79	not tested	negative	not tested	I-T79	not tested	positive	not tested
M-T80	positive	negative	negative	I-T80	positive	positive	negative
M-T81	not tested	negative	not tested	I-T81	not tested	negative	not tested
M-T82	positive	negative	negative	I-T82	positive	negative	negative
M-T83	not tested	negative	not tested	I-T83	not tested	negative	not tested
M-T84	positive	negative	negative	I-T84	positive	negative	negative
M-T85	not tested	negative	not tested	I-T85	not tested	negative	not tested
M-T86	positive	negative	negative	I-T86	positive	negative	positive
M-T87	not tested	negative	not tested	I-T87	not tested	positive	not tested
M-T88	positive	negative	negative	I-T88	positive	positive	negative
M-T89	not tested	positive	not tested	I-T89	not tested	positive	not tested
M-T90	positive	positive	negative	I-T90	positive	positive	negative
M-T91	not tested	positive	not tested	I-T91	not tested	positive	not tested
M-T92	positive	positive	negative	I-T92	positive	positive	negative
M-T93	not tested	negative	not tested	I-T93	not tested	positive	not tested
M-T94	positive	negative	negative	I-T94	positive	positive	negative
M-T95	not tested	positive	not tested	I-T95	not tested	negative	not tested
M-T96	positive	negative	negative	I-T96	positive	negative	negative
M-T97	not tested	negative	not tested	I-T97	not tested	negative	not tested
M-T98	positive	positive	negative	I-T98	positive	negative	negative
M-T99	not tested	negative	not tested	I-T99	not tested	negative	not tested
M-T100	positive	negative	negative	I-T100	positive	negative	negative
* Shaded cells indicate isolates selected for antibiotic resistance testing.							

Table A-4: Antibiotics Tested for Resistance/Susceptibility		
Salmonella	***Campylobacter***	***Enterococci***
1) Amikacin	1) Azithromycin	1) Bacitracin
2) Amoxicillin-clavulanic acid	2) Chloramphenicol	2) Chloramphenicol
3) Ampicillin	3) Ciprofloxacin	3) Ciprofloxacin
4) Cefoxitin	4) Clindamycin	4) Erythromycin
5) Ceftiofur	5) Erythromycin	5) Flavomycin
6) Ceftriaxone	6) Gentamicin	6) Gentamicin
7) Cephalothin	7) Nalidixic acid	7) Kanamycin
8) Chloramphenicol	8) Tetracycline	8) Lincomycin
9) Ciprofloxacin		9) Linezolid
10) Gentamicin		10) Nitrofurantoin
11) Kanamycin		11) Penicillin
12) Nalidixic acid		12) Quinupristin/dalfopristin
13) Streptomycin		13) Salinomycin
14) Sulfamethoxazole		14) Streptomycin
15) Tetracycline		15) Tetracycline
16) Trimethoprim-sulfamethoxazole		16) Tylosin
		17) Vancomycin

Table A-5: Number of Bacteria Isolates Chosen for Resistance Testing

Product	Organism	Number of Samples Analyzed Per Organism	Number of Positive Samples & Isolates	Number of Isolates Tested for Resistance
Chicken	*Salmonella*	200	35	35
Turkey	*Salmonella*	200	90	45
Chicken	*Enterococci*	100	100	50
Turkey	*Enterococci*	101*	101	51
Chicken	*Campylobacter*	100	95	47
Turkey	*Campylobacter*	101*	2	2

* Though the intention was to test every other turkey sample for *Enterococci* and *Campylobacter*, this protocol was imposed on each lot of samples as they came in, resulting in one extra sample being tested than was expected.

Appendix B:

Campylobacter, *Enterococci* and *Salmonella* Antibiotic Resistance Results for Whole Chicken and Ground Turkey

Table B-1: *Campylobacter* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		AZ Azithromycin	CL Chloramphenicol	CI Ciprofloxacin	CM Clindamycin	EM Erythromycin	GM Gentamicin	NA Nalidixic acid	TC Tetracycline
M-C3	MIC (ug/ml)	0.047	0.5	0.032	0.032	0.19	0.38	1.5	256
	Resistance	S	S	S	S	S	S	S	R
MC-7	MIC (ug/ml)	0.064	0.75	0.047	0.047	0.25	0.38	2	256
	Resistance	S	S	S	S	S	S	S	R
M-C9	MIC (ug/ml)	0.047	0.5	0.032	0.047	0.25	0.38	1	256
	Resistance	S	S	S	S	S	S	S	R
M-C13	MIC (ug/ml)	0.032	0.19	0.023	0.016	0.19	0.19	0.25	256
	Resistance	S	S	S	S	S	S	S	R
M-C17	MIC (ug/ml)	0.047	0.5	0.047	0.047	0.25	0.5	0.75	256
	Resistance	S	S	S	S	S	S	S	R
M-C23	MIC (ug/ml)	0.38	3	0.064	0.5	3	0.38	4	256
	Resistance	I	S	S	S	I	S	S	R
M-C27	MIC (ug/ml)	0.38	2	0.064	0.5	3	0.5	4	256
	Resistance	I	S	S	S	I	S	S	R
M-C31	MIC (ug/ml)	0.25	3	0.25	0.19	3	0.75	8	256
	Resistance	S	S	S	S	I	S	S	R
M-C41	MIC (ug/ml)	0.016	0.25	32	0.016	0.047	0.094	256	256
	Resistance	S	S	R	S	S	S	R	R
M-C43	MIC (ug/ml)	0.19	2	0.125	1	3	0.75	3	256
	Resistance	S	S	S	I	I	S	S	R
M-C47	MIC (ug/ml)	0.064	0.5	0.032	0.047	0.38	0.19	0.5	256
	Resistance	S	S	S	S	S	S	S	R
M-C51	MIC (ug/ml)	0.047	0.75	0.032	0.047	0.38	0.19	0.5	256
	Resistance	S	S	S	S	S	S	S	R
M-C55	MIC (ug/ml)	0.38	3	0.125	1	3	0.25	3	0.75
	Resistance	I	S	S	I	I	S	S	S
M-C59	MIC (ug/ml)	0.094	0.38	0.047	0.064	0.38	0.25	0.75	256
	Resistance	S	S	S	S	S	S	S	R
M-C63	MIC (ug/ml)	0.38	3	0.125	1.5	3	0.38	3	0.75
	Resistance	I	S	S	I	I	S	S	S
M-C67	MIC (ug/ml)	0.38	3	0.094	0.75	3	0.5	8	256
	Resistance	I	S	S	I	I	S	S	R
M-C71	MIC (ug/ml)	0.125	0.5	0.023	0.094	0.38	0.38	0.75	256
	Resistance	S	S	S	S	S	S	S	R
M-C75	MIC (ug/ml)	0.064	0.5	0.016	0.064	0.38	0.19	0.5	256
	Resistance	S	S	S	S	S	S	S	R
M-C79	MIC (ug/ml)	0.25	3	0.094	1	3	0.25	3	0.25
	Resistance	S	S	S	I	I	S	S	S
M-C83	MIC (ug/ml)	0.25	2	0.094	1	2	0.38	3	0.5
	Resistance	S	S	S	I	I	S	S	S
M-C87	MIC (ug/ml)	0.38	3	0.094	1	3	0.19	2	0.75
	Resistance	I	S	S	I	I	S	S	S
M-C91	MIC (ug/ml)	0.047	0.25	0.023	0.023	0.19	0.125	0.5	256
	Resistance	S	S	S	S	S	S	S	R
M-C95	MIC (ug/ml)	0.016	0.19	0.006	0.016	0.032	0.064	0.38	0.023
	Resistance	S	S	S	S	S	S	S	S
M-C99	MIC (ug/ml)	0.032	0.38	0.047	0.064	0.38	0.5	2	256
	Resistance	S	S	S	S	S	S	S	R

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive
NOTE #2: Isolates M-C3, M-C7, M-C41 and I-C23 were used instead of M-C1, M-C5, M-C39 and I-C25 because the originally positive isolates would not grow out for resistance testing. I-C23 also failed to grow.

Table B-1 (continued): *Campylobacter* Antibiotic Resistance Results for Whole Chicken									
Isolate- Sample #		**AZ** Azithromycin	**CL** Chloramphenicol	**CI** Ciprofloxacin	**CM** Clindamycin	**EM** Erythromycin	**GM** Gentamicin	**NA** Nalidixic acid	**TC** Tetracycline
I-C1	MIC (ug/ml)	0.032	32	32	0.047	0.19	0.19	256	256
	Resistance	S	R	R	S	S	S	R	R
I-C5	MIC (ug/ml)	0.023	0.38	0.047	0.047	0.125	0.094	0.75	256
	Resistance	S	S	S	S	S	S	S	R
I-C9	MIC (ug/ml)	0.023	1	0.064	0.064	0.19	0.19	0.75	256
	Resistance	S	S	S	S	S	S	S	R
I-C13	MIC (ug/ml)	0.023	0.5	0.012	0.064	0.19	0.25	0.38	256
	Resistance	S	S	S	S	S	S	S	R
I-C17	MIC (ug/ml)	0.023	1.5	0.125	0.047	0.19	0.19	3	256
	Resistance	S	S	S	S	S	S	S	R
I-C21	MIC (ug/ml)	0.023	0.5	0.023	0.047	0.094	0.25	0.5	256
	Resistance	S	S	S	S	S	S	S	R
I-C29	MIC (ug/ml)	0.047	0.38	0.023	0.064	0.19	0.19	0.75	0.032
	Resistance	S	S	S	S	S	S	S	S
I-C33	MIC (ug/ml)	0.047	1	0.064	0.047	0.5	0.25	1	256
	Resistance	S	S	S	S	S	S	S	R
I-C37	MIC (ug/ml)	0.064	0.25	0.047	0.094	0.064	0.19	0.5	0.047
	Resistance	S	S	S	S	S	S	S	S
I-C41	MIC (ug/ml)	0.032	0.38	0.016	0.047	0.125	0.19	0.19	256
	Resistance	S	S	S	S	S	S	S	R
I-C45	MIC (ug/ml)	0.023	0.25	0.023	0.064	0.19	0.094	0.38	0.032
	Resistance	S	S	S	S	S	S	S	S
I-C49	MIC (ug/ml)	0.047	0.38	0.032	0.094	0.25	0.25	0.5	0.032
	Resistance	S	S	S	S	S	S	S	S
I-C53	MIC (ug/ml)	0.023	1	0.125	0.94	0.25	6	2	0.094
	Resistance	S	S	S	S	S	I	S	S
I-C57	MIC (ug/ml)	0.023	0.38	0.023	0.047	0.125	0.125	0.75	256
	Resistance	S	S	S	S	S	S	S	R
I-C61	MIC (ug/ml)	0.047	0.38	0.016	0.064	0.25	0.19	0.25	0.016
	Resistance	S	S	S	S	S	S	S	S
I-C65	MIC (ug/ml)	0.023	0.38	0.023	0.047	0.094	0.19	0.5	256
	Resistance	S	S	S	S	S	S	S	R
I-C69	MIC (ug/ml)	0.094	0.38	0.023	0.125	0.25	0.125	0.38	0.032
	Resistance	S	S	S	S	S	S	S	S
I-C73	MIC (ug/ml)	0.032	0.38	0.23	0.016	0.19	0.19	0.38	0.064
	Resistance	S	S	S	S	S	S	S	S
I-C77	MIC (ug/ml)	0.125	1.5	32	0.04	0.75	0.125	256	0.032
	Resistance	S	S	R	S	I	S	R	S
I-C81	MIC (ug/ml)	0.064	0.5	0.023	0.064	0.19	0.19	0.38	0.047
	Resistance	S	S	S	S	S	S	S	S
I-C85	MIC (ug/ml)	0.094	1.5	0.032	0.094	0.5	0.25	1	0.19
	Resistance	S	S	S	S	S	S	S	S
I-C91	MIC (ug/ml)	0.016	0.19	0.012	0.016	0.094	0.094	0.25	0.047
	Resistance	S	S	S	S	S	S	S	S
I-C97	MIC (ug/ml)	0.016	0.38	0.012	0.016	0.094	0.047	0.19	0.094
	Resistance	S	S	S	S	S	S	S	S

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive

NOTE #2: Isolates M-C3, M-C7, M-C41 and I-C23 were used instead of M-C1, M-C5, M-C39 and I-C25 because the originally positive isolates would not grow out for resistance testing. I-C23 also failed to grow.

Table B-2: *Campylobacter* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		AZ Azithromycin	CL Chloramphenicol	CI Ciprofloxacin	CM Clindamycin	EM Erythromycin	GM Gentamicin	NA Nalidixic acid	TC Tetracycline
M-T1	MIC (ug/ml)	256	1	32	256	256	0.5	256	256
	Resistance	R	S	R	R	R	S	R	R
I-T86	MIC (ug/ml)	0.064	0.032	0.38	0.047	0.19	0.25	0.38	256
	Resistance	S	S	S	S	S	S	S	R

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive

Table B-3: *Enterococci* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
M-C1	MIC (ug/ml)	>128	8	0.5	>8	<1	>1024	>1024	>32	1	8	2	16	16	<512	>32	>32	1
	Resistance	n/a	S	S	R	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C5	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C9	MIC (ug/ml)	>128	4	0.5	>8	>32	<128	1024	>32	1	32	16	32	16	<512	>32	>32	2
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	R	R	n/a	S	R	n/a	S
M-C13	MIC (ug/ml)	>128	8	0.5	>8	<1	>1024	>1024	>32	2	8	2	16	8	>2048	>32	>32	2
	Resistance	n/a	S	S	R	n/a	R	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-C17	MIC (ug/ml)	>128	4	0.25	>8	<1	>1024	>1024	<1	<0.5	8	2	4	8	<512	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C21	MIC (ug/ml)	>128	4	0.25	2	<1	>1024	>1024	8	<0.5	8	2	2	<1	<512	>32	0.5	1
	Resistance	n/a	S	S	I	n/a	R	n/a	n/a	S	S	S	I	n/a	S	R	n/a	S
M-C25	MIC (ug/ml)	>128	4	0.5	>8	<1	>1024	>1024	>32	1	8	2	2	8	<512	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	R	n/a	n/a	S	S	S	I	n/a	S	R	n/a	S
M-C29	MIC (ug/ml)	16	4	0.25	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	<4	1	2
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
M-C33	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	2	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C37	MIC (ug/ml)	>128	4	<0.12	<0.5	<1	>1024	>1024	32	1	8	1	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C41	MIC (ug/ml)	>128	32	<0.12	>8	>32	<128	<128	>32	2	64	<0.5	>32	8	<512	>32	>32	<0.5
	Resistance	n/a	R	S	R	n/a	S	n/a	n/a	S	I	S	R	n/a	S	R	n/a	S
M-C45	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C49	MIC (ug/ml)	>128	8	0.5	>8	<1	>1024	>1024	>32	1	8	2	16	4	<512	>32	>32	2
	Resistance	n/a	S	S	R	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C53	MIC (ug/ml)	>128	8	0.5	>8	<1	<128	>1024	>32	1	8	2	16	<1	>2048	32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-C57	MIC (ug/ml)	>128	8	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-3 (continued): *Enterococci* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
M-C61	MIC (ug/ml)	>128	4	0.25	>8	<1	<128	<128	>32	1	8	2	16	4	<512	32	32	2
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C65	MIC (ug/ml)	>128	4	0.5	2	>32	<128	256	>32	1	16	2	16	8	1024	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-C69	MIC (ug/ml)	>128	4	0.5	2	>32	<128	256	<1	1	32	4	8	16	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C73	MIC (ug/ml)	>128	4	0.5	2	>32	<128	<128	>32	2	32	8	16	16	1024	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-C77	MIC (ug/ml)	>128	8	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C81	MIC (ug/ml)	>128	8	0.5	>8	<1	<128	>1024	>32	1	8	1	8	<1	>2048	>32	>32	1
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-C85	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	16	1	8	2	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C89	MIC (ug/ml)	>128	8	0.5	>8	<1	<128	<128	>32	1	8	<0.5	16	<1	<512	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C93	MIC (ug/ml)	>128	8	0.5	>8	<1	<128	<128	>32	1	8	<0.5	16	<1	<512	>32	>32	1
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-C97	MIC (ug/ml)	64	8	<0.12	>8	<1	<128	<128	>32	1	16	<0.5	<1	2	<512	<4	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	S	n/a	S	S	n/a	S
I-C1	MIC (ug/ml)	>128	8	0.5	>8	<1	<128	<128	>32	1	4	2	16	<1	<512	>32	>32	1
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C5	MIC (ug/ml)	16	4	0.25	1	<1	<128	<128	32	1	8	1	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C9	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C13	MIC (ug/ml)	32	4	0.5	1	<1	<128	<128	32	1	8	2	8	<1	<512	<4	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C17	MIC (ug/ml)	>128	2	0.5	<0.5	<1	<128	<128	32	1	8	1	16	<1	<512	>32	2	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-3 (continued): *Enterococci* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
I-C21	MIC (ug/ml)	16	8	0.5	>8	2	<128	>1024	>32	1	8	2	16	<1	>2048	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
I-C25	MIC (ug/ml)	16	4	0.25	1	<1	>1024	>1024	16	1	8	4	8	4	<512	32	1	1
	Resistance	n/a	S	S	I	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C29	MIC (ug/ml)	16	4	0.5	1	<1	<128	<128	32	1	8	2	16	<1	<512	<4	1	2
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C33	MIC (ug/ml)	16	4	0.5	<0.5	<1	>1024	>1024	>32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C37	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C41	MIC (ug/ml)	16	4	0.25	>8	>32	<128	<128	>32	<0.5	32	1	4	<1	<512	<4	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C45	MIC (ug/ml)	32	4	1	2	>32	<128	<128	16	2	64	2	4	<1	<512	<4	8	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	I	S	R	n/a	S	S	n/a	S
I-C49	MIC (ug/ml)	32	4	0.5	1	<1	<128	<128	32	1	4	2	8	<1	<512	<4	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C53	MIC (ug/ml)	128	4	0.5	<0.5	>32	<128	<128	16	1	16	1	8	<1	<512	>32	2	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C57	MIC (ug/ml)	32	4	0.25	<0.5	<1	<128	<128	16	1	8	1	8	<1	<512	<4	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C61	MIC (ug/ml)	<8	4	1	1	<1	<128	<128	32	1	8	2	8	2	<512	<4	1	2
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C65	MIC (ug/ml)	32	4	0.25	<0.5	<1	<128	<128	>32	1	8	2	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C69	MIC (ug/ml)	<8	4	0.5	2	<1	<128	<128	32	1	8	2	16	<1	<512	<4	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C73	MIC (ug/ml)	16	4	0.5	<0.5	<1	<128	<128	>32	1	8	1	8	4	<512	>32	0.5	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-C77	MIC (ug/ml)	16	4	0.5	<0.5	<1	<128	<128	32	1	32	2	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-3 (continued): *Enterococci* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
I-C81	MIC (ug/ml)	<8	4	0.5	1	<1	<128	<128	32	1	8	2	16	<1	<512	<4	1	2
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C85	MIC (ug/ml)	<8	4	1	<0.5	<1	<128	<128	32	1	8	1	16	<1	<512	<4	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C89	MIC (ug/ml)	>128	4	1	<0.5	>32	<128	256	<1	1	32	4	<1	16	<512	<4	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	S	n/a	S	S	n/a	S
I-C93	MIC (ug/ml)	16	4	<0.12	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	<4	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
I-C97	MIC (ug/ml)	32	4	4	4	>32	<128	<128	16	1	64	4	4	4	<512	<4	4	2
	Resistance	n/a	S	R	I	n/a	S	n/a	n/a	S	I	S	R	n/a	S	S	n/a	S

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive

NOTE #2: n/a = NCCLS does not presently have Enterococcus MIC interpretive standards (i.e., resistant, intermediate, sensitive) for bacitracin, flavomycin, kanamycin, lincomycin, salinomycin, and tyolsin tartrate. NARMS does monitor trends in MIC's for these antibiotics. Ranges of concentrations (ug/ml) monitored in this study and by NARMS for these antibiotics are listed below.

- bacitracin (8-128)
- flavomycin (1-32)
- kanamycin (128-2048)
- lincomycin (1-32)
- salinomycin (1-32)
- tyolsin (0.25-32)

Table B-4: *Enterococci* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/ dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
M-T1	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T5	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T9	MIC (ug/ml)	<8	4	0.5	1	<1	<128	<128	32	<0.5	8	2	4	<1	<512	<4	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
M-T13	MIC (ug/ml)	>128	4	1	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T17	MIC (ug/ml)	32	4	1	<0.5	<1	>1024	>1024	>32	2	8	2	8	<1	<512	>32	2	<0.5
	Resistance	n/a	S	S	S	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T21	MIC (ug/ml)	16	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	<4	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
M-T25	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T29	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T33	MIC (ug/ml)	<8	4	0.25	2	<1	<128	<128	>32	2	8	2	8	<1	<512	<4	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	S	n/a	S
M-T37	MIC (ug/ml)	>128	8	0.25	>8	<1	<128	<128	>32	1	8	2	8	4	<512	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T41	MIC (ug/ml)	>128	4	1	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T45	MIC (ug/ml)	>128	4	0.25	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T49	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	<0.25	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T54	MIC (ug/ml)	>128	4	1	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T58	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	16	1	8	1	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-4 (continued): *Enterococci* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
M-T62	MIC (ug/ml)	16	8	0.5	>8	<1	<128	<128	>32	1	8	2	16	<1	<512	>32	>32	2
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T66	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	>32	1	8	2	8	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T70	MIC (ug/ml)	<8	4	0.5	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T74	MIC (ug/ml)	<8	4	0.5	1	<1	<128	<128	32	1	8	<0.5	16	<1	<512	>32	1	2
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T78	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T82	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T86	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	2	8	1	8	<1	<512	32	2	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T90	MIC (ug/ml)	16	4	0.5	1	<1	<128	<128	>32	1	8	2	16	<1	>2048	>32	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
M-T94	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	32	2	1
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
M-T98	MIC (ug/ml)	>128	4	0.25	1	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T1	MIC (ug/ml)	>128	4	0.25	1	<1	<128	<128	32	1	16	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T5	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	32	1	16	2	16	<1	<512	>32	1	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T9	MIC (ug/ml)	>128	4	0.5	2	<1	<128	<128	32	1	16	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T13	MIC (ug/ml)	>128	4	0.5	2	<1	<128	<128	32	2	16	2	16	<1	<512	>32	2	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T17	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	32	1	16	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-4 (continued): *Enterococci* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
I-T21	MIC (ug/ml)	32	4	1	2	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	2
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T25	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	32	1	16	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T28	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	1	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T32	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T36	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	2	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T40	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	2	<512	>32	1	2
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T44	MIC (ug/ml)	>128	4	<0.12	<0.5	<1	<128	<128	32	1	8	2	8	2	<512	>32	2	2
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T48	MIC (ug/ml)	>128	4	1	<0.5	<1	<128	<128	32	1	8	2	8	2	<512	>32	1	2
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T52	MIC (ug/ml)	16	8	0.5	>8	<1	<128	<128	>32	1	8	2	16	<1	<512	>32	>32	<0.5
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T56	MIC (ug/ml)	>128	8	0.25	>8	<1	<128	<128	>32	1	8	2	16	<1	<512	>32	>32	1
	Resistance	n/a	S	S	R	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T60	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T64	MIC (ug/ml)	>128	4	1	1	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T68	MIC (ug/ml)	32	4	1	<0.5	<1	<128	<128	32	1	16	2	16	<1	<512	>32	2	2
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T72	MIC (ug/ml)	32	4	0.5	<0.5	<1	>1024	>1024	>32	2	8	1	8	<1	<512	>32	2	1
	Resistance	n/a	S	S	S	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T76	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	32	1	16	2	16	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S

Table B-4 (continued): *Enterococci* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		BAC Bacitracin	CHL Chloram-phenicol	CIP Cipro-floxacin	ERY Erythro-mycin	FLV Flavo-mycin	GEN Genta-micin	KAN Kana-mycin	LIN Linco-mycin	LZD Linezolid	NIT Nitro-furantoin	PEN Penicillin	SYN Quinupristin/dalfopristin	SAL Salino-mycin	STR Strepto-mycin	TET Tetra-cycline	TYLT Tylosin tartrate	VAN Vanco-mycin
I-T80	MIC (ug/ml)	>128	4	1	1	<1	<128	<128	32	<0.5	16	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T84	MIC (ug/ml)	16	4	0.5	2	<1	>1024	>1024	32	1	8	2	8	2	<512	>32	2	2
	Resistance	n/a	S	S	I	n/a	R	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T88	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	1	8	2	8	<1	<512	>32	1	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T92	MIC (ug/ml)	>128	4	0.5	<0.5	<1	<128	<128	32	2	8	2	8	<1	<512	>32	2	<0.5
	Resistance	n/a	S	S	S	n/a	S	n/a	n/a	S	S	S	R	n/a	S	R	n/a	S
I-T96	MIC (ug/ml)	>128	4	0.5	1	<1	<128	<128	>32	1	8	2	8	<1	>2048	>32	0.5	<0.5
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	R	R	n/a	S
I-T100	MIC (ug/ml)	32	4	0.5	1	<1	<128	<128	>32	1	8	1	8	<1	>2048	<4	<0.25	1
	Resistance	n/a	S	S	I	n/a	S	n/a	n/a	S	S	S	R	n/a	R	S	n/a	S

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive

NOTE #2: NCCLS does not presently have MIC interpretive standards (i.e., resistant, intermediate and sensitive) for bacitracin, flavomycin, kanamycin, lincomycin, salinomycin, and tyolsin tartrate. NARMS does monitor trends in MIC's for these antibiotics. Ranges of concentrations (ug/ml) monitored in this study and by NARMS for these antibiotics are listed below.

bacitracin (8-128)
flavomycin (1-32)
kanamycin (128-2048)
lincomycin (1-32)
salinomycin (1-32)
tyolsin (0.25-32)

Table B-5: *Salmonella* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri-axone	CEP Cephalo-thin	CL Chloram-phenicol	CI Cipro-floxacin	GM Genta-micin	KAN Kana-mycin	NAL Nalidixic acid	STR Strepto-mycin	SMX Sulfameth-oxazole	TC Tetra-cycline	SXT Trimethoprim/ sulfamethoxazole
M-C9	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	0.5	<8	4	<32	32	<4	0.25 / 4.75
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C10	MIC (ug/ml)	<4	2 / 1	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C15	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	0.03	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C16	MIC (ug/ml)	<4	2 / 1	<1	<4	0.25	<0.25	<2	4	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C18	MIC (ug/ml)	<4	<1.0 / 0.5	2	<4	0.5	<0.25	<2	4	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C-20	MIC (ug/ml)	<4	2 / 1	<1	<4	0.25	<0.25	<2	4	<0.015	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C27	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C36	MIC (ug/ml)	<4	<1.0 / 0.5	2	<4	0.25	<0.25	<2	4	<0.015	1	<8	2	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C55	MIC (ug/ml)	8	<1.0 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C57	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C63	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C64	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C69	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-C84	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	<0.25	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-C85	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

Table B-5 (continued): *Salmonella* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri-axone	CEP Cephalo-thin	CL Chloram-phenicol	CI Cipro-floxacin	GM Genta-micin	KAN Kana-mycin	NAL Nalidixic acid	STR Strepto-mycin	SMX Sulfameth-oxazole	TC Tetra-cycline	SXT Trimethoprim/ sulfamethoxazole
I-C7	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C12	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	0.5	<8	2	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C15	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	4	4	<0.015	0.5	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C17	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	0.5	<8	8	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C19	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	0.5	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C25	MIC (ug/ml)	8	<1.0 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	1	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C26	MIC (ug/ml)	<4	2 / 1	<1	<4	0.5	<0.25	<2	4	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C28	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	<2	<0.015	<0.25	<8	2	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C43	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	<2	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C51	MIC (ug/ml)	<4	<1.0 / 0.5	2	<4	0.5	<0.25	<2	4	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C65	MIC (ug/ml)	8	<1.0 / 0.5	<1	<4	0.25	<0.25	<2	<2	<0.015	0.5	<8	2	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C67	MIC (ug/ml)	<4	16 / 8	16	<4	0.5	<0.25	8	4	<0.015	<0.25	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	I	I	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C71	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	<0.25	<8	2	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C74	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	<0.12	<0.25	<2	<2	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C75	MIC (ug/ml)	<4	>32 / 16	>32	<4	0.25	<0.25	4	>32	<0.015	2	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	R	R	S	S	S	S	R	S	S	S	S	R	R	R	S

Table B-5 (continued): *Salmonella* Antibiotic Resistance Results for Whole Chicken

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri-axone	CEP Cephalo-thin	CL Chloram-phenicol	CI Cipro-floxacin	GM Genta-micin	KAN Kana-mycin	NAL Nalidixic acid	STR Strepto-mycin	SMX Sulfameth-oxazole	TC Tetra-cycline	SXT Trimethoprim/ sulfamethoxazole
I-C81	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	4	4	<0.015	1	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C83	MIC (ug/ml)	<4	2 / 1	2	<4	0.5	<0.25	<2	4	<0.015	1	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C85	MIC (ug/ml)	<4	<1.0 / 0.5	2	<4	0.25	<0.25	<2	<2	<0.015	<0.25	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C87	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	<2	<0.015	0.5	<8	2	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-C99	MIC (ug/ml)	<4	<1.0 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	1	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive

Table B-6: *Salmonella* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri- axone	CEP Cephalo- thin	CL Chloram- phenicol	CI Cipro- floxacin	GM Genta- micin	KAN Kana- mycin	NAL Nalidixic acid	STR Strepto- mycin	SMX Sulfameth- oxazole	TC Tetra- cycline	SXT Trimethoprim/ sulfamethoxazole
M-T1	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T3	MIC (ug/ml)	8	2 / 1	<1	<4	0.5	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T8	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	<8	8	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T12	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T16	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	16	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T20	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	0.25 / 4.75
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T23	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	4	8	<0.015	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-T25	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	4	8	<0.015	2	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-T40	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T44	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	>16	>64	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	R	S	R	R	R	S
M-T48	MIC (ug/ml)	<4	2 / 1	2	<4	0.25	<0.25	4	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
MT54	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
M-T67	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	4	4	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-T75	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	<0.25	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
M-T89	MIC (ug/ml)	<4	4 / 2	2	<4	1	<0.25	8	4	0.03	0.5	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

Table B-6 (continued): *Salmonella* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri-axone	CEP Cephalo-thin	CL Chloram-phenicol	CI Cipro-floxacin	GM Genta-micin	KAN Kana-mycin	NAL Nalidixic acid	STR Strepto-mycin	SMX Sulfameth-oxazole	TC Tetra-cycline	SXT Trimethoprim/ sulfamethoxazole
M-T92	MIC (ug/ml)	<4	4 / 2	2	<4	1	<0.25	16	4	<0.015	0.5	<8	4	<32	<16	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	I	S	S	S	S	S	S	S	S	S
M-T95	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T1	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	8	0.06	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T3	MIC (ug/ml)	<4	<1 / 0.5	<1	16	0.25	<0.25	<2	8	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	I	S	S	S	S	S	S	S	S	S	S	S	S
I-T5	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	2	<8	4	<32	128	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T7	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	8	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T9	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	8	4	<0.015	0.5	<8	4	<32	32	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S
I-T12	MIC (ug/ml)	<4	2 / 1	<1	<4	0.25	<0.25	<2	4	<0.015	>16	>64	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	R	S	R	R	R	S
I-T15	MIC (ug/ml)	<4	2 / 1	<1	<4	0.5	<0.25	4	4	<0.015	0.5	<8	4	<32	32	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S
I-T18	MIC (ug/ml)	8	>32 / 16	8	>32	0.5	1	>32	8	<0.015	1	<8	2	<32	32	<4	<0.12 / 2.38
	Resistance	S	R	S	R	S	S	R	S	S	S	S	S	S	S	S	S
I-T20	MIC (ug/ml)	<4	2 / 1	2	<4	1	<0.25	4	4	<0.015	>16	16	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	R	S
I-T22	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	8	<0.015	2	>64	4	>64	64	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	R	S	R	S	R	S
I-T24	MIC (ug/ml)	<4	4 / 2	2	<4	0.25	<0.25	16	4	<0.015	2	<8	4	<32	256	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	I	S	S	S	S	S	S	S	R	S
I-T51	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	4	4	<0.015	0.5	<8	4	<32	>512	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S
I-T53	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	4	8	<0.015	1	>64	4	>64	>512	>32	0.25 / 4.75
	Resistance	S	S	S	S	S	S	S	S	S	S	R	S	R	R	R	S

Table B-6 (continued): *Salmonella* Antibiotic Resistance Results for Ground Turkey

Isolate-Sample #		AMI Amikacin	AUG Amoxicillin/ clavulanic acid	AMP Ampicillin	FOX Cefoxitin	TIO Ceftiofur	AXO Ceftri-axone	CEP Cephalo-thin	CL Chloram-phenicol	CI Cipro-floxacin	GM Genta-micin	KAN Kana-mycin	NAL Nalidixic acid	STR Strepto-mycin	SMX Sulfameth-oxazole	TC Tetra-cycline	SXT Trimethoprim/ sulfamethoxazole
I-T55	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	4	8	<0.015	1	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T57	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	4	8	<0.015	0.5	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T59	MIC (ug/ml)	<4	2 / 1	<1	<4	0.5	<0.25	4	8	<0.015	1	<8	8	<32	32	<4	0.25 / 4.75
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T61	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	8	<0.015	1	<8	2	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	R	R	R	S
I-T65	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	<8	8	>64	>512	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	S	S
I-T67	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.5	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	S	S
I-T69	MIC (ug/ml)	<4	2 / 1	<1	<4	0.25	<0.25	<2	8	<0.015	0.5	>64	8	>64	32	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	R	S	R	S	R	S
I-T71	MIC (ug/ml)	<4	2 / 1	2	<4	0.5	<0.25	<2	8	<0.015	2	<8	4	<32	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T73	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	<8	4	>64	>512	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	S	S	R	R	S	S
I-T75	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	1	>64	4	>64	32	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	R	S	R	S	R	S
I-T79	MIC (ug/ml)	<4	2 / 1	<1	<4	0.5	<0.25	4	4	<0.015	1	<8	4	<32	32	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	R	S
I-T87	MIC (ug/ml)	<4	<1 / 0.5	<1	<4	0.25	<0.25	<2	4	<0.015	>16	>64	4	>64	>512	>32	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	R	R	S	R	R	R	S
I-T89	MIC (ug/ml)	<4	<1 / 0.5	2	<4	0.5	<0.25	4	8	<0.015	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T91	MIC (ug/ml)	<4	2 / 1	<1	<4	0.5	<0.25	4	8	<0.015	0.5	<8	4	<32	64	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
I-T93	MIC (ug/ml)	8	<1 / 0.5	<1	<4	0.5	<0.25	4	8	<0.015	0.5	<8	4	>64	32	<4	<0.12 / 2.38
	Resistance	S	S	S	S	S	S	S	S	S	S	S	S	R	S	S	S

NOTE #1: R = Resistant, I = Intermediate, S = Sensitive