the incidence of *Salmonella* on the carcasses.

A 1968 study demonstrated that by incorporating chlorine (20 ppm) into sheep carcass wash water, bacterial numbers were reduced significantly, but usually less than one log. Another study showed increased reductions in bacterial numbers were obtained as the chlorine level in water used to wash lamb carcasses was increased up to 357 ppm. Another researcher observed similar reductions when lamb carcasses were washed with 150 and 250 ppm chlorine. A study in 1977 found that up to log₁₀0.7/cm² reduction could be obtained by using water containing 200-250 ppm chlorine to spray beef tissue.

An initial mean reduction of 0.31 log on beef tissue has been achieved by treating it with a 200–250 ppm chlorine wash. FSIS considers the application of chlorine at levels up to 30 ppm on poultry, including giblets and salvaged parts, and in poultry chiller water, to be prior sanctioned under the food additive provisions of the Federal Food, Drug, and Cosmetic Act. The comparable use of chlorine in sprays applied to livestock carcasses is also a practice that has long been permitted by FSIS.

The vast majority of poultry establishments and a growing number of meat establishments apply chlorine solutions during slaughter and processing. To meet the intent of the regulation, FSIS would allow the application of 20–50 ppm chlorine in the final wash for livestock and poultry carcasses.

Some environmental risks have been associated with the use of chlorine, most significantly from the formation of byproducts of chlorine reactions with organic compounds in water. The trihalomethane (THM) byproducts are the current focus of regulation of drinking water chlorination by the Environmental Protection Agency under the Safe Drinking Water Act. It has been reported that there is an association between long-term exposure to chlorinated drinking water and a 9-15 percent higher incidence of human bladder and rectal cancer. The researchers were of the opinion, however, that the public health risks from microbial contamination in unchlorinated water "greatly exceed" the risks of possible increased incidence of bladder and rectal cancers.

Because one of the THMs, chloroform, is an animal carcinogen, FSIS contracted with a private firm to perform a quantitative cancer risk assessment on chloroform residues recovered from the fat and skin of whole broiler chickens purchased at retail. Based on this assessment, estimates of additional lifetime cancer risk in the population from consumption of chloroform residues in chicken ranged from two in one billion (2×10^{-9}) to five in 100 million (5×10^{-8}) for fat, and from two in one billion (2×10^{-9}) to four in 100 million (4×10^{-8}) in skin based on estimates of chicken consumption. These are well below the level of one in one million (1×10^{-6}) additional lifetime cancer risk generally considered negligible by EPA and FDA in their regulation of pesticides and other chemicals, such as animal drug residues.

FSIS believes that these extremely small risks are clearly outweighed by the public health benefits of chlorine in reducing microbial contaminants on product. FSIS permits the use of nitrites in cured products on a similar basis; the antimicrobial safety benefits provided consumers by its use greatly outweigh the very small risk posed by possible carcinogenic byproducts.

At the request of FSIS, ARS is studying the possible risks from any mutagens that might be formed with the use of chlorinated poultry chiller water. Early phases of this study indicate only that very low levels of mutagenic compounds are associated with chlorinated poultry chiller water and that they increase as the chlorine levels used increase.

FSIS will continue to monitor closely all data on the safety of chlorine when used on carcasses as an antimicrobial agent, and will continue to reevaluate the risks and benefits associated with approved use.

FSIS invites comments on the risks and benefits of chlorine used to reduce and control microbial levels on meat and poultry products.

Product for Export

Application of antimicrobial treatments under this proposed regulation might interfere with the export of the products. This may be especially true for products from carcasses treated with certain chemicals. For example, Canada limits the use of chlorine on poultry products to a maximum of 20 ppm, and chlorine is not permitted at all in some of the countries of the European Union.

Therefore, so as not to interfere with the export of meat and poultry products, and enable companies to meet the expectations of their customers, FSIS is proposing to exempt from antimicrobial treatment product designated for export only. This exemption would apply only to product being prepared for export to a country which will not accept product exposed to the antimicrobial treatment installed in the establishment under this proposed regulation. Exempted export product must be properly identified, segregated, and labeled. FSIS invites comments on this proposed exemption.

3. Temperature Controls

Temperature is one of the primary factors affecting bacterial multiplication; the lower the temperature, the more slowly the multiplication occurs. Carcass surfaces become contaminated with bacteria during the slaughter and dressing procedures, while carcass interiors remain uncontaminated. Rapid cooling of carcasses prevents the multiplication of pathogenic bacteria on the carcass surface, and thus reduces consumer exposure and risk.

FSIS has concluded that most raw meat and poultry products must be rapidly chilled to 50°F and then maintained at 40°F or below to minimize the risk to public health from pathogens on those products. The technology needed to achieve the proposed chilling standards is readily available and for the most part already installed in establishments. The change being proposed is that appropriate timetemperature controls for handling raw product, already generally adhered to by many establishments, will become mandatory for all establishments.

Accordingly, a new section 318.25 would be added to the meat inspection regulations requiring that establishments cool livestock carcasses and raw meat products so the products reach a temperature of 50°F or below within specified time periods and maintain cooled carcasses and raw meat products at 40°F or below throughout handling, holding, and shipping to other official establishments, with certain exemptions. One exception is for raw product going directly into processing that includes a pathogen-lethal heating step, and thereby results in a "ready-toeat" product. Raw product would be partially exempt from the timetemperature requirements applying to fresh carcasses because when product enters a ready-to-eat process, other timetemperature controls applicable to the raw ingredients would apply. Additionally, the processing treatment required for ready-to-eat products stabilizes the product by killing both pathogens and spoilage bacteria. Another exception to the proposed cooling requirements is for "hot-boned" product, that is, muscle tissue removed from the carcass before chilling, which would have to be cooled within 5 hours (meat) or 1.5 hours (poultry) to a surface temperature of 10°C (50°F). Any edible parts removed from the carcass and not to be heat processed directly, e.g., livers, hearts, and heads with cheek meat, must