Inhibition of E. coli in Ground Beef Patties with Ozone

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LSU AgCenter scientists are testing the use of ozone gas to kill bacteria in packaged ground beef. Behind Michael Michel, research associate in Animal Science, is a gray box, which is the ozone generator. (Photo by John Wozniak)

Recent illnesses and deaths traced to foods contaminated with *Escherichia coli (E. coli)* O157:H7 have caused processors, regulatory officials and scientists to examine different techniques to control and destroy pathogenic microorganisms. The pathogenic microorganisms in meat products may survive or grow during refrigerated storage. Foodborne illness can occur when precooked or raw meat products are eaten without adequate heating to destroy pathogens.

Irradiation has recently been approved to treat meat products and kill pathogenic bacteria. Though effective, this preservation method may be expensive and alter the palatability and shelf-life properties of meat products.

Another preservation technique being investigated involves ozone, which may be equally effective in destroying pathogenic microorganisms with less cost and fewer product changes. This study was conducted to determine the effect of gaseous ozone on spoilage and pathogenic microorganisms in ground beef.

Ground beef was treated in two ways: (1) coarsely ground and

Dr. Ken McMillin, professor in Animal Science, heads the research on ozonation of meat as a way to preserve it. The patty on the right has been treated with gaseous ozone and is a slightly lighter red than the patty on the left. (Photo by John Wozniak)

vacuum packaged or (2) finely ground (1/8-inch) and formed into 1/4-pound patties. The patties were packaged in modified atmospheres (MAP) in three ways: (1) 80 percent oxygen and 20 percent carbon dioxide (O); (2) 80 percent nitrogen and 20 percent carbon dioxide (N) or (3) 2.5 percent oxygen, 20 percent carbon dioxide and 77.5 percent nitrogen ozonated with 2,500 parts per million of ozone (O3).

All ground beef was stored in the dark at 36 degrees F. After 10 days, the coarse-ground, vacuum-packaged beef was finely ground, made into 1/4-pound patties and placed on foamed polystyrene trays overwrapped with air-permeable film, and the MAP packages for N and O3 treatments had the gaseous environments exchanged for O.

All packages were then displayed under cool white fluorescent light at 45 degrees F for 4 days.

Results included:

- The color of the ground beef patties was similar among treatments during storage and display.
- Rancidity was higher in ground beef patties in oxygen compared with the other treatments during storage. Upon repackaging or gas exchange, there was more rancidity. After 2 days of retail display, the rancidity level was very high, indicating that the product taste would probably be unacceptable to consumers.
- Microorganism counts were higher in coarsely ground beef stored in vacuum packages and remained higher through the display of patties in air-permeable, overwrapped packages compared with the other packaging treatments. The carbon dioxide in the other packaging treatments was probably responsible for inhibiting the growth of microorganisms on the beef patties. Ozone was not effective in inhibiting the general microbial species associated with ground beef.
- The level of coliforms increased in the coarsely ground beef in the vacuum package during storage, but remained stable in the other packaging treatments until display. Coliforms are the species of microorganisms, including E. coli, that indicate unsanitary conditions and potential foodborne illness hazards. The high levels of oxygen in these packages appeared to destroy coliform organisms during the first 2 days of retail display. Coliform counts in ground beef patties in the oxygen and ozone treatments decreased in the last days of storage and throughout the display time.

Different packaging environments and treatments will influence the

properties of ground beef during storage and retail display. Gas atmospheres that provide longer shelf life during storage give a purple meat color that is not acceptable for retail display. Packaging that provides contact of oxygen with the meat surface blooms the ground beef to a desired red color, but the color fades and lipid oxidation occurs within 2 to 3 days after display. Oxygen and ozone appeared equally effective in destroying coliforms in the ground beef. Studies are continuing on the effects of ozone on *E. coli* .

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