Scientific Contributions Cont'd..

Cleaning of meat fabrication equipment and control of *E. coli* O157:H7 in beef

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The prevalence of *E. coli* O157:H7 in ground beef, as determined by the USDA, declined from about 0.8% in 2000 to 0.2% in 2004. Since 2004 the prevalence has changed little, or increased somewhat. This rather modest decrease in the prevalence of *E. coli* O157:H7 requires some explanation, because during that time the implementation of decontaminating treatments for beef carcasses has reduced the numbers of generic *E. coli* on carcasses from average levels of more than 10 *E. coli*/cm^2 to less than 1 *E. coli*/100 cm^2. In fact, at some Canadian plants the numbers of *E. coli* on dressed carcass sides are known to less than 1/1000 cm^2. As *E. coli* O157:H7 can be no more than a small fraction of the total *E. coli* population, the numbers of *E. coli* O157:H7 on beef carcasses at many plants must by now be very few indeed. However, all beef packing plants still detect *E. coli* O157:H7 in beef trim at least occasionally, and the prevalence of the organism in ground beef remains unacceptably high.

Three explanations have been advanced to account for the continued presence of *E. coli* O157:H7 in beef trim and ground beef. These are that decontaminating systems cannot cope with higher numbers of *E. coli* O157:H7 on cattle in summer than in winter months; that sporadic failure of control over carcass dressing and decontaminating processes allows heavily contaminated carcasses to enter carcass breaking processes occasionally; or that meat is recontaminated by sources within the plant during carcass breaking. The available evidence shows that, for some plants at least, there is no difference in the microbiological conditions of carcasses in summer and winter months; and plant data from routine sampling of carcasses for enumeration of *E. coli* give no indication of any incidents of loss of control during periods of years. The possibility that one or both of the first two explanations describe what happens at some plants where control is marginal cannot be entirely excluded; but for plants where routine sampling of carcasses for *E. coli* gives runs of thousands of zero values for *E. coli* counts those explanations are wholly untenable.

That beef is recontaminated with *E.coli* after the carcass dressing process is easily demonstrated by simple calculation, as follows:

- If a beef carcass side measures approximately 2.5 x 0.5 m (length x width), then the total surface area of a side is about 250 x 50 x 2 cm = 25,000 cm^2.
- If no *E. coli* are detected at a level of 1 *E. coli*/12 cm^2 during routine sampling of more than 1000 carcasses, then the average numbers of *E. coli* on the carcasses must be less than 1 *E. coli*/100 cm^2.
- Therefore, the total number of *E. coli* on a beef carcass side would be < 250.

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- A carcass side can be presumed to give 50 kg of trim.
- If all *E. coli* from a carcass side are found on the trim, and no *E. coli* are added to the meat after carcass dressing, then the numbers of generic *E. coli* in ground beef prepared from the trim would be on average 1 *E. coli* in ground beef prepared at packing plants is about 5 *E. coli*/g.

It is then apparent that at least 99% of the *E. coli* that are found in ground beef are deposited on or in the meat after the carcass breaking process. Several studies have shown that the numbers of *E. coli* on beef do in fact increase by 100-to 1000-fold during collection of beef trim and fabrication of primal cuts. As there is no reason at all to suppose that the added *E. coli* can not include *E. coli* O157:H7, it is evident that most of the *E. coli* O157:H7 that occur in ground beef are deposited on the meat during beef fabrication.

The available data clearly show that, at plants where *E. coli* contamination of carcasses is already well controlled, further efforts to improve the microbiological conditions of carcasses will have little, if any effect on the microbiological safety of the raw beef products. Increased testing of beef for *E. coli* O157:H7, and the likely future requirements for testing for other serotypes that may include pathogenic strains, will of course do nothing to enhance beef safety . This is because the dictum "You cannot test safety (or quality) into a product" is as true today as it ever was. Testing for *E. coli* O157:H7 only allows discarding of product that fails the test; it does nothing to establish that the product that passes the test is safe.

Therefore, it can then be confidently predicted that, if efforts to improve the safety of beef continue to be focused on carcass decontamination and end-product testing, there will be little further improvement in the microbiological safety of beef in the foreseeable future. However, if proper attention is given to preventing the recontamination of beef during fabrication processes, it should be possible to greatly improve the microbiological safety of beef with comparatively little effort, and at comparatively modest cost.

The data referred to in this brief article are discussed at length in Gill, C.O. (2009); Journal of Food Protection 72, 1790-1801.