has been established (Schuchat, et al., 1991, 1992; Farber and Peterkin, 1991; Ryser and Marth, 1991).

E. Mechanisms of Transmission and Risk Factors

Since beef products may be eaten after cooking procedures that are insufficient to assure elimination of bacterial pathogens, intrinsic contamination of the raw product represents a potential risk. This is particularly true for ground beef where contamination that would normally be limited to the exterior of meat is spread throughout the product during grinding (ICMSF, 1980). This problem has also occurred when roast beef that was internally contaminated by restructuring or injection was inadequately cooked (Bryan and McKinley, 1979).

Food handling errors often contribute to foodborne disease outbreaks (Todd, 1983, 1989). These include such factors as improper holding temperatures, inadequate cooking, contaminated equipment, and food handler hygiene. Inadequate cooking and improper holding temperatures are particularly pertinent for beef products. A number of these factors have been addressed successfully. For example, undercooking in commercial plants has been addressed through the standardization of thermal processing requirements, such as the guidelines for roast beef (USDA, 1983 NACMCF, 1989). However, similar levels of control have not been achieved in the home or in all food service establishments.

Other factors that appear to influence the incidence of foodborne disease are the source, primary purpose, and health of the animals. At least for *E. coli* 0157:H7, there is a strong correlation with meat from dairy cattle, but not ''fed'' cattle (Wells, et al., 1991; Doyle, 1991; Griffin and Tauxe, 1991). The incidence was highest in young animals. Higher incidences of *Salmonella* contamination of raw beef products also appears to be correlated with calf slaughter operations (Hogue, et al., 1993).

The beef industry is made up of two major segments. Animals for the fed-cattle market come through feedlots to the slaughter plants. These are largely animals raised for higher quality meat, and are processed into wholesale cuts for boxed beef. The trimmings go into manufacturing ground beef or sausage. The majority of fed-cattle are slaughtered by a small number of large operators. Cow meat is produced from culled dairy cattle or beef cows advanced in age. The primary use of cow meat is ground beef and processed meats. This segment of the industry is characterized by a large number of small operators. A recent survey of the beef slaughter industry indicated that the overall microbiological quality of raw beef was inversely correlated to slaughter volume; however, no such association was observed for *Salmonella* contamination (Hogue, et al., 1993). *Salmonella* contamination was more closely related to the health of animals brought to slaughter. It is important to note that surveys of this type only provide broad statistical trends. Further work is needed to determine the operational differences both within and between large and small volume operations that could account for the observed trends.

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