Influence of natural meat microflora on *Campylobacter jejuni* survival on beef and pork under vacuum package and retail storage conditions

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Campylobacter jejuni is one of the leading zoonotic causes of human gastroenteritis in North America (2, 8). In addition to the seldom fatal but severe gastroenteritis caused by this organism, the serious immune-mediated Guillain-Barr syndrome, which is a chronic development in some previously infected individuals (11), make this organism a substantial public health concern. Outbreaks of infection due to *C. jejuni* have been linked to a number of sources including beef, poultry, eggs, seafood, water and raw milk.

Campylobacter jejuni is often present in the gastrointestinal tracts (7) and on carcasses (4, 9) of meat animals. It has also been isolated from bulk packed red meats (13) and retail ready meats (14). In the meat industry a combination of parameters, namely vacuum or saturated carbon dioxide packaging at strictly controlled -1.5°C is widely used to store and transport raw meat. A number of studies have raised concerns of the potential of these packaging conditions to increase the risk of campylobacteriosis by allowing the growth of *C. jejuni* (5, 6, 12). However, studies investigating the effect of vacuum and modified atmosphere packaging on the survival of *C. jejuni* on meat (5, 6, 12) have collectively indicated that chill storage under vacuum or modified atmosphere is likely to increase the safety of meat. More recently in 2001, a study investigating the effect of these preservative packing of meat at a strictly controlled -1.5°C on survival of *C. jejuni* showed no significant changes in numbers of this pathogen (3), raising causes for concern. *Campylobacter jejuni* is fastidious with respect to growth requirements and only grows in the temperature range of 30-44°C and is sensitive to oxygen (10). Therefore, survival rather than growth of *C. jejuni* on meat is the concern. Studies to date have focused on the effect of storage parameters rather than the influence of the natural bacterial populations on beef has on the survival of *C. jejuni*.

In a recent study, the ability of *Campylobacter jejuni* ATCC 11168 to survive on commercial beef and pork stored under chilled, vacuum packaged and retail display conditions was examined and the role of natural meat microflora on *C. jejuni* survival was elucidated (1). When sterile cores of beef and pork were inoculated with ~10^5 to 10^6 cfu cm^{-2} of *C. jejuni*, and stored under aerobic or vacuum packaged conditions at -1.5 or 4°C, *C. jejuni* numbers dropped significantly and could not be enumerated by direct plating after 28 d of the 6 wk study (Fig. 1). In contrast, survival of *C. jejuni* on commercial vacuum packaged beef and pork was significantly enhanced, resulting in only 1 log cfu cm^{-2} reduction at the end of 6 wks (Fig. 1). During 7 d of display in a retail case, numbers of *C. jejuni* dropped quickly, but could be enumerated by direct plating even on day 7 (Fig. 2).

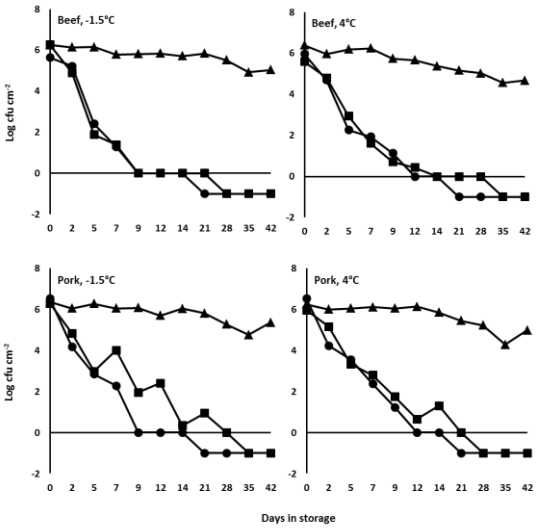

Fig. 1. Numbers of *C. jejuni* surviving on sterile beef and pork cores inoculated with *C. jejuni* and packaged by overwrapping using oxygen permeable PVC film (aerobic; ●), vacuum packaged using commercial barrier bags (■), and on commercial beef and pork inoculated with *C. jejuni* and vacuum packaged using commercial barrier bags (▲) and stored at -1.5 or 4°C. Data are least square means of bacterial numbers. SE= 0.36.

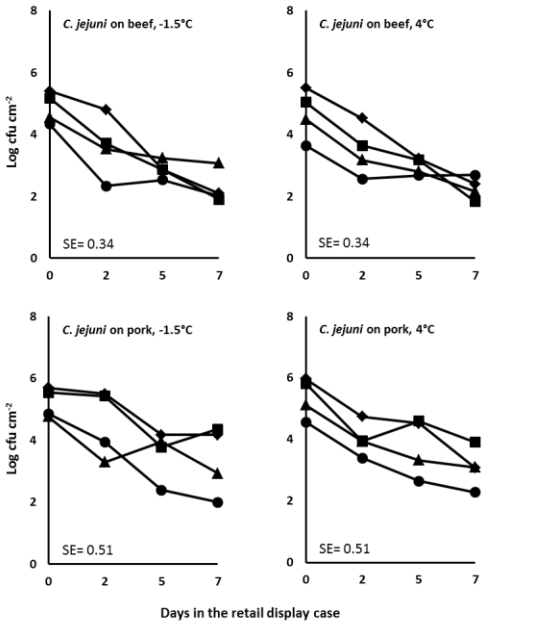

Fig. 2. Numbers of *C. jejuni* surviving on commercial beef or pork inoculated with *C. jejuni* that were stored in vacuum packages at either -1.5 or 4°C for up to 6 wks, removed, wrapped in oxygen permeable polyvinyl chloride film and stored in retail display case for up to 7 days. 0 time (□), 2 wks (■), 4 wks (▲) and 6 wks (●). Data are least mean squares of bacterial numbers.

The presence of high numbers of inoculated *C. jejuni* on beef and pork had no significant effect on the natural microflora numbers compared to uninoculated controls when the meat was stored either in vacuum or in a retail display case. These results show that natural microflora on vacuum packaged chill stored beef or pork affords enhanced survival of *C. jejuni*. This would mean that although *C. jejuni* cannot grow on preservative packaged chill stored meat, their survival on meats with high background microflora or a general poor hygiene would be enhanced, thereby compromising safety. Therefore, control of *C. jejuni* to protect the consumer will require an integrated approach throughout the meat production, processing, and sale continuum by adapting improved hygienic practices or through decontamination technologies which currently are the only way to avoid food safety concerns with respect to this pathogen.

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