THE CHANGE OF ACID TOLERANCE RESPONSE OF *SALMONELLA* DURING A SIMULATED CHILLED BEEF STORAGE

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I. OBJECTIVES

Salmonella is a major foodborne pathogen worldwide. It can be transferred from feces and hide to the carcasses' surface during processing and frequently causes human gastroenteritis and bacteremia. Methods such as spraying of organic acids on animal carcasses have been widely employed as decontamination treatments. However, its consequences should be considered. Besides reducing the antibacterial effect of acids, the acid tolerance response (ATR) can also trigger a cross-protective effect in bacteria, which may promote an enhanced virulence, endangering the safety of meat and meat products. This study aims to address the change of ATR of adapted and nonadapted *Salmonella* strains exposed to a simulated chilled beef storage environment.

II. MATERIALS AND METHODS

The *S. enterica* serovar Typhimurium ATCC 14028 strain were transferred to 50 mL of non-glucose Tryptic Soy Broth and Tryptic Soy Broth medium containing 10% (w/v) glucose (TSBG) and cultured at 37°C overnight to produce nonadapted and adapted strains, respectively. Meat extract (ME) medium was used to simulate the beef chilled storage environment of *Salmonella* strains. Cells were centrifuged and transferred into 100 mL of ME. The initial cell concentration was adjusted at 8.3 log CFU/mL, and cells were incubated at 4°C for 25 d. Gradient dilutions, followed by culture on Brain Heart Infused Agar (BHIA) plates, were carried out 1 d before the acid tolerance assay (0, 6, 12, 18, and 24 d) to obtain the exact concentration of cells. On the day of the assay, different volumes of culture media were concentrated and transferred to 10 mL of BHI medium (pH 3, adjusted with HCl) to ensure the initial concentration. After incubation in acid challenge medium for 0, 30, 60 and 120 min at 37°C, cells were collected, gradient diluted, and plated on BHIA plates. The line that best fits survivor plots was determined by linear regression, and the negative reciprocal of the slope was used for the D-value.

III. RESULTS

During the 25-d storage period in ME media, the cell number that was found in acid-adapted *Salmonella* strains was significantly lower than that of the non–acid-adapted strain. A significant decrease in the cell number was observed in both adapted and nonadapted strains ($P < 0.05$) as the storage time extended. Acid adaption significantly improved the acid tolerance of *S. Typhimurium* during storage in ME media. With regard to the acid-adapted strain, the D-value increased significantly on day 7 and then decreased to its basal level in the following days. For the nonadapted strain, the D-value was low in ME media, except for a slight increase in ME medium on day 13. Although the mild acid environment was considered the main reason for the development of ATR, and the current pH in ME media was very suitable for the nonadapted strain to develop an enhanced acid tolerance during storage, the D-value of nonadapted strain was not found raised over the adapted ones. Low temperature may inhibit the development of ATR, emphasizing the importance of keeping a low temperature during processing to prevent the development or survival of *Salmonella* spp. in meat.

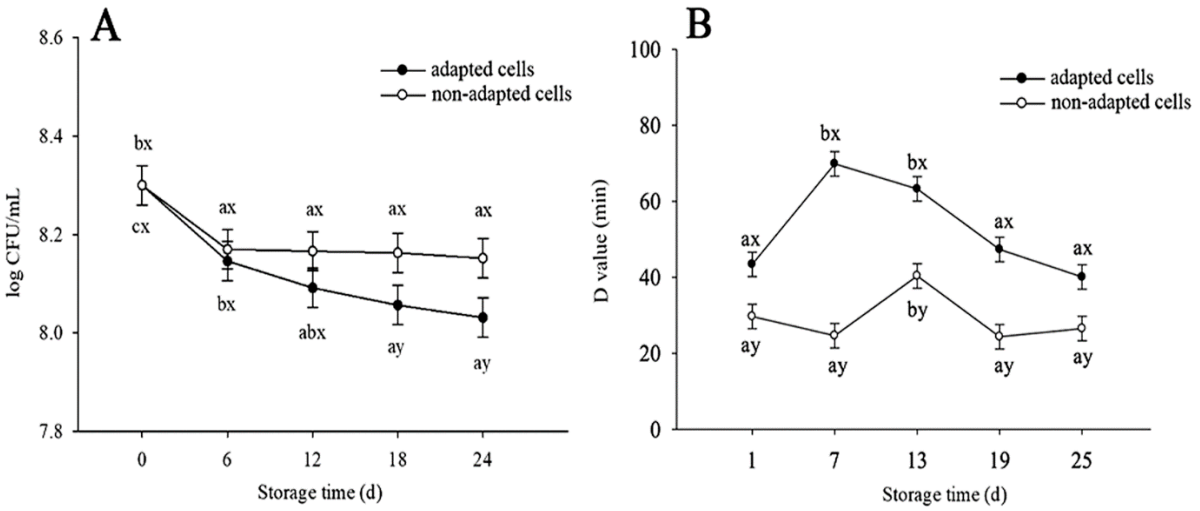

Figure 1.
Changes of the colony counting of adapted and non-adapted S. *typhimulium* (ATCC 14028) strains in Meat Extract during the storage at 4 °C (A) and D-values (min) for acid treated (pH=3, BM) cells of adapted and non-adapted strains storage in Meat Extract at 4°C at different time intervals (B).

IV. CONCLUSION

The ATR in *Salmonella* was sustained for 25 d in the ME medium, indicating that the ATR of this bacteria occurs during the aging and distribution of beef, which is a potential threat to public health. Combined with a mild acid ME environment, low temperature had a positive effect on the acid tolerance of *Salmonella*.

Keywords: acid tolerance response, chilled storage, *Salmonella*