

The biological effect of a beef derived *Lactobacillus sakei* on beef steaks during chilled storage

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Introduction: The aim of this study was to clarify the biological protection ability of beef-derived LAB. The microbial composition (*Pseudomonas*, *Brochothrix thermosphacta*, *Enterobacteriaceae*, LAB and microbial diversity) of the overwrapped packaged fresh beef was analyzed and compared to fresh beef without *L. sakei* RS-25 during the 12 days storage. The inhibitory ability of *L. sakei* RS-25 against *Salmonella typhimurium* during storage (12 days) was also evaluated.

Materials and methods: *L. sakei* RS-25 strain was isolated from chilled beef in our laboratory. *S. typhimurium* standard strain ATCC14028 was used as the simulated polluted bacteria. The *M. longissimus lumborum* (loins) from left half carcass (n=4) was selected and cut into 4×4×2 cm pieces. The specific groups were as follows: Control group (G0): No inoculation treatment, spray sterile water; LAB treatment group (G1): Beef samples were treated with *L. sakei* RS-25 at 6 lg CFU/g; *S. typhimurium* Group (G2): Beef samples were treated with *S. typhimurium* at 3 lg CFU/g; *S. typhimurium* and *L. sakei* group (G3): Beef samples were treated with *L. sakei* RS-25 at 6 lg CFU/g and *S. typhimurium* at 3 lg CFU/g. After being packaged in the overwrapped packaging, samples were stored at 4°C and analyzed at 0, 3, 6, 9 and 12 days. A total of 10 g meat was taken from the surface of each sample at each sampling day, then microbiological counting (*Pseudomonas*, *B. thermosphacta*, *Enterobacteriaceae*, LAB and *S. typhimurium*) was performed. At the same time, the total genomic DNA of the bacteria was extracted.

Results: The results of microbial count analysis showed that, the population of *Enterobacteriaceae* and *B. thermosphacta* reduced 0.29 lg CFU/g and 0.37 lg CFU/g on 3 and 6 days, respectively, as compared to control samples. At the same time, it also significantly ($P < 0.001$) reduced the re-contaminated *S. typhimurium* by 1.45 lg CFU/g on 6 days.

Based on the results of microbial diversity, *L. sakei* RS-25 occupied the advantage bacterium group within 6 days of storage period, and it delayed the succession process of the beef microflora structure to bacteria with specific spoilage organisms. The bacterial community structure of control group at 3 d and 6 d during storage period was similar to that of the LAB treatment group at 6 d and 9 d, respectively. In addition, during the entire storage period, the number of bacterial species in beef treated with *L. sakei* RS-25 was lower than that of the control group. The microbial diversity of the beef microflora was significantly reduced.

Conclusions: This work showed that *L. sakei* has a great potential application value in fresh beef. It can delay the process of the beef microflora structure to bacterial flora with specific spoilage organisms and reduce the counts of pathogenic bacteria and spoilage bacteria during storage at 4°C. However, further studies are recommended to make the use of the intraspecies diversity on the screening the cocktails of protective bacteria and further clarify the antibacterial mechanism of *L. sakei*.