P - 130

Effect of Nisin on the Storage of Korean Jerky

Hyoun-Wook Kim · Hye-Jung Kim[1] · Cheon-Jei Kim and Hyun-Dong Paik*

Division of Animal Life Science, Konkuk University, Seoul 143-701, Korea
[1]Gyeongsangnam-Do Institute of Public Health and Environmental Research, Changwon 641-825, Korea

Introduction

The safety of jerky depends primarily on heat treatment. However, because of the well-known difficulties in maintaining low storage temperatures along the distribution chain, thus ensuring a greater safety level, it has been proposed that other hurdles be included in the manufacture of jerky products, such as the incorporation of bacteriocins.

Nisin is a bacteriocin produced by certain strains of *Lactococcus lactis* subsp. *lactis*, which exhibits antimicrobial activity against a wide range of Gram-positive vegetative cells and spores[(1)]. Moreover, it has already been used in the food industry as an antagonistic additive in more than 50 countries[(1)]. Thus this study was performed to evaluate the physical qualities and microbiological safety of Korean jerky, and in particular, to evaluate the effect of nisin on its storage stability.

Material and Methods

1. Preparation of Korean Jerky

A ready-to-eat type of jerky was prepared from beef and pork meat. Fig. 1 shows jerky processing flow chart and the points from where samples were collected for analysis.

The composition (%, w/w) of jerky spice was water (10), soy sauce (9), starch syrup (5), sugar (2), D-sorbitor (6), pepper (0.5), ginger powder (0.1), garlic powder (0.2), onion powder (0.2), sodium nitrate (0.007), sodium citrate (0.01), potassium sorbate (0.1), sodium erythorbate (0.036), soup stock powder (0.1). The spice adds humectant and tenderizer for improving Aw, moisturize and texture of jerky. The humectant was prepared for 1.0 kg of raw meat as add konjack 0.05 %. The tenderizer was prepared for 1.0 kg of raw mear as follows; a protease from *Streptomyces griseus* (0.01 % and 0.005 %) and *Bacillus poryfermenticus* (0.01 % and 0.005 %).

2. Drying

Treated raw meats were phase dried at 50℃ for 60 min, 60℃ for 60 min, and 70℃ for 90

min in dehydrators. The dehydrators were rectangular in shape and consisted of a base unit and three drying trays. The dehydrator base unit generated hot air, which ventilated upward through the sides and a hole in the middle of the trays. The target temperature was based on the air temperature measurement taken from the middle hole of the dehydrator. The empty trays were then replaced with other trays pre-loaded with meat slices. After drying, the Korean jerky strips were held in the dehydrators overnight to allow the moisture level in the Korean jerky slices to equilibrate, and then placed into sterile plastic bags.

3. Strains and Culture Condition

Bacillus cereus HJ801 were used in this study. *B. cereus* HJ801 were grown on plate count agar (PCA; Difco Laboratories, Detroit, MI, USA) overnight at 30℃ and then left at ambient temperature for 1 week to sporulate. When spores were detected microscopically, spore suspensions were created in sterile 0.1% peptone water (Difco) and heat treated (80℃ for 10 min) to kill vegetative cells. Spores were enumerated by viable counts, and the suspensions were adjusted to 10^5 spores/ml. Mixed inocula were prepared by combining spore suspensions in equal concentrations. Spores were inoculated into the Korean jerky to give a predicted level of 10^3 cfu/g.

4. Nisin

Nisin was purchased from Sigma Chemical Co. (St. Louis, MO, USA). A standard stock solution of nisin containing 1×10^5 IU/ ml was prepared by dissolving 100 mg of nisin in 0.02 M HCl (1 ml) and adding 9 ml of distilled water.

5. Microbiological Analysis

To measure the microbial quality of the stored product, duplicate packs from each treatment were taken, 10 g samples of the meat were aseptically transferred into a sterile stomacher bag and 90 ml of sterile 0.1% peptone water (Difco) was added to each sample and macerated for 2 min in a stomacher. Decimal serial dilution in 0.1% peptone water was prepared. Mesophilic microorganisms were determined using PCA (Difco) at 37℃ for 48 h. Coliforms were determined using Violet Red Vile Agar with MUG (Difco) at 35℃ for 48 h.

B. cereus numbers were determined using *Bacillus cereus* selective agar (Merck, Darmstadt, Germany) at 30℃ for 24 h. The lower limit of detection for this enumeration procedure was 10 cfu/g. Microbial colonies were counted and expressed as colony forming units (cfu) per gram.

Results and discussion

1. Microbiological Analysis

A storage temperature of 25℃ was chosen to represent temperature abuse, since surveys

of retail cases in supermarkets and in domestic refrigerators have shown that 20% exceed 10℃. The inoculum level of *B. cereus* HJ801 used in this study were substantially higher than the contamination levels found in either fresh or processed meat products. Therefore, the inoculum level and the storage conditions at 25℃ represent the worst case scenario for this kind of meat product. The inoculum levels of nisin used in this study were 100 IU/g and 500 IU/g, that is, levels known to control organism growth and reduce meat spoilage. Coliform organisms was not detected in any sample during the storage period.

Changes in the numbers of microorganisms during storage of Korean jerky are shown in Fig. 1. The numbers of mesophilic microorganisms in samples inoculated with *B. cereus* spore cocktail drastically increased at 25 ℃ storage, and after 60 days exceeded the *DHSS* guideline of bacterial loading, <100,000 per gram of food in a Korean jerky product.

Mesophilic microorganisms were found to be more numerous than the other microorganism groups. According to Carlin et al. (2000), mesophilic microorganisms, which survive the pasteurization process, grow even under refrigerated conditions and cause spoilage at abuse temperatures. The effect of nisin in Korean jerky was to delay microbiological growth and spoilage. An increase in the numbers of mesophilic microorganisms depended on the storage temperature and the type of jerky, and may also have been due to initial contamination differences.

The number of *B. cereus* in Korean jerky packages without nisin was markedly increased at 25℃, and after 21 days exceeded 10^3 cfu/g, the maximum limit in France for some processed vegetables. However, packages with nisin showed no changes (Fig. 2).

B. cereus is the dominant aerobic bacterium in cooked, pasteurized and chilled products, because of the probable survival of its spores during the pasteurization step after packing. Many of Bacillus spp. are able to grow in anaerobic conditions, thus the oxygen depletion

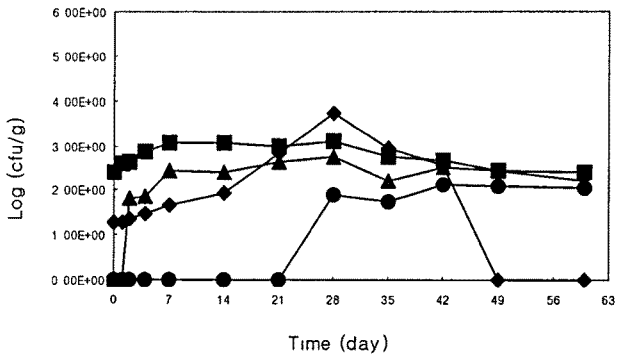

Fig. 1. The behavior of microorganisms in the absence or presence of nisin in jerky products during storage at 25℃.

Control packages (●), packages inoculated with Bacillus cereus (■), packages inoculated with Bacillus cereus and nisin 100 IU (▲), packages inoculated with Bacillus cereus and nisin 500 IU (◆).

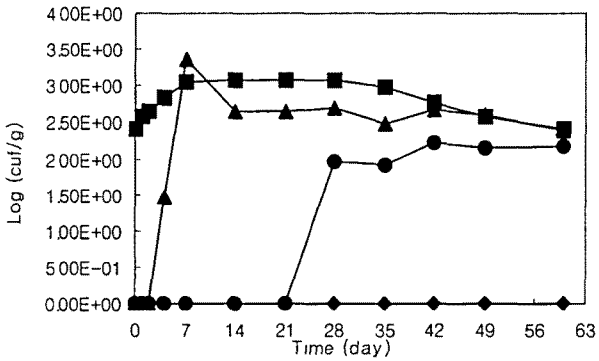

Fig. 2. The behavior of *Bacillus cereus* in the absence or presence of nisin in jerky products during storage at 25℃.

Control packages (●), packages inoculated with Bacillus cereus (■), packages inoculated with Bacillus cereus and nisin 100 IU (▲), packages inoculated with Bacillus cereus and nisin 500 IU (◆).

created by packing under vacuum does not prevent their growth.

Nisin is particularly effective at controlling the growth of spore-formers such as *Bacillus* and *Clostridium* genera as well as species of *Listeria monocytogenes*, *Staphylococcus* and many lactic acid bacteria.(2)

Summary

The aim of this study is to evaluate the microbial safety and physical qualities of Korean jerky, and the effect of nisin during storage. Jerky processed packages with or without nisin (100 IU or 500 IU) were stored at room temperature (25 ℃) for 60 days, and samples measured for quality at regular intervals throughout this storage period. In the case of 25℃ storage, the number of mesophilic microorganisms in seasonedbeef packages without nisin increased markedly, but with nisin there was no observed increase. *B. cereus* cells showed similar trends, although coliform was not detected in all samples. At 25℃ storage, changes in the cutting force of packages containing nisin showed no significant change, packages without nisin decreased markedly.

References

1. Ray, B., (1992) Nisin of *Lactococcus lactis* ssp. *lactis* as a food biopreservantive. In B. Ray (Ed), *Food Biopreservatives of Microbial Origin* (pp. 207-264). Florida: CRC Press.
2. Mansour, M., et al. (2001) An inhibitory synergistic effects of a nisin-monolaurin conbination on *Bacillus* sp. vegetative cells in milk. *Food Microbiology*, 18, 87-94.