Effect of Tenderizer on Physical Quality and Microbial Safety during Korean Beef Jerky Production

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한국형 우육포의 제조공정 중 연화제가 육포품질 및 미생물학적 안전성에 미치는 영향

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Abstract

The physical quality and microbial safety of Korean beef jerky was evaluated at various steps during its preparation. Microbial counts in raw beef demonstrated mesophillic bacteria at 4.20 Log CFU/g, psychrotrophic bacteria at 3.85 Log CFU/g, anaerobic bacteria at 4.90 Log CFU/g, and yeast and molds at 1.92 Log CFU/g. Spore-forming bacteria and coliforms were not detected in raw beef samples. Spices and spiced meats showed similar trends in microbial counts, demonstrating minimal microbial contamination during these stages of preparation. The final beef jerky product exhibited counts of mesophillic bacteria at 1.15-1.66 Log CFU/g, psychrotrophic bacteria at 1.15-1.66 Log CFU/g, and anaerobic bacteria at 0.81-1.72 Log CFU/g. Spore-forming bacteria, yeast and molds, and coliforms were not detected in beef jerky. Significant differences from added ingredients occurred for instron textural profile analysis traits for hardness. In general, Korean beef jerky with humectant and tenderizer had lower hardness than control (without humectant and tenderizer). Also, the sample added with 0.01% protease from Streptomyces griseus had lower hardness than all samples. All samples had 0.71 to 0.72 water activities, and the color and pH were not shown in significant changes of all samples.

Key words: Korean beef jerky, physical quality, microbial safety, protease

Introduction

Food-borne illness poses a significant public health threat throughout the world. Chemical and microbial contaminants pose a significant health risk for the consumers, marketers, and producers of agricultural products. Current estimates suggest that microbial food-borne illnesses will affect between 6.5 and 33 million people in the United States each year, and will account for as many as 9,000 deaths (Smith, 2000).

Jerky is a food that has been prepared by humans at least since ancient Egyptian times. This product is a nutrient-dense meat that has been made lightweight by drying. A pound of meat or poultry weights about four ounces after being made into jerky. Because most of the moisture is removed, it is shelf stable and can be stored without refrigeration, making it a handy food for backpackers and others who don’t have access to refrigeration (FSIS, 2006).

Intermediate moisture (IM) meat products are processed almost everywhere in the world and each product has its own characteristics. Since there has been an increase in refrigeration costs, increasing interest in IM meat products has developed (Garcia et al., 2001). After drying, the IM meat product reaches an $a_w$ of 0.6-0.9 equivalent to a relative humidity (RH) of 60-90% at ambient temperature (Ledward, 1981; Chang et al., 1996). The application of a processing method that involves hurdle technology results in charqui meat (Leistner, 1987). As recently described, salt, sodium nitrite, dehydration, and packaging are hurdles sequentially applied to inhibit spoilage microorganisms (Torres et al., 1994; Shimokomaki et al., 1998).
Humectants are hygroscopic, “water-pulling” substances that are incorporated into food in order to promote retention of moisture. These substances include moisture-retention agents and anti-dusting agents. Since hygroscopic substances, such as glycerin, absorb water from the air, the addition of humectants can keep foods moist.

Texture is an important characteristics of meat products that influences consumer preference. Meat toughness can be subdivided into actomyosin toughness, which is attributable to changes in myofibrillar proteins, and background toughness, which is attributable to connective tissues (Chen et al., 2006). Because most of the moisture in jerky is removed, it has a stable shelf-life, is microbiologically safe ($a_w$<0.70), is easy to prepare, light-weight, has a rich nutrient content, and can be stored without refrigeration (FSIS, 2006).

The objective of this study was to assess the physicochemical quality and microbiological safety of Korean jerky meats during its preparation.

**Materials and Methods**

**Preparation of Korean beef jerky**

A ready-to-eat type of jerky was prepared from beef. Fig. 1 summarizes the processing of the jerky product and indicates the points in this process at which samples were collected for analysis.

The composition (w/w) of jerky spice was water (10%), soy sauce (9%), starch syrup (5%), sugar (2%), D-sorbitol (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%), and soup stock powder (0.1%). The spice mixture also contains a humectant and tenderizer to improve the moisture and texture of the jerky. The humectant was prepared for 1.0 kg of raw beef as added konjack 0.05%. The tenderizer was comprised of proteases derived from Streptomyces griseus (add protease from S. griseus into tenderizer, TS1; 0.01%, TS5; 0.005%) and Bacillus polyfermenticus SCD (add protease from B. polyfermenticus SCD into tenderizer, TB1; 0.01%, TB5; 0.005%).

Treated raw beef was phase dried in dehydrators at 50°C for 60 min, 60°C for 60 min, and 70°C for 90 min. 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 measurements taken from the middle hole of the dehydrator. The empty trays were then replaced with trays loaded with meat slices. After drying, the jerky strips were held in the dehydrators overnight to allow the moisture level in the jerky slices to equilibrate. The jerky was subsequently placed into sterile plastic bags.

**Physicochemical analysis**

The texture of the meat slab was measured as piercing force by inserting a plunger of 5 mm diameter into a meat block using a Rheometer (model Compac-100, Sun Scientific Co., Japan). The texture of stored meat slices was quantified as cutting force by inserting a blade of 0.26 mm diameter using the Rheometer into a cylindrical slice, using a 10 kg load and a plunger speed of 60 mm/min.

The surface color of the meat was measured using a Hunter color system (L, a, and b values) using a Color Difference Meter (model JC 801, Color Techno System Corp., Tokyo, Japan). The pH of the product was measured for the brine solution using an Orion model 520A pH Meter (Orion Research Inc., Boston, USA). Water activity was determined, in duplicate, using a Rotronic Hygroskop DT (Rotronic Instrument Corp., Huntington, USA) at 25°C according to manufacturer’s instruction.

**Microbiological analysis**

Microbiological analysis was performed on raw beef, jerky spice mixtures, spiced meats, and processed jerky products. In order to assess the microbial contamination of