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IDENTIFICATION OF KOREAN AND IMPORTED BEEF BY MUSCLE ULTRASTRUCTURE DURING COLD STORAGE

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INTRODUCTION

Electrophoretic (Hofmann, 1985), immunological (Monique and Peter, 1990), morphological (Kang, 1992), HPLC (Jones, 1985), and DNA (Chikuni et al., 1990) methods can be used in inspections for the identification of meat species. These methods are more appropriate for the identification of one or more animal species in meat mixtures and in the case of suspected adulteration (Jones, 1985). They are also used to detect the possible substitution of boneless beef packed in carton with that of other species in international trade (Keny, 1985).

In Korea, Korean beef is consumed together with those imported from Australia, New Zealand, USA and Canada. Interestingly, the former is preferred to the foreign beef because of their freshness and palatability. This makes Korean beef more expensive than the imported, and sometimes imported beef is sold as Korean beef in retail store. Therefore, the demand for identification of Korean beef from the imported beef of different breed is on the rise in Korea. We reported previously that the myoglobin content and z-line of Korean beef is higher and wider than those of imported beef.

In this study, as the import trend favors more the cold storage beef to the frozen beef, we studied the muscle ultrastructure stored at 0°C to identify Korean beef from imported beef.

MATERIALS AND METHODS

Random samples of Korean and imported beef were obtained from Seoul Livestock Products Marketing Center of National Livestock Cooperatives Federation in Korea. Longissimus muscle of the former was obtained immediately after slaughter and that of the latter was before shipment to a retail store. Both samples were stored for 1 day and 7 days at 0°C.

For electron microscopic study, longissimus muscles were fixed in 3% glutaraldehyde-0.12M sodium cacodylate buffer at pH 7.2 overnight, and then rinsed twice for 30 min in the same buffer, followed by fixation in 1.33% osmium tetraoxide-0.12M sodium cacodylate at pH 7.2 for 3 hr. After fixation, samples were dehydrated in an acetone series (from 65 to 100%) and embedded into epon 812 mixture. Thin sections were made with an ultramicrotome (LKB 2088) using a diamond knife, and stained with 1% uranyl acetate dissolved in 50% ethanol and with undiluted lead citrate [2.66% $Pb(NO_3)_2$ and 3.52% Na_2 $(C_2H_6D_7)$]. Electron micrographs were obtained with JEM 100 CX-II electron microscope operated with an accelerating voltage of 80 kV.

RESULTS AND DISCUSSION

The sarcomere length of Korean beef that was 1.65 μm immediately after slaughter contracted to 1.2 μm during 1 day storage at 0°C and thereafter relaxed to 2.55 μm during 7 days storage at 0°C (Fig. 1A, B and C-a). However, that of imported beef, 1.1 μm before shipment to a retail store after being imported, relaxed to 2.2 μm during 1 day storage at 0°C, and to 2.2 μm during 7 days storage at 0°C (Fig. 1A, B and C-b).

The cristae of mitochondria of Korean and imported beef were not destroyed during cold storage. The width of z-line of Korean beef that was 0.1 μm immediately after slaughter extended to 0.22 μm after 1 day storage and 0.2 μm after 7 days storage (Fig. 2A, B and C-a). That of imported beef had similar patterns, which were 0.07 μm before shipment to a retail store after being imported, 0.15 μm after 1 day storage at 0°C and 0.19 μm after 7 days storage (Fig. 2A, B and C-b). However, the z-lines of Korean beef were wider than those of foreign beef. These results are consistent with the previous paper (Kang et al., 1992).

CONCLUSIONS

Korean beef muscles stored at 0°C were contracted and then relaxed during storage. However, those of imported beef become relaxed during storage without initial contraction. Therefore, the initial and the final lengths of sarcomere of Korean beef were longer than those of imported beef in the cold storage. The cristae of mitochondria were not destroyed during cold storage. The widths of z-line of Korean and imported beef both increased during storage, but those of Korean beef were wider than the imported.

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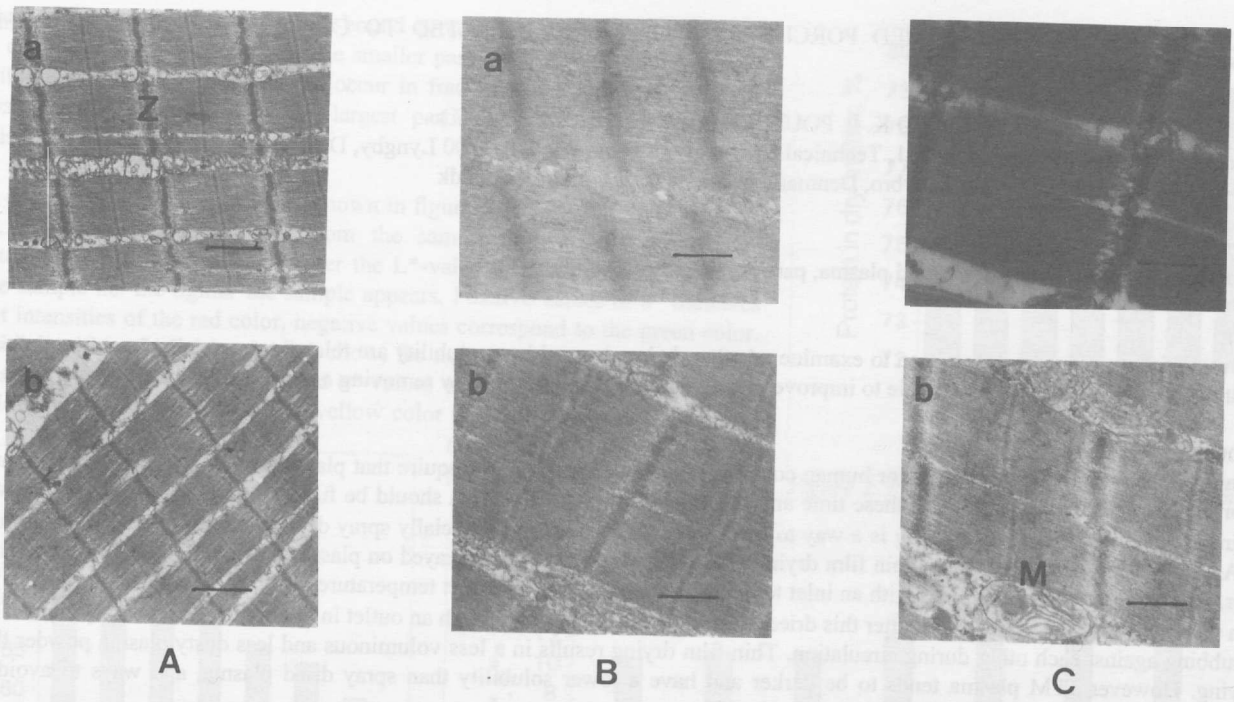

Fig. 1. Electron micrographs of longissimus muscle of Korean (a) and imported beef (b). A. The longissimus muscle of Korean beef immediately after slaughter and imported beef before shipment to a retail store after being imported; B. the longissimus muscle of Korean and imported beef stored for 1 day at 0°C; C. The longissimu muscle of Korean and imported beef stored for 7 day at 0°C. The sarcomere lengths of Korean beef muscle are longer than that of imported beef in at death and after 7 days of cold storage. Korean beef muscle stored for 1 day at 0°C is shortened, but those of the imported are not shortened. The line represents 1.0 μm. Magnification, x 10,000; Z, z-line; M, mitochondria.

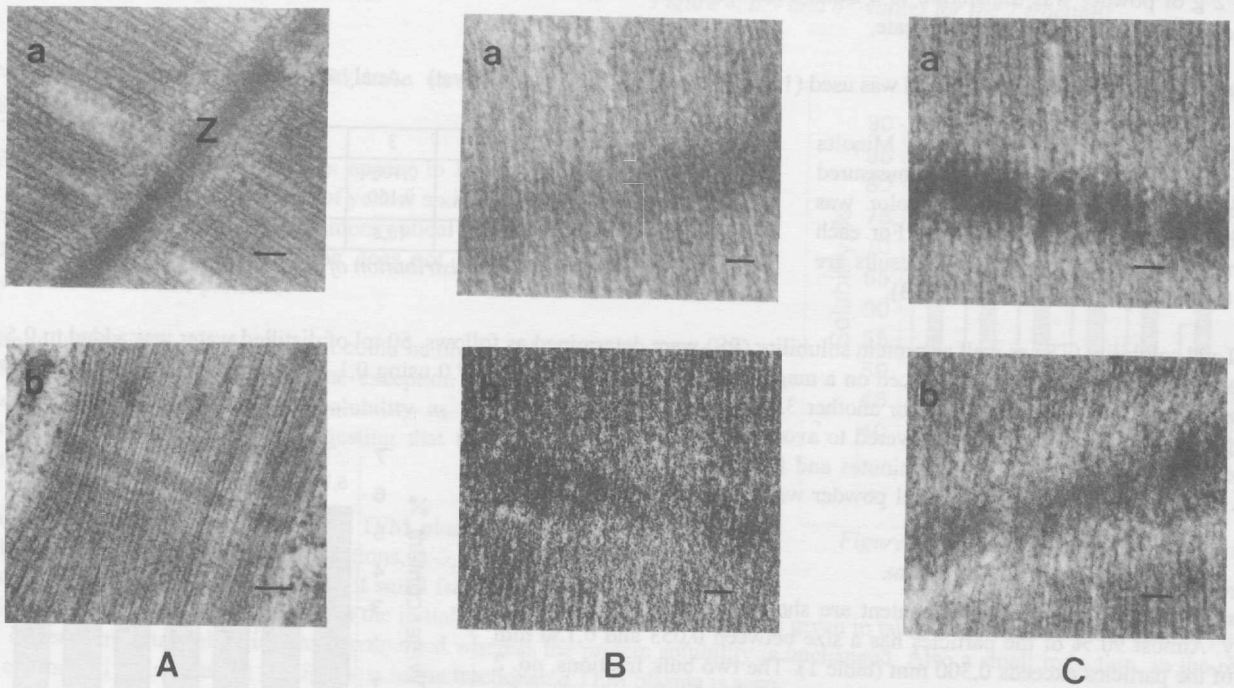

Fig. 2. Electron micrographs of longissimus muscle of Korean (a) and imported beef (b). A. The longissimu muscle of Korean beef immediately after slaughter and imported beef before shipment at a retail store after being imported; B. The longissimus muscle of Korean and imported beef stored for 1 day at 0°C; C. The longissimus muscle of Korean and imported beef stored for 7 days at 0°C. The z-line widths of Korean beef muscle are wider than those of imported beef, and they get wider during cold storage. The line represents 0.1 μm. Magnification, x 50,000; Z, z-line.