Microbiological Qualities and Post-Pasteurization Contaminations of UHT Milk Produced in Korea

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요 약

국내산 UHT-ESL우유와 UHT 처리우유 총 150 packs을 병장온도 (7°C)와 실온 (20°C)에서 5주간 저장하면서 1주마다 5 packs씩 시료로 취하여 미생물 함유 우유 packs의 발생시기, 발생 수와 미생물 종류별 함유 수준 등을 조사하였으며, 살균 후 2차 오염미생물을로서 Salmonella spp와 Staphylococcus aureus 존재 여부를 확인하였다. 종균수는 무균포장 공정을 실시하지 않은 UHT 처리우유가 UHT-ESL 우유보다 촉혈시기가 빠르고, 미생물 함유수기가 많아 미생물학적 품질이 약간 낮은 것으로 나타났다. 그러나 두 제품군 모두 대장균군은 촉혈하지 않았으며, 호기성 포자형성균은 UHT 처리우유 2 제품에서 각각 7일 및 14일 만에 포자가 발아한 우유 pack이 1 pack씩 나타났으며, 7°C에서 저장한 우유보다 20°C에서 저장한 우유에서 포자가 발아한 우유 pack의 수가 많았다. 내생균군은 2 제품군 모두 130°C 이상의 열처리로 인하여 14일까지 촉혈하지 않았으나, 20°C에서 저장한 우유는 21일 후(<3000 CFU/ml), 7°C에서 저장한 우유는 28일 후(40-3,600 CFU/ml)에는 모든 pack에서 나타나기 시작하였다. 내생균군은 UHT-ESL우유는 28일부터 촉혈되었으나, 한 제품의 UHT 처리우유는 7일 후부터 7°C에서 3,900-102,000 CFU/ml까지, 20°C에서는 7일부터 28일까지 <3,000 CFU/ml 이하의 균수가 촉혈되었으며, 다른 제품의 UHT 처리우유는 21일에 30,000 CFU/ml 이하, 28일부터는 대부분의 pack에서 30,000 CFU/ml 이하로 발견되었다. Salmonella spp와 Staphylococcus aureus에 의한 2차 오염은 모든 제품에서 없었던 것으로 나타났다. 이러한 결과는 UHT 우유의 열처리 방법 및 포장방법에 따라서 병장보관 우유의 유동기간은 3주간(21일)으로 설정하는 것이 가능한 것으로 나타났다.

(Key words: UHT-ESL milk, UHT milk, microbiological quality, post-pasteurization contamination)

I. Introduction

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Three types of milk, treated by traditional HTST, microfiltrated (MF)-ESL, and UHT-ESL, have been currently introduced to the markets around the world. A brand of milk manufactured by removing the microbial
cells and spores in raw milk by microfiltration (MF) technology and then heat treated at mild pasteurization temperature combined with aseptic packaging had been developed. Wamsler (1996) compared on the points of the processing methods of ultra-pasteurization and bactofugation in use to extend the shelf life of milk as potential market, evaluate the use of microfiltration, and the sensory and microbiological properties of ESL milk and cost comparison. Anon (1999) discussed the benefits of ESL milk, improved taste of 'freshness' over UHT milk, risks of re-infection and effect on shelf stability, and cost vs. benefits of ESL technology. Kelly (1999) also covered several aspects including definition, appeal of ESL milk, technical options, processing of milk to extend shelf life, increase flexibility for expansion of distribution channels and entry into distant market. The MF-ESL milk (pure filtered milk) in fact has become the most popular milk in Canada, and market sales have increased significantly due to the fresh taste, cold pasteurization, extended shelf life, and technologically innovative image. Evaluations of the milk quality in respects to microbiological, nutritional and environmental contaminations or safety, and economical respect requires the accurate detection methods (Byrne et al., 1989; Choi et al., 1999a; Eie and Martens, 2000; Skladal et al., 1993). Gram negative bacteria found in heat treated milks are probably the post-pasteurization contaminants during filling and sealing the milk or during from delivery to market (Choi et al., 1999b; Kang et al., 1995; Kwon and Choi, 1998). The most frequent contaminants in pasteurized milk and UHT milk have appeared to be Bacillus, Staphylococcus, Salmonella, Micrococcus species (Kessler et al., 2001; Silveira et al., 1989; Zarachenco et al., 2001), and Mycobacterium in pasteurized milk (Grant et al., 1999). Although LTLT, HTST, and UHT sterilized milks are conventionally used for decade, microfiltered (Eie and Martens, 2000; Skrzypek et al., 2001; Stepaniak, 1997), bactofuged and ELS pasteurized milk have been developed (Kelly, 1999; Wamsler, 1996). These are currently used for the supply the fresh taste of milk to the consumers around the world. While the advantage and disadvantage of ESL milk are still on the discussion (Anon, 1999; Gallman et al., 2001), many efforts have been made to produce high quality of fresh pasteurized milk (HQFP milk) in a small dairy farm by fast cooling and separate bulking of milk (Azzony et al., 1993) or HTST shelf-stable milk (Eisner, 1995) or development of the helical tube indirect UHT system (Sahoo et al., 2002). In order to enhance the keeping quality of commercialized milk, lactoperoxidase system (Barrett et al., 1999), higher temperature and longer holding times of pasteurization system (Grant et al., 1999) had been suggested.

UHT-pasteurized ESL milk incorporated with further special aseptic processing has been launched three years ago in Korea. Comparative studies on the microbiological quality of UHT- ESL milk and conventionally produced UHT- pasteurized milk have been performed by Jeong et al. (2001), Jeong et al. (2002), and Kim et al. (2003). The aim of our study was to compare the microbiological quality aspects of commercialized milks produced in spring season (May, 2003) by different processing methods in Korea.

II. Materials and Methods

1. Enumeration of Microorganisms

Total 150 milk samples manufactured by three companies in Korea were purchased from local distributors and divided into two temperature groups. One group of milk was kept under refrigeration (7 °C) and the other was kept at room temperature (20 °C). Five samples of each brand were withdrawn at 7 d-intervals for 5 weeks, and subjected to microbial tests as indicated below. All pour plate methods were used by mixing 1 ml of milk into a petri-dish containing about 20 ml of molten agar and swirling. Triplicates (1 ml or 25 ml × 3 times) were separately performed for each milk sample.

2. Total Bacteria

Total bacteria in milk samples were enumerated on Standard Plate Count (SPC) agar (Difco, USA) and incubated aerobically at 30°C for 48h by the procedure of