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Effect of Ultra High-Pressure Homogenisation on Natural-Occurring Micro-Organisms in Bovine Milk

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Abstract
This study aimed to evaluate the effects of ultra high-pressure homogenisation (UHPH) on natural-occurring micro-organisms in bovine milk and compare the effects of heat and UHPH treatments. Whole raw milk was standardised at 3.5% and was processed using a Stansted High Pressure Homogeniser (model FPG11300, Stansted Fluid Power Ltd., Essex, UK). The microbiological quality of raw, high pasteurized (90ºC, 15 s) and pressure treated (200 and 300 MPa at inlet temperatures of 30 and 40ºC) milks was studied by enumerating total bacteria, psychrotrophic bacteria, coliforms, lactococci, lactobacilli and enterococci. UHPH treatments were as efficient (99.99%) as high-pasteurization treatment in reducing the total bacterial population, reaching important reductions (3-4 log cfu/ml). Lactococci count behaviour was similar to that of total bacteria count, reaching the same reductions. Psychrotrophic bacteria counts were not detected in high-pasteurized milks and were greatly reduced (~ 4 logs) in UHPH-treated milks. Coliforms, lactobacilli and enterococci were completed destroyed by both UHPH and heat treatments.

Introduction
Milk presents a favourable environment for the multiplication of microorganisms since it contains all the necessary nutrients. To avoid the creation of negative sensory attributes during shelf life due to microbial growth, milk usually is pasteurised.

In recent years, there has been a lot of research to replace traditional food preservation technologies such as heat treatment with emerging techniques due to the increased consumer demand for tasty, nutritious and natural products. Ultra high-pressure homogenization (UHPH) is one of the food preservation treatments that is being developed and applied as a minimal process for the production of a wide variety of safe and nutritious foods. UHPH is commonly used for cell disruption of dense microbial cultures (Saboya et al.,2003) and it can also be used to cause a reduction of the microbial population, extending the shelf life and improving the microbial safety of food products (Hayes et al., 2005). In this study, the effects of UHPH treatment on naturally-occurring micro-organisms of raw bovine milk at pressures ≥200 MPa, which until now have not received much attention, were examined. The effects of heat (90ºC, 15 s) and UHPH treatments were compared.

Materials and Methods
Fresh raw bovine milk was collected on a local farm and then, milk was standardised at 3.5% and was processed using a Stansted high pressure homogeniser (model FPG11300, Stansted Fluid Power Ltd., Essex, UK).

Milk was heated and UHPH-treated under the following conditions: pasteurized (PA) milk at 90ºC for 15 s and UHPH-treated milk at 200 and 300 MPa with inlet temperatures of 30 and 40ºC for both pressures. The microbiological quality of the different milks, including raw milk, was assessed by enumerating Total bacteria, Psychrotrophic, Coliform, Lactobacilli, Lactococci, and Enterococci as was described by Pereda et al., 2006.

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Results and discussion

Microbial populations found in raw, and treated milks are shown in Table 1.

Table 1: Microbial populations of raw, pasteurized and UHPH milks (log cfu/ml)

Microorganism	**Raw**	**Past 90ºC**	**200 30ºC**	**300 30ºC**	**200 40ºC**	**300 40ºC**
Total bacteria	5.06± 0.47	0.39± 0.68	1.30± 0.12	0.97± 0.47	0.92± 0.43	1.01± 0.55
Lactococci	4.94 ± 0.28	0.46 ± 0.80	1.01 ± 0.40	0.97 ± 0.39	0.93 ± 0.44	0.84 ± 0.38
Psychrotrophic bacteria	5.34± 0.26	Nd	0.23± 0.40	0.10 ± 0.17	0.26 ± 0.45	0.30 ± 0.52

Data are means with their standard deviations of duplicate analysis from four different productions.

Total counts of refrigerated raw milks varied from 2.5×10^4 to ~3×10^5 cfu/ml. This high variation in the total counts, allowed us to study the efficiency of the UHPH treatments applied, compared to heat treatment. Overall, UHPH treatments were as efficient (99.99%) in reducing the bacterial population as was high pasteurization treatment, reaching important reductions (3-4 log cfu/ml). This reduction was higher than that obtained by Hayes et al. (2) of 1.83 log cfu/ml working at 200 MPa (Stansted 'nm-GEN' 7400H). In another study (HAYES et al., 2003) also working with the Stansted 'nm-GEN' 7400H reached a reduction of 75% of total bacterial count at 200 MPa. THIEBAUD et al., 2003 also obtained lower microbial reductions (1-1.15 log cfu/ml) working at 200 MPa and at inlet temperature of 24ºC (Stansted HP homogenizer model FPG7400 H). Differences observed in total counts between this study and other works could be explained by differences in the valve construction and machine design.

Reductions in lactococci bacteria counts were similar to those obtained in total bacteria counts (3- 4 log units). Results of Psychrotrophic bacteria agree with those of HAYES et al., (2). THIEBAUD et al. (5) obtained 1.3-1.6 log cycle reductions for this microbial group at 200 MPa (inlet T of 24ºC) and 2.7-3.1 log cycle reductions at 300 MPa.

In the present study, coliforms, lactobacilli and enterococci were reduced by heat and UHPH treatments up to undetectable levels regardless of the initial microbial level and in the case of UHPH treatment regardless of pressure and inlet temperatures applied.

Conclusion

Microbiological data showed that UHPH technology was as efficient as high pasteurization treatment in reducing the bacterial populations studied. These results suggest that UHPH could be used to obtain commercial milk with a microbiological quality similar to pasteurized milk. However, in order to confirm this, further studies must be carried out.

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