Lactose-free dulce de leche: compositional characterization, browning and texture profile

Caroline B. dos Anjos Pinto, Isis R. Toledo Renhe, Carolina C. RamosViana, Ítalo Tuler Perrone, Luiz Fernando Cappa de Oliveira and Rodrigo Stephani

SUPPLEMENTARY FILE

Supplementary Materials and methods

Analyses

The assessment of the chemical composition of both milk and manufactured DLs was carried out in addition to the analyses of the heat treatment indicator (figure 1) and each analysis was performed in duplicate. The pH was determined with a digital pH meter (GEHAKA®, PG 1400), previously calibrated according to the manufacturer's instructions using two standards covering the pH range from 4 to 7. The soluble solids content (°Brix) was determined by refractometry, using a MILWAUKER® digital refractometer (model MA871). The analysis of water activity (aw) was conducted in the Aqua Lab equipment model Decagon 3TE .

The moisture content was obtained using the infrared technique and employing the SARTORIUS® thermogravimetric scale MA 150 model, set at 145ºC for 30 minutes. The total solids content was calculated by difference, taking into account the moisture value. Following the official methods of AOAC International (2005), ash content was determined by incinerating organic matter at 550 °C (AOAC 930.30). The fat content was determined by the Gerber butyrometric method (IDF 13) using a solution of 20 g·100g-1 of dulce de leche. The same solution was used for the analysis of proteins through the Micro Kjeldahl method (IDF 20-1).

Results and discussion

The milk was analyzed according to the Brazilian regulation IN 68/2006 and presented a composition of 12.0 ± 0.3 g·100 g-1 of total solids; 3.3 ± 0.0 g·100 g-1 of lipid; 3.32 ± 0.08 g·100 g-1 of proteins; 4.58 ± 0.16 0 g·100 g-1 of lactose and 0.67 ± 0.04 g·100 g-1 of ashes, in compliance with the standards for pasteurized milk defined by the *Ministry* of Agriculture, Livestock, and Supply (MAPA) (Brasil, 2018).

The results of proteins and ashes showed that all samples meet the current Brazilian legislation (max. ashes 2.0 g·100 g-1 and proteins min. 5.0 g·100 g-1), while some results of lipids were slightly lower than the legislation value (min 6 g·100 g-1). The low humidity of the pasty DL improves the preservation of the product but it also facilitates the process

of lactose crystallization, leading to a sandy texture in the product that is sensory perceptible (Stephani *et al.,* 2018). To avoid the problem, all the DLs were produced to fit into the maximum allowed value of 30 g·100 g-1 of moisture. According to the applied statistical analysis (Tukey's Test), there were no significant differences between the main compositional attributes, and the products can be considered homogeneous due to the good standardization in their production.

The soluble solids parameter has no reference value in the legislation but, according to Stephani *et al.* (2018), values between 66 °Brix and 68 °Brix reflect a DL with approximately 70% (w·w-1) of total solids and consequently approximately 30% (w·w-1) of moisture, which meets the regulation of identity and quality for DL (Brasil, 1997). Therefore, the values of soluble solids and total solids obtained in this work are in accordance with the legislation, considering the respective standard deviations. This indicates that the mass balance calculations, as well as the use of a device that simulates industrial processes in the concentration stage, were satisfactory and reached the predetermined parameters.

Supplementary Figures

Figure S1- Geometrization of the production of DLs performed in three weeks of experiment.

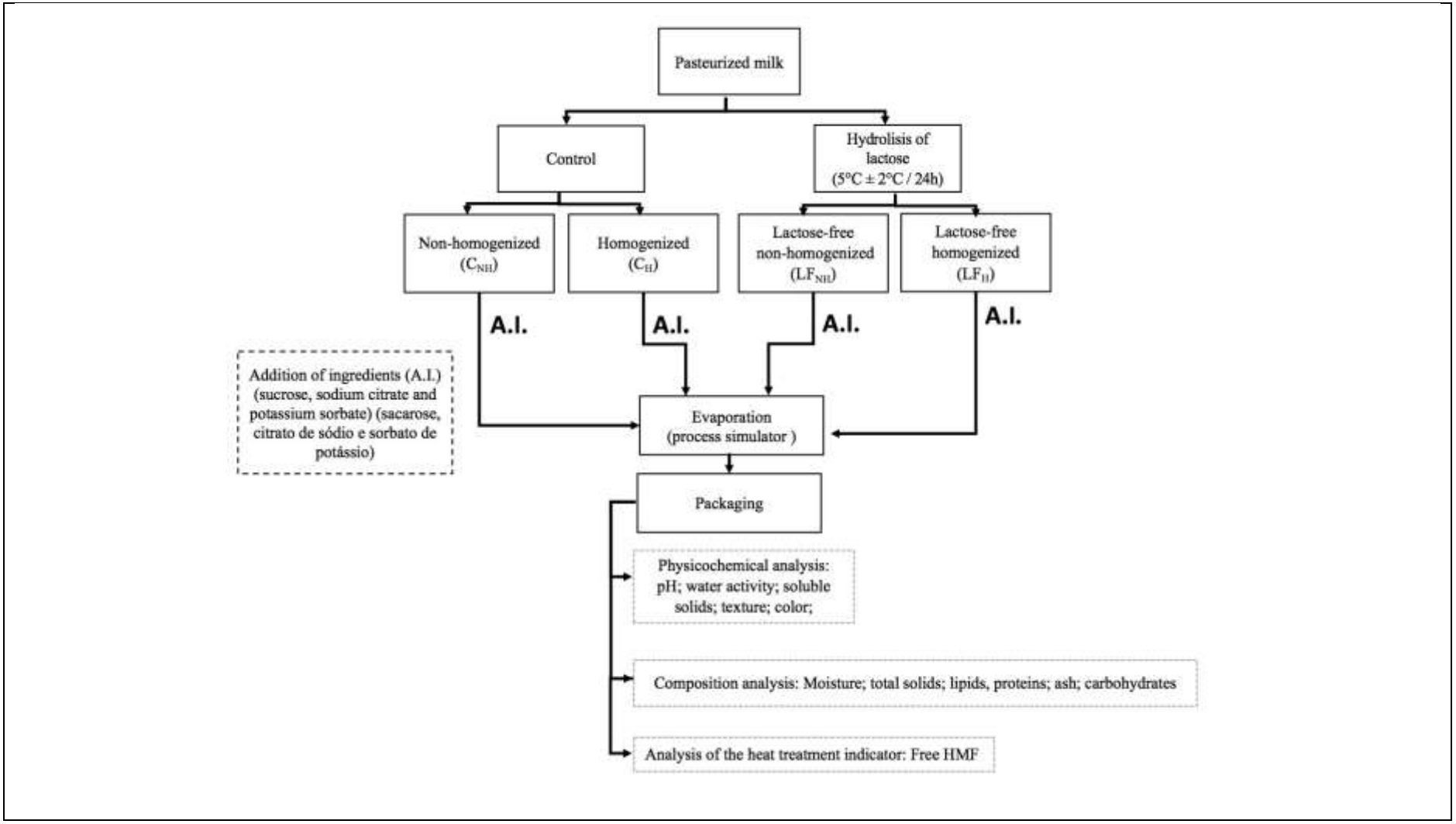

Figure S2- Photography image of final products.

Where: C = control; LF = lactose-free; NH = non-homogenized; H = homogenized