Skim milk ultrafiltration before or after fermentation: impact on mass balance and process efficiency during Greek-style yoghurt manufacture

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Ultrafiltration (UF) can be used to concentrate yoghurt to produce Greek-style yoghurt (GSY) or UF-YOG but generates acid whey permeate which represents an environmental issue. However, when UF is applied before fermentation (UF-MILK), a classical whey permeate is generated. Two model GSYs were produced and GSY composition, UF performance and energy consumption between UF-YOG and UF-MILK processes were compared. For UF-MILK skim milk was ultrafiltered with a 30 kDa spiral wound UF membrane until a 3k volume reduction factor (VRF). Retentate was fermented until pH 4.5. UF-YOG process was the same except that regular yoghurt was ultrafiltered. Membrane spacer thicknesses were 48 and 80 mils for milk and yoghurt, respectively. Both GSY had similar protein (~10%) and solid content (~17%). As expected, lactic acid was not detected in UF-MILK permeate while 7.3 g/kg was recovered in UF-YOG permeate. Highest permeation flux was obtained for UF-MILK but permeation flux decrease for UF-MILK was 50% while values for UF-YOG were ranged from 18 to 43% since UF membrane performance was never recovered even if drastic and repeated cleaning steps were applied. Energy consumption was 0.086 kWh/kg for UF-MILK and ranged from 0.06 to 0.1 kWh/kg for UF-YOG. Our results show that although the concentration of GSY from both processes was similar, UF step yoghurt concentration affected process efficiency due to drastic and permanent membrane fouling.

Dehydration of lactobacillus rhamnosus 64 in pilot spray dryer effect of matrix drying

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Cheese whey is a by-product of cheese production that has lately received much attention due to the functionality of its proteins. In previous works, we reported its capacity to support the growth and spray drying of probiotics at laboratory scale. The aim of this work was to go ahead in the scaling up of the production of dehydrated cultures of Lactobacillus rhamnosus 64. Biomass of the strain under study was produced in a whey permeate-based culture medium and was resuspended in different drying solutions (20% total solids): a) cheese whey + starch (1:1); b) cheese whey + whey protein concentrate + maltodextrin (2:1). Dehydration was carried out in two pilot spray dryers: LABMAQ (220, University of Sao Paulo) and GALAXIE® Mod. 1612 (Buenos Aires, Argentina); drying conditions were: inlet T: 172°C; outlet T: 71°C; -88°C. The survival to drying and storage at 4°C during 120 days was evaluated. Cell death due to drying varied between 1.5 and 2.5 log. The reduction of viability over time was significantly different from 120 days, with an average loss of 1.53 ± 0.16 in cheese whey + starch and 2.13 ± 0.01 in cheese whey + WPC + maltodextrin. The powders showed average between 0.2 – 0.3 and humidity: 4 – 6%. The effect of the outlet T as critical variable on survival of probiotic spray drying was confirmed. The use of combined cheese whey with other ingredients may enhance the viability of Lr. 64 during storage.

Proteomic investigation of aggregates formed during storage of whey protein drinks

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Introduction: By rehydration of WPI, visible aggregates may develop during storage. A small change in thermal treatments of WPI drinks from 90°C for 180s to 120°C for 20s can prevent the formation of visible aggregates. Here protein chemical changes occurring in these resolubilised WPI (aggregates and surrounding liquid) were investigated by proteomic and peptidomic techniques in relation to heat treatments and batch variations.

Methods: WPI (7 % w/v) at pH 3 of different qualities were heat-treated at 95°C for 15s or at 120°C for 20s and stored. Developed aggregates and aqueous phase were analysed by 2D and 2.0 gea, fluoroscammes assay and LC-ESI-MS.

Results: 1, 2D gels and LC-ESI-MS showed that storage induced aggregates were composed of especially CMP. Deactivation of both CMP and other whey proteins occurred after heat treatments. Level of free N-termini were higher in liquid from protein batches heat treated at 90°C for 180s compared with that at 120°C for 20s. In the surrounding liquids, CMP was depleted, with CMP variant A relatively lower compared to variant B after the heat treatment at 120°C for 20s. Peptide mapping of surrounding liquids confirmed more peptides present after the higher heat treatment.

Conclusions: Aggregates were composed of CMP and other whey proteins. Deactivation of 40-residues promoted subsequent weak acid hydrolysis at 120°C, leading to the prevention of aggregate formation at that temperature. Batch variations can be explained by differences in initial CMP level, as well as differences in distribution of genetic variants of CMP.