Comparative study of lactose, galacto-oligosaccharides, volatile profile and physicochemical parameters in reduced-lactose and traditional yogurts

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INTRODUCTION

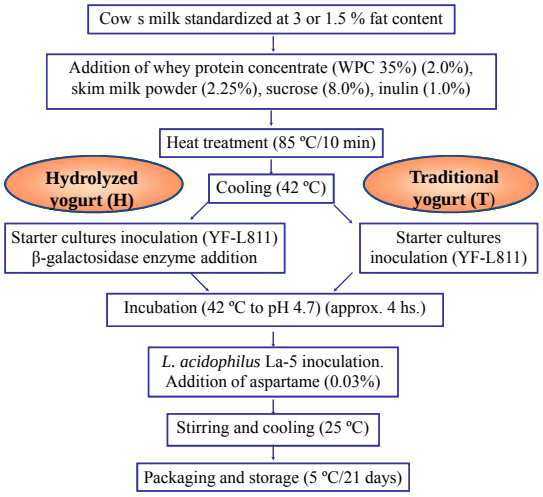
The consumption of reduced-lactose dairy products is recommended to avoid the uncomfortable gastrointestinal symptoms suffered by individuals with lactose intolerance. This problem affects about 70% of the world population; its incidence in South America is very high. Particularly, in Argentinian market, reduced-lactose fermented milks are not available. The enzymatic treatment with β-galactosidase enzyme, to hydrolyze lactose in glucose and galactose, could be added during yogurt making. Simultaneously transgalactosylation reaction takes place and the galacto-oligosaccharides (GOS) are synthesized. GOS are non-digestible carbohydrates being the prebiotic effect its more prominent function.

OBJECTIVES

This study is a comparative analysis of galacto-oligosaccharides and lactose concentrations, volatile profiles and physicochemical parameters of reduced-lactose yogurts made with β–galactosidase enzyme and traditional yogurts.

MATERIALS and METHODS

Manufacture of yogurts: Four different varieties of lactose hydrolyzed yogurts (H) prepared with the addition of commercial β-galactosidase enzyme (0.25 g/L) from *k. lactis* were compared with traditional yogurts (T): whole-fat yogurts with sucrose (WS), whole-fat yogurts with sucrose and with *L. acidophilus* La-5/inulin (WS-La5/inulin), reduced-fat yogurts with aspartame (RA); reduced-fat yogurts with aspartame and with *L. acidophilus* La-5/inulin (RA-La5/inulin). Two replicates of manufacture were performed at different days. The basic scheme of yogurt making is shown.



Analytical determinations: were carried out in fresh product and after 21 d.

- pH, titratable acidity, global composition (proteins, total solids and fat) by normalized methods [1].
- Lactose and GOS by HPLC-IR [2].
- Volatile compounds by SPME-GC/FID/MS [3].

RESULTS

Global composition and acidity

Fat, total solids and proteins contents were in average 1.4, 14.0 and 4.6 g/100 g and 2.8, 21.0 and 4.2 g/100 g for reduced-fat and whole-fat yogurts, respectively. These parameters were not modified by enzyme addition.

Generally the hydrolyzed yogurts had lower acidity than traditional ones. At 21 d, pH was in average 4.47 and 4.42 for hydrolyzed and traditional yogurts, respectively. Titratable acidity increase during storage (Fig. **A**). All parameters were suitable as established by Argentinian Legislation [4].

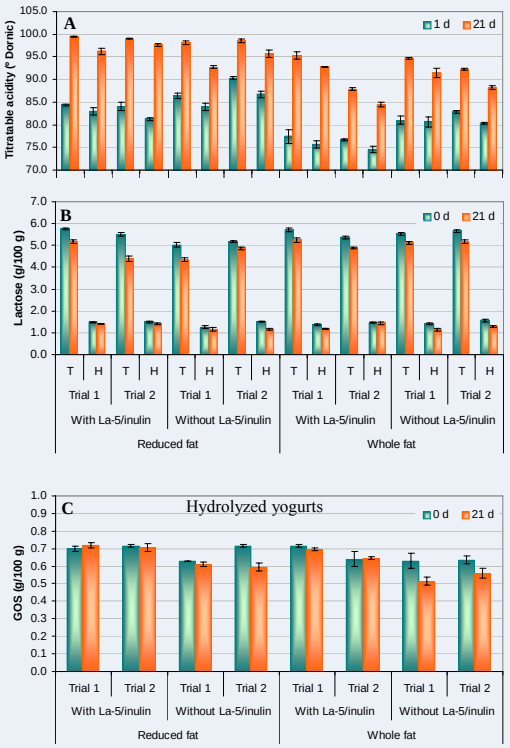
Lactose and galacto-oligosaccharides

The lactose diminution was in average 78% in hydrolyzed yogurts by the action of the exogenous enzyme during fermentation and slight changes were observed during storage. In traditional yogurts the reduction was 20% in fresh products, which continued decreasing up to 27% at 21 d due to microbial activity (Fig. **B**).

GOS content was similar among hydrolyzed yogurts varieties and it was not detected in traditional ones. In general, GOS were maintained during storage probably due to the inability of cultures to metabolize them and the inactivation of exogenous enzyme at the pH of yogurts (Fig. **C**).

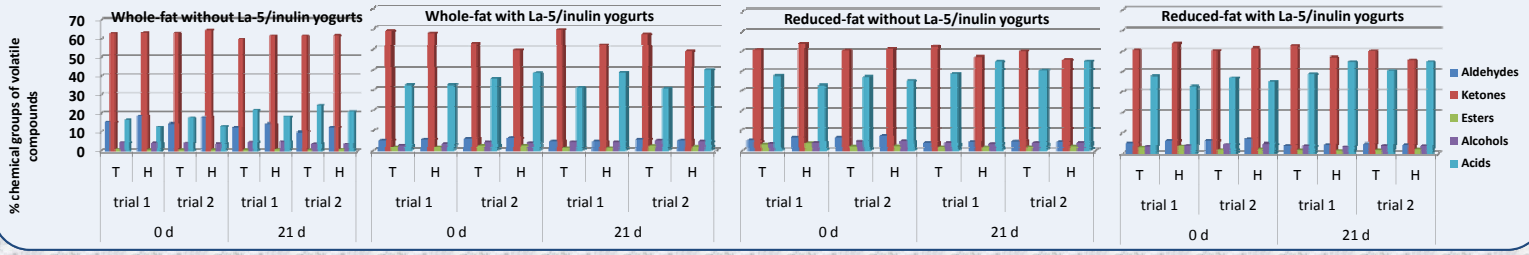
Volatile profiles

A total of 22 volatile compounds were detected in some or all varieties. They belonged to different chemical classes (9 ketones, 5 acids, 4 alcohols, 2 aldehydes and 2 esters).



For all varieties of fresh yogurts, both traditional and hydrolyzed, the volatile profiles showed a predominance of ketones. In WS yogurts, this fraction reached the highest percentages, with values that exceed 60%. Acids were the second most abundant volatile compounds isolated in RA, RA-La5/inulin and WS-La5/inulin yogurts, whereas aldehydes were an important group in WS yogurts. The remaining groups were minority in all samples. Statistical differences ($P<0.05$) between traditional and hydrolyzed samples were observed in some groups of compounds only for WS yogurts. In this case, the percentages of aldehydes were higher in hydrolyzed than traditional products whereas acid group reached higher values in traditional yogurts.

At 21 days, changes in the volatile fraction were observed for all varieties. The increase of acidic compounds and the decrease of ketones, were the most important changes detected in WS yogurts. Overall, only slight differences in the volatile profiles were detected at the end of storage between traditional and hydrolyzed yogurts. In the case of WS-La5/inulin yogurts, the hydrolyzed products showed an increase in acid group whereas traditional yogurts exhibited an increase in ketones group. In RA and RA-La5/inulin yogurts, the composition of volatile fraction of traditional yogurts was not sustantially modified during storage; by contrast, hydrolyzed yogurts showed an important increase in acidic compounds and a significant reduction in ketones and aldehydes groups.



CONCLUSIONS

- The inclusion of a β-galactosidase enzyme, of high purity and food grade, produced an important reduction in the lactose content of yogurts.
- It was confirmed the ability of this enzyme to produce GOS, while the microbial β-galactosidase enzymes from cultures did not show it.
- Yogurt matrices were adequate to maintain the GOS levels without changes during storage. This fact is important to guarantee to consumers the benefits of these biocompounds.
- The composition of volatile fraction and its evolution during storage were dependent on yogurt matrices. The volatile fraction of each yogurt variety showed only minor differences between hydrolyzed and traditional products both in fresh samples and in those stored.

Different varieties of functional yogurts, reduced in lactose content for lactose intolerant individuals and enriched in GOS were developed. The GOS levels found were similar to those reported in commercial lactose-free milks and in infant formulas in which commercial preparations of GOS are used in the formulation.

• [1] International Dairy Federation.
• [2] Vénica et al., LWT-Food Sci.Technol. 63 (2015) 198-205.
• [3] Wolf et al., Int. J. Food Sci. Technol. 50 (2015) 1076–1082.
• [4] Código Alimentario Argentino. Cap. VIII, Art. 576. www.anmat.gov.ar/alimentos/normativas_alimentos_caa.asp.

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