

Characterization of volatile compounds profiles of hard cheeses made with different strains of *Lb. helveticus*

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Introduction

Cheese flavour development is a dynamic and complex process which mainly depends on the enzymatic activities of lactic acid bacteria (LAB) present in the cheese matrix [1, 2].

Objectives

The aim of the present work was to evaluate the volatile profiles of hard cheeses made with different strains of *Lb. helveticus* as starter culture: two commercial strains (A and B) and two strains belonging to the collection of our Institute (C and D).

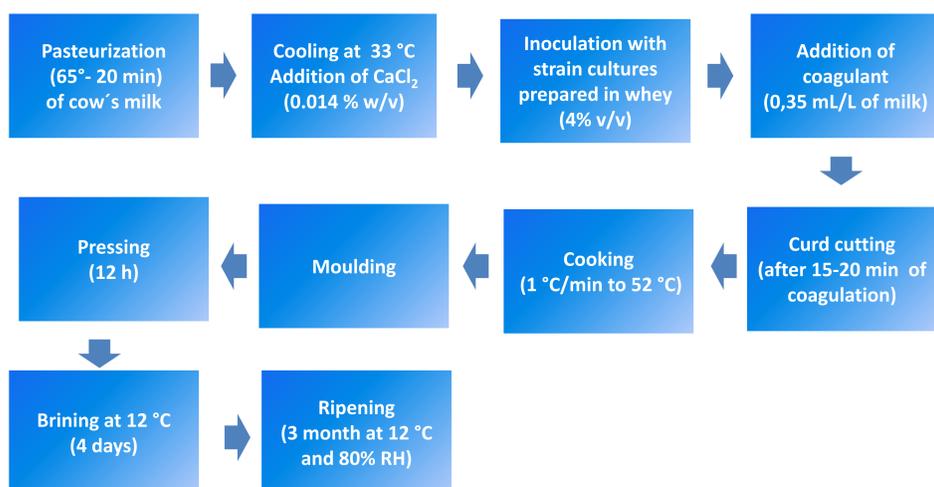
Materials and Methods

Preparation of starter cultures

The strains were individually inoculated at 2% v/v in 2 L of whey obtained from a manufacturing of hard-cooked cheese. Before inoculation, whey was treated at 85 °C/5 min to destroy vegetative cells. The inoculated whey were incubated for 24 hours at 45 °C; at this moment the values of pH and titratable acidity were in the range of 3.60 - 3.80 and 52 - 57 °D, respectively.

Cheese making

Figure 1 shows the flowchart of cheese manufacture.



Analytical determinations

Global composition: moisture, protein, fat contents and pH according to normalized methods.

Microbiological counts: thermophilic lactic flora in MRS agar (48h/43°C).

Volatile compound profiles: by SPME – GC – FID/MS. Compounds were grouped by chemical families and their relative amounts were expressed as percentages of total area [3].

Results and Discussion

Gross composition and microbiological counts

All cheeses have similar moisture, protein and fat contents and pH values at the end of ripening (3 months) ($p > 0.05$) (Table 1). The different starters composed by autochthonous and commercial *L. helveticus* strains did not modify the physicochemical characteristics of cheeses.

Table 1. Physicochemical composition of cheeses.

Parameter	Cheeses			
	Strain A	Strain B	Strain C	Strain D
Moisture (%)	37.1±0.4	35.8±0.6	37.9±0.5	35.2±0.7
Fat (%)	31.1±0.5	32.8±0.6	32.1±1.0	32.0±0.6
Protein (%)	24.7±1.2	28.2±1.0	26.0±0.9	26.0±1.2
pH	5.13±0.01	5.15±0.01	5.14±0.20	5.13±0.02

Thermophilic lactobacilli were maintained throughout ripening period above 10^7 CFU/g in all cheeses (Figure 2).

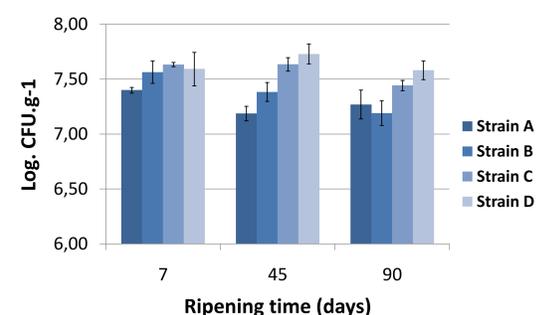


Figure 2. Microbiological counts during ripening.

Volatile compound profiles

Thirty-three compounds were identified in all samples, which were belonged to the chemical families of aldehydes, ketones, alcohols, acids and esters. The profiles are shown in Figure 3. The principal compounds identified in each group are indicated in Table 2.

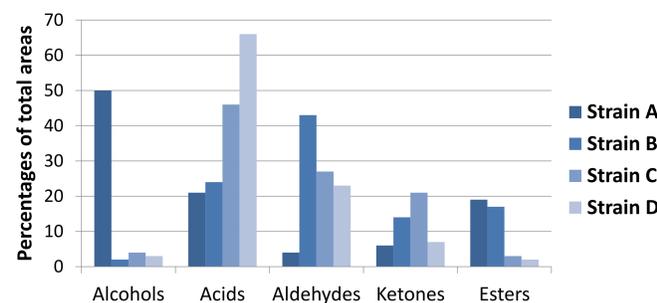


Figure 3. Volatile profiles of cheeses.

Table 2. Main volatile compounds detected in cheeses.

Cheese/Strain	Predominant Group	Percentages	Principal Compounds	Secondary Groups	Percentages	Principal Compounds
A	Alcohols	50%	Ethanol	Acids Esters	20%	Butyric acid Ethyl butanoate
B	Aldehydes	40%	Acetaldehyde Benzaldehyde 2-γ 3-methyl butanal	Acids Esters Ketones	15%	Butyric and Acetic acids Acetoin and Diacetyl Ethyl Acetate
C y D	Acids	45 - 65%	Butyric acid Hexanoic acid	Aldehydes	25%	Acetaldehyde

Cheeses made with autochthonous strains exhibited similar volatile compounds profiles, but were different to those from cheeses manufactured with commercial strains.

Conclusion

Autochthonous *Lactobacillus helveticus* strains would be good candidates to diversify the Reggianito cheese flavour, because their showed different aromatic profiles respect to commercial strains.

[1] Marilley, L., Casey, M.G. (2004). Flavours of cheese products: metabolic pathways, analytical tools and identification of producing strains. International Journal of Food Microbiology 90, 139–159.

[2] Yvon, M. (2006). Key enzymes for flavour formation by lactic acid bacteria Australian Journal of Dairy Technology 61, 16–24.

[3] I.V. Wolf, M.C. Perotti, S.M. Bernal, C.A. Zalazar (2010). Study of the chemical composition, proteolysis, lipolysis and volatile compounds profile of commercial Reggianito Argentine cheese: Characterization of Reggianito Argentine cheese. Food Research International 43, 1204–1211.