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Short communication: A new minicurd model system for hard cooked cheeses

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ABSTRACT

The aim of this study was to propose and validate a new minicurd model of young hard cheese. Curd particles and whey obtained from conventional cheese making of Reggianito Argentino were separated and frozen. Then, both fractions were thawed and the mixture of whey and curds was reconstituted, from which minicurds were made on the laboratory scale. Repeatability and the effect of freezing on minicurd composition were investigated by assessing pH, protein and moisture contents, sodium chloride content, and total thermophilic lactic flora counts. Good repeatability was achieved, and no significant differences were found between minicurds made from fresh compared with frozen materials. Composition of the minicurd was appropriate for modeling Reggianito Argentino cheese.
Key words: cheese-making technology, minicurd model, hard cheese

Short Communication

Cheese-making experiments aimed at assessing technological innovation or new additives or ingredients are expensive and time consuming. Consequently, several cheese models have been developed in which variations in the biochemistry of ripening or the cheese ecosystem can be assessed rapidly and without the complexity of a real-scale cheese matrix. Scientific research focused on technological changes in the food industry needs to be validated at the pilot scale because in vitro assays are usually not enough to inspire confidence and promote technological changes in the industry (Hunter et al., 1997). However, cheese model systems are useful in many applications. Available cheese models include miniature semi-hard or Cheddar cheeses, cheese slurries, and Ch-Easy (Farkye et al., 1995; Smit et al., 1995; Rehman et al., 1998; Jeanson et al., 2011; Milesi et al., 2011). Reggianito Argentino and Parmigiano Reggiano extracts have also been developed as a model of the aqueous phase of this type of cheese (Gatti et al., 2008; Bergamini et al., 2013). However, these models greatly differ from the composition of real cheeses. The aim of the present work was to find a model applicable to study biochemical activities naturally occurring in the cheese environment.

Examples of applications for these models include comparison of *Lactobacillus* strains, with or without glutamate dehydrogenase (GDH) activity, according to their ability to produce aroma compounds (Kieronczyk et al., 2004); assessment of lactic acid bacteria aminopeptidase activities (Gatti et al., 2008); culture of long-ripened cheese microflora (Neviani et al., 2009); and evaluation of proteolysis induced by different strains (Milesi et al., 2011).

The objective of the present work was to propose and validate a new cheese model for young hard-cooked cheeses, consisting of a reconstituted minicurd. We intended that its composition was appropriate for modeling Reggianito cheese; other requirements for the model were its cost effectiveness and simplified experimental manipulation. For that purpose, we chose a layout that included one standard cheese-making using 100 L of milk, which we stopped before final cooking of whey-curds. Curds and whey were separated at this point and became the raw materials for multiple minicurd preparations. Freezing of raw materials was also proposed.

Raw bulk milk (100 L), pH 6.65 ± 0.05, Dornic acidity 18 ± 1°D (1°D = 100 mg of lactic acid/L) was supplied by a local dairy plant (Milkaut Coop. Ltda, Franck, Santa Fe, Argentina) and standardized to 2.8% fat. Milk was batch pasteurized at 63°C for 30 min and cooled to 33°C for cheese making. Then, $CaCl_2$ was added to a final concentration of 0.014% wt/vol; pH was adjusted to 6.40 with lactic acid (1.5% wt/vol) because some acidification of the cheesemilk is required before coagulation in this type of cheese. Then, a mixed commercial starter of *Lactobacillus helveticus* and *Lactobacillus bulgaricus* (Chr. Hansen Argentina, Quilmes, Argentina) was added at a concentration of 10^6 cfu/mL of milk. After 10 min of mechanical stirring,

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Maxiren 150 (100% chymosin, Gist-Brocades, Seclin, France) was added at a final concentration of 0.012 g/L to coagulate the milk. After 18 to 20 min, the curd was cut to the required grain size (approximately half the size of a rice grain) by successive cuts under manual agitation. The mixture of curd particles and whey was continuously stirred at the coagulation temperature of 33°C. Then, approximately 15 kg of the mixture of curd particles-whey was taken from the vat and separated in a sieve (2-mm mesh size). At this step, the curd particles were quite wet and undergoing syneresis, so the operation was performed as quickly as possible to avoid heterogeneity in moisture content, acidification, or the formation of a continuous coagulum. Curd particles and whey were packed separately in tight plastic bags (2 L) and frozen at −18°C in 3 different freezers for their subsequent use. The proportion of curd and whey in the original mixture was assessed by mass balance: an aliquot of the thoroughly homogeneous mixture and its separate fractions were weighed. The proportion was 1:4 curd-to-whey.

One day before the minicurd preparations, the raw materials (whey and curds) were thawed at 4°C. Curd particles were disaggregated and mixed with a spatula in order to take representative samples from the curd contained in the plastic bags. Curds and whey were tempered at 33°C for 20 min in a bath to simulate the conditions in the vat, and pH was measured by immersing a pH electrode (Metrohm, E 516 Titriskop, Herisau, Switzerland). Then, mixtures of ∼500 g of whey and curds were prepared in the same proportion as was found in the vat (1:4).

The mixtures were then incubated at 37°C until they reached a pH of 5.6; this intermediate pH value was chosen to approach the standard value commonly found in cheeses (5.4), thus avoiding the risk of overacidification. After that, the cooking step was performed: curds and whey were gently stirred while being heated in a bath at 1°C/min up to 45°C. After reaching 45°C, the mixtures were heated more rapidly (>1°C/min) up to 50°C. When the mixtures reached the desired curd scalding temperature, the stirring was stopped. The curds were separated from the whey by centrifugation (Multi RF; Thermo Scientific, Waltham, MA) at 2,750 × g and 37°C for 20 min in 250-mL tubes, using a swinging bucket rotor to obtain minicurds with a cylindrical shape. Minicurds were refrigerated for 5 min and brined in 20% (wt/vol) brine at 12°C for 20 min. Four replicates were obtained from each batch of curd particles and whey. In each replicate, 2 minicurds of approximately 25 g were made in parallel; one was sampled immediately and the other was vacuum packed in plastic film and stored for 7 d at 12°C. An example minicurd is shown in Figure 1.

We checked the repeatability of the model for raw materials coming from different Reggianito cheese-making vats, made on different days, and with different milk. Temperature and pH curves were monitored in the curd-whey mixtures during minicurd preparation. Minicurds were analyzed in duplicate on d 1 (preparation) and d 7, as follows: pH measured by American Public Health Association method (Bradley et al., 1992); proteins by the Kjeldahl method (IDF, 1993), moisture content by oven drying to a constant weight at 102 ± 1°C according to IDF (1982), and sodium chloride by atomic absorption spectrophotometry (AOAC, 1990). Thermophilic lactic bacteria were assessed before storage by plating sample dilutions on skim milk agar and counting colonies after 48 h of incubation at 37°C (Candioti et al. 2002).

The effect of freezing and thawing of whey and curd particles on minicurd composition was also checked.

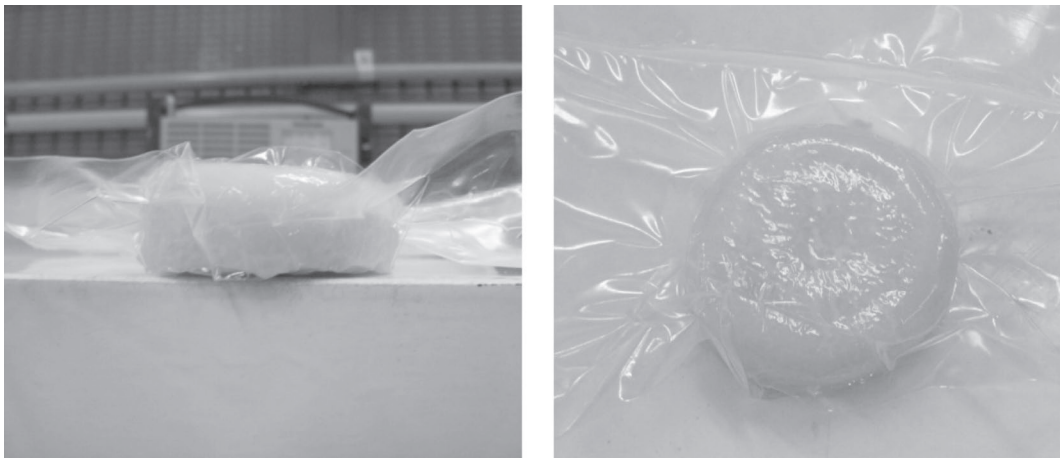

Figure 1. Example minicurd (25 g): (a) horizontal view, (b) top view. Color version available online.