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Soft cheese-like product development enriched with soy protein concentrates

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ABSTRACT

The objective of this work was to develop spreadable cheese-like product from skimmed cow's milk, supplemented with soybean proteins. The proteins were concentrated by ultrafiltration, and then freeze-dried. The cheese-like products were prepared using the acid coagulation method, without maturation, obtaining smooth products with creamy texture. The samples were identified as low-fat cheese, being the fat content between 10 and 13 (g/100 g), with moisture in the range of 68.07–70.75 (g/100 g). Compared to a control cheese, the samples containing soy protein concentrate, showed an increase of 6.8–17 in proteins and 22–32 (g/100 g) in fats; also the yield increased. The viscoelastic behavior of the samples was analyzed using oscillatory dynamic tests; in all the samples G' was higher than G''. Texture, surface color and microstructure of the cheese samples were determined. Microbial analysis showed that the incorporation of potassium sorbate increased more than twice the shelf-life of the products (up to 60 days) in comparison to the samples without preservative. Furthermore, the products were accepted by a sensory panel. Considering that both, proteins and fats, are of vegetable origin with high biological value and unsaturated fats, the developed cheese-like products were considered as functional foods.

1. Introduction

Protein foods are essential to ensure adequate nutrition. The development of new sources of proteins and the optimization of the existing ones are issues of great interest and study (Cheftel, Cuq, & Lorient, 1989). Moreover, the use of ingredients beneficial to health has been identified as a steadily growing trend in the food industry. In this way, functional foods refer to foods or food ingredients that provide specific physiological beneficial effects and/or reduce the risk of chronic disease beyond basic nutritional functions (Gomes da Cruz, Buriti, Souza, Faria, & Saad, 2009; Mazza, 1998).

Cheese is a food with high protein content, with a widespread consumption. Besides containing proteins of good quality, contributes to calcium binding and generally has fewer digestive problems that other dairy product. However, it has a high content of saturated fats, an important contribution of calories and in general, is an expensive product, due to the low yield (Karaman & Akalin, 2013; Krbavcić & Barić, 2004; Mistry, 2001).

Therefore, it is a challenge for the food industry the formulation of foods with ingredients that help to lower health risks, as in the case of substituting animal fats by vegetable fats and oils, obtaining foodstuffs low in cholesterol and saturated fats. In this sense, the cheese seems to be a good matrix to incorporate vegetable proteins. Thus, cheese analogs, imitation cheese or processed cheese food, are gaining increasing acceptance with food processors and consumers because many potential benefits (Bachmann, 2001; El-Neshawy, Farahat, & Wahbah, 1988; Farahmandfar, Mazaheri Tehrani, Razavi, & Habibi Najafi, 2010; Mounsey & O'Riordan, 2001).

Between vegetable proteins, soybean is a highly nutritious food material that contains well balanced amino acids and desirable fatty acids and it plays an important role as a protein source for many people around the word. Furthermore it must be considered that the cost of producing cheese analogs can be less than that products obtained only from animal proteins. There are various food formulations that incorporate soy proteins for various

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purposes, usually associated health benefits or employed soy to fortification milk products for ameliorates the problem of milk availability (Canabady-Rochelle & Mellema, 2010; Che Man & Yee, 1996; El-Neshawy et al., 1988; Farahmandfar et al., 2010; Kim, Park, & Rhee, 1992; Rani & Verma, 1995; Rinaldoni, Campderrós, & Pérez Padilla, 2012). Moreover there are a lot of dairy products that should be assessed in order to obtain novel products that can meet market needs, in terms of adequate protein content, nutritional benefits, production costs, higher availability and stability over time. In this regard, the content of sorbic acid/sorbate as preservative in cheeses with high moisture has been studied (Brocklehurst & Lund, 1985).

The objectives of this study were to develop a cheese-like product enriched with soy protein concentrate and to determine the effect of the incorporation of vegetable proteins in the matrix of a spread product with respect to physico-chemical and viscoelastic behavior, texture, microstructure, sensory and preservation during storage.

The shelf life of the products was studied with and without the use of sorbate as preservative and through pH, acidity, sensorial and microbiological assessments during storage.

2. Materials and methods

2.1. Raw materials

Partially skim-milk was provided by MILKAUT S.A (Argentina). The milk was pasteurized, homogenized and fortified with A and D vitamins in the factory. Commercial soy milk (ADES, Argentina) was used as source of soy protein. The soy milk was concentrated employing membrane technology. A combination of microfiltration with a frontal filter polyethylene with a pore size of 5–10 μm (Pall Corporation, USA) and ultrafiltration with a Pellicon cassette module (Millipore, USA) containing a modified polysulfone membranes with a cut-off of 10 kDa was employed (Rinaldoni et al., 2012). The process was carried out in batch mode, by continuously removing the permeate stream, at 25 ± 2 °C and a transmembrane pressure of 325 kPa. Temperature, recirculation rate, transmembrane pressure, pH and permeate flux rate were continuously recorded. The solids content was measured in the concentrate stream and the process was stopped when the desired concentration was achieved. The volume concentration ratio (VCR) was 2.3, determined as reported by Cheryan (1986) as the ratio between the initial feed volume and the obtained concentrate volume. After each filtration the membrane was cleaned in-line according to instructions provided by the manufacturer. The membrane hydraulic permeability recuperation was always tested to verify that the cleaning procedure was correctly done.

Then, the soy protein concentrates (SPC) were placed on stainless steel trays and frozen in a freezer at −40 ± 2 °C and freeze-dried using a lyophilizer (Rificor S.A., Argentina) at 1 bar of pressure for 48 h. The samples temperature was controlled by a temperature sensor. This procedure simplifies aseptic handling and enhances stability of dry powder, without excessive heating of the product (Fellows, 1994).

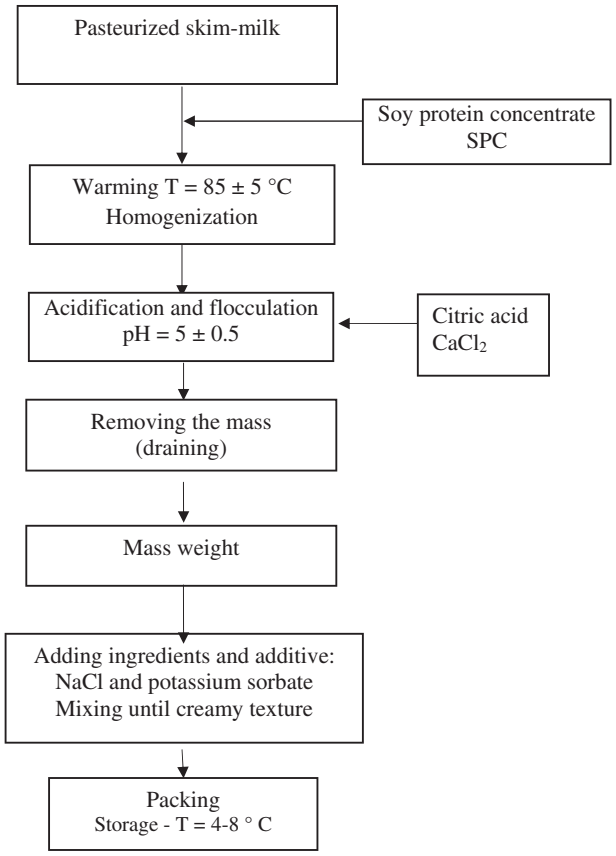

Fig. 1. Flow diagram for manufacturing control cheese and cheese-like products with SPC.

The composition of the raw materials is presented in Table 1.

2.2. Preparation of cheese-like product samples

Cheese-like product was prepared in batch according to the method shown in Fig. 1. Each sample was made in duplicate in a 5 L vat, and the volume of milk used each time was 2.5 L. One sample was reserved as witness without the incorporation of soy proteins concentrate. Different amount of freeze-dried concentrate were added to the remaining samples.The powder addition was carried out slowly, so that the protein aggregation stage is slower respect to denaturation, thus the partially unfolded protein chains can oriented more easily. This favors the formation of a homogeneous ordered gel, with smooth consistency, strongly expanded, very elastic, transparent, and more stable to syneresis and bleeding (Cheftel et al., 1989). The amounts of soy protein concentrate incorporated to milk were: 5, 10 and 15 g/L. The mixture was heated to 85 ± 5 °C and citric acid (40 g/100 mL) (Parafarm) were added until reach a pH = 5 ± 0.5 (near the isoelectric point of both, milk and soy proteins) to produce acidification and proteins aggregation. Moreover,

Table 1
Chemical compositions and pH of raw materials (means ± SD).

Material	pH	Protein (g/100 g)	Fat (g/100 g)	Sugar (g/L)	Total solid (g/100 g)	Ash (g/100 g)
Cow Milk	6.88 ± 0.02	3.5 ± 0.08	2 ± 0.18	50 ± 0.3	10.3 ± 0.10	0.7 ± 0.05
Soy Milk	7.02 ± 0.05	3.2 ± 0.05	1 ± 0.12	30 ± 0.7	8.9 ± 0.10	0.6 ± 0.08
SPC[a]	8.82 ± 0.03	43 ± 0.10	17.5 ± 0.2	10 ± 0.9	97.78±0.15	7.1 ± 0.10

[a] soy protein concentrate, freeze-dried by liophilization.