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The influence of sweeteners in probiotic Petit Suisse cheese in concentrations equivalent to that of sucrose

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ABSTRACT

As in the case of probiotic functional foods in recent years, demand has increased notably for light or diet foods with added sweeteners. However, little is known about the effect of different sweeteners on the microorganisms present. Thus, the objective of the current study was to establish the ideal sucrose concentration and equivalent concentrations of different sweeteners and to determine, by microbiological analyses, the influence of these compounds on the viability of the starter and probiotic cultures used in the production of strawberry-flavored Petit Suisse cheese during its shelf life. The ideal sucrose concentration was determined using the just-about-right (JAR) scale, and the equivalent concentrations of the sweeteners were subsequently determined by the magnitude estimation method. Microbiological analyses were also carried out to check the viability of the cultures during the product's shelf life. The results showed that the compounds Neotame (NutraSweet, Chicago, IL) and stevia presented, respectively, the greatest and least sweetening power of the sweeteners tested. None of the sweeteners used in this study exerted a negative effect on the viability of the starter or probiotic cultures, and thus we were able to obtain a probiotic, functional food with reduced calorie content.
Key words: Petit Suisse cheese, probiotic, sweetener, magnitude estimation

INTRODUCTION

Demand for functional foods has increased notably in recent years (Granato et al., 2010). When probiotics or prebiotics are added to these foods as biologically active components, they produce metabolic and physiological health benefits in addition to their basic nutritional properties (Siró et al., 2008). Petit Suisse cheese has a high moisture content and a creamy consistency. It is produced from a mass obtained using a mixed coagulation process, and can be added to sweet and savory condiments to be consumed fresh (Brasil Ministério da Agricultura, Pecuária e Abastecimento, 1996). Because of its characteristics, it is an appropriate vehicle for probiotic bacteria because it requires no maturation period and has a relatively short shelf life (Helle et al., 2003).

In parallel, low- or reduced-caloric food products with sweeteners added (as sucrose substitutes) are becoming increasingly prominent in the marketplace. According to the Brazilian Association of Industries for Diet and Special Needs Foods (**ABIAD**), the light or diet food product market grew about 800% in the last 10 yr (ABIAD, 2011). When planning to substitute sucrose with a sweetening substance, it is important to know the sweetener well and to determine the concentration that best portrays an equivalent product sweetened with sucrose, in terms of intensity and sensory profile (Souza et al., 2011). First, the ideal concentration of sucrose for the specific product should be determined and then the equivalent sweetness of each sweetener measured. Of the existing sensory techniques, the just-about-right (**JAR**) scale is one of the effective methods most used (Gagula et al., 2007) because of both the reliability and validity of its results and its simplicity in use by the sensory panel (Meilgaard et al., 2006). Various methodologies can be used to obtain information about the equivalence in sweetness of a sweetener. However, the magnitude estimation method stands out, with normalized graphical representation of the results using Steven's Law and the Power Function (Stone and Oliver, 1969), which, by staggering the ratio, makes it possible to get a direct measurement of the sweetness intensity.

The introduction of sweeteners can result in significant sensory alterations in a product, particularly in appearance, texture, and flavor (Lawless and Heymann, 2010). However, little is known about the influence of these compounds on the viability of the probiotic bacteria used in functional foods, such as probiotic lactic products. Thus, the objectives of the present study

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were to establish the ideal sucrose concentration and equivalent concentrations of the sweeteners stevia, sucralose, aspartame, and Neotame (NutraSweet Corp., Chicago, IL), and to verify, by microbiological analyses, the viability of the starter and probiotic cultures used in strawberry-flavored Petit Suisse cheeses during the product's shelf life.

MATERIALS AND METHODS

Ingredients

The Petit Suisse probiotic cheese was manufactured using the following ingredients: pasteurized milk type A (Ati Latte, Atatiba, São Paulo, Brazil), calcium chloride (0.25 g/L, ECIBRA, Santo Amaro, São Paulo, Brazil), starter culture (3% wt/vol, *Streptococcus thermophilus* TA 040, Danisco, São Paulo, São Paulo, Brazil), probiotic cultures (5% wt/vol *Lactobacillus acidophilus* LA 14, *Bifidobacterium lactis* BL 04, Danisco), rennet (Chr. Hansen, Valinhos, São Paulo, Brazil), sterilized milk cream (25% wt/wt fat, Nestlé, Araçatuba, São Paulo, Brazil), strawberry pulp (Icefruit, Tatuí, São Paulo, Brazil), artificial strawberry colorant (Arcolor, Arco-Íris Brasil Ltda, São Paulo, São Paulo, Brazil), strawberry aroma (Duas Rodas Industrial Ltda, Campinas, São Paulo, Brazil), xanthan gum (Keltrol, CPKelco, Limeira, São Paulo, Brazil), carrageenan gum (LRA 50, CPKelco, Limeira), and guar gum (Tec Pharma, São Paulo, São Paulo, Brazil).

Sweeteners

Four sweeteners were used in Petit Suisse probiotic cheese production, all of which are allowed by the current Brazilian Legislation (Brasil Agência Nacional de Vigilância Sanitária, 2008), beyond that of sucrose: aspartame (NutraSweet, Chicago, IL), Neotame (NutraSweet), sucralose (NutraMax, Catanduva, São Paulo, Brazil), stevia (Estévia com 90% de rebaudioside, Clariant, São Paulo, São Paulo, Brazil), and refined sugar (Açúcar Refinado, União, Sertãozinho, São Paulo, Brazil).

Probiotic Petit Suisse Cheese Processing

The base mass (quark cheese) and Petit Suisse cheese were prepared according to the methodology described by Cardarelli et al. (2008) with some changes, including the probiotic culture used, using cultures of *L. acidophilus* and *B. lactis.* The base mass (quark cheese) was obtained by heating pasteurized milk to 37 to 38°C, transferring it to isothermal containers and then adding the starter and probiotic cultures by direct inoculation (direct vat starter), followed by homogenization. The containers with the inoculated milk were maintained at 37°C until pH reached 6.3 to 6.5, and then the rennet was added, and the mixture rehomogenized and maintained at 37°C until a curd was formed with pH of about 5.6 to 5.8. The curd was then carefully cut into cubes, which were placed in sterile cloth sacks to drain off the whey at a temperature of 10°C for 15 h. After drainage, the quark cheese was placed in sterile containers and stored at 4°C until mixed with the other ingredients to make the Petit Suisse cheese. All the remaining ingredients were then added and homogenized in a multi-processor for 30 min (Estephan rpm 1750/3500, Geiger, Pinhais, Paraná, Brazil), until a consistent mass was obtained. After homogenization, appropriate containers were filled with cheese and maintained under refrigeration at 4°C for 28 d. The ideal test and magnitude estimation test were applied the day after filling. The processing was performed twice, on 2 different days.

Determination of the Ideal Sucrose Concentration

Five formulations of probiotic Petit Suisse cheese were prepared, varying only in sucrose concentration: 7.5, 11, 14.5, 18, and 21.5% (wt/wt). The central point was defined according to estimates of the amounts of sucrose normally used in commercial dairy products and considering a previous study with Petit Suisse cheese (Souza et al., 2011). Fifty-two panelists were used, all Petit Suisse consumers, recruited among students and employees on the university campus, aged between 18 and 45 yr, and the majority (70%) being women. The panelists evaluated the samples using a 9-cm nonstructured scale anchored at the extreme left by "extremely less sweet than the ideal" and at the extreme right by "extremely sweeter than the ideal," the central point being the ideal concentration to add to the product (Meilgaard et al., 2004). The panelists were requested to indicate on the scale the intensity of the perceived sweet stimulus.

The probiotic Petit Suisse cheese was presented monadically to the panelists according to a complete block design (MacFie et al., 1989), 5 d after the processing. Samples were presented in disposable 50-mL white plastic cups, coded with 3-digit numerals chosen at random, so as not to influence the panelists. Water and water biscuits were also provided to rinse out the mouth and neutralize the flavors between samples. The samples were served in individual booths in the Sensory Analysis Laboratory of the Department of Food and Nutrition (DEPAN) of the State University of Campinas (UNICAMP), Brazil. The booths were equipped with the FIZZ Network Sensory Software (Biosystemes, Couternon, France).