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Nutrition claims for functional guava mousses produced with milk fat substitution by inulin and/or whey protein concentrate based on heterogeneous food legislations

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ABSTRACT

Functional guava mousses were prepared with inulin (I) and whey protein concentrate (WPC), in different combinations, with the purpose of partially or totally substituting their milk fat (MF) content, using a *simplex-centroid* design. In order to verify the adequacy of mousses to comply the standards for the nutrient content and nutrient comparative claims, their composition and energy values were compared with the food legislation adopted currently in Brazil, the European Union (E.U.), and the United States (U.S.), besides the new proposal for the Brazilian standards. Most of the formulations, especially I, WPC, I + WPC, and MF + I + WPC, and except for MF + WPC, were able to fulfil the requisites for receiving the "low" (nutrient content) and "reduced" (comparative) claims for total and saturated fat. Also, products with inulin could achieve the requisites for the "high" claim for dietary fibre. Nonetheless, important differences between the legislations for achieving some claims were noted, especially when the serving portion was used as standard instead of 100 g. This would require some attention by regulatory authorities, once the possibility of manufacturers to reduce or to increase the products' serving portions up to achieve a claim, misunderstanding the consumer, may exist.

1. Introduction

The role that food industry plays on people's everyday life is undeniable, as well as the importance of diet on the prevention of diseases and its association to health promotion. Food industry has amplified market by providing practical foods and goods for consumers' convenience. The association of diet with a healthy attitude leads to the creation of products considered not only healthy but also with good palatability (Ares, Giménez, & Gámbaro, 2009).

Products may be developed through the substitution of unhealthy ingredients (e.g. fat, sugar, salt, and certain additives) for others that offer more benefits, without modifying their initial quality (Liu, Xu, & Guo, 2008). Nowadays, consumers are interested in desserts with low fat and functional claims (Ares et al., 2009). In this context, mousse production has increased and conquered the market of desserts, offering opportunities to explore the use of food ingredients that combine improved technological properties and health benefits to the consumers, such as probiotics, prebiotics, and whey proteins (Buriti, Castro, & Saad, 2010a, 2010b).

Probiotics and prebiotics are physiologically active food components that play an important role by improving the host health via modulation of the intestinal microbiota, stimulating the indigenous beneficial bacteria (FAO/WHO, 2006). The use of prebiotics, such as fructooligosaccharides and inulin, is able to reinforce the probiotic bacteria introduced in the host through food products by stimulating their growth in the gut. The fermentation of these prebiotics by intestinal microbiota, mainly bifidobacteria, has been implicated in increased intestinal absorption of minerals, as calcium and magnesium (Lavanda, Saad, Lobo, & Colli, 2011; Lobo, Mancini Filho, Alvares, Cocato, & Colli, 2009). Inulin and whey protein concentrate are food ingredients that might act as fat replacers, improving the texture of products, besides providing functional benefits to health (Akalın, Karagözlü, & Ünal, 2008;

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Luhovyy, Akhavan, & Anderson, 2007). The use of whey protein concentrate and inulin as fat replacers in foods containing probiotic bacteria may help them to retain sufficient viability along the gut, among other health benefits, and also leads to desirable changes concerning chemical composition and nutritional facts (Buriti et al., 2010b).

In dairy mousses, milk fat contributes for the formation of the foam structure, which turns out to be more opened with the increased fat content. Creaminess and flavour perception are influenced by the size and amount of air bubbles in this kind of product (Andreasen & Nielsen, 1998; Kilcast & Clegg, 2002). Both inulin and whey protein concentrate present excellent properties as emulsifier and texture agents, improving emulsification and foam formation in aerated products even when concentration of milk fat is reduced (Buriti et al., 2010a, 2010b).

For a final commercialization of a reduced-fat dairy dessert, these new nutritional features could be explored, mainly regarding advantageous changes in the fat profile and increments in protein and dietary fibre contents, besides the potential nutrition claims. Occasionally, food legislation regarding labelling and allowed claims may differ depending on the country in which food products are commercialized and these regulatory standards must be rigorously obeyed for international trade purposes. The Brazilian standards for the absolute and comparative nutrient content claims (Brasil, 1998) are being presently updated and changes will also be implemented by the state members of the Southern Common Market (MERCOSUR). Some of the proposed changes are: the inclusion of the claims presentation considering the serving portion for ready-to-eat products rather than per 100 g or 100 ml; and new standards for claims related to fat, protein, and dietary fibre composition of food (ANVISA, 2011). Therefore, it is desirable to know the extent of such changes in comparison with the food legislations of other countries.

The objectives of this study were: to investigate the effects of the substitution of milk fat by inulin and whey protein concentrate on the chemical composition of different functional guava mousse trials, manufactured with the addition of the probiotic strain *Lactobacillus acidophilus* La-5 and the prebiotic fibre oligofructose; to evaluate the consequences of these substitutions on nutritional status of the resulting products; and to know how such changes imply in fulfilling the requisites for receiving some nutrition claims according to different regulatory standards.

2. Materials and methods

2.1. Experimental design and guava mousse manufacture

The manufacturing process of guava mousses followed the same procedures already described in previous studies (Buriti et al., 2010a, 2010b). Seven distinct pilot-scale guava mousse-making trials were prepared according to Table 1, using a *simplex-centroid* design, changing the proportions of milk fat from milk cream (x_1), inulin (x_2), and whey protein concentrate (x_3). All trials were performed using *L. acidophilus* (strain La-5, Christian Hansen, Hørsholm, Denmark) as probiotic culture plus the prebiotic fibre oligofructose (FOS) (Beneo P95, Orafti, Oreye, Belgium). The proportion of 6 g/100 g FOS in all trials was chosen according to amounts of fructans considered effective to supply prebiotic benefits (Kolida & Gibson, 2008). The complete list of ingredients used for the production of mousses and total solids provided by the sum of all components are described in Table 2.

All guava mousses were produced in amounts to obtain 4 kg of the final product with commercial skimmed milk (Paulista, Divisão de Beneficiamento da Danone, Guaratinguetá, Brazil, ultra high temperature [UHT]), skimmed powdered milk (Molico, Nestlé, Araçatuba, Brazil), sucrose (União, Coopersucar-União, Limeira, Brazil), pasteurised and frozen guava pulp (Icefruit-Maisa, Icefruit Comércio de Alimentos, Tatuí, Brazil), lactic acid (85 g/100 g food-grade solution, Purac Sínteses, Rio de Janeiro, Brazil), and emulsifier (Cremodan Mousse 30-B, Danisco, Cotia, Brazil).

For mousse production, skimmed powdered milk, prebiotic FOS, and whey protein concentrate (for mousses WPC, MF–WPC, I–WPC, and MF–I–WPC) were previously incorporated in the skimmed milk one day before the production, to dissolve these powdered ingredients completely, and kept under refrigeration (4 °C) until the mixture with the further ingredients. One portion of 40 ml of this pre-mixture was sterilized and employed, in the next day, for the fermentation of the probiotic culture during 150 min at 37 °C.

Meanwhile, the further ingredients were mixed until complete homogenization and heated for approximately 10 min to achieve 85 °C (Universal Mixer Machine, model UMM/SK-12 pilot-scale, 12 kg capacity, Geiger, Pinhais, Brazil). The temperature was then reduced to 40 °C for the addition of enriched milk previously fermented with the *L. acidophilus* culture. After that, another process of cooling took place (10–15 °C) and the mixture was then submitted to over run in a planetary electric mixer (Irmãos Amadio Ltda., São Paulo, Brazil). In this process, the mass achieved a volume of about 80–85% of its initial volume. Mousse was transferred to a manual packing machine (Intelimaq Model IQ81-A, Intelimaq Máquinas Inteligentes, São Paulo, Brazil) and packaged in individual polypropylene plastic pots (68 mm of diameter, 32 mm of height, 55 ml of total volume, Tries Aditivos Plásticos, São Paulo, Brazil), each one containing 25 g of mousse, sealed with metallic cover, and stored under refrigeration (4 ± 1 °C). Fig. 1 illustrates the main steps involved in mousse production.

2.2. Chemical composition analysis and caloric value

Solid contents of all mousse trials studied were determined after one day of storage at 4 ± 1 °C on triplicate samples. Ash, mineral elements (Ca, Mg, Fe, Cu, and Zn), total fat, fatty acid (FA) composition, protein, and dietary fibre other than fructans (DF_{otf}) contents for all trials were determined on freeze-dried (freeze dryer

Table 1
Simplex-centroid experimental design employed for mousses production.

Trials	Proportion of each ingredient in the mixture (x_1, x_2, x_3)	Amounts of each ingredient (g) in 100 g of mousse		
		Milk fat (x_1)	Inulin (x_2)	WPC (x_3)
MF – control	(1, 0, 0)	4	0	0
I	(0, 1, 0)	0	4	0
WPC	(0, 0, 1)	0	0	4
MF–I	(½,½, 0)	2	2	0
MF–WPC	(½, 0, ½)	2	0	2
I–WPC	(0, ½, ½)	0	2	2
MF–I–WPC	(1/3 , 1/3 , 1/3)	1.33	1.33	1.33