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Scientific Paper

Development and characterization of a new sweet egg-based dessert formulation ☆

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Abstract

The purpose of this work was to develop and characterise a new low-cholesterol formulation of a semisolid dessert made with egg yolks and sucrose. Basing on preliminary tests, two formulations were prepared, one according to the traditional recipe (TCY) and the other one as a low-cholesterol product (TCGR). TCY ingredients were water, egg yolk and sucrose; whereas in TCGR egg yolk was substituted by a combination of egg yolk granules, sunflower oil and hydrocolloids. The new recipe showed 83% less cholesterol content per serving unit and also lower calorie value than the typical recipe. These formulations were compared by means of rheological, textural and sensorial analyses. Colour and microstructure analyses were also developed. Sensory data indicated that, beyond differences regarding physical characteristics, there were not significantly differences between samples in texture and flavour acceptance. Finally, in order to provide a culinary point of view of the new recipe, a final dish was created by a trained chef using the new sweet egg-based formulation.

Keywords: Egg yolk granules; Low-cholesterol dessert; Rheology; Texture; Sensory evaluation

Introduction

Hen egg is one of the most versatile foods, containing high-quality proteins and lipids (Anton, 2007). Furthermore, egg is widely employed as an ingredient in the food industry, due to their thickening, gelling, emulsifying, foaming, colouring, and flavouring properties, it contributes to the texture and sensory characteristics of food products (Rossi et al., 2010). Along with changes in egg-processing technology, there has been a continuous growth of further-processed egg products. In fact, today, approximately 30% of the total eggs consumption is in the form of processed products (Froning, 2008). Many of these egg products are used as ingredients in several food applications such as pasta, mayonnaise, pastry, and baked foods.

Desserts are known in many cultures of the world as courses that typically come at the end of a meal. They usually consist of sweet and creamy food and, consequently, high in sugar and fat levels (Alija and Talents, 2012). However, and since changing dietary habits and sedentary lifestyles have led to an increase in worldwide obesity, as a result, people have come to expect something different from their diet in recent decades (Seuss-Baum, 2007). Thus, largely influenced by health related concerns, there has been pressure on the food industry to reduce the amount of fat (specifically cholesterol), sugar, salt and certain additives in the diet (Alija and Talents, 2012; Nikzade et al., 2012). There are different strategies to transform traditional recipes into low fat versions for the food industry: by reducing its content and/or by using ingredients

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(such as starch, inulin, pectin, carrageenan, etc.) that mimic their functional properties (Alija and Talents, 2012).

In addition to its nutritional value, fat influences rheological properties and sensory characteristics of foods such as flavour, mouthfeel and texture. These sensory properties are very hard to reproduce in formulations without fat. Therefore it is rather difficult to imitate traditional product quality when preparing low-fat foods (Liu et al., 2007). For instance, chefs have been working on the reduction of fat in desserts but keeping same texture. Collaboration between chefs and food technologists would lead to preserve the original sensory attributes of a traditional dessert while still achieving reduced calorie contents (Alija and Talents, 2012).

This work covers the general characteristics of a semisolid sweet egg-based dessert. Despite this work is based on a Spanish product, its formulation is similar to other egg products found worldwide such as custard dessert or crème caramel; in fact, it could be described as a pudding made with egg yolks and syrup. The aim of this work was to develop a low-cholesterol product (TCGR) achieving an appearance, and aroma and texture profiles substantially as good as those of typical product (TCY). Since the egg yolk granules present interesting nutritional composition (34% lipid and 60% protein on a moisture-free basis) and functional properties (gelling, emulsifying, etc.) to be employed as ingredient in food industry (Laca et al., 2014), instead of yolk used in traditional product, low-cholesterol dessert was formulated employing yolk granules and hydrocolloids (potato starch and carrageenan) as ingredients. Both formulations were compared by means of rheological and textural measurements, as well as of their colour, microstructure and sensorial properties. Finally and, with the purpose of integrating technological advances in food science with gastronomes' vision, this study also included a final dish created by a trained chef using the new recipe.

Material and methods

Yolk and egg yolk granules preparation

Egg yolk granules were obtained according to Laca et al. (2010). Egg yolks were prepared from fresh eggs by performing manually the shelling of the eggs and the separation of the yolk from the albumen, the vitelline membrane was removed using tweezers. Granules and yolk were freeze-dried at −70 °C and 0.1 mbar in a Telstar Cryodos Lyophilizer. They were frozen at −80 °C previous to lyophilisation.

Recipes and products development

Sweet egg-based desserts were prepared based on preliminary tests. Two formulations, one according to traditional recipe (TCY) and the other one as a low-cholesterol product (TCGR) were developed. Starch and carrageenan were chosen as texturing agents since these hydrocolloids properties had been evaluated in desserts based on gelled systems by Nunes et al. (2006). For the sensory test TCGR sample with colourant (β-carotene) was also evaluated. The products were prepared by weighing the ingredients, and then, they were successively added in the order shown in Table 1 under blending for 5 min

Table 1
Formula of experimental desserts.

Ingredient	TCY (g)	TCGR (g)	TCGR with colourant
Distilled water	17	17	17 g
Sucrose	30	27.5	27.5 g
Liophilized yolk	10	–	–
Sunflower oil	–	2	2 g
β-carotene	–	–	6 mg
Potato starch	–	0.5	0.5 g
Carrageenan	–	0.3	0.3 g
Liophilized granules	–	6	6 g
Serving unit total weight	57	53.3	53.3 g

at 20,000 rpm with a Heidolph SilentCrusher Homogenizer. The dough were put in moulds and cooked at 105 °C during 15 min in a steam sterilizer AES-75 (Raypa).

Total energy value from each formulation was obtained from energy equivalents for available carbohydrate, fat, and protein, 4 kcal/g, 9 kcal/g, and 4 kcal/g, respectively (FAO, 2003; Komatsu et al., 2013).

Rheological measurements

The un-cooked dough was rheologically characterised. The rheological tests were carried out with a Haake MARS II rotational rheometer with a Haake UTC Peltier temperature control unit. All the analysis were developed at 20 ± 0.1 °C (except the temperature ramp) employing a parallel-plate sensor systems (PP60Ti) with a gap of 1 mm. The rheological measurements were performed on the samples the same day of preparation and tests were developed at least in duplicate.

Flow curves were carried out in CS (Controlled Stress) mode from 0.01 to 100 Pa in 100 s. For thixotropy evaluation, shear stress was maintained at this rate during 60 s and then was reduced to 0.01 Pa in 100 s.

Power law (1), Herschel–Bulkley (2) and simplified Carreau (3), viscous flow models commonly used to characterise different hydrocolloid dispersions and food emulsions (Razavi et al., 2011; Bortnowska et al., 2014), were selected to fit the experimental upstream flow curves obtained:

$$\tau = K_p \dot{\gamma}^{n_p} \tag{1}$$

where τ is the shear stress (Pa), $\dot{\gamma}$ is the shear rate (s^{-1}), K_p is the power law consistency coefficient (Pa s^n) and n_P is the power law flow behaviour index (dimensionless).

$$\tau = \tau_0 + K\dot{\gamma}^{n} \tag{2}$$

where τ is the shear stress (Pa), τ_0 is the yield point (Pa), $\dot{\gamma}$ is the shear rate (s^{-1}), K is the consistency coefficient (Pa s^n) and n is the flow behaviour index (dimensionless).

$$\eta = \frac{\eta_0}{\left[1 + \left(\dot{\gamma}/\dot{\gamma}_c\right)^2\right]^s} \tag{3}$$

where η_0 is the limiting viscosity for the first Newtonian region (Pa s), $\dot{\gamma}_c$ is the critical shear rate for the onset of the shear thinning