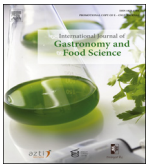

Available online at www.sciencedirect.com

ScienceDirect

International Journal of Gastronomy and Food Science 3 (2016) 30–37

International Journal of Gastronomy and Food Science

www.elsevier.com/locate/ijgfs

Scientific paper

Egg yolk and egg yolk fractions as key ingredient for the development of a new type of gels

Damián Valverde[a], Amanda Laca[a], Lluis Nel Estrada[b], Benjamín Paredes[a], Manuel Rendueles[a], Mario Díaz[a,*]

[a]*Department of Chemical and Environmental Engineering, University of Oviedo, C/Julián Clavería s/n, 33071 Oviedo, Spain*
[b]*"40 Primaveres" (Comunicación y Sabores C.B.), C/ Infante 13, 1° Izda, 33560 Ribadesella, Spain*

Received 1 September 2015; accepted 16 February 2016
Available online 23 February 2016

Abstract

The aim of this work has been the development and characterization of base gels employing egg yolk and egg yolk fractions (plasma and granules) as main ingredients. Basing on preliminary test, three different formulations were prepared with egg yolk, plasma or granules, respectively. These formulations were compared by means of rheological, textural, color and microstructure analyses. Additionally, in order to provide a culinary point of view of the base gels, some final dishes were created by a trained chef.

The employment of egg derivatives proved to be determinant on the characteristics of the developed products, enhancing the mechanical properties of the gels and also providing an appealing color to them. Thus, the use of egg yolk and egg yolk fractions allows the development of new base gels improving not only their physical properties, but also their organoleptic characteristics.

Keywords: Egg yolk fractions; Gels; Rheology; Texture; Microstructure

Introduction

The hen egg is one of the most versatile products being widely used in the food industry due to their multifunctional properties, including foaming, coagulative, emulsifying, and binding properties; no replacers can match the superior functional attributes of eggs (Anton, 2007). In addition, shell egg and egg products industry have seen large changes in the last 50 years, and, along with changes in egg-processing technology, there has been a continuing growth of further processed egg products. In fact, during recent years, there has been significant growth in the use of egg products; specifically, today approximately 30% of the total consumption of eggs is in the form of further processed eggs (Froning, 2008). Many of these egg products, such as liquid whole egg, yolk, and whites; frozen salted yolk or sugared yolk, are used as ingredients in various food applications.

Particularly, hen egg yolk is undoubtedly an efficient ingredient in many food products as it combines, not only functional, but also, nutritional and organoleptic properties. Indeed, it contains proteins of high biological value and other nutrients such as vitamins, minerals, essential fatty acids and phospholipids (King'ori, 2012; Anton, 2013).

Currently, as future new applications of egg components are pursued, it is important to explore new innovative applications (Froning, 2008). One of the main approaches accompanying these new innovative applications is the fractionation of egg components (Laca et al., 2014).

In native conditions, yolk is a complex system constituted by non-soluble protein aggregates (granules) in suspension in a clear yellow fluid (plasma) (Anton, 2013). Consequently, yolk can be easily separated into its two main fractions (plasma and granules) by centrifugation (Strixner and Kulozik, 2013).

*Corresponding author.
E-mail address: mariodiaz@uniovi.es (M. Díaz).
Peer review under responsibility of AZTI-Tecnalia.

http://dx.doi.org/10.1016/j.ijgfs.2016.02.001

Granules represent about 22% of yolk dry matter, accounting for about 50% of yolk proteins and 7% of yolk lipids; whereas plasma corresponds to about 78% of yolk dry matter and it accounts for about 90% of yolk lipids and 50% of yolk proteins (Anton, 2013).

One of the most radical revolutions in the culinary industry has occurred in the last two decades in such a way that, nowadays, the knowledge and practices promoted by the avant-garde movement have transcended the limits of the gastronomic field (Opazo, 2012). International gastronomy and food science are in search for appealing ingredients, new food products or new technology and methods for dish preparation (Krigas et al., 2015). Really, the first level of creativity in the kitchen is based fundamentally on the ingredients (Goldfarb, 2014).

Last years, different works have reported interesting composition and properties of egg yolk fractions (granules and plasma). Concretely, granules show many interesting characteristics to be employed as ingredient in food industry, providing some advantages in relation with the use of egg yolk. Even some applications of granules at a pilot scale have lately been developed (Laca et al., 2010a; Orcajo et al., 2013; García et al., 2015; Marcet et al., 2015). However, plasma has not yet been used as ingredient in innovative food products.

In this work, egg yolk fractions have been assayed as key ingredient for the development of new egg gels, furthermore yolk has also been employed. These products have been evaluated by means of rheological, textural, color and microstructure analysis. Finally, the developed formulations have been taken by a trained chef as starting point for the creation of interesting dishes.

Materials and methods

Extraction of egg yolk and egg yolk fractions

Egg yolks were prepared from fresh eggs. The shelling of the eggs and the separation of the yolk from the albumen were performed manually. The albumen residuals were eliminated from the yolk using a blotting paper, and the removal of the vitelline membrane was achieved using tweezers. The fractionation method was conducted according to Laca et al. (2010b), the egg yolk material is mixed with distilled water (1:1.5 v/v), then the pH of the diluted egg yolk is adjusted to 7 by the addition of NaOH (1 N), and it is held overnight at 4 °C before centrifuging at 4 °C and 10,000*g* for 45 min to separate into plasma (supernatant) and granule (pellet) fractions.

Egg yolk and egg yolk fractions (plasma and granules) were freeze-dried at −70 °C and 0.1 mBa in a Telstar Cryodos Lyophilizator. Samples were frozen at −80 °C previous to lyophilization.

Formulations and development of gels

Basing on preliminary tests, the formulation to obtain gels of milk proteins reported by Pang et al. (2014) was modified as follows. The gels of egg derivatives contained a 4.5% (*w/v*) of egg yolk, plasma or granules and 1% (*w/v*) of carrageenan in distilled water. Gels of 20 g were prepared by mixing the corresponding quantity of egg yolk or its fractions and carrageenan with water, then the mixture was blended with a Heidolph SilentCrusher Homogenizer during 10–20 s at 17,500 rpm. The homogenize dough was cooked at 105 °C during 20 min in a heater (Memmert), with two hand mixing at 10 and 20 min. Afterwards, the gel was cooled at 4 °C at least during 20 min. Gels of 60 g were developed to be evaluated with the texture analyser by means of penetration tests, in this case, dough was cooked during 40 min. Control gel, product without egg derivatives, was prepared following the same steps with the same conditions, but without adding egg yolk or yolk fractions.

Rheological measurements

The rheological tests were carried out with a Haake MARS II rotational rheometer with a Haake UTC Peltier temperature control unit. A parallel-plate sensor system (PP60) with a gap of 1 mm was employed in all measurements. All tests were realized in dynamic conditions at a constant frequency of 1 Hz and a glass hood and silicona oil AR 20 (Sigma-Aldrich) were employed to avoid desiccation during the measurements. All the analyses were carried out at least in duplicate.

The un-cooked dough of gels was rheologically characterized by means of two different temperature sweeps, a “fast” temperature sweep and a “slow” temperature sweep. “Fast” temperature sweep were developed as follows, sample was heated from 20 to 100 °C (16 °C/min), then it was cooled to 4 °C (9.5 °C/min) and finally it was heated to room temperature (20 °C) (3 °C/min). Once the cooked sample was at 20 °C, stress sweep was performed from 0.01 Pa to 500 Pa. “Slow” temperature sweep were carried out in three steps, first the sample is heated to 90 °C and this temperature is maintained during 30 s, then the sample was cooled to 4 °C and finally, the sample was heated to room temperature (20 °C)., all the temperature ramps were carried out at a rate of 3 °C/min. Temperature sweeps were performed in CD mode with a constant deformation of 0.1%.

Texture analysis

Tests were carried out with a TA.XT*Plus* Texture Analyzer (Stable Micro Systems) with a load cell of 5000 g, two different analyses were developed.

Penetration tests with a penetration distance of 4 mm and a speed of 0.5 mm/min were performed employing a cylindrical probe (SMS P/0.5) to characterize gels of 60 g that were previously gelled in Bloom jars. In these assays, the maximum force recorded corresponds with gel strength.

Compression tests were carried out employing a cylindrical probe (SMS P/50) to characterize gels of 20 g with 16 mm of height and 33 mm of width. Two consecutive tests were developed on each sample, first a 20% compression test and afterwards a 50% compression test. First compression did not break the gel, providing an evaluation of product hardness,