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Egg protein hydrolysates: New culinary textures

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Abstract

The purpose of this work was to obtain new textures from egg proteins by enzymatic hydrolysis, to diversify their applications in daily and haute cuisine. Pasteurized liquid egg white, yolk and whole egg were hydrolyzed with a food grade aminopeptidase. Before enzyme inactivation, several ingredients were added, such as flavors and colors in liquid or powdered forms (salt, sugars, fruit or vegetal infusions). This yielded novel gels with various textures – from smooth and creamy to rigid – and light foams with a high foaming capacity and ability to re-incorporate air once collapsed, which were characterized by sensory and texture profile analysis. The elaboration process proved simple and fast, allowing an optimum use of the starting material without by-products. It provided the means to improve the techno-functional properties of the egg as an ingredient and to expand its use in new recipes, as well as in the development of new food products, particularly suitable for people with chewing limitations or digestion problems, overweigh, obesity, or sensitive to dairy products.

Keywords: Egg proteins; Enzymatic hydrolysis; Textures

Introduction

Texture is a critical attribute that is essential to the overall quality and acceptability of most food products because, in addition to its relevance to mouthfeel, texture is also a property generally related to freshness (Isaksson et al., 2002). During the last decade, gastronomy has become an important feature of the socio-economic landscape of many countries, being the culinary activity a balance between tradition and technology (García-Segovia et al., 2012). New textures are essential to the success of haute cuisine (Adrià et al., 2005; Blumenthal, 2008) and, nowadays, it is usual to find traditional dishes that have been modified by various cooking techniques to present very different textures, such as slush, ice cream, sorbet, crunchy, foam, gelatine spheres and crystals. While it is generally recognized that the development of successful products is a difficult and time-consuming task, these textures are possible through technological and culinary innovations in a joint work between scientists and cooks.

Egg is one of the highest quality protein sources in our diet and one of the most versatile ingredients used in cooking. It is well known that the ability of egg to form and stabilize different food structures is due to the protein fraction and its physicochemical properties. Egg proteins act in food products as texture improvers and stabilizers, controlling consistency and water retention, by virtue of their foaming, emulsifying, gelling and heat setting properties (Mine, 1995). Therefore, they are widely used as ingredients in the food industry for different purposes.

Enzymatic hydrolysis is a well-known method for increasing the added value of food proteins by modifying their physical and nutritional properties. Breaking of peptide bonds can change these properties in three ways: reducing the molecular weight, increasing the number of ionizable groups and causing the exposure of hydrophobic groups. Enzymatic hydrolysis improves the solubility of food proteins in a wide pH range and modulates their surface or interfacial properties, essential, for instance, for the stabilization of emulsions and foams (Foegeding and Davis, 2011). Thus, hydrolysis modifies the

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Table 1
Egg-derived products.

	Material	Centrifugation	Post-treatment	Final product
Product 1	Egg white	Yes	No	Cream
Product 2	Egg white	Yes or manual liquid draining	No	Cottage cheese
Product 3	Egg white	No	No	Junket
Product 4	Whole egg	No	No	Custard dessert/créme caramel
Product 5	Yolk	No	No	Custard dessert
Product 6	Egg white	Yes	Whipping	Foam

sensory quality of proteins, their contribution to texture and flavor – as peptides do have a taste and, in fact, cover the entire range of known taste modalities, including bitter tastes that could cause food rejection (Temussi, 2012) –; but also improves digestibility and nutrient bioavailability and provides health benefits through the release of bioactive peptides and the reduction of their allergenic potential (Tavano**,** 2013).

The physicochemical properties of a culinary preparation are commonly modified using additives, such as agar-agar, gellan, methylcellulose, locust bean gum, lecithin, sucrose ester or gases, such as carbon dioxide or liquid nitrogen, among others, with an enormous range of potential applications to produce foods of novel and interesting consistencies in the kitchen (Barham et al., 2010). However, to the best or our knowledge, the enzymatic hydrolysis of egg proteins has not been explored in depth for obtaining new textures of culinary use. The inclusion of egg hydrolysates with the right techno-functional properties may lead to the modification or generation of food products new attributes of taste, texture, odor, acidity, rheological properties, stability and appearance. Moreover, it may lead to products that can mimic the properties of dairy products of interest for some population groups for health reasons, like allergies, intolerances or specific diseases.

The aim of this work was to obtain new textures from egg proteins through treatment using food grade enzymes. The objectives were to achieve a pleasant appearance, appropriate sensory characteristics and diverse applications in daily and haute cuisine.

Material and methods

Products

Commercial pasteurized whole egg, egg yolk and white were purchased from Pitas Agropecuaria S.L. (Guadalajara, Spain). Food grade aminopeptidase from *Aspergillus oryzae* (Flavorpro 750 MDP) was purchased from Biocatalysts (Cardiff, United Kingdom). HCl food grade CODEX was from Sigma-Aldrich (Tres Cantos, Spain) and natural flavoring liquid extracts were provided by Mario Sandoval (Restaurante Coque, Madrid, Spain).

General protocol of hydrolysis

Pasteurized liquid egg products were hydrolyzed with *Aspergillus* aminopeptidase at an enzyme to substrate ratio of 2:100 (w:v). Before hydrolyzes, the egg products were acidified to the optimum enzyme pH, 5.5, with concentrated food grade HCl (37%). Hydrolyzes were carried out at 50 °C under constant stirring in a thermostatic water bath for up to 120 min. Enzyme inactivation was achieved by heating the samples at 95 °C for 15 min in a water bath, followed by cooling at 4 °C. Depending on the required final product, several ingredients were added as flavorings and colorings in liquid or powdered forms (salt, sugars, fruit or vegetal infusions). Because the heating step caused the hydrolyzed proteins to gel, and in order to favor a homogeneous mixture, the addition of ingredients was conducted before enzyme inactivation.

As shown in Table 1, five different gel textures (products 1–5) were obtained, depending on the starting material (whole egg, egg yolk or egg white) and the use of salt or sugar, or centrifugation to favor liquid draining from the egg white gels. In the latter case, following separation of the precipitate (product 1), the supernatant was whipped with a Kitchen Aid Ultra Power Mixer (Kitchen Aid, St. Joseph´s, MI) coupled with a stationary bowl and rotating beaters, what resulted in a product with foam texture (product 6).

Sensory analysis

Panelists were recruited among members of the Institute staff who had previously participated in sensory descriptive tests. Criteria for recruitment were: (1) age (between 18 and 55 years-old), (2) absence of allergy to egg and/or dairy products, (3) consumption of dairy and egg-based desserts at least twice per week, and (4) willingness and availability to participate during testing dates. There were 12 female panelists and 9 male panelists.

A five-point hedonic scale (5 – excellent, 3 – good, 1 – unacceptable) with a clear description of each point was used for the assessment of appearance, texture and flavor of the 6 products (UNE-ISO 4121:20036). All panelists were similarly trained to examine these attributes (ISO 8586:2012).

Texture profile analysis

Texture profile analysis (TPA) was carried out using a TA. XT2i Texture Analyser (Stable Microsystems Ltd., Surrey, England) with a 49 N load cell at a crosshead speed of 1 mm/s and a cylindrical plunger with a flat base of 35 mm of diameter. Samples were cut in pieces of, approximately, 20 mm thick and 20 mm height, which were axially