Original scientific paper
UDC 664.692:[664.644.4:635.656

A STUDY ON THE POSSIBILITY OF USING SELECTED PLANT PROTEINS AS SUBSTITUTES OF ANIMAL PROTEINS IN FORMING AND STABILIZING FOOD FOAMS

Tzvetelin Dessev[1], Vesela Chalova[2], Ivelina Desseva[3*], Rosen Chochkov[1], Magdalena Stoyanova[3], Petya Ivanova[2]

[1]Department Technology of cereals and bakery products, University of food technologies, Maritsa Boulevard 26, 4002 Plovdiv, Bulgaria
[2]Department of Biochemistry and Molecular Biology, University of Food Technologies, Maritsa Boulevard 26, 4002 Plovdiv, Bulgaria
[3]Department Analytical chemistry, University of food technologies, Maritsa Boulevard 26, 4002 Plovdiv, Bulgaria

[*]e-mail: dessev@mail.bg

Abstract

In recent years the demand for plant protein-based products has increased. There are plant-based proteins reported in the literature that poses emulsification and foaming properties such as pea, lupine, soy, chickpea, potato proteins etc. Among them pea and lupine proteins indicate strong capability to form and stabilize food foams, though they are not systematically studied yet. That is why our approach in this study was focused on testing the possibilities of pea and lupine protein concentrates to substitute partially or completely whole eggs used in sponge cake formulation.

Pea (Pulsin, UK) and lupine (Bionia, Bulgaria) protein concentrates were purchased from the local market and subjected to the following analysis: i) chemical composition - total lipids and ash content were determined by gravimetric method; total carbohydrates were analyzed by colorimetric method; total phenols were extracted with 70% aqueous ethanol solution and quantified by using Folin–Ciocalteu reagent. The crude protein content was determined by the Kjeldahl method and conversion factor of 6.25 was used for final calculation ii) the amino acid content was determined after derivatization with AccQ-Fluor reagent kit and further chromatographic analysis, while iii) the protein profile was determined by using SDS-PAGE. The control cake batter was prepared by mixing 60g white flour type 500, 100 g fresh egg, and 50 g sugar. To aerate the cake batter, whole eggs, sugar and sifted wheat flour were mixed together "all in" for 6 min. with a kitchen mixer. For plant protein modified cakes 50% and 100% of the egg protein was replaced by the pea and lupine protein concentrates keeping the dry matter and protein content in the recipe constant. The corresponding sponge cake batters were further analyzed for density (determined as the mass of a known volume), microstructure quantification (bubble size determined by image analysis of taken digital microphotographs) and apparent viscosity using rotational viscometer equipped with 15mm disc spindle. Cakes were baked and analyzed about specific volume and crumb pore size by using image analysis of digitally scanned slices.

SDS-PAGE analysis revealed that in the group of proteins with molecular weights from 50 to 150 kDa the relative amount of individual fractions of the lupine concentrate was more than 2-fold higher than those of the pea protein. In contrast, the pea protein isolate contained higher amounts of low molecular weight fractions that is an indicative characteristic for potentially good foaming properties. The sponge batter density increased significantly with the level of reconstituted eggs. At the same time, the control batter presented more heterogeneous bubble distribution with medium to large-sized air bubbles, while batters containing pea and lupine proteins showed more uniform bubble size distribution and smaller air bubbles. The control batter demonstrated higher kinetic of microstructural changes (bubble growth) over time compared to lupin and particularly to pea protein foam that indicates higher stability of the plant protein based foams. Replacement of egg proteins by pea and lupine

proteins affected the porosity and pore size of cake crumb. Control cake was more porous and had larger pores while the cakes with no eggs but 100% pea/lupine proteins had the lowest specific volume and pore size.

The possibilities for partial or complete substitution of eggs with non-modified pea and lupine protein concentrates for production of food foams were tested on model sponge cakes. The results indicated decrease in the foaming capacity of the tested plant-based proteins with an increase of their presence in the sponge batter formulation at the expense of egg protein. Apparently, despite of the deteriorated foaming formation of the pea and lupine proteins it was evident that sponge batter formulation containing pea protein exhibited an improved foam stability over time as it could prevent the coalescence of air bubbles by reinforcing the structure of air bubble cell walls.

***Key words**: Pulse proteins, Pea, Lupin, Foams, Amino acid composition.*