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A predictive modelling study for using high hydrostatic pressure, a food processing technology, for protein extraction

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Abstract

The aim of this study is to fit a response model to one response, extracted protein concentration by using high hydrostatic pressure, a food processing technology, as a function of two particular controllable factors of extraction procedure. These factors are "pressure" (applied in MPa) and the "extraction solvent". Data were taken from a previously published data, where the minimum and maximum values chosen for pressure were 100 MPa and 300 MPa with a center point of 200 MPa. The solvents were PBS, TCA-Acetone and Tris-HCl. Protein concentration values were the mean values of 3 replicates.

Firstly, a regression statistics were conducted by the data mentioned above to identify coefficients for intercept, pressure and solvents. The coefficients for intercept, pressure and solvents were identified as 34.29753333, 0.008442 and 0.85425 respectively with *p*-values of 0.03 for pressure and 0.10 for solvents.

A predictive analysis model was fitted to the protein concentration response by using the predictive analysis model proposed with the analysis conducted.

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Keywords: High hydrostatic pressure; protein extration

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1. Introduction

High Hydrostatic Pressure (HHP) processing is a non-thermal food processing technology, in which food samples are subjected to 100 to 800 MPa or even higher pressures such as 1000 MPa in some cases[1]. HHP processing is a cold isostatic super high hydraulic pressure and it is not only used in food engineering. It has some other application areas, for example the extraction of active ingredients from natural biomaterials[2,3]. There are several studies which show that HHP can be used to extract biomaterials from plants[4].

HHP processing has some advantages such as not requiring heating process. This is important in extraction of biomaterials, such as proteins, which can cause some deformation[5].

It is a well-known issue that during HHP processing the solubility increases. Due to the pressure increase pressurized cells show increased permeability, which can be explained by the mass transfer theory[3,6,7,8,11]. When the cells are pressurized, more solvent can enter into the cell. This will cause more compounds to permeate the cell membrane and increases yield of extraction[9]. A rapid permeation is observed according to the large differential pressure between the cell interior and the exterior[3]. These are the main ideas behind using HHP processing to extract proteins from pollens successfully, which was shown by previous studies[2,10].

The aim of this study is to fit a response model to one response, extracted protein concentration by using high hydrostatic pressure, as a function of two particular controllable factors of extraction procedure.

1.1. Experiment description

The aim of this study was to fit a response model to one response, *extracted protein concentration* (γ), as a function of two particular controllable factors of extraction procedure. The experimental design and the data were taken from a previous study published previously[10].

The factors used in the previous study were:

- *Pressure* and
- The *extraction solvent*.

The minimum and maximum values chosen for *Pressure* were 100 MPa and 300 MPa with a center point of 200 MPa.

Three different types of *extraction solvents* were used in the study. The extraction solvents were as follows:

- Phosphate buffer saline (PBS)
- Trichloroacetic acid (TCA-Acetone)
- Tris-HCl

1.2. Design and experimental responses

As it was mentioned before, data used in this study were provided from a study published previously[10]. Table 1 shows the design and experimental responses, in the order in which they were run.

The last two columns in the Table 1 show coded values of the factors.

1.3. Regression statistics

First of all a regression statistics were conducted by the data mentioned in Table 1 to identify coefficients for intercept, pressure and solvents by MS Excel 2013. The results for this regression statistics are given in Table 2.

The coefficients for intercept, pressure and solvents were identified as 34.29753333, 0.008442 and 0.85425 respectively with *p*-values of 0.03 for pressure and 0.10 for solvents.