FORTIFICATION OF MUSHROOM WITH CALCIUM BY VACUUM IMPREGNATION

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***Abstract*-- Foods with added physiologically-active food components (PAC) are receiving special attention by their potential in disease prevention and health promotion. Additional intake of any nutrient might be achieved by the application of vacuum impregnation technique to fruits and vegetables. Viability of mushroom as matrix for the incorporation of calcium was then evaluated. It was found that, due to the high impregnated liquid fraction observed (17 - 40 %), the calcium incorporated in 100 g of mushroom would satisfy about 24 - 32 % of the Adequate Intake (AI). Thus, there would seem to be much potential for the introduction of high Ca^{2+} concentration in mushroom tissue through vacuum impregnation, combating the widespread Ca^{2+} deficiencies that occur in human populations. Although mechanical properties are affected by the vacuum treatment, similar or greater mushroom softening is produced during post-harvest storage or commercial thermal processing.**

***Keywords*-- Mushroom, Functional foods, Calcium.**

I. INTRODUCTION

In the last years there has been a growing interest in the design of the so-called functional foods. These include foods with added physiologically-active food components (PAC) in order to facilitate or to increase the consumption of a specific vitamin or mineral that may provide an additional health benefit beyond the traditional nutrients they contain (IOM/NAS, 1994; Clare and Hasler, 1998; Hasler, 1998). In particular, calcium is a fundamental mineral for human body, since low intake is one of risk factors in the bone disease osteoporosis. Its deficiency is also endemic in Argentine. Causes are linked not to economic situation but to food habits common to the majority of population, that is, insufficient calcium consumption in the different life stages and high levels of protein, fiber, phosphate and polyphosphates containing industrialized foods which may affect the bioavailability of this nutrient.

An additional intake of this micronutrient might be achieved by impregnation soaking processes. Vacuum impregnation (VI) treatment of a porous material consists of exchanging the internal gas or liquid occluded in open pores for an external liquid phase (of controlled composition) due to pressure changes. Fruit and vegetables have a great number of pores occupied by gas or native liquid and offer the possibility of being impregnated by a determined solution (Fito and Chiralt, 2000). Thus product composition as well as its physical and chemical properties may be changed to improve the properties of the final product. The impregnated liquid fraction (X) means the pore fraction of the matrix that can be penetrated by the external solution at the mechanical equilibrium status, and is a function of the product porosity and the applied vacuum pressure.

Very few studies have been carried out by using impregnation techniques for the development of functional foods with vegetable matrices. Anino *et al.* (2001) compared two impregnation methods (vacuum and atmospheric) for the incorporation of Ca^{2+} in apple tissue. Fito *et al.* (2001) proposed a mathematical model to calculate the PAC concentration of the impregnation medium in order to formulate functional foods with the addition of different Ca^{2+} and Fe^{++} salts and satisfy a specific percentage of the Recommended Daily Intake (RDI). These studies suggest that these impregnation methods could be used for the incorporation of PAC in fruits and vegetables matrices.

The objective of this work was to evaluate the viability of a highly porous matrix (i.e. mushroom) for the incorporation of calcium by vacuum impregnation on the basis of matrix properties (impregnated liquid fraction, Ca^{2+} content, tissue microstructure and mechanical properties).

II. METHODS

A. Sample Preparation and Treatments

Fresh mushrooms (*Agaricus bisporus*, pH 6.8, $a_w \cong 0.99$) were cut into cylinders (1.5 cm in diameter and 1 cm in length) including three kinds of mushroom tissue (cap, stipe and cap/stipe interface). Each experiment was performed with the same lot of mushrooms in order to minimize biological variability due to age and/or cellular structure.

Two VI treatments (run 1 and run 2) were conducted at room temperature by immersion of fresh samples in agitated isotonic salt aqueous solutions (5.88 % p/p calcium salts). A mixture of calcium gluconate and calcium lactate was chosen because of its relatively high solubility at room temperature and the neutral taste it imparts to the food. Potassium sorbate (1500 ppm) was added to all the systems and the pH was adjusted to 3.5