IMPACT OF MATRIX COMPOSITION ON THE VIABILITY OF ENCAPSULATED LACTICASEIOBACILLUS CASEI

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Abstract. *The development of stable delivery systems for lactic acid bacteria (LAB) is becoming increasingly important in the production of functional foods. The aim of this study was to evaluate the effectiveness of encapsulating the Lacticaseiobacillus casei strain using various microcapsule materials, including sodium caseinate, pea protein, maltodextrin, as well as multilayer systems based on chitosan and acetic acid. The physicochemical properties of the microcapsules, the yield of the encapsulated powder, and bacterial viability during storage were investigated. The results demonstrated significant differences among the studied encapsulation systems in terms of efficiency and LAB stability, confirming the potential of protein-based matrices, particularly pea protein for enhancing the survival of probiotic microorganisms.*

Keywords: *lactic acid bacteria, encapsulation, Lacticaseiobacillus casei, sodium caseinate, pea protein, maltodextrin.*

Аннотация. *Разработка стабильных систем доставки молочнокислых бактерий (МКБ) приобретает всё большее значение в производстве функциональных продуктов питания. Целью настоящего исследования являлась оценка эффективности инкапсуляции штамма Lacticaseiobacillus casei с использованием различных материалов микрокапсул, включая казеинат натрия, гороховый белок, мальтодекстрин, а также многослойные системы на основе хитозана и уксусной кислоты. В работе изучены физико-химические свойства микрокапсул, выход инкапсулированного порошка и жизнеспособность бактерий в процессе хранения. Полученные результаты показали значительные различия между исследуемыми системами инкапсуляции по показателям эффективности и стабильности МКБ, что подтверждает перспективность использования белковых матриц, особенно горохового белка, для повышения сохранности пробиотических микроорганизмов.*

Ключевые слова: *молочнокислые бактерии, инкапсуляция, Lacticaseiobacillus casei, казеинат натрия, гороховый белок, мальтодекстрин.*

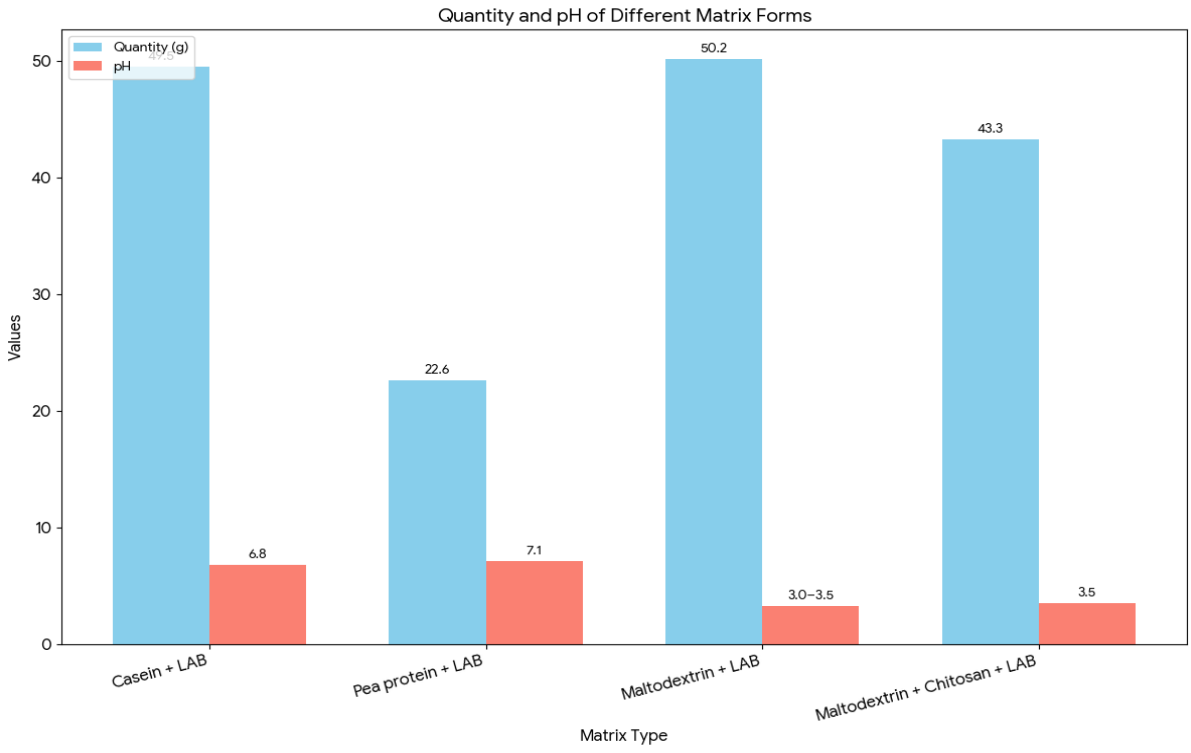
Introduction

Lactic acid bacteria (LAB) are widely used in the food industry due to their probiotic properties and positive effects on human health. However, the viability of LAB is significantly reduced under the influence of adverse environmental factors, such as oxygen, moisture, low pH, and prolonged storage. Therefore, developing effective encapsulation methods to protect microorganisms and preserve their functional activity is an urgent task.

Encapsulation using protein and polysaccharide matrices is considered one of the most promising approaches for enhancing the stability of probiotics in functional foods.The object of this study was the *Lacticaseiobacillus casei* strain. The materials used for encapsulation included sodium caseinate, pea protein, maltodextrin, and multilayer systems based on maltodextrin, chitosan, and acetic acid.

The encapsulation process was carried out via emulsification followed by drying. After obtaining dry microcapsules, their physicochemical parameters were determined, including pH, viscosity, water activity, moisture content, color, and solubility. The viability of LAB was evaluated using the pour-plate method on MRS agar, followed by counting colony-forming units (CFU) at various dilutions immediately after encapsulation, as well as after 2 weeks and 1 month of storage.

The results demonstrated that the type of matrix significantly affects encapsulation efficiency and bacterial survival. Microcapsules based on sodium caseinate showed a dry powder yield of approximately 49.5 g and a neutral pH value (6.8). After one month of storage, a moderate LAB viability was retained, yielding up to 49 CFU at a 10^{-7} dilution.



The use of pea protein resulted in a lower powder yield (22.6 g), but provided superior bacterial preservation: after one month, the number of viable cells exceeded 300 CFU at a 10^{-5} dilution. This indicates the pronounced protective properties of the plant protein.

Maltodextrin-based systems ensured a high powder yield (50.2 g), but were characterized by an acidic medium pH 3,0-3,5, which negatively affected LAB viability, leading to a sharp decline during storage.

Multilayer microcapsules comprising maltodextrin, chitosan, and acetic acid exhibited good structural stability; however, their initial bacterial viability was low and dropped to minimal values within just two weeks of storage.

Overall, the study demonstrated that the encapsulation efficiency of *Lacticaseiobacillus casei* is largely determined by the type of matrix utilized. Protein-based systems, particularly those incorporating pea protein, provide higher retention of LAB viability compared to polysaccharide and multilayer systems. These findings can be applied to the development of functional foods and nutraceuticals featuring enhanced stability of probiotic cultures.

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