World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:9, No:03, 2015

Encapsulation of Probiotic Bacteria in Complex Coacervates

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Abstract : Two probiotic strains of Lactobacillus paracasei subsp. paracasei (E6) and Lactobacillus paraplantarum (B1), isolated from traditional Greek dairy products, were microencapsulated by complex coacervation using whey protein isolate (WPI, 3% w/v) and gum arabic (GA, 3% w/v) solutions mixed at different polymer ratio (1:1, 2:1 and 4:1). The effect of total biopolymer concentration on cell viability was assessed using WPI and GA solutions of 1, 3 and 6% w/v at a constant ratio of 2:1. Also, several parameters were examined for optimization of the microcapsule formation, such as inoculum concentration and the effect of ionic strength. The viability of the bacterial cells during heat treatment and under simulated gut conditions was also evaluated. Among the different WPI/GA weight ratios tested (1:1, 2:1, and 4:1), the highest survival rate was observed for the coacervate structures made with the ratio of 2:1. The protection efficiency at low pH values is influenced by both concentration and the ratio of the added biopolymers. Moreover, the inoculum concentration seems to affect the efficiency of microcapsules to entrap the bacterial cells since an optimum level was noted at less than 8 log cfu/ml. Generally, entrapment of lactobacilli in the complex coacervate structure enhanced the viability of the microorganisms when exposed to a low pH environment (pH 2.0). Both encapsulated strains retained high viability in simulated gastric juice (>73%), especially in comparison with non-encapsulated (free) cells (<19%). The encapsulated lactobacilli also exhibited enhanced viability after 10–30 min of heat treatment (65oC) as well as at different NaCl concentrations (pH 4.0). Overall, the results of this study suggest that complex coacervation with WPI/GA has a potential to deliver live probiotics in low pH food systems and fermented dairy products; the complexes can dissolve at pH 7.0 (gut environment), releasing the microbial cells.

Keywords : probiotic, complex coacervation, whey, encapsulation
Conference Title : ICPFF 2015 : International Conference on Probiotics and Functional Foods
Conference Location : Miami, United States
Conference Dates : March 09-10, 2015