

Microencapsulation for Enhancing the Survival of *S. thermophilus* and *L. bulgaricus* during Spray Drying of Sweetened Yoghurt

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Abstract : Microencapsulation is an established method of protecting bacteria from the adverse conditions. An improved extrusion spraying technique was used to encapsulate mixed bacteria culture of *S. thermophilus* and *L. bulgaricus* using sodium alginate as the coating material. The effect of nozzle air pressure (200, 300, 400 and 500 kPa), sodium alginate concentration (1%, 1.5%, 2%, 2.5% and 3% w/v), different concentration of calcium chloride (0.1, 0.2, 1 M) and initial cell loads (10^7 , 10^8 , 10^9 cfu/ml) on the viability of encapsulated bacteria were investigated. With the increase in air pressure the size of microcapsules decreased, however the effect was non-significant. There was no significant difference ($p > 0.05$) in the viability of encapsulated cells when the concentration of calcium chloride was increased. Increased level of sodium alginate significantly increased the survival ratio of encapsulated bacteria ($P < 0.01$). Encapsulation with 3% alginate was treated as optimum since a higher concentration of alginate increased the gel strength of the solution and thus was difficult to spray. Under optimal conditions 3% alginate, 10^9 cfu/ml cell load, 20 min hardening time in 0.1 M CaCl₂ and 400 kPa nozzle air pressure, the viability of bacteria cells was maximum compared to the free cells. The microcapsules made at the optimal condition when mixed with yoghurt and subjected to spray drying at 148°C, the survival ratio was 2.48×10^{-1} for *S. thermophilus* and 7.26×10^{-1} for *L. bulgaricus*. In contrast, the survival ratio of free cells of *S. thermophilus* and *L. bulgaricus* were 2.36×10^{-3} and 8.27×10^{-3} , respectively. This study showed a decline in viable cells count of about 0.5 log over a period of 7 weeks while there was a decline of about 1 log in cultures which were incorporated as free cells in yoghurt. Microencapsulation provided better protection at higher acidity compared to free cells. This study demonstrated that microencapsulation of yoghurt culture in sodium alginate is an effective technique of protection against extreme drying conditions.

Keywords : extrusion, microencapsulation, spray drying, sweetened yoghurt

Conference Title : ICFP 2017 : International Conference on Food Properties

Conference Location : Singapore, Singapore

Conference Dates : January 08-09, 2017