

Ref: 4391

Layer-by-layer microcarrier production and characterization as a model to probiotics microencapsulation

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Keywords: Probiotics; Folate; microencapsulation; layer-by-layer

Abstract

The recommended daily intake of folate (B-complex vitamin) for an adult varies between 200 and 400 µg, being the intake of folate inefficient due its extremely unstable chemical forms. One of the presented solutions is the in situ production using probiotics. However, two concerns exist for this solution: a) probiotic bacteria may need protection towards the gastric medium (encapsulation); and b) microcapsule sizes should be smaller than 100 µm, to avoid modifying food texture.

Alginate-based microcapsules were produced and three layers were added using the layer-by-layer technique: 1st - poly-L-lysine (0.1%); 2nd - sodium alginate (1%); 3rd - chitosan (0.03%). Confocal microscopy was used to confirm the consequent adhesion of the layers, and if they were in the correct position (the layers labelled were the first (Poly-L-lysine/FITC) and the third layer (Chitosan/Rhodamine). After production the particles were put into a 10 mL solution of KCl-HCl (pH 2) during 1 hour, at 100 rpm and then into a PBS solution (pH 7.2), during 3 hours in order to mimic the gastrointestinal tract during digestion.

The average size of the particles was 21.01 ± 0.493 µm and 39.84 ± 0.794 µm during the process at pH 2 and at pH 7.2, respectively. The sizes were smaller than 100 µm and showed a swelling capacity (particles duplicate their size upon passing from pH 2 to pH 7.2). Confocal images showed the adhesion of the different layers, also proving indirectly the existence of the second layer (not labelled). Further, after the contact with the KCl-HCl (pH 2) and PBS (7.2) media, the structure of the capsules with the layers was maintained, thus showing the robustness of this structure at pH values typical of the gastrointestinal system.

Alginate microcapsules production through LbL technique showed potential for encapsulation of probiotics, allowing their protection against harsh conditions in gastrointestinal tract.