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ORIGINAL PAPER

Entrapment of ethyl vanillin in calcium alginate and calcium alginate/poly(vinyl alcohol) beads

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Electrostatic extrusion was applied to the encapsulation of 3-ethoxy-4-hydroxybenzaldehyde (ethyl vanillin) in calcium alginate and calcium alginate/poly(vinyl alcohol) beads. The calcium alginate/poly(vinyl alcohol) hydrogel spheres were formed after contact with the cross-linker solution of calcium chloride, followed by the freeze–thaw method for poly(vinyl alcohol) gel formation. The entrapment of aroma in beads was investigated by FTIR and thermal analysis (thermogravimetry/differential thermal gravimetry; TGA/DTG). The mass loss in the temperature range of 150–300 °C is related to degradation of the matrix and the release of ethyl vanillin. According to the DTG curve, the release of ethyl vanillin occurs at about 260 °C. TGA measurements of the stored samples confirmed that formulations were stable for a period of one month. FTIR analysis provides no evidence for chemical interactions between flavour and alginate that would alter the nature of the functional groups in the flavour compound.
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Introduction

Flavour is one of the most important properties of any food product. It is created by aroma compounds, most of which are volatile and odorous organic molecules. Food processing and inadequate storage conditions may cause irreversible changes in aroma composition. Encapsulation is a popular approach for aroma preservation during the production, transport, and processing of food. Microspheres or micro-beads made from a polymer gel network entrapping an active compound are often used as delivery forms. Calcium alginate gel is the gel system most frequently used for encapsulating various active compounds. Alginate is a natural, high-molecular-mass polysaccharide distributed in brown seaweeds (*Phaeophyceae*, mainly *Laminaria*). It is a linear copolymer of 1,4-linked-β-D-mannuronic acid (M) and α-L-guluronic acid (G), wherein the G and M units are joined in blocks. Three types of blocks are identified: homopolymeric G blocks (GG), homopolymeric M blocks (MM), and heteropolymeric sequentially alternating blocks (MG). Alginates possess some favourable properties, such as being non-toxic, biodegradable, and biocompatible. As a consequence, alginate gels have been exploited in food applications for the encapsulation of aroma and essential oils (Vauchel et al., 2009; Lai et al., 2007).

There are two common methods for producing alginate gel microspheres: the extrusion or dripping method and the emulsification method. The extrusion method is based on the production of droplets of a 0.6–4.0 mass % sodium alginate aqueous solution and an active compound, which are then collected in a gelling bath, usually made from 0.05–1.5 M calcium chloride

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