
Release kinetics and encapsulation efficiency of embedded active ingredients in fat-based matrices using cold extrusion

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Cold extrusion offers great potential as a continuous and gentle encapsulation technique. Due to their melting and crystallization properties, lipids are ideal matrix materials as they can be influenced by extrusion process parameters, such as temperature and shear. This offers the possibility to develop various lipid-based matrix materials with specific release properties, ensuring a delayed release during gastrointestinal digestion. The objective of the present work was a methodical physicochemical characterization of cold extruded fat matrices serving as matrix material for the embedding of 10 % beetroot powder, which was used as model active agent due to its detectability by photometric measurement. The matrices were composed of a high-melting fully hydrogenated rapeseed oil as the base fat and one of four low-melting fats/oil. By performing a semi-dynamic in vitro digestion test, physicochemical characteristics of fat-based matrices influencing release properties and encapsulation efficiency of encapsulated beetroot powder were identified. The results showed that the matrix composition influenced, particle size distribution, melting behavior and microstructural fat distribution. Melting behavior and solid fat content proved to be determinant properties influencing the release behavior – especially, the deviation of solid fat contents in the temperature range from 20.0 °C to 36.5 °C (room and body temperature) during in vitro digestion. Generally, a higher content of low-melting fat led to an increased release of beetroot powder during the intestinal phase of up to 48 %, whereas only 3.3 % on average were released during oral and gastric phase each. Microstructural analysis showed that melting properties are also influenced by the time factor as a temporal delayed release of beetroot powder was determined.