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Microcontainers for Oral Vaccine Delivery

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Vaccination is considered one of the most significant contributions to public health and disease prevention and it is also believed to be a very cost-effective medical intervention [1]. Vaccination has reduced the morbidity and mortality resulting from diseases such as tuberculosis and smallpox and has thereby saved millions of lives. In spite of this, many infectious diseases remain endemic in large parts of the world, and therefore vaccination is an area in continuous development [1].

Delivery of vaccines is often done by injection, but it would be much more convenient for the patients and provide prospective for mass vaccination, if the vaccines could be dosed via the oral route. For being able to do so, a combination of an antigen, adjuvant and a particulate system is necessary. An example of such a particulate system is cubosomes. Cubosomes are highly twisted, continuous lipid bilayers with two congruent, non-intersecting water channels providing both hydrophilic and hydrophobic domains and a large surface area for associations of antigens and adjuvants [2]. Following the oral delivery of the vaccine formulation, it needs to pass through the harsh environment of the stomach with low pH value and degradation enzymes, and then reach the small intestine where absorption into the blood stream should occur. For protection of the vaccine formulation, micro fabricated drug delivery devices can be used. Of these micro devices, microcontainers are suggested as especially promising [3]. Microcontainers are polymeric, cylindrical devices in the micrometer size range (Fig. 1). A potential advantage of microcontainers is that these devices allow for unidirectional release, as only one side is open compared to conventional particles where release occurs from the whole surface [3]. Moreover, microcontainers have been observed to interact with the intestinal mucus layer resulting in prolonged and increased absorption of poorly soluble drugs compared to controls without microcontainers [3,4].

In this work, cubosomes powder carrying the model antigen ovalbumin and the adjuvant Quil-A was prepared using spray drying as production method [5]. The powder was subsequently loaded into SU-8 microcontainers. For protection of the vaccine formulation in the microcontainers, a lid of the pH-sensitive polymer Eudragit L100-55 was deposited on the cavity of the microcontainers for protection of the vaccine formulation through the stomach (Fig. 2). This vaccine-loaded microcontainer system is further tested for the potential application in oral vaccine delivery.

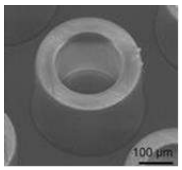
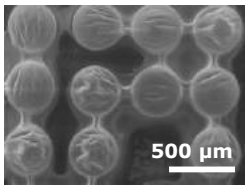


Fig. 1: SEM image of a microcontainer



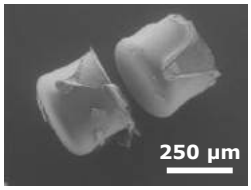


Fig. 2: SEM image of coated vaccine-loaded microcontainers

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