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Abstract

Functionalization of 3D-printed tablets by atmospheric pressure plasma coating

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One of the greatest challenges in the future design of pharmaceutical products is to guarantee the highest product qualities while at the same time flexibility in the production of pharmaceutics is demanded [1]. Implementation of these requirements necessitates small batch sizes and also, in extreme cases, the production of one dosage form, e.g. one tablet for a patient to take at a defined time in order to meet their health needs as precisely as possible. The production of tablets using 3D printing from non-toxic thermoplastic polymers loaded with active ingredients is suitable for this purpose.

Tablets are coated to adjust their properties, for example their release profiles. Traditionally, these coatings are produced using batch processes by applying wet coating to the tablets [2]. Such processes are inherently uneconomical for the coating of just one tablet [3]. To overcome this problem, gas-based coatings, deposited by a so-called cold plasma can be used to perform dry chemical surface modifications and coatings. One application of plasma treatment is the incorporation of functional groups, such as carboxylic acids, on the surface of tablets [4]. Conventional tablet coatings utilize the pH-dependent solubility of carboxylic acid to delay the drug release after the passage through the stomach [5]. Plasma deposition can also be used to create a barrier layer which may enhance the stability of the drug [6].

First experiments address the deposition of barrier layers based on plasma-polymerized hexamethyldisiloxane (HMDSO) on 3D-printed tablets to influence their release profile. 3D-printed tablets made from polyethylene oxide (PEO) and hydroxypropyl methylcellulose (HPMC) were investigated after coating. The analysis of the coating was performed by FTIR spectroscopy and water contact angle measurements. After exposing the coated tablets to 0.1 mol HCl, a more pronounced swelling was observed for the coated tablets based on HPMC than for the uncoated tablets. Furthermore, the spectral changes due to coating were retained after HCl exposition and subsequent drying, which hints at a resistance to gastric acids. These results are first indications that plasma treatment may potentially influence the drug release profile.

Author's statement

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