Challenges and Future Prospects for the Delivery of Biologics: Oral Mucosal, Pulmonary, and Transdermal Routes

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© 2017, American Association of Pharmaceutical Scientists. Biologic products are large molecules such as proteins, peptides, nucleic acids, etc., which have already produced many new drugs for clinical use in the last decades. Due to the inherent challenges faced by biologics after oral administration (e.g., acidic stomach pH, digestive enzymes, and limited permeation through the gastrointestinal tract), several alternative routes of administration have been investigated to enable sufficient drug absorption into systemic circulation. This review describes the buccal, sublingual, pulmonary, and transdermal routes of administration for biologics with relevant details of the respective barriers. While all these routes avoid transit through the gastrointestinal tract, each has its own strengths and weaknesses that may be optimal for specific classes of compounds. Buccal and sublingual delivery enable rapid drug uptake through a relatively permeable barrier but are limited by small epitheli