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An Overview on Drug Delivery through Oral Route: Advances, Challenges, and Future Prospects

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ABSTRACT

The most popular and extensively utilized medication administration technique is still oral drug delivery because of its high patient compliance, affordability, and ease of use. The method has a number of drawbacks despite these benefits, including first-pass hepatic metabolism, poor drug solubility, and enzymatic degradation. Pharmaceutical technological advancements have produced novel approaches to increase the efficacy and safety of medications taken orally, such as controlled-release formulations, mucoadhesive systems, and nanoparticles. The anatomy and physiology pertinent to oral drug delivery, variables influencing bioavailability, current technology developments, and prospective future directions are all covered in this article.

1. Introduction:

Approximately 60% of all marketed pharmaceutical medicines are administered orally, making it the most practical and widely used approach worldwide [1]. Benefits include decreased risk of infection, safety, and convenience of administration. However, problems such first-pass metabolism, restricted permeability, and drug degradation in the gastrointestinal (GI) tract might lower a drug's bioavailability and therapeutic effectiveness

2. GI Tract Anatomy and Physiology:

When it comes to the absorption of medications taken orally, the gastrointestinal system is essential. The small intestine is the primary site of drug absorption because of its huge surface area (~200 m2), abundant blood supply, and ideal pH range (pH 6–7.4). [4]. The stomach's acidic environment can break down sensitive medications, and it largely serves as a reservoir (pH 1-3) [5]. Absorption is also influenced by diet, GI motility, and drug dissolution [6].

3. Elements That Impact Oral Medication Administration:

3.1 Permeability and Solubility of Drugs For drugs to be effectively absorbed, they must have sufficient water solubility and membrane permeability. medications are divided into four classes by the Biopharmaceutics Classification System (BCS) according to their permeability and solubility; Class I medications are best suited for oral administration

3.2 The Stability of pH In the stomach, medications that are susceptible to acidic environments may break down, decreasing their effectiveness. These medications necessitate formulation changes or protective coverings [8].

3.3 Degradation by Enzymes Because peptide-based medications can be broken down by stomach enzymes like pepsin and small intestinal enzymes like trypsin, oral distribution of biologics like insulin can be difficult [9].

3.4 Initial Metabolic Process Many medications go through hepatic metabolism after absorption before reaching the bloodstream, which can drastically lower their bioavailability [10].

4. Methods to Enhance Oral Medication Administration:

4.1 Formulations Based on Lipids By encouraging lymphatic transport and avoiding hepatic metabolism, lipid-based carriers, such self-emulsifying drug delivery systems (SEDDS), improve the solubility and absorption of lipophilic medicines [11]. Microparticles and Nanoparticles

4.2 Nanotechnology has made it possible to create nanoparticles (10–1000 nm) that improve membrane permeability, prevent drug degradation, and permit targeted distribution [12].

4.3 Systems for Mucoadhesive Drug Delivery Mucoadhesive methods cling to the intestinal mucosa, increasing absorption and extending the duration of drug residence [13].

4.4 Tablets with an enteric coating Enteric coatings enable the delivery of medications into the gut while shielding them from stomach acid. These are particularly helpful for medications that are stomach-irritating or unstable at low pH [14].

5. Oral Dosage Forms with Controlled and Sustained Release:

In order to sustain therapeutic levels for prolonged periods of time, controlled-release formulations control the pace and site of medication release. Osmotic pumps, matrix tablets, and multiparticulate systems are a few examples. Chronic treatments for conditions including diabetes, hypertension, and mental illnesses benefit from these systems [15,]

6. Difficulties and Restrictions:

Because of poor permeability and enzymatic breakdown, oral administration of proteins, peptides, and big molecules is still challenging despite technological breakthroughs [17]. Drug absorption and bioavailability are further impacted by variations in GI physiology and dietary effects [18].

7. Prospects for the Future:

For accurate targeting and controlled release, future oral medication delivery systems are probably going to use nanorobotics, smart polymers, and 3D-printed tablets. The creation of customized oral formulations may be made possible by personalized medicine techniques that use genetic and microbiome data [19].

The most economical and patient-friendly method of medicine delivery is still oral. Many of the current obstacles can be addressed with continued research and development, enabling the very effective oral delivery of a wider variety of medications, such as biologics and peptides.

References

1. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, 11th Ed., 2021, Allen LV, et al.

2. Shargel ., Pharmacokinetics & Applied Biopharmaceutics, 8th Ed., 2022.

3. "Challenges and Approaches in Oral Drug Delivery." J Control Release, 2020;322:313–329; Patel A, et al.

4. "Drug Targeting : Approaches and Applications." Drug Deliv. 2003;10(1):19–31; Chourasia MK, Jain SK.

5. Dressman , "Dissolution Testing as a Prognostic Tool for Oral Drug Absorption."... In 1998, Eur J Pharm Biopharm, 45(3), 229–243.

6. Varum FJ, et al. "Gastrointestinal Transit of Pharmaceutical Dosage Forms in Humans." 2010;395(1-2):26–30; Int J Pharm.

7. Amidon G, "A Theoretical Basis for a Biopharmaceutic Drug Classification." 1995;12(3):413–420; Pharm Res.

8.. "Poor Aqueous Solubility—An Industry Wide Problem in Drug Discovery." Drug Discovery Today, 1(4), 2004: 337–341.

9. , Narang AS. Drug Delivery and Pharmaceutical Dosage Forms, CRC Press, 2011.

10. Varma MV, "Mechanisms of First-Pass Hepatic Metabolism." Drug Dispos. Biopharm. 2003; 24(6):263–273.

11. Pouton . "Lipid Formulations for Oral Administration of Drugs." S93–S98 in Eur J Pharm Sci. 2000;11 Suppl 2.

12. Müller CM. "Drug Nanocrystal Technology: Obstacles and Progress." 2004;113(1–3):151–170; J Biotechnol.

13. , G. P., and colleagues. "Mucoadhesive Polymeric Platforms for Controlled Drug Delivery." 2009; 71(3), Eur J Pharm Biopharm. 505–518.

14. , M., and associates. "Enteric-Coated Formulations and Drug Bioavailability." Clinical Pharmacokinet. 45(6), 535–555, 2006.

15. "Oral Controlled Release Formulations: Design and Optimization." Advances in Drug Delivery, 39(2–3):139–151, 2000.