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THE ROLE OF POLYMER-BASED DOSAGE FORMS IN ENHANCING PHARMACEUTICAL PRODUCT EFFICIENCY

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Relevance. Polymer-based dosage forms have become a key innovation in modern pharmaceutical development. They enhance drug stability, bioavailability, and controlled release, which increases therapeutic efficacy and reduces side effects. This thesis examines the physicochemical properties of polymers, their mechanisms of action in drug delivery, applications in different dosage forms, and their clinical and market relevance. The study integrates current scientific literature and practical examples to highlight their significance in pharmacy.

Improving drug efficacy and patient safety is a central goal in pharmaceutical sciences. Conventional dosage forms often face challenges such as poor solubility, low bioavailability, and unpredictable pharmacokinetics. Recent advances in polymer science offer innovative solutions. Polymers can modify drug release profiles, protect labile drugs from degradation, and target specific tissues, thereby increasing therapeutic outcomes.

The purpose of the study. To evaluate the effectiveness of polymer-based dosage forms in pharmaceutical products, their mechanisms, and clinical applications.

Research methods and tasks. Polymers used in pharmacy can be natural (e.g., chitosan, alginate) or synthetic (e.g., polyethylene glycol, polyvinylpyrrolidone). Their physicochemical properties directly influence drug performance: Molecular weight and chain structure affect viscosity, solubility, and controlled release. Hydrophilic polymers (e.g., HPMC) improve drug dissolution for poorly water-soluble drugs. Hydrophobic polymers (e.g., Eudragit) enable sustained release over hours or days. Biodegradability ensures polymers are safely metabolized or excreted without toxicity. Scientific studies show that polymer coatings can reduce enzymatic degradation, enhance intestinal absorption, and increase bioavailability by up to 50% for certain drugs (Kumar et al., 2021; Smith & Jones, 2020).

Applications in Dosage Forms. Oral Dosage Forms: Tablets and capsules coated with polymers achieve enteric protection, ensuring the drug reaches the intestine intact. Controlled-release formulations reduce dosing frequency and maintain therapeutic plasma levels. Topical and Oral Films: Polymer films release drugs locally, improving efficacy in oral mucosal diseases such as periodontitis. Adhesive polymer matrices prolong contact time with mucosa, increasing local drug absorption. Nanoparticulate Systems: Polymers are used to create nanoparticles, liposomes, or micelles for targeted drug delivery, minimizing systemic side effects. Example: PLGA nanoparticles loaded with anticancer drugs show enhanced tumor accumulation in preclinical studies (Zhang et al., 2019). Advanced Delivery Systems: Hydrogel-based polymer systems can provide pH-responsive release, delivering drugs specifically to desired regions of the gastrointestinal tract. Clinical and Market Relevance. Clinical benefits: Improved patient compliance, reduced dosing frequency, minimized side effects, and enhanced therapeutic index.

Market perspective: Polymer-based drugs represent a high-value segment due to

innovation, patent protection, and patient preference. Global polymer drug delivery market is projected to exceed \$30 billion by 2027 (GlobalData, 2023). Regulatory considerations: Polymers must meet pharmacopeial standards for safety, purity, and performance.

Conclusion. Polymer-based dosage forms significantly enhance pharmaceutical efficacy, safety, and patient compliance. Their versatility allows for tailored drug delivery solutions, from immediate to sustained and targeted release. Continued research and development of polymer technologies will remain a promising avenue in pharmaceutical innovation.

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