

**A REVIEW: THE ADVANCEMENT IN TABLET FORMULATION AND
MANUFACTURING TECHNOLOGIES FOR ENHANCED DRUG DELIVERY****K. Deekshitha*, Neefa and A. R. Shabaraya**

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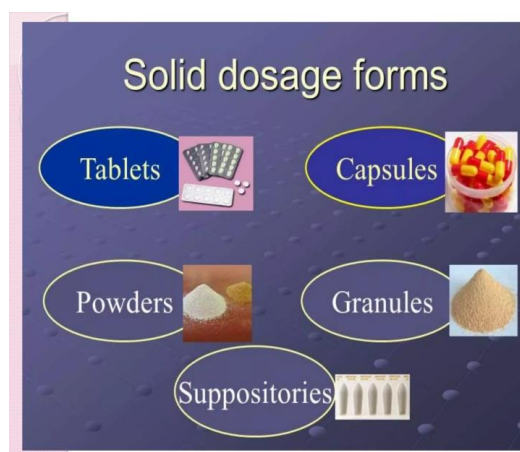
ABSTRACT

Tablets are widely used as solid oral dosage forms due to self-administration, stability, ease of handling, transportation, and good patient compliance. New excipients with functionalities like solubility enhancement and taste masking have been developed. Excipient selection for oral solid dosage forms is influenced by factors like desired pharmacokinetic performance. Novel, non-invasive methods have been created to assess tablet attributes. Some of the evaluations of tablets include dissolution, disintegration, porosity, density etc. Technological advances in tablet manufacturing, analytical techniques, analytical approaches, and tablet dosage form. Advancements and novel tablet technologies are reviewed in this article. These advances will contribute to creating excellent tablet dosage forms. The review focuses on advancements, approaches, novel tablet technologies, advancements in tablet dosage forms, and their applications in solid dosage forms.

KEYWORDS: Dosage form, Tablets, Advancement, Technology, Drug delivery.**INTRODUCTION**

The pharmaceutical industry continually evolves to enhance drug delivery systems, notably through oral administration using tablets, the most popular form due to convenience and manufacturing ease. Advancements include novel formulations like orodispersible and

bilayer tablets, alongside technologies like nanotechnology for improved solubility and targeted delivery. Challenges persist, such as drug stability and manufacturing costs, underscoring the importance of ongoing research and development.^[1]

**OBJECTIVES**

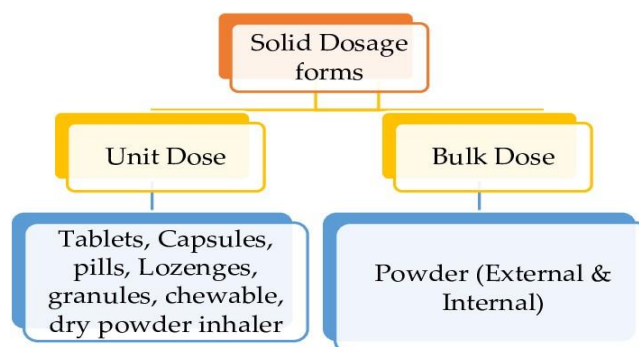
- Convenience and patient compliance.
- Accurate dosing and uniform drug content.
- Stability and shelf life.
- Improving in optimising therapeutic outcomes.

METHODOLOGY

A systematic literature search from 2010 to 2024 was conducted using databases like PubMed, Scopus, and Google Scholar with keywords including "tablet", "drug delivery" and "advancement". Inclusion criteria comprised articles focusing on Advancement of tablet

formulation, excluding pre-2010 publications, non-English articles, and studies unrelated to the

Advancements in tablet formulation and manufacturing technologies for enhanced drug delivery.^[2]



APPLICATION

- controlled release
- taste masking
- improved solubility
- site-specific drug delivery
- stability
- customized formulation.^[3]

TECHNOLOGIES

Novel Tableting Technologies

- Recent innovations include fast disintegrating, matrix, multi-layered tablets, and multiparticulate systems.
- These technologies aim to enhance product performance and formulation customization.

Advanced Analytical Approaches

- Physical-mechanical attributes of tablets like disintegration, porosity, and density are crucial quality indicators.
- Invasive traditional methods are being replaced by advanced, non-invasive techniques for real-time monitoring and quality control.^[4]

Tablet Dosage Form Advancements

- Tablets remain popular due to convenience, with improvements in excipients, manufacturing methods, and analysis approaches.
- Despite challenges, continuous enhancements aim to offer controlled release, taste masking, and site-specific drug delivery.

Excipient Advancements

- Functional excipients now enable drug release modulation, mucoadhesion for extended tablet residence time, taste masking, and solubility enhancement.
- Excipient selection for oral solid dosage forms is influenced by factors like desired pharmacokinetic performance.^[5]

Challenges related to Tablet in Tablet technology

- The cross contamination possibility between the layers.

- Between the adjacent layers, the elastic modulus is a mismatch. There are an inadequate layer attachment and relatively low interfacial strength because of the high elastic modulus ratio between neighboring layers.
- Face challenges for long term retaining physical and chemical integrity of device during its storage.
- Due to the large tablet size, it creates a swallowing problem.
- The difference in coating performance when the core tablet is not located in the center of the system.^[6]

Tablet in Tablet manufacturing process

Among all the available dosage forms, tablet is the most popular and convenient solid oral dosage form. Tablets are classified into various types; in one class of tablet, preparations are modified release dosage form that has added significance in drug therapeutics because it offers a variety of advantages. Nowadays, to develop modified released products, the Tablet in Tablet technology is the best alternative for bilayer tablet formulation for the incompatible drug. It involves the compression of granular materials around a preformed tablet core using specially designed tableting equipment. The Tablet in Tablet is also known as compression coating or solvent-free-coating technique.^[7]

The internal core and outer layer are the two parts of the Tablet in Tablet dosage form. The internal core is a small tablet and prepared by using a somewhat small size of tooling than tooling used for the preparation of the outer coat. After internal tablet core was produced, it is placed (centrally positioned) to another die which is moderately occupied with coating powder and which is larger than core tablet then the remaining amount of coating powder is placed on the top of core tablet and compressed resulting in the formation of tablet within tablet. This process leads to a problem like during the transfer of the core tablet into another die, it may be tilted. To achieve an immediate release product, generally the coat is water soluble and disintegrates easily after oral administration. The Tablet in Tablet can be utilized for the development of repeat action tablets in such a way that initially the external layer releases the initial dose of the drug while

the inner core releases later on. The repeat action Tablet in Tablet dosage form showing the risk of overdose toxicity because when the core tablet has rapidly discharged the drug which is completely attained dissimilar blood levels.^[8]

Recent advancement

Conventional dry-coating or Tablet in Tablet manufacturing methods depicted as above can create problems, like non-core, double-core, off-center, and inlay, caused by the core tablet transport system. Hence, dry coating or Tablet in Tablet is not as widely used as conventional tablets. The compression of the core tablet in advance is the primary requirement in the abovementioned method, so it will increase the overall manufacturing cost of the dosage form. To resolve the problems related to the manufacturing of conventional dry-coating methods or Tablet in Tablet formation, new one-step dry-coating equipment was introduced and has brought revolution in tablet manufacturing. With this technique, by changing the thickness of outer coating layer formulation, scientist made control over drug release.^[9]

Firstly the space made by lower center punch and lower outer punch is filled with outer coating layer powder, and then, it is precompressed by the upper center punch. Then, while the upper-center punch pushes the pre-compressed first-outer layer, the lower-center punch is slid down. The upper-center punch is then pulled away to make a space, which is filled with the powder for the core. This is then pre-compressed by the upper-center punch. Finally, the lower-outer punch is slid downward, and the powder for the second-outer layer fills and surrounds the pre-compressed core/first-outer layer. The core/first-outer layer and the second-outer layer complex are then compressed by the upper and lower punches, in which the center punches are unified with the outer punches, respectively.^[10]

CONCLUSION

The current review gathered information on the latest formulation, advantages, and disadvantages of Tablet in Tablet or compression coating. The review also elaborates on the importance of Tablet, Advancements in tablet formulation and manufacturing technologies have revolutionized drug delivery, offering improved efficacy, safety, and personalized treatment options for patients.

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