ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug729

Formulation Development and Evaluation of Nebivolol Hydrochloride Mouth Dissolving Tablets using Factorial Design

Umesh Sanjay Gohad[1]; S. B. Gondkar[2]

[1;2]Department of Pharmaceutics, KCT's R. G. Sapkal College of Pharmacy, Anjaneri, Nashik, India

Publication Date: 2025/08/25

Abstract: This study aimed to develop and evaluate mouth dissolving tablets (MDTs) of Nebivolol hydrochloride using a 3^2 factorial design approach. Nebivolol hydrochloride, a β1-selective adrenergic receptor blocker, was selected for its poor aqueous solubility and the need for rapid onset in hypertensive patients. Formulations were prepared by direct compression using Croscarmellose sodium and Microcrystalline cellulose as superdisintegrant and binder, respectively. Preformulation studies confirmed compatibility of drug and excipients. Nine formulations were developed and evaluated for pre-compression and post-compression parameters, including hardness, friability, drug content, disintegration time, and dissolution profile. The optimized formulation (F5) demonstrated a disintegration time of 18 seconds, hardness of 3.1 kg/cm², and >95% drug release within 15 minutes. ANOVA results indicated that both independent variables significantly affected disintegration time and hardness. Stability studies confirmed formulation robustness over 3 months at accelerated conditions. The study concludes that factorial design is an effective approach for developing stable MDTs of Nebivolol hydrochloride with rapid disintegration and enhanced patient compliance.

Keywords: *Nebivolol Hydrochloride; Mouth Dissolving Tablet; Factorial Design; Croscarmellose Sodium; Microcrystalline Cellulose.*

How to Cite: Umesh Sanjay Gohad; S. B. Gondkar (2025) Formulation Development and Evaluation of Nebivolol Hydrochloride Mouth Dissolving Tablets using Factorial Design. *International Journal of Innovative Science and Research Technology*, 10(8), 1116-1117. https://doi.org/10.38124/ijisrt/25aug729

I. INTRODUCTION

Oral drug delivery remains the most convenient and preferred route of administration, with solid dosage forms being the most widely used due to their stability, ease of administration, and cost-effectiveness. However, conventional tablets can pose swallowing difficulties, particularly in pediatric, geriatric, and bedridden patients. Mouth dissolving tablets (MDTs) offer an innovative solution, disintegrating rapidly in the oral cavity without the need for water. This not only enhances patient compliance but also improves bioavailability by facilitating partial absorption through the oral mucosa.

Nebivolol hydrochloride is a third-generation β1-selective adrenergic blocker with vasodilatory properties, used primarily for the treatment of hypertension. Its poor aqueous solubility and need for rapid onset make it an ideal candidate for MDT formulation. In this study, a 3^2 factorial design was employed to systematically evaluate the effect of Croscarmellose sodium and Microcrystalline cellulose concentrations on critical quality attributes such as disintegration time and hardness.

II. MATERIALS AND METHODS

Nebivolol hydrochloride was obtained as a gift sample from a pharmaceutical manufacturer. Croscarmellose sodium, Microcrystalline cellulose (MCC PH-102), mannitol, aspartame, magnesium stearate, and talc were procured from standard suppliers and used without further purification.

Formulations were prepared by direct compression method using a 3^2 factorial design. Two independent variables, Croscarmellose sodium (X1) and Microcrystalline cellulose (X2), were studied at three levels each. The dependent variables evaluated were disintegration time (Y1) and hardness (Y2). Accurately weighed ingredients were passed through sieve #60, blended in a tumbling mixer, and compressed into tablets using an 8 mm flat-faced punch.

Pre-compression parameters such as bulk density, tapped density, Carr's index, Hausner's ratio, and angle of repose were determined. Post-compression evaluations included hardness, friability, drug content, wetting time, water absorption ratio, disintegration time, and in vitro

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug729

dissolution using USP type II apparatus in pH 6.8 phosphate buffer.

III. RESULTS AND DISCUSSION

Preformulation studies confirmed the identity and purity of Nebivolol hydrochloride, with melting point and FTIR spectra consistent with literature. No significant interactions between drug and excipients were observed.

Pre-compression parameters indicated good flow properties, with Carr's index ranging from 11.3–14.8% and Hausner's ratio between 1.12–1.17. Post-compression evaluation showed tablet hardness between 2.9–3.4 kg/cm², friability below 0.7%, and drug content between 98.4–101.2%.

The disintegration time ranged from 14–28 seconds, with formulation F5 showing the fastest disintegration (18 s) and highest drug release (>95% within 15 min). ANOVA analysis confirmed that both Croscarmellose sodium and MCC significantly influenced disintegration time and hardness. Response surface plots indicated that increasing Croscarmellose sodium reduced disintegration time, while higher MCC levels slightly increased tablet hardness.

Stability studies performed at 40°C/75% RH for 3 months showed no significant changes in physical appearance, disintegration time, or drug release, indicating formulation stability.

IV. CONCLUSION

The present study successfully developed mouth dissolving tablets of Nebivolol hydrochloride using a 3^2 factorial design. The optimized formulation (F5) exhibited rapid disintegration, high drug release, and acceptable mechanical strength. Factorial design proved to be a valuable tool in optimizing the formulation variables. The developed MDT offers potential for improved patient compliance, particularly in populations with swallowing difficulties.

REFERENCES

[1]. Chang RK, Guo X, Burnside BA, Couch RA. Fast-dissolving tablets. Pharm Tech. 2000;24(6):52–58.
[2]. Seager H. Drug-delivery products and the Zydis fast-dissolving dosage form. J Pharm Pharmacol. 1998;50(4):375–382.
[3]. Abdelbary G, Eouani C, Prinderre P, Joachim J, Reynier JP, Piccerelle P. Determination of the in vitro disintegration profile of rapidly disintegrating tablets and correlation with oral disintegration. Int J Pharm. 2005;292(1-2):29–41.