***ABSTRACT***

*To accelerate the delivery of medical supplies during emergencies in remote or difficult-to-access areas, drone-based logistics offer a promising solution. However, drop-based delivery poses challenges in designing impact-resistant storage compartments. This study aims to optimize a capsule-shaped compartment that is both lightweight and durable by applying a biomimicry approach inspired by the trabecular bone structure. The design was evaluated through explicit dynamic simulation using Autodesk Nastran 2025. Design parameters including tube thickness and width of the trabecular-inspired multiscale structure were analyzed using the Taguchi method and Grey Relational Analysis (GRA) to handle multi-response optimization for displacement and strain values. The results indicate that the optimal configuration is achieved at a thickness of 2 mm and a tube width of 21.5 mm, producing the lowest displacement and strain, with the highest Grey Relational Grade (GRG) of 0.78. These findings provide a basis for developing efficient, safe, and impact-resistant drone compartments to support medical logistics in extreme terrains.*

***Keywords: Biomimicry, Trabecular Bone Structure, Drone Compartment, Grey Relational Analysis, Drop Test Simulation, Design Optimization.***