Nanosuspensions for Challenging Drugs using Amphiphilic Janus Dendrimers as Stabilising Agents

Telma A. Rodrigues[1,2], Sami Nummelin[3], Mauri Kostiainen[3], Vera Moura[4], Ana Fortuna[2,5], Luis M. Bimbo[1,2]

[1] Centre for Neuroscience and Cell Biology - Centre for Innovative Biomedicine and Biotechnology, PORTUGAL; [2] Faculty of Pharmacy, University of Coimbra, PORTUGAL; [3] BioHybrid Materials, Aalto University, FINLAND; [4] Basinnov Life Sciences, PORTUGAL; [5] Coimbra Institute for Biomedical Imaging and Translational Research, PORTUGAL

1 INTRODUCTION

Poor solubility and instability continue to limit the bioavailability of many drugs [1]. Nanosuspensions offer a way to address these challenges, but their performance relies heavily on the choice of stabiliser [2]. Conventional agents often struggle to maintain long-term stability across different drug types [2]. Amphiphilic Janus dendrimers (JDs) provide tunable architectures and have already shown superior stabilisation in drug suspensions [3].

This project develops JD-based nanosuspensions for ceftazidime, ampicillin and glucagon to establish structure-activity relationships and improve formulation stability.

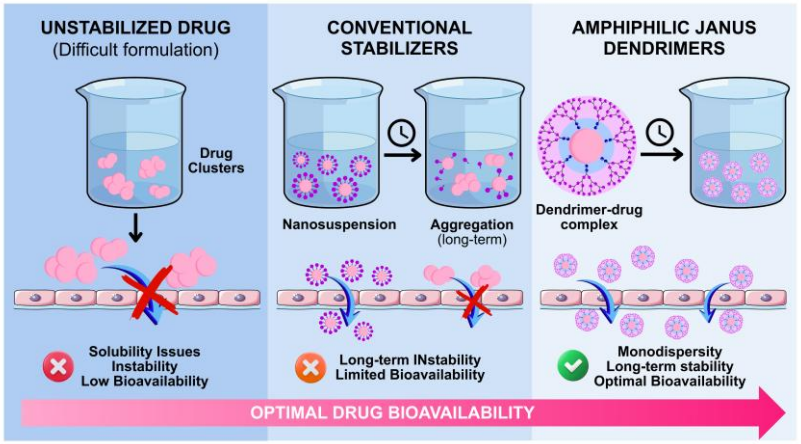

Fig. 1 Targeting formulation and bioavailability challenges using amphiphilic Janus dendrimers as stabilising agents in drug-based nanosuspensions.

2 METHODS

G4 Janus dendrimers will be synthesised using click chemistry and characterised by NMR, MALDI-TOF, DSC, TGA, surface tension analysis and CAC. The model drugs will be assessed for polymorphism, dissolution, lipophilicity and surface energy.

Nanosuspensions will be produced by wet ball milling under a design-of-experiments approach. Their performance will be evaluated through stability studies, particle size, zeta potential, SEM-EDS and ATR-FTIR. Dissolution testing, pharmacokinetic studies in rodents and an industrial scale-up assessment will complete the workflow.

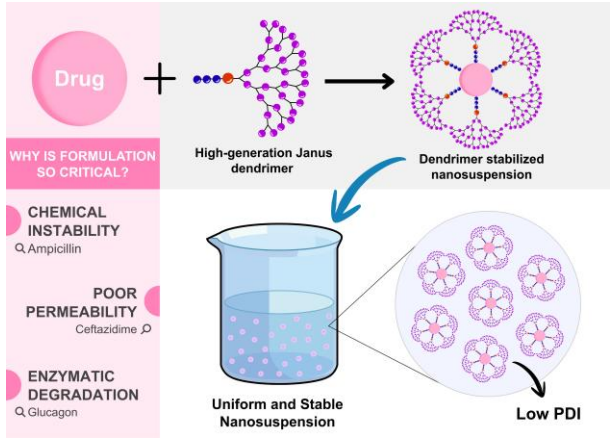

Fig. 2 Formulation strategy using Janus dendrimers to achieve enhanced stability and uniformity in nanosuspensions. To explore some of the key challenges many drugs face, we select three model drugs - ampicillin, ceftazidime and glucagon peptide. The effects of dendrimer-stabilised nanosuspensions can thus be assessed regarding chemical instability, poor permeability and enzymatic degradation, respectively.

3 EXPECTED OUTCOMES

The project is expected to generate a diverse library of G4 Janus dendrimers with tunable amphiphilicity. These structures are anticipated to produce nanosuspensions with reduced particle growth, improved wettability and enhanced dissolution compared with standard stabilisers.

Mechanistic studies will help clarify how branching pattern and hydrophilic-hydrophobic balance influence drug–surface interactions. Predictive models linking JD structure to drug properties such as logP, pKa, surface energy and crystallinity will support rational design.

Pharmacokinetic studies are expected to demonstrate improved oral bioavailability for selected formulations. Industrial feasibility work will outline scale-up needs and regulatory considerations to support future translation.

4 SIGNIFICANCE

Amphiphilic Janus dendrimers show strong potential as stabilisers for nanosuspensions of chemically diverse drugs. By combining synthesis, mechanistic insight, formulation optimisation and preclinical evaluation, this project aims to build a predictive framework for JD-based nanosuspensions and support their progression towards industrial application.

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