SNEDDS present a promising solution for enhancing the bioavailability of poorly soluble drugs

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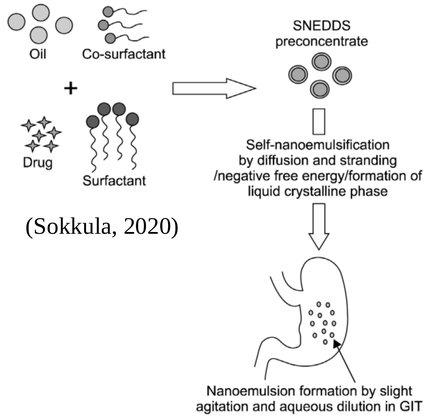
Abstract

Around 70% of newly developed drugs suffer from poor solubility, limiting their efficacy, dosage portability, and therapeutic outcomes. Lipid-based drug delivery systems have been extensively studied for their ability to enhance drug solubility, permeability, and bioavailability. Self-nanoemulsifying drug delivery systems (SNEDDS) are particularly effective for oral administration of hydrophobic drugs, especially class II (low solubility, high permeability) and class IV (low solubility, low permeability) drugs. SNEDDS work by spontaneously forming a nanocarrier composed of oil, surfactant, and co-surfactant around the active drug ingredient. This review discusses the preparation, components, mechanisms, and clinical applications of SNEDDS for better-regulated administration of poorly soluble pharmaceuticals. Key conclusions highlight that SNEDDS formulations can enhance the release rate of specific drugs and yield more promising outcomes in achieving a drug's intended and desired effects compared to conventional approaches. Future directions involve exploring alternative routes of administration, focusing on intranasal delivery to bypass the blood-brain barrier.

Introduction



(Sokkula, 2020)

- Mixture of oils, surfactants, cosurfactants, and active drugs
- Long-chain-triglycerides as the oil enhances drug dispersal
- Surfactants reduce surface tension to aid emulsion formation, nonionic surfactants preferred for safety (ex: Tween 80)
- Cosurfactants Stabilize the emulsion while ensuring optimal drug dispersal and packaging compatibility (ex: Butanol)
- Spontaneously form stable oil-in-water nanoemulsions in gastrointestinal fluids

Results

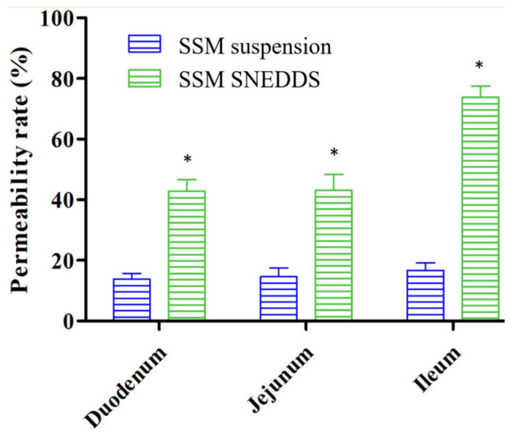


Figure 1. Comparative in vitro permeability evaluation of SSM suspension and SSM-SNEDDS in various small intestinal components (Wang, 2020). SSM stands for sesamin, which is a blood pressure medication* Indicates $p < 0.001$, compared to SSM suspension results

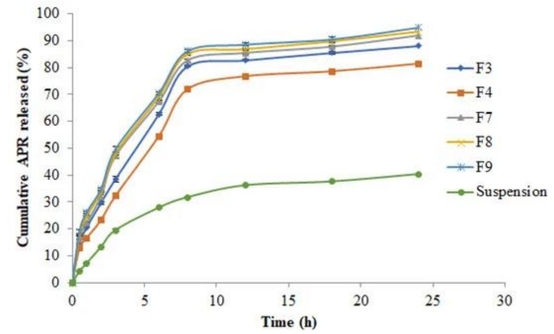


Figure 2. Cumulative APR released overtime from prepared APR-SNEDDS and APR suspension (Abushal, 2022) APR stands for Apremilast, a medication taken for arthritis

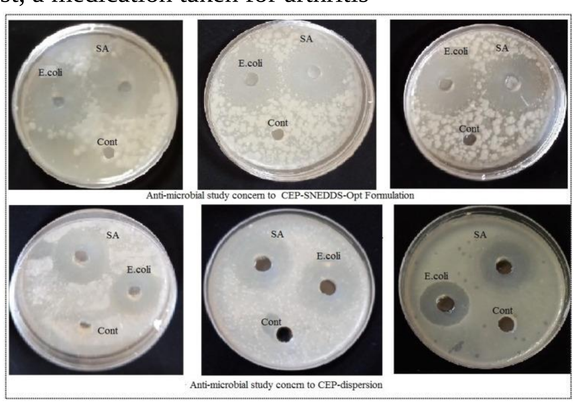


Figure 3. Comparison of antimicrobial activity between CEP-SNEDDS (top) and CEP-suspension (bottom) (Zafar, 2022). CEP stands for Cephalexin, an oral antibiotic.

Discussion

- **Improved Pharmacokinetics**: SNEDDS enhances the pharmacokinetics of the administered drug, reducing the frequency of required dosages.
- **Increased Intestinal Permeability**: SNEDDS significantly boosts drug permeability in the small intestine, with a notable effect in the ileum.
- **Higher Release Rate**: SNEDDS exhibit a significantly higher release rate (approximately 10% more) compared to drug suspensions, maintaining consistent release without plateauing.
- **Enhanced Antibacterial Efficacy**: Poorly soluble antibiotics loaded into SNEDDS are more effective at hindering bacterial growth, demonstrated by larger zones of inhibition compared to antibiotic suspensions.
- **Enhanced Water Solubility and Bioavailability**: Overall, SNEDDS is crucial for improving the water solubility and oral bioavailability of poorly water-soluble drugs.
- Drug enzymatic degradation of inhibitors (ex: hormones, peptides, enzyme substrates) can be reduced by converting SNEDDS to a solid form

Future Directions

• Explore spray drying techniques using Aerosil 200 to extend SNEDDS shelf life (Nasr, 2016; Rajesh et al., 2018) by preventing active drug degradation by enzymes
• Investigate intranasal delivery for SNEDDS to directly target CNS active drugs more effectively
• Bypassing the blood-brain barrier (Meirinho, 2022)
• Utilizing pharmacogenomic insights to better understand if genetic predisposition has effect on SNEDDS optimization
• Transition findings from animal models to human applications for accurate and relevant clinical representation.

Acknowledgments

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