UNIVERSITÀ DEGLI STUDI DI SALERNO

Department of Industrial Engineering

Master's Degree in Food Engineering

Curcumin nanoprecipitation in coaxial jet mixer: experiments and modeling

Thesis in

Transport Phenomena

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“Non fermatevi là dove siete arrivati.” (Pitagora)

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Tables of contents

Table of figures

Table of tables

Abstract

This thesis discusses about relationship between fluid dynamics conditions within a coaxial jet mixer and the resultant production of curcumin nanoparticles. Curcumin, a potent bioactive compound derived from turmeric, exhibits immense therapeutic potential but faces substantial challenges in its pharmaceutical application due to its poor water solubility and aggregation tendencies. The primary objective of this research is to investigate how different fluid dynamics parameters, such as flow rate, influence the size, morphology, and distribution of curcumin nanoparticles produced in a coaxial jet mixer. The study observes a recurrent issue in curcumin nanoparticle production: the nanoparticles display high instability characterized by the aggregation phenomenon. To address this challenge, the research delves into the potential of polyvinylpyrrolidone (PVP). PVP is a widely employed polymer known for its exceptional stabilizing properties in nanoparticle formulations. Through a series of experimental investigations, this study seeks to determine the optimal conditions for incorporating PVP into the curcumin nanoparticle synthesis process, ultimately aiming to mitigate aggregation and enhance the stability of the nanoparticles. In addition to experimental work, this research employs computational modeling tools, particularly COMSOL Multiphysics®, to establish a comprehensive understanding of the impact of different fluid dynamic conditions on the growth of curcumin nanoparticles. The numerical simulations will provide valuable insights into the complex interplay between fluid dynamics and nanoparticle formation, allowing for the prediction and optimization of curcumin nanoparticle production under various operational conditions. The findings of this thesis not only contribute to the fundamental understanding of curcumin nanoparticle synthesis but also hold significant implications for the pharmaceutical industry, offering a pathway towards the development of stable and bioavailable curcumin-based formulations with enhanced therapeutic

efficacy. Ultimately, this research bridges the gap between fluid dynamics, nanotechnology, and pharmaceutical science, offering valuable insights into the production and stabilization of curcumin nanoparticles.

Chapter One

Introduction

This chapter presents an overview of the nanoparticles, especially curcumin based. The synthesis techniques, the applications, and the stabilization phenomenon, from literature, are discussed. Finally, the aims of the thesis work are reported.

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