Green manufacturing process using spinning disc system for preparation of acetalated maltodextrin nanoparticles

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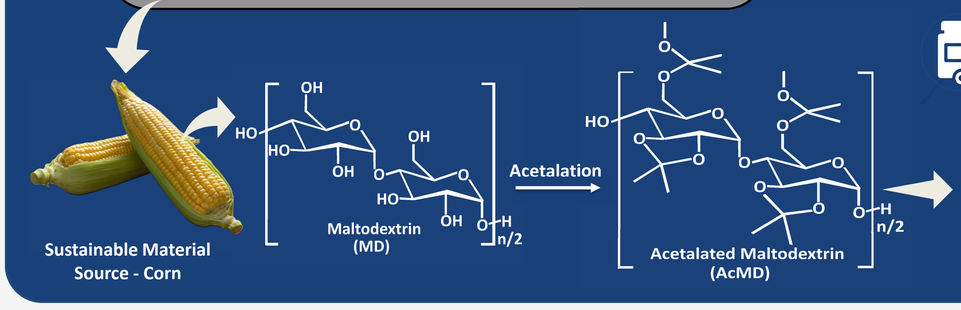
Introduction

Reducing the CO_2 emisssion of manufacturing process of nanoparticles by developing a greener process using
- **Spinning disc system (SDS), and**
- **Sustainable material source**

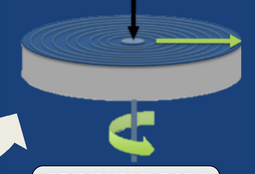


FOCUS OF THIS RESEARCH

- **Develop a green manufacturing process for Acetalated maltodextrin nanoparticles**
- **Spinning disc system to control the particle size of nanoparticles and improve encapsulation efficiency.**
- **Using acetalated maltodextrin as green material source to release the drug into target site of action.**
- **To encapsulate hydrophobic drugs.**

PACLITAXEL – DRUG OF CHOICE
Very effective chemotherapeutic agent.
Effective against lung, ovarian, and breast cancer.
Very hydrophobic and very low bioavailability.
POTENTIAL TO IMPORVE ENCAPSULATION WITH SDS AND HAVE TARGET RELEASE WITH AcMD

NANOPRECIPITATION + **SPINNING DISC SYSTEM**

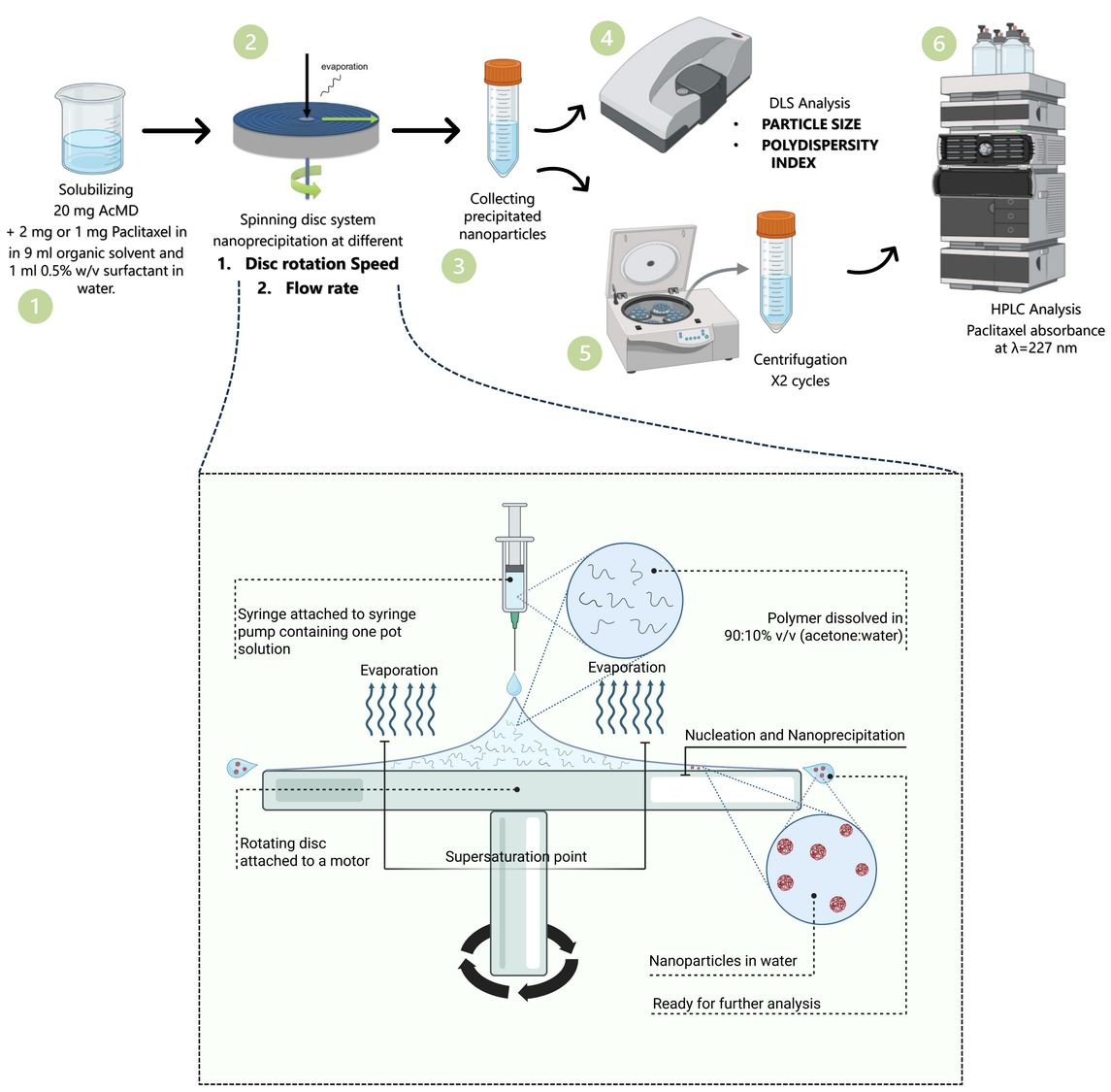


ADVANTAGES OF USING SPINNING DISC SYSTEM

- HOMOGENOUS NANOPARTICLES
- VERY SIMPLE & FAST PROCESS
- POSSIBLY HIGHER ENCAPSULATION
- TUNABLE NANOPARTICLES
- LOW AMOUNT OF ENERGY REQUIRED

Methods

1. AcMD nanoparticles preparation with spinning disc system with Paclitaxel



Sketch 1. Illustration of the lateral view of the spinning/rotating disc.

Results

1. Tunable nanoparticles size using SDS

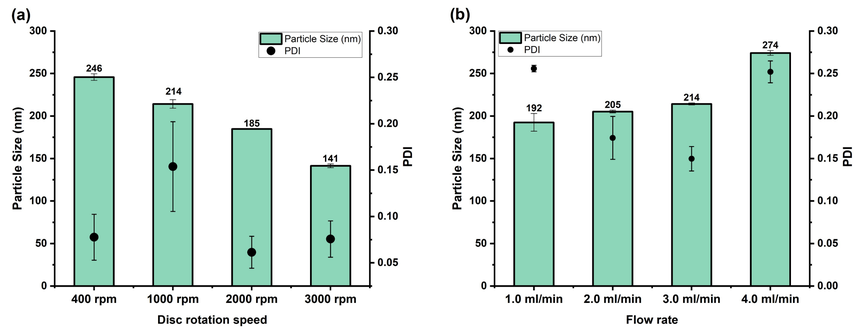


Figure 1: Particle size and PDI of AcMD produced using spinning disc system. (Mean ± SD, n=3) (n=3 represents 3 DLS measurements)

- **Tunable AcMD nanoparticles** were successfully produced.
- Increasing the disc rotation speed produced **smaller nanoparticles**.
- Increasing the flow rate produced **bigger nanoparticles.**

2. Paclitaxel loaded AcMD nanoparticles

- **Paclitaxel loaded AcMD nanoparticles** were prepared successfully.
- AcMD nanoparticles with Poloxamer P407 show **highest encapsulation efficiency of around 90%.**
- Very **high drug loading** is achieved i.e., around **7.0 to 9.0 %** calculated from EE.
- AcMD nanoparticles prepared **without stabilizer** also showed high encapsulation of **around 80%.**

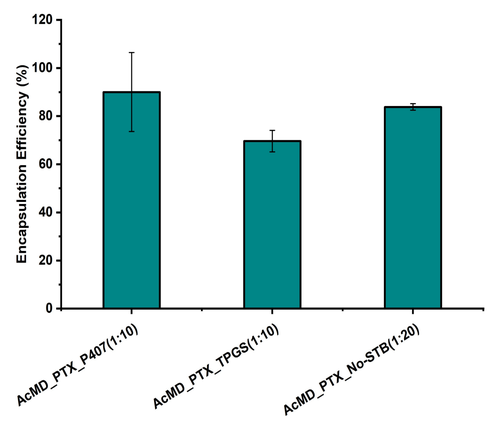


Figure 2: Encapsulation efficiency of paclitaxel in AcMD nanoparticles. (Mean ± SD, n=2)

3. SEM images of AcMD nanoparticles

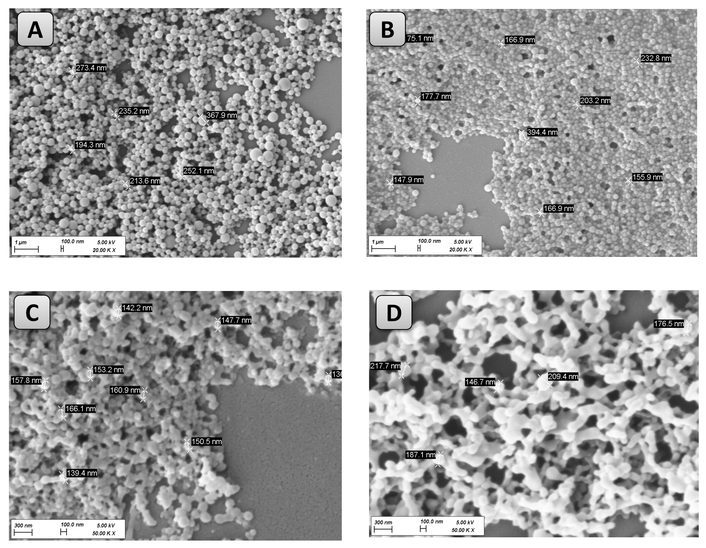


Figure 3: Scanning electron microscopic images of AcMD nanoparticles a) Blank (*20 kX* magnification), b) blank (*20 kX* magnification) c) with Paclitaxel and TPGS (*50 kX* magnification), and d) with Paclitaxel without stabilizer (*50 kX* magnification).

- SEM images of blank AcMD nanoparticles **confirm the DLS** results.
- SEM pictures also show **homogenous nanoparticles.**
- SEM images of paclitaxel loaded nanoparticles also shows homogenous nanoparticles, where **free crytals of Paclitaxel were not observed**. Which proofs that Paclitaxel is encapsulated inside AcMD nanoparticles.

Conclusion & Outlook

Acetalated maltodextrin nanoparticles prepared with spinning disc system represents a versatile drug delivery platform combining:

- By integrating functional polymer chemistry with tunable nanoparticles' size through spinning disc system, strong potential for future nanomedicine and drug delivery applications is offered
- Simplicity, no requirement for removing solvent, and low energy requirement of spinning disc system makes the process very green.
- Using AcMD as a polymer providing pH responsive degradation could give precise control over the stability under physiological condition and release mechanism.

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