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# Development of Electrosprayed Particles from Chitosan and Soy Protein Isolate for Drug Delivery


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## INTRODUCTION & AIM

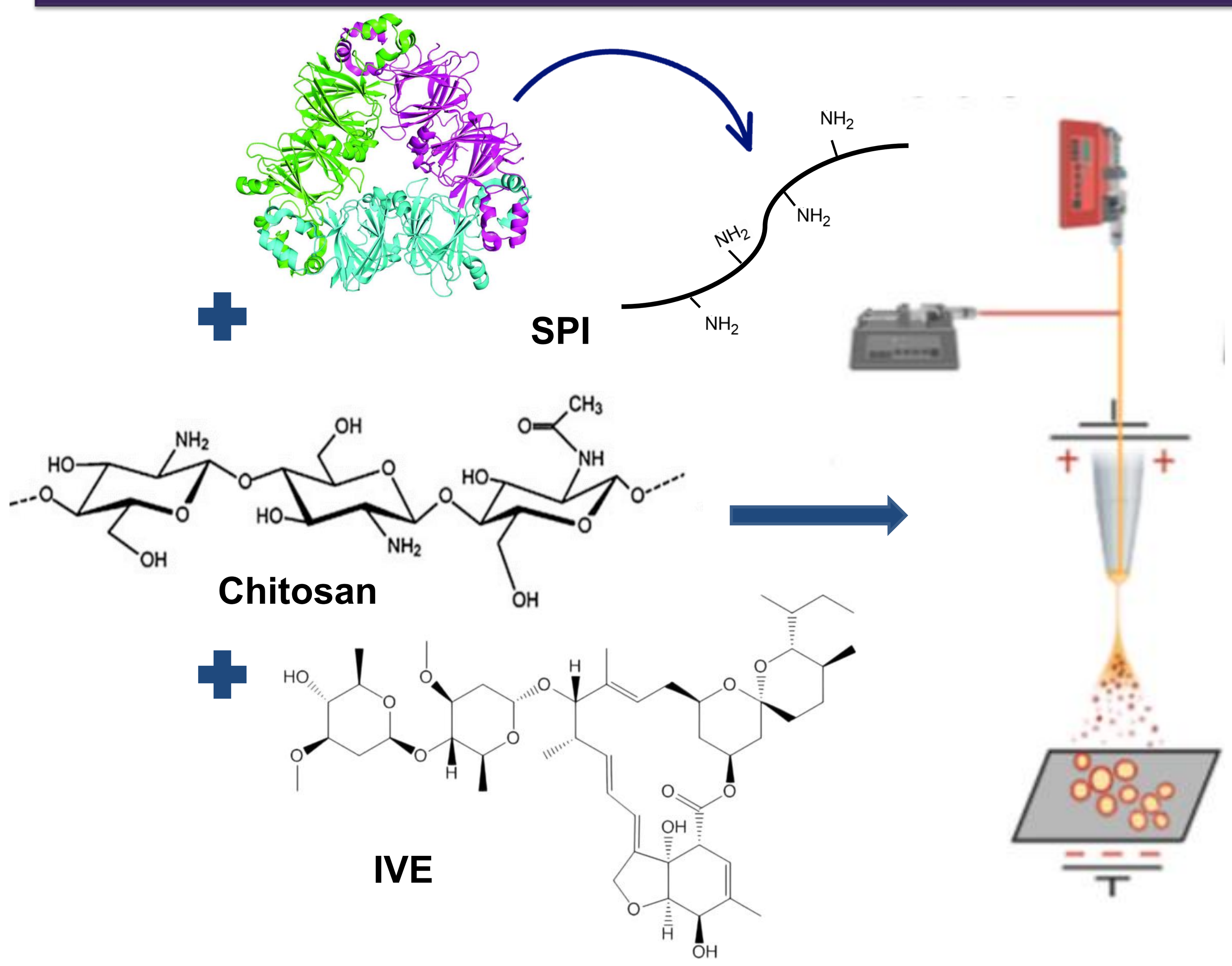
In this study, we selected two biopolymers for microparticle production: chitosan, obtained in our laboratory from industrial shrimp exoskeleton waste collected in Mar del Plata, and soy protein isolate (SPI), derived from the byproducts of soybean oil extraction. Both biopolymers represent an opportunity to promote a circular economy. The polymeric microparticles fabricated using the electrospray technique offer several advantages for biomedical applications, particularly in controlled drug delivery. This technology aims to overcome challenges associated with the administration of therapeutic agents characterized by low water solubility and high toxicity, such as the antiparasitic Ivermectin (IVE). Encapsulation strategies based on this approach can significantly reduce toxicity risks and treatment costs, while enabling the development of patient-specific therapies.

## METHODS

### Chitosan synthesis

**Industrial shrimp exoskeleton waste**

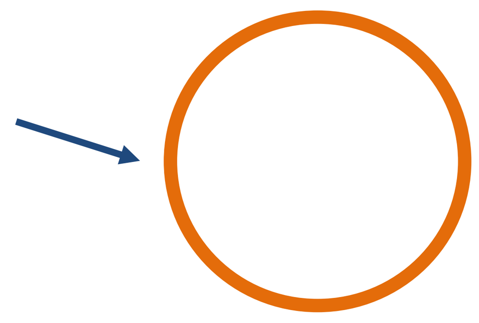
1. **Demineralization**
   HCl 1.5 mol/L, 75 min, 20°C
2. **Deproteinization**
   NaOH 4.5 % w/v, 3 h, 80°C
3. **Deacetylation**
   NaOH 50% w/v, 2 h, 120°C




### Electrospray

**Uniaxial**

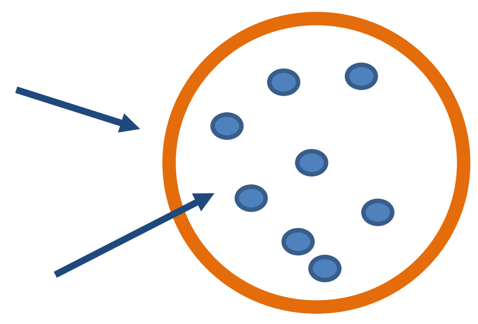
SPI + QO in acetic acid 10 mol/L



**Coaxial**

SPI + QO in acetic acid 10 mol/L

IVE 10% w/w in acetic acid/dicloromethane (80:20)



**Processing conditions:**
Distance (cm): 10, 15, 20
Voltage (kV): 8.5, 10, 12.5, 15, 17.5, 20, 22.5
Temperature (°C): 24-25
Humidity (%): 31-34

## RESULTS & DISCUSSION

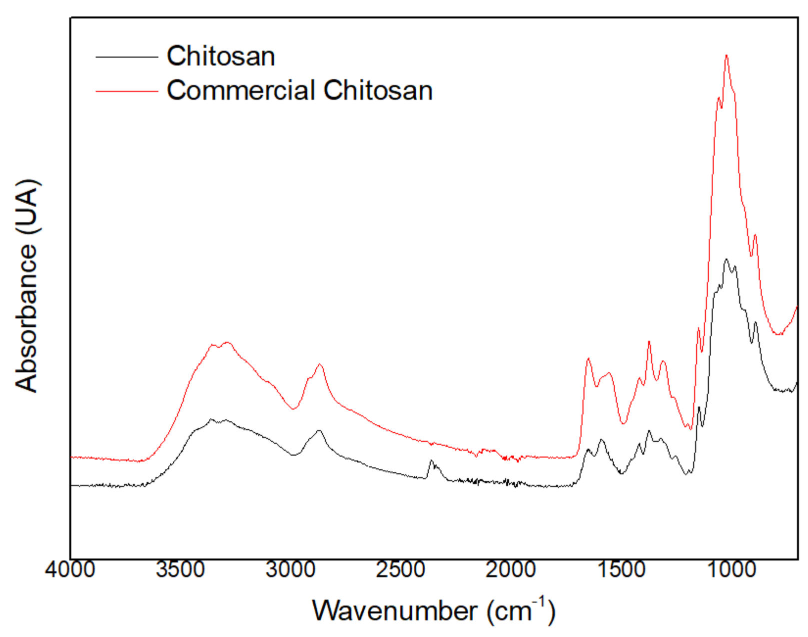



FIGURE 1: ATR-FTIR Spectra of chitosan and commercial chitosan (Sigma-Aldrich)

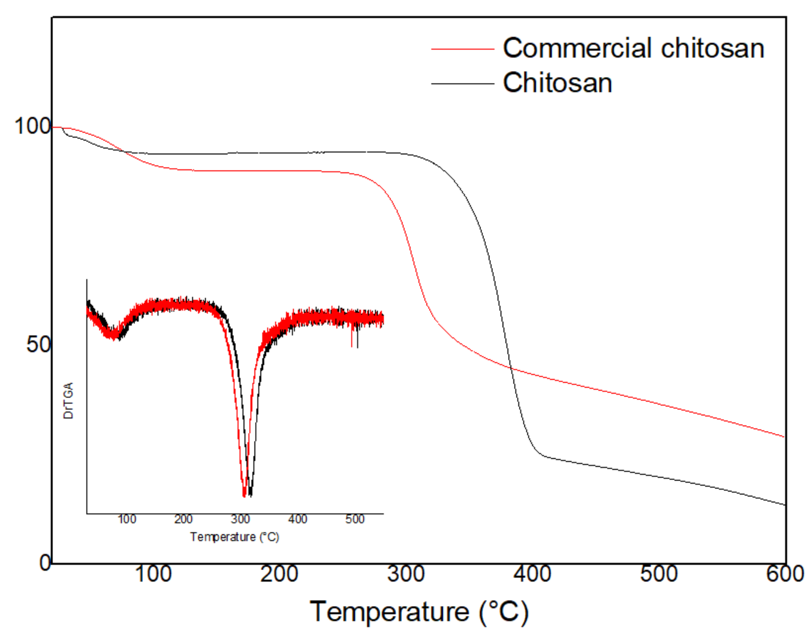



FIGURE 2: TGA thermogram of chitosan and commercial chitosan (Sigma-Aldrich)

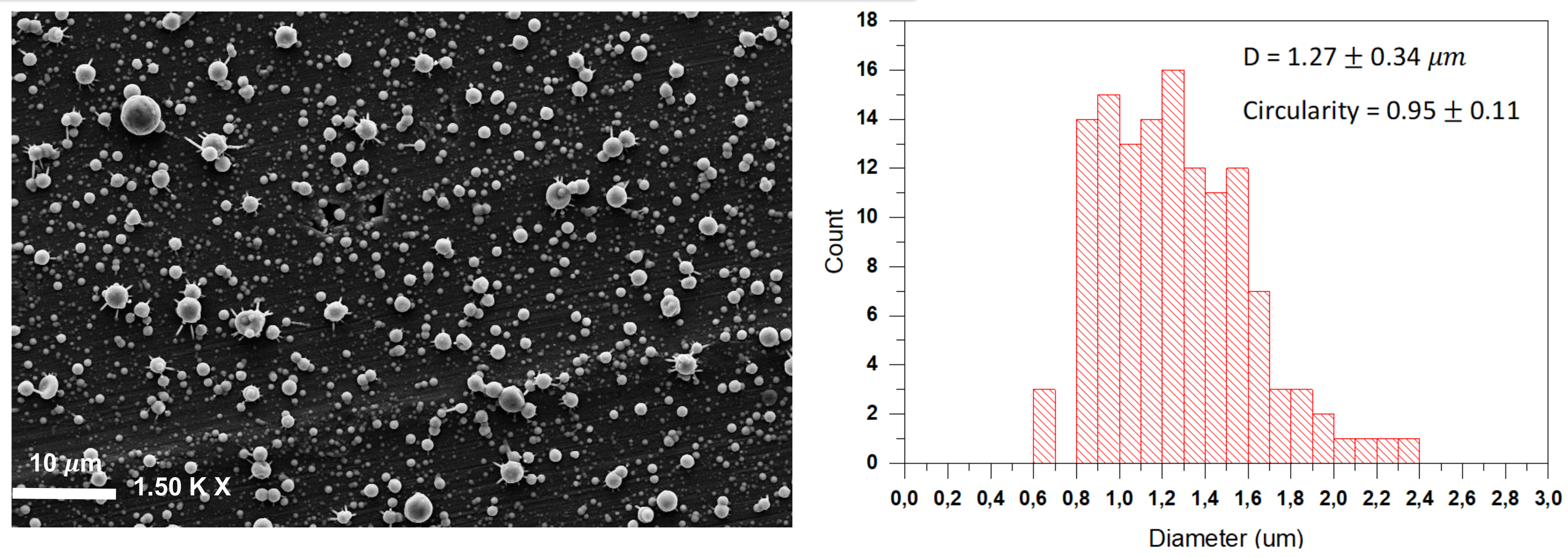



FIGURE 3: SEM micrograph of the particles and distribution of particle diameters (D) obtained under uniaxial condition at 20 kV and 20 cm.

TABLE 1: Results of characterization of chitosan

| Characterization and properties of chitosan | |
|---|---|
| **Reaction yield (%)**<br>Chitin/ Shrimp exoskeleton waste | 26.2 |
| **Reaction yield (%)**<br>Chitosan/Chitin | 75.3 |
| **Reaction yield (%)**<br>Chitosan/ Shrimp exoskeleton waste | 19.70 |
| **Deacetylation degree (%)**<br>*(Potenciometric titration)* | > 90 |
| **Viscosity-average molecular weight - Mv (kDa)**<br>*(Capillary viscosimetry)* | 211 |

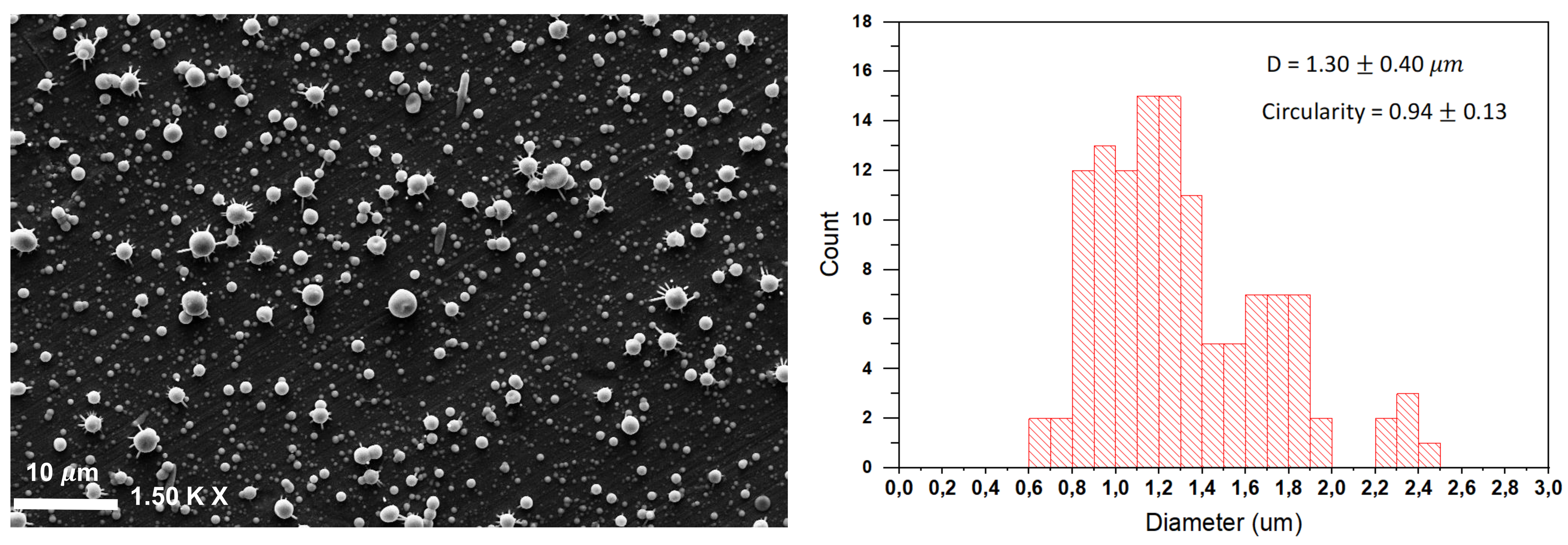



FIGURE 4: SEM micrograph of the particles and distribution of particle diameters (D) obtained under coaxial condition at 20 kV and 20 cm.

## CONCLUSION

Chitosan with a high degree of deacetylation was successfully synthesized and, along with SPI and IVE, utilized for particle fabrication via the electrospray technique. Both uniaxial and coaxial configurations were explored by varying the applied voltage and the needle-to-collector distance. In both configurations, the optimal parameters were determined to be 20 cm and 20 kV (Figures 3 and 4).

## FUTURE WORK

We are currently in the processing stage, with efforts focused on evaluating the ivermectin release kinetics and the physicochemical characterization of the particles.