

FORMULATION OF CANNABIDIOL-LOADED MICRO/NANOPARTICLES VIA ELECTROSPRAY TECHNIQUE

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Introduction

This study was conducted to increase the low solubility of cannabidiol (CBD), which therapeutic use is limited due to low solubility (0.714 µg/mL) and bioavailability. Using the electrospray method, which enables the production of micro/nanoparticles in solid form by creating fine droplets under high voltage, the aim was to develop CBD-loaded, homogeneous, and controlled-release particulate systems (1).

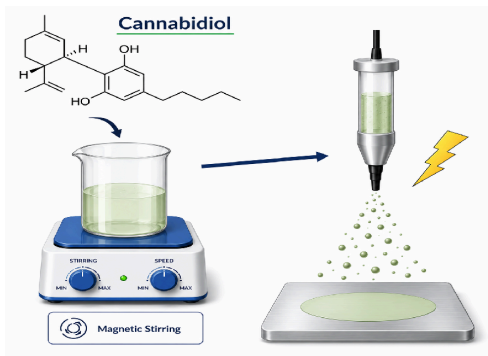


Figure 1: Schematic Representation of Electrospayed CBD Nanoparticle Fabrication

Methodology

Micro/nanoparticles containing 1% CBD were prepared by dissolving them in different polymer solutions such as PVP 40000, Poloxamer® 407, Lutrol® F68, and Soluplus®, and particle production was carried out using the electrospray method (Table 1). The morphology of the obtained particles was examined using scanning electron microscopy (SEM). The particles were soaked in distilled water and ethanol at 37°C for 24 hours, and then solubility increases and % encapsulation efficiencies were determined using a validated HPLC method.

Table 1. Composition of formulations

FORMULATION CODE	CBD	PVP 40000	POLOXAMER 407	LUTROL F68	SOLUPLUS
NP 1	1%	15%	2,5%	-	-
NP 2	1%	15%	5%	-	-
NP 3	1%	15%	-	2,5%	-
NP 4	1%	15%	-	5%	-
NP 5	1%	15%	-	-	2,5%
NP 6	1%	15%	-	-	5%

Results

The viscosity, conductivity, and surface tension of the polymer solutions varied depending on the formulation composition. All formulations demonstrated a significant enhancement in CBD solubility, while encapsulation efficiencies exceeded 75% (Table 3). Furthermore, increasing the concentration of amphiphilic solubility enhancers such as Soluplus® affected particle morphology during the electrospaying process, leading to the formation of fibrous structures in some formulations. This phenomenon is thought to be associated with enhanced polymer chain interactions and increased viscoelastic properties of the solutions. In addition, increasing the concentrations of Lutrol® F68, Poloxamer 407, and Soluplus® resulted in larger particle sizes, which may be attributed to the increased solution viscosity and alterations in jet behavior during electrospaying (Table 2).

Table 2. Physicochemical properties of NP formulations

FORMULATION CODE	Viscosity (mPa·s)	Conductivity (µS/cm)	Surface Tension (mN/m)
NP 1	29.916 ± 0.663	0.978 ± 0.132	29.24 ± 0.07
NP 2	29.893 ± 0.245	108 ± 3.176	27.93 ± 0.09
NP 3	14.666 ± 0.221	44.623 ± 3.312	30.95 ± 0.54
NP 4	28.66 ± 0.220	8.458 ± 0.297	29.68 ± 0.24
NP 5	26.573 ± 0.295	1.194 ± 0.304	28.01 ± 0.007
NP 6	39.616 ± 0.172	20.436 ± 0.893	28.21 ± 0.004

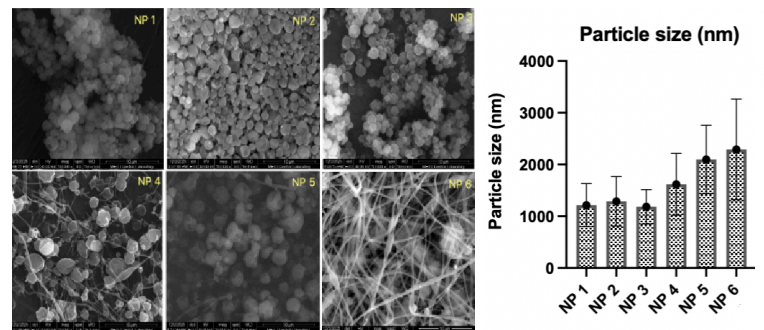


Figure 2: SEM images and particle size analyses results

Table 3. Increase in solubility and % encapsulation efficiency values of the prepared particles

FORMULATION CODE	% EE	SOLUBILITY INCREASE (X-times)
NP 1	76,27	3068,69
NP 2	96,05	3007,07
NP 3	80	2227,68
NP 4	90,23	2235,73
NP 5	91,47	1325,69
NP 6	86,09	235,29

Conclusion

CBD-loaded micro/nanoparticles have been successfully produced using the electrospray method. The high encapsulation efficiency values of the prepared particles and the sharp increase in their solubility values are expected to increase bioavailability under in vivo conditions.

Acknowledgements

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References

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