OPTIMASI DAN KARAKTERISASI *NANOSTRUCTURED LIPID CARRIER L-DOPA-PALM OIL-STEARIC ACID* (NLC-DPS) SEBAGAI KANDIDAT OBAT PARKINSON

SKRIPSI

Diajukan untuk memenuhi sebagai syarat untuk memperoleh gelar Sarjana Sains pada Program Studi Kimia

Oleh:
Muhammad Naufal Mutawakkil
2106459

PROGRAM STUDI KIMIA
FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS PENDIDIKAN INDONESIA
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Universitas Pendidikan Indonesia

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LEMBAR PENGESAHAN

MUHAMMAD NAUFAL MUTAWAKKIL

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Disetujui dan disahkan oleh pembimbing:

Pembimbing I

Prof. Dr. Ratnaningsih Eko Sardjono, M.Si.
NIP. 196904191992032002

Pembimbing II

Prof. Dr. Asep Kadarohman, M.Si.
NIP. 196305091987031002

Mengetahui,
Ketua Program Studi Kimia FPMIPA UPI

Prof. Fitri Khoerunnisa, M.Si, Ph.D
NIP. 197806282001122001

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ABSTRAK

Penanganan penyakit Parkinson memanfaatkan L-Dopa sebagai prekursor dopamin. Namun, karena stabilitas dan bioavailabilitas L-Dopa yang rendah, diperlukan sistem penghantaran yang lebih efektif seperti *Nanostructured Lipid Carrier* (NLC). Penelitian ini bertujuan untuk memperoleh formulasi *Nanostructured Lipid Carrier L-Dopa-Palm Oil-Stearic Acid* (NLC-DPS) yang optimal. NLC-DPS disintesis melalui homogenisasi panas dan ultrasonikasi dengan memvariasikan perbandingan lipid, waktu dan *power rate* ultrasonikasi. Karakterisasi mencakup pengukuran ukuran partikel, indeks polidispersitas, zeta potensial, morfologi, dan identifikasi gugus fungsional. Efisiensi penjebakan, pemuatan obat dan pelepasan obat dianalisis menggunakan UV-Vis. Hasil menunjukkan bahwa formulasi terbaik didapatkan pada perbandingan asam stearat dengan minyak sawit 1:9 dan ultrasonikasi selama 80 menit dengan *power rate* 50%. Produk ini memiliki ukuran partikel rata-rata 87.9 ± 0.80 nm, PDI 0.229 ± 0.06, dan zeta potensial −38.63 ± 0.80 mV. Spektrum FTIR menunjukkan interaksi L-Dopa dengan lipid melalui ikatan N-H, C=O, dan O-H. Morfologi dengan TEM dan SEM-EDS menampilkan partikel berbentuk *spherical*. Pemetaan EDS menunjukan distribusi karbon (66.63%), oksigen (23.61%), dan nitrogen (9.77%). Formulasi ini memiliki efisiensi penjebakan sebesar 16.64% dan pemuatan obat sebesar 0.185%. Profil pelepasan obat pada pH 1.2 dan 7.4 menunjukkan pola pelepasan lambat selama 8 jam, dengan total pelepasan sebesar 5.36% dan 19.4%. Berdasarkan parameter-parameter tersebut, formulasi NLC-DPS diindikasikan cukup potensial sebagai sistem penghantaran obat untuk L-Dopa.

Kata Kunci: Parkinson, L-Dopa, *Nanostructured Lipid Carrier*, Minyak Sawit, Asam Stearat.

ABSTRACT

The treatment of Parkinson's disease employs L-Dopa as a dopamine precursor. However, due to the low stability and bioavailability of L-Dopa, a more effective delivery system such as a Nanostructured Lipid Carrier (NLC) is required. This study aimed to obtain an optimal formulation of Nanostructured Lipid Carrier L-Dopa–Palm Oil–Stearic Acid (NLC-DPS). NLC-DPS was synthesized through hot homogenization and ultrasonication by varying the lipid ratio, power rate and ultrasonication time. Characterization included particle size, polydispersity index, zeta potential, morphology, and functional group identification. Entrapment efficiency, drug loading and drug release were analyzed using UV-Vis spectroscopy. The results indicated that the best formulation was obtained at a stearic acid with palm oil ratio of 1:9 with ultrasonication for 80 minutes at a power rate of 50%. The product exhibited an average particle size of 87.9 ± 0.80 nm, PDI 0.229 ± 0.06, and zeta potential −38.63 ± 0.80 mV. FTIR spectra revealed interactions between L-Dopa and lipids through N-H, C=O, and O-H bonds. Morphological analysis using TEM and SEM-EDS revealed spherical-shaped particles. EDS mapping demonstrated the distribution of carbon (66.63%), oxygen (23.61%), and nitrogen (9.77%). The formulation achieved an entrapment efficiency of 16.64% and a drug loading of 0.185%. The drug release profile at pH 1.2 and 7.4 exhibited a sustained release pattern over 8 hours, with total release values of 5.36% and 19.4%, respectively. Based on these parameters, the NLC-DPS formulation is considered a promising drug delivery system for L-Dopa.

Keywords: *Parkinson's disease, L-Dopa, Nanostructured Lipid Carrier, Palm Oil, Stearic Acid.*

DAFTAR ISI

DAFTAR TABEL

DAFTAR GAMBAR

DAFTAR SINGKATAN

AS	= Asam Stearat
BBB	= *Blood–Brain Barrier*
DBS	= *Deep Brain Stimulation*
DL	= *Drug Loading*
DLS	= *Dynamic Light Scattering*
DM	= Demineralisasi
DP-NLC-*hydrogel*	= *Date Palm–Nanostructured Lipid Carrier–hydrogel*
EE	= *Entrapment Efficiency*
FTIR	= *Fourier Transform Infra-Red*
HLB	= *Hydrophilic–Lipophilic Balance*
LCNP	= *Lipid Core Nanoparticle*
LID	= *Levodopa-Induced Dyskinesia*
LRRK	= *Leusin Rich Repeat Kinase*
MS	= Minyak Sawit
MSNs	= *Mesoporous Silica Nanoparticles*
NLC	= *Nanostructured Lipid Carrier*
NLC-DPS	= *Nanostructured Lipid Carrier L-Dopa–Palm Oil–Stearic Acid*
PD	= *Parkinson's Disease*
PDI	= *Polydispersity Index*
PSA	= *Particle Size Analyzer*
RG-NLC	= *Red Ginger–Nanostructured Lipid Carrier*
ROS	= *Reactive Oxygen Species*
RSM	= *Response Surface Methodology*
SEM	= *Scanning Electron Microscope*
SEM-EDS	= *Scanning Electron Microscope–Energy Dispersive Spectroscopy*
SLN	= *Solid Lipid Nanoparticle*
TEM	= *Transmission Electron Microscope*
UV-Vis	= *Ultraviolet–Visible Spectroscopy*
ZP	= *Zeta Potential*

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