Original Article

Study of Loading, Cytotoxicity, Uptake, and Release of Curcumin from a Novel Gemini Surfactant Nanocarrier

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Abstract

Objective: Numerous researches have been conducted to comprehend the anti-cancer effects of curcumin (Cu). Although the anti-proliferative properties of Cu on cancerous cells is known, the clinical application of this gold substrate is limited. This limitation is mostly due to low solubility, inefficient bioavailability, rapid metabolism, and improper uptake. In this study, we have synthesized a novel biodegradable gemini surfactant (Gs), after which the curcumin (Cu) molecules were encapsulated within the polymer to overcome its physicochemical limitations.

Methods: We prepared Gs-Cu nanoparticles by the nanoprecipitation method. Size and polydispersity index of the nanoparticles were determined by the dynamic light scattering (DLS) technique. The release profile of Cu from the polymer matrix was studied, and the MTT assay and cellular uptake of Gs-Cu on MDA-MB-231 cells were investigated in vitro.

Results: The Gs polymer had the capability to form polymersomes in an aqueous solution; a narrow size distribution was obtained (PDI≅0.3). The encapsulation efficiency approximated 87%. We observed a sustained release profile due to incorporation of Cu into the polymer matrix. The Gs-Cu complex showed more cytotoxicity compared to free Cu because of the higher rate of cellular internalization.

Conclusions: The data indicate that Gs polymersomes can be regarded as nanocarriers for hydrophobic curcumin molecules.

Keywords: Curcumin, Anti-cancer, Gemini surfactant, Nanocarrier, Polymersome

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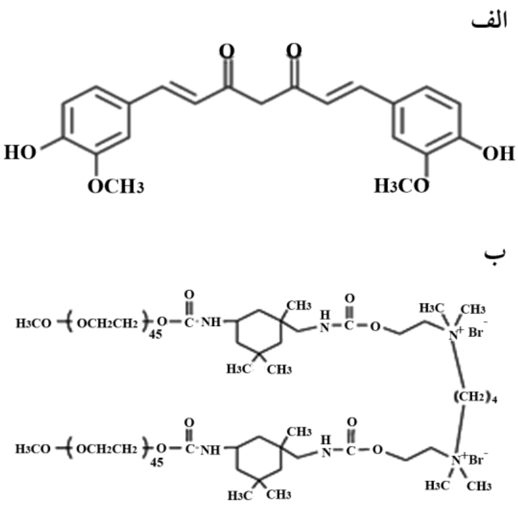
(Stealth) ... (Opsonin) ...

(Selectivity) ...

(Curcumin) ...

(Bioavailability) ... (pH) ...



(PEG urethane Gemini surfactant)

(Gemini surfactant) ... (Amphiphile) ... (Biodegradable) ...

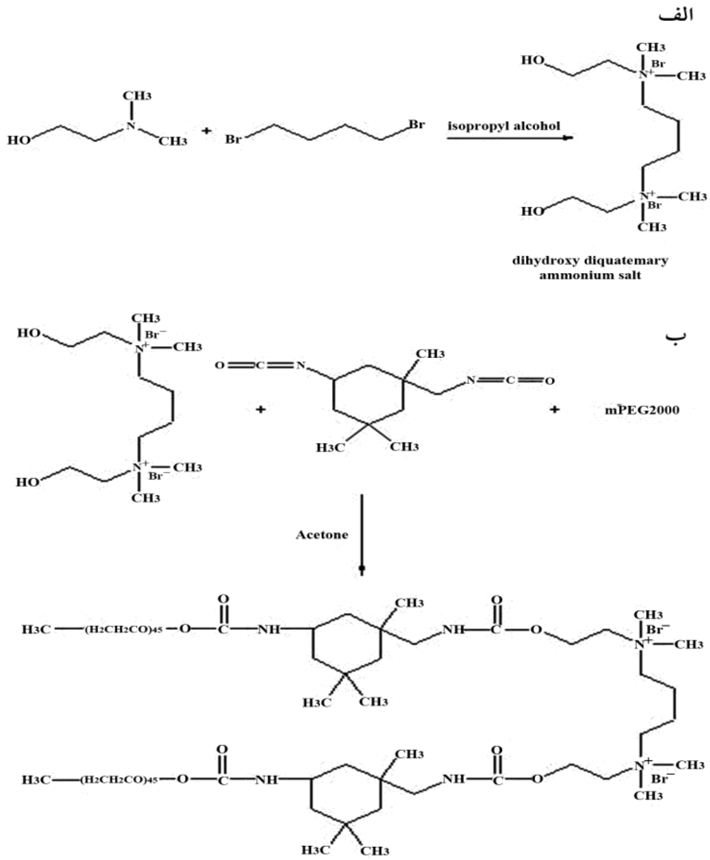
(MDA-MB-231) ...

RPMI 1640 ...

Fetal Bovine (FBS) ...

(Brush) ... (PEG) ...

(PEG) ...


الف
HO
CH3
N
CH3
Br
Br
isopropyl alcohol
dihydroxy diquaternary ammonium salt
ب
O=C=N
mPEG2000
Acetone
H3C
(H2CH2CO)45
NH
Br⁻

GmbH Ultrasonic UP200H

Bruker

H NMR

CDCl3 500 MHz

Rotary evaporator

Critical Micelle Concentration: CMC

freeze dry

Gs-Cu

Lyophilized

PBS pH 7.4 Phosphate Buffer Saline: PBS

Shake

Dragon Laboratory D3024R

Perkin Elmer

Instruments Limited

Gs

Thermo Fisher Scientific NanoDrop 1000

Gs-Cu

Nano

Gs-Cu

Encapsulation Efficiency:

precipitation

Drug Loading: DL

Dynamic Light Scattering: DLS

Gs

Gs-Cu

MTT pH 6.0 pH 6.2 Poly Dispersity Index Dimethyl DMSO © Malvern Instruments Zetasizer Nano ZS sulfoxide Enzymed-Linked Immunosorbent Assay; ELISA

Cellular uptake

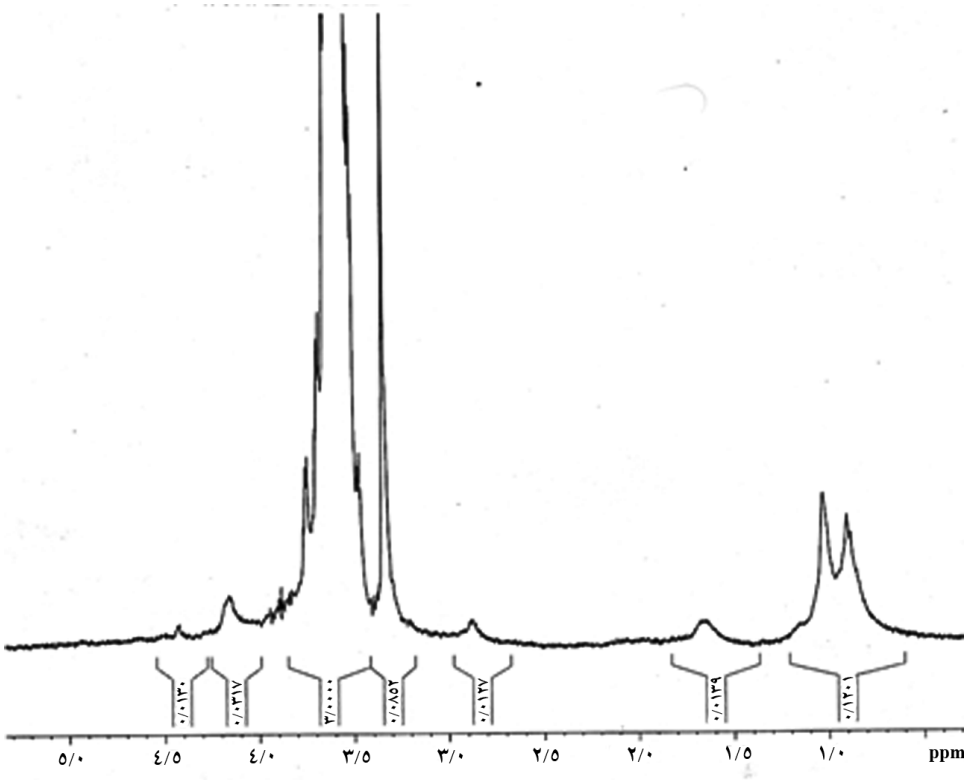
Gs-Cu MDA-MB-231 Direct dispersion Sealed pH 6.0 pH 6.2 Gs-Cu Eppendorf PBS PBS BD FACSCanto™ II BD Bioscience Flowing Software 2

Gs-Cu MTT MDA-MB-231 Excel 2010

Gs pH 6.2 PBS Gs-Cu PBS

Gs

NMR NMR



H (NMR