MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Medicinal and Analytical Chemistry International Journal
ISSN: 2639-2534

Anticancer activity of Curcumin-Loaded Nanoparticles

Hussein HA*

University of Basrah, College of Dentistry, Iraq

***Corresponding author:** Hanaa Ali Hussein, University of Basrah, College of Dentistry, Basrah, Iraq, Email: hanaahussein@uobasrah.edu.iq

Mini Review

Volume 6 Issue 1

Received Date: October 25, 2022

Published Date: November 15, 2022

DOI: 10.23880/macij-16000176

Abstract

Curcumin (CUR) is a natural bioactive compound with different bioactivities such as anti-cancer, anti-inflammatory, antioxidant, anti-microbial, and anti-parasitic, but the CUR exhibited low bioavailability, poor water solubility, and rapid hydrolysis. However, this review summarized the anticancer activities of CUR-loaded nanoparticles (NPs) and their ability to enhance CUR water solubility and increased loading efficiency in an in vitro and in vivo animal model.

Keywords: Bioavailability; Poor Water Solubility; Rapid Hydrolysis

Introduction

Curcumin (CUR) is a natural bioactive compound isolated from the *Turmeric longa* plant with different bioactivities such as anti-cancer, anti-inflammatory, antioxidant, anti-microbial, and anti-parasitic. CUR showed several disadvantages including low bioavailability, poor water solubility, and rapid hydrolysis. However, to solve this problem CUR is loaded with nanoparticles ((NPs) to enhance its bioactivities, especially against cancer cells by increasing its solubility and reducing the decomposition rate [1].

Recently, researchers have used nanomaterials (e.g. polymeric NPs, solid lipid NPs, mesoporous silica NPs, polymeric micelles, protein-based NPs, liposomes, dendrimers, magnetic NPs, and inorganic NPs) in drug delivery, imaging agent, and targeted therapy to improve water solubility and enhance the bioavailability of therapeutic agents such as CUR as shown in (Figure 1). It has been shown that CUR-loaded NPs significantly improve CUR stability and prevent enzymatic and pH degradation. In addition, the composition of CUR in NPs increases their turnover within the body [2].

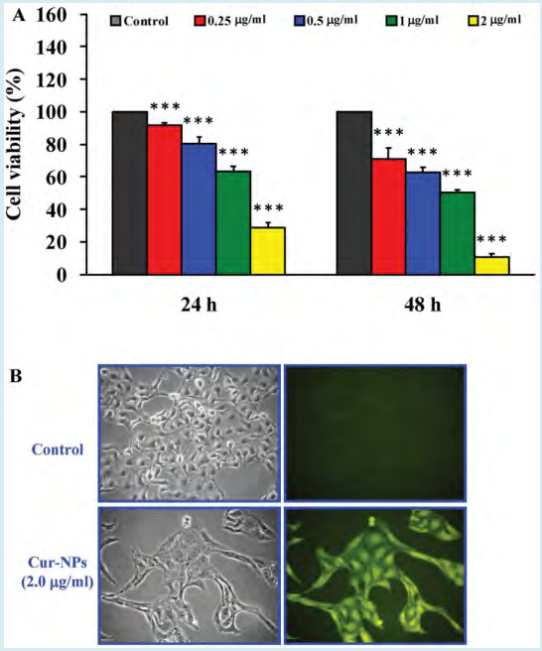

Figure 1: CUR-loaded Nanoparticles for drug delivery system [2]. Under a Creative Commons Attribution (CC-BY) License.

The previous studies reported that the anticancer activity of CUR-loaded dextran sulphate–chitosan NPs was higher against cancer cells but not normal cells, while the free NPs showed insignificant toxicity on both cancer and normal cells. CUR-loaded NPs causes a higher reduction in cell viability with MCF-7 breast cancer (57.9 %), followed by osteosarcoma cell (MG63, 69.6%), human prostate cancer cells (PC-3, 68.67%), and Mouse fibroblast cells (L929, 80.5%) after 48 h incubation. Thus, these results confirmed that CUR-loaded NPs could be used as a potential carrier to deliver CUR (hydrophobic drugs) in cancer drug delivery [3]. Further, CUR-loaded NPs showed higher anti-proliferative activity by forming apoptotic bodies, stimulating DNA fragmentation, decreasing the expression level of protein p-Akt, and increasing the levels of Caspases 3/7 and Caspase 9 in treated human osteosarcoma cells (U2OS) cells (Figure 2). These results confirmed that the Cur-loaded NPs are efficient in enhancing apoptosis in U2OS cells and therefore could be used as potential cancer therapeutics [4]. Furthermore, the CUR-loaded CUR loaded Haylouronic-Fatty Acid NPs enter the cells and decrease their sensitivity to apoptosis in Huntington's disease (*in vitro* model) [5]. The anticancer activity of CUR-loaded *Prunus armeniaca* gum exudates nanoparticles (CUR-PAGE NPs) was evaluated against 4T1 mammary carcinoma and A2780 ovarian cancer cell lines using the MTT assay. The results showed that both CUR-PAGE NPs and pure CUR were toxic to tested cell lines but the CUR-PAGE NPs exhibited strong anticancer activity, demonstrating synergistic effects of CUR and PAGE [6].

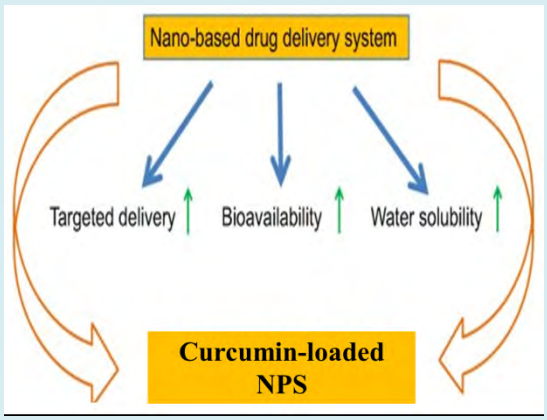

Figure 2: Effects of Cur-loaded NPs on U2OS cells [4]. Under a Creative Commons Attribution (CC-BY) License.

CUR-loaded NPs (CUR-NPs) have been synthesized using amphilic methoxy poly-ethylene glycol-polycaprolactone (mPEG-PCL) copolymers and were applied as antitumor agent's *in vivo* animal models. The results showed that CUR-NPs with excellent anticancer effects by reducing or delaying lung tumor growth as compared to CUR alone with low toxicity to normal tissues (liver, kidney, and bone marrow). These results confirmed that CUR-NPs are able to reduce the growth of lung tumors without effects on normal tissues [8]. For *in vivo* study, the authors loaded CUR with NPs on the quantum gold clusters surface (AuQCs) using a new in situ synthesis process which can reduce metal content when injected into the body for treating the tumor with increase the water solubility of CUR and loading efficiency. The results showed that CUR-loaded AuQCs NPs can inhibit tumor growth in xenografts of breast cancer (MDA-MB 231) cells with no side effects on internal organs such as the heart, lung, liver, Kidney as shown in (Figure 3) [7].

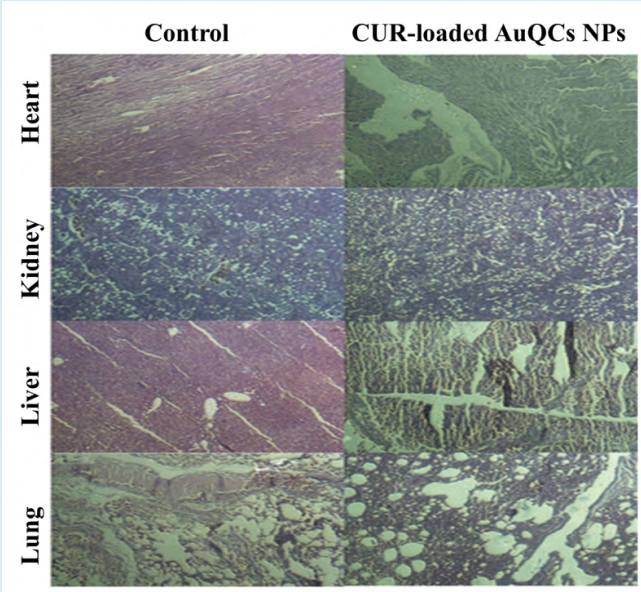

Figure 3: Mice model internal organs after treated with CUR-loaded AuQCs NPs. The results confirmed no significant toxicity was observed in the treated heart, liver, lung, and kideny [7]. Under a Creative Commons Attribution (CC-BY) License.

Conclusion

In this study, we conclude that the CUR-loaded NPs can cause higher cytotoxic activity in cancer cells but not normal cells. Further, the *in vivo* study confirmed that this application can reduce tumor growth without significant effects on normal tissues like the liver, lung, heart, and other internal organs. This finding suggests using this application in the future as a therapeutic drug to treat different types of cancer.

References

1. Rai M, Avinash PI, Raksha P, Priti P, Netravati A, et al. (2020) Curcumin and Curcumin-Loaded Nanoparticles:

Antipathogenic and Antiparasitic Activities. Expert Rev Anti Infect Ther 18(4): 367-379.

2. Yavarpour-Bali HM, Pirzadeh, Ghasemi-Kasman M (2019) Curcumin-Loaded Nanoparticles: A Novel Therapeutic Strategy in Treatment of Central Nervous System Disorders. Int J Nanomedicine 14: 4449-4460.

3. Anitha A, Deepagan VG, Divya Rani VV, Deepthy M, Nair SV, et al. (2011) Preparation, Characterization, in Vitro Drug Release and Biological Studies of Curcumin Loaded Dextran Sulphate-Chitosan Nanoparticles. Carbohydr Polym 84(3): 1158-1164.

4. Peng SF, Chao-Ying L, Mann-Jen H, Shih-Chang T, Daih-Huang K, et al. (2014) Curcumin-Loaded Nanoparticles Enhance Apoptotic Cell Death of U2OS Human Osteosarcoma Cells through the Akt-Bad Signaling Pathway. Int J Oncol 44(1): 238-246.

5. Pepe G, Enrica C, Valentina V, Michele S, Vittoro M, et al. (2020) Curcumin-Loaded Nanoparticles Based on Amphiphilic Hyaluronan-Conjugate Explored as Targeting Delivery System for Neurodegenerative Disorders. Int J Mol Sci 21(22): 1-13.

6. Salarbashi D, Mohsen T, Fathi M, Seyyed MA, Farzaneh S (2021) Development of Curcumin-Loaded Prunus Armeniaca Gum Nanoparticles: Synthesis, Characterization, Control Release Behavior, and Evaluation of Anticancer and Antimicrobial Properties. Food Sci Nutr 9(11): 6109-6119.

7. Khandelwal P, Aftab A, Arpankumar C, Samit C, Pankaj P (2018) Retention of Anticancer Activity of Curcumin after Conjugation with Fluorescent Gold Quantum Clusters: An in Vitro and in Vivo Xenograft Study. ACS Omega 3(5): 4776-4785.

8. Yin HT, De-Geng Z, Xiao-Li W, Xin-En H, Gang C (2019) In Vivo Evaluation of Curcumin-Loaded Nanoparticles in a A549 Xenograft Mice Model. Asian Pacific J Cancer Prev 14(1): 409-412.