


In vitro and in silico molecular interaction of multiphase nanoparticles containing inositol hexaphosphate and jacalin: Therapeutic potential against colon cancer cells (HCT-15)

Malti Arya | Nidhi Mishra | Pooja Singh | Chandra B. Tripathi | Poonam Parashar | Mahendra Singh | Krishna P. Gupta | Shubhini A. Saraf 

Department of Pharmaceutical Sciences,
Babasaheb Bhimrao Ambedkar University
(A Central University), Lucknow, India

Correspondence

Shubhini A. Saraf, Department of
Pharmaceutical Sciences, Babasaheb Bhimrao
Ambedkar University (A Central University),
Vidya Vihar, Raebareilly Road, Lucknow, U.P.
226025, India.
Email: shubhini.saraf@gmail.com

Abstract

Inositol hexaphosphate (IP6) is a natural constituent found in almost all cereals and legumes. It is known to cause numerous antiangiogenic manifestations. Notwithstanding its great potential, it is underutilized due to the chelation and rapid excretion from the body. Jacalin is another natural constituent obtained from seeds of jackfruit and can target disaccharides overexpressed in tumor cells. The current study was in-quested to develop and evaluate a surface-modified gold nanoparticulate system containing IP6 and jacalin which may maximize the apoptotic effect of IP6 against HCT-15 cell lines. IP6 loaded jacalin-pectin-gold nanoparticles (JP-GNPs) were developed through reduction followed by incubation method. The developed formulation was tested for various in vitro and in silico studies to investigate its potential. HCT-15 cells when exposed to JP-GNP resulted in significant apoptotic effects in dose as well as time-dependent manner, as measured using 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide, micronucleus, and reactive oxygen species assay. JP-GNP displayed cell cycle arrest at the G0/G1 phase. To further explore the mechanism of chemoprevention, in silico studies were performed. The docking results revealed that the interactive behavior of IP6, P-GNP, and jacalin could target and inhibit the tumor formation activity, supported by in vitro studies. Taken together, all the findings suggested that IP6 loaded nanoparticles may increase the hope of future drug delivery strategy for targeting colon cancer.

KEYWORDS

cell cycle arrest, DAPI, MTT assay, phytic acid

1 | INTRODUCTION

Colon cancer is amplifying its threat and is one of the sources of high mortality rate globally. It constitutes about 10% of the total cancer burden. Colorectal cancer is anticipated to augment by 60% by 2030 (Arnold et al., 2016). To invade expensive and unsafe therapies, there

is a need to either repurpose natural drugs or to utilize natural moieties which were earlier discarded because of some flaw.

For cancer prevention and therapy, numerous efforts are being made among which, the use of naturally occurring agents is an important approach owing to their availability, safety, and general acceptance. Inositol hexaphosphate (IP6) is one such agent, it is a

Abbreviations: DAPI, 4,6-diamidino-2-phenylindole; DCFH-DA, 2,7-dichlorodihydrofluorescein diacetate; DMEM, Dulbecco's modified Eagle's medium; GNPs, gold nanoparticles; HAuCl₄, chloroauric acid; HCT 15, human colorectal adenocarcinoma cell lines; IC50, half maximal inhibitory concentration; JP-GNPs, IP6 loaded jacalin-pectin-gold nanoparticles; IP6, inositol hexaphosphate; MTT, 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide; NCM, normal human colon epithelial cell lines; P-GNPs, pectin-gold nanoparticles; PBS, phosphate-buffered saline; PDB, Protein Data Bank; PI, propidium iodide; ROS, reactive oxygen species; RPMI, Roswell park memorial institute medium; SMILES, simplified molecular input line entry specification.