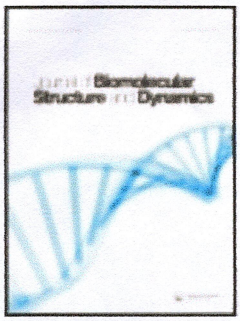
3.3.1-2



Taylor & Francis
Taylor & Francis Group

Journal of Biomolecular Structure and Dynamics

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tbsd20

Evaluation of the size effect of hydrophobic ring substitution on 9-O position of berberine on DNA binding

Munira Khatun, Gopal Chandra Jana, Sk Nayim, Asima Dhal, Anirudha Patra & Maidul Hossain

To cite this article: Munira Khatun, Gopal Chandra Jana, Sk Nayim, Asima Dhal, Anirudha Patra & Maidul Hossain (2023): Evaluation of the size effect of hydrophobic ring substitution on 9-O position of berberine on DNA binding, Journal of Biomolecular Structure and Dynamics, DOI: 10.1080/07391102.2023.2180436

To link to this article: https://doi.org/10.1080/07391102.2023.2180436

JOURNAL OF BIOMOLECULAR STRUCTURE AND DYNAMICS
https://doi.org/10.1080/07391102.2023.2180436

Evaluation of the size effect of hydrophobic ring substitution on 9-O position of berberine on DNA binding

Munira Khatun, Gopal Chandra Jana, Sk Nayim, Asima Dhal, Anirudha Patra and Maidul Hossain

Department of Chemistry, Vidyasagar University, Midnapore, West Bengal, India

Communicated by Ramaswamy H. Sarma

ABSTRACT

The interaction of deoxyribonucleic acid (DNA) with medicinally significant small molecules has long piqued the interest of researchers because its applications are directly related to the discovery of new classes of drugs. Keeping this in mind, here we report berberine derivatives and their interaction with calf thymus DNA (CT-DNA). In this report we discussed on the structural perspectives and thermodynamic characteristics of the interaction of four 9-O-substituted berberines (BRDR1 to BRDR4) with CT-DNA. The binding affinity of BRDR–DNA complexes increased with increasing the cycloalkane ring size of the substitution except BRDR2. The binding constant value obtained from UV–Visible spectral analysis was 1.12×10^6 for BRDR1, 0.37×10^6 for BRDR2, 1.72×10^6 for BRDR3 and 3.20×10^6 for BRDR4. Ferrocyanide quenching experiments revealed unequivocally that the analogues except BRDR2 had a partly intercalative binding to DNA. From the ITC experiment it was found that the bindings of BRDR1, BRDR3 and BRDR4 to DNA was favoured by negative enthalpy and positive entropy while BRDR2 was driven by positive enthalpy and positive entropy. In all cases the hydrophobic interaction plays a crucial role. Thus, the complete multispectroscopic and thermodynamic binding studies may be useful for new drug design and development.

ARTICLE HISTORY
Received 22 December 2022
Accepted 8 February 2023

KEYWORDS
Berberine derivative; deoxyribonucleic acid; isothermal titration calorimetry

1. Introduction

Recent drug–DNA interaction studies focused on its binding mechanism, structural features, site selectivity, and application in molecular biology, pharmacology and bioengineering (Budzisz et al., 2004; Dragojew et al., 2008; Wochner et al., 2008). The ligand–DNA interaction study might useful to develop more effective therapeutic medicines and specific target DNA probes. To identify better molecules which can be superior is still being searched in numerous laboratories all across the world (Graves & Velea, 2000; Maiti & Kumar, 2007). These DNA bounded molecules alter the structure of DNA, or damage its replication in a way that stops cell growth and proliferation (Krishnan & Bastow, 2000; Shaikh et al., 2004). Understanding how small molecules bind to DNA could help to develop and synthesise ligands with better selectivity and therapeutic effects for gene regulation (Chenoweth & Dervan, 2009). So, scientists have been trying to understand how drugs and small molecules interact with DNA (Maiti & Kumar, 2007).

Isoquinoline is a class of natural products found in a variety of botanical families that have a wide range of established therapeutic uses. Berberine, a quintessential candidate of the isoquinoline family, has gained growing emphasis for its widespread application in the field of biomedical research, owing to its numerous pharmacologic properties (Yin et al., 2008). It possesses various key bioactivities, including antibacterial (Samosorn et al., 2009), antifungal (Park et al., 2006), anti-malarial (Jamshaid et al., 2020), anti-plastic (Tang et al., 2009), and anti-inflammatory properties (Tillhon et al., 2012; Wang et al., 2017), HIV infection (Park et al., 2006), Alzheimer's disease (Kapoor, 2013), etc. are few of the maladies that berberine may be used to cure. Berberine's other biological activities include interactions with alpha-2 adreno receptors of human platelet (Li et al., 2011), genotoxicity in eukaryotic and prokaryotic organisms (Rad et al., 2017), and vasodilating effect in the rat artery (Abushouk et al., 2017). Many literature reports that it has antitumor and anticancer properties over different cell lines (Tang et al., 2009). Berberine has been shown to cause cell cycle pause and apoptosis in cell lines such as human gastric carcinoma SNU-5 cell (Lin et al., 2006), human prostate cancer cells (Choi et al., 2009), human leukemia cell (Mazandaranian et al., 2022) and human osteosarcoma cells (Liu et al., 2009) occurs by causing DNA damage and cell death. Additionally, it has been reported that the alkaloid berberine exhibits antiproliferative *in vitro* actions and causes U937 and B16 cells to undergo cell death or necrosis (Islam et al., 2011). By reducing the production of matrix metalloproteinase-2 and urokinase-plasminogen activator, berberine inhibits the spread of cancer cells (Peng et al., 2006). Berberine's pharmacological characteristics, including anticancer activity owing to its high

CONTACT Maidul Hossain hossainm@mail.vidyasagar.ac.in Department of Chemistry & Chemical Technology, Vidyasagar University, Midnapore, West Bengal 721102, India.

Supplemental data for this article can be accessed online at https://doi.org/10.1080/07391102.2023.2180436.