Send Orders for Reprints to reprints@benthamscience.net

Current Drug Delivery, xxxx, *xx*, 1-13

RESEARCH ARTICLE

Appraisal of Nano-lipidic Astaxanthin Cum Thermoreversible Gel and its Efficacy in Haloperidol Induced Parkinsonism

Deepika Gautam[1], Samipta Singh[1], Priyanka Maurya[1], Manjari Singh[1,2], Sapana Kushwaha[1] and Shubhini A. Saraf[1,*]

[1]*Department of Pharmaceutical Sciences, Babasaheb Bhimrao Ambedkar University, Lucknow, India;* [2]*Department of Pharmaceutical Sciences, Assam University, Silchar-788011, India*

ARTICLE HISTORY

Received: December 07, 2020
Revised: January 20, 2021
Accepted: March 12, 2021

DOI:
10.2174/1567201818666210510173524

Abstract: ***Background*:** Parkinsonism has a toxic cascade of neurodegeneration, with akinesia as a major manifestation. Some antioxidants have shown promise against the disease. Astaxanthin is a powerful antioxidant, demonstrates free radical scavenging, and is also a potential neuroprotective agent.

***Objective*:** The objective of this study was to formulate astaxanthin-laden nanostructured lipid carriers based thermoreversible gel for better neuronal uptake and better neuronal efficacy.

***Methods*:** The method for fabricating astaxanthin-nanostructured lipid carriers (ATX-NLC) was melt-emulsification, and these were optimized using factorial design and further evaluated for diverse parameters. Neurotoxicity was induced in rats by haloperidol. The treated and non-treated rats were then witnessed for their behaviour. TBARs and GSH levels were also determined. Pharmacokinetics was studied *via* HPLC.

***Results*:** The average particle size (by DLS), entrapment efficiency and zeta potential of optimized ATX-NLC were 225.6 ± 3.04 nm, 65.91 ± 1.22% and -52.64 mV, respectively. Astaxanthin release (after 24 h in simulated nasal fluid) from optimized ATX-NLC was 92.5 ± 5.42%. Its thermoreversible nasal gel (ATX-NLC *in-situ* gel) was prepared using poloxamer-127. The obtained gel showed *in-vivo* betterment in the behaviour of animals when studied using the rotarod and akinesia test. Pharmacokinetic studies showed better availability of astaxanthin in the brain on the rats treated with ATX-NLC *in-situ* gel as compared to those treated with ATX-*in-situ* gel.

***Conclusion*:** Astaxanthin-loaded lipidic nanoparticulate gel can be a hopeful adjuvant therapy for Parkinsonism and holds scope for future studies.

Keywords: Nose to brain delivery, *in-situ* gel, astaxanthin, nanostructured lipid carriers, motor imbalance, neuroprotection.

1. INTRODUCTION

In humans, Parkinson's Disease (PD) is amongst the prevalent neurological disorders that affect approximately 6-10 million people worldwide [1, 2]. Incidence rates tend to be higher with increasing age [3]. It is a progressive neurodegenerative disorder that leads to dopaminergic neuronal loss in the region of *Substantia Nigra Pars Compacta* (SNPC) [4]. It is marked with motor as well as non-motor symptoms [5]. Motor dysfunctional characteristics of PD often include terminologies such as bradykinesia, hypokinesia, and akinesia. Slowness in the execution of movement is denoted as bradykinesia, decreased amplitude of movement as hypokinesia and the complete lack of movement as akinesia. These terminologies advanced over time. Currently, their use is inconsistent. Indeed, akinesia is a more problematic condition among these for PD [6].

Several findings have revealed that the oxidative stress of the cells at specific regions in the brain is a significant factor in the pathogenesis of several neurodegenerative conditions, including Parkinson's disease [7]. Early antioxidant supplementation might prevent or decrease the progression rate of Parkinson's disease [8]. Varieties of anti-oxidants are available, and selecting the valuable antioxidant becomes important for circumventing costly failures [9]. Astaxanthin (ATX) is a potent antioxidant that is reported to be valuable in attenuating neurotoxicity in Parkinson's disease mouse models [10, 11]. It can interrupt the multiple pathways that are involved in the neurodegenerative cascade, which occurs in Parkinsonism, including oxidative, nitrative stress, neuroinflammation, and impaired mitochondrial membrane potential. It can exert its activity within CNS and demonstrate

*Address correspondence to this author at the Department of Pharmaceutical Sciences, Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India; Tel: +91- 9628176500, E-mail: shubhini.saraf@gmail.com

