Journal of Pharmaceutical Research International

33(62A): 414-422, 2021; Article no.JPRI.77775
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Antioxidant and Antiinflammatory Activity of Titanium Dioxide Nanoparticles Synthesised Using *Mucuna pruriens*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i62A35616

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/77775

Original Research Article

Received 24 October 2021
Accepted 27 December 2021
Published 28 December 2021

ABSTRACT

Introduction: The genus *Mucuna*, belonging to the Fabaceae family, sub family Papilionaceae, includes approximately 150 species of annual and perennial legumes. Titanium dioxide (TiO2) nanoparticles (NPs) are manufactured worldwide in large quantities for use in a wide range of applications.Various studies have been done in this topic like determining the efficacies of antibacterial and antioxidant activities of aqueous leaf extract of *Psidium guajava* mediated biosynthesis of titanium dioxide nanoparticles. Other studies have suggested that Obtaining biopeptides by enzymatic hydrolysis adds value to proteins of vegetative origin, such as *Mucuna pruriens* L. Thus it evaluated the effect of enzymatic digestion of protein derivatives obtained from *M*. *pruriens* L. Although a lot of studies have been done on Titanium dioxide nanoparticles and its various activities like anti-inflammatory, antioxidant and anti diabetic, there are not many studies in the area of checking anti inflammatory and antioxidant activity of titanium dioxide nanoparticles synthesised using Mucuna pruriens The aim of this study is to observe the antioxidant and anti inflammatory activity of Titanium dioxide nanoparticles synthesised using Mucuna pruriens.
Materials and Methods: A titanium dioxide nanoparticle is synthesised using Mucuna pruriens,

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extract used to perform albumin denaturation assays and DPPH method, where % zone of inhibition increases as the concentration of nanoparticles increases.
Results: The Mucuna pruriens medicated titanium dioxide nanoparticle has positive antioxidant and anti-inflammatory properties.
Conclusion: The present study concluded that Mucuna pruriens mediated copper nanoparticle has good antioxidant and anti-inflammatory activity at its high concentration which is nearer to that of the standard drugs.

Keywords: Mucuna pruriens; titanium dioxide nanoparticles; anti-inflammatory; antioxidant; eco friendly; drugs and diagnosis.

1. INTRODUCTION

The genus *Mucuna*, belonging to the Fabaceae family, sub family Papilionaceae, includes approximately 150 species of annual and perennial legumes ('Enhanced Extraction of Levodopa from Mucuna pruriens Seeds Using Aqueous Solutions of Eutectic Solvents', no date). Among the various under-utilized wild legumes, the velvet bean *Mucuna pruriens* is widespread in tropical and sub-tropical regions of the world. It is considered a viable source of dietary proteins [1,2,3] due to its high protein concentration (23–35%) in addition to its digestibility, which is comparable to that of other pulses such as soybean, rice bean, and lima bean [4]. It is therefore regarded as a good source of food. The dozen or so cultivated *Mucuna Spp*. found in the tropics probably result from fragmentation deriving from the Asian cultigen, and there are numerous crosses and hybrids (Bailey and Bailey, 1976). Titanium dioxide (TiO2) nanoparticles (NPs) are manufactured worldwide in large quantities for use in a wide range of applications. TiO2 NPs possess different physicochemical properties compared to their fine particle (FP) analogs, which might alter their bioactivity. A nanomaterial is defined as "an insoluble or biopersistent and intentionally manufactured material with one or more external dimensions, or an internal structure, on the scale from 1 nm to 100 nm" (Jayasundara, no date). To date, nanotechnologies and nanomaterials have been extensively employed and the potential for growth in nanomedicine appears significant. Three principal fields of application are particularly targeted: diagnosis, drug administration, and regenerative medicine (Ross, no date). The main domains of nanoparticles in the field of dentistry globally may involve the teeth-whitening, polishing pastes for the enamel surface, dental implant coatings, dental filling, anti sensitivity agents, and the prevention of caries [5].

One sector is particularly relevant to consumers: cosmetics, much of which is based on nanoparticles (NP) [6]. Cosmetics is specified as whatever substance or preparation is planned to be in contact with external parts of the human body or with mucous membranes and teeth of the buccal cavity with a view, principally or exclusively, to changing their appearance, cleaning them, flavoring them, balancing body odors, keeping them or preserving them in a healthy condition [7,8] .

Various studies have been done in this topic like determining the efficacies of antibacterial and antioxidant activities of aqueous leaf extract of *Psidium guajava* mediated biosynthesis of titanium dioxide nanoparticles [9,10]. Other studies have suggested that Obtaining biopeptides by enzymatic hydrolysis adds value to proteins of vegetative origin, such as *Mucuna pruriens* L. Thus it evaluated the effect of enzymatic digestion of protein derivatives obtained from *M. pruriens* L [11,12]. Similarly another experiment shows the protective effect of M. pruriens against arsenic-induced liver and kidney, where the experiment was divided into short-term treatment (45 days) [13,14] and long-term treatment (90 days), with each group divided into nine sub-groups consisting of six animals each. Sub-groups 1 and 2 served as normal, and N-acetylcysteine (NAC) controls, respectively. It is also used in making toothpastes as they are cosmetic hygiene products requiring daily use [15]. In the oral care market, toothpaste is the biggest part [16]. The toothpaste market was estimated in 2018 to be worth USD 26.1 billion, and it is predicted to reach USD 37.0 billion by 2024 [17] Various forms of toothpaste, such as pastes, powder, and gels, give more choice to consumers, thus propelling demand [18]. High product usage across all age groups and income is the prime element driving this segment. The use of cosmetic products containing nano-objects, such

as dentifrices containing titanium dioxide NPs, is commonly used in periodontal health [19,20].

Mouthwash is expected to show profitable growth in the coming years because of the growing professional recognition of biofilm disorganization, and their increasing use by consumers linked to oral quality of life [21]. Our team has extensive knowledge and research experience that has translate into high quality publications [22-34,26,35-41]. Although a lot of studies have been done on Titanium dioxide nanoparticles and its various activities like anti-inflammatory [42], antioxidant and anti diabetic [43,44,45], there are not many studies in the area of checking anti inflammatory and antioxidant activity of titanium dioxide nanoparticles synthesised using Mucuna pruriens, thus the present study aims to assess the antioxidant activity and anti inflammatory activity of titanium dioxide nanoparticles synthesised using Mucuna pruriens.

2. MATERIALS AND METHODS

2.1 Preparation of *Mucuna pruriens* Plant Extract

Mucuna pruriens seed powder was commercially purchased. 0.8g of Mucuna pruriens seed powder was diluted with 80 mL of distilled water. This solution was then boiled for 10 minutes. After boiling the solution was filtered using Whitman filter paper and was allowed to settle. This setup was kept undisturbed for 20 minutes. Then the filtrate mixture was measured and found to be 50mL. This freshly prepared plant extract was used for green synthesis.

2.2 Synthesis of Titanium Dioxide Nanoparticle

Titanium nanoparticles of 0.477g were mixed with 50mL of water and 50 mL of Mucuna pruriens extract was mixed with 50mL of the titanium nanoparticle. This solution was then placed in the laboratory shaker for the synthesis of the nanoparticle. The synthesis of nanoparticles was investigated by using the UV-Beckmann spectrometer. For every 2 hours, the solution was withdrawn from the shaker to note the reading and color change (5 times the reading was taken). This was periodically maintained until there was a proper synthesis of the copper nanoparticle. As time increased there was a gradual change in the color of the solution which was darker when compared to the initial stage. Centrifugation was carried out after the synthesis for a few minutes. After the process, the pellets were collected separately. This extract with properly synthesized nanoparticles was used to assess the antioxidant and anti-inflammatory activity of adhatoda vasica mediated copper nanoparticles.

2.3 Anti-inflammatory Activity

2.3.1 Albumin denaturation assay

The anti-inflammatory activity for Mucuna pruriens was tested by the following convention proposed by Muzushima and Kabayashi with specific alterations. 0.05 mL of Mucuna pruriens leaf extract of various fixation (10µL,20µL,30µL,40µL,50µL) was added to 0.45 mL bovine serum albumin (1% aqueous solution) and the pH of the mixture was acclimated to 6.3 utilizing a modest quantity of 1N hydrochloric acid. These samples were incubated at room temperature for 20 min and then heated at 55°C in a water bath for 30 min. The samples were cooled and the absorbance was estimated spectrophotometrically at 660 nm. Diclofenac Sodium was used as the standard. DMSO is utilized as a control.

Percentage of protein denaturation was determined utilizing following equation, % inhibition =Absorbance of control **/** Absorbance of sample×100/Absorbance of control.

2.4 Antioxidant Activity

DPPH assay was used to test the antioxidant activity of biogenic synthesized zinc oxide nanoparticles. Diverse concentrations (2-10 µg/mL) of Mucuna pruriens leaf extract interceded zinc oxide nanoparticle was mixed with 1 mL of 0.1 mM DPPH in methanol and 450 µl of 50 mM Tris HCl buffer (pH 7.4) and incubated for 30 minutes. Later, the reduction in the quantity of DPPH free radicals was assessed dependent on the absorbance at 517 nm. BHT was employed as control. The percentage of inhibition was determined from the following equation, % inhibition=Absorbance of control-Absorbance of test sample× 100/ Absorbance of control.

3. RESULTS

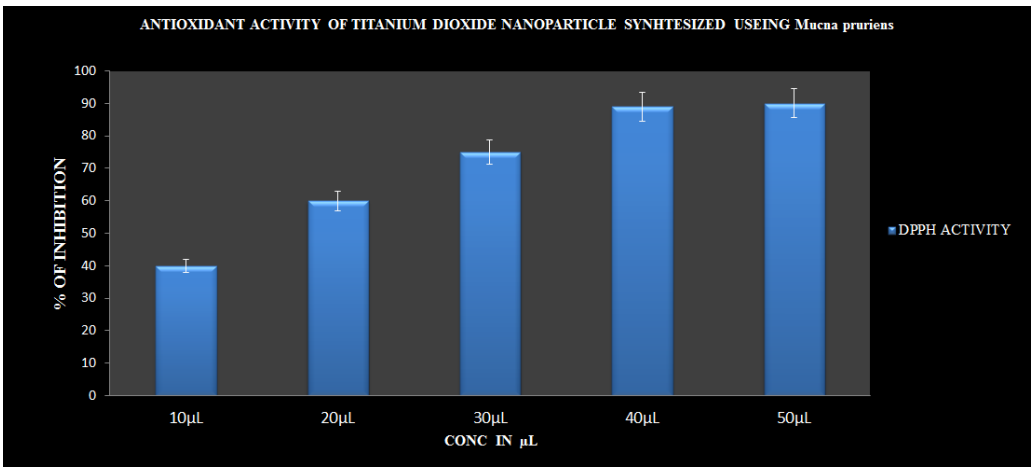

Fig. 1. Graph showing the antioxidant activity of Mucuna pruriens mediated titanium dioxide nanoparticle, data implies as mean±SEM

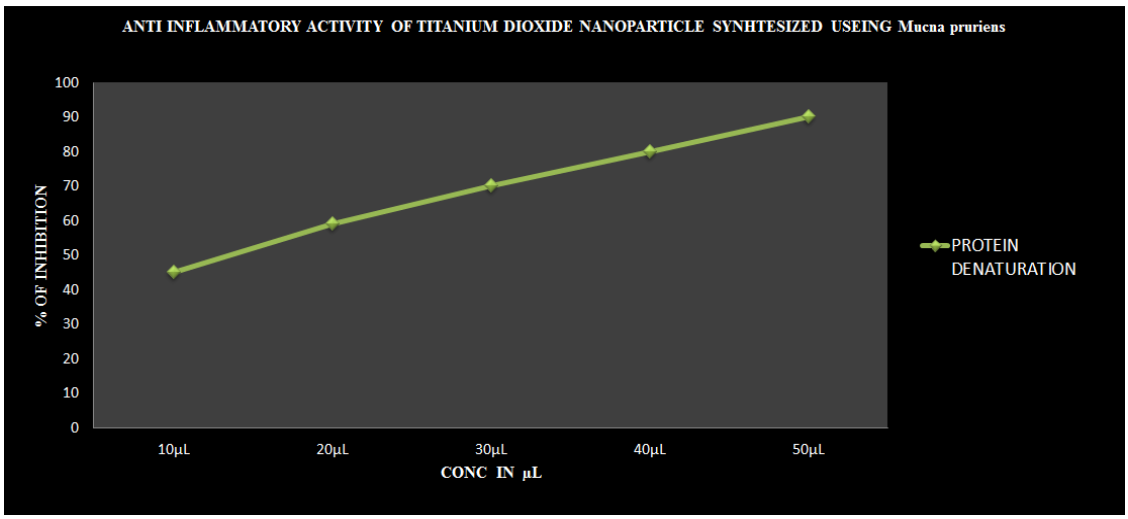

Fig. 2. Graph showing the anti-inflammatory activity of Mucuna pruriens mediated titanium dioxide nanoparticles, data implies as mean±SEM

In this study the antioxidant activity was assessed in five different concentrations of reaction mixture from 10µL, 20µL, 30µL, 40µL and 50µL. Antioxidant activity of different percentages of inhibition of oxidation such as 52%, 63%, 71%, 85% and 90%. Which plant extract mediated by titanium dioxide nanoparticle at 40µL and 50µL concentration exhibited a high Antioxidant activity of 90%.

In this study the anti-inflammatory activity was assessed in five different concentrations of reaction mixture from 10µL, 20µL, 30µL, 40µL and 50µL. Anti-inflammatory activity of different percentages of inhibition such as 45%, 60%, 70%, 80% and 90%. Which plant extract mediated by titanium dioxide nanoparticles at 50 µL of concentration exhibited a high anti-inflammatory activity of 89%.

4. DISCUSSION

In a previous study and ZnO its derivatives can be widely used in various drug delivery systems, such as nanoparticle drug delivery systems, gel drug delivery systems due to its effective cytotoxic potential [46]. Our study clearly shows the biomolecule hyaluronic acid mediated silver

nanoparticles size in the range of less than 50 nm and less cytotoxic effect confirmed by brine shrimp lethality assay. Based on the present study, the Titanium dioxide nanoparticles will be used for many biomedical applications in future [47].

In another study showed that it was first one to develop an efficient protocol for the biosynthesis of Titanium dioxide nanoparticles using *H. enneaspermus* to highlight eco-friendly approach for commercial application of Plant based nanoparticles in agriculture as nano-bio-fertilizers and in the field of medicine [48-52]. (*First Report on Marine Actinobacterial Diversity around Madras Atomic Power Station (MAPS), India*, no date) [53] (*Physicochemical Profile of Acacia Catechu Bark Extract – An in Vitro Stud - International Journal of Pharmaceutical and Phytopharmacological Research*, no date) [54,55] (*Awareness of Drug Abuse among Teenagers - International Journal of Pharmaceutical and Phytopharmacological Research*, no date) [56,57] (*COX2 Inhibitory Activity of Abutilon Indicum - Pharmaceutical Research and Allied Sciences*, no date) [58,59-62].

5. CONCLUSION

The synthesis of titanium dioxide nanoparticles using Mucuna pruriens seed extract was successfully achieved and anti inflammatory and antioxidant assays have been performed and shown respective activities [63-72], with more effectiveness and less toxicity.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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