



Free Radical Scavenging and Anti-Inflammatory Activity of Chlorogenic Acid Mediated Silver Nanoparticle

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Authors' contributions

This work was carried out in collaboration among all authors. Idea and study was conceptualized by authors LA and SR, collection of the literature and drafting the manuscript was by authors AIJ and LA. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Nanotechnology is a field of research and innovation concerned with building 'things' - generally, materials and devices on the scale of atoms and molecules. It is a booming field of this 21st century. The role of nano technology is becoming very crucial in nearly every aspect of life ranging from cosmetics to advanced bio technological approaches. In recent years, silver nanoparticles have gained considerable attention in the field of medicine. The green synthesis of nanoparticles eliminates the generation and use of hazardous substances and thus sustains non toxicity. Chlorogenic acids are phenolic compounds formed by the esterification of cinnamic acids. They exhibit various pharmacological Properties. Our study deals with the green synthesis of Chlorogenic acid mediated silver nanoparticles and assessment of their anti inflammatory and antioxidant properties.

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Aim: The present study aims at assessing the antioxidant and anti-inflammatory property of chlorogenic acid mediated silver nanoparticle and investigating the efficacy of Chlorogenic acid mediated Silver nanoparticle.

Materials and Methods: The methodology includes Green synthesis of Chlorogenic acid mediated Silver nano particle synthesis followed by tests for Anti inflammation and Anti oxidation.

Results: Both the Anti-inflammatory and Anti-oxidation activity of the chlorogenic acid mediated silver nanoparticle had shown a proportionate increase in activity with increasing concentration of the compound.

Conclusion: Chlorogenic acid mediated silver nanoparticles have shown significant anti-inflammatory and anti-oxidation activity and they are considered as potent anti-inflammatory and antioxidant agents.

Keywords: Chlorogenic acid; silver nanoparticle; anti-inflammatory; antioxidant; nanotechnology.

1. INTRODUCTION

Nanotechnology is an incredibly growing field in the era of modern science. It is a booming field of this 21st century. The role of Nano technology is becoming very crucial in nearly every aspect of life ranging from cosmetics to advanced biotechnological approaches. Nanotechnology is the field of science that mainly consists of the processing of separation, consolidation and deformation of materials by one atom or one molecule [1]. In simple terms, Nanotechnology is the design, characterisation, production and application of structures, devices and systems by controlled manipulations of size and shape at the nanometer scale. Basically Nanotechnology can be defined as manipulation of matter on an atomic and supramolecular scale. It deals with the synthesis and fabrication of materials at the nanoscale level (1 - 100 nm) [1]. This is the scale at which the materials exhibit some unexpected and unusual new properties that cannot be defined by the classical laws of physics [2]. In recent years, silver nanoparticles have gained considerable attention in the field of medicine. Silver nanoparticles have become a focus of interest because they play a significant role in biological systems, living organisms, and medicine [3]. Silver nanoparticles are nano-scale particles that are made of silver between 1nm and 100 nm in size [4]. They are largely composed of silver oxide. Silver nanoparticles are greatly known for their application in drug delivery, diagnosis and treatment of various diseases [5]. They have got a large surface to bulk silver atom ratio. The anti-bacterial, anti-fungal, anti-inflammatory, anti-oxidation properties of them are studied by various researchers [6]. They have got excellent antimicrobial properties that extend their applications nearly in every sphere of life. The Silver nanoparticle interacts with sulfhydryl groups of

Proteins and DNA of the bacteria [7]. They cause unwinding of DNA, alter the hydrogen bonding and cause interference to Cell wall synthesis and cell division [8]. They have got increased surface area that permits the coordination of various ligands [9]. Their quantum effects attribute to their unique mechanical and physicochemical properties [10]. Silver nanoparticles provide additional mechanical, optical, chemical and biological peculiarities that recommend them for the design, obtaining, evaluation, and clinical assessments of performance enhanced biomaterials and medical devices [11]. But its short-lived longevity caused by particle aggregation and its high cost serve as hindrance in the chemical production of the particles [9]. This has paved the way for evolution of green synthesis of silver nanoparticles. Here the biological organisms reduce the silver ions in solution into colloidal nanoparticles. The green method also eliminates the generation and use of hazardous substances and thus sustains non-toxicity [12]. In our study, the green synthesis of silver nanoparticles are mediated through Chlorogenic acids. Chlorogenic acids are phenolic compounds formed by the esterification of cinnamic acids [13]. They exhibit various pharmacological Properties. Its antioxidant, anti-obesity, anti-viral, anti-hypertension, antipyretic and anti-inflammatory properties are being studied by various researchers [14]. Chlorogenic acid is a biologically active polyphenol which is soluble in ethanol and acetone [15]. Chlorogenic acids are present in abundance in green coffee beans [16]. They are also found in potatoes, peaches, prunes and bamboo [17]. Its wide availability makes them economical and aids in easy application. In addition, it has been found that the Chlorogenic acids have the capability to modulate lipid metabolism and glucose in both genetically and healthy metabolic related disorders [18]. It is speculated that Chlorogenic

acids can perform crucial roles in lipid and glucose metabolism regulation and thus help to treat many disorders such as hepatic steatosis, cardiovascular disease, diabetes and obesity as well [19]. So, they serve as a good alternative to synthetic antibiotics. In our study, the anti-inflammatory and anti-oxidation properties of Chlorogenic acid mediated silver nanoparticles are studied. Inflammation is the protective response of the body to a variety of etiological factors like Infective agents, Immunological agents, Physical changes, Chemical changes and inert materials. Though inflammation is protective in nature, they may cause considerable harm to the body as well. Anaphylaxis to bites by insects or reptiles, drugs, chronic rheumatoid arthritis, fibrous bands and adhesions in intestinal obstruction are to name a few. So, It becomes really very important to treat an Inflammatory response. Phenolic compounds are able to inhibit either the production or the action of pro-inflammatory mediators, resulting in an anti-inflammatory effect. Chlorogenic acids are rich in phenolic compounds [20]. On the other hand, Oxidation is a chemical reaction that can produce free radicals, thereby leading to chain reactions that may damage the cells of organisms [21]. Anti oxidants are the compounds that prevent oxidation [21]. The human antioxidant system consists of small antioxidant proteins, ROS-metabolizing enzymes, as well as many regulator proteins that mediate adaptive responses to oxidant stress [22]. Chlorogenic

acids are said to have good anti-oxidation property [14]. So, the present study aims at assessing the antioxidant and anti-inflammatory properties of chlorogenic acid mediated silver nanoparticle and investigating the efficacy of Chlorogenic acid mediated Silver nanoparticle.

2. MATERIALS AND METHODS

2.1 Synthesis of Nanoparticle

0.1 gram of the Chlorogenic acid extract was added to 100 ml of distilled water. The solution was heated for minutes. Then 2 milli molar silver nitrate was added to the solution and kept in the shaker for nano particle synthesis (Fig. 1.).

2.2 Anti Inflammatory Activity

2ml of 1% bovine albumin was mixed with the Chlorogenic acid extract of different concentrations (10-50 g/ ml). Then distilled water (390-350l) was added to Chlorogenic acid extract of varying concentrations (10-50 g/ ml) And it is incubated at room temperature for 10 minutes. Then the mixture was heated at 55 degree Celsius for 20 min in a water bath and was cooled to room temperature. The absorbance value was recorded at 660 nm. An equal amount of plant extract was replaced with DMSO for control. Diclofenac sodium was used as a standard. All the tests were done in triplicate.

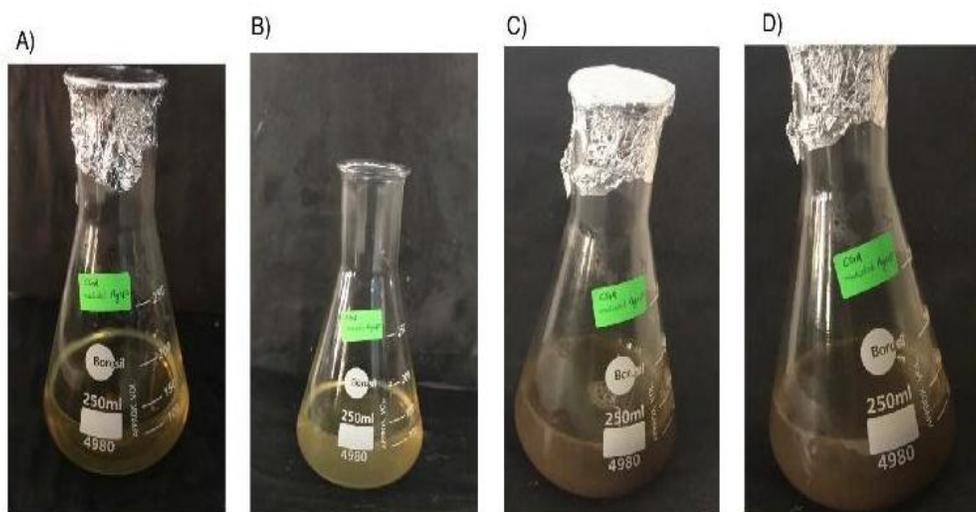


Fig. 1. A) Mixture of Chlorogenic acid extract with 100ml distilled water B) Chlorogenic acid mediated silver nano particle synthesis C) After 33 hours D) After 72 hours

2.3 Antioxidant Activity

2ml of the Chlorogenic acid extract in the concentration range of 10 - 50 g / ml was prepared in 50% methanol solution and was added to equal volume of 0.1 mM of DPPH solution. The reaction mixture was incubated for 20 min in dark at room temperature. Absorbance value was measured spectrophotometrically at 517 nm. The methanol solution was used as a blank. Methanol solution mixed with 0.1 mM of DPPH solution had been used as a control. Ascorbic acid was used as a standard. The IC50 Value was calculated. % inhibition was calculated using the below mentioned equation

$$\% \text{ Inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

3. RESULTS AND DISCUSSION

3.1 Anti Inflammatory Activity

From the Fig. 2. We can infer that the chlorogenic acid mediated silver nanoparticle showed about 40% protein denaturation

inhibition at 10 µl concentration, 51% inhibition at 20 µl concentration, 69% inhibition at 30 µl concentration, 78% inhibition at 40 µl concentration and 88% inhibition at 50 µl concentration.

3.2 Antioxidant Activity

Similarly, Fig. 3. shows the results of Anti oxidation activity. The DPPH activity is analysed. At 10µl concentration the DPPH activity is about 69%, At 20µl concentration it is about 70%, At 30µl concentration it is 78%, At 40µl concentration the DPPH activity is 80% and at about 50µl concentration it is about 89%.

Both the Anti inflammatory and Anti oxidation activity of the chlorogenic acid mediated silver nanoparticle had shown a proportionate increase in activity with increasing µl concentration. They are almost equal to the standards taken. This shows their significance in anti inflammation and anti oxidation activities. The silver nanoparticle synthesized using herbal extracts and herbal formulations show very good anti-inflammatory and antioxidant activities using biochemical procedures [23,24,25] .

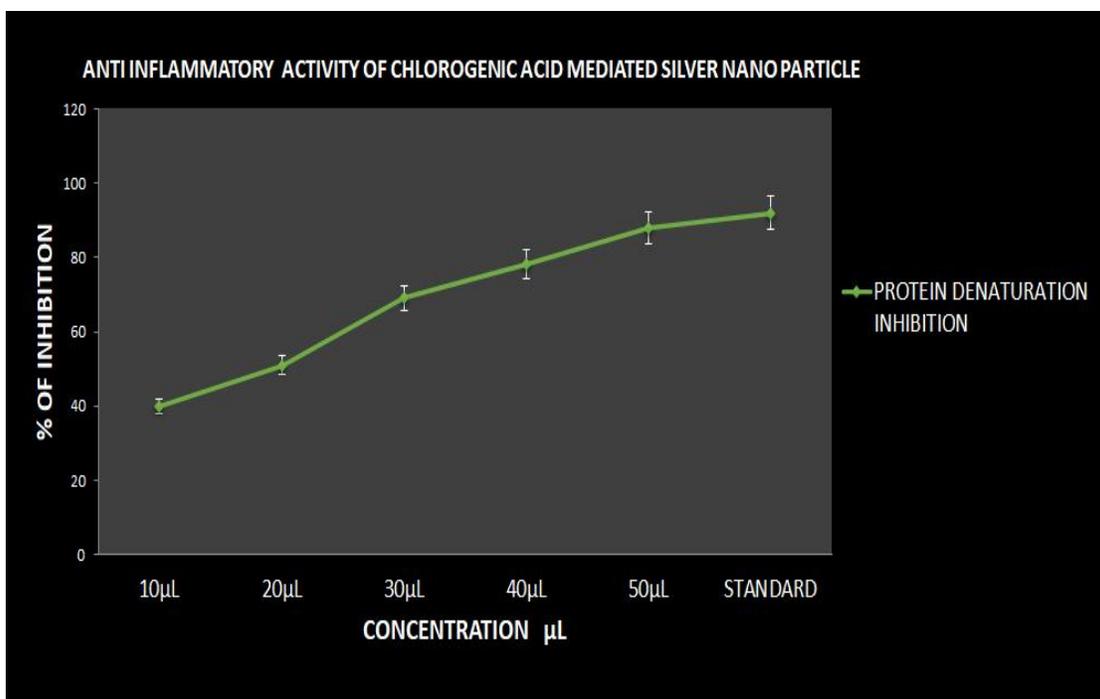


Fig. 2. Anti inflammatory activity of chlorogenic acid mediated Silver nanoparticle

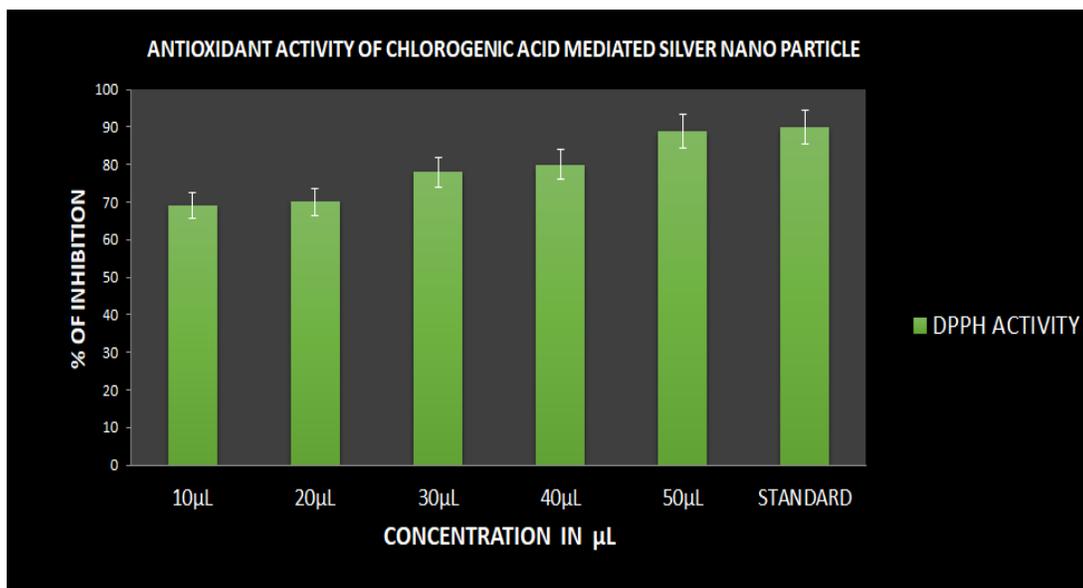


Fig. 3. Antioxidant activity of Chlorogenic acid mediated silver nanoparticle

4. CONCLUSION

From our Results, We can conclude that Chlorogenic acid mediated silver nanoparticles have got significant Anti inflammatory and anti oxidation activity and they are considered as potent Anti inflammatory and antioxidant agents. In recent times, the world is shifting towards the herbal cures because of the pronounced cumulative and irreversible reactions of modern therapeutic drugs. Plants have got an extraordinary ability to synthesize aromatic substances which are the useful phenols or their oxygen substituted derivatives. The maintenance of good health of the people in most of the developing countries forms the normative basis of the usage of traditional medicines. On that note, It is right to say that our study paves the way for further research and development of a new drug that can be used as a good alternative to the already existing therapeutic drugs.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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