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Characterisation and surface plasmon resonance of omeprazole loaded silver nanoparticles

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ABSTRACT

Background: Green synthesis approach of nanoparticles formulation utilizes simple, cost-effective, and eco-friendly techniques with no toxic by-products. This method was adopted in this study.
Aim: the main objective of this research was to develop and characterise omeprazole loaded silver nanoparticles using standard techniques

Methods: Curcuma longa aqueous extract was used as both the reducing and stabilizing agent for the silver nanoparticles. The nanoparticles obtained was characterized using UV, FTIR and SEM analysis.

Results: A colour change from light yellow solution to reddish brown indicated silver reduction. UV-Vis spectrum of reaction medium displayed an emission peak at 320.5nm, which corresponded to the absorbance of silver nanoparticles and showed well dispersed nanoparticles in the aqueous solution without aggregation in UV-Vis absorption spectrum. The particle size of the resultant nanoparticles was 70.37 nm.

Conclusion: Omeprazole silver-loaded nanoparticles was successfully formulated using green method.

Keywords: Green synthesis, Ulcers, Nanoparticles, *Curcuma longa*

1. INTRODUCTION

Nanotechnology deals with nanoparticle which is any material with dimension of less than 1micrometer (Jackson *et al*., [1]. According to Rizvi and Saleh [2], nanoparticles exist as a solid, colloidal particle having a size ranging from 10nm to less than 100nm but its use in nano medicine requires size less than 200 nm. Nanoparticles enables drug to be taken up by cell more efficiently than larger micro molecules. In the drug delivery through nanoparticles, drugs are dissolved, entrapped, encapsulated or attached to a nanoparticle matrix [3]. The use of nanotechnology in drug delivery is a technique for targeted drug release which reduces rate of drug accumulation and interaction with other non-diseased part of the body thereby reducing side effects. According to Ochekpe et al., [4], the size of the nanostructure permit penetration into tissues and uptake by cells thereby enhancing drug delivery to site of action. Omeprazole is a potent anti-acid drug which works by inactivating the enzyme responsible for acid secretion; H/K ATPase. As a proton pump inhibitor, it is used to treat conditions like peptic ulcers, gastric esophageal disorders and Zollinger-Ellison syndrome. Gastric acid is simply described as hydrochloride acid which are species produced by the parietal cells in

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the gastric glands in the stomach. It is one of the contributing factors of peptic ulcer disease and other acid related diseases. In most pharmacological treatment of gastric ulcer, it often requires reducing acid secretion by either blocking the pathway of acid secretion or neutralizing the gastric acid itself. Omeprazole comes under BCS (Biopharmaceutical classification system) class II with low solubility and high permeability. The dissolution is a prerequisite in the process of absorption. Solubility is also a basic requirement for the absorption of drug from the GIT. Although readily absorbed in the gastrointestinal tract, one of the major drawbacks of this poorly water-soluble drug is it low bioavailability not exceeding 7% in human. Omeprazole is susceptible to degradation from heat, humidity, light, and organic solvents and is chemically unstable in acidic solutions. Hence, on exposure to the acidic contents of the stomach, approximately 50% of the dose is inactivated leading to its poor bioavailability [5]. Its instability, poor solubility in water, short biological half-life, rapid metabolism and rapid elimination from the body limits its therapeutic applications. [6]. In order to overcome these pitfalls, several drug delivery systems have been developed for the improvement of oral absorption and bioavailability [7]. Incorporating omeprazole into enteric-coated polymeric nanoparticles is the most effective approach to prevent its degradation by stomach acid [5]. Nanotechnology is a phenomenal technique designed to curb some challenges of drug delivery system such as poor bioavailability, in-vivo stability, solubility, intestinal absorption, sustained and targeted drug delivery to the site of action etc due to the development of nanostructures. There is however dearth of information on the development of omeprazole silver nanoparticles using Curcuma longa. Based on this fact, the main aim of this research is to develop and characterise Omeprazole-loaded silver nanoparticle for improved treatment of duodenal and gastric ulcer.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Biological Materials

Tubers of Curcuma longa (turmeric)

2.1.2 Reagents and Equipment

Silver nitrate (Sigma Aldrich,USA), Omeprazole powder(BDH Chemicals, England), distilled water. Other reagents and chemicals were of analytical grade.

2.2 Methods

2.2.1 Collection of plant material

The tubers of Curcuma longa (turmeric) were collected and identified by a taxonomist in the University of Uyo, Nigeria. The tubers were washed and dried under sunlight for a week to completely remove the moisture and later chopped into smaller pieces, powdered in a mixer and then sieved using a 20-mesh sieve to get uniform size range. The final sieved powder was used for further analyses.

2.2.2 Extraction procedure

The aqueous extract from the turmeric powder were obtained by dissolving 20 g of the powdered rhizome of curcuma longa in distilled water (100ml) with mechanical agitation. The resultant extract was obtained by filtering using Whatman filter paper, funnel and a beaker.

2.2.3 Synthesis of silver nanoparticles using aqueous extracts of curcuma longa

This was carried out in accordance to the method of Jackson et al., [8] with slight modification;

2.2.4 Preparation of 1% w/v of silver nitrate solution

Silver nitrate solution (1% w/v) was prepared by dissolving 1.0 g of silver nitrate in distilled water and making the volume to 100ml in a beaker. 10 ml of 1% AgNO3 was measured and transferred into a beaker. 20 ml of curcuma longa extract was measured and transferred into the same beaker in drops using a 20 ml syringe under constant stirring using a magnetic stirrer. The mixture was allowed to stand for a few minutes. 5 ml of the 1% silver nitrate was measured transferred into a beaker and set apart. Another beaker was obtained and 0.02 g of Omeprazole was weighed and transferred into 10 ml of distilled water in order to dissolve the drug (Omeprazole) and the mixture was transferred into the beaker containing the AgNO3 and stirred to give a uniform mixture. 15 ml of Curcuma longa extract was incorporated in a dropwise manner into silver nitrate - drug mixture under constant stirring using a magnetic stirrer. The resultant sol was allowed to stand for a few minutes. The preparations were kept for freeze drying to carry out further studies.

2.2.5 Characterization of synthesized nanoparticle
This was carried out through standard techniques involving Uv spectroscopy, FTIR and morphological studies

2.2.6 Determination of surface Plasmon resonance of the silver nanoparticles

2.2.6.1 Ultraviolet- visible light spectroscopy
UV scanning was carried out (using Shimadzu UV visible, Model uv1800) at a wavelength of 300 nm to 450 nm to determine the surface Plasmon Resonance for the nanoparticles.

2.2.6.2 Fourier Transform –Infrared Analysis
The FTIR analysis of sample was carried out with Shimadzu FTIR, Model IR Affinity-1 using the range of 4000-400cm^{-1}

2.2.7 Morphological Studies of nanoparticles
The size and shape of nanoparticles was determined by Scanning Electron Microscope (SEM, Hitachi X650, Tokyo, Japan)

2.3 Statistical Analysis
Data analysis was done using SPSS version 25. For two sets of data. Student t test was used to determine the significant difference while analysis of variance (ANOVA) was employed for data sets of more than three. All experiments were carried out in triplicates

3. RESULTS
Two batches of drug-silver-extract mixtures were prepared.
The first batch (Nano) was prepared using 0.02g of Omeprazole powder dissolved in 10ml of distilled water, Omeprazole A 5ml of silver nitrate and 15ml of Curcuma longa. On incorporation of the extract into the AgNO3 mixture, there was a visible colour change from light yellow to brownish after 24 hours.

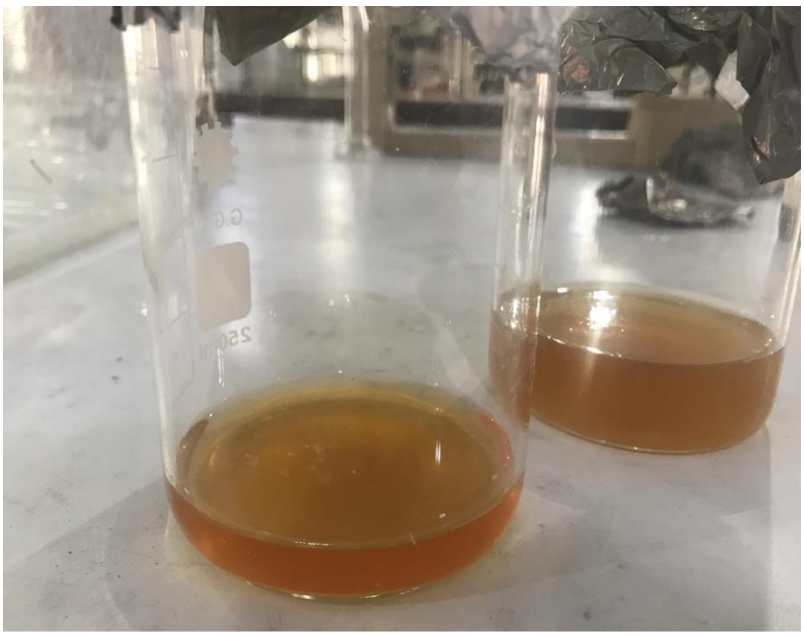

Figure 1: Synthesis of Nano omeprazole

Figure 2: SEM for omeprazole

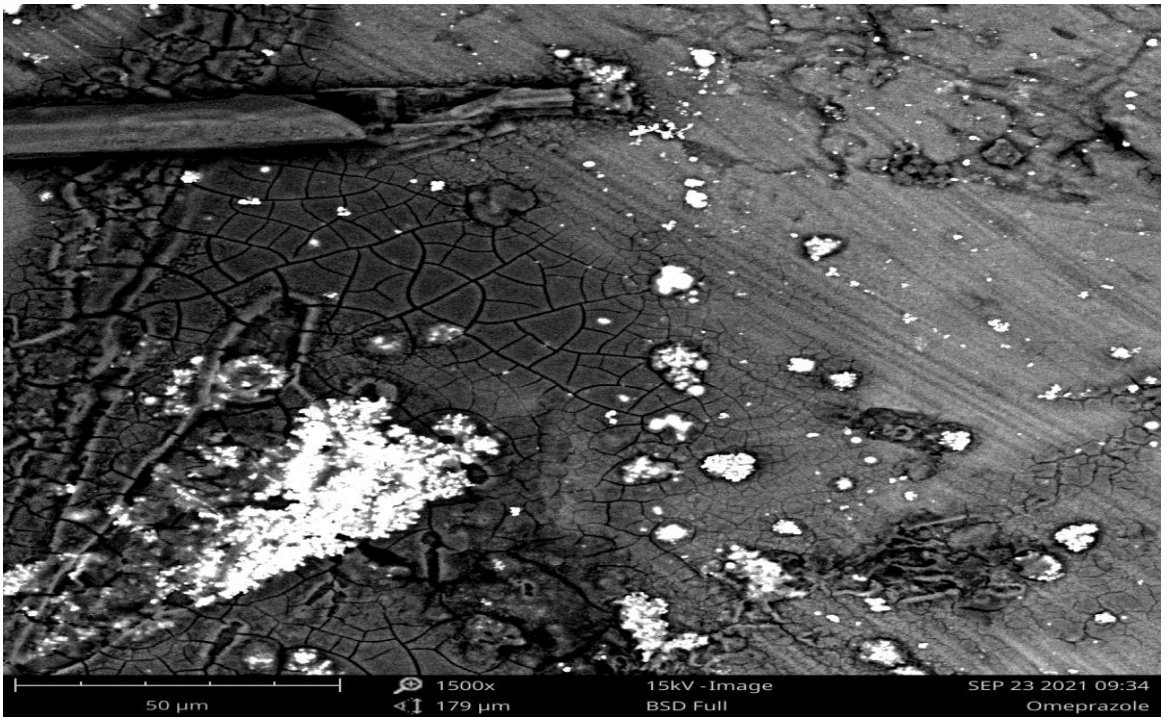

Figure 3: SEM for Omeprazole-silver nanoparticles

4. DISCUSSION

The two batches had characteristic color change from yellow to reddish brown indicating the formation of silver nanoparticle [8][5]. The reduction of silver ions was evidenced by a distinct color transition of the solution from yellow to reddish brown. The UV-Vis spectrum of the reaction medium exhibited an emission peak at 320.5 nm, which is indicative of the absorbance characteristic of silver nanoparticles, demonstrating the presence of well-dispersed nanoparticles in the aqueous solution without evidence of aggregation. The scanning electron microscopy of omeprazole powder (figure 2) showed the formation of spherical well-dispersed particles with an average size of 100µm while that of omeprazole nanoparticle (fig 3) depicted the formation of silver nanoparticles with a value of 500nm. The average particle size of the synthesized nanoparticles was determined to be 70.37 nm.

5. CONCLUSION

From the research carried out, green synthesis of nanoparticles loaded with omeprazole was successfully carried out and confirmed by ultraviolet-visible light spectroscopy, scanning electron microscopy and Fourier transform-infrared spectroscopy. It has also been proven that Curcuma longa is a good reducing agent and stabilizer in the synthesis of silver nanoparticles.

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Conflict of Interest

Authors declared no conflict of interest

Contribution of Authors

Bernard O. Patani - collection and/or assembly of data, writing the article;
Tenderwealth C. Jackson - research concept and design; final approval of the article
Covenant O. Otafu - writing the article
Martha E. Etim - writing the article
Yakndara J. Etim - data analysis and interpretation;
Grace U. Ntia - collection and/or assembly of data collection
Ekema S. Essien - collection and/or assembly of data

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