Antioxidant Activity of Silver Nanoparticles Prepared from Capsicum Annuum (Bell Pepper) Extract

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Abstract Vegetables have reported to contain high content of wide verity of important phytochemicals that can be used in medical approach. Bell pepper are one of the most important vegetables that can be used as spice in foods, as well as it has a diversity of the phytochemical compounds. Carotenoids, vitamin A, vitamin C, polyphenolic compounds and other metabolites were found in bell peppers of all colors. Red pepper is characterized by its high content of β-carotene. Our goal was to prepare an aqueous red pepper extract solution and use it to synthesize Ag NPs, then examine the antioxidant activity of the extract and the nanoparticle solutions. Ag NPs were prepared at room temperature by utilizing the aqueous red pepper extract solution as well as characterized by using UV-Vis spectrophotometry and field emission scanning electron microscope. The characterization result has shown the presence of Ag NPs in particle average of approximately 58 nm. The antioxidant activity was determined by using a DPPH assay, where ascorbic acid has shown IC50 of 23.71 μg/mL which was lower than Ag NPs (IC50 = 43.72 μg/mL). The best antioxidant behavior was obtained from the red pepper extract solution (IC50 = 17.26 μg/mL). This may attributed to the high content of phytochemicals in the extract solution. Importantly, the use of red pepper extract solution in preparing AgNPs have shown to improve their antioxidant activity, which is considered as good additive to the medical features of Ag NPs.

Keywords: Ag NPs, DPPH, antioxidants, pepper.

1. Introduction

Bell peppers, also known as capsicum, have long been prized for their anti-oxidant effects. Bell pepper, which comes in a variety of colors (green, yellow, orange, and red), has been extensively researched for its potential benefits in a variety of illnesses, particularly those involving mental health. Different bioactive chemicals, as well as considerable levels of beta-carotene (pro vitamin A) and other related substances, are found in bell peppers. When the hue of the bell pepper was compared to the quantities of active ingredients, red bell pepper had the most beta-carotene as well as yellow bell pepper had the least. Antioxidant activity

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was found to be comparable in all bell peppers. Bell pepper was found to prevent the oxidation of important fatty acids when used in cooking [1].

Antioxidants are micronutrients that have become more popular in recent years as a result of their ability to neutralize free radicals or their effects [2]. Free radicals have been linked to the causes of a variety of significant human diseases, including cancer, cardiovascular disease, neurological disorders, diabetes, and arthritis [3]. The antioxidant ability of bell pepper, which has protective effects on brain cells, was discovered in a rat study. Bell pepper chemical components inhibited the oxidation of important lipids in brain cells, which are thought to be crucial for healthy brain function [4].

The use of green chemistry to make biocompatible silver nanoparticles (Ag NPs) has attracted a lot of attention in recent years because of its potential applications in biomedicine. Due to unique features not seen in single molecules or bulk metals, metal nanoparticles are of interest in both study and technology. Nanoparticles have numerous critical uses in catalysis, sensing, and imaging, among others, due to these qualities. Ag is the metal of abundance among the beneficent metals (e.g., Au, Pt, Ag, as well as Pd) for potential applications in biological systems, living creatures, and medicine.

Ag NPs have a wide range of applications due to their exceptional properties, including catalysts in chemical reactions [5, 6], electrical batteries, as well as spectrally discriminative coatings for solar energy absorption [7, 8], optical elements, pharmaceutical works, also chemical sensing as well as biosensing [9-11]. The rate of nanoparticle production using plant extracts is comparable to chemical approaches in addition faster than green synthesis using microorganisms [12]. We have aimed to synthesis Ag NPs by using an extract of red sweet pepper and investigate the antioxidant activity exhibited by the nanoparticles with reference to ascorbic acid as standard.

2. Materials and Methods

2.1. Materials

Red sweet pepper were purchased fresh from the local market. Silver nitrate, Diphenyl-1-picrylhydrazyl (DPPH), and methanol were purchased from Merck (Germany).

2.2. Preparation of pepper extract

The red peppers were washed and cleaned perfectly with water, then it was cut to pieces. 100g of pepper cuts were placed in the blender with 250mL of deionized water and then blended for a few minutes. The mixture was filtered by using Whatman filter paper No.1 and the aqueous solution of the pepper was stored at 4 °C.

2.3. Preparation of Ag Nps

The nanoparticles of sliver was prepared according to the previous method reported by Agarwal *et al.* [13] In a beaker, 10mL of 0.01M $AgNO_3$ were mixed with 100mL of fresh pepper extract solution. The mixture was stirred at 27 °C until the color of the solution was changed from light red to dark brown solution. This was attributed to the reduction of silver ($Ag^+ \rightarrow Ag^0$). The solution was filtered and dried at 65 °C overnight in close oven. Then the precipitate was collected and stored for analyses.

2.4. Characterization of Ag NPs

The absorbance (A) spectrum of the prepared Ag NPs was examined by using UV-T80 spectrophotometer (Labomed, UK) with interval in range of 200-700 at 1 nm measuring interval. The morphology of Ag NPs was monitored by FESEM (Tescan, mira3, France) at

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20 kV voltage accelerating in high vacuum. Horizontal and vertical visualization of the films was taking at different magnification.

2.5. Antioxidant assay

The activity of pepper extract solution and AgNPs to scavenge DPPH was determined in a spectrophotometric method [14]. A series of concentrations (in methanol) each of ascorbic acid, pepper extract solution, and Ag NPs were prepared (10, 20, 40, 80, and 160 µg/mL). A weight of 0.36 g of DPPH was dissolved in 4mL methanol. 0.15mL of the DPPH solution was mixed with 3mL of each of the prepared concentrations, and with deionized water as control. The tubes were allowed to stand in dark for 30 minutes, then the absorbance of each tube was determine at 517 nm. The activity of each material was calculated from the following equation:
$\% \text{ Activity} = (A_{DPPH} - A_{test}) / A_{DPPH}$

3. Results and Discussion

3.1. Characterization of Ag NPs

Figure 1 shows the UV-Vis absorbance spectrum of Ag NPs. The peak around 450nm refers to the formation of Ag NPs, while the sharp shape of the peak could indicate the presence of a relative small particles in nm. These outcomes are in agreement with the study of Tripathi *et al.* [15] and Taha *et al.* [16].

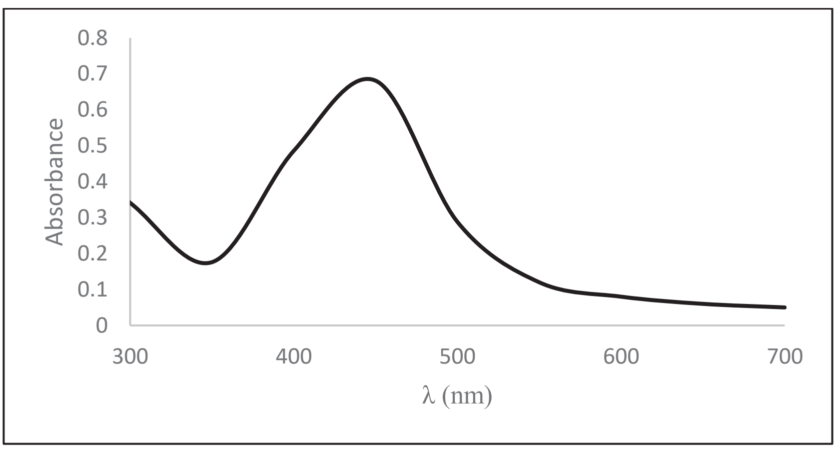

Figure 1: UV-Vis spectrum of Ag NPs prepared from pepper extract solution.

Figure 2 shows the FESEM image of Ag NPs, the particles appeared in a spherical-like shape with agglomeration. The Ag NPs average size was around 58 nm, which gave the particles good medical features.

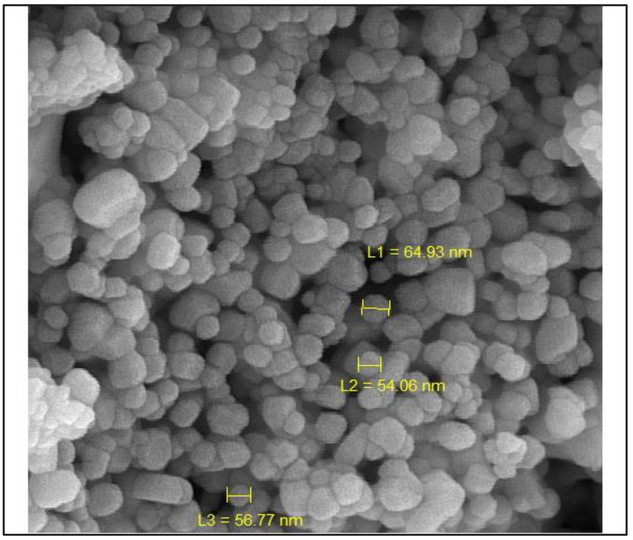

Figure 2: FESEM image of Ag NPs.

3.2. Antioxidant activity

Figure 3 shows the inhibition percentage of ascorbic acid against DPPH. The IC50 (the concentration required to achieve 50% inhibition of DPPH) of ascorbic acid was obtained as 23.71 μg/mL. This was very close to the recorded activity of vitamin C in methanol [17].

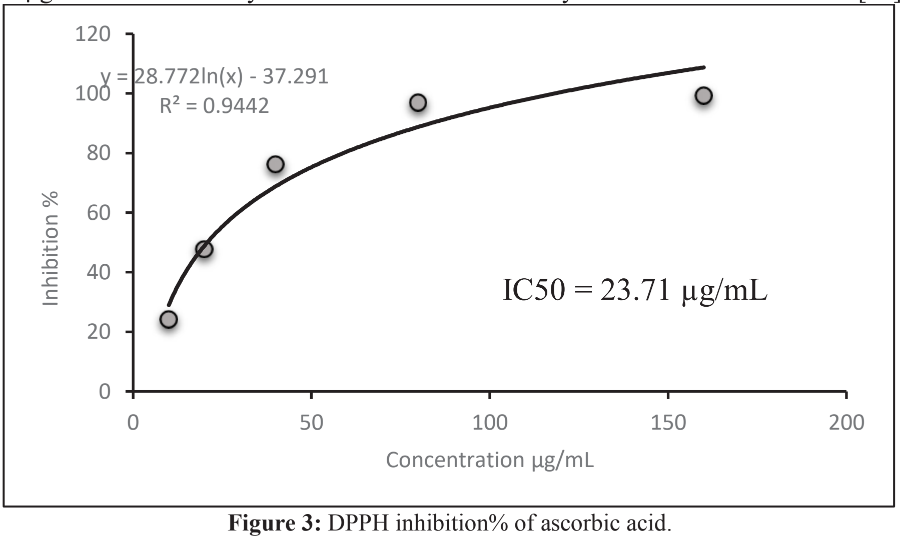

Figure 3: DPPH inhibition% of ascorbic acid.

Figure 4 shows the inhibition percentage of pepper extract solution against DPPH. The IC50 of the pepper extract was obtained as 17.26 μg/mL. This means that the pepper extract solution could exhibit a greater antioxidant activity compared to vitamin C at the same dose. This can be explained by the phytochemical content of red bell pepper, as it was reported to contain a high percentage of β-carotene, vitamin C, vitamin A, and polyphenolic compounds [18-20]. The presence of these components in the pepper extract solution would make up a network of cooperated material that are work together to detoxify DPPH, which make them more powerful than ascorbic acid by its own.

Figure 5 shows the inhibition percentage of Ag NPs against DPPH. The IC50 of Ag NPs was obtained to be 43.72 μg/mL, and it was the lowest IC50 of the three tested materials. It was reported that Ag NPs prepared by green method from plant extract have gained an antioxidant activity but still lower than ascorbic acid [21], which is agreed with our data.

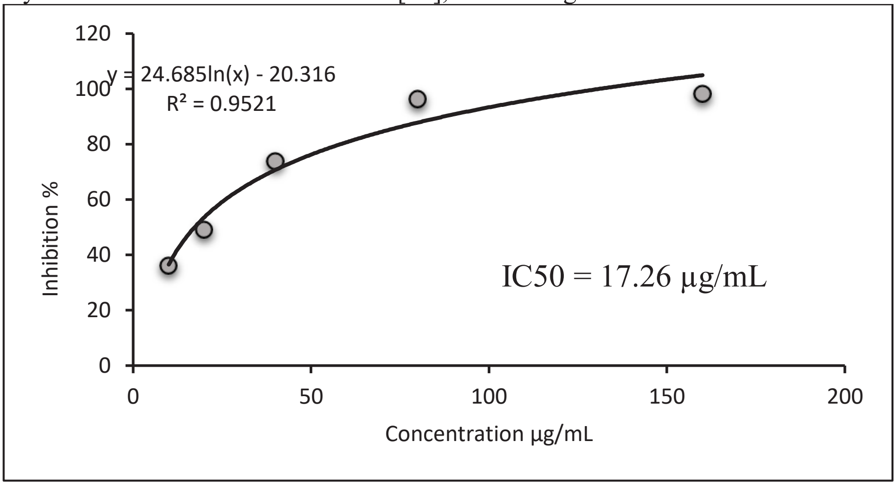

Figure 4: DPPH inhibition% of pepper extract solution.

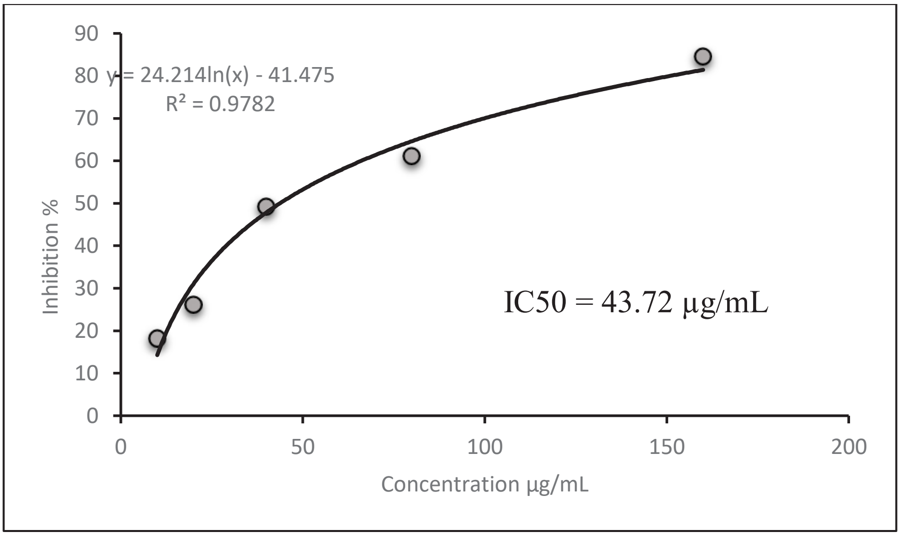

Figure 5: DPPH inhibition% of Ag NPs.

4. Conclusion

Red bell pepper extract solution was a good reducing agent to prepared silver nanoparticles in efficient quantity with non-toxic behaviors and low cost. The data indicated an average particle around 58 nm of Ag NPs that synthesized in this method. The DPPH assay has revealed that pepper extract solution is more powerful antioxidant compared to ascorbic acid at the same concentration. Furthermore, using pepper extract in synthesizing Ag NPs has shown to produce an antioxidant behavior to the nanoparticles. This is a beneficial additive to the already remarkable medical features of Ag NPs.

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