

## 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 variety 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  $\beta$ -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  $IC_{50}$  of 23.71  $\mu\text{g/mL}$  which was lower than Ag NPs ( $IC_{50} = 43.72 \mu\text{g/mL}$ ). The best antioxidant behavior was obtained from the red pepper extract solution ( $IC_{50} = 17.26 \mu\text{g/mL}$ ). 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

Capsicum, usually referred to as bell peppers, have long been praised for its antioxidant properties. Bell peppers are

available in a range of hues, including green, yellow, orange, and red. They have been the subject of substantial research regarding their possible health benefits for

a number of disorders, notably those concerning the mental health. Bell peppers contain a variety of bioactive molecules, as well as high levels of beta-carotene (pro vitamin A) and other related compounds. The amount of beta-carotene varied depending on the color of the bell pepper, with red having the highest amount and yellow having the lowest. All bell peppers were found to have similar antioxidant activity. Bell pepper was found to prevent the oxidation of important fatty acids when used in cooking [1]. Micronutrients known as antioxidants have gained popularity recently due to their capacity to counteract the effects of free radicals or their presence [2]. Numerous serious human illnesses, including as cancer, cardiovascular disease, neurological conditions, diabetes, and arthritis, have been related to the sources of free radicals [3]. A rat study revealed bell pepper's antioxidant capacity, which has protective benefits on brain cells. Bell pepper chemical components prevented the oxidation of vital lipids known to be essential for good brain function in brain cells [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 into 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 silver was prepared according to the previous method reported by Agarwal *et al.* [13] In a beaker, 10mL of 0.01M AgNO<sub>3</sub> 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 ( $\text{Ag}^+ \rightarrow \text{Ag}^0$ ). 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 20 kV voltage accelerating in high vacuum. Horizontal

and vertical visualization of the films was taking at different magnification.

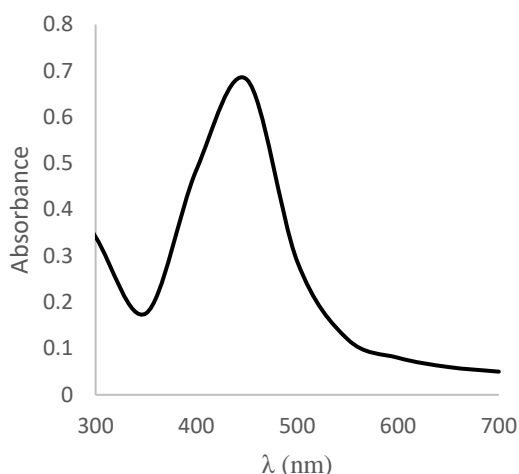
## 2.5. Antioxidant assay

Employing a spectrophotometric technique, the ability of pepper extract solution and Ag NPs to remove DPPH was determined [14]. Ascorbic acid, pepper extract solution, and Ag NPs were produced in a series of concentrations (10, 20, 40, 80, and 160 g/mL) in methanol. In 4 mL of methanol, 0.36 g of DPPH was dissolved. Deionized water served as the control, and 0.15 mL of the DPPH solution was combined with 3 mL of each of the produced concentrations. The tubes were left in the dark for 30 minutes, after which each tube's absorbance at 517 nm was measured. The following equation was used to calculate each material's activity: % Activity =  $(A_{\text{DPPH}} - A_{\text{test}}) / A_{\text{DPPH}}$

## 3. Results and Discussion

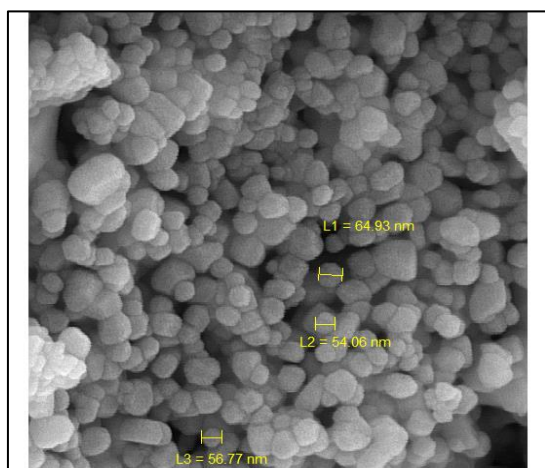
### 3.1. Characterization of Ag NPs

Figure 1 shows the UV-Vis absorbance spectrum of Ag NPs. The peak around 450nm refers to the formation of Ag NPs, while the broad shape of the peak could indicate the presence of a relatively 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.

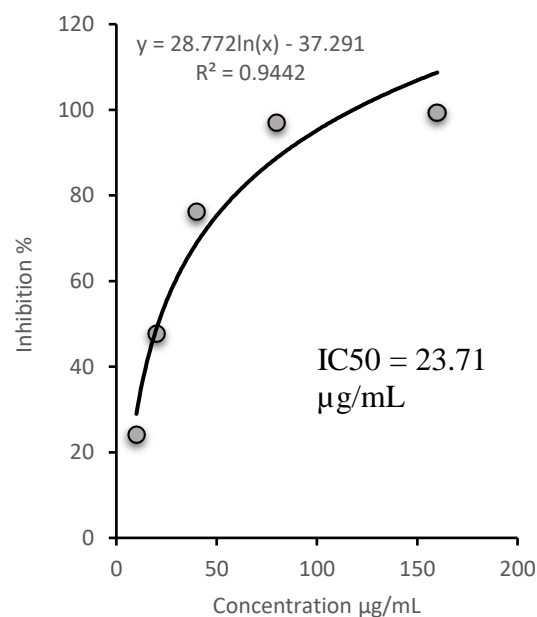


**Figure 2:** FESEM image of Ag NPs.

### 3.2. Antioxidant activity

Figure 3 shows the inhibition percentage of ascorbic acid against DPPH. The IC<sub>50</sub> (the concentration required to achieve 50% inhibition of DPPH) of ascorbic acid was obtained as 23.71 μg/mL. This was very

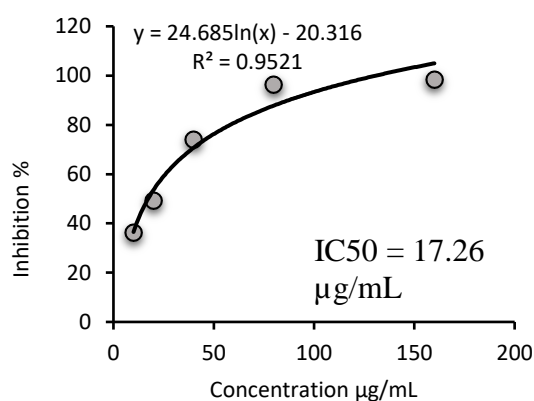
close to the recorded activity of vitamin C in methanol [17].



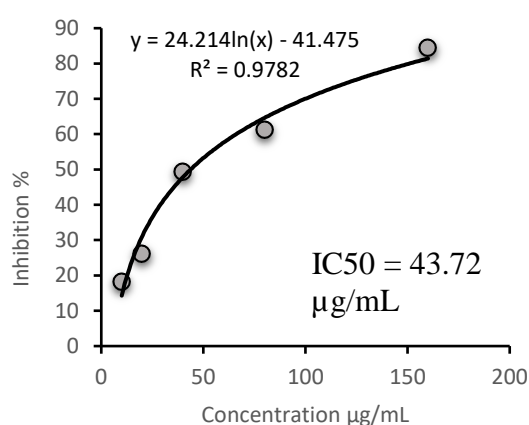
**Figure 3:** DPPH inhibition% of ascorbic acid.

Figure 4 shows the inhibition percentage of pepper extract solution against DPPH. The IC<sub>50</sub> 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 IC<sub>50</sub> of Ag NPs was obtained to be 43.72 µg/mL, and it was the lowest IC<sub>50</sub> 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.

#### 5. References

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