SYNTHESIS OF COLLOIDAL AgNP – SUBSTITUTED ZnPc SYSTEMS AND THEIR ANTIMICROBIAL ACTIVITY

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Colloidal solutions of noble metals have catalytic properties and biological properties. It is known to use them as catalysts for carrying out various transformations of organic compounds, and also for the defense against pathogens [1]. In addition, colloidal silver is also promising for the manufacture of lubricating and light-absorbing materials, coatings, sensors, conductive pastes, highly effective electrode materials, etc. The main method for the synthesis of colloidal silver is reduction of Ag(I) cations using various reducing agents. For the stabilization of AgNP different compounds are used, including high molecular weight ones (polyvinylpyrrolidone, polyvinyl alcohol, etc.). The synthesis of colloidal silver was carried out using next technologies:

1. To 100 mL deionized H_2O, 0.002 ml $AgNO_3$ solution is added. The vessel with solution is placed in a water bath, heated to 50 ℃ and subjected to continuous stirring. When the set temperature is reached, 3 drops of 0.01 mL of tannic acid and 3 drops of 1% trisodium citrate solution was added. After 20 minutes of continuous stirring, the heater is disconnected. It is obtained a light-yellow solution. Testing by centrifugation the obtained solution showed that sedimentation does not occur.
2. To 99.9 mL deionized H2O it adds 0.1 g of "Glucose Anhydrous” (ACS), then under the action of continuous stirring and upon reaching the temperature of 50 ℃, the 0.002 mL AgNO3 solution is added. As a stabilizer 3 drops of tannic acid are used.

After 20 minutes of continuous stirring, the heater is disconnected. A light brown colloidal Ag solution is obtained.

3. The prepared colloidal AgNPs were characterized by using ultraviolet-visible (UV-Vis) spectroscopy. The absorption spectrum of AgNP colloidal solution shown a peak at around 420 nm in the case when is used glucose as reducing agent, while in the case of tannic acid agent, the absorption peak is situated at 410 nm. The use of tannic acid as a reducing agent in the synthesis of AgNp provides colloidal solutions with more astability. Both Ag colloidal solutions were conjugated by self-assembly with water-soluble Zinc Phthalocyanine (ZnPc) substituted with sulfur-containing group. Probably, electrostatic attraction occurs between negatively charged Pcs and positively charged AgNPs. The conjugates were evaluated for photodynamic antimicrobial chemotherapy against *S. aureu and, E. coli.* The concentrations of ZnPc-AgNP were optimised for each of the microorganisms wherein 5 μM of the of ZnPc-AgNP was applied for *S. aureus* and 10 μM was applied for *E. coli*. Log reductions (LR) were used for the quantification of viable microorganisms [2]. The LR = log (number of organisms per carrier before exposure) – log (number of organisms per carrier after exposure). The calculated log reductions for the ZnPc-AgNP with tannic acid and glucose agents are listed in the below table.

Sample	Log reduction	
	S. aureus	E. coli
ZnPc- AgNP- glucose	7.38	6.86
ZnPc- AgNP-tannic acid	8.70	7.35

The microorganisms treated with ZnPc- AgNP using tannic acid as reducing agent show a greater survival percentage than when treated with ZnPc- AgNP- glucose reducing agent.

References:

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