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SILICA SUPPORTED COPPER, SILVER AND IRON FOR REMOVAL OF E-COLI FROM WATER

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Abstract - Silica supported materials were prepared from nitrate precursor of silver, copper and iron. Wet impregnation method was adopted to synthesize the material. The antimicrobial activity of prepared materials against Escherichia coli was investigated as a model for Gram-negative bacteria. Bacteriological tests were performed in nutrient broth medium with same amount of different materials. Antimicrobial efficacy of the prepared material was evaluated and compared. It was found that the material prepared from copper nitrate was the most effective among all showing 38 % growth of E. coli after 24 hours.

Keywords - Silica, Copper, Wet impregnation, Antimicrobial, E. coli.

INTRODUCTION

Water purification generally means freeing water from any kind of impurity it contains, such as contaminants or microorganisms. At the beginning of the 21st century, major three of these factors - microbiology, chemicals, and aesthetics - are foci for consumers, water producers, and monitoring agencies related to the delivery of safe drinking water [1]. Escherichia coli, is a rising cause of food borne and waterborne illness. Although most strains of E. coli are harmless and live in the intestines of healthy humans and animals, it produces a powerful toxin and can cause severe illness. Contamination of drinking water by microorganisms represents a chief human health hazard in many parts of the world. An estimated 3.4 million deaths a year are attributable to waterborne diseases [11]. Conventional methods of water purification has some demerits. Distillation takes time, uses electricity and requires periodic cleaning of apparatus to purify the water. UV radiation is not suitable for water with high levels of suspended solids, turbidity, color, any non-living contaminants or soluble organic matter. Ozone treatment can create undesirable byproducts, requires electricity to operate and not effective at removing dissolved minerals and salts.

Some pesticides, solvents and other volatile organic chemicals (VOCs) are not completely removed by RO. Depending on the type of impurity or contamination present in the water, considerable progress has been made to utilize the chemistry of nanomaterials for water purification. The application of noble metal nanoparticle based process for drinking water purification can be applied for three major types of contaminants: halogenated organic compounds including pesticides, heavy metals and microbes [12]. Nanotechnology provides a long-term water quality, availability and viability of water resources. For this different forms of materials having nanoparticles like filters, tubes, membranes can be used, which facilitates reuse & recycling of Water [8]. Antimicrobial activity of starch capped water soluble copper nanoparticles is excellent[7]. Some natural and engineered nanomaterials have demonstrated strong antimicrobial properties by damaging cell components and viruses compromising the bacterial cell envelope, interruption of energy transduction and inhibition of enzyme activity and DNA synthesis [5]. The
antimicrobial activity of silver nano particles was observed against all tested microorganisms at a very low concentration of 24 µg/ml [9] Fe2[FeL3](4+) was found bactericidal for E. coli also it binds bacterial DNA in vivo and, strikingly, that it kills B. subtilis cells very rapidly [10]. Therefore three different metals (Cu, Ag and Fe) are used in this study to check anti-microbial behavior against gram negative bacteria Escherichia coli.

EXPERIMENTAL

Materials: The chromatographic silica gel (100-200 mesh size), concentrated HCl (35%), copper nitrate, silver nitrate and iron nitrate were purchased from Merck, India. All the chemicals were used without any further purification. E. coli culture (24 hours old) was used in the experiment to evaluate the antimicrobial activity of the prepared samples. Nutrient broth for growing and maintaining bacterial culture was obtained from Himedia.

Synthesis of silica supported materials: The silica gel was washed with dill HCl solution, with distilled water and drying at 100°C for 14 h prior to use. The silica supported copper samples were synthesized by wet impregnation of silica (20 g) with 200 mL aqueous solution of copper nitrate, silver nitrate and iron nitrate under stirring for 24 h at room temperature. The copper, silver and iron impregnated materials were filtered and washed with distilled water to remove free copper, silver and iron and nitrate ions and then dried at 120°C for 5 h in oven followed by calcinations at 500°C for 5 h in muffle furnace. In the sample nomenclature used, SCu stands for supported copper samples, SAg stands for supported silver samples and SFe stands for supported iron samples and N in parentheses denote the nitrate precursors, respectively. The number 1 in parentheses represents the molar concentration of copper, silver and iron salt solution as 0.5 M.

Characterization of silica supported copper samples: The copper content in the copper containing samples was estimated by Atomic adsorption spectroscopy (AAS double beam Elico,SL-243, India). Copper content found on the surface was 1.8% wt for copper nitrate precursor.

ANTIMICROBIAL BEHAVIOUR

Experiments to examine growth delay were conducted for each after calculations of the material. To assess the inhibition of E. coli growth in presence of supported copper, silver and iron samples, optical density of the medium was measured at different time interval using UV-VIS spectrophotometer (Systronic UV spectrophotometer-166) under ambient conditions. Optical density (OD) of the medium was measured at 600 nm. 0.5 mL E coli culture having OD equals to 0.8 was then inoculated with a 4.5 mL sterilized Nutrient both medium and taken as the reference. 0.5 mL E coli culture having OD equals to 0.8 was then inoculated with a 4.5 mL sterilized Nutrient both medium along with 10 mg supported copper. This was taken as the test sample. The same test samples were prepared with 10 mg supported silver and 10 mg supported iron samples separately. After that optical density of the medium was measured at different time.

Table 1. Inhibitory Action of prepared materials.

<table>
<thead>
<tr>
<th>Sample code</th>
<th>Optical density after 24 Hrs.</th>
<th>% growth</th>
<th>% inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCuN1</td>
<td>0.432</td>
<td>38.12886</td>
<td>61.871</td>
</tr>
<tr>
<td>SFeN1</td>
<td>0.537</td>
<td>47.39629</td>
<td>52.603</td>
</tr>
<tr>
<td>SAgN1</td>
<td>0.654</td>
<td>57.77286</td>
<td>42.277</td>
</tr>
<tr>
<td>N-broth &amp; E. coli</td>
<td>1.135</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>
RESULT AND DISCUSSION

Copper has a long history of usage in sanitary and medical contexts because of its antimicrobial properties [3,6]. To evaluate antimicrobial activity, optical density of the prepared materials were measured. E. coli culture grown in the nutrient broth medium was taken as the reference. Comparison of optical density of the different test samples in which silica supported materials (Cu, Ag, Fe) were introduced was done. It was observed that all the prepared silica supported materials showed a decrease in optical density of the medium as compared with that of reference. This was because of antimicrobial nature of all the materials derived from different metals. Also samples treated with copper showed the highest surface area and metal ions exposure resulting in high activity against E. coli.

Copper attached to the bacterial cell wall causes irreversible damage to the membrane eventually leading to cell death. A 7-log reduction was obtained in 75 min for copper, but no meaningful reduction was seen at 360 min on the silver ion-containing materials or the experimental control stainless steel [4]. U.S. Environmental Protection Agency officially registered copper alloys, allowing them to be marketed with the label “kills 99.9% of bacteria within two hours.” Copper ions are known to penetrate bacteria and disrupt molecular pathways important for their survival [2]. In this study, Copper supported on silica showed minimum bacterial growth (38%) and maximum inhibition (61.87%) as compared to silver and iron supported on silica.

REFERENCES


Antimicrobials: Silver (and Copper) Bullets to Kill Bacteria, Science Daily, Nov. 10, 2009.


Comparing Antimicrobial Efficacy of Copper and Silver for Interior Touch Surface Applications, Copper Development Association, UK. Elsevier, water research, volume 42, issue 18, pg 4591-4602.


Souter PF et al., Evaluation of a new water treatment for point-of-use household applications to remove microorganisms and arsenic from drinking water, J Water Health, 2003 Jun, 1(2), 73 - 84.