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ANTIMICROBIAL ACTIVITIES OF GERANIUM EXTRACT AND SILVER, COPPER NANOPARTICLES

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ABSTRACT

The antimicrobial of silver and copper nanoparticles were recently focused on studied in the literature. In this article five experiments were done to see the effect of silver and copper nanoparticles alone or with Geranium leaf extract on two grams positive and two grams negative bacteria beside *Candida albicans*as fungi. The effect of both nanoparticles was higher in *Pseudomonasaerugenosa* and *E.coli*, while the lower effect was on *Streptococcus pyogenes* and *Bacillus cereus*. Silver nanoparticles alone had better effect on *Candida albicans* growth than other treatments. In our opinion this is the first experiment to be done on the effect of silver and copper Nanoparticles on Iraqi bacterial strains.

Key Words: Silver and copper Nanoparticles, *Bacteria*, Fungi, Antimicrobial.

INTRODUCTION

WHO estimates that 25% of the total 57 million annual deaths that occur worldwide are caused by microbes and this proportion is significantly higher in developing countries, With the increase in urban population density, emerging and re-emerging food borne and water borne diseases caused by multi-resistant pathogenic organisms constitute a major threat in the world. Antimicrobial resistance is a major factor in virtually all infections and poses serious public health problems. These concerns have led to major research effort to discover alternative strategies for the treatment of bacterial infections (Manonmani V and Juliet V, 2011). A rapid increase in microbes that are resistant to conventionally-used antibiotics has been observed in recent years (Goffeau A, 2008). Currently used antibiotic agents are failing to bring an end to many bacterial infections due to super resistant strains. Plants have a great potential for producing new drugs of great benefit to mankind. There are many approaches to the search for new biologically active principles in higher plants (Farnsworth NR, 1987).

One of such resources is folk medicine and systematic screening of them may result in the discovery of novel effective compounds (Kuda O *et al*., 2009).

As a result, there has been a tremendous increase in knowledge of microbial pathogenesis and development of new therapeutics. But the rate of morbidity and mortality due to the microbial infections is still high(Taneja SK and Dhiman RK, 2011). Therefore, it is a pressing need to discover novel strategies and develop new antimicrobial agents by easy, rapid, and eco-friendly route with broad-spectrum antimicrobial activity. Such kinds of agents will be the new generation of antimicrobial agents, which will control a wide range of microbial infections (Rai *et al*., 2009).

Recent advances in the field of nanotechnology leads to the development of different inorganic and organic nanomaterials including nanoparticles, which are finding a multiple applications in many sectors like electronics, medicine, pharmaceuticals, therapeutics, textile industries, and in food packaging (Bhattacharya S *et al*., 2012; Cohen-Karni T *et al*., 2012; Duncan TV, 2011; Surendiran A *et al*., 2009; Tauran Y *et al*., 2013; Teli M and Sheikh J, 2013).

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Green synthesis provides advantages over chemical and physical method as it is cost effective, environment friendly, easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals (Ojha AK *et al*., 2013).

Nanomaterials, particularly metal nanoparticles, ranging from 1–100 nm possess different unique properties like physicochemical, electrical, optical, and most important biological as that of their bulk metal. The antimicrobial activity of various metal nanoparticles including silver nanoparticles is well studied and known, but the efficacy of copper nanoparticles on different microorganisms has been less studied, and therefore, a little literature is available on it as compared to the activity of silver nanoparticles. The available results on antimicrobial studies of silver nanoparticles, copper nanoparticles and both with Geranium (*Pelargonium graveolens) leaves* as plant extract proved the effectiveness of copper nanoparticles against various bacteria and fungi infections.

MATERIALS AND METHODS

Nanoperticles for silver and copper were imported from NANO pars SPADANA Technology. The concentration was 4000mg/l for silver Nanoparticles and 800 mg/l for copper respectively.

The bacteria and fungi samples were collected from postgraduate students, they were identifying by special team in the University. Three Antibiotics were used as follow:

Sofalaxin 500mg/l, used for *E.coli*, *S.pyogenes*, *B.cereus*., fefirm 100mg/l, for *P.aerugenosa*, imidazole 125mg/l for *Candida albicans* . Each antibiotic was prepared in 0.5 mg/l as positive control.

Different media were used to culture those microbes. The preparation of these media was according to the following:

1. Nutrient Agar 28g/l from Himedia laboratory
2. Brain heart 52 g /l from Acumedia company
3. Potato dextrose agar 28g /l from Himedia company .

Five experiments were done as follow:

1. Silver and copper Nanoparticles as they were without dilution.
2. Silver and copper Nanoparticles were diluted to 0.5mg/l and added over bacterial growth samples
3. Silver and copper nanoparticles plus `Geranium extract in ratio 50mg/50ml were added over dishes with bacterial growth
4. Same as in 2 above except the bacterial samples were substituted with Candida growth.
5. The interaction between the bacterial growth and treatments above, were also calculated.

All statistical analysis was done on Genestat computer program version 8.2 .

Figure 1. Silver nanoparticles with different Bacteria

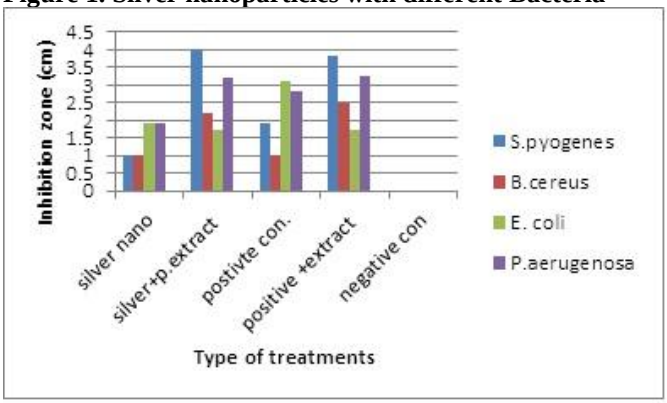


Figure 2. copper nanoparticles with different Bacteria

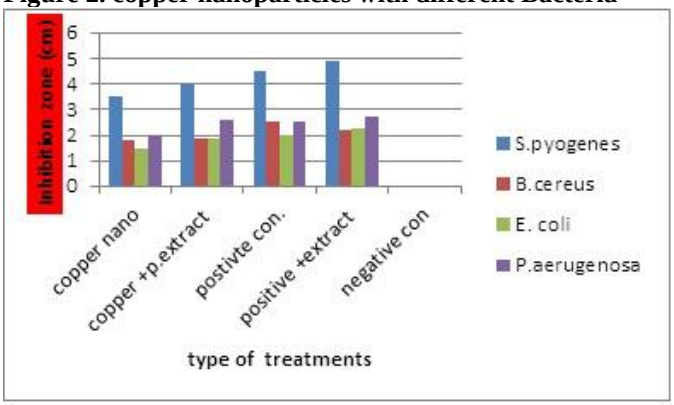


Figure 3. Effect of and copper nanoparticles on *candida spp*

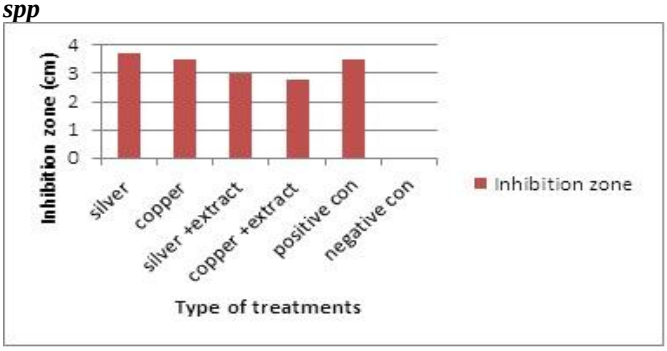


Figure 4. Interactions for silver treatments with bacteria

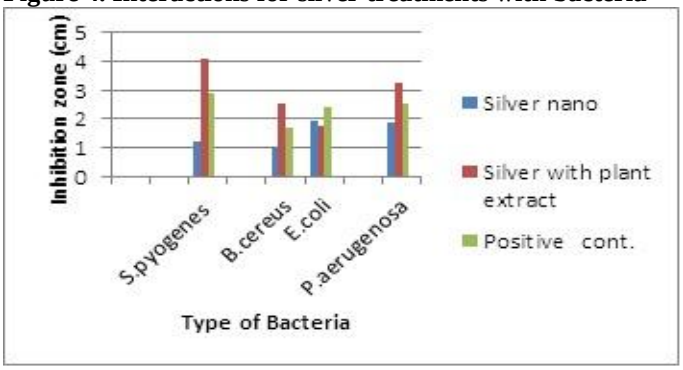
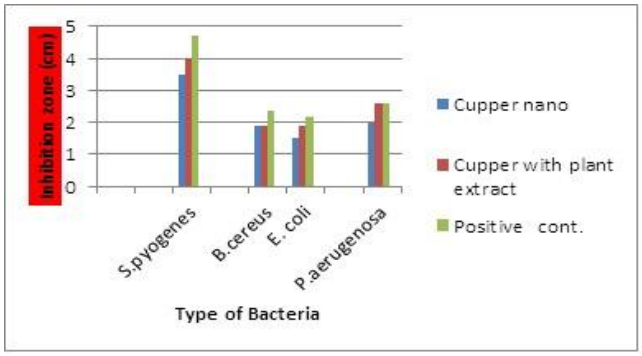


Figure 5. Interaction for copper treatments with Bacteria



RESULTS AND DISCUSSION

In the first experiment the Nanoparticles used as they are without dilution all the bacterial were killed. This may be due to high concentrations of these Nanoparticles. In experiment two, The plant extract had a better effect on *Streptocoocus* spp. than other treatments, similar results were conducted in (Shahverdi AR *et al*., 2007). However, The lowest effect was on *P.aerugenosa* and this may be due to the differences in a cell wall composition between different bacteria.. It has been well known that nanoparticles attach to the cell wall may affect the cell wall functions (Rai M *et al*., 2009). For *E.coli.* The Nano treatments were less than positive control, while, the positive control plus extract had better effect (Figure 1).

As for copper experiment (experiment 3) there were high effects on S.pyogenes and lest effect on *E.coli*. And this may be for the same reason as in experiment 1. (Figure 2). Adding plant extract there were various results according to the type of bacteria. In *E.coli*, and *P.aerugenosa* the plant extract increase the effect, while in *B.cereus* it was reduced the effect. (Figure 4).

In fungi the results (experiment 4). The best effect was on silver nanoparticles and then copper Nanoparticles. Adding plant extract reduced the effect of the Nanoperticles (Figure 3).In experiment 5. Adding plant extract effect the growth for all bacteria, and the more effect was on *S.pyogenes* and lest on *B.cereus*. The silver Nanoparticles was more effective than the fungi.

As for interaction between silver nanoparticles (fig 4) and copper nanoparticles (Figure 5) and bacteria, adding plant extract increase inhibition zone in both figures . Silver and copper nanoparticles were more effective in Gram (-) bacteria than Gram (+), and this may be due to the differences in the structure of cell wall between the two types.

CONCLUSION

There are good effects for Geranium extract as antimicrobial in combination with Nanoparticles or alone. However, these effects may varies according to the type of microbes. We think that this experiment may be the first at least in Iraqi stains of microbes.

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