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Applications of anti-microbial activities of Magnesium oxide nanoparticles against foodborne pathogens in juices

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ABSTRACT
MgO nanoparticles have the strongest antibacterial activity and they work against Pathogenic bacteria which are caused by food products. In the preservation of the Food Industry, different types of antibacterial chemicals are used which prevent. The microbial spoilage such as – MgO nanoparticles has the strongest antibacterial activity which prevents the growth of pathogenic bacteria. MgO suspension (1,3and 5mM) with citric acid have shown a significant inhibitory effect on the growth of all strains during 12 hrs of incubation. When the concentration of MgO NP increased as the antibacterial activity of MgO increased. The antibacterial mechanism is not exactly defined but there are no. A mechanism such as the Formation of reactive oxygen species (ROS), Damaging the cell of the bacteria. And it is due to the formation of reactive oxygen species like superoxide anion. Hence the result that MgO NP with citric acid could potentially be used as an antibacterial agent to increase the shelf life and increase food safety long times.

Keywords: Anti-bacterial agent, Citric acid, Nanoparticle, Magnesium oxide, Micro Organism.

I. INTRODUCTION
Today there are many types of microorganisms present in our environment which are beneficial as well as harmful to our environment. The major effect of microorganisms on food products will cause different food-borne diseases and spoilage. Unpasteurized fruit juices are rich in vitamins, freshness,low caloric value as well as their derivatives. All the components of unpasteurized fruit juices are important for human health. But on the other hand, microbial outbreaks occur at a higher rate than the pasteurized products such as spoilage caused by E.coli, salmonella, and staphylococcus, etc.

In recent years, there are various inorganic antimicrobial agents are used to pathogenic microorganisms in different areas of food industries. The metal oxide including MgO shows antibacterial activity (Sawai, Igarashi & Hashimoto 1995). These nano-sized particles prevent the activity of microbes and improved the various quality of food like physical, chemical, and biological also (Nicole, Vinaya, Koodali& Ranjit, 2008) because of the distinct form of nanoparticles, they were not of much interest in the past. But now due to advanced technology, these particles are not topic for researchers and seek more attention.

MgO nanoparticles can be used in petrochemical products and coating techniques. MgO is also applied in dermatological treatment as it is non-toxic and has antimicrobial properties and works as drug carriers and medical filling materials.

The objective of my research is to study the effect of MgO and citric acid on microbial activity (E.coli, salmonella, staphylococcus) and evaluating their antimicrobial effect on Guava juice and apple juice.

Materials and methods

MgO nanoparticles (average size –20 nm) and citric acid were from Amorphous and nanostructured materials were taken from the laboratory of the Food Science & Technology department of HD&FS.

Culture

Staphylococcus, Escherichia coli, and salmonella were collected from the cultured collection of the department of environmental microbiology lab, BBAU central University, Lucknow.

Antibacterial activity of MgO NP suspension with citric -

Preparation of fruit juice

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Guava and Mango were purchased in a Sahara Ganj mall, Alambagh, Lucknow for obtaining their juices. And each fruit was washed, peeled, cut into small pieces, and blended with a Maharaja blender. The extracted guava & Apple juices were collected in a bowl separately.

Guava and Apple juices were treated with MgO nanoparticles by different concentrations (1, 3, and 5mM of MgO). And citric (0.5%) In uniform suspension and obtained o4 samples –

- Guava juice without nanoparticles and citric acid.
- Guava juice with nanoparticles and citric acid.
- Apple juice without nanoparticles and citric acid.
- Apple juice with nanoparticles and nanoparticles.

Each sample was stored at room temperature 27℃ for 15 days for microbial detection in each sample.

pH determination

The pH of fresh apple and guava juices 4.0±0 and 4.1±.04 respectivelywas determined by pH meter. After the addition of MgO NPs and citric acid, the pH of both samples is slightly acidic (06±2).

Result and Discussion-

Antibacterial activity of citric acid

Antibacterial properties of .5, 1, 1.5, and 2% citric acid were measured in line with the inhibition region method againstE.Coli, salmonella, and staphylococcus. In table 1, different concentrations of citric acid show different inhibition regions.According to the result when increasing the concentration of citric acid increase the inhibition region.

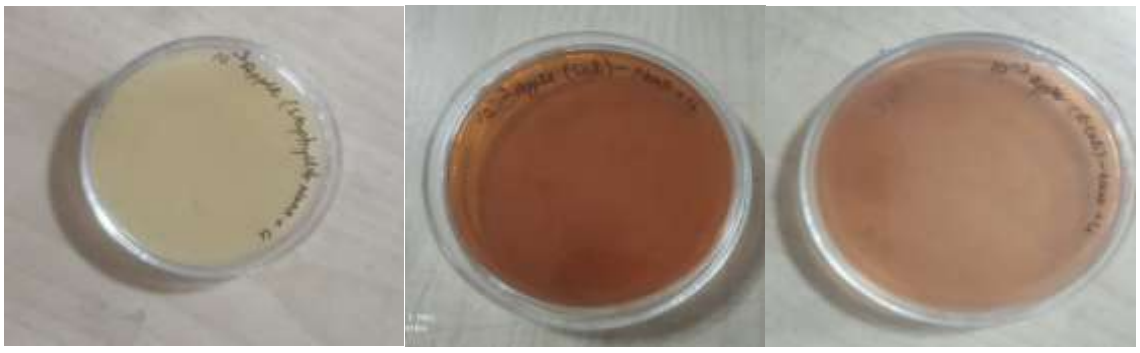
Inhibition region diameter of citric acid

The concentration of acetic acid.	Staphylococcus.	E coli
.5% citric acid	7.0±0	6.5±0.5
1% citric acid.	13.0±5	10.5±.5
1.5 citric acid.	18.5±0	20.0±.5
2% citric acid.	20.5±.5	18.5±.5

Table -1

Detection and antibacterial activity of MgO nanoparticles suspension containing citric acid

MgO NP suspension with citric acid reduces the microbial growth rate when increasing the concentration of MgO NPs then decreased the growth rate of staphylococcus, salmonella, and E.colias compared to control in guava and Apple juice simultaneously. In this study, there is no growth of staphylococcus, salmonella, and E.coliin the sample of guava and Apple juice which are treated with MgO suspension with citric acid within 24hr.at 30℃.



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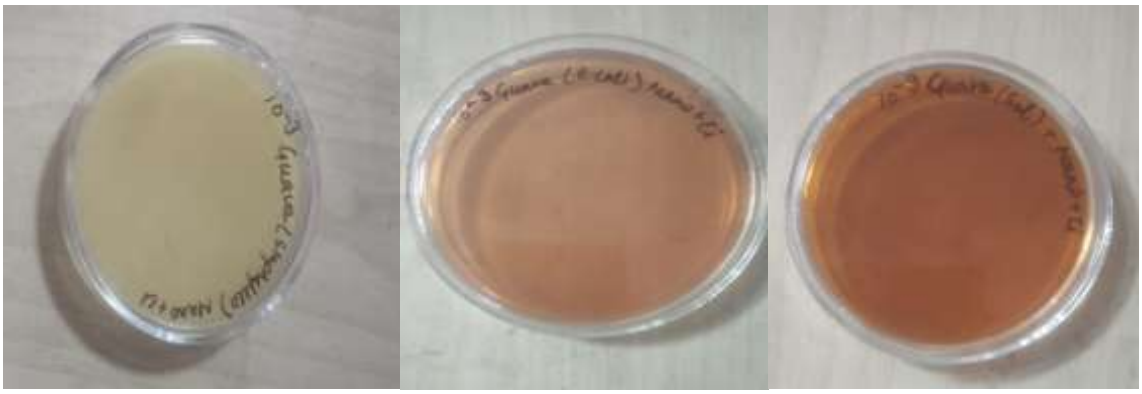


Fig. 1 There is no growth of staphylococcus, salmonella, and E.coli after the mixing of MgO NPs and citric acid in the guava and apple juices.

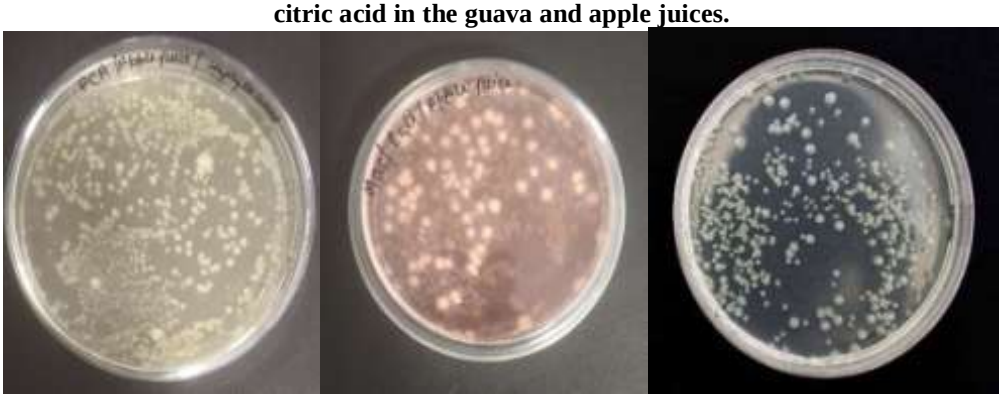
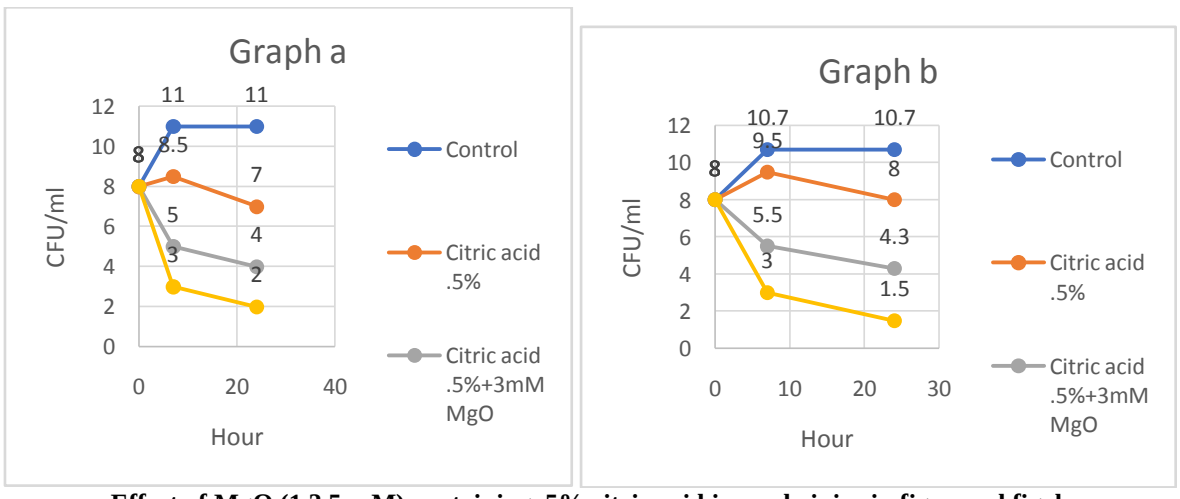


Fig. 2 Growth of Staphylococcus and E.coli before adding the MgO NPs and citric acid in Apple and guava juices.

In fig.1, cell counts of staphylococcus, salmonella, and E.coli in guava and apple juice which are treated MgO nanoparticles suspension with citric acid(.5%), shown no microbial growth rate within 24h. But inthe Control sample of guava and apple juice has a very dense colony of E.coli and staphylococcus will appear In fig.2

In this study when MgO was combined with a .5% concentration of citric acid then this suspension perform synergistic effects, shown strong antibacterial activities against food-born pathogens staphylococcus, salmonella, and E.coli. because MgO and citric acid both have antibacterial properties against pathogens.



Effect of MgO (1,3,5 mM) containing .5% citric acid in apple juice in fig. a and fig. b

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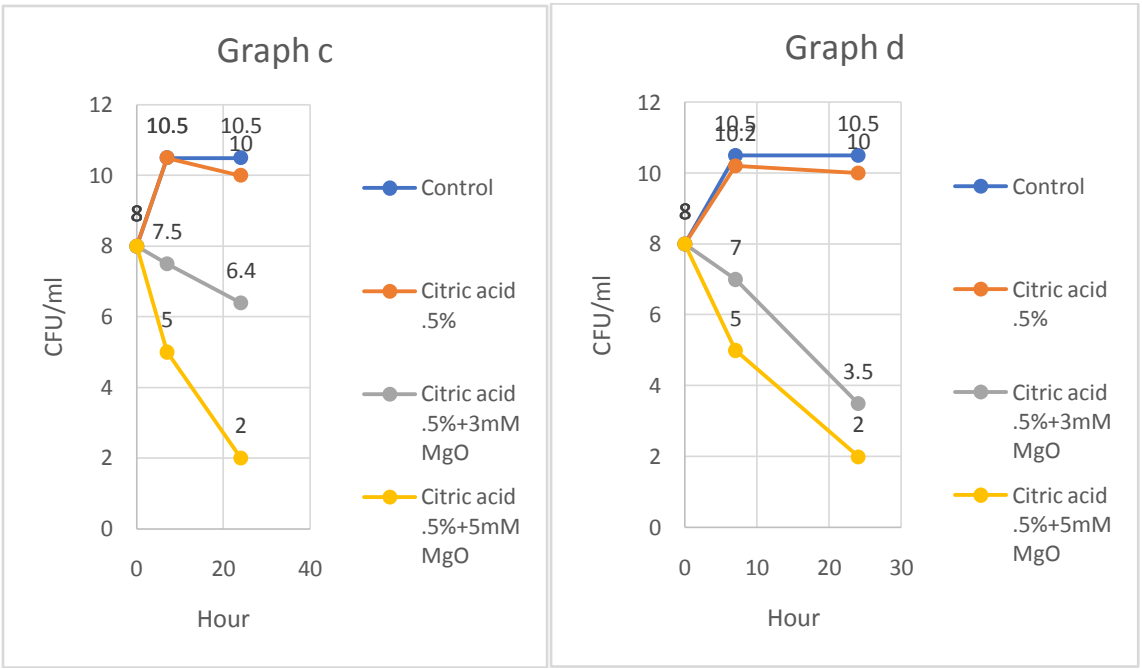

Effect of MgO (1,3,5 mM) containing .5% citric in guava juice in fig. c and fig. d.

MgO NP has very strong antibacterial activity against microorganisms staphylococcus, salmonella, andE.Coli. The activity of the microbes depends on the size of MgO nanoparticles which are shown in different reports. According to Huang et al. (2005), The antibacterial activity was increased with a decrease in the size of MgO NPs.

TheMgO NP have antibacterial properties because they form ROS (Reactive oxygen species) such as superoxide anion (O2-) (Huang et al., 2005 a, b, Lin et al., 2005, Yamamato et al., 2010, Yamamato et al., 2001). It has been reported that when increase the surface area of MgO particles means to decrease the size of particles leads to an increase in the superoxide anion O2- concentration in the solution then they are more damage the cell wall of the bacteria.MgO nanoparticles are less toxic as compared with copper oxide, silver oxide, and other kinds of bactericides and prepared from radially available material under simple conditions (Huang et al. 2005). For human beings, MgOis an essential nutrient and it is found in almost every food. According to The Food and Nutrition Board (1997), the RDA (recommend diary allowances) for men and women is 420 mg/ day and 320 mg/day respectively.

II. CONCLUSION

In this research, MgO NP suspension containing citric acid has shown strong antibacterial activity against staphylococcus, salmonella, and E.coli.MgO synergistically enhances the antibacterial effect when they combine with citric acid. It is a non-toxic material and there are no harmful effects on humans.This study shows that the MgO nanoparticles combine with citric acid then they are more effective against foodborne pathogens and increase the shelf life of apple and guava juices.

Conflict of Interest statement
There is no conflict of interest.
Funding statement
There is no any funding takes place in this research.

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