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PREPARATION OF WATER FILTER USING POLYURETHANE FOAMS COATED WITH SILVER NANOPARTICLES BIOSYNTHESISED FROM *TRACHYSPERMUM AMMI* SEEDS (AJWAIN SEEDS) AND CHECKING THE EFFICACY OF WASTE WATER FILTER.

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Abstract : Silver nanoparticles have been known to the world for its potent antimicrobial property and used in biomedical products for getting beneficiary effects. In the research conducted for assessing the potency of silver nanoparticles synthesised using *trachyspermum ammi* (ajwain seeds), the preparation and modifications of filter were carried out. The waste water filters were prepared using polyurethane foams (PUFs) soaked in the AgNP solution. The reduction in growth of microorganisms in filtered sewage water was assessed qualitatively using the most probable number (MPN) method. The procedure followed for the synthesis of nanoparticles and waste water filter was cost effective, convenient and easy to perform.

Keywords - Silver nanoparticles (AgNPs), *Trachyspermum amm*, polyurethane foams(PUFs), , waste water filters

INTRODUCTION

Each year the increasing death rate is the result of cleanliness issues, sanitation problems and no access to germ free water. Approximately 780 million people around the globe are unable to get clean potable water instead, there's the provision of water from their contaminated resources due to lack of hygiene maintenance. Clean water is more scarce than contaminated water, though, because it's one of the best environments for bacteria to grow. When consumed, these germs may result in a number of illnesses that are harmful to health and even prove fatal. Utilizing the antibacterial properties of silver nanoparticles, contaminating pathogens are successfully removed from water to render it safe for consumption. PU foam is utilized to provide nanoparticles with a sturdy surface.

Given their high stability against chemical deterioration, high mechanical durability, good swelling behavior, ease of separation from a solution, and status as one of the most affordable polymers, filters made of polyurethane foams (PUFs) coated with silver nanoparticles may be a good choice. Additionally, the carbamate group (-NH-(C=O)-O-) found in PU foam increases the silver nanoparticles' antibacterial activity.

Water is the common breeding ground for many pathogens. The presence of bacteria is the main indication of water contamination. In countries such as India, 80% of the diseases are due to bacterial contamination in drinking water. Earlier studies suggests that consumption of contaminated groundwater and surface water sources with pathogenic bacteria such as *Escherichia coli O157:H7, Salmonella typhimurium, Shigella dysenteriae,* and *Vibrio cholera* remains a major cause of diarrheal illnesses and gastrointestinal infections. This indicates that clean drinking water is critical to human health and well-being.

The removal or inactivation of pathogenic microorganisms is the last step in the treatment of wastewater. To achieve this, Stoimenov et al., in 2002 and Zhang et al., in 2003 found out that chemical and physical agents, such as chlorine and its derivatives, AgNO3, ultraviolet light and radiation can be used to decontaminate the water. Another research conducted in 2016 signify the use of polyurethane foams (PUFs) in water purification could be a good approach since these materials exhibit high stability against

chemical degradation, high mechanical durability, good swelling behaviour, ease of separation from a solution and they are also one of the most cost-effective available polymers.

According to recent studies, silver nanoparticles can remove up to 100% of antibacterial action. Extremely better bactericidal activity is obtained from silver nanoparticles as the silver ions present in it show a high surface to volume ratio. Due to silver nanoparticles' potent and wide-ranging antibacterial properties, researchers have been considering using them to clean drinking water. Silver nanoparticles may be easily placed on solid surfaces for the deactivation of microorganisms in the water treatment process due to the improvement of material development.

Paper proposed by Mpenyana-Monyatsi et al., (2012) describes how simple portable devices could eliminate water pathogens by using Silver Nanoparticles, based on their antibacterial properties. Results are showing Silver Nanoparticles retention in the filter structure with *Escherichia coli* bacteria removal.

SYNTHESIS OF SILVER NANOPARTICLES FROM TRACHYSPERMUM AMMI SEEDS (AJWAIN SEEDS) AND ASSESSING ITS ANTIBACTERIAL ACTIVITY AGAINST TARGET MICROORGANISM STAPHYLOCOCCUS AUREUS study was referred for this research. An approach of biosynthesising AgNPs using *Trachyspermum ammi* seeds (Ajwain seeds) extract was achieved using Green chemistry method, demonstrated antimicrobial activity against Gram-positive S. aureus(Anushka *et. al.* 2023).

METHODS AND MATERIALS:

1. Preparation of filter coated with silver nanoparticles to treat Wastewater:

Silver nanoparticles coated polyurethane foam filter preparation:
Polyurethane foams were obtained from local sources and washed 3 times thoroughly with distilled water to remove any adsorbed ions like citrate and were air-dried. 2 different 10cm by 10cm Polyurethane (PU) foams were soaked in both the silver nanoparticles solution extracted for 24h. This leads to saturation coverage. Partial coverage was achieved for shorter exposure times or reduced nanoparticle concentrations. MPN for Filtered water and unfiltered water was performed. Results were observed and noted down.

2. Performing MPN Test

Presumptive test:

3 ml of MacConkey's broth (double strength) in 4 test tubes and 3 ml of Macconkey's broth (single strength) in 8 test tubes were placed. 2 ml of unfiltered water sample to 2 tubes of double strength and 4 tubes of single strength were added. 2 ml of filtered water sample to 2 tubes of double strength and 4 tubes of single strength were added. The tubes were incubated for 24 h and observed for gas production and colour change. Tubes with gas production and colour change were labelled as positive tubes. All positive tubes are taken further for a confirmatory test.

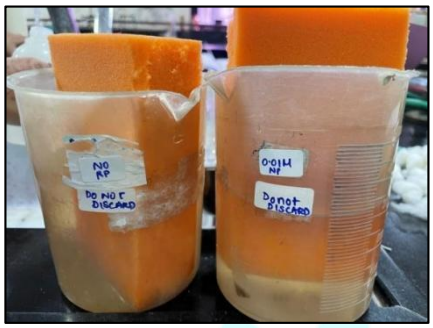
Confirmatory test:

Positive tubes from day 1 were selected. Loopful from each tube were streaked on Eosin Methylene Blue agar and Endo agar plates. Plates were incubated for 48h.

OBSERVATION :

Prepared modified Wastewater filter:

Set up:



A **B**

Fig.1 (**A**) Polyurethane foam soaked in only distilled water
(B) Polyurethane foam soaked in 0.01M AgNP

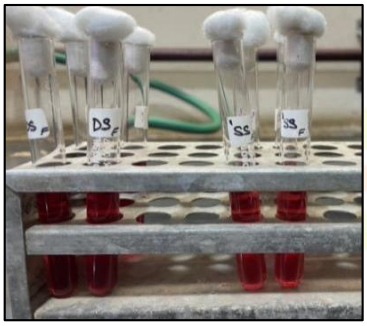


Fig.2 MacConkey broth before incubation

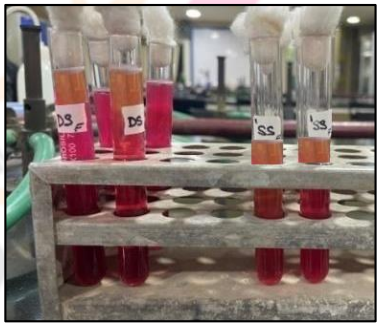


Fig.3 Unfiltered water

MPN day 1 results:

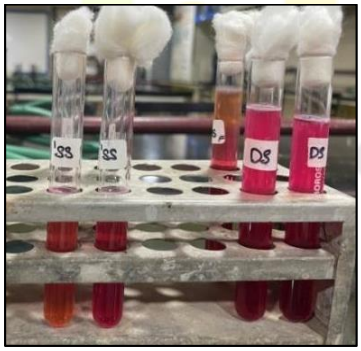


Fig.4 Filtered water through 0.001M AgNp fused filter

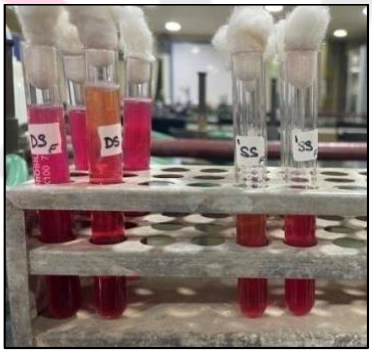


Fig.5 Filtered water through 0.01M AgNP fused filter

Table 1. Result of presumptive test :

Result of MPN Tubes	ss	ss	ds	ds
Filtered water through 0.01M AgNP fused filter	+	+	+	+
Filtered water through 0.001M AgNp fused filter	+	+	++	++
Unfiltered water	+	+	+++	+++

MPN day 2 results:

EMB Agar

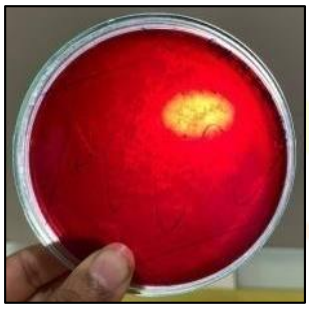


Fig. 6 DS tube of filtered water sample through 0.01M AgNP fused filter

Fig. 7 DS tube of filtered water sample through 0.001M AgNp fused filter

Fig. 8 DS tube of unfiltered water sample

ENDO Agar

Fig. 9 DS tube of filtered water sample through 0.01M AgNP fused filter

Fig. 10 DS tube of filtered water sample through 0.001M AgNp fused filter

Fig.11 DS tube of unfiltered water sample

RESULT :

The filters made up of polyurethane foam after soaking it in water containing silver nanoparticles made from 0.01 M and 0.001 concentrations of silver nitrate were used as AgNP1 and AgNP2 respectively, for filtration of sewage water(Fig. 1). For testing the effectiveness and efficacy of modified water filters the MPN of sewage water before and after the treatment was performed. The MPN day 1 presumptive test showed presence of microorganisms with colour change and gas production in ss and ds tubes for water

filtered from the normal PUF filter whereas the solutions for ss and ds tubes were observed in case of filter soaked in AgNP 1 as compared to AgNP 2 (Fig.3-5). The positive tubes from day 1 tests were streaked onto EMB agar (Fig. 6-8) and Endo agar (Fig. 9-11) which showed only minimal growth for ds turbid tubes of water filtered from the normal PUF filter while no growth for ds tubes was observed in case of filter soaked in AgNP1. The Filter coated with 0.01 M nanoparticles was found to be giving a more inhibitory effect on microorganisms by reduction in their load in water samples.

CONCLUSION :

Through the MPN test, the prepared waste water filter showed its potential by reducing the load of microorganisms in the filtered water. Polyurethane foam was the only component required for the synthesis which made the whole product cost effective and simple. The filter could be used to filter out waste in sewage water or any water body. Although the filter was able to show antimicrobial activity, its toxicity testing needs to be conducted along with the efficiency in reducing inorganic waste. It can be used for water purification to remove pollutants like pesticides, heavy metals and microorganisms, as inhibitors of microbial growth in pond water which causes contagious disease known as white spot disease in prawns, lobsters. Because of which the fishes have higher mortality rate & their production obtained wouldn't have market value in the international market.

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