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USE OF BIOSYNTHESISED SILVER NANOPARTICLES FROM *TRACHYSPERMUM AMMI SEEDS* (AJWAIN SEEDS) TO MODIFY COMMERCIAL WALL PAINT AND ASSESSMENT OF ITS EFFICACY TO REDUCE MICROBIAL LOAD ON WALLS.

Tawde Hrutika Minal , Sawant Anushka Ashish, Jirange Shloka Subhash, Salvi Anagha Rajesh

[1]Research Scholar, [2]Research Scholar, [3]Research Scholar, [4]Research Scholar
Department of Biotechnology ,
Ramnarain Ruia Autonomous College , Mumbai , India

Abstract : Nanotechnology has become one of the fastest growing sector in the world. Silver nanoparticles(AgNps) biosynthesised from *Trachyspermum ammi* (Ajwain seeds) were used for modification of wall paint by exploiting their antimicrobial property. Simple streaking on Nutrient agar was done to check the efficiency of the modified wall paint. Assessment of efficacy of modified product with antimicrobial property of silver nanoparticles, showed reduction in microbial load on the wooden test sample after usage of modified wall paint.

Keywords : Nanotechnology, Silver nanoparticles(AgNPs), *Trachyspermum ammi*, Nutrient agar, Modified wall paint, Antimicrobial activity.

INTRODUCTION:

Nowadays, there is an increase in the health related issues caused due to contaminated indoor environments which may occur because of improper maintenance, poor building design or occupant activities. This can often result in a condition called "Sick Building Syndrome" (SBS), where occupants experience adverse health effects that appear to link with the time spent in a building (Ebbehoj *et al*., 2002; Zeliger, 2003). The complaints may be localized to a particular room or widespread throughout a building and relief usually occurs soon after leaving the building (Bholah and Subratty, 2002; Bakke *et al.*, 2008). The most common signs of SBS are headaches, pressure on the head and throbbing, feeling of tiredness.

Along with the presence of microorganisms other factors that may lead to indoor pollution and cause SBS are various abiotic agents like dust, particulate matter, wall coverings, synthetic paints, glue, polishes, and Volatile Organic Compounds (VOCs) (Chao *et al*., 2002; Horner, 2003). Other household items like hair spray, perfume, room deodorizer, paints, thinners, home appliances, photocopiers, printers, computers, and air purifiers may also contribute (Rossnagel, 2000; Wilson and Straus, 2002; Rylander. 2004). Use of disinfectants (linear alkyl benzene sulfonates) and fatty acid salts (soap) in cleaning agents (rug shampoo) can cause enhanced eye and airway irritation (Herbarth *et al.*, 2003; Guo, 2011).

The epidemiological study "Dampness in Buildings and Health" (DBH) started in Sweden in 2000 with the aim of identifying health-relevant exposures in buildings. The main focus of the study was on asthma and allergic symptoms among small children and their parents. The first step in the study was an epidemiological cross-sectional questionnaire on housing and health involving 14,077 preschool children in the county of Värmland in Sweden (March-April 2000). In children and adults, self-reported moisture-related

problems, water leakage through roofs, rising damp, and defective plumbing installations were the main reasons for water damage in the building were strongly associated with asthma, allergic symptoms, and airway infections. Other factors associated with symptoms among the children were allergic heredity, smoking in the family, male sex, urban living, short breastfeeding, pet keeping, day care attendance, non-farming life and some food habits. This study was followed by a nested case-control study involving 198 children with symptoms and 202 healthy controls. (Bornehag *et. al.* 2004). Complex genetic and environmental interactions are the root cause for triggering & developing allergies. Taking determined steps to decrease indoor allergen exposure can potentially lower the incidence of sensitization and allergic symptoms, however further study is needed to determine the most practical strategies.(Robert *et. al*. 2004)

From various researches conducted in past years, it has been reported that silver nanoparticles can show its antimicrobial activity against a wide range of microorganisms. Its advantages can be seen in the form of development of a number of products in the field of biomedical science and biotechnology. These include creams and dressings to treat burns and ulcers, food packaging to prevent contamination, and so on. Along with being antimicrobial, it is less toxic to humans that makes it a superior choice in using along with wall paint for painting the walls. It will not only help in inhibiting the growth of microorganisms but also help in reducing factors contributing to SBS. However, the efficacy of nanoparticles in wall paint has never been checked and would be checked through this research.

The method of doing research via surveys that researchers send to respondents is known as survey research. To get significant study conclusions, the survey data is statistically examined after collection. As an online survey is one of the cheapest & easiest methods to conduct surveys with highly accurate responses. Hence the research has the base of data collection by survey to choose the topic of the research from a market perspective with a combination of scientific strategies to consider & fulfil the demands of customers. For this research, SYNTHESIS OF SILVER NANOPARTICLES FROM *TRACHYSPERMUM AMMI* SEEDS (AJWAIN SEEDS) AND ASSESSING ITS ANTIBACTERIAL ACTIVITY AGAINST TARGET MICROORGANISM *STAPHYLOCOCCUS AUREUS* study was referred. The synthesis of AgNPs using *Trachyspermum ammi* seed extract was performed through a green chemistry approach and those biosynthesised nanoparticles showed antimicrobial activity against Gram-positive *S. aureus.* (Hrutika *et. al. 2023*).

MATERIALS AND METHODS:

1. Usage of silver nanoparticles biosynthesised from 0. 01 M and 0.001 M silver nitrate:

AgNP 1 and AgNP 2 were biosynthesized using 0.01M and 0.001 M silver nitrate respectively and ultrasonicated for 2 h.

2. Preparation of Wall paint containing silver nanoparticles:

1 mL of each AgNP 1 and AgNP 2 were mixed with 1 mL of paint in 2 different watch glasses. 1 mL paint was painted on wooden pieces of 5cm by 2cm. 1 ml of AgNP 1, 1 ml of AgNP 2 and 1 ml of tap water were taken as control on 3 different watch glasses respectively. 1 ml of White Asian paint to all the watch glass was added and the mixtures were mixed well for 15 minutes. 3 wooden pieces of 5cm by 2cm were painted using the modified paints.

3. Checking efficacy of modified wall paint:

Cotton swabs of surface from 1 painted wooden piece was collected and swabbed on a NA plate for baseline. Incubation for 24 h was carried out and the number and type of bacterial growth was observed. For next 7 days incubation of wooden pieces at room temperature was carried out. After 7 days 3 swabs of different wooden pieces were collected respectively and swabbed on NA plates. Incubation for 24 h was carried out and the number and type of bacterial growth was observed.

OBSERVATION :

1. Survey

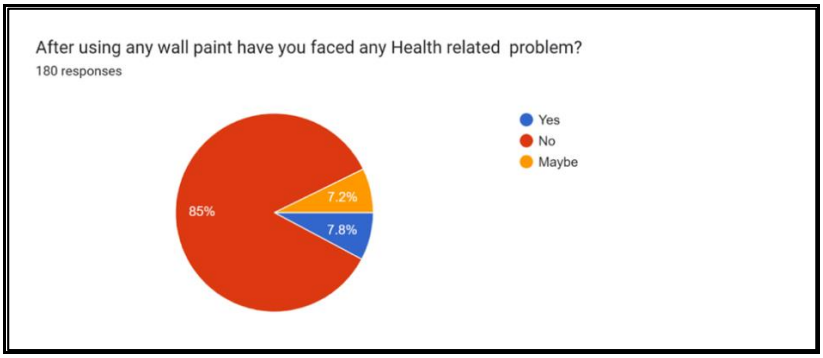

Figure 1 - Pie chart of Question: 'After using any wall paint have you faced any Health related problem'

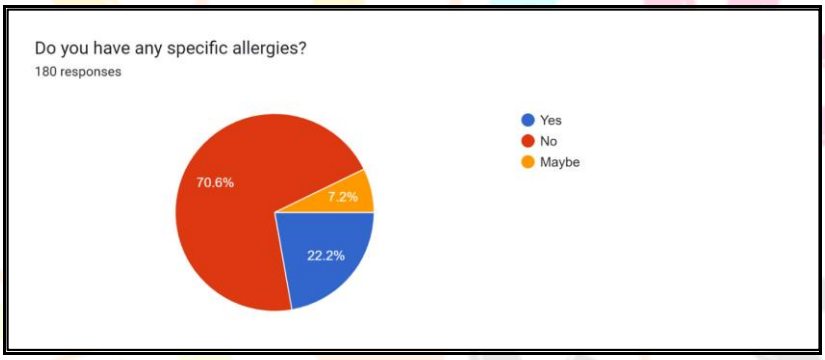

Figure 2- Pie chart of Question: 'Do you have any specific allergies'

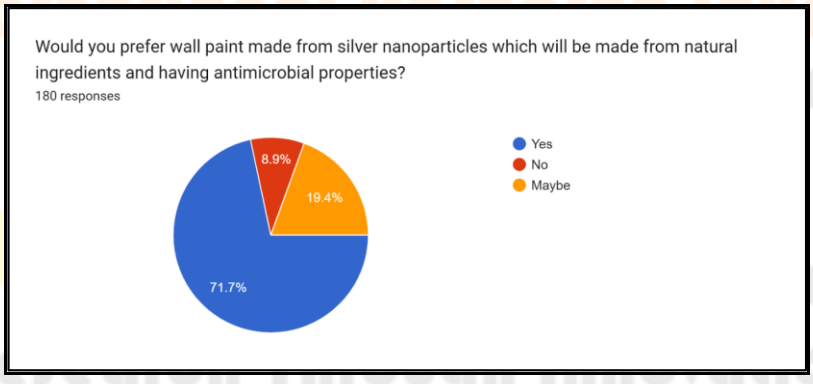

Figure 3 - Pie chart of Question: 'Would you prefer wall paint made from silver nanoparticles which will be made from natural ingredients and having antimicrobial properties'

2. Application of modified wall paint on wooden test surface:

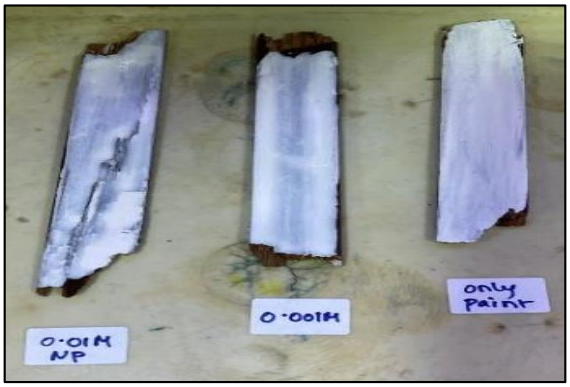

Figure 4 - (A) White wall paint fused with AgNPs biosynthesised from 0.01M Silver nitrate and painted on a piece of wood. (B) White wall paint fused with AgNPs biosynthesised from 0.001M Silver nanoparticles and painted on a piece of wood. (C) White wall paint painted on a piece of wood.

3. Testing the efficacy of modified wall paint

Swab after 7 days incubation at room temperature:

Figure 5- Swab of direct wooden surface.

Figure 6- Swab from wood piece coated with only **w**hite wall paint.

Figure 7 - Swab from wood piece with **w**hite wall paint fused with 0.01M Silver nanoparticles

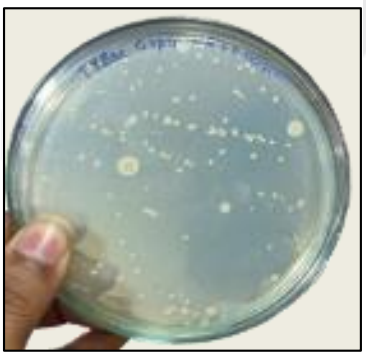

Figure 8 - Swab from Wood piece with White wall paint fused with 0.001M Silver nanoparticles

RESULT AND DISCUSSION :

The online survey methodology provided an important element in the research study. Out of responses from 180 individuals were noted. Out of 100 %, 70.6%(Fig. 2) of them submitted the response of having allergies. While out of 100 %, 71.7%(Fig. 3) of the population showed willingness to opt for wall paint made by silver nanoparticles extracted from natural ingredients and having antimicrobial properties as a product. Wall paint was fused with silver nanoparticles and applied on wooden pieces (Fig.4). Maximum growth was observed in agar containing direct samples from wooden surfaces without paint(Fig.5). Even after painting the wood with regular paint, there was no significant decrease in the population of microorganisms(Fig. 6). Although a massive difference was seen between only paint and paint with silver nanoparticles, agar containing wall paint with biosynthesised AgNPs from 0.001 M silver nitrate concentration(AgNP 2) had more microorganism (Fig. 8) than 0.01M silver nanoparticles swabbed agar(Fig.7).

CONCLUSION :

The survey based research method which was used as the deciding factor for product modification, led this research to gain a importance of thorough understanding of the business and marketing according to the users' point of view. For getting benefits of both protective properties of wall paint and additional inhibitory properties of silver nanoparticles against Microorganisms, mixing the solution of diluted Silver nanoparticles with regular paint was very easy to carry out. Achieving the goal for tackling the problem of growth of unwanted microorganisms which may lead to decrease the functioning of the immune barrier was dealt successfully with observed and expected results. The antimicrobial paint synthesized was able to reduce the population of microorganisms on the painted surface. Using such antibacterial paint may reduce the incidences caused due to Sick Building Syndrome. Reduction in microbial load and further their by products can further ensure the safety of children, elderly and people with weakened immunity. The whole procedure makes use of only two materials making it cost effective as compared to various disinfectants available in the market. However, the effect of nanoparticles on the environment along with toxicity testing needs to be carried out.

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