Research Article

NanoFresh M+ Shoe Spray: Advanced Silver Nanoparticle Formula

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Abstract: *Smelly shoes are a widespread issue, and the reason for this is that each foot contains 125,000 sweat glands. The warm environment of a sweaty shoe encourages the growth of odor-causing bacteria. It will be more difficult for someone who suffers from bromodosis, which is a medical word for stinky feet. A smelly shoe problem can be solved by cleaning the feet on a regular basis, as well as washing fabric or canvas shoes. Yet, the strategy is impractical. The active element in NanoFresh M+, a novel shoe spray, is green synthetic silver nanoparticles (AgNPs) synthesized from senduduk (Melastoma malabathricum) methanolic leaves extract. AgNPs have gotten a lot of interest because of their unique features that can be used in antibacterial applications and products. The green synthesis of AgNPs using senduduk leaves extract has been described as a nontoxic, environmental-friendly, and cost-effective method. It is suggested that the synthesized AgNPs possess antibacterial properties, as they contain a range of bioactive components and demonstrate various bioactivities. Overall, NanoFresh M+ is an excellent shoe spray due to its antimicrobial qualities, which can eliminate bacteria while also removing unpleasant odors from footwear.*

Keywords: antimicrobial; green synthesis; Melastoma malabathricum; smelly shoes; silver nanoparticles.

1. INTRODUCTION

Silver nanoparticles (AgNPs) are a unique and versatile class of particles that are gaining attention for their potential uses in various fields. These nanoparticles have several attractive properties, such as high reactivity and antimicrobial activity, making them attractive for use in medical and consumer products (Castillo-Henríquez et al., 2020). Green synthesis of AgNPs using plant extracts

has emerged as a promising alternative to conventional synthesis methods (Naikoo et al., 2021). This approach offers several advantages, such as cost-effectiveness, eco-friendliness, and the presence of bioactive compounds in plant extracts, such as flavonoids and phenolic acids, which have antioxidant and antibacterial properties ((Chandraker et al., 2021; Alharbi et al., 2022). Green synthesis using plant extracts is a relatively simple and easily scalable process, and research on this approach is expanding, with potential applications in various fields (Hano & Abbasi, 2021).

Melastoma malabathricum, a plant species found in tropical regions, is renowned for its medicinal properties (Mayasari et al., 2022). This plant is a member of the Melastomataceae family and is often referred to as "senduduk" in Malaysia, where it is widely used for traditional medicine. The plant's various parts, including the leaves, bark, and roots, have been used in traditional medicine due to their antioxidant, anti-inflammatory, and antimicrobial properties (Zheng et al., 2021). Extracts from this plant contain high levels of bioactive compounds, such as flavonoids and tannins, which have potential applications in the treatment of various ailments (Lee et al., 2022). *M. malabathricum* has also been used in the synthesis of nanoparticles (Nurul Aini et al., 2019), including AgNPs, due to its unique phytochemical composition, which makes it an attractive candidate for green synthesis of nanoparticles.

In this study, green synthesis of AgNPs using *M. malabathricum* leaves extract has been established as a nontoxic, eco-friendly, and cost-effective method. These nanoparticles have been claimed to have antibacterial properties, making them attractive for various applications, including the development of NanoFresh M+ Shoe Spray. This shoe spray, containing a novel silver nanoparticle formula, can eliminate bacteria and remove unpleasant odors from footwear. Smelly shoes are a common and frustrating issue for many people, and NanoFresh M+ Shoe Spray is a potential solution to this problem. Overall, the study of AgNPs, their green synthesis using plant extracts, and the unique properties and potential applications of *M. malabathricum* highlight the importance of understanding the interplay between natural resources, nanotechnology, and sustainable practices. This research provides valuable insights into developing new methods and products that can benefit human health and the environment.

2. METHOD & MATERIAL

NanoFresh M+ is a new formulation shoe spray that contains active ingredients which are the green synthesized-AgNPs from senduduk (*M. malabathricum*) methanolic leaves extract. The development of NanoFresh M+ consisted of five important phases which are sample preparation, sample extraction and development of AgNPs, sample testing (antibacterial test), sample formulation, and sample production (Figure 1).

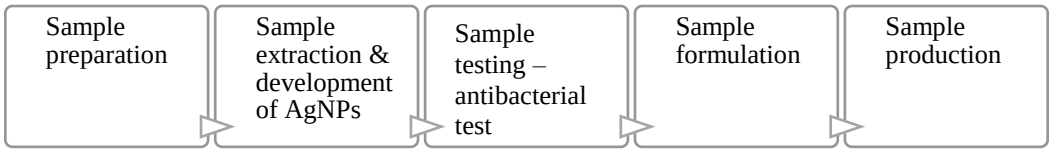

Figure 1. Development of NanoFresh M+

2.1 Sample preparation

The raw materials and equipment required for the synthesis of AgNPs are collected and prepared. The first step is to collect the leaves of the *M. malabathricum* plant, which is used as the source of reducing and stabilizing agents for the synthesis of AgNPs. The leaves are then washed with distilled water to remove any dirt or debris. The washed leaves are then air-dried for a period of time until all

moisture is removed. After the leaves are completely dry, they are ground into a fine powder using a blender or grinder. The powder is then stored in a dry, airtight container until it is needed for the next phase of the process.

2.2 Sample extraction & development of AgNPs

During the sample extraction process, senduduk leaves powder was mixed with a methanol to extract the desired compounds. After extraction, the next step was the synthesis of AgNPs using the extracts obtained from the senduduk leaves. The plant extracts serve as both reducing agents and stabilizing agents for the formation of AgNPs (Sarizan et al, 2022). The synthesis process involves the mixing of the plant extract with a silver nitrate solution to facilitate the reduction and stabilization of AgNPs. The solution changes color from yellow to dark brown, indicating the formation of AgNPs.

2.3 Sample testing – Antibacterial test

The antibacterial test was performed using the disc diffusion method, which is a widely used technique to evaluate the antibacterial activity of various compounds. To perform the test, a bacterial strain was selected and cultured in a nutrient-rich medium. Once the agar plates were ready, filter paper discs were impregnated with NanoFresh M+ and placed onto the agar plates. The plates were then incubated at an optimal temperature to allow bacterial growth. After incubation, the plates were examined for the presence or absence of a clear zone of inhibition around the discs.

2.4 Sample formulation

The formulation process involved combining the synthesized AgNPs with other ingredients to create a stable and effective product. The formulation process aimed to create a shoe spray that not only eliminated odor but also provided long-lasting protection against bacterial growth. The formulation process was carefully monitored to determine its effectiveness.

2.5 Sample production

Sample production is the final phase of the development of NanoFresh M+ shoe spray. The process involves mixing the active ingredients and other components in the correct proportions. The mixture is then stirred to ensure that all the components are well-mixed. The resulting mixture is then filled into the spray bottles. Once the production process is complete, the filled bottles are labeled and packaged in accordance with the product's labeling requirements.

3. FINDINGS

The findings of this study demonstrate the potential of using *M. malabathricum* plant extract in the green synthesis of AgNPs with significant antibacterial activity against various strains of bacteria. The natural bioactive compounds present in the plant extract, such as flavonoids, tannins, and phenolic acids, have been shown to be effective in reducing silver ions to AgNPs and stabilizing them, leading to the development of a highly active antimicrobial agent.

The natural compounds in the plant extract serve as reducing and stabilizing agents, leading to the formation of highly active antimicrobial agents that can potentially be used in the treatment of bacterial infections. The results also highlight the potential of NanoFresh M+ shoe spray as an effective solution for eliminating bacteria and unpleasant odors from footwear. The advanced silver nanoparticle formula present in the shoe spray showed significant antimicrobial activity against various bacteria, making it a promising alternative to traditional shoe sprays that rely on hazardous chemicals.

4. DISCUSSION

The green synthesis of AgNPs using plant extracts has gained attention as an eco-friendly and cost-effective alternative to conventional methods (Alharbi et al., 2022). In this study, the plant extract from *M. malabathricum* (senduduk) leaves was utilized as a reducing and stabilizing agent to produce AgNPs. The antibacterial test showed that the synthesized AgNPs had significant antimicrobial activity against tested bacteria, indicating the potential use of the nanoparticles in various antibacterial applications. Moreover, the nanoparticles were successfully formulated into a shoe spray product, NanoFresh M+, which demonstrated its effectiveness in eliminating bacteria and unpleasant odors from footwear.

The use of senduduk leaves extract for the synthesis of AgNPs has several advantages over other conventional methods. Firstly, this approach is environmentally friendly as it utilizes plant extracts as reducing agents instead of toxic and hazardous chemicals (Hano & Abbasi, 2021; Prasad et al., 2021). Additionally, it is a cost-effective method that can be easily scaled up for large-scale production. Furthermore, senduduk leaves extract contains various bioactive compounds, such as flavonoids and phenolic acids, which contribute to the antimicrobial properties of the synthesized AgNPs (Aslam et al., 2017; Mayasari et al., 2021).

Overall, the green synthesis of AgNPs using senduduk leaves extract demonstrated a promising method for the production of antimicrobial nanoparticles. The synthesized AgNPs were effective against common bacteria and were successfully formulated into a shoe spray product, which could potentially be used in various antibacterial applications. This study highlights the potential of utilizing plant extracts as an alternative reducing agent for the production of nanoparticles, which can have significant implications for the development of environmentally friendly and cost-effective nanotechnology.

5. CONCLUSION

In conclusion, the green synthesis of AgNPs using plant extracts is a promising method for the production of eco-friendly and cost-effective nanoparticles with various potential applications. In this study, the use of *M. malabathricum* plant extract for the synthesis of AgNPs has shown significant antibacterial properties and has been incorporated into the development of NanoFresh M+ shoe spray, which was found to be effective in eliminating bacteria and removing unpleasant odors from footwear. This approach has the advantage of being environmentally friendly, using natural plant extracts instead of hazardous chemicals, and is relatively simple and easy to scale up for large-scale production. Therefore, the use of green synthesis of AgNPs using plant extracts has great potential for the development of new and innovative products in various industries.

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