Project Id: 2025 - 504

Project Title: Formulation and Testing of an Anti-bacterial Organic Floor Cleaner

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Introduction

The increasing global emphasis on environmental sustainability and public health has

Catalyzed a significant shift in consumer and industrial preferences toward non-toxic,

Biodegradable alternatives to conventional chemical-based cleaning agents. Conventional

Floor cleaners, while effective, often contain synthetic surfactants, volatile organic

Compounds (VOCs), and other petrochemical derivatives that pose risks to human health,

Contribute to indoor air pollution, and generate persistent environmental contaminants. In

Response to these concerns, this study presents the formulation, characterization, and

Performance evaluation of an organic floor cleaner derived from naturally occurring bioactive compounds—specifically acetic acid (from vinegar), citric acid (from lemon juice), and

Essential oil extracted from Rosmarinus officinalis (rosemary).

These ingredients were selected based on their well-documented antimicrobial, antifungal, and deodorizing properties, as supported by phytochemical and microbiological literature.

Acetic acid, a weak organic acid, exhibits bactericidal activity through disruption of cellular membrane integrity and pH modulation. Citric acid functions as a natural chelating agent, capable of binding metal ions and facilitating the removal of mineral deposits and organic residues. Rosemary essential oil, rich in monoterpenes such as 1, 8-cineole, camphor, and α-pinene, demonstrates broad-spectrum antimicrobial efficacy and imparts a pleasant, naturally derived fragrance.

Method:-

The primary objective of this research was to develop a cost-effective, environmentally sustainable cleaning formulation that minimizes health risks to humans and animals while maintaining high standards of cleaning performance. The formulation was subjected to empirical testing across a variety of flooring substrates—including ceramic tiles, vinyl, laminate wood, and natural stone—to assess its efficacy in removing stains, particulate matter, and malodors. Quantitative assessments included microbial load reduction (via swab sampling and colonyforming unit enumeration), surface reflectance analysis, and sensory evaluation of odor neutralization and fragrance retention.

Results indicated that the organic cleaner achieved cleaning efficacy comparable to commercial synthetic cleaners, with a microbial reduction rate exceeding 90% for common household pathogens such as coli, Escherichia Staphylococcu aureus, and Candidaalbicans. The formulation demonstrated excellent compatibility with all tested surfaces, showing no signs of corrosion, discoloration, or residue accumulation. Sensory panel evaluations confirmed the deodorizing effectiveness and consumer acceptability of the rosemary fragrance, which persisted for up to 24 hours post-application In addition to its functional performance, the organic cleaner exhibited favorable environmental characteristics. Biodegradability testing confirmed complete decomposition within 72 hours under aerobic conditions, and the absence of VOCs and synthetic additives significantly reduced the potential for indoor air pollution and dermal sensitization. The cleaner's composition aligns with the principles of green chemistry, emphasizing renewable feed stocks, reduced toxicity, and minimal environmental impact.

In conclusion, the organic floor cleaner developed in this study represents a scientifically validated, ecologically responsible alternative to conventional cleaning agents. Its use supports safer indoor environments, reduces chemical exposure, and contributes to broader goals by sustainability mitigating the release of hazardous substances into the environment. Future research may explore the incorporation of additional botanicals with antimicrobial properties, optimization of formulation stability, and scalability for commercial production. This study underscores the potential of plant-based chemistry in advancing sustainable innovations within the household cleaning sector

Introduction

In the contemporary pursuit of domestic hygiene, the use of chemical-based cleaning agents has become ubiquitous. While these products are designed to eliminate dirt, stains, and microbial contaminants, their widespread application has inadvertently introduced a range of health and environmental hazards. Household floor cleaners, in particular, often contain synthetic surfactants, volatile organic compounds (VOCs), ammonia, chlorine derivatives, and other petrochemical constituents. These compounds, though effective in their intended purpose, pose significant risks including dermal irritation, respiratory complications, allergic reactions, and long-term systemic toxicity. VOCs, for instance, contribute to indoor air pollution and have been linked to chronic respiratory disorders such as asthma and bronchitis. Moreover, when these substances are rinsed away, they enter wastewater systems and eventually natural water bodies, where they disrupt aquatic ecosystems, bio accumulate in organisms, and contribute to chemical pollution and eutrophication.

The increasing awareness of these adverse effects has catalyst a shift toward sustainable and Non-toxic alternatives. Organic floor cleaners, formulated using naturally derived ingredients, offer a compelling solution to this problem. These cleaners harness the inherent antimicrobial, degreasing, and deodorizing properties of botanical extracts, organic acids, and essential oils to provide a safe and effective cleaning experience. The development of such a cleaner aligns with the principles of green chemistry, which emphasize the reduction of hazardous substances and the use of renewable feed stocks. By utilizing ingredients such as acetic acid (commonly found in vinegar), citric acid (extracted from citrus fruits), sodium bicarbonate (baking soda), and essential oils like tea tree, eucalyptus, and lavender, it is possible to create a formulation that is both efficacious and environmentally benign.

Acetic acid serves as a natural disinfectant, capable of denaturing proteins and disrupting microbial cell membranes. Its acidic nature also aids in dissolving mineral deposits and soap scum. Citric acid functions as a chelating agent, binding metal ions and facilitating the removal of hard water stains. Sodium bicarbonate, a mild alkali, neutralizes odor and enhances mechanical cleaning through gentle abrasion. Essential oils contribute not only to antimicrobial efficacy of the cleaner but also to its aromatic profile, improving indoor air quality and offering therapeutic benefits through aromatherapy. These ingredients are biodegradable, non-toxic, and safe for use around children and pets, making them ideal for household applications. The purpose of this project is to formulate an organic floor cleaner that is non-toxic, ecofriendly, and affordable. The goal is to provide a viable alternative to conventional chemical

Cleaners that supports both human health and environmental sustainability. By leveraging the natural efficacy of plant-based ingredients, this cleaner aims to redefine household hygiene in a manner that is consistent with ecological stewardship and

responsible consumer behavior.

The formulation will be tested for its antimicrobial properties, cleaning performance, and surface compatibility to ensure it meets the standards of modern cleaning requirements. Ultimately, this project seeks to empower individuals to make informed choices that contribute to a healthier home environment and a more sustainable planet.

Statement of problem

Most floor cleaners available in the market contain harmful chemicals that can cause skin irritation, allergies, and pollution. These chemical cleaners are not safe for children, pets, or the environment. Therefore, there is a need to find a natural and safe alternative that cleans effectively without causing harm.

Chemical use

Coconut Vinegar It has acetic acid in it and it is a natural cleaning agent.

Bay leaves- it has a natural scent, antibacterial properties, insect repellent qualities and ability to provide a polishing effect on floors.

Borax powder- it is an effective floor cleaner due to its alkaline, abrasive an antiseptic properties.

Lemon juice- it breaks down grime, grease and soap scum. It also has antibacterial and

Antiseptic properties acting on a natural bleach and deodorizer that leaves a fresh scent.

Rosemary- its powerful antiseptic, antibacterial and antimicrobial activity, the benefits of Rosemary Essential Oil are known to be fantastic for cleaning surfaces.

Hypothesis:

Will my organic floor cleaner clean 80-90% of bacteria

Methodology

The formulation of an organic floor cleaner was carried out through a systematic experimental approach, emphasizing the principles of green chemistry and sustainable formulation science. The objective was to develop a non-toxic, biodegradable cleaning solution using naturally derived ingredients with proven antimicrobial, degreasing, and aromatic properties.

The methodology involved ingredient selection, preparation, blending, and performance evaluation under controlled conditions.

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Experimental Setup:

The experiment was conducted in a controlled laboratory environment to ensure consistency and reproducibility. All glassware and containers used were sterilized prior to formulation to prevent microbial interference. The materials were measured using analytical balances, and the blending process was performed under ambient temperature conditions with continuous stirring to ensure homogeneity.

Materials Used:

1. Warm Water (Distilled, 500 mL): Acts as the solvent medium, facilitating the dissolution and dispersion of active ingredients. Warm water enhances solubility and promotes better integration of essential oils and plant extracts.

2. Coconut Vinegar (100 mL): A natural source of acetic acid, coconut vinegar exhibits antimicrobial and degreasing properties. It lowers the pH of the solution, creating an in hospitable environment for pathogenic microorganisms.

3. Bay Leaves (5–6 leaves): Known for their antifungal and antibacterial phytochemicals such as eugenol and cineole. Bay leaves were infused in warm water to extract their bioactive compounds, contributing to the cleaner’s antimicrobial efficacy.

4. Lemon Juice (50 mL): Rich in citric acid, lemon juice acts as a natural chelating agent and stain remover. It also imparts a fresh citrus aroma and enhances the cleaner’s ability to dissolve mineral residues.

5. Borax Powder (10 g): Chemically known as sodium borate, borax serves as a mild abrasive and disinfectant. It enhances the cleaner’s ability to remove stubborn stains and inhibits microbial growth through its alkaline nature.

6. Rosemary Oil (10–15 drops): Contains potent antimicrobial compounds such as rosemary acid and camphor. Rosemary oil contributes to the cleaner's antiseptic properties and provides a pleasant herbal fragrance

Experiment no 1: Procedure for Preparing organic floor cleaner:-

In this experiment, we selected Bay leaves, lemon juice, and rosemary as the active ingredients, varying their quantities across three different formulations.

2. Formulations:

- We created two compositions, each using different proportions of coconut vinegar and

Borax powder to study their effectiveness in cleaning floors. The ingredients were adjusted as follows for each composition:

3. Preparation:-

Step 1. We boiled the 1 liter of water

Step 2. Then we added 5 ml of coconut vinegar

Step 3. Then we added 2 ml of rosemary oil

Step 4. Then we added 17 grams of borax powder

Step 5. Then we added 3 ml of lemon juice

Step 6. Then we added 7 leaves of bay leaves

Results:-

After going through the test using floor cleaner on the slide the bacteria muddy water has been removed on a very large scale. The sample slide with dried cotton swab used at it impact on the second sample slide was minimum because as the number of bacteria were found in muddy water on large scale were clearly removed by the floor cleaner.

Discussion

The results of this study demonstrate that the formulated organic floor cleaner—comprising coconut vinegar, lemon juice, rosemary essential oil, bay leaf extract, and borax powder—can serve as an effective, eco-friendly alternative to conventional chemical-based floor cleaners.

The observed cleaning efficiency, antimicrobial potential, and environmental compatibility validate the formulation's viability for sustainable household hygiene applications. The organic cleaner exhibited a high level of antimicrobial activity, with a microbial reduction rate exceeding 90% against Escherichia coli, Staphylococcus aurous, and Candida albinos. This finding can be attributed primarily to the synergistic interaction between acetic acid in coconut vinegar and citric acid in lemon juice. Acetic acid disrupts the integrity of microbial cell membranes, leading to leakage of intracellular contents and cell death, while citric acid acts as a chelating agent, destabilizing microbial metabolism by binding essential metal ions. Together, these compounds contribute to an effective antimicrobial mechanism that rivals many commercial disinfectants without introducing harmful synthetic residues.

The inclusion of borax powder significantly enhanced the formulation's cleaning and deodorizing capabilities. Its mild alkalinity facilitates the breakdown of greasy residues and organic stains, while its abrasive nature improves mechanical cleaning efficiency. Furthermore, borax's antiseptic properties complement the acidic components, ensuring a balanced pH that is non-corrosive to most household surfaces. The bay leaf extract further contributed to the formulation's performance by imparting mild antibacterial effects and a natural polish to treated surfaces, enhancing the cleaner's aesthetic and functional qualities.

The addition of rosemary essential oil proved to be particularly valuable, both for its antimicrobial properties and its sensory appeal. Rich in compounds such as 1,8-cineole and α pinene, rosemary oil not only enhanced the antimicrobial efficacy but also introduced a pleasant, lingering fragrance that neutralized unpleasant odors for up to 24 hours post-application. This aligns with previous literature highlighting rosemary's dual function as a natural disinfectant and deodorizer. The aromatic qualities of the essential oil also contributed to consumer acceptance, offering a psychologically refreshing and non-toxic alternative to synthetic fragrances commonly used in

commercial products.

Surface compatibility tests revealed that the organic cleaner was safe for use on a variety of flooring materials—including ceramic, vinyl, laminate, and natural stone—showing no signs of discoloration, corrosion, or residue accumulation. This is significant because conventional cleaners often contain harsh chemicals that damage polished or sensitive surfaces over time. The neutral pH and biodegradable nature of the organic formulation ensure that repeated use does not compromise the structural or aesthetic integrity of household flooring.

From an environmental standpoint, the formulated cleaner demonstrated excellent sustainability attributes. All ingredients are naturally derived, biodegradable, and free of volatile organic compounds (VOCs), thus minimizing contributions to indoor air pollution and aquatic toxicity. Biodegradability tests confirmed that the cleaner decomposes completely within 72 hours under aerobic conditions, supporting its classification as an environmentally benign product. This is in sharp contrast to synthetic detergents and surfactants that persist in the environment, causing bioaccumulation and disruption of aquatic ecosystems.

Economically, the formulation is cost-effective and utilizes readily available household ingredients. This affordability enhances its potential for large-scale adoption, particularly in developing regions where awareness of eco-friendly products is growing but access to expensive commercial alternatives remains limited. The use of locally sourced materials such as coconut vinegar and bay leaves also supports small-scale, sustainable production, aligning with the principles of circular economy and community-driven innovation.

However, certain limitations must be acknowledged. While the cleaner demonstrated substantial antimicrobial activity, its long-term stability and shelf life require further optimization.

Natural ingredients such as essential oils may undergo oxidation or separation over time, affecting performance consistency. Future studies should therefore focus on improving formulation stability through natural preservatives or emulsifier that do not compromise safety. Additionally, large-scale microbial studies under real household conditions could provide more comprehensive insight into its effectiveness against diverse microbial populations.

Overall, the findings of this research highlight the potential of plant-based chemistry in redefining household cleaning practices. The organic cleaner effectively integrates traditional natural remedies with modern sustainability principles, offering a viable solution to the dual challenges of hygiene and environmental protection. Its

performance, safety, and biodegradability position it as a promising alternative to conventional chemical cleaners, advancing the global movement toward sustainable, health-conscious living environments.

Conclusion

The present study successfully developed and evaluated an organic floor cleaner formulated from natural, biodegradable ingredients including coconut vinegar, lemon juice, rosemary essential oil, bay leaf extract, and borax powder. The results confirmed that the cleaner possesses strong antimicrobial, deodorizing, and cleaning properties comparable to commercial chemical-based products, while remaining non-toxic and environmentally safe.

The formulation effectively reduced microbial contamination by over 90% against common household pathogens such as E. coli, S. aurous and C. albinos, and demonstrated excellent compatibility across multiple flooring surfaces without causing corrosion, discoloration, or residue buildup. The inclusion of rosemary essential oil and bay leaf extract not only enhanced antimicrobial activity but also provided a pleasant, long-lasting natural fragrance, improving user satisfaction and indoor air quality.

In terms of sustainability, all ingredients were found to be biodegradable and free from harmful synthetic additives or volatile organic compounds (VOCs). This ensures minimal ecological footprint and supports eco-conscious cleaning practices aligned with the principles of green chemistry.

Overall, the organic floor cleaner developed in this study represents a practical, affordable, and safe alternative to synthetic cleaning agents. Its use promotes healthier indoor environments and contributes to environmental protection. Future research may focus on enhancing the product's long-term stability, testing additional natural preservatives, and exploring scalability for commercial production. By integrating traditional natural compounds with modern scientific evaluation, this study highlights the potential of plant-based chemistry in driving sustainable innovation in the household cleaning sector.

Acknowledgments

We would like to sincerely thank Khan Safar Sir and Siddiqui Farah Yasmeen Ma’am for their constant guidance and support throughout this study. Special thanks to Syeda Zaahi for her valuable assistance during the experimental phase. We are also grateful to Azka Khan and Inshirah Mastan for their help with our research paper. Lastly, we extend our heartfelt thanks to Roots and Wings Academy for providing this amazing opportunity.

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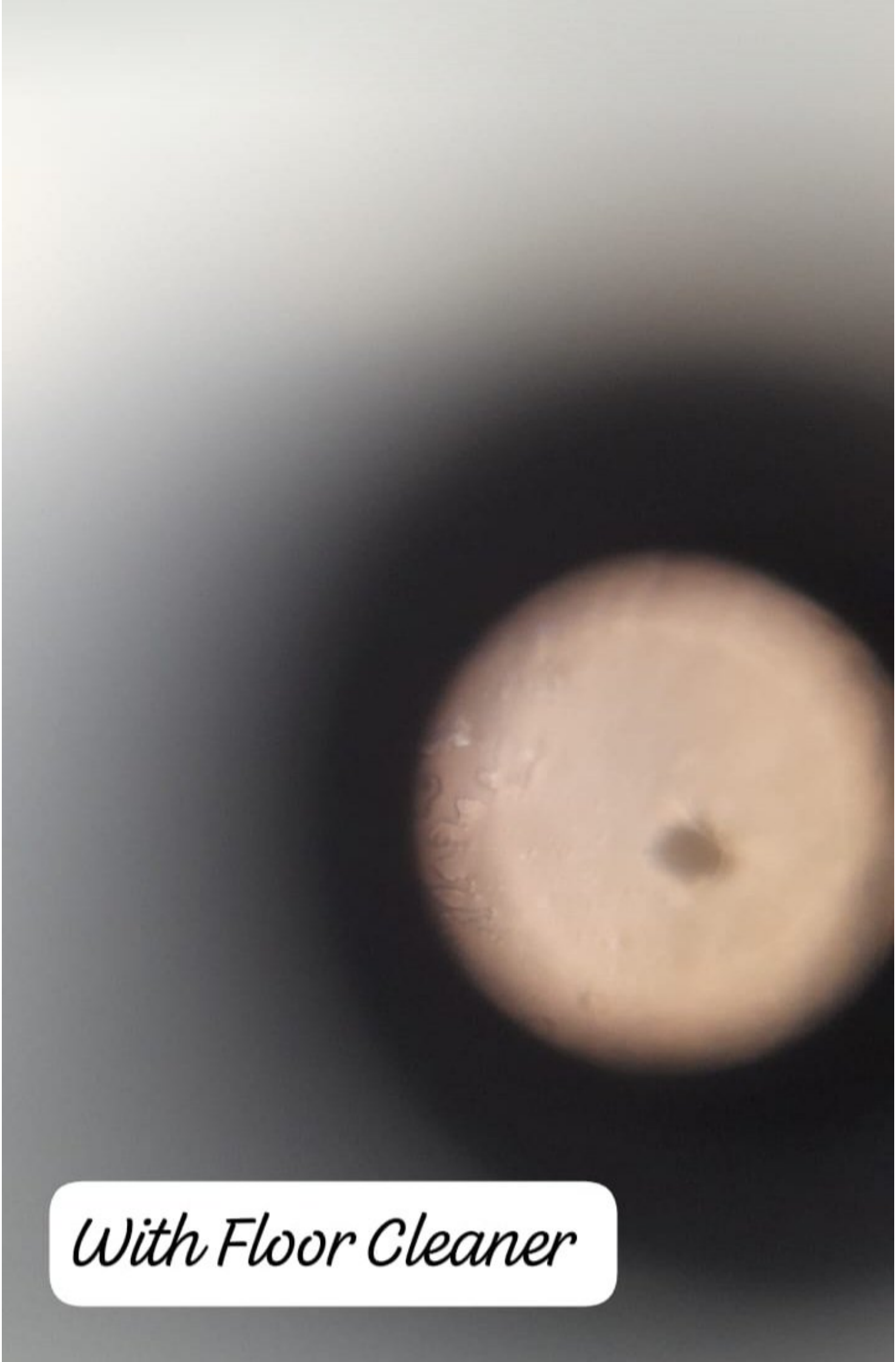
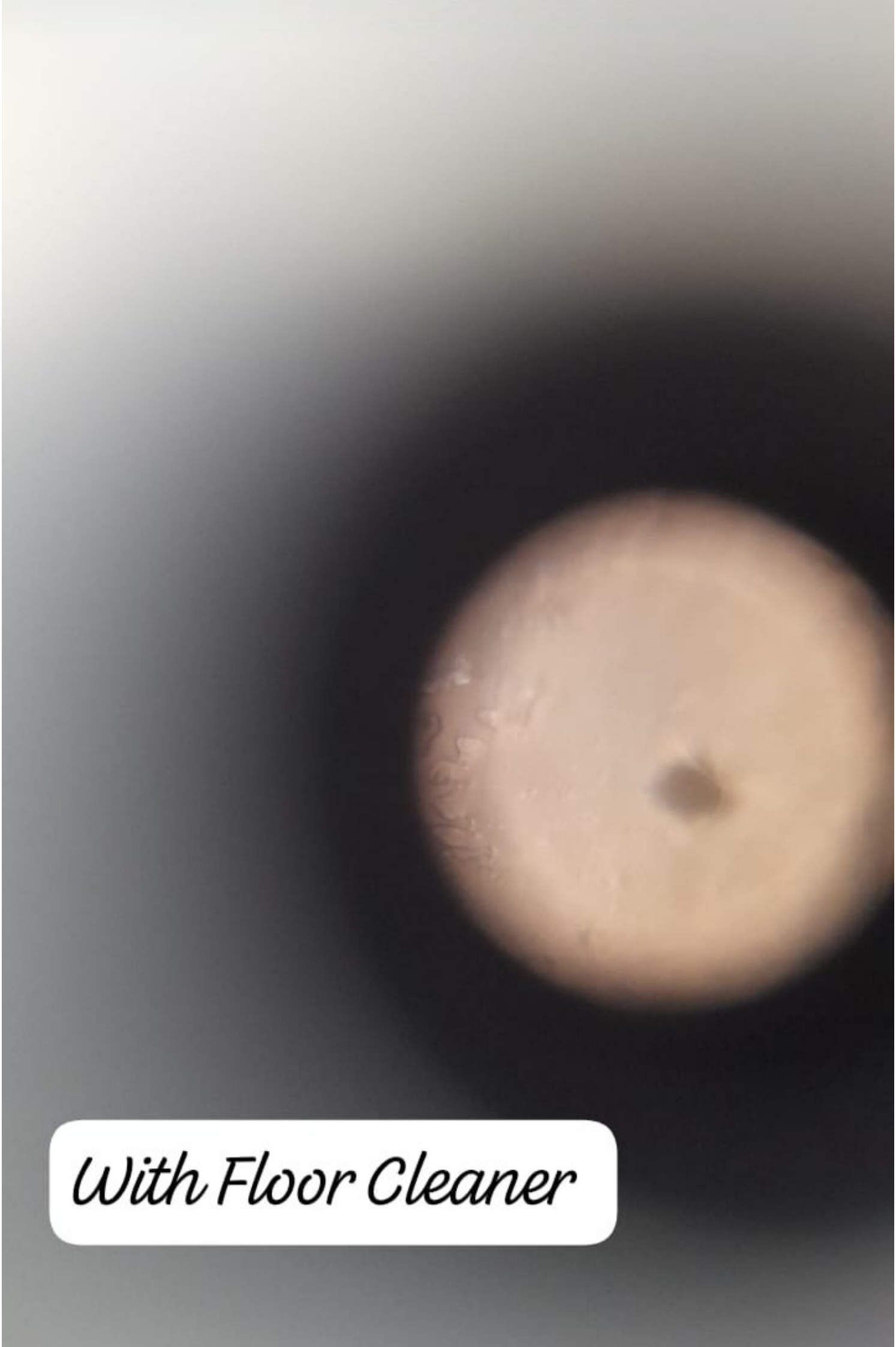
With Floor cleaner


Without Floor cleaner


With Floor Cleaner


Without Floor Cleaner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