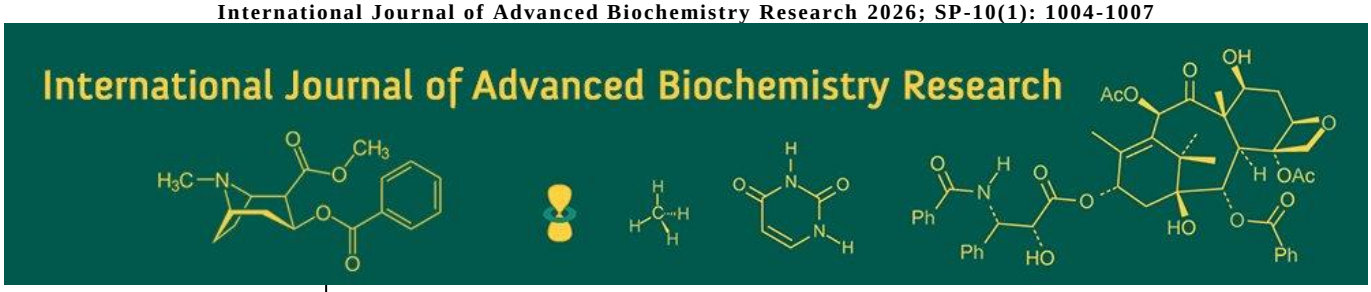

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Assessment of quality parameters in phenyl

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Abstract
This study focused on the development and evaluation of two phenyl formulations, Formula-I (F-I) and Formula-II (F-II), to assess their physical, chemical, and antimicrobial properties. Conducted during 2015-16 in Dharwad, Karnataka, the research aimed to formulate effective, safe, and environmentally friendly disinfectant solutions. The formulations included Turkey Red Oil and Pine Oil (F-I) and Lethol with Pine Oil (F-II), with color added to enhance visual appeal.
Quality analysis revealed that both formulations maintained a pH range of 6.5-7.2, indicating a neutral to slightly alkaline nature suitable for safe cleaning. They were soluble in water and organic solvents, stable for up to three months, and unaffected by hard water conditions. Additionally, both formulations showed no presence of alcohol-insoluble matter, indicating high purity.
Antimicrobial assessments demonstrated strong efficacy against common pathogens. Both F-I and F-II exhibited significant antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*, with F-I showing a lower Minimum Inhibitory Concentration (MIC) of 1.56 µL for *S. aureus*, indicating higher potency. F-II displayed an MIC of 6.25 µL for *E. coli*, confirming its effectiveness.
The results highlight the potential of these phenyl formulations as reliable disinfectants for household, industrial, and healthcare settings. Both formulations showcased optimal disinfectant properties, combining safety, stability, and environmental compatibility. The findings contribute to the development of sustainable cleaning solutions, offering insights for future research on eco-friendly disinfectants and alternative green ingredients for broader applications.

Keywords: Phenyl, disinfectant, antimicrobial activity, quality parameters, turkey red oil, pine oil, Lethol, *Staphylococcus aureus*, *Escherichia coli*, pH stability, hard water test, eco-friendly, household cleaners, sustainable products

Introduction
Household chemicals, commonly referred to as consumer chemicals, are non-food substances widely used in and around the average household to support cleaning, pest control, and general hygiene. These chemicals are specially formulated from various ingredients to serve specific human needs, enhancing health, beauty, and cleanliness (Winer, 1986) [7]. While these products offer significant convenience and efficacy, they also pose potential risks to human health and the environment if improperly manufactured, used, or disposed of. The scope of consumer chemicals extends beyond basic cleaning to include products designed for health protection, odor control, and the prevention of contamination. Many of these chemicals also possess antimicrobial properties, contributing to both personal and public hygiene (Farn, 2006) [3].
In today's health-conscious society, consumers are increasingly focused on improving not just their dietary habits but also their overall lifestyle through healthy living practices. Hygiene remains a critical component of this approach, playing a vital role in disease prevention and health maintenance. Household chemicals such as soaps, detergents, and cleaning agents are integral to this pursuit. These products can be categorized into four primary groups: personal cleansing products (e.g., bar soaps, gels, and hand cleaners), laundry detergents and aids (available in various forms like powders, gels, and sheets), dishwashing products (for both hand and machine use), and household cleaners (designed for multiple surfaces and applications) (Blackwell *et al.*, 2013) [1].
Marketing plays a crucial role in the distribution and consumption of these products. It not only facilitates the exchange of goods between producers and consumers but also drives competition among manufacturers. Marketing strategies, ranging from word-of-mouth promotion to sophisticated advertising campaigns, aim to influence consumer preferences

and purchasing decisions (Seetharaman & Sethi, 2011) [6]. This competitive landscape affects pricing mechanisms, where supply and demand dynamics dictate market trends rather than government-imposed rates.

Manufacturers of household cleaners face the challenge of balancing product performance, ingredient safety, cost-efficiency, and environmental impact. The growing consumer demand for eco-friendly products has led to the emergence of "green" cleaning solutions. However, the definition of "green" varies among manufacturers, reflecting differences in environmental standards, ingredient sourcing, and life cycle assessments of their products (Davis *et al.*, 1992) [2].

Phenyl, a widely used household chemical, is a powerful disinfectant and cleaning agent known for its antimicrobial properties. It is a liquid solution with a strong, distinct odor, commonly used to sanitize floors, walls, bathrooms, and other surfaces in residential and commercial settings. Phenyl is effective in killing bacteria, fungi, and viruses, making it essential in environments where cleanliness is critical, such as hospitals, kitchens, and public spaces.

Chemically, phenyl is derived from coal tar or petroleum and contains phenolic compounds, which disrupt the cell membranes of microorganisms, leading to their destruction. It is available in various formulations, including concentrated liquids and ready-to-use solutions, often blended with fragrances to mask its strong odor. Despite its effectiveness, phenyl must be handled with care due to its toxic nature. Ingestion, inhalation of large quantities, or prolonged skin contact can cause health risks, including skin irritation and respiratory issues. Proper usage, storage, and disposal are crucial for safety.

Concerns over environmental impact have led to the development of eco-friendly, biodegradable alternatives without compromising efficacy. Overall, phenyl remains a staple in cleaning, valued for its disinfectant qualities while emphasizing responsible use and environmental awareness. The development of an effective phenyl disinfectant requires careful consideration of its formulation to ensure it meets performance expectations while being safe for users and environmentally friendly. This investigation focuses on (i) formulating a phenyl with optimal disinfectant properties and (ii) assessing its cleaning efficacy and user safety. Through this study, the goal is to contribute to the advancement of effective and sustainable cleaning solutions for both household and industrial use.

Materials and Methods

The present study was conducted during the year 2015-16 in Dharwad city of Dharwad district of Karnataka state. The experimental research involved development of Phenyl under laboratory condition and assessment of quality characteristics testing with different parameters. The raw materials and chemical composition is maintained as per the process developed and standardized under SRP, Department of Family Resource Management (2014-15). The developed Phenyl were sent for quality characteristics with different parameters was tested under Chemistry Laboratory of JSS College, Dharwad and antimicrobial study was tested under BioGenics Research and Training Centre in Biotechnology, Hubli.

Plate 1: Development of Phenyl under laboratory

Results and Discussion

Table 1: Development of Phenyl for experimental research

	Chemical Composition (Raw materials)	Quantity in terms of percentage
Phenyl (F-I)	Turkey Red Oil	25 %
	Pine Oil	75 %
	Colour	q.s
Phenyl (F-II)	Lethol	77 %
	Pine Oil	23 %
	Colour	q.s

qs-quantity sufficient
(F-I)-Formula-I and (F-II)-Formula-II

Table 1 outlined the development of two different phenyl formulations for experimental research, designated as Formula-I (F-I) and Formula-II (F-II). These formulations were designed to evaluate the effects of varying chemical compositions on the disinfectant properties, cleaning efficacy, and overall performance of the phenyl. Formula-I (F-I) consisted of Turkey Red Oil and Pine Oil in a ratio of 25% and 75%, respectively, With the addition of an appropriate amount of color to enhance its visual appeal and improve the user experience. Turkey Red Oil, known for its emulsifying properties, contributed to improved surface adhesion and cleaning efficiency, while Pine Oil added a natural, refreshing fragrance and additional antimicrobial activity. Formula-II (F-II), on the other hand, included

Lethol and Pine Oil in a ratio of 77% and 23%, respectively, with color added as required. Lethol, a compound with strong disinfectant properties, enhanced the antimicrobial efficacy of the formulation. The term "q.s" stands for "quantity sufficient," indicating that the color was added in appropriate amounts to achieve the desired sensory characteristics without compromising the formulation's primary disinfectant function. This comparative study aimed to determine the optimal formulation for effective, safe, and sustainable phenyl products. Analogous results reported by Rao (1998) [5] focused on traditional formulations using phenolic compounds from coal tar and petroleum, emphasizing ingredients like Turkey Red Oil and Pine Oil for their disinfectant and emulsifying properties. In contrast, Moses *et al.* (2013) [4] introduced modern approaches, incorporating alternatives like Lethol for stronger antimicrobial effects and reducing toxicity. They also prioritized environmental sustainability through biodegradable formulations.

Table 2: Analysis for quality characteristics of developed Phenyl under laboratory

Parameters		Phenyl (F-I)	Phenyl (F-II)
Physical parameters	**Colour**	Yellow	Pink
	Fragrance	Phenolic	Phenolic
Chemical parameters	pH	6.5-7.2	6.5-7.2
	Solubility	Soluble in H_2O & Organic solvents	Soluble in H_2O & Organic solvents
	Stability test	3 Months	3 Months
	Hard water test	Not affected	Not affected
	Alcohol Insoluble Matter	Nil	Nil

(F-I)-Formula-I and (F-II)-Formula-II

Table 2 presents the quality characteristics of two developed phenyl formulations, Formula-I (F-I) and Formula-II (F-II), evaluated under laboratory conditions. In terms of physical parameters, F-I is characterized by a yellow color, while F-II has a pink hue, likely due to different colorants used to enhance their visual appeal. Both formulations exhibit a phenolic fragrance, a common trait attributed to the presence of phenolic compounds that contribute to their strong disinfectant properties. Regarding chemical parameters, both formulations maintain a pH range of 6.5-7.2, indicating a neutral to slightly alkaline nature suitable for effective cleaning without causing skin irritation. They are both soluble in water and organic solvents, ensuring versatility for various cleaning applications. The stability test showed that both formulations remained stable over a period of three months, suggesting good shelf-life and consistent performance. Additionally, neither formulation was affected by hard water, demonstrating strong efficacy in different water conditions. Both F-I and F-II also showed no presence of alcohol-insoluble matter, indicating high purity and the absence of undesirable residues. Overall, both formulations displayed satisfactory physical and chemical characteristics, making them effective and reliable disinfectant options. Matching observations reported by Rao (1998) [5] focused on traditional phenyl formulations, emphasizing a balanced pH (6.5-7.2) for effective disinfection and minimal skin irritation. His formulations, based on phenolic compounds, demonstrated good stability over time. Moses *et al.* (2013) [4] introduced modern formulations with agents like Lethol to improve safety and sustainability. They optimized pH levels and confirmed stability under various conditions.

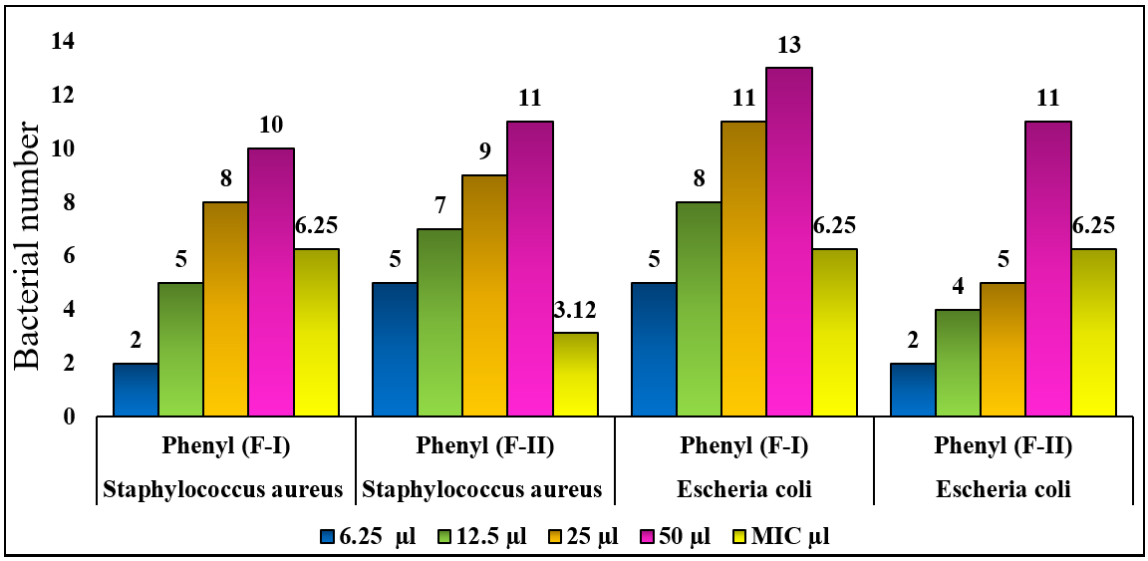


Fig 1: Anti-bacterial analysis of the developed Phenyl

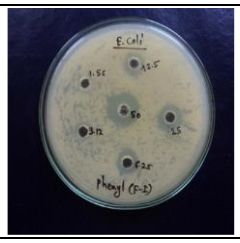
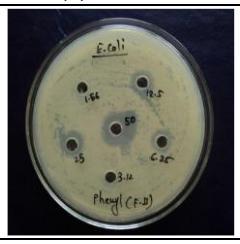
Phenyl (F-I)		
	Plate 2 (a): *Staphylococcus aureus*	**Plate 2 (b):** *Escherichia coli*
Phenyl (F-II)		
	Plate 2 (a): *Staphylococcus aureus*	**Plate 2 (b):** *Escherichia coli*

Figure 1 illustrated the anti-bacterial analysis of the developed phenyl formulations, showcasing their effectiveness in inhibiting bacterial growth. The analysis involved assessing the zone of inhibition, where clear areas around the phenyl samples indicated bacterial suppression. The size of these zones reflected the strength of the antibacterial activity, with larger zones indicating higher effectiveness. An antimicrobial study revealed that for *Staphylococcus aureus*, bacterial death occurred in both Gram-positive and Gram-negative strains at a minimum concentration of 6.25 µL, with a Minimum Inhibitory Concentration (MIC) of 1.56 µL. For *Escherichia coli*, bacterial death was observed at a minimum concentration of 6.25 µL, with an MIC of 6.25 µL.

These results highlighted the strong antimicrobial properties of the developed phenyl formulations, demonstrating their potential for effective disinfection in household and industrial cleaning applications. The findings provided valuable insights into the formulations' efficacy, supporting their suitability for diverse cleaning environments. Corresponding outcomes reported by Rao (1998) [5] demonstrated effective bacterial reduction in traditional phenyl formulations using phenolic compounds, with strong disinfectant properties and stability. Moses *et al.* (2013) [4] introduced modern formulations with Lethol, showing comparable or superior antimicrobial activity and enhanced safety.

Conclusion

The development and evaluation of two phenyl formulations, Formula-I (F-I) and Formula-II (F-II), provided valuable insights into their physical, chemical, and antimicrobial properties. Both formulations were successfully developed under laboratory conditions, with distinct compositions—F-I containing Turkey Red Oil and Pine Oil, and F-II incorporating Lethol and Pine Oil. These variations aimed to optimize disinfectant efficacy while ensuring safety and environmental sustainability. The quality analysis revealed that both formulations maintained a pH range of 6.5-7.2, indicating a neutral to slightly alkaline nature suitable for effective cleaning without causing skin irritation. Their solubility in water and organic solvents, along with stability over three months and resilience in hard water conditions, confirmed their reliability for diverse cleaning applications. The absence of alcohol-insoluble matter in both formulations highlighted their purity and absence of undesirable residues.

The antimicrobial analysis demonstrated strong efficacy against common pathogens, including *Staphylococcus aureus* and *Escherichia coli*. Both formulations exhibited significant antibacterial activity, with F-I showing a lower Minimum Inhibitory Concentration (MIC) for *Staphylococcus aureus* (1.56 µL), indicating higher potency. F-II also demonstrated effective bacterial suppression, particularly against *Escherichia coli*, with an MIC of 6.25 µL. These results affirmed the potent disinfectant properties of both formulations, suitable for household, industrial, and healthcare environments.

The study successfully developed phenyl formulations with optimal disinfectant properties, ensuring safety, stability, and environmental compatibility. The findings support the potential of these formulations as effective cleaning agents, contributing to advancements in sustainable and efficient disinfectant products. Further research could focus on refining these formulations to enhance their environmental impact and explore alternative eco-friendly ingredients for broader applications.

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