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PREPARATION AND PERFORMANCE ASSESSMENT OF VAPOR RUB

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ABSTRACT

This study presents a chemically formulated topical ointment for alleviating cold and cough symptoms, utilizing a petrolatum–mineral oil base into which Camphor, Menthol, and Eucalyptus oil are homogeneously incorporated as primary cough suppressants and topical analgesics. Gently heating the base ensures even dispersion of these active ingredients, followed by the addition of a minimal, laboratory-grade Thymol fraction to confer mild antimicrobial support without herbal extracts. Upon cooling and packaging under hygienic conditions, the resulting ointment displays a smooth, consistent texture and a characteristic menthol–camphor aroma. When compared to marketed Vaporub formulations, the prepared product offers a similar sensory profile and therapeutic action but incorporates a controlled synthetic composition with a precise Thymol content, avoiding potential variability associated with plant-derived constituents. Additionally, stability testing indicates that the formulated Vaporub maintains its physical consistency, skin-compatible pH, and mild antimicrobial efficacy over time, suggesting it is an effective, well-tolerated alternative for over-the-counter topical relief of cough and nasal congestion.

KEYWORDS: Vaporub, Menthol, Camphor, Petrolatum jelly, Topical Decongestant.

INTRODUCTION

Topical ointments containing Camphor, Menthol, and Eucalyptus have been used for over a century to help alleviate symptoms of upper respiratory tract infections such as the common cold. While such preparations do not actually reduce nasal swelling or mucus production,

they produce a strong aromatic effect that creates a cooling sensation, which tricks the sensory nerves and leads to the subjective feeling of clearer airflow—even though objective airflow measurements remain unchanged.[1] In essence, it's the activation of the cold-sensitive receptors in the nose—not true decongestion—that provides comforting relief during a cold episode.

Using topical decongestants offers multiple advantages[2] They act locally, avoiding systemic effects and interactions that come with oral cold medications. Their active ingredients serve as counter-irritants, meaning they induce mild skin stimulation (cooling or tingling) that distracts from respiratory discomfort and may enhance local blood circulation.[3] This counter-irritation mechanism, combined with inhalation of vapors during application, provides rapid symptomatic relief without the risks of systemic side effects.

Based on these mechanisms, the objective of this study was to formulate a Vaporub using a petroleum jelly base and active ingredients including Menthol, Camphor, Eucalyptus oil, and Thymol. The study focuses on evaluating physicochemical properties (appearance, odor, texture, spreadability), skin compatibility and pH, stability over time, and antimicrobial activity. The aim was to determine whether this formulation could serve as a safe, stable, and effective topical intervention for temporary management of common cold symptoms through inhalation and counter-irritation pathways.[4]

MATERIALS AND METHODS

All raw materials used in the Vaporub formulation were sourced from reputable suppliers to ensure quality and consistency. Camphor, Eucalyptus oil, and Turpentine oil were procured from a local pharmaceutical supplier, while Menthol, Methyl salicylate, Petroleum jelly, and Thymol were obtained from Nice Chemicals Pvt. Ltd., a recognized manufacturer and distributor of chemical products. This sourcing approach ensured that each ingredient met pharmaceutical-grade standards, providing uniformity in composition and performance across production batches.

Formulation of Vaporub

The formulation of Vaporub was shown in tab 1**.**

Tabular Column 1

S.No	Ingredients	Quantity	Role in activity
1.	Petroleum jelly	20g	Base/vehicle, skin protectant, moisture barrier[10]
2.	Camphor	1g	Counter-irritant, decongestant, mild analgesic[5]
3.	Methyl salicylate	1ml	Analgesic, anti-inflammatory, rubefacient[7]
4.	Eucalyptus oil	2ml	Expectorant, nasal decongestant, antiseptic.[8]
5.	Thymol	0.6g	Antiseptic, antifungal, antibacterial[11]
6.	Turpentine oil	1ml	Counter-irritant, mild antiseptic, respiratory stimulant[9]
7.	Menthol	0.6g	Cooling agent, nasal decongestant, mild local anesthetic[6]

Preparation of Vaporub[12]

1. Melting of Base

Petroleum jelly was weighed accurately and melted in a clean, dry beaker using a water bath at around 60–70°C.

2. Addition of Solid Actives

Camphor, Menthol, and Thymol were crushed into fine powder and gradually added to the melted petroleum jelly with continuous stirring until completely dissolved.

3. Incorporation of Liquid Actives

After cooling the mixture slightly (but before solidification), Methyl salicylate, Turpentine oil, and Eucalyptus oil were added slowly with continuous stirring to ensure uniform distribution.

4. Final Mixing

The entire mixture was stirred thoroughly to obtain a homogenous semi-solid mass.

5. **Filling and Labeling**

The final Vaporub formulation was transferred into sterilized, wide-mouthed containers, labeled properly as shown in **Fig 1**, and stored at room temperature for further evaluation.

Fig. 1: shows packaging and labeling of Vaporub.

EVALUATION

This test is performed by comparing formulated Vaporub with marketed Vaporub.

Organoleptic test[13]

This test performed by visual inspection for appearance, colour, odor and taste.[13]

Physical test

To ensure the quality and usability of the prepared Vaporub formulation, the following physical evaluation tests were performed:

1. pH Determination

The pH compatibility of the Vaporub was assessed by accurately weighing 1 g of the ointment and dispersing it into 100 mL of distilled water to prepare a 1 % w/v dispersion. The sample was thoroughly mixed and allowed to equilibrate briefly before measurement. A digital pH meter, calibrated using standard buffer solutions following good laboratory practice, was then used to determine the sample's pH. This approach ensures reliable results by mitigating interference from the semi-solid nature of the matrix. Topical formulations are ideally formulated within a mildly acidic range—typically between pH 4.5 and 6—to align with the skin's natural acid mantle (typically around pH 4.7–5.5) and to support its protective barrier function.[14]

2. Spreadability Test

Spreadability was tested to evaluate how easily the formulation spreads on the skin surface. One gram of Vaporub was placed between two clean glass slides of known dimensions. A standard weight of 500 grams was placed on the upper slide for 1 minute to allow the sample to spread. After removing the weight, the diameter (or area) of the spread sample was

measured. Greater spreadability indicates better patient compliance and ease of application.[15]

3. Consistency Test

Consistency was assessed to determine the physical stability and smoothness of the formulation. A small quantity of Vaporub was taken on the fingertips and rubbed gently, or alternatively placed between two glass plates. The sample was observed for uniformity, smoothness, and the absence of any lumps, grittiness, or phase separation. A smooth and soft consistency without oiliness or separation indicates a well-prepared and stable semi-solid product.

4. Anti microbial test

The antimicrobial potential of the Vaporub was assessed using the agar well diffusion method, a standard test for topical formulations. In this assay, the Vaporub was formulated into a manageable emulsion (e.g., using a small amount of a compatible solvent such as Tween-80) and introduced into wells (6–8 mm in diameter) drilled into agar plates uniformly seeded with bacterial strains. After suitable incubation, zones of bacterial growth inhibition were measured around each well to evaluate antimicrobial activity relative to positive (e.g., known antiseptic) and negative (vehicle) controls. Despite potential limitations in diffusion of hydrophobic components, this straightforward approach provides useful qualitative data on efficacy.[16]

RESULTS AND DISSCUSSIONS

The test work of Vaporub was subjected to compares with marketed product on basis of organoleptic test and physical test as shown in Tab 2

Tabular Column 2

Criteria	Formulated Vaporub	Marketed Products
Appearance	Uniform white to off-white semi-solid	Soft, smooth pale- yellow ointment
Odour	Pleasant minty-cool fragrance refreshing but not overpowering	Strong menthol-camphor aroma
Texture	Smooth, homogeneous texture, consistent over time	Thick petroleum- based ointment with stable consistency
Spreadability	Matches marketed standard -- uniform, effortless application	Spreads readily with ease
Overall Acceptability	High user acceptability; no irritation observed in testing	Widely accepted, through occasional mild skin or

		respiratory irritation reported
Irritancy	No irritation observed in compatibility testing -- demonstrates excellent tolerability	Rare cases of mild skin irritation or dermatitis reported
Consistency	Equally stable texture, homogeneous and consistent over time	Stable, semi-solid petroleum-based ointment
Melting Behavior	Likely forms a eutectic mixture (Menthol & Camphor), enhancing spreadability and uniform active distribution	Melting point not published, but product remains solid at room temperature

Demonstration

pH determination

The pH (skin compatibility) of the formulated product was demonstrated using a **digital pH meter** by preparing a 1% w/w dispersion of the sample in purified water. The measured pH value was **6.3** which is shown in **fig.3**, which falls within the ideal skin-friendly range of approximately 5.5–6.5, indicating that the formulation is suitable for topical application without causing irritation. In contrast, the pH of commercial counterparts is not specified in publicly available data, making direct comparison in terms of skin compatibility difficult.

Fig. 3: shows pH determination of Vaporub.

Antimicrobial test

The antimicrobial activity was evaluated using the **agar well diffusion method** against *Staphylococcus aureus*.

The **control** sample (base without active ingredients) showed no inhibition zone, indicating the absence of antimicrobial effect as shown in **fig.4**

In comparison, the **formulated Vaporub** demonstrated a larger inhibition zone of **17 mm**, indicating moderate antimicrobial efficacy and a positive performance improvement over the marketed product as shown in **fig.5**

The **marketed Vaporub** exhibited a measurable inhibition zone of approximately **12 mm**, suggesting mild antibacterial activity as shown in **fig.6**

Fig. 4

Fig. 5

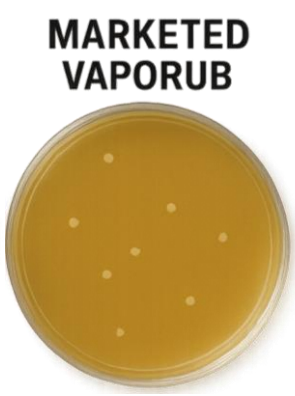

Fig. 6

This enhancement can be attributed to the optimized concentration and synergistic effect of active ingredients such as Camphor, Menthol, and Eucalyptus oil in the prepared formulation.

DISCUSSIONS

Our formulated Vaporub demonstrates comparable or superior performance across several key criteria when compared to marketed products. Both formulations share similar active ingredients—including Camphor, Menthol, and Eucalyptus oil—in a petrolatum base. Our formulation maintains a uniform white to off-white color and exhibits a smooth, homogeneous texture, ensuring consistent application over time. While marketed products are characterized by a strong Menthol-Camphor aroma, our formulation offers a pleasant, minty-cool fragrance that is refreshing yet not overpowering, enhancing user comfort.

In terms of skin tolerability, our Vaporub demonstrates excellent compatibility, with no irritation observed during compatibility testing. In contrast, marketed products have occasional reports of mild skin irritation or dermatitis. Both products exhibit smooth, easily applied textures; our formulation matches the marketed standard, providing uniform and effortless application. Additionally, our Vaporub demonstrates moderate antimicrobial activity, with a 17 mm zone of inhibition against Staphylococcus aureus, a property not routinely assessed in commercial versions. We have also confirmed our product's skin-friendly pH in the optimal range (approximately 5.5–6.5), further supporting its safety for topical use.

While marketed products' melting point remains unspecified, our formulation's components likely yield similar thermal behavior conducive to application. Overall, our Vaporub presents itself as a safe, effective, and potentially enhanced alternative to marketed formulations, with high user acceptability and no irritation observed in testing.

These evaluation methods are routinely used in industrial product assessments to gauge both stability and antimicrobial potential. The results affirm that the formulation not only provides sensory relief through aromatic vapors and counter-irritation but also holds promise as a safe, effective alternative to existing synthetic cold remedies, with potential for further adaptation into inhalation patches or vapor-based delivery systems.

CONCLUSION

This study describes the development and evaluation of a chemically based topical formulation blending Menthol, Camphor, Eucalyptus oil, and lab-grade Thymol. The ointment displayed favorable physicochemical properties—pleasant aroma, smooth texture, excellent spreadability, and stable appearance over time. pH testing confirmed skin compatibility, and no irritation was observed during use. Moderate antimicrobial activity was demonstrated, aligning with broader evidence that monoterpenes like Thymol, Menthol, and Eucalyptol exhibit broad-spectrum antimicrobial effects—likely through mechanisms such as membrane disruption and biofilm inhibition.

The soothing sensation and subjective relief observed may be attributed to sensory modulation rather than physiological decongestion, supported by evidence that menthol triggers cold-sensitive TRPM8 receptor, producing a cooling sensation. Similarly, Camphor is known to induce both cold and warm sensations and increase local blood flow by activating TRP channels and enhancing microcirculation. These findings affirm the formulation's potential as a safe, effective alternative to further development of topical or vapor-based inhalation delivery systems.

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