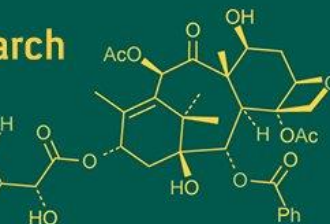
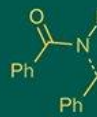
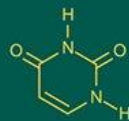


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 1665-1667
www.biochemjournal.com
Received: 24-04-2026
Accepted: 28-05-2026

Vaishali Singh

Ph.D. Scholar, Department of
Apparel & Textile Science,
Chandra Shekhar Azad
University of Agriculture
& Technology, Kanpur, Uttar
Pradesh, India

Ritu Pandey

Associate Professor,
Department of Apparel &
Textile Science, Chandra
Shekhar Azad University of
Agriculture & Technology,
Kanpur, Uttar Pradesh, India

Sakshi

Ph.D. Scholar, Department of
Apparel & Textile Science,
Chandra Shekhar Azad
University of Agriculture
& Technology, Kanpur, Uttar
Pradesh, India

Shikha Maurya

Ph.D. Scholar, Department of
Human Development and
Family Studies, Chandra
Shekhar Azad University of
Agriculture & Technology,
Kanpur, Uttar Pradesh, India

Komal Shukla

Ph.D. Scholar, Department of
Extension Education &
Communication Management,
Chandra Shekhar Azad
University of Agriculture
& Technology, Kanpur, Uttar
Pradesh, India

Mahima Mishra

Ph.D. Scholar, Department of
Apparel & Textile Science,
Chandra Shekhar Azad
University of Agriculture
& Technology, Kanpur, Uttar
Pradesh, India

Corresponding Author:**Vaishali Singh**

Ph.D. Scholar, Department of
Apparel & Textile Science,
Chandra Shekhar Azad
University of Agriculture
& Technology, Kanpur, Uttar
Pradesh, India

Fragrance retention and consumer acceptance of citronella oil-fragranced cotton sewing thread: A sensory panel study

Vaishali Singh, Ritu Pandey, Sakshi, Shikha Maurya, Komal Shukla and Mahima Mishra

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7St.9284>

Abstract

Beyond its physical performance, the value of a fragranced textile depends on how strongly and how long its scent is perceived, and on whether consumers actually want it. This paper reports a sensory-panel evaluation of a citronella oil-fragranced cotton sewing thread, produced by coating cotton thread with citronella oil-treated paraffin wax. A 25-member panel (60% aged 20–25 years, 64% female) rated the fragrance intensity of the treated thread before washing and after 1, 5, 10, 15, and 20 washes on a five-point scale, and separately rated the pleasantness of the fragrance, their preference for inbuilt fragrance in clothing, prior awareness of fragranced thread, and their agreement with statements about citronella's fragrance, insect-repellent, antifungal, medicinal, and mood-lifting properties. The freshly treated thread was rated very strong or strong by 92% of panellists (mean score 4.44), remained rated strong-to-mild through the fifth wash, and declined to a predominantly "worse"/very-mild rating for most panellists (68%) by the twentieth wash. Eighty per cent of respondents perceived the fragrance as pleasant, 76% said they would prefer garments with an inbuilt fragrance, and the fragrance property itself was the most strongly endorsed of citronella's attributes, followed by insect repellency, antifungal action, medicinal value, and mood/fatigue-lifting effect, in that order. A paired comparison between mean fragrance-retention score and mean inbuilt-fragrance preference score was statistically significant ($t = 3.599$, $P < 0.05$). These findings indicate that citronella oil-fragranced sewing thread is well received by consumers and delivers a clearly perceptible scent for at least five washes, but that fragrance durability declines markedly beyond ten washes, pointing to encapsulation or similar slow-release approaches as a priority for future development.

Keywords: Citronella oil, fragranced textiles, sensory evaluation, consumer acceptance, fragrance retention, wash durability

1. Introduction

A pleasant fragrance is increasingly treated as a functional attribute of textiles in its own right: certain scents are believed to elicit positive emotions, reduce tension, and improve mood, and aromatherapy-based textile applications have been explored for their calming and mood-regulating effects. Whatever fragrance-delivery technology is used, however, the practical value of a scented textile ultimately depends on two consumer-facing questions: how strong and long-lasting the fragrance is perceived to be through normal use and laundering, and whether wearers actually find the scent pleasant and want it built into their clothing.

Citronella oil, obtained from *Cymbopogon* (lemongrass) species, is a natural essential oil long used in perfumery and cosmetics and best known for its insect-repellent activity, alongside reported antifungal, antimicrobial, and mood-regulating (adaptogenic/sedative) properties (Kamal *et al.*, 2020; Nakahara *et al.*, 2013; Tahya *et al.*, 2022) ^[1, 2, 6]. As a volatile monoterpene-rich oil, however, citronella's fragrance and repellent activity are known to fade with time and washing once applied to a textile surface (Specos *et al.*, 2010) ^[5], so consumer-facing questions of perceived strength, durability, and acceptability are central to judging whether a citronella-based fragrance finish is practically useful, independent of its underlying mechanical or chemical performance.

This paper reports a structured sensory-panel evaluation of a citronella oil-fragranced cotton sewing thread — produced by coating cotton thread with citronella oil-treated paraffin wax

— focusing on (i) how panellists rated fragrance intensity before washing and after successive washes; (ii) how pleasant the fragrance was perceived to be; (iii) panellists' preference for, and prior awareness of, inbuilt fragrance in clothing; and (iv) panellists' awareness of citronella's associated functional properties. The physical and morphological characterisation of the same treated thread is reported in a companion paper.

2. Literature Review

Citronella oil applied to cotton fabric by conventional padding has been reported to give strong initial mosquito-repellent activity that diminishes within roughly three weeks, reflecting the oil's weak binding to the fibre surface when applied without an encapsulating carrier (Specos *et al.*, 2010) ^[5]. Microencapsulated citronella oil, by contrast, has been reported to sustain repellency above 90% for about three weeks (Specos *et al.*, 2010) ^[5] and up to 80% after 30 industrial-type washes at higher microcapsule loadings (Reis *et al.*, 2022) ^[4], underscoring that consumer-perceived durability of a citronella finish depends heavily on the delivery method rather than on the oil itself. Reviews of essential-oil textile finishing more broadly note the trade-off between simple, low-cost application methods and the greater wash-fastness achievable with microencapsulation or similar slow-release technologies (Textile School, 2021; Verma *et al.*, 2023) ^[8, 9].

Consumer or sensory-panel evaluation of fragranced textiles is comparatively underreported relative to the chemical and durability testing of the finishes themselves, even though acceptance and perceived pleasantness are ultimately what determine whether such products succeed commercially. This paper addresses that gap for a citronella oil-fragranced sewing thread specifically.

3. Materials and Methods

3.1 Study Area, Duration, and Respondents

The study was carried out in Kanpur, Uttar Pradesh, India, at the Department of Home Science, Chandra Shekhar Azad University of Agriculture and Technology, during 2022–23. The sensory questionnaire was administered between the last week of March and the first week of April 2023. Twenty-five respondents were randomly selected from students of the

College of Community Science and Agriculture to form the evaluation panel.

3.2 Preparation of the Fragranced Thread

Unfinished cotton sewing thread was coated with citronella oil-treated paraffin wax: paraffin wax was melted at 100°C, blended with 5 ml of citronella oil, moulded, and cured for 15–20 minutes; the cotton thread was then drawn through the cured, fragranced wax on a yarn winder so that its surface was coated with the fragrance-loaded wax as it passed through. Samples were packaged for evaluation before washing and after 1, 5, 10, 15, and 20 washes.

3.3 Sensory/Panel Evaluation Protocol

For each wash stage, each of the 25 panellists smelled the packaged sample from a distance of 10 cm and rated the fragrance intensity on a five-point scale: very strong, strong, mild, very mild, or worse/none. Panellists separately rated (i) whether they sensed the fragrance as pleasant, irritating, or having no effect; (ii) whether they preferred garments with an inbuilt fragrance; (iii) whether they had previously heard of fragranced sewing thread; and (iv) their agreement, on a five-point scale (strongly agree to strongly disagree), with five statements about citronella's properties — fragrance, insect repellency, medicinal value, antifungal action, and mood/fatigue-lifting effect. Panel demographic data (age group, gender) were also recorded.

3.4 Statistical Analysis

Responses were analysed using percentages, weighted mean scores, and rank ordering for each wash stage and each statement. A paired t-test was used to compare the mean fragrance-retention score across washes with the mean preference score for inbuilt fragrance.

4. Results and Discussion

4.1 Panel Demographics

Of the 25 panellists, 60% were aged 20–25 years, 32% were aged 25–30 years, and 8% were above 30 years; 64% of the panel were female and 36% male.

4.2 Fragrance Intensity Across Washes

Table 1: Perceived fragrance intensity of citronella-treated thread across washes

Sample	Very strong (%)	Strong (%)	Mild (%)	Very mild (%)	Worse (%)	Mean score	Rank
Citronella (0 wash)	52.0	40.0	8.0	0.0	0.0	4.44	I
After 1 wash	20.0	64.0	12.0	0.0	4.0	3.96	II
After 5 washes	8.0	32.0	44.0	4.0	12.0	3.20	III
After 10 washes	0.0	4.0	72.0	16.0	8.0	2.68	IV
After 15 washes	0.0	0.0	32.0	40.0	28.0	2.04	V
After 20 washes	0.0	0.0	0.0	32.0	68.0	1.40	VI

The freshly treated thread was rated very strong or strong by 92% of panellists, and the fragrance remained detectable as strong or mild through the fifth wash for most panellists. By the tenth wash the fragrance had shifted predominantly to mild/very mild, and by the twentieth wash most panellists (68%) rated it as worse/negligible. This progressive decline mirrors the wash-durability pattern reported for unencapsulated citronella finishes elsewhere, where fragrance and repellent activity fade within a few weeks of laundering (Specos *et al.*, 2010) ^[5], and suggests that microencapsulation or a comparable slow-release carrier

(Reis *et al.*, 2022) ^[4] would be needed to extend the fragrance life of the thread beyond the roughly five-to-ten-wash window observed here.

4.3 Perceived Quality of the Fragrance

Table 2: Citronella fragrance as sensed by respondents

Response	Frequency	Per cent
Pleasant	20	80.0
Irritating	3	12.0
No effect	2	8.0

Eighty per cent of respondents described the citronella fragrance as pleasant, 12% found it irritating, and 8% reported no effect, indicating broadly favourable sensory reception of the fragrance among the panel.

4.4 Preference for, and Awareness of, Inbuilt Fragrance

Table 3: Preference for inbuilt citronella fragrance in clothing

Response	Frequency	Per cent
Yes	19	76.0
No	6	24.0

Seventy-six per cent of respondents said they would prefer clothing with an inbuilt fragrance, while 24% would not. Just over half of respondents (56%) reported having previously heard of fragranced thread; 44% had not, suggesting the concept, while appealing once experienced, is not yet widely familiar to consumers.

4.5 Awareness of Citronella's Functional Properties

Table 4: Respondent agreement with statements on citronella's properties

Statement	Mean score	S.D.	Rank
Pleasant fragrance	3.44	3.33	I
Insect repellent	2.96	2.91	II
Antifungal agent	2.64	2.56	III
Medicinal property	2.56	2.45	IV
Lifts mood/reduces fatigue	2.48	2.40	V

The fragrance property itself was rated most strongly, followed by insect repellency — consistent with citronella's established role as a natural mosquito repellent (Verma *et al.*, 2023; Kamal *et al.*, 2020) ^[9, 1] — and then antifungal, medicinal, and mood-lifting properties, in that order. This ranking suggests panellists' awareness and endorsement of citronella's benefits tracked most closely with its most immediately perceptible property (fragrance) and declined for properties that are less directly experienced through casual use.

4.6 Relationship Between Fragrance Retention and Preference

A paired comparison between the mean fragrance-retention score across washes (18.0, S.D. 3.6) and the mean preference score for inbuilt citronella fragrance (11.4, S.D. 8.4) was statistically significant ($t = 3.599$, $P < 0.05$). This indicates that perceived fragrance strength in the thread and stated preference for an inbuilt fragrance, while related, are measured on different scales and do not move in lockstep — respondents' overall fragrance rating was considerably higher than their inbuilt-preference score, implying that strong initial fragrance alone does not fully translate into stated purchase-style preference and that other factors (e.g., expected durability, price, or prior familiarity) likely also shape consumer preference.

5. Conclusion

This sensory-panel study shows that citronella oil-fragranced cotton sewing thread delivers a strong, clearly perceptible, and largely pleasant fragrance immediately after treatment and through at least five washes, with 80% of panellists rating the fragrance pleasant and 76% expressing a preference for inbuilt fragrance in clothing. However, fragrance intensity

declined steadily with laundering, falling to a predominantly “worse”/very-mild rating by the twentieth wash, reflecting the volatile, surface-bound nature of citronella oil when it is not chemically bound or microencapsulated. Among citronella's associated properties, fragrance and insect repellency were most strongly recognised by respondents, followed by antifungal, medicinal, and mood-lifting effects. These findings support citronella oil-fragranced sewing thread as a consumer-acceptable, functional textile innovation, while indicating that wash durability beyond roughly ten washes is the main limitation to address. Combined with the mechanical and morphological findings reported in the companion paper, encapsulation or other slow-release carrier systems appear to be the most promising direction for extending the useful fragrance life of citronella-treated sewing thread while preserving its consumer appeal and cost advantage over more resource-intensive finishing routes.

References

- Kamal HZA, Ismail TNNT, Arief EM, Ponnuraj KT. Antimicrobial activities of citronella (*Cymbopogon nardus*) essential oil against several oral pathogens and its volatile compounds. *Padjadjaran Journal of Dentistry*. 2020;32(1):1-7.
- Nakahara K, Alzoreky NS, Yoshihashi T, Nguyen HTT, Trakoontivakorn G. Chemical composition and antifungal activity of essential oil from *Cymbopogon nardus* (citronella grass). *Japan Agricultural Research Quarterly*. 2013;47(4):381-386.
- Nelson G. Microencapsulation in textile finishing. *Review of Progress in Coloration and Related Topics*. 1991;21(1):72-85.
- Reis DR, Ambrosi A, Di Luccio M. Fabrication of highly durable functional textile through microencapsulation of organic citronella oil. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 2022;654:130070.
- Specos MMM, García JJ, Tornesello J, Marino P, Della Vecchia M, Defain Tesoriero MV, *et al.* Microencapsulated citronella oil for mosquito repellent finishing of cotton textiles. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 2010;104(10):653-658.
- Tahya CY, Kolo SMD, Karnelasatri. Antimicrobial and antioxidant properties of *Cymbopogon nardus* L (citronella grass) oil from Kefamenamu, Timor Tengah Utara Regency, Indonesia. *AIP Conference Proceedings*. 2022;2391(1):050003.
- Tarrant P. An introduction to sewing thread. *American & Efird Inc.*; 1994.
- Textile School. Insect repellent textile finishing using natural bio-molecules. *Textile School*; 2021.
- Verma RS, Padalia RC, Chauhan A, Verma RK. Potential applications of microencapsulated essential oil components in mosquito repellent textile finishes. *Coatings*. 2023;13(8):1467.