

COMPARATIVE ANALYSIS OF LEMONGRASS OIL APPLICATION ON TEXTILE SUBSTRATE THROUGH MICROENCAPSULATION AND EXHAUST METHOD

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ABSTRACT

In this study application of lemongrass oil on fabric was done via two methods: oil microcapsules applied through padding and exhaust method. Lemongrass oil microcapsules were prepared using complex coacervation technique and applied on fabric using pad dry cure technique. The retention of aroma on the samples treated with both techniques was assessed before and after washing and the one giving better results was subjected to further testing i.e. SEM analysis and antimicrobial efficacy. The antimicrobial assessment of the control and treated fabric was done through AATCC-100. The results revealed that fabrics treated with lemongrass oil microcapsules were more effective in fragrance retention as compared to the fabrics treated with exhaust method. The lemongrass oil microcapsules treated fabric showed 80% bacterial reduction. SEM micrographs revealed that the microcapsules were spherical in shape and the fabrics were able to retain microcapsules till 30 washes.

Keywords: *Aroma Finish, Antimicrobial, Exhaust, Microencapsulation, Textile Finishing, Wash Durability*

INTRODUCTION

Essential oils are the highly concentrated extracts from herbs, plants and flowers [1]. They are used in single or in combination to bring about soothing and curative process in mind and body. They have calming, stimulating, pain reducing and mood enhancing effects. [2]. Recently consumers' expectations are very much higher, they expect their clothing to perform multiple functions from aesthetic to basic protection. Garments act as second skin so they are the excellent media to transfer wellness effect too. The addition of fragrances to textiles has been carried out for many years in the form of fabric conditioners in the wash and tumble drying process but the effect was short lived. To achieve durable aroma finish on textiles has been a long time dream for textile chemists. As fragrances are volatile so they evaporate away and do not stay for long periods and are not resistant to wash.

Microencapsulation can effectively control the release rate of fragrance compounds and essential oils as required which ensures the storage life of volatile substance [3] Microencapsulation is a technique to prepare microcapsules, small particles that contain an active agent or core material surrounded by coating or shell of limited permeability [4]. Microencapsulation is an innovation wherein active material is enveloped in a coating or capsule which protects it from external environment. The aroma capsule is a kind of container that provides both space for storing a certain amount of aromatic matter and a protective shield from the effects of sunlight, moisture and oxygen. Release of aroma is by diffusion of the fragrance through the capsule wall and rupture of the capsules [5]. These capsules can be applied to fabric through simple pad-dry sequence. During wear, simple mechanical rubbing of fabric gradually ruptures the membrane releasing active ingredient as moisturising or deodorising effects.

The wellness business is proactive. People voluntarily become consumers to feel fresh, to reduce the effects of odour and to alleviate their moods. Aroma textiles offer a new challenge and field is wide open to innovation. As well they can also act as antibacterial, mosquito repellent, insect repellent etc. The present work aimed to develop lemongrass oil microcapsules and to analyse the effect of application method on durability of finish.

II. MATERIALS AND METHODS

Cotton Fabric 200 thread count was sourced from local market of Haryana. Lemongrass oil was purchased from Fine fragrances, Mumbai. Gum Acacia, Gum Arabic, Gelatine, Acrylic Binder ST and alcoholic formalin was procured from Dalton Chemicals, New Delhi

1.1 Preparation of Fabric

The cotton fabric was desized, bleached and scoured to make it ready for treatment.

2.2 Application of Lemongrass oil by Exhaust Method

Cotton the fabric finished by exhaustion method with 5% acrylic binder ST which is used as cross-linking agent. The fabrics were kept immersed in the solution containing 10 % lemongrass oil, (ML ratio – 1: 10) for 20-30 minutes at 40 °C in water bath. After finishing, the fabrics were removed, squeezed and dried at 100 °C in the oven for 5 minutes and then cured at 120 °C for 2 minutes. [6]

2.3 Preparation of lemongrass oil microcapsules

Complex coacervation technique was used to prepare microcapsules. 12 g of gelatin was dissolved in warm water and stirred at high speed for 10 minutes. 4 g of core material was added to the solution at 40°C. 12 g of gum acacia was dissolved in water separately and was added to the gelatine solution and the temperature of the solution was maintained at 40°C. The pH of the solution was decreased to 4.5. The solution was stirred at high speed for 20 minutes and the temperature was lowered to 5°C for gel formation. The pH was increased to 8.5 to form microcapsules. 1 ml of alcoholic formalin (17 percent) was added to the formed capsules for stabilization.

The resultant precipitate obtained was analyzed under inverted microscope to ensure the formation of microcapsules. [7]

2.4 Application of Microcapsules on Fabric

The cotton fabric sample was immersed in the padding solution with 110-120 expression using pneumatic padding mangle, squeezed and cured at 80-85°C for few minutes. [8]

2.5 Assessment of Finished Fabrics for Wash Durability

Wash durability test was carried out as per the recommendation of IS: 3361-1979 (ISI handbook of textile testing, 1982e) in a 'laundrometer' using 5gpl of soap and M:L ratio 1:50 for 45 minutes at $50 \pm 2^\circ$ C. After removing fabric specimen from laundrometer after 5, 10, 15, 20, 25 and 30 wash cycles it was rinsed twice in cold water and then in running tap water for 10 min and squeezed. The finished specimen was dried in air at a temperature not exceeding 60 °C.

2.6 SEM analysis of treated and washed fabrics

Scanning electron microscope was used to ensure the presence of microcapsules in the treated samples and samples after different number of washing. The treated fabric samples of 10 mm diameter were mounted on the circular metallic sample holder and samples were analyzed at a magnification of 1200 x and images were captured.

2.7 Retention of aroma after wash

The treated samples and washed samples were evaluated against aroma retention by 20 experts through survey technique using olfactory analysis. The aroma assessment was based on Lewis's procedure [9]. A portion of each fabric was removed after 5, 10, 15, 20, 25 and 30 wash cycles, tested for the presence of fragrance by the experts. To detect odour, a specimen was put on a desk and the expert used a fingernail to scratch "X" on the specimen to rupture some capsules and smell the swatch. The size of "X" was about 3x3 cm. The responses were recorded as 'Yes' or 'No'. If the aroma was judged to be present by majority of experts, the condition was noted as passing.

2.8 Antimicrobial Assesment of Treated Fabrics

AATCC 100 was used for antimicrobial testing. Treated test samples and untreated control samples were inoculated with a representative test organism. The test organism is allowed to expose to the test material at an elevated temperature, typically for 24 hours. Following exposure, the samples are neutralized and quantitatively assayed for survivors. The resulting plates are incubated, the number of survivors is enumerated and a percentage reduction is determined for the treated test material as compared to the untreated control material. [10]

III.RESULTS AND DISCUSSION

3.1 Selection of Oil

Table 1 shows that the survey results and reveals that Lemongrass oil was the most preferred essential oil on the basis of fragrance preferred by people, therefore it was used for further experimental work

3.2 Microcapsule Formation

The precipitate obtained through complex coacervation technique was analysed under inverted microscope and it was observed that several spherical shaped microcapsules were formed. (Fig 1).

3.3 Wash Fastness of Treated Fabric

Table 2 and Fig 2 shows the olfactory analysis results of the washed samples revealed that the fabric treated through exhaust method retained fragrance only till 10 washes while the fabric treated through the oil microcapsules retained fragrance till 30 washes.

3.4 Intensity of Aroma after Wash

The treated and washed samples were evaluated against intensity of aroma by 20 respondents on a 5 point scale. Table 3 and Fig. 3 clearly depicts that the intensity of aroma is strong during the first few washes and then it decreases gradually, but faint aroma is present even after 30 washes in the fabric treated with oil microcapsules while the fabrics treated by exhaust method retained faint aroma only till 10 washes.

3.5 SEM Analysis of Microencapsulated Fabrics

Fig. 4 shows the SEM analysis of microencapsulated fabric depicts the presence of too many microcapsules the treated fabric and few microcapsules can be seen in the fabric with 30 washes. As the number of washes increases the number of microcapsules on fabric decreases.

3.6 Antimicrobial Assessment of Microcapsule treated fabric

As the wash fastness of microcapsule treated fabric samples was better than the one's treated with exhaust therefore the microcapsule treated samples were further tested for the antimicrobial efficacy using the AATCC 100 method. The treated fabric showed 80% reduction in bacterial colonies as compared to control. (Fig 5)

IV.CONCLUSION

Spherical shaped stable microcapsules can be prepared with complex coacervation technique. The wash durability results revealed that the finishing done on fabrics with exhaust method are less durable as compared to the ones treated with microcapsules. SEM analysis of the microencapsule treated fabric also revealed the presence of large number of microcapsules in the treated fabric and the number gradually decreased with the increase in the number of wash cycles. Microencapsulation technique can be used to apply essential oils on the fabric in order to impart various effects. Lemongrass oil has been found to give good antimicrobial effect on the

treated fabric. Further studies can be done to increase the wash durability of the finish and application of different oils.

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Table 1: Preferences of the respondents for essential oil for microencapsulation

Essential oil	Aroma (WMS)	Rank
Basil oil	3	II
Lemongrass oil	3.48	I
Orange oil	3.04	III
Tea Tree oil	2.52	III

Table 2. Retention of Aroma after Wash in Fabrics treated by exhaust method and Microencapsules

Wash cycles	Unwashed	5	10	15	20	25	30
Retention of aroma (exhaust)	20 (100)	15 (75)	2 (10)	0	0	0	0
Retention of aroma (microencapsulated)F(%)	20 (100)	20 (100)	20 (100)	19 (95)	17 (85)	15 (75)	4 (20)

Table 3. Intensity of Aroma after Wash in Fabrics treated by exhaust and oil Microcapsules

Wash cycles	Intensity of aroma(WMS)	
	Microencapsulated	Exhaust
Unwashed	4.35	4.2
5	4.2	2.5
10	3.7	1.2
15	2.95	0
20	2.5	0
25	2.3	0
30	1.2	0

Figure 1. Microcapsules analysed under inverted Microscope

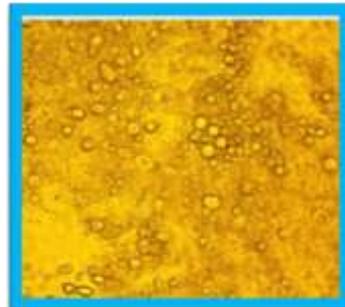


Figure 2. Retention of Aroma after Wash in Fabrics treated by exhaust and oil Microcapsules

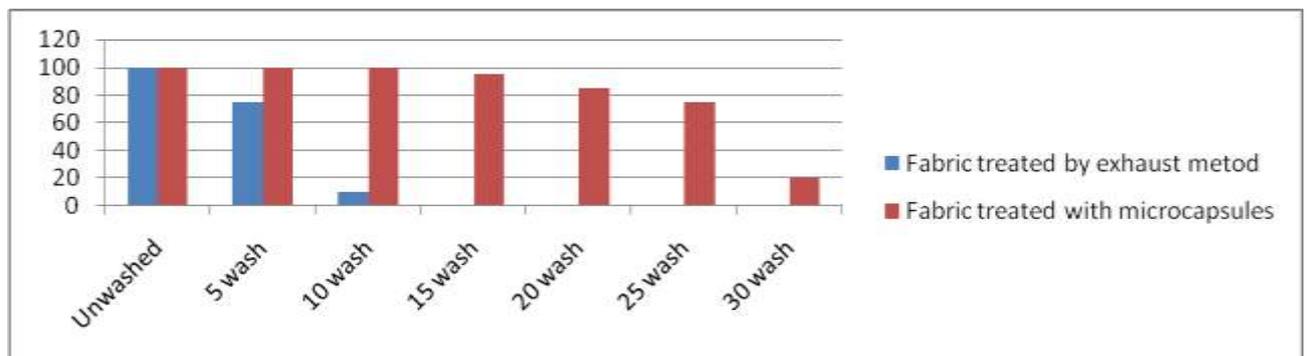


Figure 3. Intensity of Aroma after Wash in Fabrics treated by exhaust and oil Microcapsules

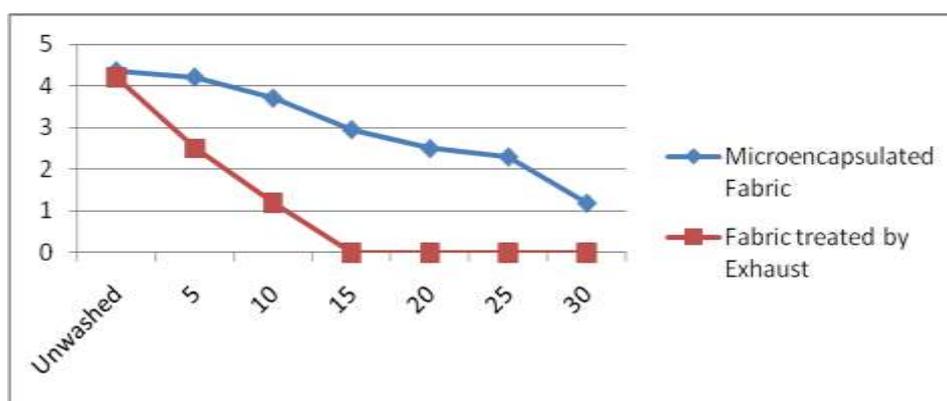
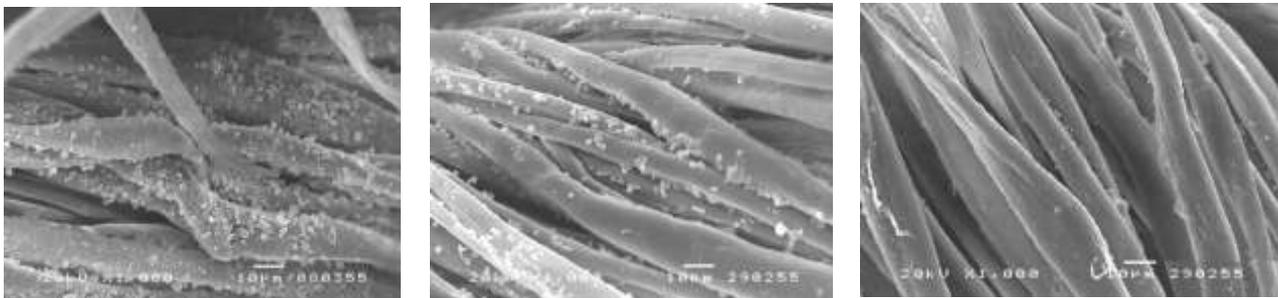


Figure 4. SEM analysis of cotton fabric treated with Lemongrass Microcapsules



Unwashed

After 15 Wash

After 30 wash

Figure 5. Antimicrobial Efficacy of control and treated samples



Control

Treated