

A Study on the Efficiency of Lavender Microcapsules on Silk/Lyocell Blended Fabrics



Mariyam Adnan and J. Jeyakodi Moses

Abstract In this study, silk/lyocell 50:50 blended fabrics were treated with lavender microcapsules and its efficacy was evaluated by two methods, namely psychophysical assessment to test the fragrance properties and organoleptic evaluation of odour control for anti-odour assessment. Further, a panel of 25 judges were made to assess the wash durability of the finish by rating the intensity of the aroma after 5, 10 and 15 washes. Lavender treated silk/lyocell 50:50 blended fabrics performed well in terms of aroma finish. In the evaluation of aroma finish by psychophysical assessment, very good ratings were given by the participants in the survey with respect to aroma's pleasantness and intensity. The participants also showed interest in buying perfumed products by giving positive ratings in the survey. Organoleptic evaluation of odour control also gave good anti-odour results. When wash durability of the finish was evaluated subjectively after 5, 15 and 25 washes, the participants rated the intensity of the finish as good up to 25 washes. Characterization of lavender treated fabrics with the untreated ones by SEM, EDX and FTIR analyses confirm the presence of lavender finish on the silk/lyocell 50:50 blended fabrics.

Keywords Silk · Lyocell · Aroma · Lavender · Organoleptic evaluation

1 Introduction

Silk fabrics are priced for their vanity, versatility, wearability and comfort. It absorbs moisture, which makes it cool in summer and warm in winter. It retains the shape, drapes well and sparkles with a dazzling lustre. In spite of all the wonderful properties silk possesses, it is extremely costly. Due to constant increase in price of silk fabrics,

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demand for blended silk fabrics is increasing thereby making silk and synthetic blended fabrics more popular in the market [1]. Lyocell fibre is the latest cohort of man-made cellulosic fibre shaped by extremely advanced environment friendly and engineered technical process [2]. Blending of silk with lyocell has many advantages over blending of silk with cotton or any other synthetic fibres. Lyocell is more versatile and uniform than cotton as it is a man-made fibre. It scores over synthetics because it is a biodegradable fibre and thus causes fewer burdens to the ecosystem [3]. Thus, considering the properties of silk and lyocell an attempt is made in the present study to blend silk and lyocell in different proportions and explore its properties so that even a common person can enjoy the unique richness of silk with excellent softness of lyocell.

In recent times, fragrances which can be readily added on textiles are available. The finished fabrics emit a pleasant aroma which is used as a medicine renowned as aromachology [4]. Because the sense of smell cannot be turned off and it gives an immediate emotional response, marketers are getting aware of its usefulness in communicating with consumers. Therefore, since the last few years consumers have started to become increasingly influenced by scents [5].

Lavender is the most used of all the essential oils. It is distilled from *Lavandua Angustifolia*, native of the Alpine slopes of the Mediterranean. It is very useful oil, especially when used against symptoms of a nervous problem. The major compositions of lavender essential oil are linalyl acetate, linalool, lavandulol and leaf alcohol isobutyrate [6]. The present work addresses the application of lavender microcapsules on silk/lyocell blended fabrics to develop an aroma-finished fabric.

2 Materials and Methods

2.1 Materials

Commercially available mulberry silk cut filaments were brought from M. Jiju Silk Mills, Bengaluru, Karnataka, India and lyocell fibres were purchased from KG Mills, Coimbatore, Tamil Nadu, India. Lavender fragrance microcapsules and binder supplied by Resil Chemicals, Bengaluru, India were used for aroma finish.

2.2 Methods

Fabric Development A blended yarn containing silk/lyocell in the ratio of 50:50 (S/L 50:50) was manufactured in a spinning unit and processed to produce 60 s Ne (9.84 tex) yarn. The blended yarn was woven into fabric having the specifications of plain weave, with warp 30 ends/cm, weft 25 picks/cm and 71.8 GSM fabric weight.

Table 1 Sample questionnaire of psychophysical assessment of lavender finish on S/L 50:50 blended fabrics

| Question No. | Question |
|--------------|---|
| 1 | Please rate the intensity of the fragrance in the fabric 1. Excellent 2. Good 3. Average 4. Poor 5. Nil |
| 2 | Please rate the pleasantness of the fragrance in the fabric 1. Excellent 2. Good 3. Average 4. Poor 5. Nil |
| 3 | Please rate to what extent does the fragrance on this fabric influence your mood 1. Excellent 2. Good 3. Average 4. Poor 5. Nil |
| 4 | Please rate the intensity of your interest/preference in purchasing innovative products such as a shoe insole, a baby diaper or a handkerchief from scented fabrics 1. Excellent 2. Good 3. Average 4. Poor 5. Nil |
| 5 | Please rate the intensity of the fragrance of this sample if a company were to create clothing or textile goods (shoe insole, a baby diaper or a handkerchief) from this fabric 1. Excellent 2. Good 3. Average 4. Poor 5. Nil |

Aroma Finishing Using Lavender Microcapsules To acquire aroma finish on S/L 50:50 blended fabric, commercially available lavender fragrance microcapsules (3% of) were mixed with binder in a dry beaker with a ratio of 4:1. The homogenous mixture was added to distilled water at a material to liquor (M:L) ratio of 1:10. Samples were then treated in the solution for thirty minutes at pH 5.5 set by acetic acid and passed in a padding mangle, dried at 80 °C for 15 min and cured at 130 °C for 3 min.

Aroma Finish Evaluation S/L 50:50 blended fabrics were treated with lavender microcapsules and the efficiency of aroma finish was tested subjectively by psychophysical assessment of aroma finish and organoleptic evaluation of odour control.

Psychophysical Assessment A psychophysical assessment was carried out by 50 participants for evaluating the lavender treated S/L 50:50 blended fabrics. Each participant rated the treated fabric in a single evaluation session. Table 1 gives the questions asked to all participants for evaluation. Participants rated each sample for intensity and pleasantness. Participants were asked to rate their interest in aroma-finished products also. All ratings were made with a 5-point Likert scale; 5 being the maximum fragrance and 0 being nil fragrance [7].

Organoleptic Evaluation of Odour Control The effectiveness of the treatment was assessed using the organoleptic evaluation of odour control of untreated and lavender treated S/L 50:50 blended fabrics. Five-male panellists were each given an untreated and lavender treated shoe insole daily over the five-day test period. Each shoe insole was supposed to be worn on a specific foot. During the end of a workday, panellists reported to the lab to remove the shoe insoles, the shoe insoles were sealed

in plastic bags, and the panellists received shoe insoles for the next day. Four judges made odour evaluations after 14 h from the removal of the insoles on each test day. The judges were given individual scoring sheets and new sheets were given every day for the evaluation. The odour rating scale was 10–0 (with 10 being “no odour” to 0 being “very intense and disagreeable odour”).

Wash Durability The durability of the aroma finish for lavender treated fabrics was evaluated by subjective method after 5, 15 and 25 wash cycles as per the AATCC 135-2004 method. Twenty-five judges evaluated the intensity of the fragrance by ratings made along a 5-point Likert scale with 0 being very poor fragrance and 5 being excellent fragrance.

Characterization by SEM, EDX and FTIR Analysis A Scanning Electron Microscope (SEM), model JEOL SEM JSM-6360, was used to observe the morphology. Energy Dispersive X-ray (EDX) was carried out using a system fitted on the SEM to allow identification of the elements present in the surface of the fabrics. Infrared transmission spectra of the fabrics were recorded using a Shimadzu FTIR spectrophotometer.

3 Results and Discussion

Scents can improve mood, promote optimism, reduce anxiety and facilitate creative thinking [7]. Silk/Lyocell 50:50 blended fabrics were treated with lavender microcapsules and its efficacy was evaluated by two methods, namely psychophysical assessment to test the fragrance properties and organoleptic evaluation of odour control for anti-odour assessment. Further, a panel of 25 judges was made to assess the wash durability of the finish by rating the intensity of the aroma after 5, 10 and 15 washes. The results obtained are discussed below.

3.1 Psychophysical Assessment

Fifty participants in total took part in the assessment of aroma of lavender treated S/L 50:50 blended fabrics. The questions were evaluated for their aroma along a 5-point Likert scale, with 5 being excellent fragrance and 0 being very poor fragrance. Table 2 gives the mean ratings of the lavender treated fabrics.

From Table 2, it is seen that the participants gave uniformly positive ratings to the lavender finished silk/lyocell blended fabric in the proportion of 50:50. The mean rating for intensity was found to be 4.4 which signify that participants rated the intensity of the fragrance as very good, though not excellent. The mean rating for pleasantness of fragrance received similarly positive ratings (4.3). Participants also gave a mean rating of 3.9 for fragrance influencing mood which signifies a very good

Table 2 Psychophysical assessment of lavender treated S/L 50:50 blended fabrics

| Questions to the participants | Mean rating ^a | Standard deviation |
|---|--------------------------|--------------------|
| Intensity of the fragrance | 4.4 | 0.59796 |
| Pleasantness of the fragrance | 4.3 | 0.66425 |
| Fragrance influencing mood | 3.9 | 0.80407 |
| Interest in buying a scented product | 3.9 | 0.66517 |
| Intensity of lavender fragrance in buying | 4 | 0.75593 |

^aInterpretation: 1. Very poor, 2. Poor, 3. Good, 4. Very good, 5. Excellent

rating. In the survey, participants rated highly (3.9) their interest in purchasing scented products. The results also showed consistent positive rating of 4 by participants for buying lavender-infused fabrics and other products such as a diaper or a handkerchief.

3.2 Organoleptic Evaluation of Odour Control

The average rating for anti-odour assessment performed on five-male subjects and evaluated by four judges for lavender treated S/L 50:50 blended fabrics are given in Table 3.

Four judges evaluated the shoe insole for organoleptic evaluation of odour control. From Table 3, it is observed that among the five subjects, the maximum average anti-odour rating given was 8, for Subject 5, which signifies very good anti-odour behaviour of lavender treated fabrics, followed by a rating of 7, which was given for Subject 1 and signifies good anti-odour behaviour of lavender treated S/L 50:50

Table 3 Organoleptic evaluation of odour control on lavender treated S/L 50:50 blended fabrics

| Subjects | Ht (cm)/Wt(Kg) | Average rating ^a |
|------------------------|----------------|-----------------------------|
| Subject 1 (Male/39 yr) | 175/62 | 7 |
| Subject 2 (Male/40 yr) | 170/78 | 6 |
| Subject 3 (Male/28 yr) | 172/81 | 6 |
| Subject 4 (Male/29 yr) | 165/75 | 6 |
| Subject 5 (Male/24 yr) | 163/72 | 8 |

^aInterpretation: 10. Ideal, 9. Excellent, 8. Very good, 7. Good, 6. Fairly good, 5. Acceptable, 4. Fair, 3. Poorly fair, 2. Poor, 1. Very poor

Table 4 Wash durability of lavender treated S/L 50:50 blended fabrics by subjective evaluation fabrics

| Number of washes | Mean rating ^a | Standard deviation |
|------------------|--------------------------|--------------------|
| 5 | 4 | 0.53852 |
| 15 | 3.3 | 0.45826 |
| 25 | 2.8 | 0.55377 |

^aInterpretation: 1. Very poor, 2. Poor, 3. Good, 4. Very good, 5. Excellent

blended fabrics. The least odour rating given by the judges is 6, for Subject 2, 3 and 4, which signify fairly good odour control of the lavender treated S/L 50:50 shoe insole given to the subjects. The overall average rating is 7, which signify good anti-odour behaviour of lavender treated shoe insoles, thereby giving a positive result on further diversification of scented products such as a shoe insole, handkerchief or baby diaper.

3.3 Wash Durability

The wash durability of lavender microcapsules on S/L 50:50 blended fabrics were evaluated subjectively. A total of 25 participants were asked to evaluate the aroma of the lavender treated test samples after 5, 15 and 25 washes along a 5-point Likert scale with 0 being very poor fragrance and 5 being excellent fragrance. Table 4 gives the mean ratings of the lavender treated fabrics after 5, 15 and 25 washes.

From Table 4, it is observed that the mean rating of lavender treated S/L 50:50 blended fabrics were 4 after 5 washes, which imply very good intensity of aroma. As the number of washes increased to 15, the mean rating came down to 3.3 which still imply a good aroma. For lavender treated S/L 50:50 blended fabrics after 25 washes, the mean rating went down to 2.8 which imply the average intensity of aroma. Hence, it can be concluded that S/L 50:50 blended fabrics gave good aroma up to 25 washes. This excellent wash durability of the aroma can be attributed to the microencapsulation technology used for the application of lavender finish in the fabrics.

3.4 Characterization of Untreated and Lavender Treated S/L 50:50 Blended Fabrics

Characterization of untreated and lavender treated S/L 50:50 blended fabrics by SEM, EDX and FTIR analysis are presented below.

SEM Analysis The SEM images of untreated and lavender treated S/L 50:50 blended fabrics are given in Fig. 1a, b, respectively. For the untreated fabric, the fabric surface is smooth without any coating. In comparison, the lavender treated

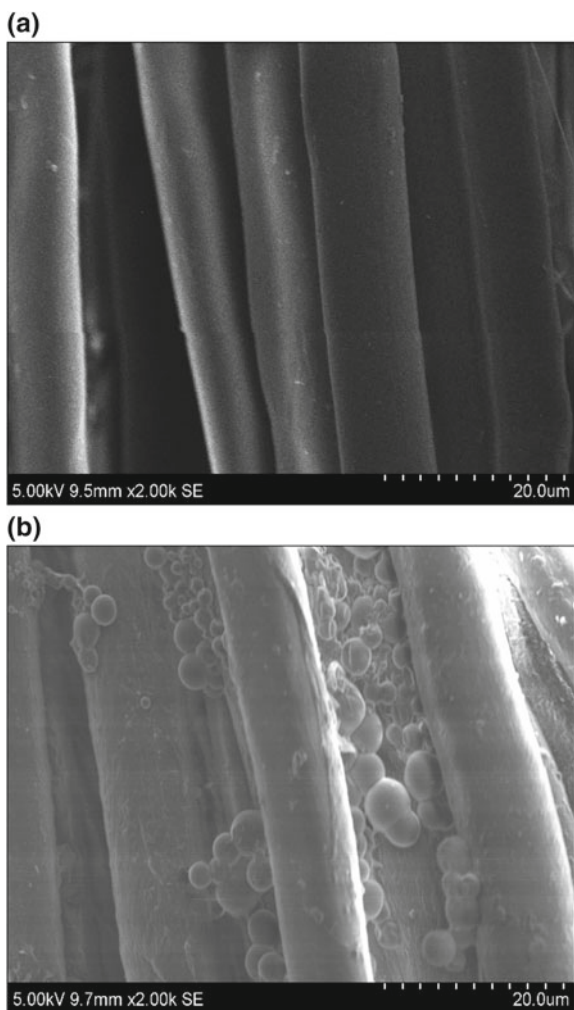


Fig. 1 SEM images of **a** untreated, **b** lavender treated S/L 50:50 blended fabrics

fabrics show clear microcapsules. The microcapsules are clear spheres and spread uniformly over the fabric surface.

EDX Analysis The EDX spectrum of untreated S/L 50:50 blended fabric (Fig. 2a) exhibits significant strong peaks for carbon and oxygen, the main constituents of the cellulose substrate. In treated fabrics (Fig. 2b), distinct peaks are observed for silica (Si), sulphur (S) and chlorine (Cl) along with those for carbon (C) and oxygen (O). This confirms the presence of lavender finish on S/L 50:50 blended fabrics.

FTIR Analysis Figure 3 shows the FTIR spectra of both the untreated and the lavender treated S/L 50:50 blended fabric. Compared to the FTIR spectra of untreated

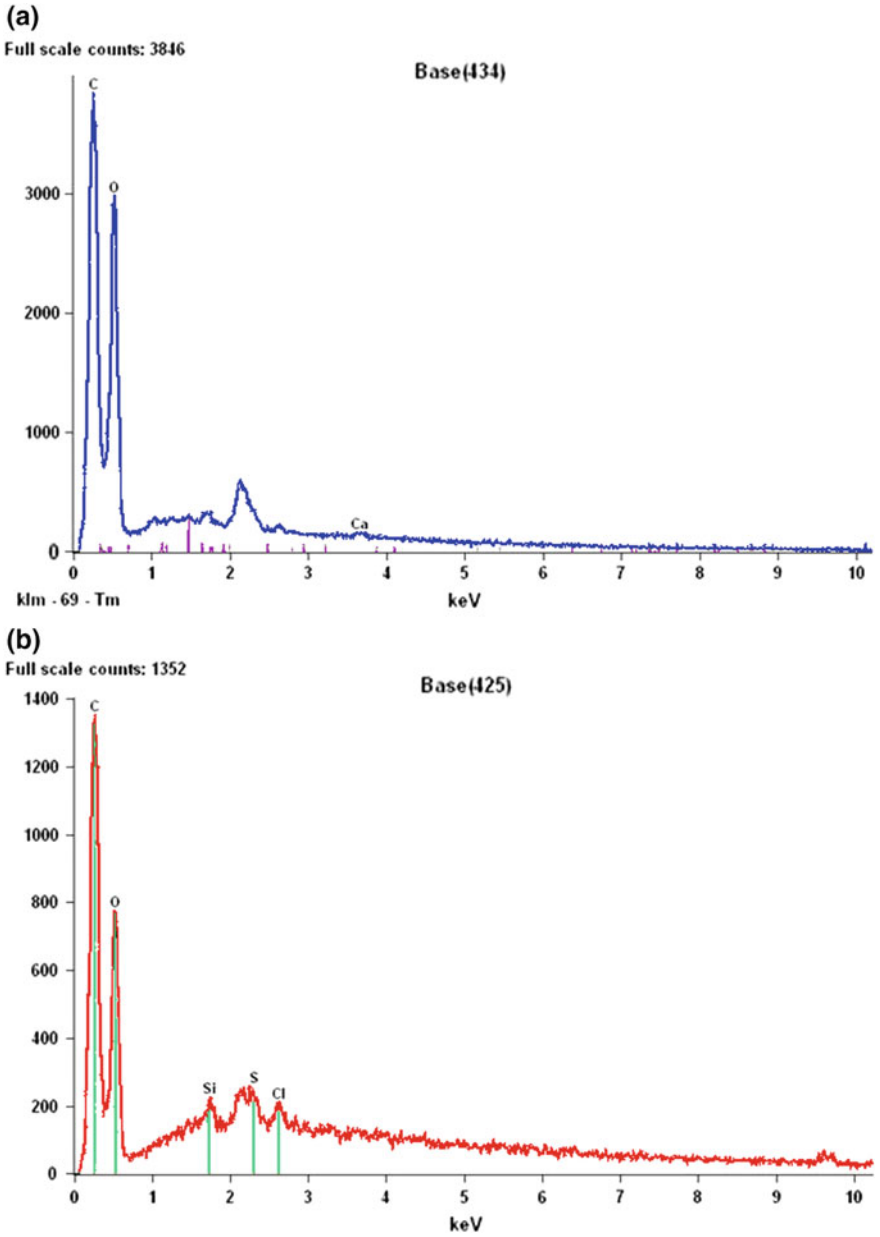


Fig. 2 EDX images of a untreated b lavender treated S/L 50:50 blended fabrics

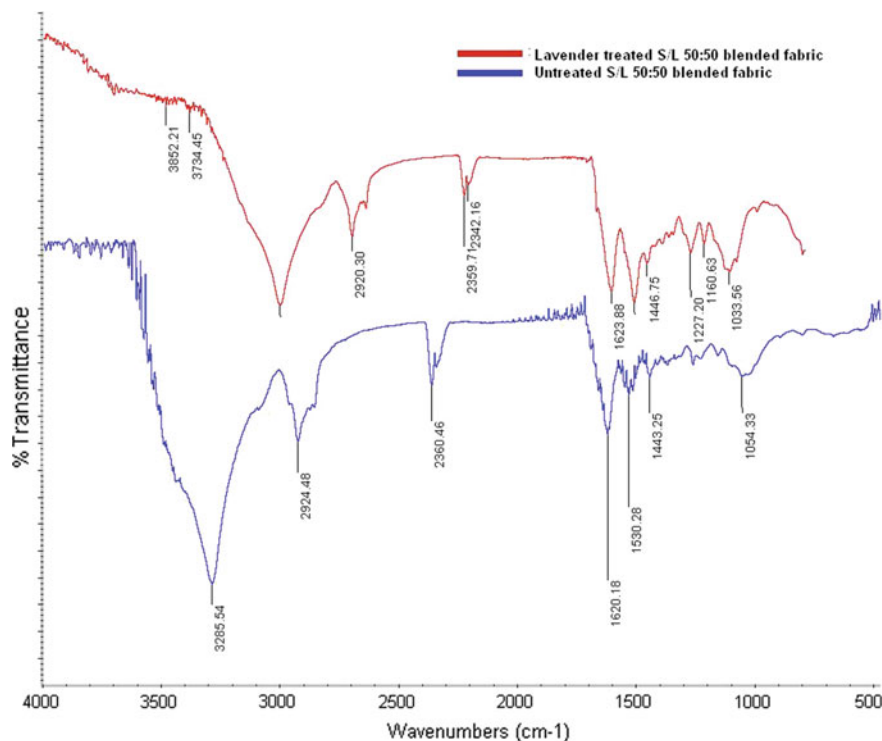


Fig. 3 FTIR spectra of untreated and lavender treated S/L 50:50 blended fabrics

S/L 50:50, the spectrum of lavender treated S/L 50:50 shows a peak at 1447 cm^{-1} for alkanes and 1034 cm^{-1} for ester functional groups, indicating the presence of lavender in S/L 50:50 blended fabrics [8].

4 Conclusion

Scents can improve mood, promote optimism, reduce anxiety and facilitate creative thinking. Silk/lyocell 50:50 blended fabrics were treated with lavender microcapsules and its efficacy was evaluated by two methods, namely psychophysical assessment to test the fragrance properties and organoleptic evaluation of odour control for anti-odour assessment. Further, a panel of 25 judges was made to assess the wash durability of the finish by rating the intensity of the aroma after 5, 10 and 15 washes. Lavender treated silk/lyocell 50:50 blended fabrics performed well in terms of aroma finish. In the psychophysical assessment of the aroma finish, participants in the survey gave very good ratings for intensity and pleasantness of the aroma. The participants also gave positive ratings for their interest in purchasing scented products. Organoleptic

evaluation of odour control also gave good anti-odour results. When wash durability of the finish was evaluated subjectively after 5, 15 and 25 washes, the participants rated the intensity of the finish as good up to 25 washes. Characterization of lavender treated fabrics with the untreated ones by SEM, EDX and FTIR analyses confirm the presence of lavender finish on the silk/lyocell 50:50 blended fabrics. Silk and lyocell possess similar properties in terms of lustre and strength. The cost of lyocell is nearly one-third of silk and lyocell is an eco-friendly fibre. Therefore, blending silk and lyocell will merge the richness of silk and softness of lyocell and give a techno-economic edge over other fabrics in the textile industry. Thus, it can be concluded that aroma infused silk/lyocell blended fabrics can be commercialized as there will be a niche market for aroma fabrics.

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