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MICROENCAPSULATION OF CITRONELLA OIL FOR FRAGRANT COTTON FABRICS

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ABSTRACT

Essential oils are the highly concentrated essences of aromatic plants. Aromatherapy is the art of using these oils to promote healing of the body and the mind. Applying these fragrances of essential oils on textiles can incorporate these properties of oils into the material. Microcapsules are a special form of packaging, in that particulate matter can be individually coated for protection against environment and release the volatile substance from the enclosed capsule as required. Hence, micro-encapsulation can effectively control the release rate of the fragrance compounds and essential oils as required, which ensures the storage life of volatile substances like essential oils.

In this study, optimization of microencapsulation process using simple coacervation technique was done with sodium alginate as wall material and citronella oil as core material. Microcapsules were prepared by optimized process and coated on cotton fabrics which were tested for various physical parameters in order to ensure its suitability as clothing and textile product.

Keywords: microencapsulation, simple coacervation, sodium alginate, citronella oil, aromatherapy, cotton

INTRODUCTION

India is endowed with a rich wealth of medicinal plants. Use of different parts of several herbs to cure specific ailments has been in vogue from ancient times. Therapeutical properties of medical plants are very useful in healing various diseases and the advantage of these medicinal plants is being 100% natural.

Essential oils are the highly concentrated essences of aromatic plants. Aromatherapy is the art of using these oils to promote healing of the body and the mind. As close friend of the human body, all types of textile are excellent media for transferring fragrant compounds, and are essential to people according to their preference for them. Microencapsulation technology is an effective technique used to control the release properties of active ingredients that prolong the functionality of aromatic textiles. In order to exploit the goodness of therapeutic oils in textiles, the present research work was designed to encapsulate the therapeutic aromas in the textile materials to study their effect.

In the present work, process of microencapsulation using simple coacervation technique has been optimised using sodium alginate as wall material and citronella oil as core. The final finish was applied on the fabric and it was tested for various physical properties in order to see the effect of finish.

METHODOLOGY

1. Materials used

A protein fabric (cotton) was selected for the application of finish in the present study. It was scoured before application of the finish of microcapsules. For this study, citronella oil was selected as core material and sodium alginate as wall material.

2. Selection of microencapsulation technique

Simple coacervation technique was selected for microencapsulation.

3. Optimization of conditions for processing

Concentration and temperature are the conditions which were optimized. The process of microencapsulation was first optimized for concentration. For this microcapsules were prepared using different concentrations in the ratios 1:1, 1:2, 2:1, 1:3 and 3:1 of gum and oil. The optimized concentration process was then subjected to different temperatures ranging from 30°C to 60°C in order to select the best temperature thus standardising the process.

4. Ensuring the presence of microcapsules

During the optimization stage, an optical microscope was used to ensure the presence of capsules at x45 magnification.

5. Application of finish

The optimised process for the combination of gum and oil for simple coacervation was then prepared for application. The finish was applied on the pre-treated cotton fabric with the help of padding rollers. After application each fabric was given heat treatment at 80-85°C in an oven for 5 minutes.

6. SEM analysis

Finished samples were analysed with scanning electron microscopy using FET QUANTUM 200 apparatus to ensure microcapsules' presence in the fabrics at magnification of x800.

7. Physical testing of the treated fabrics

Physical properties of both control and treated fabrics were evaluated to compare the changes that have occurred after the application of the finish, hence to ensure their suitability for their intended purpose and expected quality. So for this purpose fabrics were compared by testing various physical properties.

RESULTS AND DISCUSSION

The standard recipe was followed for different ratios of gum and oil. The resultant precipitate obtained from each experiment was analysed under a high definition optical microscope to ensure the formation of microcapsules.

Table-1: Concentration ratios of sodium alginate with citronella oil.

S. no.	Ratios Gum(g): Oil(ml)	Amount Gum(g): Oil(ml)
1.	1:1	1.0:1.0
2.	1:2	0.5:1.0
3.	2:1*	1.0:0.5
4.	1:3	0.5:1.5
5.	3:1	1.5:0.5

Ratio selected for citronella oil

Sodium alginate showed the formation of microcapsules at the ratio of 2:1 having 1 g of the sodium alginate and 0.5 ml of the oil with all the three oils, citronella, citronella and mint. This concentration ratio was considered optimized and taken as base for further optimization stage of temperature.

The optimized gum-oil concentration ratio was then subjected to different temperatures of 30°C, 35°C, 40°C, 45°C, 50°C and 60°C. Microscopic analysis of the precipitate from each experiment showed that lower temperatures of 30°C and 35°C were not able to produce microcapsules. At higher temperatures of 45°C, 50°C and above, the solution began to bubble and microcapsules were not observed to be formed at this temperature. This may be because the high temperature broke the formed capsules. At this temperature the oil, which is volatile in nature, evaporated at higher rate leaving very less quantity to encapsulate hence leading to no formation of microcapsules. At the temperature of 40°C, formation of microcapsules was noted hence it was considered as optimized temperature.

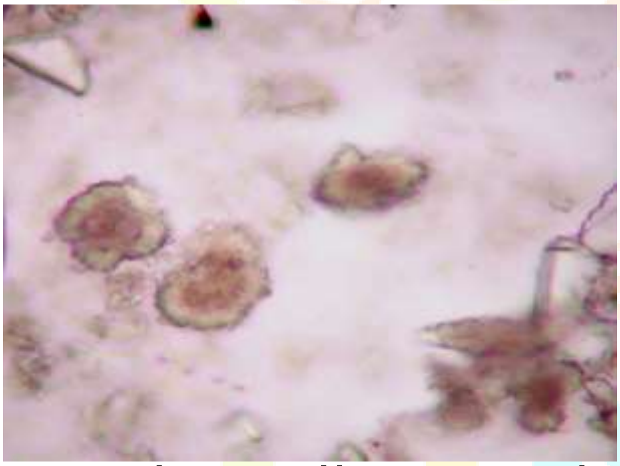

Fig. A

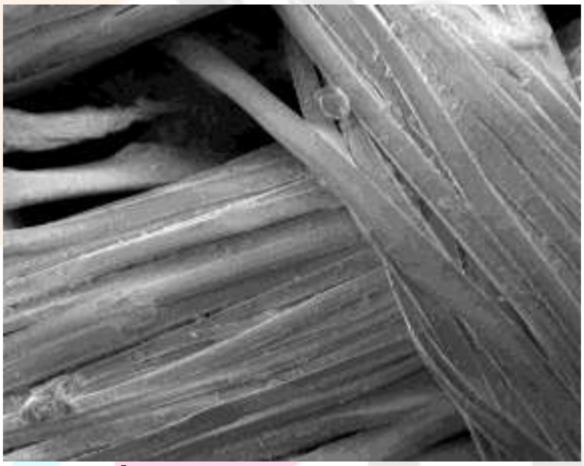

Fig. B

Fig: (A) optical microscopic image of the sodium alginate-citronella oil microcapsules

(B) SEM image of microcapsules on cotton fabric

The optimized process was used to make sodium alginate-citronella oil microcapsules which were then applied on the fabric. Both control fabric and finished fabric were then subjected to various physical tests.

Table 2: Physical properties of fabrics

Name of the property	Control sample	Finished cotton
Fabric thickness (mm)	2.5	2.6
Bending length (cm) *Warp way*	1.3	1.4
Weft way	1.2	1.2
Drape coefficient (%)	79.31	82.06
Abrasion loss (%)	3.92	3.70
Thermal conductivity (clo)	0.126	0.129
Crease recovery angle (^{0}) *Warp way*	60	65
Weft way	50	60
Breaking strength (gm/cm) *Warp way*	10832.03	8957.78
Weft way	6342.93	5342.67
Elongation at break (%) *Warp way*	14.64	11.83
Weft way	18.52	16.79

1. **Thickness**

It was indicated in the results that thickness of finished sample increased as compared to the control sample which can be attributed to the coating of finish applied to the fabrics.

2. **Bending length**

Results in the Table 2 show that bending length of the finished sample increased as compared to the control sample of cotton fabric which is the degummed fabric. This may be because of the finished applied which caused stiffness in the fabric. Bending length was observed to be more in weft direction as in warp which may be due to the presence of thicker yarns in weft direction as compared to warp.

3. **Fabric Drape**

Drape coefficient of finished fabric increased as compared to the control fabric resulting in stiff handle because of the coating of gum in finished fabrics which collected in the interstitial sites of the fabric samples to make them less drapable.

4. **Abrasion resistance**

Abrasion resistance of finished fabric increased as compared to the control fabric because of the coating of gum in finished fabrics which acted as a shield.

5. **Thermal conductivity**

It was observed that thermal conductivity of finished sample increased as compared to control sample. This was the result of the coating of finish of microcapsules applied to the fabrics as the finish closed the interstitial sites as well as covered the fibres thus reducing the conduction of heat through fibres.

6. **Crease recovery**

Crease recovery angle of finished fabric was slightly lower than control sample in both the directions due to the added stiffness by finish applied.

7. **Tensile strength and elongation**

Decrease in the tensile strength in both ways (warp and weft) finished fabrics as compared to control samples was noted which can be attributed to the use of alcoholic formalin for the formation of microcapsules. From the results it was observed that elongation of the finished fabric slightly decreased as compared to the control fabric which can be attributed to the coating of finish as it restricted the yarns and fibres to show their natural elasticity.

CONCLUSION

The microencapsulation of natural derivative gum, sodium alginate, and essential oil, citronella oil was optimized successfully with simple coacervetion technique followed by its application on the cotton fabric using pad-dry-cure method. The light microscopy with image processing attachment and SEM studies reveal the presence of microcapsules on the fabric. The physical testing of finished fabric revealed that a slight stiffness and loss in tensile strength occurred but overall the fabric is suitable for both apparel and textile purposes. This aromatherapic fabric will help in keeping people healthy in their day lives using natural and environment safe materials. Hence this study can help in increasing the use of aromatherapy as an alternative type treatment for medical textiles.

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