A STUDY ON THE WORSTED WOOL FINISHING WITH CINNAMON OIL MICROCAPSULES

NGHIÊN CỨU VỀ VIỆC XỬ LÝ HOÀN TẤT VẢI LEN VỚI VI NANG TINH DẦU QUẾ

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ABSTRACT

Although wool is a valuable material for the textile industry, especially for the high-end fashion industry, it faces several problems in the washing process, which can negatively affect its quality. In this study, microcapsules from cinnamon bark essential oil at a concentration of 80g/l were finished on worsted wool fabric by the dipping-padding method. The functional effectiveness was analyzed by visual assessment, washing fastness, pH assessment, and odor test. Fabric was being treated with a microcapsule concentration of 80g/L showed a low and uneven distribution on the surface. The result of scent assessment was low, showing the consistency with the density of microcapsules distributed on the fiber surface. The smell of cinnamon bark on the fabric almost disappeared under a 3 - time washing impact, and the presence of microcapsules almost disappear after 5-washing cycles . Briefly, our study created functional add-valued properties on wool fabrics throughout the encapsulation technology and textile padding method with microcapsules from a cinnamon bark extract.

Keywords: *Microcapsules, dip-pad, cinnamon oil, wool, finishing.*

TÓM TẮT

Mặc dù len là nguyên liệu có giá trị đối với ngành dệt may, đặc biệt là đối với ngành thời trang cao cấp, nhưng nó lại gặp phải một số vấn đề trong quá trình giặt, có thể ảnh hưởng tiêu cực đến chất lượng của nó. Trong nghiên cứu này, các vi nang từ tinh dầu vỏ quế ở nồng độ 80g/l được xử lý hoàn tất trên vải len chải kỹ bằng phương pháp ngấm ép. Hiệu quả chức năng được phân tích bằng cách đánh giá trực quan, độ bền giặt, đánh giá độ pH và kiểm tra mùi. Vải len sau khi được xử lý với nồng độ vi nang 80g/L cho thấy sự phân bố vi nang thấp và không đồng đều trên bề mặt. Kết quả đánh giá mùi hương thấp, cho thấy sự nhất quán với mật độ của vi nang phân bố trên bề mặt vải. Mùi vỏ quế trên vải gần như biến mất dưới tác động giặt 3 lần và sự hiện diện của vi nang như biến mất sau chu kỳ giặt 5. Tóm lại, nghiên cứu của chúng tôi đã tạo ra các đặc tính bổ sung chức năng trên vải len thông qua phương pháp hoàn tất bằng các vi nang từ chiết xuất vỏ quế.

Từ khóa: *Vi nang, ngấm ép, tinh dầu vỏ quế, len, xử lý hoàn tất.*

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1. INTRODUCTION

Today, wool materials have become a popular choice for couture designs, and most often used in very traditional types of textiles, such as suits, knitwear and carpets [1]. However, wool materials face many quality risks such as difficulty in washing [2], which can emit unpleasant odors from felt products, especially coarse wool fibers [3]. In another aspect, various fungi (such as Keratinophilic fungi) could cause damage to the wool structure [4]. In cosmetic aspect, cosmetotextiles have become more popular with attractive scents and other functions from natural resources, especially cinnamon oil. Cinnamon oil includes cinnamaldehyde, phenolic compound, terpenes with antidiarrheal, vasoactive, analgesic, and antifungal effects [5]. Cinnamon oil has various applications for textiles such as insect/mosquito repellent, medical and cosmetic finishing agents in several forms, especially microcapsules [6]. In previous study, we had successfully put microcapsules on fabric with certain effects.

In this study, we use microcapsules from cinnamon bark essential oil at a concentration of 80g/l for finishing treatment on worsted wool fabric. The effectiveness was evaluated in various aspects including visual assessment, pH evaluation, washing, scent of cinnamon microcapsule finished fabric and evaluation the distribution of microcapsules on fabrics throughout SEM.

2. MATERIALS AND METHODS

2.1. Material

Fabrics: 100% worsted wool fabric, plain woven (EPI = 102, PPI = 76, fabric weight = 181.3g/m^2) from Lien Chau Weaving Co., Ltd (Viet Nam).

Chemicals: Cinnamon bark essential oil (Evodia Viet Nam Co., Ltd, Viet Nam), Marseille Jenny's Milk Organic Soap, Cetearyl Alcohol (Xilong, China), Tween 80 (Xilong, China), Citric Acid (Xilong, China).

2.2. Preparation of microcapsules

Encapsulation: Mixture A was made with 4g of cinnamon bark essential oil and 8g of Cetearyl alcohol. Mixture B included 4g of Tween 80 and 184g of distilled

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water. The emulsion was made by the combination of A and B at 70 - 75°C using a stirrer at 1500rpm for 10 minutes. Then, the resulting emulsion was agitated at 0°C for 5 minutes. The obtained microencapsulated emulsion (considered 100 % concentration) was diluted to concentrations of 80g/L.

2.3. Microcapsules finishing

Microcapsules are applied to the fabric by dipping - padding method. The fabric is dipped in the finishing solution for 5 minutes, then pressed with a pressure of 0.05MPa, and finally the fabric is line dried.

2.4. Washing tesst

The washing test was conducted on a 10.5x15cm pattern of microcapsule finished fabric according to AATCC LP2 standard - Home Laundering: Hand Washing. Washing conditions included Marseille Jenny's Milk Organic Soap, line drying, 5 washing times. The test was repeated 3 times.

2.5. pH assessment

Treated samples were measured pH with a sample weight of 10 ± 0.1g.

2.6. Odor test

The odor test was conducted on finished worsted wool fabric based on ASTM E679-19 Standard Practice for Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits. The test was performed at FITI Testing and Research Institute, Viet Nam Limited Liability Company.

To conduct the experiment, each evaluator will receive three samples, one containing the odor to be evaluated and the other two odorless. The reviewer was asked to select one of the three gas samples and select the level of recognition as odorless, possible and certain that the sample smelled. The reviewer then went on to receive three other samples with a more diluted odor and continued to select.

Odor intensity is explained and evaluated on a scale from 1 to 5 as described in Table 1, with each value from 1 to 5 characterizing a level of odor perceived by the evaluator. The point between 1 and 2 can be viewed as the threshold for odor recognition.

Table 1. Odor test assessment scale

Intensity Level	Intensity	Description
1	Very weak or odorless	Unable to recognize odors
2	Weak	Able to recognize but very faint
3	Medium	Can easily notice the scent
4	Distinct	Has a clear scent
5	Very distinct	The scent is very strong, can be unpleasant

2.7. Surface assessment

Fabric samples were analyzed by Hitachi FE SEM S4800 machine Hitachi Japan.

3. RESULTS AND DISCUSSION

3.1. Visual assessment of finished textiles

Observing the fabric surface at 100X magnification, untreated fabric samples (Figure 1a) appear dirt particles with very large sizes, treated samples appear very small particles on the fiber surface, and sometimes appear as plaques in some places.

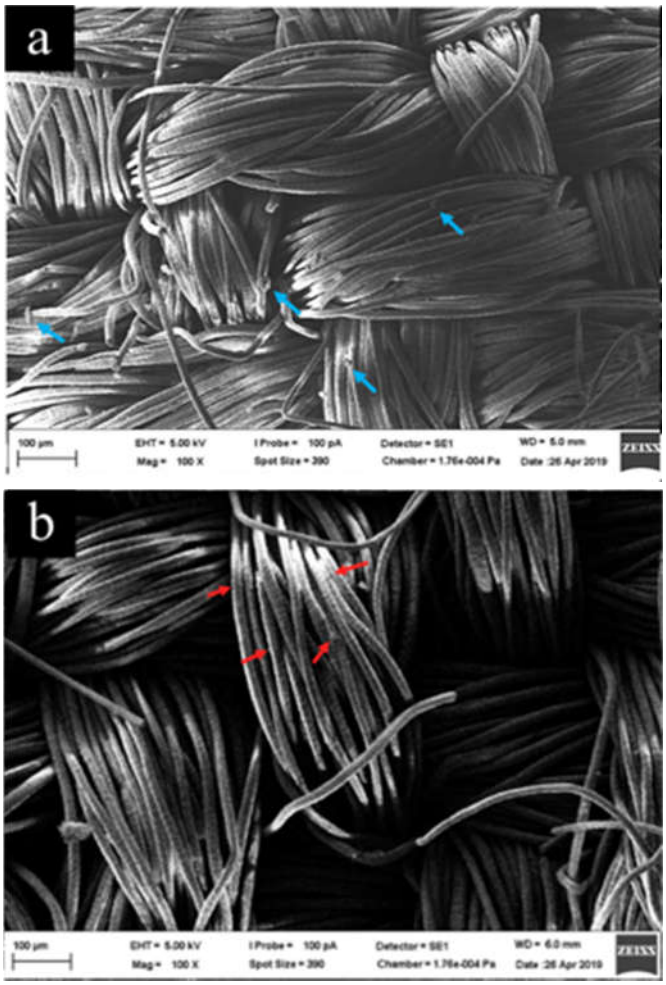
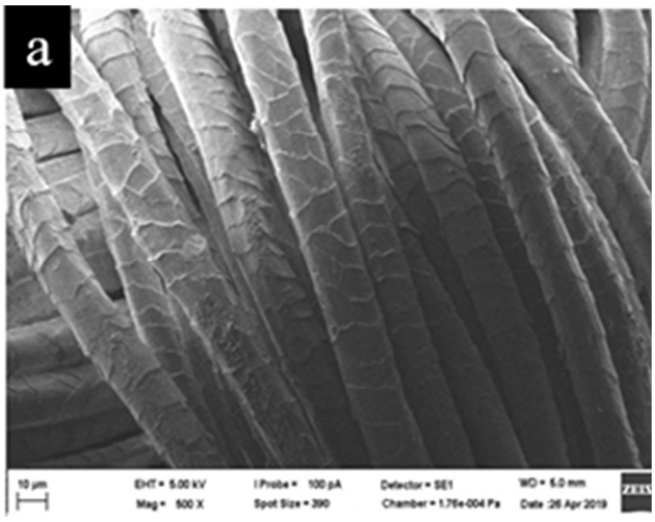


Figure 1. 100X SEM image: a) untreated sample, b) finished sample



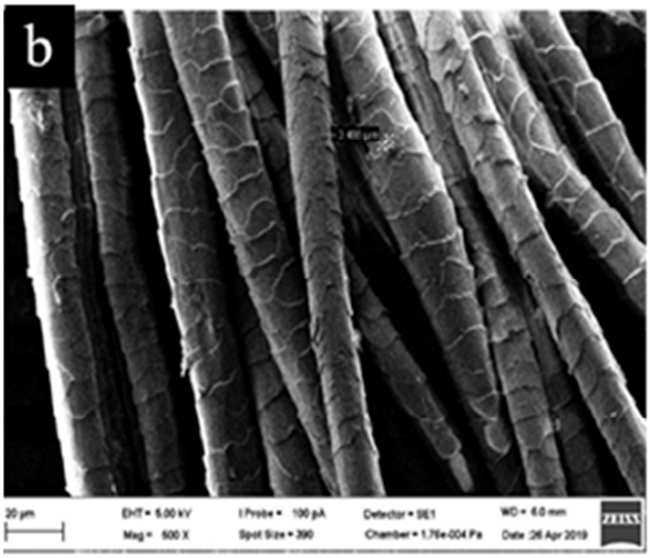


Figure 2. SEM image of sample: a) untreated fabric, b) finished sample.

Observing the SEM image of the sample after treated at a microencapsulation concentration of 80g/L (Figure 2b), it can be seen that on the untreated fabric sample (Figure 2a) the fibers appear a little dusty. In the remaining sample, the appearance of small dots and microcystic plaques on the fibrous surface could be observed. Similar to the distribution of capsules in the surface of wool which was not uniform and gathered around the scales of wool fibers of the same experiment at a concentration of 40g/l [7]. In general, the coating density on the fibrous surface of microcapsules is quite low and uneven.

3.2. Evaluation of the washing fastness of microcapsules on fabrics

The study used citric acid as a cross-link agent because citric acid has the ability to form esterification reactions with the OH hydroxyl group of wool fiber and fatty alcohol (cetearyl alcohol). Besides, citric acid is capable of reacting with the NH2 amine group of wool, forming ester crosslinks or ionic bonds. Citric acid forms the most effective cross-link with oxidized wool, which enhances the antibacterial and antiseptic capabilities of woolen fabrics.

At the end of a wash cycle, the amount of microcapsules remaining on the fabric compared to the time it was not washed did not change significantly. The change can start to be noticed after five wash cycles, the microencapsulation density is now significantly reduced but the appearance of large microencapsulated plaques is still noticeable, similar to the washing properties of finished fabric of the same experiment at a concentration of 40g/l [7]. In addition, on the surface of wool fibers, there appeared some very large plaques surrounding the fibers (Figure 3d). The cause may stem from the amount of soap left on the fabric after washing.

Overall, the appearance of microcapsules on fabrics dramatically declined after 5 - washing cycle, however, microencapsulated plaques is still noticeable.

Figure 3. Sample SEM images: a) unwashed, b) after 1 wash, c-d) after 5 washes

3.3. Assessment of the pH on finished fabric

The sample showed a pH = 4.05, just reached the safe pH threshold for users. This result proves that the amount of citric acid binder used for the experiment is just enough to create a bond between microcapsules and Merino wool fabric, and at the same time, the product is safe for humans.

3.4. Odor test on cinnamon microcapsules finished fabric

Odor assessment was carried out at the laboratory of FITI Testing & Research Institute Vietnam Co., Ltd. The results showed that, after the aromatherapy treatment with cinnamon bark essential oil microcapsules, it was possible to perceive the cinnamon bark scent at a poor average intensity of 2, lower than the odor intensity level of 3 of the same experiment at a concentration of 40g/l [7]. After 3 washes, the smell of cinnamon bark on the fabric almost disappeared and was rated at 1.

To sum up, the intensity scent level of treated fabrics was quite low and nearly disappeared after 3 washes.

4. CONCLUSION

The research had achieved the goal of researching and building a process to produce cinnamon bark essential oil core microcapsules suitable for application in the textile industry with the shell made from Cetearyl Alcohol, with a diameter ranging from 600nm to more than 5µm. During the experiment, the study used the dipping - padding procedure. Visual assessment was conducted to assess the surface property of finished textiles. Observing the treated fabric surface at 100X magnification, the distribution of microcapsules was low not uniform. Fabric after treatment had a pH = 4.05 within the safety range for users. The change in the amount of microencapsulation on the fabric surface could be noticed after five wash cycles, but the appearance of large microcystic patches is still noticeable and after 3 washes, the smell of cinnamon bark on the fabric is almost disappear. In addition, the SEM image of the woolen fabric surface finished with microcapsules showed sparse and uneven distribution.

Our study had resulted in innovation in the application, quality, and value of the worsted wool materials. In detail, we proved the potential of cinnamon bark essential oil microcapsule to functionally finished worsted wool woven fabrics. This paper created the functional add-valued properties on wool fabrics for enormous potential in the high-end fashion of wool.

REFERENCES

[1]. Colloe S., 2009. *Intelligent wool apparel.* In N. A. Russell, Advances in wool technology (pp. 308-318). Cambridge: Woodhead Publishing.

[2]. H. Kuffner, C. Popescu, 2012. *Wool fibres.* In R. M. Kozłowski, Handbook of Natural Fibres Volume 1: Types, Properties and Factors Affecting Breeding and Cultivation (pp. 171-195). Cambridge: Woodhead Publishing.

[3]. K. Steven, M. Fuller, 2015. *Thermoregulation and clothing comfort*. In D. B. McCann, Textile-Led Design for the Active Ageing Population (pp. 117-138). Cambridge: Woodhead Publishing.

[4]. Soomro I. H., 2000. *Keratinophilic Fungi: The Destroyer of the Wool Fibres*. Pak. J. Biol. Sci., 1323-1325.

[5]. Galland L., 2013. *Unctional foods - Health Effects and Clinical Applications*. In L. A. Benjamin Caballero, Encyclopedia of Human Nutrition (2nd ed., pp. 366-371). Cambridge, USA: Academic Press.

[6]. Nagender Singh, Javed Sheikh, 2020. Microencapsulation and its application in production of functional textiles. Indian Journal of Fibre and Textile Research 45(4):0971-0426.

[7]. P.T.N. Chau, P.N. Hung, H.T. Thao, B.M. Huong, 2021. *Functional treatments on worsted wool fabric: self-cleaning and microcapsule fixation.* Vietnam Journal of Science and Technology (pp. 33-42).

[8]. L.T. Tho, 2017. *Research survey of some properties effects of nonwoven to create high level wet towels.* Journal of Science and Technology - Hanoi University of Industry Vol. 41 (pp. 76-79).

THÔNG TIN TÁC GIẢ

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