Research Progress of Aromatic Bed Curtains for Aiding Sleep Based on Lavender Microcapsule Technique

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Abstract In this paper, the preparation technique of lavender essential oil microcapsules and the construction method of aromatic textiles were expounded, and the research status of bed curtains and lavender microcapsules at home and abroad was analyzed and studied from the perspective of application in textiles. The application of lavender essential oil to bed curtains through the microcapsule technique was put forward to allow lavender essential oil to play its role of helping sleep in bed curtains. This paper expounded the material selection and preparation technique of lavender microcapsule agents, and put forward the preparation method of microcapsules with mixed solutions of pure Chinese medicine extracts and natural essences as core material and high-viscosity epoxy resin as wall materials. The post-processing techniques and the spray ironing method for clothing were studied and developed, and these techniques and methods were applied to bed curtains, and good results were obtained.

Key words Lavender; Sleep aid; Aromatic bed curtain; Microcapsule
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With the development of society, the pace of people's work and life is accelerating, and the mental stress is gradually increasing, and then people suffer from different degrees of sleep disorders, which seriously affect the physical and mental health of the public, especially contemporary college students. In the environment of Neijuan, college students feel anxious, depressed and nervous, resulting in insomnia. At present, there are various sleep aid products on the market, and modern domestic sleep aid schemes can be divided into online and offline schemes. Online products include video, audio, amsr and many other fields. Offline schemes include seeking medical treatment, bedding, sleep aid instruments, aromatherapy equipment, *etc.*[1]. The long-term effect of treating insomnia with western medicine alone is not ideal, and there are some adverse reactions. Traditional Chinese medicine aromatherapy is effective in treating insomnia, and it has unique advantages such as no addiction or dependence, good tolerance and compliance, low treatment cost and no toxic and side effects.

Based on the theory of aromatherapy and traditional Chinese medicine, in this paper, a new type of bed curtain was developed using aromatic Chinese medicinal materials having the effect of tranquilizing and allaying excitement, by the aromatic microcapsule technique. In the enclosed space formed by the bed curtain serving as the main body, the bed curtain emits a light and suitable aroma using special materials, so that the aroma lingers around the human body, and through nasal sniffing, it can regulate the airway, and harmonize the balance of yin and yang in the body, thereby relieving anxiety, calming the mind, and helping sleep.

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Introduction of Current Research at Home and Abroad

Theoretical basis of aromatherapy

Aromatherapy, as an external therapy, can regulate qi movement of Zang-fu organs and harmonize yin and yang of human body by making the qi of medicinal materials enter human body through nasal orifices. It has a long history of application and can treats a variety of diseases, mainly emotional diseases, pulmonary diseases and exogenous diseases. Specifically, it involves wearing sachets, taking soup baths, steaming moxa, and smoking incense. This therapy belongs to *in-vitro* administration and has the characteristics of safety, greenness, convenient operation, and significant therapeutic effect.

Traditional Chinese medicine believes that the human body is an organic whole, with the five organs and six viscera interconnected. The five organs accommodate the spirit, and the brain is the "house of the original spirit", closely related to the physiological functions of the five organs. *Yilin Gaicuo* put forward: "The nose is connected to the brain, and the smell of incense goes to the brain". Therefore, aromatic qi can awaken the mind and open the mind, such that clear yang can rise.

Aromatic qi can disperse and run. The nose is the opening of the lung, and the lung governs the whole body's qi. It breaths in the clear qi of nature, which is transformed together with the foodstuff essence which is transported by the pleen and stomach, into Zongqi. Because the lung is directed towards hundreds of meridians, through the dispersive and descending functions of the lung,

Zongqi is transmitted to the organs and viscera of the whole body, and the activities of qi are regulated, so that the yin and yang of the human body are harmonized.

Aromatic qi can enliven the spleen and resolve damp. *Yellow Emperior's Inner Canon* said, "The five qi have their own responsibilities, and only aromatic qi acts on the spleen." The spleen likes dryness and hates dampness, and it elevates clear qi and lowers turbid qi. If the spleen qi does not rise, the spleen will be trapped by dampness, while aromatic qi is warm, pungent and dispersive mostly, and if it is warm, yang will rise, and if it is pungent and dispersive, it will turns qi into blood, and will help to discharge the dampness and separate clear qi from turbid qi.

The documentary record of aromatherapy was first seen in *The Classic of Mountains and Seas* in the pre-Qin period: "If you wear it, it can prevent and treat infectious diseases". It shows that people were already using aromatic drugs to prevent and treat diseases at that time. *Jingchu Suishiji* during the Northern and Southern Dynasties recorded: "Wormwood is collected by human being and hung on the door to get rid of poisonous gas". It shows that it was very common for people to use wormwood to prevent and treat diseases and expel toxic discharge at that time. With the continuous development of later generations, the use of aromatic medicines is not limited to wearing medicine bags, but the dosage forms are gradually increasing, such as aromatherapy, medicine pillows, steaming incense and so on. *Shen Nong's Herbal Classic* said: "fragrant qi, can support Zhengqi, and when Zhengqi wins, the evil and filth are eliminated." Meanwhile, the theory of four qi and five flavors was put forward, which lays a foundation for future generations to use aromatic medicines.

Sun Simiao's *Beiji Qianjin Yaofang* describes incense prescriptions for fumigating clothes. The original text said: "dryness and dampness must be adjusted appropriately, and both should not be excessive. If it is too dry, it will be difficult to pill, and if it is too wet, it will be difficult to burn. And if it is wet, aromatic qi will not be emitted, and if it is dry, there will be more smoke." The process is already quite mature. In the book *Xiangcheng*, Qingzhen Xiang, which is used to cure head wind, is prepared from benzoin, Nardostachyos Radix Et Rhizoma, Rhizoma Atractylodis, mirabilite and Liqnum Dallergiae Odoriferae. *Compendium of Materia Medica* of the Ming Dynasty recorded the use of joss sticks in sore treatment, and most of the medicinal herbs used are Radix Angelicae, Herba Agastaches, Flos Caryophylli, Fructus Anisi Stellati, Alpiniae Officmarum Rhizoma and other herbs that promote qi and blood circulation.

Modern pharmacological studies have found that aromatic Chinese herbs and their active components can promote autonomous activities, excite the central nervous system, reduce sleep duration and improve cognitive, learning and memory ability.

Hu *et al.* [2] found that among 108 subjects who had the same living environment and habits, but different levels of sleep quality problems, the sleep quality was improved by using lavender essential oil alone, and the essential oil extracted from Semen Ziziphi Spinosae, Platycladi Semen, Angelicae Sinensis Radix, sweet orange, Fructus Gardeniae and Albiziae Flos was directly inhaled through the nose and quickly absorbed, thus promoting sleep, and it exhibited obvious curative effect on patients with sleep disorder due to heart-kidney disharmony according to TCM syndrome differentiation. It shows that it is feasible to diffuse plant essential oil into human body through aromatic qi. Chen *et al.* [3] found that lavender aromatherapy combined with EFT was helpful to improving the sleep quality of breast cancer patients with insomnia due to deficiency of both heart and spleen, and this method is safe, non-toxic and effective. Meng *et al.* [4] achieved the effects of strengthening the spleen and soothing the nerves, relieving anxiety and improving treatment efficiency through acupuncture combined with traditional Chinese medicine aromatherapy. It can be seen that aromatherapy has a significant effect in the treatment of sleep disorders, especially when combined with other therapies, which is worthy of further clinical research and promotion.

Research status at home and abroad

For college students, the use of bed curtains can not only improve the privacy and comfort of their living and learning environment, but also have a positive impact on their sleep quality, learning efficiency and mental health.

However, from the invention and application to the present, bed curtains have not been combined with the medical field for innovation. Their function just stays in general shading. At present, there are many innovations about bed curtains, but they are not widely popularized and expensive, and not suitable for most college students. Furthermore, the combination of medicines and sleep in the market is mostly some tranquilizing oral liquids, sleeping aid patches, sachets, aromatherapy, *etc.*, but the innovation of combining bed curtains as daily necessities for college students with medicines has not yet appeared, and such products have not appeared in the market.

Lavender fragrance microcapsule bed curtains are a type of sleep aid product which combines the privacy protection of traditional bed curtains with modern techniques, aiming at improving sleep quality by releasing lavender fragrance. Lavender has been considered to have the effects of soothing mood, reducing anxiety and promoting sleep since ancient times. The combination of lavender fragrance and microcapsule technique provides users with a novel way to improve their sleeping environment.

Effects of Lavender in Sleep

Lavandula is a popular plant, which is widely used because of its unique aroma and various health benefits, especially in promoting sleep and improving sleep quality. The main functions of lavender were summarized as below.

Relieving anxiety and stress

The aroma of lavender is considered to have the function of calming nerves and reducing anxiety and stress. This relaxing

effect helps people to fall asleep more easily.

Improving sleep quality

Lavender can not only help people fall asleep faster, but also improve the overall quality of sleep. Studies have found that people who use lavender oil or lavender fragrance is emitted in their sleep environment have a more stable sleep cycle, a longer deep sleep stage, and feel more awake and rested after waking up in the morning.

Reducing sleep disorders

Lavender may provide a natural relief for people with mild insomnia or other sleep disorders. Some studies have pointed out that the use of lavender can help reduce insomnia and make it easier for people to stay asleep.

Safe sleep aid means

Compared with some drug sleep aid means, lavender provides a more natural and less risky choice. Although doctors may recommend specific treatment schemes for severe sleep problems, as an auxiliary means, lavender is promoted because of its relative safety and few side effects.

Aromatherapy in traditional Chinese medicine refers to the use of the aromatic smell of Chinese herbal medicines or aromatic essential oils extracted from them to act on the human body in various forms, so as to achieve the functions of regulating the qi of Zang-fu organs and harmonizing the yin and yang of Zang-fu organs. Lavender essential oil is one of the most commonly selected essential oils for aromatherapy. Studies have proved that its main components, linalool and linalyl acetate, have sedative and hypnotic effects, and it is a new sedative with mild effect[5-6]. The characteristics and mechanism of its hypnotic effect are that it inhibits the activity of orexin awakening neurons in the lateral hypothalamus through olfactory pathway to play a hypnotic role[7].

Technical Route of Developing Aromatic Sleeping-aiding Curtains Based on Microcapsule Technique

Aromatic sleep-aiding medicinal curtains adopt the technique of late microcapsule attachment to the finished product of medicinal curtain fiber. Microencapsulation technique is to treat aromatic extracts into nano-sized particles similar to capsules by certain chemical and physical methods, which have surfaces covered with a very thin colloidal film. These microcapsules will rupture in turn in a long period of time, thus releasing aromatic odor continuously.

The overall technical route is as follows: selection of medicinal curtain material → selection and configuration of aromatic essential oil → combination of essential oil extract and microcapsule technique → the finished product of medicinal curtain fiber attached with microcapsules.

Development of microcapsule reagent

Based on the microcapsule agents that have been developed for textile finishing in the market at present, we considered developing aromatic microcapsule agents for sleep-aiding medicinal curtains from two aspects: microcapsule materials and preparation methods of microcapsules.

Selection of microcapsule material

Lavender essential oil is selected as the core material, and lavender essential oil microcapsules are prepared by an emulsification · solvent evaporation method. Lavender essential oil can improve the insomnia of patients, and it is commonly used in aromatherapy with low toxicity and low sensitization. Zhang[8] prepared lavender essential oil microcapsules to help sleep, and the microcapsule innovation and development seminar evaluated the sleep-adding effect by Pittsburgh Sleep Quality Index Scale. The results showed that the lavender microcapsules could effectively improve sleep, which is of great benefit to improving sleep and promoting sleep.

Through the experimental study on the particle size, oil loading and encapsulation efficiency of microcapsules, it was found that the optimum preparation process was as follows: ratio of organic phase to water phase 1 ∶ 20, ratio of core material to wall material 1 ∶ 10, mass percentage of PVA 0.8%, concentration of emulsifier 2%, stirring speed 1 000 rpm, particle size of microcapsules 1 μm, oil loading 84.63%, and encapsulation efficiency 90.54%, respectively. The capsules were round and non-adherent, and had uniform particle size distribution and good reproducibility. The obtained microcapsules also had high oil loading and encapsulation efficiency. Because they were prepared at room temperature, the loss of volatile core materials by heating and solvent removal was avoided, and the method is an excellent method for preparing microcapsules with thermally unstable core materials. The method has the advantages of simple operation, low cost and easy molding, and is suitable for industrial production. The comparative study on the slow release of natural fragrance microcapsules and the mixture of essential oil and wall materials showed that microcapsules could slow down the release of fragrance and greatly prolong the fragrance retention time of essential oil[9].

Preparation methods of microcapsules[10]

Emulsification

(1) An oily emulsifier is dissolved in an appropriate solvent at room temperature, and heated slightly, and a solution is formed when the temperature drops to room temperature.

(2) At room temperature, a curing agent is mixed with the core material in a reaction kettle to form a solution B, which is stirred vigorously to form an emulsified liquid.

(3) Solution A is then slowly added into solution B at a reduced stirring speed, to form emulsion.

Diffusion and encapsulation

(1) The emulsion is slowly added into a certain amount of distilled water while controlling the stirring speed, to ensure the generation and separation of microcapsules.

(2) After the formation of microcapsules, a certain amount of curing agent is added for secondary curing to stabilize the

uniform microcapsules and increase their viscosity.

(3) Finally, filtration and extraction are performed to get microcapsules.

Research Achievements of Lavender Microcapsule Technique in Textiles

Technical principles

Microcapsule technique refers to encapsulating lavender essential oil or its extract in tiny capsules, which can be attached to bed curtain fabric. During normal use, the microcapsules will rupture through friction, pressure or temperature changes, and gradually release the fragrance of lavender. This kind of slow-release mode can ensure that the bed curtains can maintain a certain lavender aroma concentration for a long time, thus giving play to their sleep-aiding effect[8].

Efficacy and effects

Improving the quality of sleep: The aroma of lavender is widely believed to help reduce bedtime anxiety and tension, thus helping to shorten the time of falling asleep and improve the quality of sleep.

Emotion regulation: The fragrance of lavender is also considered to be helpful to regulate emotions, providing users with a relaxed and soothing environment, which is conducive to mental health.

Air purification: In addition to providing pleasant fragrance, lavender also has certain air purification effect, which can improve the air quality of sleeping environment[9].

The combination of fragrance microcapsule technique and textiles is an innovative application. This technique can encapsulate fragrance, skin care agents, antibacterial agents or other types of active substances in microcapsules and integrate them into textiles. These microcapsules can be broken by mechanical pressure (such as wearing and sitting) or temperature changes (such as body temperature and external temperature), thus releasing encapsulated substances.

Application in textiles

Preparation of aromatic microcapsules The preparation of microcapsules usually involves wrapping active substances (such as aromatic oil) in a stable polymer shell, which will rupture under certain conditions (such as friction, pressure and temperature), releasing internal substances. The preparation techniques of microcapsules include coprecipitation, phase separation, spray drying and spray condensation.

Integration of textiles The integration of microcapsules into textiles can be achieved by different methods.

Coating method: The coating method is to suspend microcapsules in an adhesive solution, and then coat this mixture on the surface of textiles.

Impregnation method: The textiles are immersed in a solution containing microcapsules, and then the microcapsules are fixed on the fibers through the processes of drying and curing.

Thermal transfer: This method is to print microcapsules on paper first, and then transfer the microcapsules from paper to textiles by hot pressing.

Fiber formation: Microcapsules can be added to the fibers of textiles in the process of fiber formation, making microcapsules a part of the fiber structure.

Release mechanism of microcapsules: The design of microcapsules should ensure that active substances are released only when needed, which is usually achieved by the following ways: mechanical stress, temperature change, and dissolution or expansion. Mechanical stress: The shells of microcapsules break under the action of friction or pressure, releasing internal substances. Temperature change: When specific shell materials are designed to cause the rupture of microcapsules when a certain temperature is reached and causes physical or chemical changes. Dissolution or expansion: In a specific chemical environment, the shells of microcapsules may dissolve or expand, thus releasing the contents.

Applications and benefits Sustained fragrance release: Microcapsules can continuously release fragrance for a long time, improve environmental odor, and even have the function of relaxing and relieving stress.

Functional textiles: In addition to fragrance, the microcapsule technique can also be used to integrate antibacterial agents, sunscreens and skin care ingredients into textiles to provide additional functions.

Personalized products: According to the needs of different consumers, personalized textiles with different flavors and functions can be developed.

Commercial potential: The aromatic microcapsule technique provides new business opportunities and promotes the innovation and growth of textile market.

Safety and environmental impact When applying the aromatic microcapsule technique, we need to pay attention to its safety and environmental impact. The materials of microcapsules should be safe, non-toxic and biodegradable, so as to reduce the negative impact on the environment. In addition, strict safety tests are needed to ensure that long-term exposure to textiles will not harm the health of users.

In a word, the integration of aromatic microcapsule technique enhances the added value of textiles and gives them new use functions. This field has broad development prospects, but meanwhile, it is necessary to ensure the safety of techniques and the sustainable development of the environment.

Prospects

The application of aromatherapy in today's society is not very extensive, not complete enough in types, and insufficient in clinical practice, or there are some problems such as limited equipment. In the application of mental and emotional diseases, at present, oral medication is more commonly adopted, and after

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enterohepatic circulation's metabolism, the effect has certain limitations. Aromatherapy still has broad application prospects.

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