

# Study on the Innovative Role of Chinese Medicine on the Management of Mask Pollution: A Case Study of Chinese Medicine Bead Mask

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**Abstract.** By summarizing the severity of pollution caused to the natural environment by the massive use of disposable masks since the outbreak of the epidemic, this paper analyzes the impact of pollution on society as well as the natural environment to prove the innovation and effectiveness of the role of Chinese medicine bead mask. Methods: Volatile oils from various Chinese medicine with antiseptic efficacy are extracted and separated by grinding device and herbal volatile oil extraction device to prepare herbal disinfection beads, which are used with masks to increase utilization rate and reduce environmental pollution. Results: Compared with disposable masks, the Chinese medicine bead mask greatly increases the utilization rate of masks, reduces "white pollution", and greatly improves the convenience of operation compared with washable masks, which is safer and more effective. Moreover, it reduces the waste of social, human and material resources, and promotes the benign development of the prevention and control of the Covid-19 pandemic.

**Keywords:** Chinese medicine, Covid-19, mask pollution.

## 1. Introduction

The ability to protect the environment is an important indicator of a country's strength and is regarded as the foundation of survival and development for society. Since the outbreak of the Covid-19 pandemic, mask has become a necessity of people's lives. Most masks sold today are disposable medical protective masks, which are difficult to recycle because they are made of molten plastics, and because of their composition and the risk of contamination and infection. When these masks are littered without proper waste-management systems in place, or simply overloaded, they end up in the ocean. Moreover, the plastic particles are not easy to degrade, which seriously affects the development of the ecological environment and causes irreversible serious pollution. In order to effectively deal with the environmental protection issues, not only is the government supposed to promulgate relevant laws and policies, but also the concerted efforts of the whole country are urgently needed. Everyone should raise the awareness of environmental protection, but more importantly, we need to innovate production technology, either by changing the material or by improving the efficiency of masks to reduce environmental pollution. At present, environmental protection masks have been widely used in the market, such as degradable masks and washable masks. Using this innovative approach to technology is a new challenge for the young generation.

## 2. Research Background

### 2.1 Policy Support

To further strengthen the whole chain of plastic pollution management and to promote the "14th Five-Year" white pollution management to achieve greater results, "Action Plan for the Control of the Plastic Pollution during the 14th Five-Year Plan" was issued, requiring in-depth implementation of Xi Jinping's thought on ecological development, so as to further improve the whole chain of plastic pollution management system, and fulfill the local, departmental and corporate responsibility. It aims to focus on key links, areas, regions, and actively promote the reduction of plastic production and use at source, the scientific and appropriate use of plastic alternative products. At the same time, in the

context of epidemic, the state also strongly supports the development of the mask industry sector. The General Office of the State Council issued an "Emergency Notice on Organizing Manufacturers of Key Materials for Epidemic Prevention and Control to Resume Work and Production and Dispatch Arrangements", quickly organizing the resumption of production of masks and other protective materials enterprises. "Comprehensive Work Plan for Energy Conservation and Emission Reduction in the "14th Five-Year Plan"" by the State Council clearly pointed out that we should vigorously promote green consumption, increase the promotion of green and low-carbon products. Moreover, we are supposed to intensify the promotion of green and low-carbon products, and the research, development and promotion of advanced energy conservation and emission reduction technologies. It is suggested to play the role of industry associations, business groups, public welfare organizations, in order to support the public welfare of energy saving and emission reduction.

## 2.2 Development Status

Since the outbreak of the Covid-19 pandemic, protective items such as mask, alcohol, and disinfectant have become one of the daily sources of security for all people. In response to the spread of the Coronavirus, WHO estimated that frontline medical personnel worldwide need 89 million medical masks, 76 million pairs of medical examination gloves, and 1.6 million pairs of goggles per month in March 3rd, 2021. According to statistics, the number of masks produced worldwide in 2021 was estimated at 52 billion, with a conservative attrition rate of 3%, and an average weight of about 3 or 4 grams for a mask, which will cause 4,680 to 6,240 metric tons of plastic waste pollution. Currently, there are environmentally friendly masks on the market, including biodegradable masks and washable masks, while they are expensive and troublesome to use, so they do not have a broad development prospect. A new type of environmentally friendly mask is urgently needed to promote the development of environmental protection.

## 3. Product Introduction

### 3.1 Product Structure

The structure of the new environmentally friendly Chinese medicine bead mask is mainly divided into four parts: outer layer, middle layer, bead layer and inner layer.

(1) The outer layer is made of non-woven material with fine structure, mainly used for anti-droplet.

(2) The middle layer is made of melt-blown fabric, which is also the core functional layer for filtering droplets and adsorbing bacteria and viruses.

(3) The bead layer is located between the middle layer and the inner layer, which is close to the bacteria and viruses adsorbed in the middle layer and kills the filtered bacteria and viruses more efficiently, while relying on the inner layer which plays the role of moisture absorption, so that the PVA water-soluble film can be better dissolved in the moisture.

(4) The inner layer of the mask is made of skin-friendly non-woven material, which is mainly used to absorb moisture.

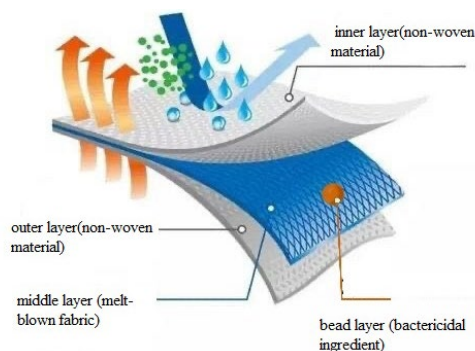


Fig. 1 Structure diagram

## 3.2 Core Components

### 3.2.1 Manufacture of Bead

By using the extraction methods of distillation, solvent extraction, pressing, and SFE, volatile oil disinfection and antiseptic components were extracted from Chinese medicines mainly from clove, atractylodes rhizome, menthae herba, cinnamon, listsea cubeba, fennel, thyme, and eupatorium adenophorum spreng; and aromatic components were extracted from Chinese medicines such as lavender and menthae herba. The disinfecting and antiseptic ingredients are mixed with the aromatic ingredients in a reasonable ratio and placed in PVA water-soluble film to prepare a new type of Chinese medicine disinfection bead.

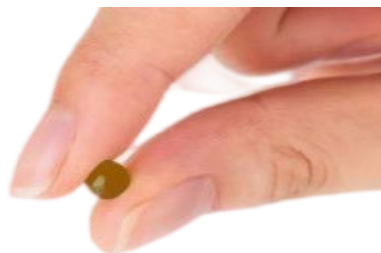


Fig. 2 sample

### 3.2.2 Selection of Chinese Medicine

1). Asarum: Asarum volatile oil can disrupt the selective permeability of the cell membrane of the test strains, resulting in the extravasation of the contents. Its L-asarinin, L-sesaminin, kakutol and  $\beta$ -sitosterol of Asarum inhibit the effects of Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa and Candida albicans. Also, asarum has inhibitory effect on H1N1 influenza virus.

2). Schizonepeta tenuifolia: Schizonepeta tenuifolia volatile oil can inhibit Staphylococcus aureus, Bacillus subtilis, Proteus vulgaris, Escherichia coli etc., which increases the permeability of cell membranes or rupture them by destroying the structure of cell membranes, so that the cell contents leak out. It also has a broad-spectrum antibacterial effect and has a strong inhibitory and inactivating effect on pathogenic bacteria commonly used in clinical pathogens, including Streptococcus B, Bacillus anthracis, Escherichia coli, etc.

3). Folia artemisiae argyi: Folia artemisiae argyi volatile oil on Staphylococcus aureus, Escherichia coli, S. typhi, Pseudomonas aeruginosa, Klebsiella tularensis and Klebsiella pneumoniae have a certain inhibitory effect, especially on Staphylococcus aureus.

4). Clove: Clove volatile oil inhibits the effects of Staphylococcus aureus, Aspergillus, Bacillus cereus, Escherichia coli, Salmonella, Bacillus subtilis, Aspergillus niger, Penicillium, Aspergillus flavus and yeast.

The extracted volatile oils of litsea cubeba, eupatorium adenophorum spreng, thyme, fennel, atractylodes rhizome, menthae herba and cinnamon have a certain inhibitory effect on the bacteria both in the air and in the respiratory tract. The volatile oils are mixed with a special proportion to give full play to the disinfection and bactericidal effect of Chinese medicine disinfection bead.



Fig. 3 Picture of traditional Chinese medicine

**Table 1.** Ingredient list

Ingredients	Representative Chinese Volatile Oils	Objects	Experimental results	Antibacterial mechanism	References
Eugenol	Clove	<i>Shewanella putrefaciens</i> , <i>Pseudomonas fluorescens</i>	MIC are 750 mg·L <sup>-1</sup>	Disrupting cell walls, increasing cell membrane permeability, and leaking intracellular solutes	
Atractylone	<i>Atractylodes lancea</i>	<i>Acinetobacter baumannii</i> , <i>Staphylococcus aureus</i> , <i>Viridans Streptococci</i>	The inhibition effect on <i>Acinetobacter baumannii</i> , <i>Staphylococcus aureus</i> , <i>Viridans Streptococci</i> is obvious, the antibacterial rate reaches more than 95%.	—	
Pulegone	<i>Menthae herba</i>	<i>Escherichia coli</i> , <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , <i>Klebsiella pneumoniae</i> , <i>Staphylococcus epidermidis</i>	MIC are 0.05~0.10, 0.05~0.10, 0.10~0.20, 0.20~0.39, 0.10~0.20 μL·mL <sup>-1</sup> respectively.	—	
Cinnamaldehyde	Cinnamon	<i>Escherichia coli</i> , <i>Candida albicans</i> , <i>Staphylococcus aureus</i> , <i>Staphylococcus albicans</i> , <i>Pseudomonas aeruginosa</i>	MBC are <0.297%, <0.297%, <0.297%, 0.594%~1.188%, <0.297% respectively.	—	
Citronellal	<i>Litsea cubeba</i>	<i>Aspergillus niger</i> , <i>Staphylococcus aureus</i> , <i>Bacillus subtilis</i>	MIC are 0.11, 0.47, 0.47 μL·mL <sup>-1</sup> respectively.	Disrupting bacterial cell Membrane structure, resulting in deformation of bacterial cells and reduction of bacteriophage proteins	
Anisaldehyde	Fennel	<i>Escherichia coli</i> , <i>Staphylococcus aureus</i> , yeast, <i>Aspergillus niger</i>	MIC are 31.25, 15.625, 62.5, 62.5 mg·L <sup>-1</sup> respectively.	—	
β-Elmene	Purple stem med Zealand	<i>Staphylococcus aureus</i> , <i>Escherichia coli</i> , <i>Candida albicans</i>	Order of antibacterial effect: <i>Staphylococcus aureus</i> > <i>Candida albicans</i> > <i>Escherichia coli</i> , where the MIC of <i>Staphylococcus aureus</i> is 200 μL·mL <sup>-1</sup>	Affecting the permeability of cell membranes and inhibiting the synthesis of bacterial proteins and nucleic acids to exert antibacterial effects	
Thymol	Thyme	<i>Staphylococcus aureus</i> , <i>Listeria monocytogenes</i> , <i>Escherichia coli</i>	MIC are 0.188, 0.375, 3.00 mg·mL <sup>-1</sup> respectively	Increasing cell membrane permeability	

### 3.3 Extraction Technology of Chinese Medicine

The volatile oil extraction device used in this product is composed of water vapor generator, receiver and condenser, and the receiver is composed of sample collection tube, condensing device, branch pipe, liquid storage tube and gas guide tube. The device combines the sample collection tube

and condensing device together, which reduces the temperature of the scale tube, so that some volatile substances with low boiling point can be condensed effectively in time, without the temperature being too high to cause their volatilization. At the same time, it condenses the volatile oil with high boiling point quickly, and the part connected with the gas guide slope tube is within the length of the condensation tube outside the collection tube, so that the sample collection tube can be condensed effectively.



**Fig. 4** Product legend

### 3.4 Product Features

(1) Higher extraction rate of volatile oil of Chinese medicine: the raw materials of Chinese medicine used are easy to extract the sterilization volatile oil of Chinese medicine, which will not lead to its excessive waste.

(2) Short disinfection time: Chinese medicine volatile oil has a special volatility, which disinfects the mask in a relatively short time, making it easy for customers to use it next time when they go out.

(3) Less irritation: The extracted aromatic ingredients of Chinese medicine make the mask glow with a fresh fragrance after sterilization and disinfection, which will not produce irritating odor and affect customers' wearing.

(4) No foreign body sensation: PVA water-soluble film wrapped with Chinese medicine extracts is dissolved in the water vapor exhaled by customers after disinfection and sterilization, so there is no foreign body sensation when wearing.

(5) Easy to handle: Users can Gently pinch the Chinese medicine beads located in the interlayer of the mask and place it in the air circulation after using it.

(6) Reusable: It Improves the utilization of a single mask by sterilization and disinfection.

(7) Low cost: The special extraction process improves the extraction rate of Chinese medicine and significantly reduces the cost of the product.

## 4. Prospects

With the global spreading and normalization of the Covid-19 pandemic, people are gradually enhancing their awareness of self-protection, and the demand for masks is rising year by year, accompanied by the pollution and destruction of our environment. The Chinese medicine bead mask greatly reduces people's consumption of masks while meeting their needs for virus prevention and promoting ecological and environmental protection. Young people gradually see it as their responsibility to contribute through their own strength. Based on that, the Chinese medicine disinfection bead mask abides by the duty of environmental protection and sustainable development, seizes the opportunity of development with a good prospect.

By observing the disinfection effect of Chinese medicine disinfection bead on protective masks, it will be developed for more fields in the future and can be used for disinfection of kitchenware, clothing, furniture and other household items.

## 5. Innovation Value and Social Significance

(1) Save social resources: By realizing the sustainable utilization of masks, we are expected to save social human, material and financial resources, improve the waste caused by disposable masks, reduce the waste of human resources, save social capital to invest in other fields, finally strengthening social integration.

(2) Reduce the spread of bacteria and viruses: The efficient disinfection of Chinese medicine volatile oil effectively inhibits the growth of germs and reduces the wide spread of the Coronavirus. In addition, it also reduces the probability of transmission between people, strongly restraining and promoting the prevention and control of the epidemic.

(3) Increase environmental protection: Soluble film is easy to dissolve naturally, while the use of biodegradable paper outer packaging in harmless and pollution free effectively alleviates the environmental white pollution brought about by disposable masks. In this way, it effectively carries out social environmental protection publicity, and stimulates the public environmental protection fervor.

## 6. Conclusion and Outlook

Natural ecology has contributed to the national economic development, and governments have focused on the economic impact of the epidemic. However, with the normalization of the epidemic at present, various environmental pollution is also a key social issue that we should seriously consider.

This study discusses the pollution of disposable masks to the natural environment under the present situation, and explains the special efficacy of the Chinese medicine bead mask compared with other environmentally friendly masks, as well as its innovative value and important social significance. Meanwhile, this product is expected to cover a broad market and enjoy a wide range of consumers. In the future, with the improvement of people's awareness of environmental protection, the Chinese medicine bead mask will play an indispensable role in preventing mask pollution.

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