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**Research Paper**

# Analysis of wall materials and preparation methods of microcapsules

Yongkang Zou, Rong Zhang, Yanjie Li*
*[*1]School of Agricultural and Food Engineering, Shandong University of Technology, Zibo, Shandong, PR China*
*Corresponding Author: Yanjie Li*

***ABSTRACT:*** *Microcapsule were introduced in this paper the common wall materials and preparation methods of microcapsule, firstly summarizes the current the main material of microcapsule wall material types, including natural polymers of sodium alginate and chitosan, pectin, and half a synthetic polymer material and synthetic polymer materials of simple introduction, then introduces the current methods of microcapsule preparation, Including single coagulation method in physical chemistry method, chemical method of in situ polymerization, interfacial polymerization, sharpening method of coagulation bath and the physical and mechanical method of spray drying method, air suspension method and so on several main preparation methods, finally introduces the microcapsule technology applied in medicine, food, etc, shows that this technology of microcapsule broad application prospects.*

***KEYWORDS:*** *Microcapsules, Wall material, Preparation method, Application*

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## I. INTRODUCTION

Microcapsule technology is a technology that uses membrane forming wall material to embed the core material that needs to be protected to form tiny particles, which can protect the core material from adverse environment and effectively play its biological active function [1]. Microcapsule technology is widely used in food, medicine, cosmetics, pesticides and other industries because of its functions of changing the state and nature of substances, protecting the sensitive ingredients of food raw materials, covering up the bad odor and controlling the release of active substances [2-3]. Microcapsule technology originated in the 1950s, the development has become a very promising technology, according to statistics, now there are more than 200 kinds of microcapsule preparation methods. According to the properties, preparation methods and formation mechanism of capsule wall, the preparation methods of microcapsules can be divided into three categories: physical method, chemical method and physical chemical method. In recent years, more and more scholars pay attention to and study microcapsule technology. The development direction of microcapsule technology mainly lies in the innovation of wall material and preparation method, and the nature of wall material affects the selection of preparation method to a certain extent. Therefore, this paper mainly reviews the microcapsule wall materials and preparation methods which are widely used in the research of microcapsule technology in recent years to provide theoretical reference for the research of microcapsule technology.

## II. MICROCAPSULE WALL MATERIAL

The ideal microcapsule shell material should not react with the core material and have appropriate mechanical strength, solubility, fluidity, emulsification, permeability and stability [4]. Commonly used microcapsule wall materials include natural polymer materials, semi-synthetic polymer materials and synthetic polymer materials.

### 2.1 Natural polymer materials

Natural polymer materials have the advantages of non-toxic, good film forming, is the most commonly used microcapsule wall material, mainly including carbohydrates, protein, lipid three categories. Carbohydrate wall materials mainly include chitosan, Arabic gum, cellulose, sodium alginate, etc. Protein wall materials are mainly gelatin, albumin, soy protein and so on.

### 2.2 Sodium alginate

Sodium alginate has the molecular formula of ($C_6H_7O_6Na$). It is a white or light yellow amorphous powder, tasteless, soluble in water, with strong moisture absorption, good water retention, insoluble in alcohol, chloroform and other organic solvents. It is a natural polysaccharide with the characteristics of biological adhesion, biocompatibility and biodegradation. The viscosity varies with the degree of polymerization, concentration and temperature. Sodium alginate has the stability, solubility, adhesion and safety of pharmaceutical preparation excipients, and is suitable for the preparation of pharmaceutical preparations.

### 2.3 Chitosan

Chitosan, also known as chitosan, is the product of chitin heated by concentrated alkali to remove N-acetyl group. It is white or slightly yellow flake solid, chitosan contains amino group, is the only basic polysaccharide in natural polysaccharides, soluble in hydrochloric acid and most organic acids, insoluble in water and alkali solution. Chitosan has good biological adhesion property, biocompatibility, biodegradability and good film-forming property, due to its superior functional properties and unique molecular structure of chitosan used as biodegradable materials in the new drug delivery system, delivery system by changing can greatly improve drug efficacy, a controlled release, increase the target, reduce the stimulation, and reduce the side effects. As well as improving the effect of hydrophobic drugs through cell membrane and increasing drug stability [5].

There are two reactive groups on the macromolecular chain of chitosan. In the weak acid solution, the free amino group can combine protons to become a polyelectrolyte with positive charge. It has strong adsorption and chelation ability, and can be used as the immobilized carrier of cells and biological macromolecules, and easy to carry out chemical modification. In addition, some N-acetamide groups form various intramolecular and intermolecular hydrogen bonds with hydroxyl and amino groups. Due to the existence of these hydrogen bonds, chitosan molecules are easier to crystallize, and chitosan has high crystallinity, good adsorption, film formation, fiber formation, moisture retention and other good physical and mechanical properties [6].

### 2.4 Gelatin

Gelatin is a mixture of proteins that do not dissolve in cold water but do dissolve in hot water, also known as white gelatin. Its appearance is colorless or light yellow transparent flakes or particles, can absorb its own weight of 5-10 times the water and expansion. Gelatin can cross-link with formaldehyde and other aldehydes to form a sustained release layer. Gelatin has biocompatibility, biodegradability and gel formation, and is suitable for microcapsule wall material. Because a single wall material is difficult to meet the requirements of preparing microcapsules in all aspects, so in recent years, many scholars use mixed wall materials in the study of microcapsules [7]. Arabic gum and P-cyclodextrin were selected as microcapsule wall materials of eucommia ulmoides leaves. It was found that when the ratio of arabic gum and P-cyclodextrin was 1:1, microencapsulation could achieve better results. Zha et al. [8] mixed gelatin and sucrose at a mass ratio of 3:7 as wall material, and added a small amount of sucrose ester to embed lycopene. The microcapsule efficiency and yield were the highest, 91.26010 and 89.35 %, respectively. Du et al [9] applied aspartic acid and gelatin as mixed wall material, adopted single coagulation combined with spray drying of VA palmitate microcapsules prepared Gao et al. [10] used polyurea - melamine formaldehyde resin as wall material to prepare microcapsule products, whose sealing effect and thermodynamic stability are better than that of single polyurea wall material.

### 2.5 Semi-synthetic polymer materials

The semi-synthetic polymer wall materials are mainly cellulose derivatives, which are usually used as pharmaceutical polymer excipients or drug microcapsules. Among cellulose derivatives, ethyl cellulose is the most widely used controlled release carrier material for drugs. It is prepared by etherification of cellulose and diethyl sulfate or ethyl chloride. It has the characteristics of green safety, non-sensitization and good film formation, and has been widely used in drug carriers [11-12]. The working principle of ethyl cellulose microcapsules is that ethyl cellulose is used in water-insoluble solvents. Its solubility will decrease with the decrease of temperature, and it is almost insoluble at room temperature. Under high temperature conditions, additives dissolve in the solvent as a non-solvent of ethyl cellulose. During the cooling process, phase separation takes place, and ethyl cellulose is coated around the core material to form microcapsules [13]. At present, ethyl cellulose has been successfully used in the microencapsulation of sulfa oxazole, theophylline, aspirin, vitamin D2, folic acid, salmon calcitonin and amide and other chemicals. Ethyl cellulose as the wall material of microcapsules can also be used to control the release of water-soluble substance. In order to reduce the ulcerative property of piroxicam, El-Habashy et al. prepared piroxicam containing ethyl cellulose microcapsules by evaporation method with different stabilizers. The research results showed that the particle size and encapsulation rate of nanoparticles reached 240nm and 85.29 %, respectively, and the sustained release time of piroxicam reached 12h. Compared with the suspension of piroxicam, piroxicam coating can significantly inhibit the occurrence of gastric ulcer in rats, and the ulcer index decreased by 66% on average, providing a new technical means for the treatment of NSAIDS [14].

### 2.6 Synthetic polymer materials

Fully synthetic polymer wall materials can be divided into non-biodegradable materials and biodegradable materials. As non-biodegradable materials, polyacrylamide and polymethyl methacrylate have been used as carriers for controlled release of pesticides [15]. The biodegradable synthetic polymers are mainly polylactic acid and its copolymers. Polylactic acid is a new biodegradable material based on starch, which is considered as a renewable plant resource. A single lactic acid molecule has hydroxyl and carboxyl groups, and the molecular morphology of multiple lactic acid molecules is covered together after forming polymers, which has the characteristics of good biocompatibility, non-toxic and easy degradation, and is widely used in drug delivery systems. At present, the combination of polylactic acid and polylactic acid/glycolic acid polymer has been applied in the preparation of microcapsules with sustained release properties as biodegradable completely synthetic wall materials. α-polyester is one of the most widely studied complete polymer synthetic wall materials at present. After entering the human body, it can be biodegraded and esterified to form lactic acid monomer, and then oxidized by lactate dehydrogenase and endogenous tricarboxylic acid cycle, finally forming carbon dioxide and water, and discharged from the body through lungs, kidneys and skin. Liu et al. filled the premixed film emulsified pesticide into biodegradable poly (lactic acid) microcapsules. The results showed that the loading amount and efficiency of cypermethrin reached 41 % and 82 %, respectively, and the microcapsules prepared were 0.68 μm and 4.60 μm, respectively. The continuous release time of cypermethrin in the microcapsule system was extended to 250h, which showed high thermal stability and inhibited the survival of *Plutella xylostella* larvae [16]. It has important guiding significance to develop high efficiency and environmental protection pesticide sustained-release preparation.

### 2.7 Preparation method of microcapsules

The preparation methods of microcapsules can be divided into three types: physicochemical method, chemical method and physicomechanical method, which can be selected according to the properties of the core material and the material of the capsule, as well as the particle size and drug release requirements of the required microcapsules. The core of the microcapsule is usually solid or liquid. In addition to active drugs, it may also include other additives, such as stabilizers, thinners, blockers and promoters to control the release rate, plasticizers to improve the plasticity of the capsule.

## III. CONCLUSION

Storage and preservation approach become increasingly important for postharvest fruit and vegetables. And with the increase of nutrient and safety demand, the more convenient and more effective storage or preservation approach with enough safety will become necessary. Therefore, research on safe, non-toxic, broad-spectrum antibacterial, efficient natural storage approach and food package will become the direction of future development.

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