

Preparation, characterization and application of duck 's egg white alkali - induced gel

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Abstract: In recent years, as a natural polymer, silk fabric has low biodegradability, excellent mechanical and processing properties, good biological adaptability and so on, especially in various fields. "Polyurethane is considered to be a substitute for natural materials and is gradually used in biomedical field due to its protein structure." In terms of performance, the widely tunable properties of capacitors and polyurethane materials enable the existing hydrogel materials to have slower pH response and lower mechanical strength defects. These materials are supported by researchers wishing to prepare suitable biomedical materials. Hydrogels can be applied in the field of drug loading and drug release to produce better pH stimulation response and better mechanical properties. The bromine / polyamine (SF / PU) hydrogels were prepared. The kinetics of water expansion and expansion of hydrogels is discussed. The drug release and drug release characteristics are discussed. It provides a theoretical and experimental basis for the application of SF / PU hydrogels in pharmaceuticals.

1. Introduction

Dakolin is a natural plant component with the same structure as cholesterol [1]. The main function is to reduce the absorption of cholesterol. It also has the effects of reducing cardiovascular disease, anticancer, anti-inflammatory, anti-oxidation and anti arteriosclerosis. Research shows that the daily intake of 2 - 3G duck egg white can also reduce LDL by 15%. Therefore, duck eggs will gradually be considered as a functional component, which can be added to food. However, the solubility of duck protein in water is very low, and it is easy to crystallize, resulting in low bioavailability. In order to solve the problem of duck egg white paper, a separation system of food protein duck egg white turbid nanoparticles was made by using emulsification evaporation technology, which improved the solubility and bioavailability of duck egg white cells in water. On the other hand, we studied the characteristics and formation mechanism of PS nanoparticles, analyzed the relationship between the particle size of nanoparticles and the bioavailability of PS, and further applied nanoparticles to the protein gel system. This not only provides some theoretical and technical guidance for the development of protein resources, but also has important significance for the application of duck egg white cells in the field of food.

2. Overview of Food Protein

Among all kinds of food grade active substances, food protein is a kind of biological polymer with many groups and high nutritional value [2]. Protein is an important raw material in the food industry because of their important functional properties (such as emulsification, gelation and foam formation). Due to the diversity of structure, protein is a good carrier for derivatization. Proteins can be used in various delivery modes (such as granules, emulsions, fibers, edible films and hydrogels),

and can transfer hydrophilic or hydrophobic active substances. Proteins have a natural affinity structure, so in principle, all proteins, such as animal and plant proteins, can be used for colloidal transport. The plant protein commonly used in the laboratory is soybean protein. The most commonly used natural protein in the food industry is casein (80%) and soybean protein (20%). Casein is a flexible and irregular structure with typical protein, apple belongs to protein, whey protein is β - lactam, α - lactam, albumin and immunoglobulin, mainly including relatively hard structure with globular protein.

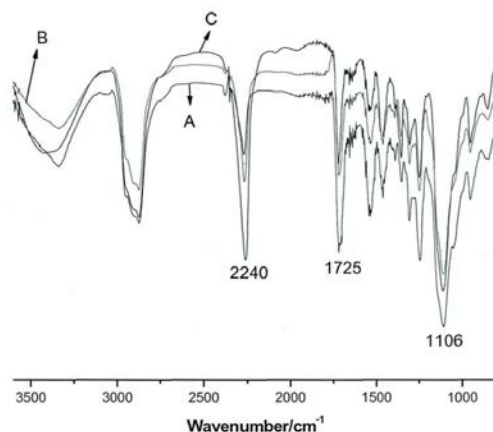


Figure 1 Infrared spectrum of polyurethane prepolymer with different chain extension reaction time

3. Progress in Gel Research

The definition of colloid was first proposed by the founder of colloidal chemistry at the end of the 19th century. "The application of gel can be traced back to the tofu making in ancient China." In gelatin hydrosol field, modern gel research has begun. Research "since 1930s, researchers have gradually begun to systematically study gelation process. Previous studies have been very evident in the discussion of basic gel theory and gel technology research. " The key conditions for obtaining the network structure by monomer polymerization are proposed. Later, foory and rehner put forward the theory of network structure expansion [3]. "Eldridge and Ferry have studied the relationship between the gel point of thermo reversible sol and the viscosity of polymer. Gel is a special dispersion, and colloidal particles or polymer chains are combined to form a crosslinking network. At present, polymer gel is usually defined as a three-dimensional network structure containing a large number of solvents. Polymer system "the molecular chain of this three-dimensional network polymer will expand when it interacts with the system solvent. The complex crosslinking structure limits this swelling behavior to some extent: "in the swelling process, the solvent will diffuse into the internal space of the crosslinking network." The higher the crosslinking density is, the more 3D network there is. The space between them is small, and the gel absorbs less solvent during swelling.

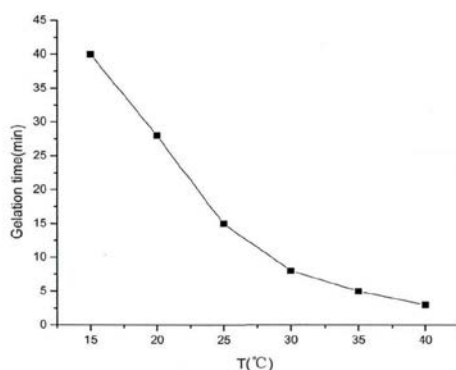


Figure 2 Relationship between gel formation time and temperature of crosslinking reaction

3.1 Classification Of Gels

Polymer hydrogel materials can be divided into two categories: natural materials hydrogels and synthetic polymer hydrogels [4]. The composition and structure of natural hydrogen gels are similar to those of natural extracellular matrix. Therefore, it has good biological adaptability in various tissues of adult animals, alginate and chitosan with similar structure to glycogen. Polymers must have two conditions: first, the main chain or aspect of the polymer chain. Most of the water and interaction energy of the polymer have a hydrophilic basis. The structure of the bridge network and the mechanical properties of the materials prove the form of the bridge network combination of the gel, which is classified according to the physical map of the Mongolia bag and the chemical bridging gel. The hydrogen bonds between polymer chains are almost the same as those of chemical bridging bridge bridging gel. According to the three-dimensional network polymer microgel formed by chemical bonding, a very small bridge network is formed according to the linear molecular bridge. Next, all polymer chains inside the hydrogels are bridged to form giant bentonite.

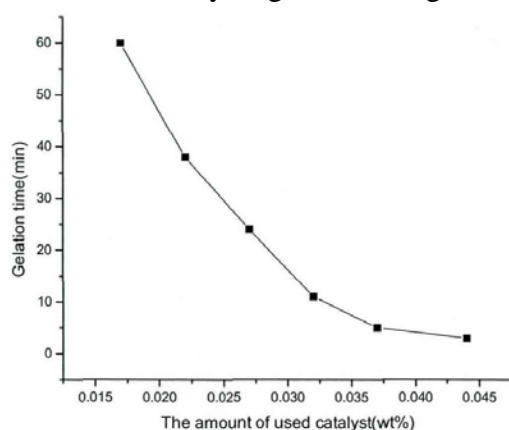


Figure 3 Relationship between gel formation time and catalyst dosage

3.2 Preparation of Gel

Polymer hydrogel is a polymer with three dimensional bridging network [5]. It absorbs a lot of water in water and expands volume. After expansion, the original structure can be maintained without dissolution. Hydrophilic monomers and hydrophobic monomers are polymerized together. The interaction between hydrogen bonds and polymer chains forms the surface of hydrogen and protein on proteins and cells. The adhesion is very small. When it contacts with blood, it shows good biocompatibility. The body fluid and human hydrogel structure itself contains a lot of water, similar to the soft living tissue, so it is transplanted as human body. It can reduce harmful reactions and is widely used as high quality biomaterials. Polyurethane is a small chain extender of copolymers formed by polymerization on polyols and the polymerized molecular chain is composed of soft segment, hard segment and polymer. The software segment is composed. Isocyanate and small molecular chain extender (diamine or diol) constitute a hard part, while mechanical properties, due to the good physiological acceptance of human body, polyurethane material can maintain the stability of human body implantation for a long time [6]. Adhesives combine the advantages of hydrogels and polyurethanes, which has brought great attention to the research and has been widely applied in the biomedical field.

3.3 Synthesis of Isocyanate Terminated Polyurethane Vinegar Prepolymer

Under the protection of dry nitrogen, after vacuum dehydration and isoprene acid salt (IPDI), the mixture of polyoxyacetone and polyglycone in different proportions was added into three bottleneck flasks of 250ml [7]. Use a large Freon mixing rod. After the thermometer and nitrogen inlet are evenly mixed in the system, the temperature rises to 85e, and react with 1.5h. Add the metered DMPA to react at a constant temperature of 80e. Finally, diethyl alcohol ketone and catalyst were added in 60E reaction.

4. Preparation of Silk Fibroin Aqueous Solution

The cocoon was cut off, weighted 10g, boiled in 0.5% Na₂CO₃ aqueous solution for more than 40 minutes to remove serine, and then washed with deionized water several times until the surface of the cocoon became smooth. Place in a 40°C vacuum drying oven for 72 hours. Dissolve the solution in 9.5 mol / L phenol aqueous solution at a certain temperature of 40 °C, filter the solution containing the obtained silk with a filter cloth, remove a small amount of undissolved silk, and then fill it with deionized water for 3 days. Change water every 12 hours [8]. In order to remove the insoluble substances, centrifugation was carried out at 6000 rpm for 10 minutes. Put it in 4°C refrigerator for preservation. The prepared silk fabrics were measured by the previous measurement method.

5. Preparation of Silk Fibroin / Poly (Vinyl Acetate) Gel

Please take the appropriate amount of polyurethane prepolymer at the end of isocyanate and put it on a 500 ml polytetrafluoroethylene mixing rod to connect the thermometer and rubber tube on the vacuum instrument. After 5 minutes, slowly stir the evaporated silk solution to make the system solidify, stop mixing for 20 minutes, and maintain the system temperature for 6 hours to obtain silk / polyurethane.

6. Preparation of Adhesive

Before the distilled water becomes mud, soak it in purified water for 48 hours, and change the water every 24h to remove unreacted monomers and impurities. Sea mud gel, take out 60 g vacuum drying, drying box weight reduced to dry, desiccant dry from the gel samples are thin parts are cut off, a certain weight of 1 weeks of 50 g vacuum drying into the oven [9]. After freezing treatment with liquid nitrogen, the surface was sprayed with gold. The surface morphology of the hydrogel membrane was observed by KYKY - 1010B scanning electron microscope. The accelerating voltage is 20kV.

7. Conclusion

Along with the reduction of the ratio of ingredients to SF / PU, the compression strength and compression coefficient of gel materials gradually decrease, and the maximum deformation speed is an upward trend. This trend is an increase in the amount of silk mainland China, which can not be explained. It is the increase of electron beam density and the equal valence of gel materials, which increases the bridge configuration in three-dimensional network structure, and the relaxation of polymer chains will restrict the movement [10]. Therefore, in order to cause deformation, large external stress is needed. The modulus of compression indicates the rigidity of hydrogel materials, and the greater the modulus of compressibility, the more difficult the material is to deform. The maximum deformation velocity of the hydrogel reflects the elastic deformation characteristics of the material. On the other hand, when the SF / PU ratio is reduced and the number of bridging points is reduced, the polymer chain can move freely, that is to say, it shows a large deformation speed. Because more free volume is displayed by polyurethane polymer, it can have more elastic deformation under pressure. The gel has good mechanical properties. When SF was used at 65/35, the ratio of u to SF was higher than that of SF / PU hydrogel. When the ratio of maximum deformation 50/50 was 85.8%, the compressive strength of hydrogel material was stronger than 0.57MPa.

References

[1] Bo Li, Hui He, Wen Shi,. Effect of duck egg white peptide-ferrous chelate on iron bioavailability in vivo and structure characterization. Journal of the science of food and agriculture, vol. 99, pp. 1834-1841, 2019.

- [2] Kotatha D, Morishima K, Uchida S, et al. Preparation and characterization of gel electrolyte with bacterial cellulose coated with alternating layers of chitosan and alginate for electric double-layer capacitors, no. 12, pp. 1-17, 2018.
- [3] Benyakhrou S, Belmokhtar A, Zehhaf A, et al. Development of novel hybrid materials based on poly(2-aminophenyl disulfide)/silica gel: Preparation, characterization and electrochemical studies, pp. 1150, 2017.
- [4] Vittoria Chimisso, Viviana Maffei, Dimitri Hürlimann,. Self assembled Polymeric Membranes and Nanoassemblies on Surfaces: Preparation, Characterization, and Current Applications. Macromolecular Bioscience, 2019.
- [5] Zhong Wang, Seiya Fujisawa, Masahiro Suzuki,. Easy preparation of graphite-containing gel electrolytes using a gelator and characterization of their electrochemical properties. Soft Materials, vol. 15, no. 3, 2017.
- [6] Haley Cummings, Weiguo Han, Sahar Vahabzadeh,. Cobalt-Doped Brushite Cement: Preparation, Characterization, and In Vitro Interaction with Osteosarcoma Cells. JOM: the journal of the Minerals, Metals & Materials Society, vol. 69, no. 195, pp. 1348-1353, 2017.
- [7] Vishwas Pardhi, Rahul B Chavan, Rajesh Thipparaboina,. Preparation, Characterization, and Cytotoxicity Studies of Niclosamide Loaded Mesoporous Drug Delivery Systems. Int J Pharm, vol. 528, no. 1, pp. 202-214, 2017.
- [8] Ren X, Yue J, Lu X, et al. Preparation and characterization of PDMS-D2EHPA extraction gel membrane for metal ions extraction and stability enhancement, 2018.
- [9] Qiyi Li, Wang Liao, Hongbing Fan,. Optimization and Scale: p Preparation of Egg White Hydrolysate with Angiotensin I Converting Enzyme Inhibitory Activity. Journal of Food Science, vol. 83, pp. 1762-1768, 2018.
- [10] Appala Naidu Uttaravalli, srikanta dinda. Hydroxyl-functionalized resin: Preparation, characterization, parameter optimization and property prediction. Pigment & Resin Technology, vol. 47, no. 3, 2018.