Application Analysis of Biodegradable Polymer Materials in Food Packaging

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Abstract: With the rapid development of biotechnology, the society pays more attention than in the past to the production and development of environmental protection. Choosing materials has always been a more important part of environmental protection work, among them, the degradable polymer materials are also professional research topics, it can be self-degradation under certain conditions, with far-reaching environmental protection value and social significance. Food packaging is a kind of carrier that plays a protective role in packaging, preservation and sales of food, the application of degradable polymer materials in food packaging can play a positive role in environmental protection, reducing environmental pollution and building an ecological society. In this paper, the active application of biodegradable polymer materials for food packaging is elaborated, hoping to provide theoretical reference.
***Keywords*:** biodegradable polymer materials; food packaging; application direction

1. Introduction

Food packaging is an indispensable part of people's lives, although the traditional plastic packaging materials can bring convenience to people's lives, meanwhile it also bring a heavy burden to the environment. It's necessary to find environmentally friendly and practical alternative materials for development. "Biodegradable polymer materials" is a series of materials that can be decomposed into low molecular compounds by microorganisms under certain conditions. Compared with traditional plastic packaging materials, biodegradable polymer materials perform better in the aspect of environmental protection.

2. The importance of biodegradable polymer materials for food packaging

With the increasing awareness of environmental protection, the application of biodegradable polymer materials has gradually been widely concerned, them can be decomposed by microorganisms in the natural environment, and eventually converted into water and carbon dioxide, so as to effectively reduce the pollution of plastic waste to the environment. In addition to its environmental protection value, its application in food packaging also has deeper positive significance. First of all, biodegradable polymer materials perform well in preventing external factors such as oxygen, moisture and odor from corroding food, so as to maintain the freshness and taste of food. Secondly, biodegradable polymer materials usually have good flexibility and toughness, which can adapt to packaging needs of various shapes and provide safe protection for food. Finally, the application of biodegradable polymer materials in food packaging is a good help to reduce production costs. Because the materials can be naturally degraded, without additional recycling and processing costs, thus saving a lot of costs for enterprises. With the continuous progress of biodegradable polymer material technology, its production cost is gradually decreasing, making the application of this material in the food packaging field more competitive.

3. The application strategy of biodegradable polymer materials in food packaging

3.1 Natural biodegradable polymer materials

Generally speaking, the natural biodegradable polymer materials used in food packaging include starch-based materials, protein-based materials and chitosan-based materials.

3.1.1 Starch-based materials

Starch-based materials can be naturally degraded in all environments, whether natural starch or modified starch, can be used in food packaging and processing. From the point of view of chemical molecular properties, this kind of component can be used to make materials with high synthetic properties, with the characteristics of relatively light texture, no abnormal color and taste, and low oxygen permeability. However, relatively speaking, there are also some shortcomings of the materials in

practical application, such as low mechanical properties and strong water permeability, which makes starch-based materials have certain constraints (limitations) when used as food packaging. With the development of science and technology, some scholars and experts now try to combine PCL materials with starch-based materials and modify them to form a new single film material, which are equipped with stronger composability, higher safety (edible), and ideal flexibility and ductility, and can be applied together with other materials. In practical applications, this kind of starch-based material is usually applied to the packaging of fried foods (such as beef patties, fried chicken and other semi-finished products), to prevent fat oxidation, water loss, microbial growth, thus prolonging the preservation time of meat products and to a certain extent.

3.1.2 Protein-based materials

Protein-based materials are also a more natural material, from soybeans, peas and other materials, its water resistance, mechanical strength is relatively weak (compared with common synthetic membranes), a little acid and alkali treatment may lead to changes in structural standards, but its barrier property is ideal. In addition, it is worth noting that with the development of science and technology, the application of collagen membrane has been widely recognized. Compared with traditional protein films in the past, collagen films have richer protein components, mostly from animal bone tissue or blood vessels, providing a stronger guarantee for food preservation. Especially in terms of preservation and preservation. Collagen films have a wide range of applications, such as artificial sausage casings (one of the raw materials for sausages), inner packaging materials for candies or preserved fruits, which have good tensile strength and good properties such as gas resistance, oil resistance, and moisture resistance after heat sealing.

3.1.3 Chitosan-based materials

Chitosan comes from common crustaceans such as shrimp and crabs, with strong properties of polysaccharide (alkaline amino polysaccharide), without any toxicity, compared with most types of biodegradable polymer materials, its biocompatibility is better, renewability is stronger, environmental protection performance is relatively high, and the antibacterial activity of chitosan materials is also very ideal. In practical operation, it is generally used in the packaging of fresh fruit foods to form a directly edible biofilm. In addition, chitosan-based material is also a single film material that can be compatible with some polymers to form composite materials. For example, chitosan-based materials can form a composite film with polyvinyl alcohol, which has excellent waterproof and heat blocking effects. It can reduce the “breathing” intensity of fresh fruit foods and prolong their preservation time.

In addition, cellulose materials, straw pulp, and other materials can also be applied. Considering the actual situation, there are many choices of natural biodegradable polymer materials, which are very important issues in people’s food safety industry.

3.2 Non-natural biodegradable polymer materials

Non-natural biodegradable polymer materials, also known as artificial biodegradable polymer materials, are not widely present in nature but are formed through artificial chemical intervention. They are a relatively emerging type of biodegradable polymer materials.

3.2.1 PLA material (Polylactic Acid)

The raw material of PLA is lactic acid, which can be properly extracted and processed to obtain polyester materials. Currently, internalized Polylactic Acid is a common material and typical optical isomer, generally speaking, the application of food packaging is “L-isomeric polymer Polylactic Acid” (L-PLA), which has strong biodegradability and environmental friendliness, and is widely used in food packaging, lunch boxes or tableware, with good preservation effects. Additionally, it is worth noting that L-PLA materials are generally coated with wheat protein, which can effectively enhance its resistance properties. When applied in strawberry packaging, it can effectively extend its fresh duration.

3.2.2 PVA (Polyvinyl Alcohol)

Polyvinyl alcohol is a commonly used biodegradable polymer material with broad application prospects in the field of food packaging. It has good water solubility, film-forming properties, and barrier properties, which can effectively protect the quality of food and extend its shelf life. PVA also has good mechanical strength and processing properties, which can meet the needs of different food packaging. In practical applications, PVA can be used to make food packaging film, packaging bags and containers, such as fruits, vegetables and other fresh food packaging. By applying PVA packaging materials in food packaging, the loss of food in the transportation and storage process can be effectively reduced, the food safety and hygiene can be improved. In addition, with the continuous development of science and technology, the modification research of Polyvinyl Alcohol is also deepening. By introducing other functional groups or blending with other polymer materials, the biodegradation performance, barrier performance and processing performance of polyvinyl alcohol can be further improved,

thus better meeting the needs of food packaging.

3.2.3 PPC (Polypropylene Carbonate)

PPC material is an alternating copolymer with abundant aliphatic polyols. After self degradation (complete degradation), it can obtain polymer materials with ideal biocompatibility. In addition, the semi transparency and impact resistance of PPC are also relatively ideal. The most significant advantage of this material is its low cost, which can be widely used. However, its mechanical properties are relatively weak, and it may soften at temperatures around 40°C, which poses certain limitations on practical applications. However, in the current field of bio-materials science in China, PPC has been improved to a certain extent, for the four layers of composite film of cold meat products, it can extend its self life to more than 20 days. Basically, it can completely replace traditional PE film. It is worth noting that in this case, the temperature resistance of PPC materials has also been improved to approximately 42.5°C, which has greatly expanded the application range of this material, highlighting its practical value.

In addition to the common non-natural biodegradable polymer materials mentioned above, there are still some new types of materials that are constantly being developed and applied. These materials perform better in the aspects of biodegradable, mechanical and resisted, which can meet the requirements of material performance and environmental friendliness in the field of food packaging. With the progress of science and technology and the improvement of people's environmental protection awareness, it is believed that there will be more excellent biodegradable polymer materials applied in the field of food packaging in the future, making contributions to food safety and environmental protection.

4. Conclusion

To sum up, the application strategies of biodegradable polymer materials in food packaging are diverse, and suitable materials can be selected according to different food types and packaging needs. The development of biodegradable polymer materials is also facing some challenges and problems, although certain progress has been made, there are still some shortcomings in cost, performance, processing technology and other aspects, such as the cost of materials is still high and difficult to large-scale application in life, the performance of some materials needs to be improved and so on. However, with the continuous progress of science and technology and the deepening of research, it is believed that these problems will be gradually solved. Through continuous research and development of new biodegradable polymer materials, the safety performance and environmental protection performance of food packaging can be further improved, the application field of biodegradable polymer materials can be expanded, and the innovation of related technologies and the development of professional industries can also be promoted.

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