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脱水热处理改善鱼皮明胶可食膜的性能

Dehydrated thermal treatment improving properties of edible films from tilapia skin gelatin

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中文摘要:

为了改良鱼皮明胶可食膜的性能，拓宽可食膜的资源，以罗非鱼皮为原料提取明胶制备可食膜，考察了脱水热处理对其理化性质的影响。结果发现罗非鱼皮明胶中亚氨基酸含量为19.3%，主要由β链和α链组成，制备的可食膜其抗拉伸强度（tensile strength，TS）达37.5 MPa。80℃热处理对明胶膜的理化性质无明显的影响。当热处理温度提高到100℃或120℃时，伴随热处理明胶膜的TS逐渐增大而溶解性逐渐降低。在热处理过程中，膜的颜色略微变黄，但断裂延伸率和透明度却无明显的变化。SDS-PAGE图谱和明胶膜在蛋白变性剂中的溶解性结果显示，高于100℃的热处理使明胶α链和β链发生交联，增强疏水相互作用和共价键在明胶膜中的贡献，使膜的玻璃化转变温度得到提高。以上结果表明，脱水热处理可改善鱼皮明胶膜的机械性能、耐水性能和热稳定性，有利于拓宽可食膜的资源和鱼皮明胶膜的应用。

英文摘要:

Abstract: Oil-derived synthetic plastic films have been led to serious environmental problems and stress on limited resources due to their non-biodegradability and excessive use. On the other hand, a large amount of wastes such as protein-rich skin are generated during the preparing of steaks, fillets, and surimi products in China. With the increasing focus on resources and environment, extraction of gelatin from fish skin to produce edible films that can improve product quality and reduce waste problems has been explored. However, fish gelatin-based edible films present poorer mechanical properties and water resistance ability than some synthetic films, resulting in the restriction of their wide application as packaging materials. For these reasons, many studies on the modification of gelatin films have been carried on by physical, chemical, or enzymatic treatments. In this study, edible films based on a tilapia skin gelatin were prepared, and the properties of these films as affected by thermal treatment which was regarded to be safer and more cost-effective than addition of physical or enzymatic cross-linking agents were also investigated. Tilapia skin gelatin was extracted with distilled water at 80℃ after non-collageneous proteins were removed by alkali and acid treatments. The obtained gelatin was mainly composed of β-chain and α-chain with an imino acid content of 19.3%, which seemed to lead to the formation of strong films. The tensile strength (TS) of the resulting films could reach up to 37.51 MPa. These films were subjected to thermal treatment at 80, 100 or 120℃ for 0.5, 1, 2, 4 and 6 h respectively. Then the properties of thermal modified gelatin films were analyzed after conditioning at (50%±5%) RH and (25± 0.5)℃ for 48 h. As a result, when these gelatin films were heated at 80℃, no significant changes in the properties of the films were observed. As the temperature of the heat treatment was increased up to 100 or 120℃, the TS of the films was increased gradually with heating time increasing, while film solubility (FS) and protein solubility (PS) were decreased. As gelatin films were heated at 120℃ for 6 h, the TS of the films was increased to 54.85 MPa, meanwhile the FS and PS were decreased from 57.62% to 29.90% and 72.96% to 40.58%, respectively. During the heating process, the yellowness of the gelatin films was increased slightly, but the elongation at break and transparency value of the films was not affected. Based on the SDS-PAGE analysis and the protein solubility of the gelatin films in various protein denaturant solutions, it was shown that the cross-linking in the gelatin film network between β-chain and α-chain could be induced by heating at 100℃ or above, resulting in an increased contribution of hydrophobic interactions and covalent bonds to the stability of film structure, and thus higher glass transition temperature of the films were observed. From the above results, it leads to the conclusion that the mechanical properties, water resistance ability, and thermal stability of skin gelatin films could be obviously enhanced with the thermal treatment of films at 100℃ or above. With improving the mechanical properties and water resistance ability of fish skin gelatin-based edible films, the application of these films can be expanded.

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