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Active Biodegradable Packaging Films Based on the Revalorization of Food-Grade Olive Oil Mill By-Products

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Introduction

The olive oil industry generates large quantities of by-products, including olive pomace and Olive Mill Wastewater (OMWW), which, if not managed properly, can lead to environmental pollution. Olive pomace, the solid residue left after olive oil extraction, contains valuable components like cellulose, polyphenols, and oils, making it an attractive feedstock for sustainable products. Among the various uses of olive oil mill by-products, one innovative application is the development of active biodegradable packaging films. These films offer an environmentally friendly alternative to conventional plastic packaging, which contributes significantly to global pollution. The key advantage of using olive oil mill by-products, especially olive pomace, is their richness in bioactive compounds such as antioxidants and antimicrobial agents. These properties make them ideal for producing packaging films that can not only protect food from external contaminants but also extend its shelf life by preventing microbial growth and oxidative damage. Thus, transforming food-grade olive oil mill by-products into active packaging materials aligns with the principles of a circular economy, where waste is turned into valuable, sustainable products that contribute to both waste reduction and environmental protection.

These films can provide food with added protection against spoilage, thus enhancing food preservation without the need for synthetic preservatives. The incorporation of natural bioactive agents into the film matrix allows it to actively interact with the food, providing an intelligent packaging solution that responds to changes in the food's condition, such as microbial contamination or oxidative stress. This approach to food packaging not only reduces the environmental footprint of plastic packaging but also supports the agricultural economy by revalorizing waste from olive oil production into high-value products for the food industry [1].

Description

The process of developing active biodegradable packaging films from food-grade olive oil mill by-products begins with the extraction of cellulose from olive pomace. Olive pomace is typically rich in cellulose, which can be extracted through various chemical treatments, such as alkali or acid treatments, to remove lignin and other impurities. Once the cellulose is isolated, it can be processed into a film-forming material. To improve the mechanical properties of the films, the cellulose can be blended with other natural biopolymers, such as starch or chitosan. These additional biopolymers help enhance the flexibility, strength, and durability of the final film. Furthermore, the phenolic compounds found in olive pomace are incorporated into the film matrix to provide antioxidant and antimicrobial functions. Polyphenols, such as oleuropein and hydroxytyrosol, have been shown to inhibit the growth of harmful bacteria and fungi, which is particularly beneficial for food preservation. The integration of these natural compounds into the films helps reduce microbial contamination and extends the shelf life of food products.

The incorporation of polyphenols into the film matrix also helps prevent oxidative damage to food. Many food products, especially those rich in fats and oils, are prone to oxidation, which leads to rancidity and a decline in nutritional quality. Antioxidant films made from olive pomace can effectively mitigate this issue by scavenging free radicals and preventing oxidative degradation. The antimicrobial and antioxidant properties of the films are particularly useful for packaging perishable food items, such as fruits, vegetables, meat, and dairy products, as they help reduce spoilage and maintain food quality for a longer period. Additionally, the biodegradability of these films ensures that they will break down naturally in the environment, unlike conventional plastic packaging, which can persist for hundreds of years. The use of natural materials derived from olive oil mill by-products not only offers an environmentally friendly alternative to plastic packaging but also contributes to reducing the environmental impact of food packaging waste.

The physical properties of the biodegradable films, such as tensile strength, flexibility, and water resistance, are key factors in determining their effectiveness as food packaging. The addition of olive pomace-derived cellulose significantly improves the film's mechanical strength, while the incorporation of plasticizers, such as glycerol, enhances the film's flexibility. Water resistance is an essential property for food packaging, as it helps to maintain the integrity of the packaging and protect food from moisture-related damage. The active properties of the films, such as their antimicrobial and antioxidant activities, further enhance their suitability for food packaging applications. These films can actively prevent microbial growth and oxidative damage, which are major causes of food spoilage. Moreover, the natural origin of the films, combined with their biodegradability, makes them an attractive solution for reducing plastic waste and promoting more sustainable food packaging practices [2].

Conclusion

In conclusion, the revalorization of food-grade olive oil mill by-products into active biodegradable packaging films offers a sustainable and innovative solution to the growing problem of plastic waste. By utilizing the cellulose and polyphenolic compounds found in olive pomace, these films provide an environmentally friendly alternative to conventional plastic packaging, while offering additional benefits for food preservation. The development of these active biodegradable films aligns with the principles of a circular economy, where waste from one industry is repurposed into valuable products for another. While further research is required to optimize the production processes and improve the scalability of these films, the potential for food-grade olive oil mill by-products to contribute to the sustainable packaging industry is significant. This innovative approach not only helps to mitigate environmental pollution but also supports the olive oil industry by adding value to its by-products, creating a more sustainable and circular agricultural system.

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