

INOPTEP 2025  **PTEP 2025**

**NINTH INTERNATIONAL CONFERENCE
SUSTAINABLE POSTHARVEST AND
FOOD TECHNOLOGIES
INOPTEP 2025**

and

**XXXVII NATIONAL CONFERENCE
PROCESSING AND ENERGY
IN AGRICULTURE
PTEP 2025**

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ODRŽIVE POSLEUBIRAJUĆE I
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i

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U POLJOPRIVREDI
PTEP 2025**

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FUTURE TRENDS AND LIMITATIONS OF ESSENTIAL OILS AND PLANT EXTRACTS AS ADDITIVES IN THE FORMULATION OF EDIBLE PACKAGING

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Edible packaging is most commonly used in the form of films or coatings that cover various types of food to extend shelf life and serve as carriers of bioactive compounds that promote human health. Additionally, edible films and coatings can serve as sustainable alternatives to commercial plastic packaging, which poses both environmental and health concerns. These formulations primarily rely on natural hydrocolloids, including polysaccharides such as pectin, starch, alginate, and carrageenan; proteins like collagen, casein and gelatin; and lipids and waxes. One of the key advantages of edible films and coatings is their ability to incorporate active compounds (e.g., antimicrobials, antioxidants, nutraceuticals, flavors, colors) into polymer matrices. Essential oils and plant extracts are among the most valuable naturally derived ingredients due to their antimicrobial, antioxidant and antifungal properties, attributed to their bioactive compounds. As a result, the food industry has recognized them not only as natural preservatives but also as agents for enhancing the aroma and taste of foods. According to literature data, plant extract incorporation into edible packaging has been successfully implemented; however, the resulting films often exhibit undesirable properties, such as structural instability, reduced elasticity and break resistance, lower transparency and gloss, and diminished effectiveness. Additionally, using essential oils and plant extracts in larger-than-necessary quantities to achieve antimicrobial and antioxidant effects may negatively impact the organoleptic properties of packaged foods. Significant losses of volatile compounds have also been observed during the drying phase of edible films and coatings. To mitigate this, essential oils and plant extracts have been incorporated in the form of nanoemulsions. Encapsulation in nanoemulsions has been shown to enhance stability and minimize strong flavors and odors. However, before these agents are introduced into the food chain, appropriate safety assessments and toxicological studies must be conducted.

Key words: *edible packaging, essential oils, plant extracts, nanoemulsion.*

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BUĐUĆI TRENDovi I OGRANIČENJA ETERIČNIH ULJA I BILJNIH EKSTRAKATA KAO ADITIVA U FORMULACIJI JESTIVE AMBALAŽE

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Jestiva ambalaža najčešće se koristi u obliku folija ili premaza kojima se prekrivaju različite vrste hrane kako bi se produžio rok trajanja i služila kao prijenosnik bioaktivnih spojeva koji promiču ljudsko zdravlje. Osim toga, jestive folije i premazi mogu poslužiti kao održiva alternativa komercijalnoj plastičnoj ambalaži, koja predstavlja brigu za okoliš i zdravlje. Ove se formulacije primarno oslanjaju na prirodne hidrokoloide, uključujući polisaharide poput pektina, škroba, alginata i karagenana; proteine poput kolagena, kazeina i želatine; te lipide i voskove. Jedna od ključnih prednosti jestivih filmova i premaza njihova je sposobnost ugradnje aktivnih spojeva (npr. antimikrobnih sredstava, antioksidansa, nutraceutika, aroma, boja) u polimerne matrice. Eterična ulja i biljni ekstrakti među najvrjednijim su sastojcima prirodnog podrijetla zbog svojih antimikrobnih, antioksidativnih i antifungalnih svojstava, koja se pripisuju njihovim bioaktivnim spojevima. Zbog toga ih je prehrambena industrija prepoznala ne samo kao prirodne konzervanse, već i kao sredstva za poboljšanje arome i okusa hrane. Prema literaturnim podacima uspješno je provedena ugradnja biljnih ekstrakata u jestivu ambalažu; međutim, dobiveni filmovi često pokazuju nepoželjna svojstva, kao što je strukturna nestabilnost, smanjena elastičnost i otpornost na lomljenje, manja prozirnost i sjaj, te smanjena učinkovitost. Osim toga, korištenje eteričnih ulja i biljnih ekstrakata u količinama većim od potrebnih za postizanje antimikrobnih i antioksidativnih učinaka može negativno utjecati na organoleptička svojstva pakirane hrane. Također su primijećeni značajni gubici hlapljivih spojeva tijekom faze sušenja jestivih filmova i premaza. Kako bi se to ublažilo, eterična ulja i biljni ekstrakti ugrađeni su u obliku nanoemulzija. Pokazalo se da inkapsulacija u nanoemulzijama poboljšava stabilnost i smanjuje jake okuse i mirise. Međutim, prije nego što se ti agensi uvedu u prehrambeni lanac, moraju se provesti odgovarajuće procjene sigurnosti i toksikološke studije.

Ključne riječi: *jestiva ambalaža, eterična ulja, biljni ekstrakti, nanoemulzija.*

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