

## INNOVATIVE ANTIMICROBIAL AND ANTIOXIDANT FILMS AND FOILS FOR FOOD PACKAGING

### Fields of use

Foil, Film, Chitosan, Antimicrobial, Antioxidant, Nanoparticles, Permeability, Food packaging material

### Current state of technology

TRL 4, technology is ready to be licensed out

### Type of cooperation

Technical cooperation and license agreement

### Intellectual property

Patent applied, but not yet granted

### Developed by

Jožef Stefan Institute

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### Summary

Researchers from the Jožef Stefan Institute and University of Maribor have developed innovative method and initial design of apparatus for synthesis of antimicrobial and antioxidant foils and films. The material treated with this method has considerable antimicrobial and antioxidant properties, while oxygen permeability is greatly reduced. We are looking for manufacturers and other industrial companies involved in a production of flexible plastic packaging.

### Description of the invention

Increased public awareness about environment and health issues along with strict packaging guidelines and regulations, are shifting focus of the global food packaging market towards biodegradable packaging materials and other solutions, appropriate in terms of costs, environment and health.

For manufacturing foils and films, polypropylene (PP) and polyethylene (PE) are quite often used, although they have very low (if any) measurable antimicrobial and antioxidant activity, while they also show permeability for oxygen. As a result, these materials are getting less appropriate for food packaging, since they don't provide enough resistance against pathogens, spoilage of packed food is not slowed down as it could and chemical preservatives need to be added to the food to prolong its use, while nutritional and sensorial properties diminish relatively fast.

The solution: Innovative antimicrobial and antioxidant polymer foils and films with a layer of chitosan and additional active layer for food packaging.

According to this specific method, the substrate layer (PP, PE) is first treated with neutral oxygen atoms to improve wettability and afterwards chitosan layer is applied. The role of this layer is to provide a barrier for oxygen diffusion and antibacterial activity. Additionally, it helps the following layer, called active layer, to be adhered firmly and effectively on the previous one.

In the last step, third layer – active layer – of antioxidant (e.g. pomegranate extract) and chitosan nanoparticles is applied on the previous two. As shown in the following figures, first two columns represent untreated PE and PP, while the remaining columns represent innovative packaging material and laboratory tests have shown greatly increased antimicrobial activity (Figure 1) and antioxidant activity (Figure 2).

Simultaneously with the method, the researchers have also developed a design of apparatus to implement it in production process.

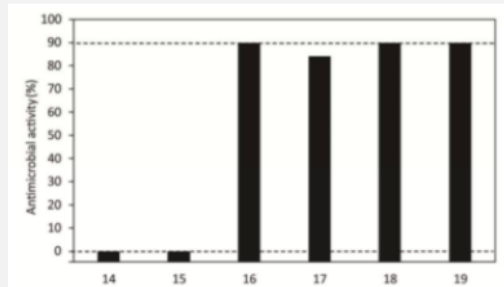


Figure 1: Antimicrobial activity of untreated (14-15) and treated samples (16-19).

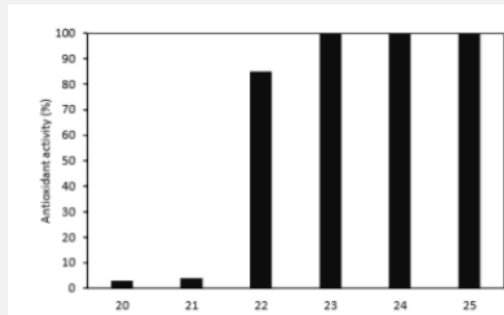


Figure 2: Antioxidant activity of untreated (20-21) and treated samples (22-25).

The technology has been developed at the Jožef Stefan Institute and University of Maribor, both leading Slovenian research institutions. The research group of [Laboratory for Characterization and Processing of Polymers](#) are experts in functional polysaccharide materials, while [The Department of Surface Engineering and Optoelectronics](#) has strong expertise in surface treatment technologies.

### Main Advantages

Oxygen permeability is reduced by 90% and more

- Antioxidant activity is increased by a factor of more than 10
- Antimicrobial activity is significantly increased (e.g. in tests *Staphylococcus aureus* were reduced by more than 90%)
- Packed food is preserved for a prolonged period of time

### Partner Sought

We are looking for manufacturers and other industrial companies involved in a production of flexible plastic packaging (foils and films). Technology is ready to be licensed out.