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# Production of bilayer polymeric films for future use in active food packaging materials

**Charalampos Giannios,** Sevasti Matsia, Athanasios Salifoglou

Laboratory of Inorganic Chemistry and Advanced Materials, School of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece
E-mail: **harrisgiannios@hotmail.com**

**Abstract**: Polylactic acid (PLA) is a biopolymer of great interest to the field of food packaging. Compared to widely used polymers (PVC, PET) emerging from petrochemicals, PLA is produced from renewable sources, it is biodegradable and concurrently exhibits mechanical and thermal properties similar to those materials. That makes it an acceptable, environmentally friendlier alternative to food packaging. However, biological packaging materials, such as chitosan (CH), can also be used in biomanufacturing antimicrobial films, with the latter acting as a) barriers to control the transfer of oxygen, and carbon dioxide, and b) carriers of active compounds, such as essential oils. In this work, PLA-CH bilayer films were produced as alternative matrix for enrichment with antioxidant and antibacterial materials as alternative use in food packaging. The solvent casting method was used for preparing films for that purpose. The results project a well-structured film, which can be used as biodegradable material in antimicrobial packaging of a variety of food products.

## • Introduction

Nowadays, materials commonly used in food packaging include polymers emerging from petrochemicals, such as polyvinyl chloride (PVC) and polyethylene terephthalate (PET), due to their high availability, low cost, and good thermal and mechanical properties. These materials, however, are not biodegradable and their recycling is very costly. These two reasons render the aforementioned polymeric materials unsuitable, with a negative impact on the environment. In response to changes in market trends and increasing consumer demand for high quality, safe and extended shelf-life of food products, active packaging is a new approach in the current market and becoming increasingly important. Active packaging is defined as a type of packaging in which the product and the environment interact to extend the shelf-life or improve safety and convenience or sensory properties, while maintaining the quality and freshness of the packaged food [**1**]. Active packaging, incorporating antimicrobials (antimicrobial packaging) and antioxidants (antioxidant packaging), has become one of the most rapidly developing research areas in food technology [**2**]. On this basis, the purpose of the present research in our Laboratory has been to create bilayer films for use in packaging for foodstuffs, with the generated films being biodegradable and capable of preventing growth of microorganisms, all as a consequence of using the antioxidant substance i.e. carvacrol. Thus, to create the desired films, PLA was used as the first layer, and then after extensive study, the second layer was created with chitosan and glycerol.

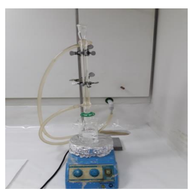
## • Materials and methods

PLA

+

chloroform

solvent casting method



Heating with vertical reflux

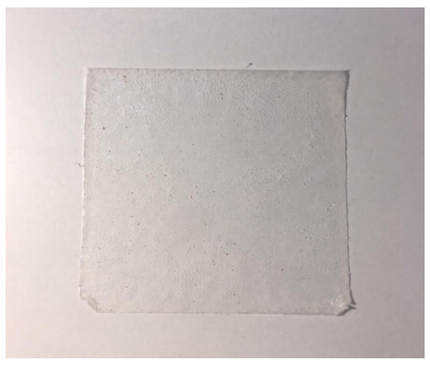
Pouring

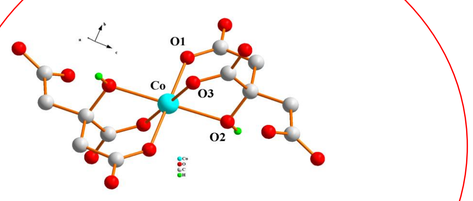
Glass molds

After 1 day

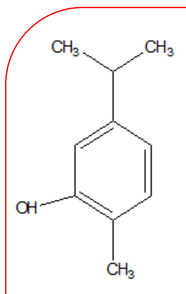
Pouring Chitosan solution enriched with antioxidants

Film production






**Co-Citrate as antibacterial agent**



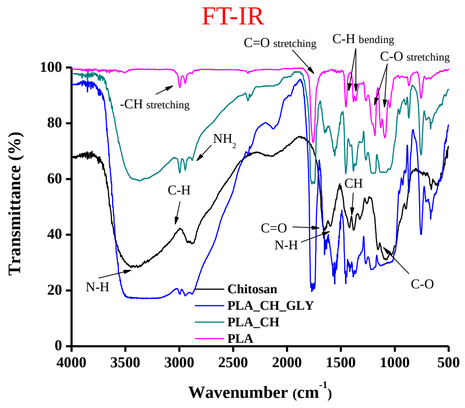

**Pure Carvacrol extracted from Greek oregano plant**


## • Results and Discussion

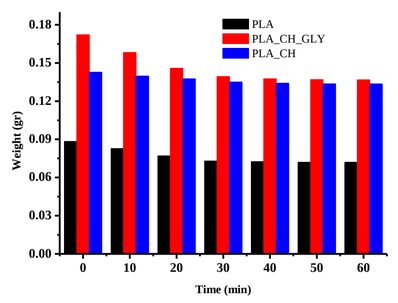
**Thickness of monolayer and bilayer films**

| PLA | 17 μm | 18 μm | 17 μm | 17 μm | 17 μm |
|---|---|---|---|---|---|
| PLA_CH_GLY | 29 μm | 30 μm | 29 μm | 31 μm | 29 μm |
| PLA_CH | 23 μm | 24 μm | 22 μm | 23 μm | 23 μm |

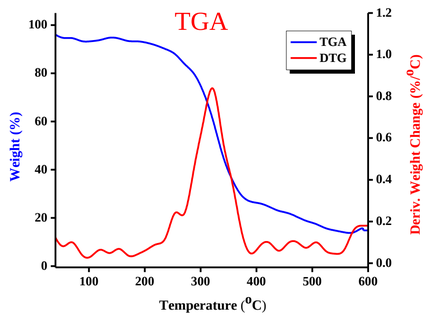
FT-IR

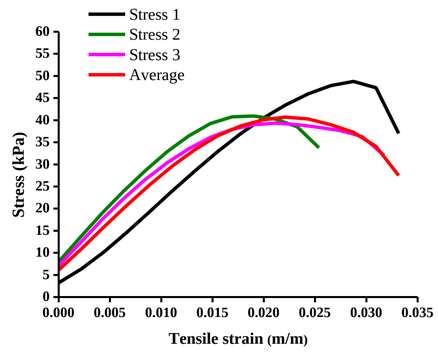


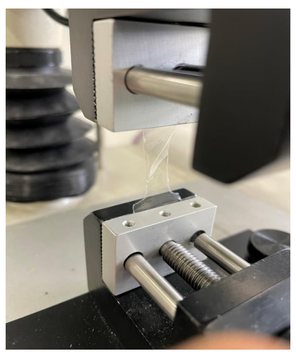

Weight Variation




TGA



**Dog-bone like films after tensile strength tests**

## • Conclusions

- ❑ We have produced monolayers and bilayer biodegradable films of PLA and PLA-Chitosan.
- ❑ Extensive physicochemicial analysis, including FT-IR, thermal properties through TGA, weight variation and mechanical properties, have validated the production of reproducible films.
- ❑ Further attempts include the production of enriched films with antioxidant and/or antibacterial materials.
- ❑ The morphology and the thickness of the films will also be investigated through SEM Microscopy.

## Literature

1. V. Nithya, P.S.K. Murthy, P.M. Halami, Me1. J. Appl. Microbiol. 115 (2013) 475–483.
2. Â. Luís, E. Gallardo, A. Ramos, F. Domingues, Antibiotics (Basel) 9(8) (2020) 443.