

# Final Report

**Project acronym: *GRAFOOD***

**Project number:**

***72/2017 in Romania***

***MIZS 4126 in Slovenia***

***1-2895 del 06/08/2019 in Italy***

***PCIN-2017-037 in Spain***

**M-ERA.NET Call 2016**

**Period covered:**

- ✓ **01/01/2019 to 30/06/2020 for the following partners:**
  - **Technical University of Cluj Napoca Romania (UTCN),**
  - **Ceprohart Romania (CEPRO),**
  - **National Institute of Chemistry Ljubljana Slovenia (NIC),**
  - **University of Camerino Italy (UNICAM)**
  - **Synbiotec Italy (SYN)**
  
- ✓ **01/10/2018 to 31/03/2020 for Andaltec Spain (ANDA)**

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## Publishable project summary

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The main scope of the project is the design, characterization and validation of a prototype of active package, either polylactic acid (PLA) film or paper structure modified with composite based on  $\text{TiO}_2$  with Ag and graphene selected from the previous stage. Additionally, a market study about the perception of the consumers and packaging producers regarding the introduction of the obtained PLA based package as commercial wrap for cheese and meat storage was performed. In the same time, the validation of the selected prototypes of active packages took place. In the final part, the procedures for patent obtaining in Romania (OSIM) and at European level (EPO) were started.

According to the work plan, active paper packaging and PLA modified with composite based on Ag,  $\text{TiO}_2$  and graphene were obtained. Thus, three types of composite modified sheets of paper were prepared containing the composite in a mass percentage of 0.5%, 1% and 5%, respectively. Active PLA film was also obtained with the same content of composite. Because of the fact that the properties of the modified paper were poor in terms of mechanical resistance and water vapour and grease permeability, this material was abandoned and, the consortium agreed to obtain an active packaging system having a sandwich structure: PLA-paper (H-PLA). Also, the mentioned packages were modified with probiotics and analyzed. The characterization of these packages was performed and the preservation efficiency was tested during the preservation of chicken and cheese. Also, the used packaging was reused and recycled. The results obtained were compared with those of the currently used packaging and the most efficient active packages were selected. It, then, underwent migration tests for validation. From the physical-mechanical characteristics's point of view, the H-PLA complex can be a solution for a high-performance packaging. The results assessed from the performance of the migration tests point of view are encouraging, the packaging having the necessary characteristics for use in direct contact with food in food safety conditions. The experimental activity rich in various tests at laboratory level, led to optimal working variants from the point of view of the physical - mechanical characteristics of the GRAFOOD concept packaging. The composite can be successfully introduced into the composition of the paper support at an addition of 0.5% to the material a.u. to a suitable granulometry to ensure the correct embedding (without the danger of detaching from the paper and being found on the packaged food) and a homogeneous dispersion in the paper structure.

The food tests were performed as follows: PLA, PLA modified with composite in a mass content of 0.5%, 1% and 3% were used to store the fresh cheese. H-PLA, H-PLA with composite 0.5%, and 3% nonmodified and modified with probiotics (LP) were used to store the chicken meat. The packages PLA and PLA 0.5% maintain the fresh cheese for a longer time than the other tested packages. If it is taken into consideration the number of the total coliforms, the storage period in PLA increased with 2 days comparing to PLA 1% and with 2.5 days comparing to PLA 3%. Thus the PLA and PLA 0.5% packages increase the storage period of the fresh cheese with almost 50% comparing to PLA 1% and PLA 3%. The microbiological analyses showed that the meat tests can be kept in safe conditions in H-PLA for 6 days, in H-PLA-probiotics and H-PLA 0.5% for 3.5 days, and in HPLA-probiotics for 4.5 days.

The results of the marketing study showed that most respondents were aware of the importance of the preservative characteristics of the packaging. In general, the consumers surveyed would be willing to pay an additional amount for these new packages. Most respondents agree to promote new active packaging capable of improving the quality and safety of food products developed in the GRAFOOD project. Many companies would introduce these materials into their production chain, either as a manufacturer or as a distributor. The biggest handicap is in the price that companies are willing to pay, as 97.5% would pay between 10 and 20% more and, of these, 62.5% would pay only 10% more.