Developing a Tannin-based, Eco-fungicidal Packaging Material

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About the project

Dendromass4Europe (2017 – 2022) aims at establishing sustainable, Short Rotation Coppice (SRC)-based, regional cropping systems for woody biomass (dendromass) production on marginal agricultural land. The dendromass produced in SRC (ligneous biomass, bark and wood) are supplied to dedicated bio-based value chains that create additional income and job opportunities in rural areas. The supply chains will be tailored for optimum efficiency of supply logistics and for reducing CO_2 emissions. Four innovative bio-based materials will help to replace fossil-based materials.

Fibre pulp plant pots

Our tasks

Poplar bark, which currently serves primarily as a source for energy, will be used for three bark-based materials. As one of these, an eco-fungicidal moulded fibre pulp for packaging is to be developed. These fibre parts can replace plastics in packaging, are biodegradable and can also be recycled without any problems. Our task was to determine the necessary proportion of natural bark fungicides for a protective effect of at least six months for moulded fibre parts. In addition, a cost-effective separation method is to be developed.

Fig. 1: Rapid Köthen Lab sheet maker

Fig. 2: Lab sheets with tannin on compost under glasshouse conditions

Fig. 3: Moulding pots after 6 weeks without tannin

Methods

As natural bark-based fungicide, tannin was identified in a wide range of tree species such as poplar. We decided to use tannin as a natural fungicide for the laboratory tests because of its good availability, moderate price and high quality.
In the first part of the laboratory tests, lab sheets with a diameter of 200 mm were produced using a Rapid Köthen sheet former method (see Fig. 1 and 2). Various recipes were tested on these for their suitability for mold prevention. Parts of the sheets were placed on compost in a laboratory glasshouse for 6 months under specific conditions with minimum 90 % humidity and 30 °C (see Fig. 4).
In the second part of the laboratory tests, 12 cm pulp plant pots made with tannin were produced and placed next to the reference series of plant pots without tannin for comparison (see Fig. 5). This allowed a direct comparison of both types under the same environmental conditions.

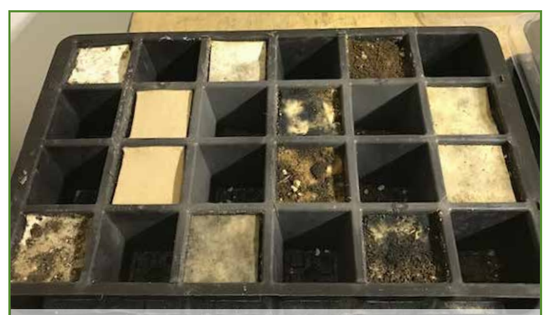


Fig. 4: Mould lab tests with and without tannin after 6 month under glasshouse conditions

Fig. 5: Plant pot arrangement, pots with 3 % tannin placed next to the reference without tannin

First Results and Summary

It turned out that the conventional 12 cm pot showed traces of mold after only three weeks. These were mainly found at the bottom of the pods where waterlogging occurred. First signs of white mold on the outer surface were observed where the pots stood closer and air exchange was lower. However, no changes have been observed in the tannin-filled samples.

Further observation showed that the tannin-free samples were infested with black mold after 6 weeks (see Fig. 3). Such aggressive fungi are able to break down cellulose and thus cause a considerable loss of strength. From the 8th week on, the pots started collapsing, showing first defects in the material. The upper edge easily separated from the wall, the bottom and the wall broke open. The samples were no longer intact.

The tannin-filled fibre moulded parts showed a slight mold growth on the outside only from the 20th week. The assumption is obvious that the mold has already spread on the inside of the pot below soil level. At this time, the pots were still firm and intact.

From week 23, the mold penetrated the tannin-material more strongly and was more apparent on the outside of the moulded parts. First material degradation started on some samples, others were still completely intact. From week 24 all tannin-free samples were more or less infested by mold. The first signs of failure also appeared on the tannin-filled moulded parts.

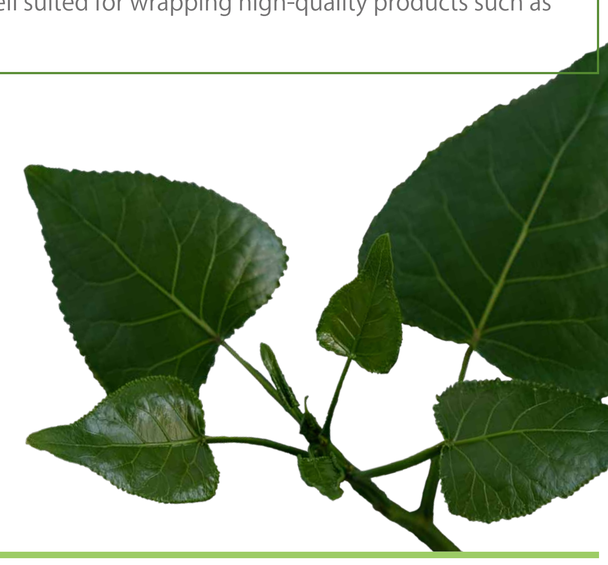
Summary:

As a result, it was found that under these considerably more difficult conditions than with conventional container shipping, a tannin-filled product were able to achieve a protective effect for six months. It is therefore assumed that a protective effect can also be achieved on packaging parts that are intended for overseas transport for up to six months. Thus, the eco-fungicidal packaging material developed by D4EU is also very well suited for wrapping high-quality products such as wine bottles, toys or electrical goods.

Fig. 6: Pulping machine for pulp preparation

Fig. 7: Pressing of high-quality fibre parts

Fig. 8: Eco-fungicidal packaging material



[1] Pulp-Tec Sp.Z.o.o.Sp.K. (former Pulpack Sp.Z.o.o.Sp.K.)

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