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From studying fruit skins to developing new elastomeric materials ...

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Marc M. *et al.*

Bioinspired co-polyesters of hydroxy-fatty acids extracted from tomato peel agro-wastes and glycerol with tunable mechanical, thermal and barrier properties

Industrial Crops and Products . 2021

https://doi.org/10.1016/j.indcrop.2021.113718

Partnerships

INRAE (TRANSFORM BIA, IATE, UCAI), GEPEA, ITQB Lisbonne

Valorisation

Patent

Bakan, B., Marc, M., Lourdin, D., Leroy, E., Lopez, C., Valentin, R., Mouloungui, Z., Marion, D. Method for preparing an elastomer from a hydroxylated fatty acid and elastomer obtained by such a method. Ref. FR1906915

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Context

All plants are covered by a cuticle that provides crucial biological functions for the plant (e.g., resistance to dehydration, adaptation to climatic and biological stresses). This cuticle is also a source of original substances that are currently undervalued, and so we developed a biorefinery process to exploit those substances.

Glycerol is another agro-industrial co-product from the oil and biodiesel production process. The study of the fine structure of cutin polyester in crack-resistant plant cuticles led us to mimic this polyester using a solvent- and catalyst-free polycondensation process.

Inspired by the natural polymer of the plant cuticle, our aim is to produce hydrophobic elastomers from synthons extracted from agro-industrial waste (i.e., cuticle monomers and glycerol).

Results

By modifying the ratio of these two synthons, it is possible to modulate the degree of cross-linking of the polyesters and their functional properties, such as their thermomechanical and barrier properties (e.g., oxygen permeability or adhesion of pathogenic bacteria). In the co-polyesters formed, increasing the amount of esterified glycerol (up to 6 %) induced a decrease in the cross-linking rate of the polyesters and the formation of crystalline domains. These structural changes are directly correlated with:

i) an increase in rubber elasticity (to over 200 % extensibility),

ii) a reduction in oxygen permeability and

iii) a reduction in bacterial adhesion.

Future outlook

This research opens up opportunities where several thematic fields overlap, such as being able to:

i) determine biorefinery processes for the exploitation of agro-industry co-products (biomass use, bioeconomy)

ii) design new biobased and bioinspired materials

iii) develop new hypotheses on how plants adapt to changes in their environment.