Development of biogenic packaging

Sustainable packaging - the devil is in the detail

Modern packaging often boils down to a tick list of biogenic origin and/or biodegradability. But comprehensive sustainable packaging concepts need more than just that. Perishable foods, for example, require special barrier properties. The Albstadt-Sigmaringen University of Applied Sciences is researching packaging concepts for their sustainability.

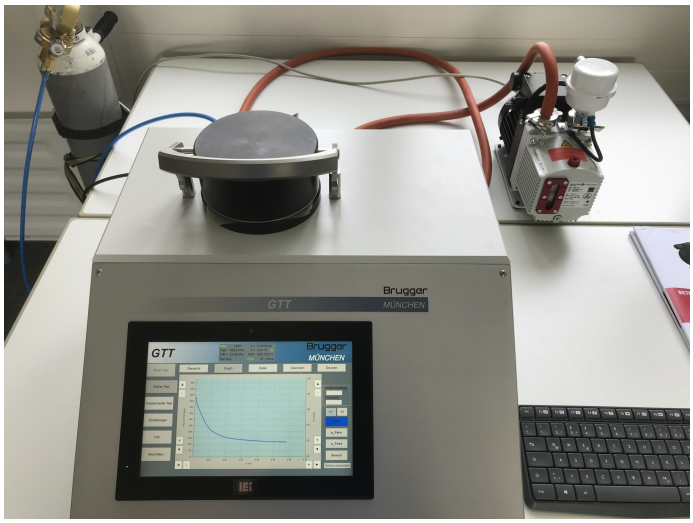
Everybody is familiar with the transparent films - often in combination with plastic or cardboard trays - used to wrap the most diverse foods from meat and dairy products to a whole range of fruit and vegetables. This kind of packaging has major advantages for shelf life and product visibility for the consumer. Transparent packaging films would be a good thing, were it not for the crude oil-based material used to produce them. Developing biogenic substitutes that can be used as an adequate, sustainable substitute is a particular challenge, and it is being tackled by the Sustainable Packing Institute SPI at the Albstadt-Sigmaringen University of Applied Sciences. A research team at the university led by Prof. Dr. Markus Schmid is working with partners on several national and international cooperative projects aimed at developing innovative packaging concepts for perishable foods.

Prof. Dr. Markus Schmid, a master butcher by training with a doctorate in food technology, has been head of the Sustainable Packaging Institute SPI at Albstadt-Sigmaringen University of Applied Sciences since 2019.
© Albstadt-Sigmaringen University of Applied Sciences, Corinna Korinth

"On the one hand, packaging should offer a high level of protection and on the other, it should biodegrade quickly and completely. We are looking to solve this conflict between the dual objectives," says Schmid. A suitable starting material, i.e. polylactic acid (PLA) has already been identified for producing transparent films. It can be processed on its own, as a copolymer or mixed with other biopolymers to form transparent, flexible and compostable films. "The material offers the desired degradation properties, but unfortunately not the barrier properties required for packaging cold cuts and cheese slices, to give just two examples," explains Schmid. This is precisely what Schmid is working on as part of the EU-funded BIOnTop project. Twenty-one partners from eight EU countries have joined forces under the leadership of the Spanish AIMPLAS - Instituto Tecnológico del Plástico to develop cost-effective, biobased plastic concepts that offer sufficient barrier properties even for sensitive foods as well as being recyclable. They are using a PLA copolymer for these purposes.

Achieve as much as possible with a small quantity of material

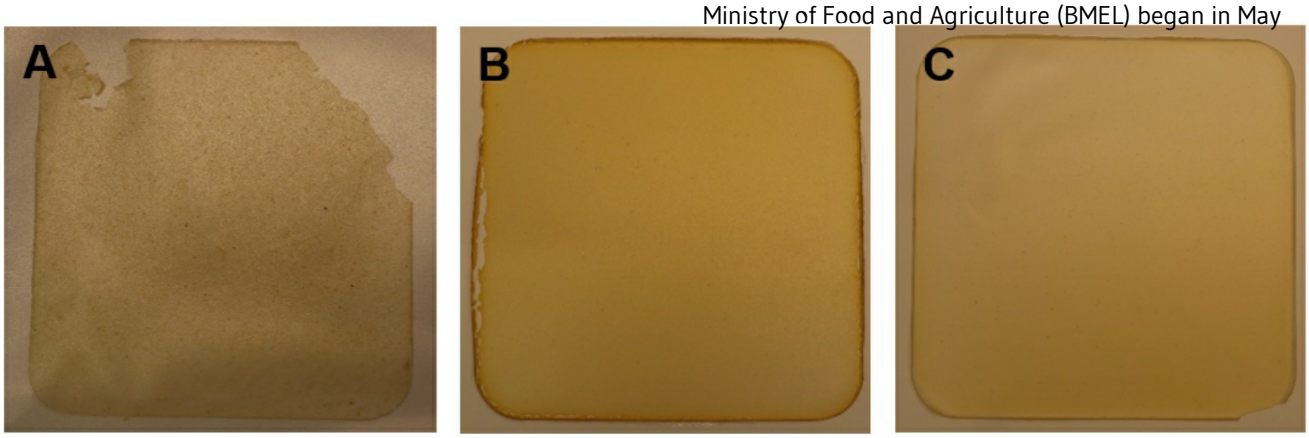
Any film must provide a barrier - against oxygen and water vapour in particular - in order to fully exert its protective effect. If too large a quantity of water vapour and oxygen find a way through, the food would prematurely deteriorate. "The PLA-based copolymer alone does not provide a sufficient barrier, so we are looking to functionalise the film," says Schmid. A protein coating provides an oxygen barrier. The team is using animal proteins present in whey that have already been well researched.



The barrier properties of biobased packaging films are measured with a gas permeation meter.
© Albstadt-Sigmaringen University of Applied Sciences, Matthias Bucher

However, while the protein layer provides good protection against oxygen, unfortunately it has the disadvantage of being sensitive to moisture. Therefore, the researchers are looking to apply a nanoscale layer of fatty acids in a second process step. Fatty acids are hydrophobic by nature, i.e. water-repellent, and thus provide the desired water vapour barrier. But this is not all. The nanocoating also improves the residual emptying properties of the packaging. Less product sticks to it, which is another plus point for sustainability. "The coating is only a few nanometres thick, so it does not impair the mechanical properties of the packaging and also shows high material efficiency, which makes it all the more sustainable," adds Schmid. It goes without saying that the new packaging film has to work not only in the laboratory, but also on an industrial scale. And it has to be cost-effective, too. This aspect, as well as its suitability for home composting, will be investigated by the consortium's industrial partners.

The PLA4MAP project also addresses sustainable food packaging. Project funding from the German Federal Ministry of Food and Agriculture (BMEL) began in May



In the PLA4MAP project, proteins from various plants (here shown: field beans (A), peas (B) and soy protein (C)) are tested for their suitability as sustainable coatings for equally sustainable PLA packaging (PLA= polylactic acid). The packaging is intended for perishable food products packaged in a protective atmosphere.
© Albstadt-Sigmaringen University of Applied Sciences, Corina Reichert

2020 and will last for three years. Together with the Fraunhofer Institute for Process Engineering and Packaging IVV in Freising, Schmid and his team are developing PLA trays for perishable foods that are packaged in a protective atmosphere. MAP in the project title stands for "modified atmosphere packaging". It is a process that slows down the ageing of food such as fish, meat, rolls and other baked goods and prolongs their shelf life.
The research group uses commercially available PLA as packaging material. They are working on increasing the oxygen barrier with a plant-based protein layer; a coating of waxes from the IVV's development forge will provide the water vapour barrier. The special feature of this project is the use of cross-linking electron beam treatment (eBeam) to reinforce the material composite and thus increase its mechanical resistance. "The application of eBeam for producing this multilayer system takes us into new scientific territory", says Schmid. New paths are also being taken as regards the fate of packaging after use: the project's declared goal is to enable material recycling - with layer separation as a special challenge.

Assessing the overall bioeconomic profile

The active university team has also discovered the world of "smart" packaging as a research topic in its own right. "18 million tonnes of food are thrown away every year in Germany alone. We want to do something about this by developing intelligent packaging that indicates when a food product is spoiled," says Schmid. This would allow the researchers to focus on the actual condition of a food product rather than on its minimum shelf life. "The metabolites of degradation processes are known. These can be biogenic amines or sulphides, for example. One idea is to integrate suitable indicator substances as chemical sensors in the form of small 'dots' or 'patches' in the cover film," continues Schmid. He wants to make the process as sensitive as it needs to be and as cost-efficient as possible. The interfaculty research team is supported by the Carl Zeiss Foundation.

The project is a good fit for the SPI's mission to develop innovative packaging concepts for a sustainable and circular bioeconomy. As of September 2020, the SPI is working on research projects with a total funding volume of around three million euros, all of which address innovative sustainable packaging concepts. "We want to make a real contribution to

sustainability," says Schmid. "Therefore, together with our partners, we are researching not only materials and processes, but also consumer perception and acceptance."

This might also interest you ...

20.04.2022

Using microorganisms to create a source of sustainable protein

21.04.2023

CELLUN - A fiber composite made from biopolymers

05.07.2023

Every tenth of a degree matters when it comes to mitigating the consequences of global warming: sustainability measures in the laboratory

11.10.2023

Land Use: Producing More Food and Storing More Carbon

09.10.2023

Microalgae: Environmentally friendly and healthy alternative to fish

26.09.2023

Local Food Systems: How sustainable are the business models for local food chains?

Article

16-Nov-2020
Dr. Heike Lehmann

Further information

Hochschule Albstadt-Sigmaringen
Sustainable Packaging Institute SPI
Prof. Dr. Markus Schmid
Anton-Günther-Str. 51
72488 Sigmaringen
Phone: +49 (0) 7571 732 8402
E-mail: schmid(at)hs-albsig.de

- SPI - Albstadt-Sigmaringen University
- Project BIOnTop

The article is part of the following dossiers

Industrial biotechnology: a challenging change to the raw material base

The alternative: “bioplastics”

environment | biopolymers | recycling | proteins | sustainability | food