

# More sustainable



More and more manufacturers are focusing on finding more sustainable methods and materials for packaging and transporting their products. Wageningen is involved in this development on several fronts. 'Packaging is an important channel of communication.'

TEXT RENÉ DIDDE PHOTO HOLLANDSE HOOGTE INFOGRAPHIC JORRIS VERBOON

# able packaging



## BIOBASED PACKAGING MATERIALS

The best-known biobased packaging materials are the biobased plastics. For consumers it is not always clear what the properties of these materials are.

### PLA (polylactic acid)

Relatively common and one of the cheapest biobased packaging materials.



### PEF (polyethylene furanoate)

A new biobased plastic. Can replace PET (Polyethylene terephthalate).



#### Raw materials

Sugars from sugar beets, sugar cane and maize.



#### Properties

Porous and breathable. Can be substituted for polypropylene as packaging for fruit and vegetables.



#### Disposal

Biodegradable in professional composting installations.



#### Raw materials

Glucose from sugar beet, maize, and other grains.



#### Properties

Has proven in lab tests to retain carbon dioxide longer.



#### Disposal

Not biodegradable; can be recycled like PET.

**T**ake a stroll through any supermarket and you'll see a vast and ever-growing assortment of bottles, jars, packets and trays containing vegetables, fruit salads, ready meals, desserts and countless other fresh products. And nearly all of the packaging is made of plastic, a by-product of the oil industry. In the near future, however, we shall increasingly find ourselves filling our supermarket trolleys with products packaged partially or wholly in biobased or recycled material: a new bottle of washing powder made entirely out of old ones, for instance.

You can already get PET bottles – Coca Cola's 'plant bottle' is one – which are made partly out of cane sugar, and more and more plastic trays and foils are being manufactured from polylactic acid (PLA), sourced mainly from the waste products of sugar beet and maize. Another sustainable innovation is the Rondeel egg box made of PaperFoam, which consists of starch and natural fibres. Coming

soon, too, is a tray for vine tomatoes made out of tomato foliage.

### AVERSION

'Public attitudes have been changing fast in recent years in favour of sustainable packaging,' notes Christiaan Bolck, Renewable Materials programme manager at Wageningen Food & Biobased Research. 'You can see a widespread aversion to materials based on coal and oil. Serious attention is being paid at last to the plastic soup in the oceans, and people are going into action on the Paris climate agreement. Also, the European Parliament has ruled that member states must take steps to reduce the use of disposable plastic bags.' Producers are responding to these trends and realize that the story behind the packaging of a product is becoming more and more important, notes researcher Marieke Meeusen of Wageningen Economic Research (formerly agricultural economics institute LEI). 'Consumers want to know where their product comes from. If a

product is grown organically, for instance, and comes from the local region, many consumers feel a stronger connection with it. The packaging, and what it is made of, are an important channel of communication for that.'

No research has been done yet, though, on whether consumers are also willing to pay more for sustainable packaging, says Meeusen. She thinks packaging made of biobased material only has a persuasive impact on the consumer if it also has a function of some kind: 'If it makes ice cream melt more slowly, for example, or keeps salad fresh for longer.'

### ON THE COMPOST HEAP

Rondeel's PaperFoam egg boxes are an example of biobased packaging which adds something to the product's narrative. The boxes stand out on the supermarket shelves. They are brown, contain seven eggs rather than the standard six, and are made of a foam-like material. 'But the packaging can be recycled after use, or it can go on the

**Bio-PET** (polyethylene terephthalate)

Made partly with renewable resources. Familiar from Coca Cola's plant bottle.



**Raw materials**

Ethylene glycol, one of the building blocks of traditional PET, is replaced with cane sugar.



**Properties**

Like traditional PET, suitable for bottles and materials such as fleece.



**Disposal**

Not biodegradable; can be recycled with traditional PET.

**PHA** (polyhydroxyalkanoates)

A family of bioplastics based on fatty acids.



**Raw materials**

Can be manufactured by bacteria, yeasts and plants from a wide range of substances.



**Properties**

Very versatile: can be used for carrier bags, foils, coatings and medical products.



**Disposal**

Biodegradable in most environments.

compost heap or into the organic waste bin,' says Thomas van Sintmaartensdijk, business developer at PaperFoam's factory in Barneveld, where he give a guided tour of the production process.

PaperFoam packaging is made of a combination of potato starch, paper fibres and a secret blend of additives. The ingredients are mixed with water in a large tub, and brown colouring is added. A machine like a Belgian waffle iron then bakes the mixture for one minute at 200 degrees. The egg boxes land with a soft plop on the conveyor belt, at the end of which a woman in a pink hairnet checks the freshly baked packaging. 'Busy and hot today,' she puffs.

Communicating with consumers through packaging is important, thinks Van Sintmaartensdijk. 'A box of seven eggs not only encourages consumers to eat an egg a day; it also relates to the chicken-friendly Rondeel barn, which consists of seven segments like seven slices of pie.'

Producer Rondeel and retailer Albert Heijn accept the fact that the biobased packaging is a bit pricier than standard paper pulp egg boxes. 'Because of the striking appearance and the fact that the packaging is biobased, they sell more eggs. The price is becoming less and less important,' says Van Sintmaartensdijk.

Van Sintmaartensdijk shows other PaperFoam packaging: mainly trays which

protect the FairPhone (a sustainable smartphone), the Nest (a smart thermostat) and the Valve game controller (a joystick) in their boxes. And then there is the special packaging provided for the famous brand of champagne, Veuve Cliquot. The champagne bottle sits in a PaperFoam holder which keeps the bubbly cold for at least two hours.

**NICHE WITH GROWTH POTENTIAL**

Wageningen researchers have made significant contributions to the formula for several new packaging materials such as PaperFoam. Wageningen was involved, too, in the development of ice cream packaging made of Biofoam. Christiaan Bolck: 'We developed this polystyrene packaging made of polylactic acid (PLA) in collaboration with polystyrene producer Synbra Technology in Etten-Leur. Thanks to the insulating foam, you can keep the box out of the freezer for a couple of hours before the ice cream melts. It is no problem to take ice cream along to the beach.' Biofoam can also be used as transport packaging for fish, and >

**'It has to be clear at a glance where to dispose of packaging'**

## ‘Where three trucks were needed to transport flowers, one is enough now’

Wageningen is doing research on whether it could be used for a cool box in Post NL vehicles.

‘Companies can see that the end is in sight for fossil fuel-based polystyrene, and they want to get off that road to nowhere,’ says Bolck. ‘They want to take sustainability further in their own company. We’re still talking mostly niche products, but something like the ice cream packaging could be of interest to major players such as Ben & Jerry’s.’

The holy grail for the Wageningen researchers is packaging material which keeps food fresh for a long time and can replace aluminium and glass. The material has to be highly impermeable to water vapour and gasses. ‘We are already well on the way,’ says Bolck. ‘In fact, biobased polyethylene furanoate (PEF) is less permeable than its fossil fuel equivalent PET, which is already in use as a substitute for glass. The barrier requirements for products such as coffee or crisps are even stricter and we are still looking for a substitute for the packaging of those products. We have found one for coffee,

with the proviso that the familiar thin layer of evaporated aluminium film is still necessary,’ says Bolck. But the biodegradable plastic that has been developed meets the European norm for compostable packaging material, even with the evaporated aluminium film. ‘The material falls apart quickly enough, micro-organisms break down the plastic and the aluminium particles have no ill effect on the compost. In fact, aluminium is a trace element for bacteria, fungi and earthworms.’

### REUSABLE OR BIODEGRADABLE?

Previous research has shown that it is important to consumers that packaging is ‘reusable and biodegradable’. This poses quite a communications challenge because ‘reusable’ material is not biodegradable and, by definition, ‘biodegradable’ material is not reusable as new material. Meeusen of Wageningen Economic Research: ‘It is very important to have a simple, clear logo that makes clear to the consumer at a glance where the packaging should go: into the bin for organic waste, for paper or for plastic.’

This is Ulphard Thoden van Velzen’s research field. ‘We are looking at how we can improve the quality of the ever larger volumes of synthetic packaging,’ says the researcher at Wageningen Food & Biobased Research. Thoden van Velzen measures the returns on sorting waste by waste disposal and recycling companies by comparing the amount of packaging that goes there with the amount of secondary material that is sent on for recycling. ‘This tells us which packaging contributes less or not at all to the recycling system, and we can provide packaging companies with precise advice on improving their process design. We advised one company to change the material it uses for its PET bottle labels, thus making the bottles more reusable.’ The infrared techniques used by waste disposal and processing companies then separate the PET better from all the other kinds of packaging consumers dispose of. Paper producer Van Houtum in Swalmen uses it for toilet paper and other products. ‘There too, we contribute technical know-how so as to raise recyclability levels and possibly find methods of making sure less

### MAKING BIOBASED PLASTICS PLIABLE

Biobased plastics are less pliable than fossil fuel-based plastics. ‘So PLA, for example, is only suitable for making trays and foil for food packaging and magazine wrappers,’ says Gerald Schennink, a researcher at Wageningen Food & Biobased Research. ‘To make complex forms such as salad boxes and butter tubs with thin walls, or to make rounded shapes, curling edges and spray tops with hinges, the material has to be very fluid.’

You can make a mushroom tray out of a sheet of biobased plastic 0.8 mm thick by heating it up and pushing it into a mould using compressed air or vacuum technology. ‘But if you need packaging in complex forms that is only 0.4 mm thick, this thermoform technology is not up to it. The plastic has got to reach all the corners of the mould during this

injection-moulding process, as it is called,’ explains Schennink. And biobased plastics are too thick for that. Schennink: ‘We are trying to get these gooey plastics to flow better.’ In the Agri&Food public-private Top Sector research consortium made up of WUR, SFA Packaging, Arburg and TN Plastics, researchers are going to see whether they can achieve this by adding additives to the biobased materials. Another route is research into adaptations to the injection-moulding process, including looking for ways of improving the barrier function of the packaging. ‘If less water vapour escapes from the packaging, the cookies stay fresh longer. PLA exhibits some negative characteristics in this regard. We are going to see whether we can improve the barrier qualities of bioplastic by integrating an extra layer of foil made of other material into the tray.’

recycled material has to be rejected because of contamination,' says Thoden van Velzen.

### SALVAGING

Another material that interests him is aluminium, which has been reclaimed from the ash after waste incineration for years. 'Aluminium from trays that quiches come in, or from lightweight whipped cream cans, can easily be salvaged from the ash,' explains Thoden van Velzen. This is less successful with ultrathin aluminium kitchen foil. 'We are studying whether the recycling works better if the aluminium is collected with all the other packaging material.' This does of course have implications for the already rather complicated waste-sorting rules for consumers.

The packaging industry is aware of this problem. 'It has to be clear where you are supposed to dispose of packaging, whether it is biobased or fossil fuel-based,' says Hester Klein Lankhorst, director of the Netherlands Institute for Sustainable Packaging (KIDV). She too knows that more and more chemical companies are looking into how to make packaging more sustainable. 'Biobased is trending, even if the global volume of four million tons is still only a little over one percent of the 300 million tons of conventional packaging.' It is good to see, though, that the market for biobased packaging is slowly growing and the environmental impact is growing too, she says. 'A lot more research is needed on biobased materials. For the time being I expect both kinds of materials will be in use, with the proportion of both biobased and recyclable fossil fuel-based packaging increasing.'

### TULIPS AND CARNATIONS

There is more to making the packaging industry sustainable though, including transport and storage issues – the field of



PH. OTTO/APA

Mark Geerts, director of Paperfoam, exhibits one of his products: the Rondeel eggbox made out of potato starch and paper fibres.

Eelke Westra of Wageningen Food & Biobased Research. He is collaborating on making improvements in new trends such as home delivery of fresh fruit and vegetables in the form of meal boxes and standing orders for vegetables. There are gains to be made by reducing the size of the often hefty boxes and bags and by extending the shelf life of products. Some companies have the produce delivered in special refrigerated trucks but even the postal service PostNL is involved in this market, delivering perishable goods along with letters and parcels. 'We are helping these transporters come up with improvements to the insulated boxes they deliver fresh goods in, and we have been testing packaging' says Westra. 'We also provide information which helps the distributor see quickly how many cooling elements are needed in the insulated boxes in a truck at a given outdoor temperature.' And it is better to pack tulips, carnations and some roses in boxes when transporting them internationally, adds Westra. This does away with the need for buckets of water. 'Flowers turn out to be less perishable than we thought,' he says: 'If we

add fluid-retaining packaging in the form of a foil around the leaves and keep the environment cool, the flowers stay fresh for three weeks. And without the buckets of water you can get a lot more flowers in a truck. Our research shows that one truck full of flowers now takes the place of three on the road to Germany or France. The environmental impact of that is huge, even if the insulating foil cannot be made of biobased material because it is too expensive.' ■

[www.wur.eu/sustainablepackaging](http://www.wur.eu/sustainablepackaging)

### POST-HARVEST TECHNOLOGY

Technological developments in the storage, packaging and processing of fresh horticultural produce are the focus of the course on Post-harvest Technology offered by Wageningen Academy in October. [www.wur.nl/academy](http://www.wur.nl/academy)