



GLOBAL  
BIOECONOMY  
SUMMIT 2015



M. Schuppich/fotolia.com

# Bioeconomy in everyday Life

# Armchair

Sector:  
Furniture

Producer:  
Wet-green |  
N-Zyme Biotec



Sources: Kessler/fotolia.com (left), Heller Leder GmbH (right)

## Raw material

Toxic acids and heavy metal salts such as chromium are traditionally used in the tanning process of leather production. **Olive leaves** are an environmentally and dermatology friendly alternative. Secondary plant compounds form the basis for a biobased tanning agent.

## Procedure

Tonnes of olive leaves fall every year at harvest time in the Mediterranean. They are mostly burned as waste. German company Wet-green has developed a process that uses extracted **tannins** in an aqueous solution produced from olive leaves for the production of premium leather for armchairs.

# Beer (gluten-free)



**Sector:**  
Food &  
Beverages

**Producer:**  
Lammsbräu |  
N-Zyme Biotec



Sources: hjschneider/fotolia.com (left), Roman Sigaev/fotolia.com

## Raw material

For many gluten-intolerant people, beer is off the list of consumable products. The malted **barley** in beer contains the gluten protein that can cause inflammation of the intestinal mucus. German beer brewer Lammsbräu and specialist N-Zyme Biotec have developed a gluten-free beer.

## Procedure

Huge **fermenters** made of steel are used for brewing: starch in the malted barley is turned into sugar and fermented by yeast. Lammsbräu adds special enzymes developed by N-Zyme Biotec to the beer after the brewing. They change the gluten structure so that it can be removed easily.

# Bike



Sources: abet/fotolia.com (left), Lignotubes Technologies (right)

**Sector:**  
Consumer goods

**Producer:**  
Lignotube  
Technologies



## Raw material

In comparison to resources such as aluminium, steel or carbon, **wood** is a renewable resource. Engineered wood is an optimal resource when it comes to strength and processability. German company Lignotube Technologies produces lightweight hollow tubes out of wood for bikes.

## Procedure

German inventors from Lignotube have developed a resource-saving procedure for the production of lightweight hollow **tubes**. The multi-layer composite tubes are made from layers of real wood veneer. The thin-walled tubes are robust and can, for example, be used for bicycle frames.

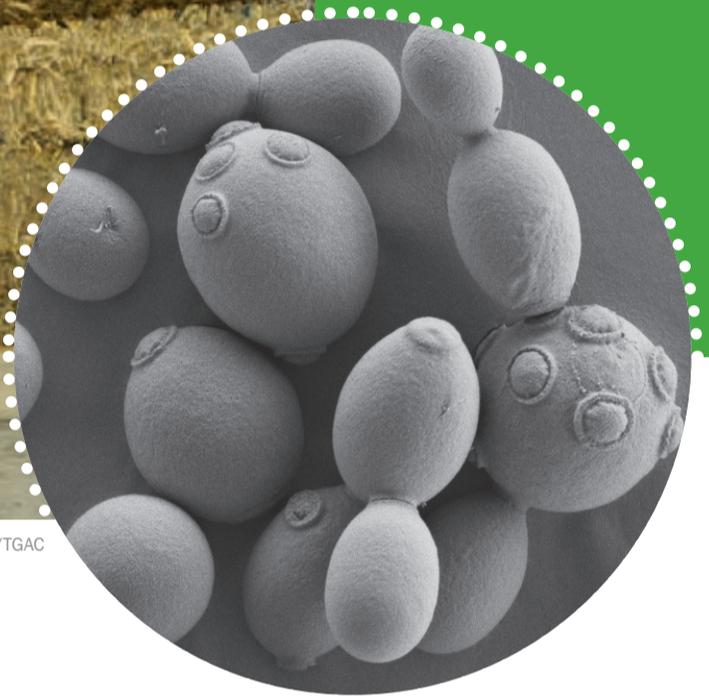
# Bioethanol



Sources: Clariant/Rötzer (left), Kathryn Cross/TGAC

**Sector:**  
Chemical  
industry

**Producer:**  
Clariant



## Raw material

Until now, bioethanol has mostly been made from the sugars in arable crops. To avoid competition with food production, residual materials such as **straw** have come to the attention of biofuel manufacturers. Straw is largely composed of lignocellulose fibres, which can be utilised further.

## Procedure

Wheat straw provides the basis for Swiss company Clariant's biorefinery. Inside the biorefinery, enzymes decompose the lignocellulose into its individual components. **Yeasts** use the resulting sugars as food – they ferment it into alcohol. This fuel can be mixed with premium petrol.

# Car tyre



**Sector:**  
Automotive

**Producer:**  
Continental



Sources: C. Schulze Gronover (left), Fraunhofer IME (right)

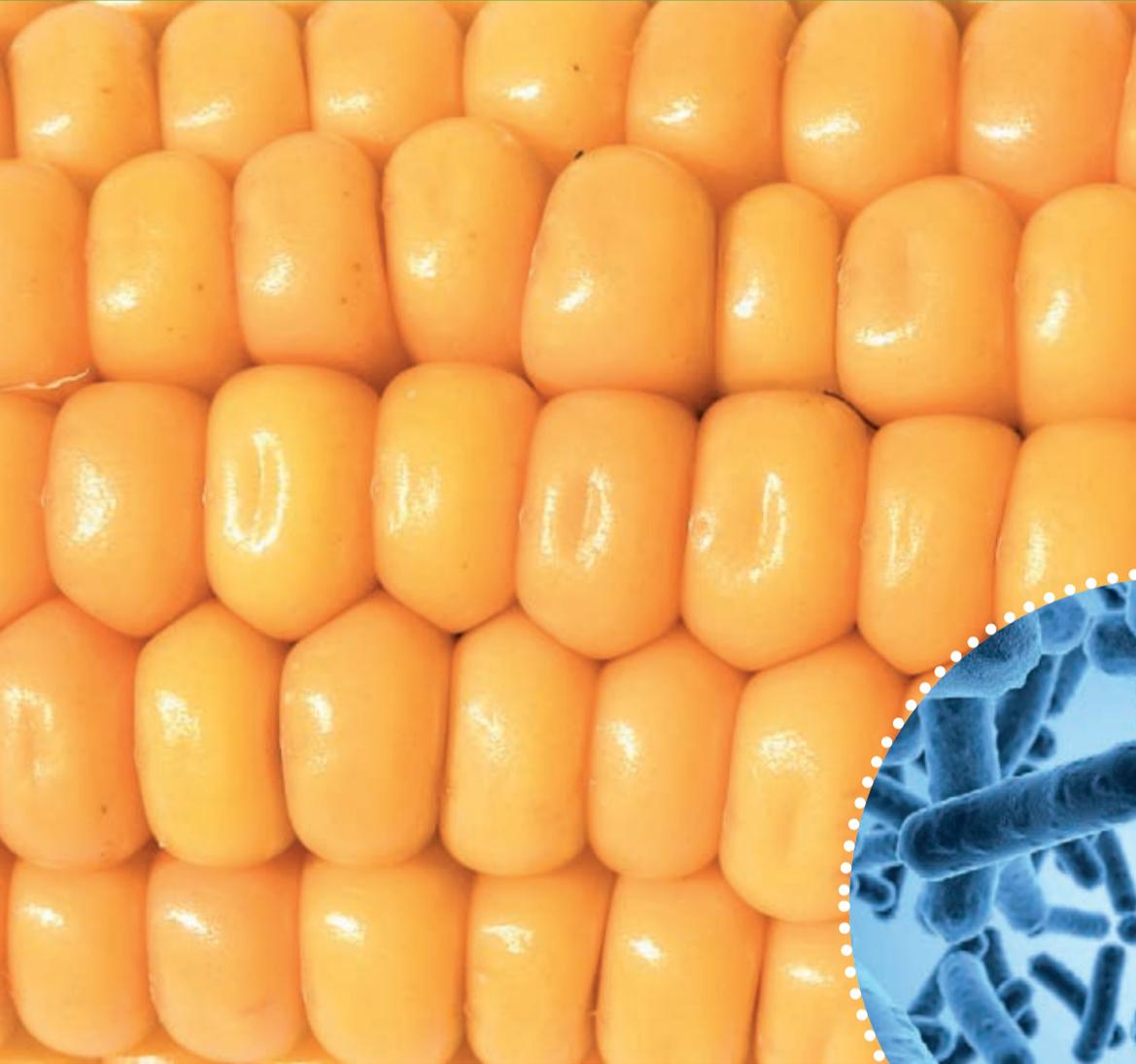
## Raw material

Traditionally, rubber used in the production of winter tyres in the automobile sector is made from latex, which comes from the subtropical rubber tree. The Russian **dandelion** is an alternative. The advantage: it also thrives in Central Europe – even in soil unsuitable for farming.

## Procedure

Researchers from the German Fraunhofer society have turned the dandelion into a robust and high yielding plant. Together with the German tyre manufacturer Continental, they have built a **pilot plant** for the production of dandelion rubber. Prototypes for winter tyres are currently being tested.

# Carpet



**Sector:**  
Chemical  
industry

**Producers:**  
Dupont |  
Mohawk



Sources: Rike/pixelio.de (left), beawolf/fotolia.com (right)

## Raw material

Carpets need to be durable, easy to clean and as soft as possible. This is achieved through special fibres of which some are biobased. The chemical company Dupont uses **corn starch** as a raw material. It serves as food for bacteria which produce a bioplastic component.

## Procedure

The bacteria are converted into living **mini-factories** which can produce 1,3-propanediol (Bio-PDO). US companies Dupont and Mohawk combine this chemical building block with the petrochemical building block TPA to create a synthetic fibre, which is 37% biobased.

# Chewing gum



Sources: USDA/wikipedia (left), Kathryn Cross/TAGC (right)

**Sector:**  
Food &  
Beverages

**Producer:**  
Evolva |  
Fertin Pharma



## Raw material

Many luxury foods contain healthy ingredients such as **resveratrol**. This polyphenol is originally found in the skins of red grapes and the plant Japanese knotweed. As an antioxidant, it may be protective against various diseases.

## Procedure

The concentration and quality of grape extract varies greatly. Companies like Swiss Evolva rely on biotechnology: **yeast** cells produce the natural resveratrol in large quantities by fermentation. The result is a white powder that can be used as an ingredient for food.

# Clothing



**Sector:**  
Textiles

**Producers:**  
Qmilch |  
Calida



Sources: Pavel Losevsky/fotolia.com (left), gertrudda/fotolia.com (right)

## Raw material

Every year, millions of tonnes of raw **milk** is accrued which cannot be utilised for consumption. German company Qmilch and Swiss Calida use the protein casein from this milk for the manufacture of textile fibres. The fibres are silky to the touch, antibacterial and can be easily dyed.

## Procedure

It has long been known that casein can be manufactured into fibres. However, only by using a lot of water and chemicals. In contrast, the Qmilch fibres are manufactured by the addition of **beeswax** and zinc. This means that fewer resources are consumed.

# Coffee capsules



**Sector:**  
Food &  
Beverages

**Producers:**  
Lavazza | Ethical  
Coffee Company



Sources: touchingpics/pixelio.de (left), Novamont (right)

## Raw material

Coffee capsules have become very popular. But the pods produce large amounts of plastic and aluminium waste. Coffee producers such as the Swiss Ethical Coffee Company or Italian Lavazza have developed capsules based on **corn starch** and plant fibres.

## Procedure

The capsules are manufactured on the basis of plant fibres, starch or vegetable oil derived from thistles, resulting in a **bioplastic**. These products are biodegradable and compatible with a range of espresso machines.

# Coffee cup



**Sector:**  
Consumer  
goods

**Producer:**  
Kafform



Sources: Maksim Shebeko/fotolia.com (left), Kafform UG (right)

## Raw material

Transform old coffee into new products: that is the idea of German company Kafform. Based on used **coffee ground** it manufactures cups and saucers. Each cup is made of 60 grammes of coffee grounds, which is equivalent to eight espressi.

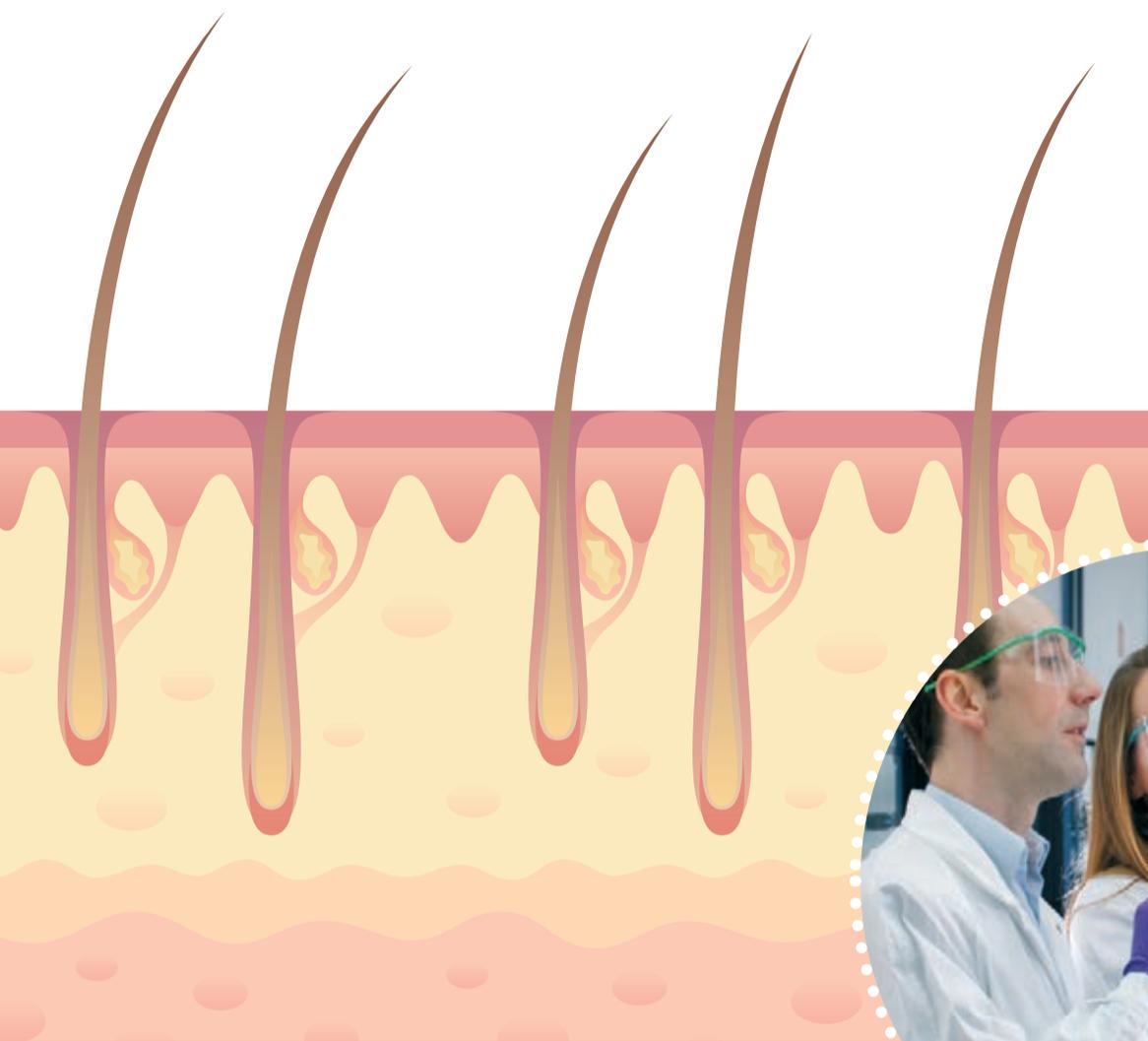
## Procedure

The recycled material consists not only of coffee grounds, but also of plant fibres, cellulose and a resin made of biopolymers. The company uses an **injection moulding** procedure to manufacture the goods. The resulting products are stable and washable.

# Conditioner

Sector:  
Cosmetics  
industry

Producer:  
L'Oréal



Sources: lenka/fotolia.de (left), L'Oréal (right)

## Raw material

Hair regeneration depends on the activity of **stem cells**, which reside at the hair follicles and act as the source of new cells. When not working properly, the hair falls out. French cosmetics company L'Oréal has discovered a bioactive molecule, that impacts the functioning of hair stem cells.

## Procedure

The hair researchers have identified a molecule that was named **stemoxydine**. When applied to the scalp, it stimulates stem cell activity in the skin and thereby revitalises hair growth. According to L'Oréal, the compound has clinically proven its capacity to increase hair density.

# Dishes



**Sector:**  
Consumer goods

**Producers:**  
Magu |  
Capventure



Sources: oly5/fotolia.com (left), Andrea Izzotti/fotolia.com (right)

## Raw material

Fast-growing plants such as bamboo are easy to cultivate. Therefore, they are increasingly being used as a raw material. Companies like German Magu or Dutch company Capventure sell several dishes made from **bamboo fibres**. The bamboo comes from plantations that are replanted.

## Procedure

So that utensils can be produced out of the bamboo fibres, they must be ground and mixed with other raw materials, such as corn and dyes. A synthetic resin provides durability and hygiene. Some companies use natural **resins** as a binding agent.

# Engine cover



Sources: fabianosodi/fotolia.com (left), digitalstock/fotolia.com (right)

**Sector:**  
Automotive

**Producers:**  
DSM | Daimler

## Raw material

Car engine components have to withstand extreme heat. German car producer Daimler uses **castor oil** as a raw material for its Mercedes A-Class engine covers, which is provided by Dutch company DSM. The oil is extracted from the seeds of the castor oil plant.

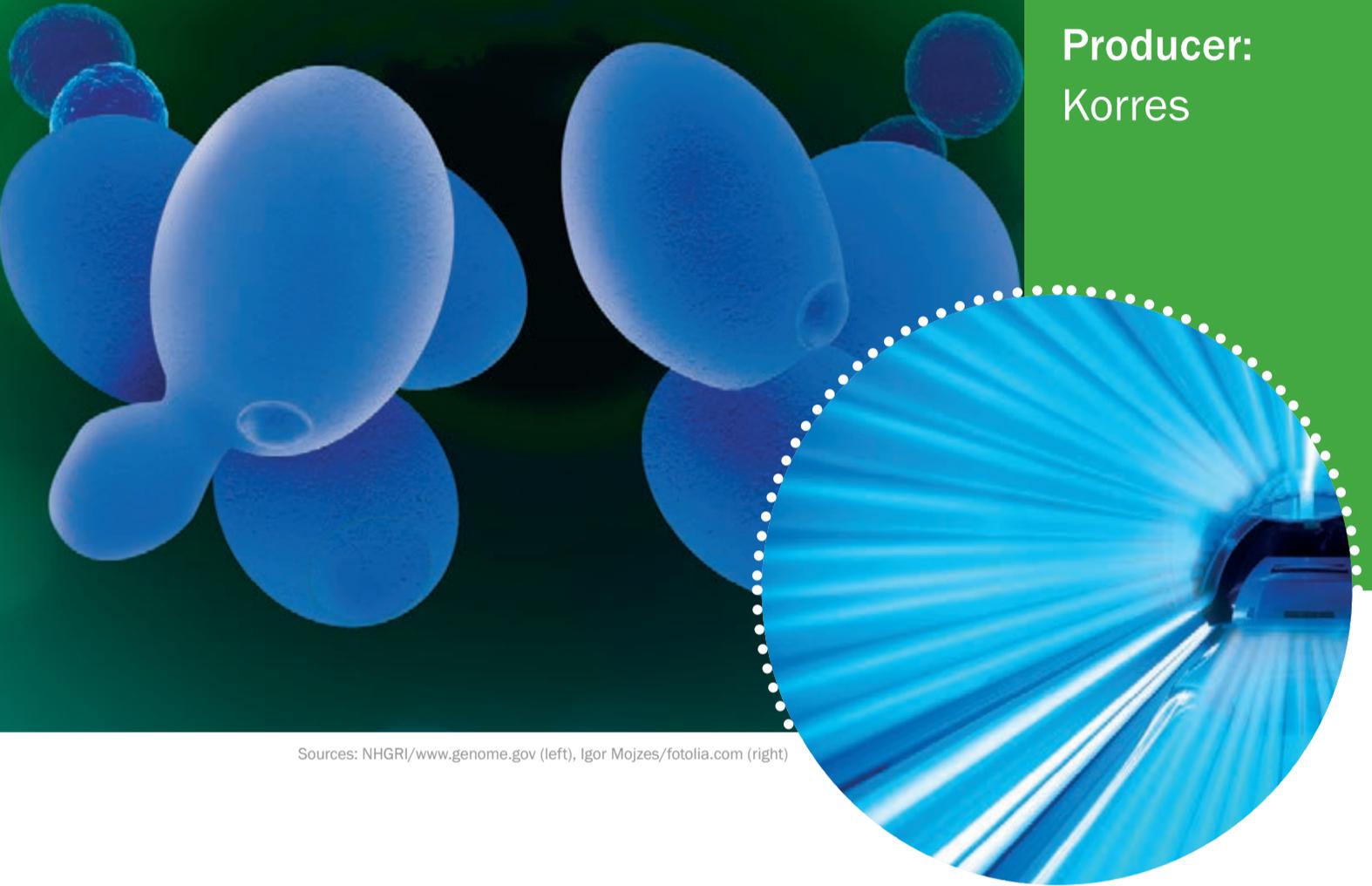
## Procedure

The process was established by DSM. The company has derived a chemical building block from castor oil. When this is combined with other building blocks, a **bioplastic** is created. The polymer is 70% biobased, heat-stable and vibration proof.

# Face cream

**Sector:**  
Cosmetics  
industry

**Producer:**  
Korres



Sources: NHGRI/www.genome.gov (left), Igor Mojzes/fotolia.com (right)

## Raw material

It's been known for centuries that yeast extract aids in wound healing. As a response to stress factors such as ultraviolet light, ozone or heat, **yeast** cells start to produce a set of protective molecules. Some of these natural agents have skin firming properties.

## Procedure

Greek company Korres uses yeast that is cultivated in fermenters. When the yeast cells are irradiated with **UV light** or ozone, they start to produce hexapeptides. These short biomolecules can be isolated and used as bioactive ingredients in anti-aging cremes.

# Fibreboard



**Sector:**  
Construction

**Producer:**  
Etouch  
Innovation



Sources: rutchapon/fotolia.com (left), Etouch Innovation (right)

## Raw material

Agricultural waste such as **rice husks**, corn stalks and coconut shells are a rich source of fibres. When combined with a biobased resin, they can be processed into a fibre composite building material that has similar properties as conventional oil-based plastics.

## Procedure

The fibres are mixed with natural resins to give rise to a **bio-composite** material. As it comes in pellets, it can be used with current plastic manufacturing equipment. The bio-based material can also be combined with plastics based on oil chemistry.

# Ice cream

Sector:  
Food &  
Beverages

Producer:  
Rewe | Prolupin



Sources: Elena Butinova/fotolia.com (left), Fraunhofer IVV (right)



## Raw material

As natural nitrogen fixers, legumes such as **lupines** improve the soil quality of arable land. In addition, the seeds are a very rich protein source, but they taste pretty bitter. The blue sweet lupine has a low content of bitter substances.

## Procedure

German company Prolupin has developed a process to extract lupine protein from the **seeds**. This procedure also removes the unwanted flavours. The lupine protein is used to make ice cream that contains neither lactose nor gluten.

# Plastic bags

**Sector:**  
Consumer goods

**Producers:**  
Novamont |  
Ibiplast



Sources: M. Schuppich/fotolia.com (left), Novamont (right)



## Raw material

Packaging materials can be made of bioplastics which are both biodegradable and compostable. Italian company Novamont uses vegetable oil derived from **thistles** as a raw material for the production of such polymers. Cellulose, corn starch and their combinations are also included.

## Procedure

The biobased material is traded as Mater-Bi. According to Novamont the **bioplastic** is suitable for processing by all common conversion technologies. It is biodegradable and compostable and therefore can be used for cling film and plastic bags utilised in organic waste management.

# Plastic bottles



Sources: ExQuisine/fotolia.com (left), aykuterd/fotolia.com (right)

Sector:  
Consumer  
goods

Producer:  
Coca-Cola



## Raw material

Most bottles are made out of PET plastic. This polymer is made from combining two different chemical building blocks. One of which – monoethylene glycol (MEG) – can be obtained from **sugar cane**.

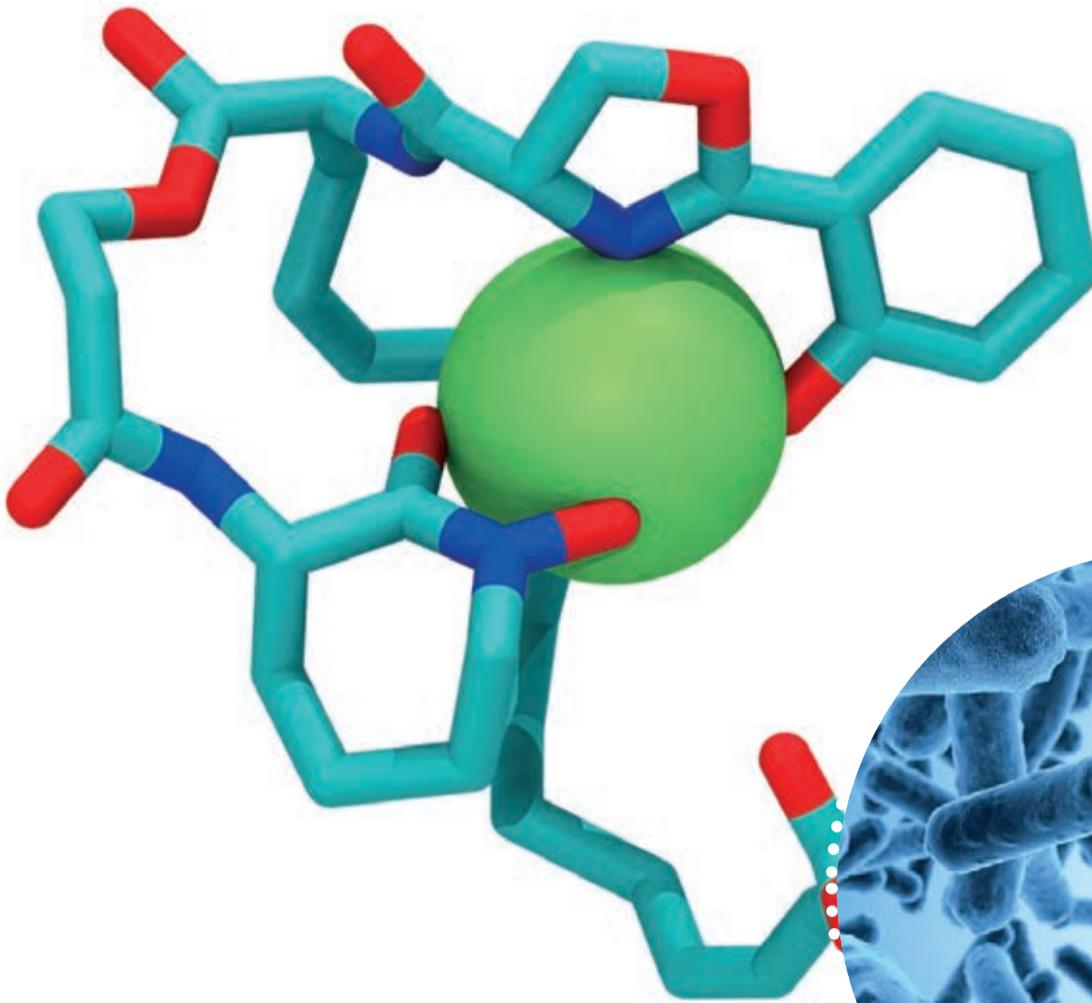
## Procedure

Yeast feeds on cane sugar and ferments it into the alcohol MEG. When mixed with other chemical building blocks, the plastic **BIO-PET** is produced. It is 30% biobased. Although the plastic bottles are not biodegradable, they can be recycled.

# Rust remover

**Sector:**  
Mechanical  
engineering

**Producer:**  
ASA Spezial-  
enzyme



Sources: Ayacop/wikimedia (left), beawolf/fotolia.com (right)

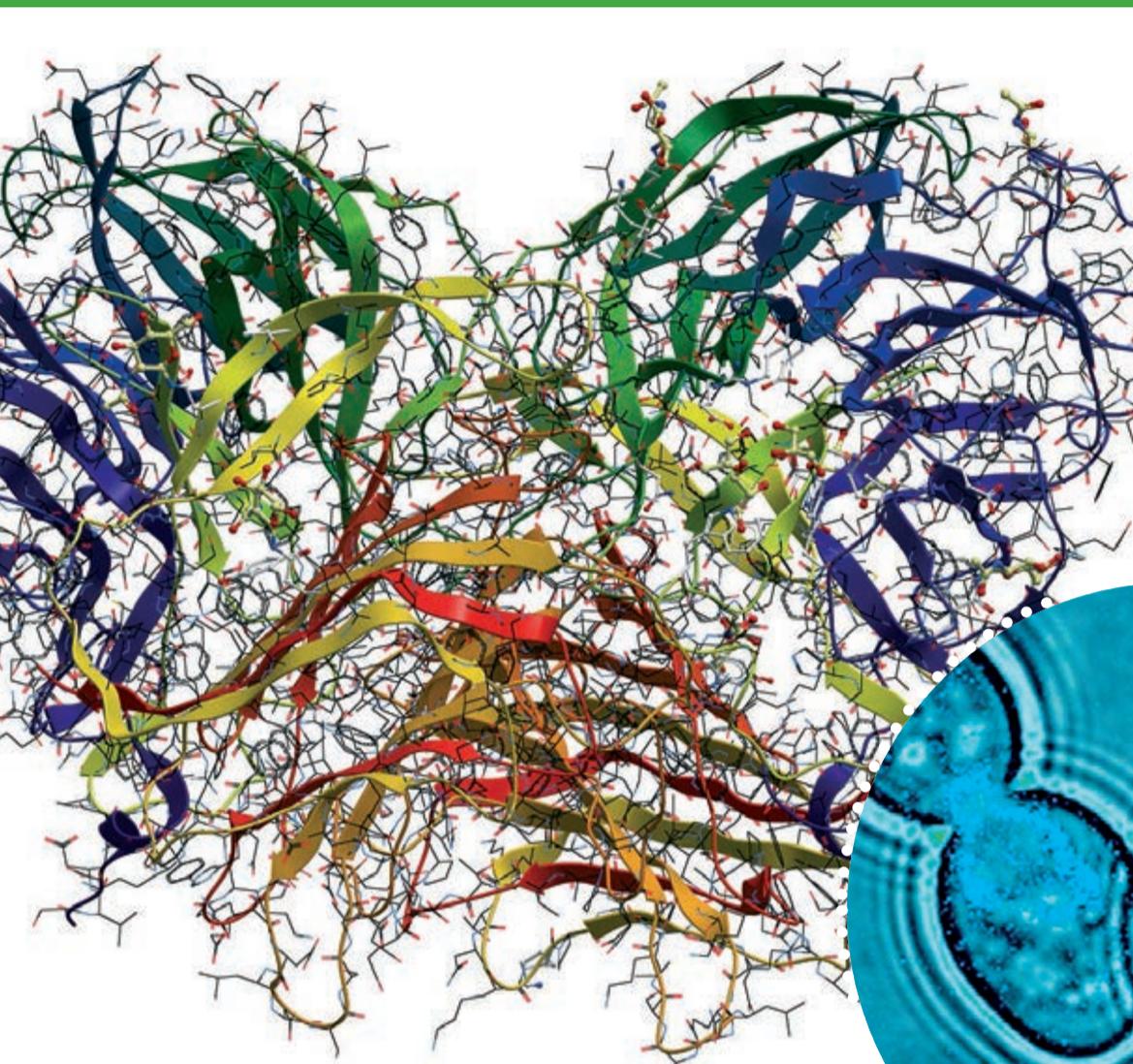
## Raw material

Rust is formed when iron atoms react with oxygen. Some types of bacteria like to eat iron. These bacteria have developed specialised protein molecules called **siderophores** in order to catch iron atoms from their surroundings.

## Procedure

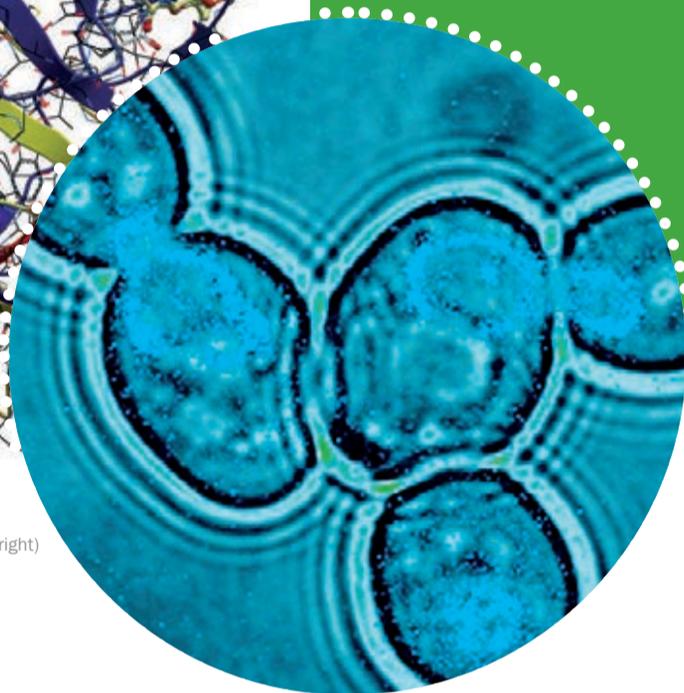
German biotech company ASA Spezialenzyme uses the siderophores to make a biological rust remover. Biomolecules from **bacteria** of the species *Streptomyces olivaceus* are produced on an industrial scale. Instead of using concentrated acids, iron parts can be easily de-rusted.

# School uniform



**Sector:**  
Textiles

**Producers:**  
Marks &  
Spencer |  
Novozymes



Sources: Leonid Andronov/fotolia.com (left), M. Peter/ETH Zürich (right)

## Raw material

Kids can be rough on their clothes, especially when they wear the same school uniform day in and day out. British retailer Marks & Spencer and Danish Novozymes have developed schoolwear that is produced with the help of **enzyme** technology that keeps uniforms looking like new longer.

## Procedure

The enzymes – which are produced by **microbes** – are added during the textile bleaching and dyeing process. Here, they help to eliminate fibre ends that can stick out from the surface. This keeps the surface smooth, reduces pilling and ensures consistent bright colours.

# T-Shirt

Sector:  
Textiles

Producers:  
Singtex | Nike |  
Hugo Boss



Sources: rdnzl/fotolia.com (left), Justin Guariglia/IHT Redux (right)

## Raw material

At best, coffee remains land in the compost bin. But there is more to **coffee grounds** than meets the eye. They absorb unpleasant odours, dry quickly and protect against UV rays. The Taiwanese company Singtex processes coffee grounds from Starbucks into sustainable textile fibres.

## Procedure

The biggest challenge in the manufacture of the sustainable **textile fibres** was neutralising the coffee aroma. The coffee grounds are crushed into microscopic pieces and mixed with polyester fibres. Hugo Boss, Nike and Vaude use these fibres to make sport and leisurewear.

# Tennis racket



**Sector:**  
Sports

**Producer:**  
Decathlon |  
Lineo



Sources: windu/fotolia.com (left), Elke Wetzig (elya)/wikimedia (right)

## Raw material

Tennis players seek out rackets that maximise performance and lower the risk of injuries. French firms Lineo and Decathlon have developed a racket made of a plant-based material: **flax fibres**. Within the rackets, the flax fibres make up an important structural component of a hybrid material.

## Procedure

The flax and an epoxy resin are combined to give rise to a bio-based **composite**. The flax fibres are incorporated into the frame as drape-formed plies of flax/epoxy and carbon/epoxy prepregs. Thanks to the vibration-damping properties of flax fibre, the risk of tennis elbow is reduced.

# Toothpaste



**Sector:**  
Cosmetics  
industry

**Producers:**  
BASF | Neva  
Cosmetics



Sources: Jezper/fotolia.com (left), BASF SE (right)

## Raw material

Bacteria are among the pathogens that damage tooth enamel and cause caries. Probiotic toothpaste sends targeted **lactic acid bacteria** to fight the pathogens. They attach themselves to the pathogens and clump together with them so that they can be easily removed.

## Procedure

Before the bacteria can be used as an additive in toothpaste, German chemical company BASF cultivates the microbes on a large scale in **bioreactors** according to the high standards of the food industry. The resulting toothpaste is marketed by Neva Cosmetics in Croatia.

# Trainers



**Sector:**  
Consumer goods

**Producer:**  
Puma



Sources: rutchapon/fotolia.com (left), Puma (right)

## Raw material

During food production **rice husks** are discarded as waste. For its eco-friendly trainers, German sportswear company Puma replaces a portion of the rubber content of the outsole with a rice husk filler. Therefore less petroleum-based rubber is used.

## Procedure

The remake of Puma's classic sneaker "Suede" was designed as an eco-product based mainly on **recycling** and reduces CO<sub>2</sub> emission by 80%. The outsole is not the only part made from waste. The synthetic upper material is also comprised of recycled materials.

# Wall plugs



Sources: fabianosodi/fotolia.com (left), digitalstock/fotolia.com (right)

**Sector:**  
Construction

**Producers:**  
Fischer |  
Dupont

## Raw material

Wall plugs are made from extra strong plastics such as nylon – a classic product of petrochemistry. German construction company Fischer relies on a polymer that is made from **castor oil**. It comes from the inedible seeds of the castor oil plant.

## Procedure

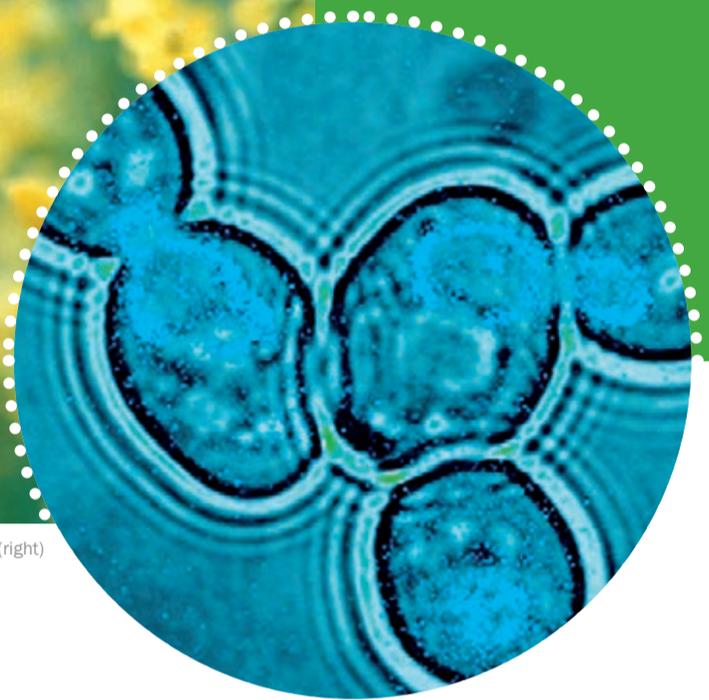
US chemical company Dupont extracts a chemical synthetic building block from castor oil from which they produce a plastic called **polyamide**. The polymer is 58% biobased. The biobased wall plug is just as strong as a wall plug made from nylon.

# Washing-up liquid



Sector:  
Consumer  
goods

Producer:  
Ecover



Sources: BLE Bonn Thomas Stephan (left), M. Peter/ETH Zürich (right)

## Raw material

The active components in washing-up liquids and household cleaners are called surfactants and tensides. Conventionally, they are produced on the basis of oil chemistry. The tensides that Belgian company Ecover produces are based on plant-derived ingredients such as **rapeseed oil**.

## Procedure

In a biobased process, the **yeast** *Candida bombicula* plays a key role as a living mini-factory. The fungus was once isolated from bumblebees. In combination with glucose, it produces the desired biosurfactants from renewable raw materials.