TOP DUTCH

A good place to be great

THE PROTEIN TRANSITION

The crops feeding a food revolution

Globally changing consumption patterns are driving a revolution - the protein transition. More and more food is produced based on the demand for plant-based proteins. The TopDutch region is at the forefront, as we extract valuable proteins from potatoes, peas, beans, vegetables, seeds and other crops. Our AgriFood industry supplies these plant-based proteins in large quantities to accelerate the protein transition. Today, we're looking at three protein-rich typical TopDutch crops.

HOW THE TOPDUTCH REGION IS ACCELERATING THE PROTEIN TRANSITION

Protein: the new food frontier

The world is looking for new sources of food. Proteins are the new frontier in food production, as a growing part of our daily diet is based on plant-based proteins. This is not surprising, because red meat is often seen as a source of health problems in the Western world, and at the same time it is evident that the quantities of meat that are produced for consumption demand too much from our soil and our natural resources. Yet, people do need their daily protein. Increasingly they come from plant-based sources, such as vegetables, fruit, nuts and leaves. Plant-based proteins are healthier, and for a growing number of consumers they are easier to digest than animal proteins. Achieving the European climate targets will require a shift from animal to plant-based consumption. This realization has sparked a veritable protein transition. In 2018, Grand View Research estimated the size of the global protein-ingredients market at USD29.42 billion (€24.93 billion). The market has an annual growth rate of 7.5%.

Many AgriFood companies are working hard on developing meat substitutes, which are often based on beans, such as soy. Even so, the new frontier is where proteins are extracted from crops that have been used for other purposes for decades, if not centuries. Or even from crops that were previously not fit for consumption. In the Netherlands, for example, the focus is on the circular processing of waste flows that are created by cultivating crops. The TopDutch region has three staple crops that are at the heart of pioneering work carried out by researchers and scientists, together with farmers, start-ups and established companies. Proteins, fiber, carbohydrate, oil, lignin and micronutrients from crops and leaves are used for new purposes. Traditionally, the rich coastal soil of the TopDutch region has been used to cultivate plenty of potatoes and sugar beets. The grass-lands, made famous by the Dutch Masters, also offer opportunities in the new circular economy. You can read more about those opportunities in this article.

1.

THE POTATO: FROM STAMPPOT TO SPORTS BARS

Large quantities of potatoes are cultivated and processed in the TopDutch region. Seed potatoes, processing potatoes and starch potatoes in particular are cultivated in the **clay-rich soil** on the northern coast and in the peat areas east of the city of Groningen. The region is perhaps even more famous for the enthusiasm with which the tuber was studied as a research object. In the 19th century, the potato growers Geert Veenhuizen and Kornelis Lieuwes de Vries developed dozens of new varieties that found favor in the Netherlands. Local cuisine is famous for its one-pot dish - 'stamppot' - **a mashed-potato based dinner** usually served with kale and sausage.

Naturally, the TopDutch region has a great number of potato-processing companies. Avebe, global market leader in the production of potato starch and protein, is the best known. A century ago, the company was incorporated as the *Coöperatief Aardappelmeel Verkoop Bureau* or the 'Potato Flour Sales Bureau' in English. Avebe is still a cooperative with more than 2,200 potato growers who are members and owners.

The potato is a versatile crop. The crop's tuber has traditionally been harvested for its starch content. In recent years, a growing group of scientists and businesses has been studying the crop for additional applications in food and non-food products. Besides starch, the focus is largely on the proteins in the tuber. At Avebe, Gerard ten Bolscher is responsible for Research & Development and Innovations as member of the Executive Board. He sees more and more opportunities for new applications of the crop.

Applied knowledge community

A potato consists of three quarters of juice, and one fifth of starch. The secret to the future will be in the other ingredients. This margin is the frontier for the company that is managing to isolate more and more raw materials. The potato continues to be a permanent object of study - a large part of the research into the potato takes place at Campus Groningen where The University of Groningen (RUG, a top 100 university) and the Hanze University of Applied Sciences are located. Gerard Ten Bolscher commented 'It's where we can connect with start-ups, businesses, scientific partners, professors and the student community. This is where applied knowledge is concentrated.' In the Avebe Innovation Center, Avebe carries out biochemical research and experiments with various applications for ingredients from the starch potato. For example, the use of plant-based potato protein as a substitute for animal protein in food. In cooperation with the scientists and start-ups in the campus, Gerard Ten Bolscher expects to develop new applications and derivatives.

Starch derived from a potato

Opportunity in each component

Gerard Ten Bolscher stressed that this thorough approach means that Avebe barely produces waste flows. 'These days, every component of the potato has its own application.' For example, the fiber from the peel now serves as feed. Potato juice and its foam are no longer discharged to surface water. These days, protein is extracted from the juice, and the proteins are coagulated by heating the juice. Coagulated protein no longer dissolves in liquid, is beautifully white, and is used as a nutrient in meat substitutes, sports bars, and milk.

The most promising innovation is in coagulated potato protein.
The product marketed by Avebe, known as Solanic, looks like a boiled egg. It is firm in structure, does not dissolve in liquid, and is full of nutritional value. With that product, potatoes play an important role in the protein revolution. Gerard Ten Bolscher commented 'Coagulated protein is used in meat and dairy substitutes.'

The latter ensures a rising value of potatoes in the food chain - potatoes are used more often as high-grade energy-rich human food and less often as feed. Although the share of coagulated protein in a potato amounts to just 2%, the applications are disproportionately lucrative for the manufacturer.

Avebe also sees opportunities in the unboiled, so-called native proteins (next page). Gerard Ten Bolscher refers to applications in raw products as 'ready-to-heat'. 'Potato protein is anti-allergenic, which is a unique property. The protein also has an amino-acid composition that is comparable to that of milk protein.' Potato proteins make the crop suitable as a source for healthy and sustainable food. Gerard Ten Bolscher's investment decisions in Avebe are focused on the process used to isolate the proteins.
The TopDutch region is a breeding ground for innovative food producers who want to join in to move the crop's application ahead.

'These days, every component of the potato has its own application.'

Gerard Ten Bolscher, menber of Executive Board at Avebe

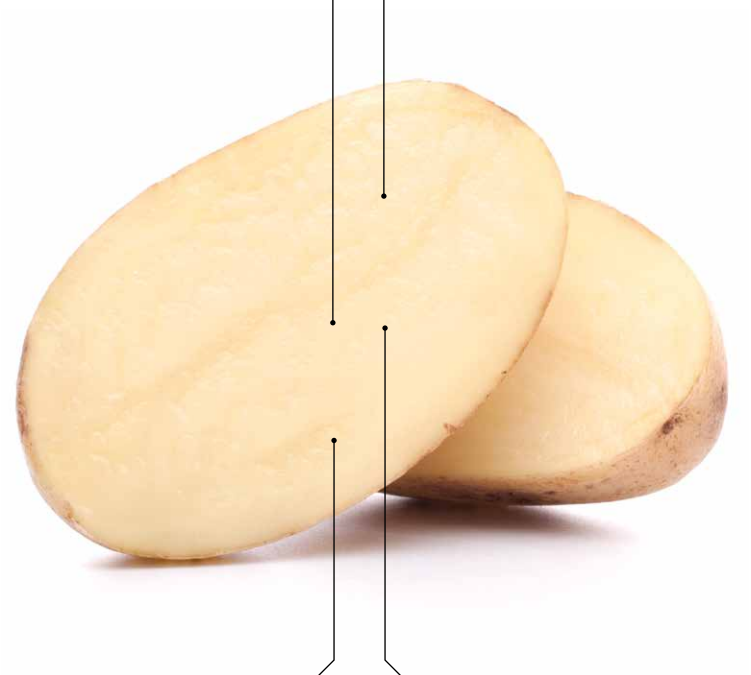
About the potato

75%

Water

20%

Starch for food and non-food texturizing qualities (food thickeners, paper, glue, textiles, construction materials)



1.6%

Protein
- Native protein: Best anti-allergenic texturizing protein
- Coagulated protein: Best plant-based protein for nutrition

3.4%

Other
(fibers, amino acids, organic acids, minerals, lipids, peptides)

The make-up of a potato

The crop

A potato consists of 75% water, and some 20 percent of the tuber is starch. Just 1.5 to 2% of the potato is protein. Starch has been the main component of the processing process for years, but these days the focus is more on the proteins that are characteristic to potatoes and the combination of both ingredients.

The production

In the Netherlands, 8 million metric tons of potatoes are harvested each year, and half of that is destined for consumption. Approximately 30% is starch potatoes, the remaining 20% are seed potatoes. The Netherlands exports more than 1 million metric tons of potatoes abroad, and around 2.5 million metric tons of potatoes end up in the potato-processing industry.

The process

Potatoes are washed after delivery, when stones and leaves are removed. Then the potatoes are grated to a pulp, and starch and fibers are separated from the potato juice. Starch is isolated, washed again and then dried. This so-called native starch can be marketed for use in food and non-food. Native starch can also be given a different treatment, known as derivatization. Derivatized starch is also used in food and non-food.

The end products

Native starch can be used in food as a thickening agent, for example. Non-food applications range from wallpaper glue, construction applications, paper and textiles. Derivatized starch is used to make snacks crunchy or to make low-fat milk taste creamy. Avebe focused a research program on meat substitutes as a mega trend in the food market. 'We see a growing group of flexitarians, people who choose to eat fewer animal products. Our potato ingredients respond to this trend and are used in 100% plant-based hamburgers, cheese and yogurt, gluten-free bread and sweets without gelatin,' explained Gerard Ten Bolscher.

2.

THE SUGAR BEET
SUGAR, SYRUP AND ALL THINGS SUSTAINABLE

Sugar beets also fare well in clay soil and peaty areas. Sugar beets have been cultivated in the **rich soil of the TopDutch region** since the end of the 19th century. They are then processed into refined sugar, and that is still done in the Northern Netherlands beet sugar factory near Groningen. **This factory - the largest in Europe** - makes the product that used to be the only product from sugar beets - granulated sugar.

These days, sugar-beet fields can still be seen throughout the TopDutch region. However, granulated sugar is no longer the only product made from the beets. Innovation has made sugar beets suitable for a whole range of different product lines, said Bram Fetter, Operations Director of Suiker Unie, a subsidiary of the AgriFood group Royal Cosun. Suiker Unie is in the top five of European beet-sugar producers. Up until 2017, Mr. Fetter was responsible for the production facility in Vierverlaten, near the city of Groningen.

A field of sugar beet

Developing sustainable production

Sugar beet is still a common crop in the TopDutch region, and its acreage has actually increased since 2015. In 2018, the Netherlands entered the top five producers, measured in hectares of agricultural land, following France, Germany and the UK. The background of this increase was the abolition of European quota on sugar-beet production in 2017. Bram Fetter says that Suiker Unie increased the capacity of its Dutch factories by 20% in that same year. 'These days the production of sugar is a free market, a global market even.' For Suiker Unie, Europe is still the most important sales market, but the world beckons, particularly now sugar beets increasingly produce other products.'

The production process is acquiring a more bio-based form, explained Bram Fetter. 'When sugar beets arrive in the factory they are washed and sliced into thin chips. Warm water opens the cell wall of the chips and the sugar ends up in the solution. The juice is pressed. The beet pulp that remains serves as a source of silage or feed and for the production of green gas. The fiber in the beet pulp is also used to make ingredients for the soap and paint industry.'

The beet juice is purified with lime, heated and evaporated. Bram Fetter continued 'That requires a lot of energy. So we invested heavily in an energy-efficient evaporation method, and that has halved the energy consumption. We crystallize the thickened juice and capture syrup after centrifugation.' This syrup then goes through the same process again, to ensure maximum sugar extraction. 'In the end, molasses remains, which is full of concentrated minerals and salts. That is used by the food industry and the fermentation industry, where it is used to produce yeast.
By modifying the process, Suiker Unie has saved more than 50% on energy since 1995.

No more waste

Bram Fetter emphasized that this leaves no residues, as everything is used. The pulp serves as feed, for the production of green gas, and the production of ingredients for the soap and paint industry. The lime fertilizer finds its way to agricultural fertilizers. The molasses is a source for other nutritional products. 'The soil that is delivered with the beets is taken to the land as raw material and it is used to raise dykes.' Then there is all the water. Sugar beets contain 75% water, which is released during the production process. Bram Fetter joked 'We're a water factory really. We purify the water and return it to surface water.'

Suiker Unie has its own innovation center, where it researches and develops new production flows from sugar beets. Bram Fetter explained 'Part of the pulp is converted into green gas with digesters. At the moment, we are generating some 30 million cubic meters of green gas; 20 million is

supplied to the gas grid and the rest we use ourselves. That is only a first step.' Bram Fetter strives for energy-neutral operations. Besides gas, the company also produces bio-ethanol, which is added to petrol in Germany. The company has pilot plants, where they try to convert the beet fiber in the pulp into a new product. Bram Fetter continued 'We are striving for a product that can replace fossil raw materials in washing-up liquid. Beet fibers have cleaning properties.' On a relatively small scale, the company already supplies an ingredient for dishwasher tablets to the market. Bram Fetter has high expectations for biodegradable plastics based on sugar-beet fibers.

For the latter, Bram Fetter is collaborating intensely with the chemical companies in the TopDutch region. 'The fun part of developing biobased production processes is that we can't do it on our own. We work together with large and small innovative chemical companies.' Chemport Europe has a keen sustainability ambition, which Bram Fetter believes to offer major opportunities for expanding cooperation. 'We would like to set up new production processes with companies that have the ambition to produce biobased products.'

Making sugar healthy?

Then there is the forgotten part of the sugar beet plant - the leaf. Beet leaf consists of 20% protein, and it is a new frontier in studying new applications for this crop. In October 2019, Suiker Unie opened a pilot plant to isolate the protein in beet leaf. Bram Fetter says 'We are studying whether beet-leaf protein can substitute meat-based protein in food. You could replace chicken protein in all manner of products and even imitate meat with beet-leaf protein.' Bram Fetter continued 'The fact is that sugar beets will be used for more sustainable and healthier aims than just sugar.'

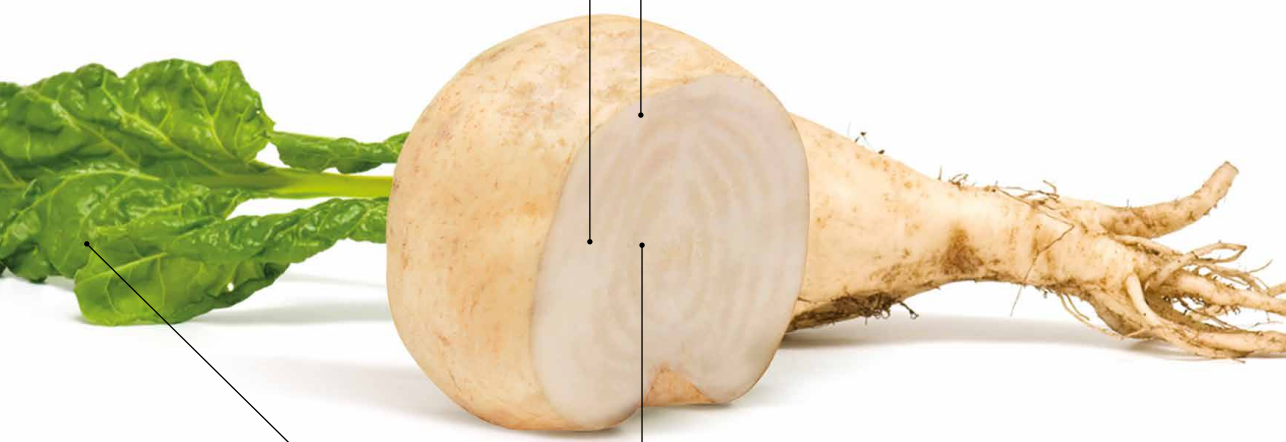
About the sugar beet

75%

Water

15-20%

Sugar for nutrition, bioplastics & bio-ethanol and molasses for feed & yeast production



20%

Beet leaf
protein for nutrition – of soy quality

5%

Pulp
for feed & biogas

The make-up of a potato

The crop

Sugar beets contain 75% water. In the Low Countries, the sugar content of the beet is relatively high at between 15 and 20%. The rest of the beet consists of fibers, roots and pulp. The sugar content can vary and depends on growing conditions, soil quality and the climate.

The production

In the Netherlands, between 5 and 8 million metric tons of sugar beets are harvested each year. Dutch sugar beets are relatively rich in sugar. The 2019 season is expected to yield approximately 14 metric tons of sugar per hectare. Since 2015, Dutch sugar-beet acreage has been rising significantly and these days the Netherlands is in the top 5 in Europe.

The process

On arrival, the beets are cleaned with powerful water jets and clay and stones are removed. Then the relatively hard tubers are cut into thin chips. They are heated in water to beet juice. The remaining pulp serves as the basis for feed and green gas. Lime is added to beet juice to bind the substances from the beet. This raw juice is boiled and evaporated to thick juice. The sugar is crystallized from the thick juice in large pans. In centrifuges, the white granulated sugar is separated from the brown syrup. The granulated sugar is then dried, cooled, and packaged.

The end products

Thick juice can be processed into sugar or as a raw materials for the biobased (fermentation) industry. The pulp and the beet tails are processed into feed, green gas and are used for biobased ingredients. The filtered lime is reused as betacal, and spread as fertilizer on the beet fields. The molasses is used as food for micro-organisms and yeast. Promising new end products include detergents, coatings, bioplastics and protein for human consumption.

3.

GRASS: NO LONGER JUST FOR COWS?

Three of Europe's largest rivers – the Meuse, the Rhine and the Scheldt – flow into the North Sea in the Netherlands. There is water in abundance in the Low Countries, and grass grows well in the wet polders under clear-blue Dutch skies in a moderate maritime climate. The landscape and the **fertile soil** have produced a good life for centuries, and famine has been a rarity in the Low Countries. The characteristic landscape is reflected in the paintings of Johannes Vermeer, and it is still the most vivid image for today's visitors.

You can see this landscape in the TopDutch region. In Friesland skies are blue and grass is green. Although grass has never been edible for humans, Dutch people found a use for it - Frisian pedigree cows have been reared for centuries and they turn it into milk. Amongst the many different species of birds, you will find cows on this grazing land. According to Kees de Koning, associated with Wageningen University

& Research (WUR) as Manager of the Dairy Campus in Leeuwarden, the Dutch grasslands are part of a local cycle. ‘Cows graze the grass and their manure feeds the soil.’ In this cycle, one hectare of grass or maize is sufficient food for two cows. In the summer cows graze pasture, in the winter they are given a full indoor feed with wilted hay silage and silage maize.

With international soy flows from the Americas and Asia as feed for cows, the use of fertilizer and manure as soil enhancer, Kees De Koning believes that global mineral flows are out of balance. He argued that there is now a new circular movement, where food, milk and manure are produced, distributed, consumed and applied locally again. That saves on transport costs, on CO_2 emissions and on the emissions of harmful substances, and it produces a world that is more in balance with its environment. 'The circular agriculture of the past is coming back,' predicted Kees De Koning.

This requires new technologies and new biobased innovations. With sensor technology on drones and tractors, it is possible to apply precision agriculture. It makes it possible to be specified in applying fertilizer to grasslands. The combination of soil and grassland is a new research area that is attracting a lot of attention. Kees De Koning commented 'Part of this is about the botanical composition of grassland. The dominant grass variety in the Netherlands is English rye grass, but is it the best composition for cows in a cycle system? With herb mixtures and concentrated-feed substitutes, it is possible to produce a more biobased concentrated feed.'

The new circular agriculture offers new opportunities for using grass, as grass contains raw materials for various applications. Wageningen University & Research ran a project for refining grass. Kees De Koning explained that 'With biorefinery it is possible to isolate the amino acids from grass, and that is a good basis for concentrated feed. The raw cell material that remains can be used to make packaging material.' Refining releases more nutrients for animals that they cannot or can only barely digest with their own digestive system. It means the same size herd can be fed with less protein.

Dutch companies, such as Grassa and HarvestaGG, are filtering the proteins from grass and processing this into specific feed for dairy cows. It means cows receive the useful proteins they need for milk production, without the harmful ones. Wageningen University & Research (WUR) is training students to refine grass. It's not just applications for grass for animals that are on the agenda. The protein rubisco from grass is even used in human food.

Pasture cycles for improved quality

Cattle farmers and arable farmers in the TopDutch region are working together on longer grass cultivation on pasture. With a four-year cycle for pasture, consisting of two years of grass cultivation, one year of potato cultivation and one year of sugar beets, followed by grass, grass is fertilized more intensively. The other crops need less fertilizer. Furthermore, the burden of disease on sugar beets and potatoes reduces with one harvest every four year. The grass yield of the field increases by 10 to 20%, ensuring a better soil quality and better root systems for the grass.

About grass

80-90%

Water

10-20%

Dry matter

- 20% protein (and amino acids) for feed & nutrition
- 80% other (fibers, sugars, minerals, organic acid, fats) for silage & packing materials

The make-up of grass

The crop

Grass consists of 80 to 90% water. The remaining 10 to 20% of solids are largely fibers, proteins, amino acids, sugars and minerals. The protein percentage in grass differs throughout the season - spring grass contains more protein and a higher energy value for grazers than summer grass.

The production

The Netherlands has more than 900,000 hectares of grass land. The larger part of that acreage is temporary grassland that is used to cultivate other crops at the end of the season. In the Frisian part of the TopDutch region there is relatively more permanent grassland, which is grazed by cattle.

The process

In biorefinery, grass is pulped first at a temperature of 40 to 50 degrees Celsius. The grass-fiber mass is pressed, releasing the protein-rich juice. The fiber remnants are turned into silage. Although the fiber contains less protein, cows find it easier to digest the fiber from the compressed cake and obtain more nutrients from them. The juice is heated, producing a protein concentrate. During this process, amino acids, sugars and phosphates are separated.

The end products

Grass serves as the raw material for proteins for human and animal consumption. The fibers can be used to produce silage. The cellular matter serves for the production of biobased paper and cardboard. Minerals and phosphates are also extracted from grass.

Potato proteins have anti-allergenic properties, beet leaf has opportunities as an ingredient for meat substitutes. Grass proteins enable cows to produce more milk, but in the future humans may consume more food based on grass protein. In the TopDutch region we are able to extract valuable proteins from potatoes, peas, beans, vegetables, seeds and other crops. Although today most proteins consumed are still animal-based, from protein-rich dairy and meat, we see a strong shift in demand for plant-based proteins in the industry and consumer market. Our AgriFood industry supplies these plant-based proteins in large quantities to accelerate the protein transition.

JOIN TOPDUTCH

Want to find out more about what makes the TopDutch region a good place to be great, or view the digital edition? Head over to our website www.topdutch.com

Are you interested in exploring what your business possibilities could be? Connect with Joep de Vries, our AgriFood expert.

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