

I N T E R N A T I O N A L

# DAIRY

January/February 2023

SPECIAL "PLANT BASED ALTERNATIVES"



magazine

PROCESSING | INGREDIENTS | PACKAGING | IT | LOGISTICS

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## Delight plant lovers with dairy- free cream cheese

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**CHR HANSEN**

*Improving food & health*

# 4 CHOICE

## THE PLANT-BASED ALTERNATIVE SOLUTION

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## NATURAL, TASTY, HEALTHY AND SUSTAINABLE



# Health is becoming increasingly important

Dairy alternatives have a lot to offer here



Sales of dairy products positioned for gut health, digestion and immune enhancement have increased significantly. According to the new "Euromonitor International's Voice of the Consumer: Health and Nutrition Survey (2022)", 63% of consumers worldwide believe that a strong immune system is particularly important for their health.

But claims such as high protein, organic and no added sugar are also on the rise as consumers increasingly view food as a form of "medicine". In general, health claims have become increasingly important to consumers worldwide. 43% of respondents to Euromonitor International's Lifestyles Survey (2022) pay close attention to nutritional information and labelling and emphasise the importance of clear labels and messages.

This health reference does not only apply to dairy products, but should be considered and used even more for dairy alternatives. Many of these products still run much more under the sign of sustainability than under health claims. Of course, in view of the hurdles for health-related advertising, most of these cannot be real health claims in the sense of the law, but weakened statements should be quite possible for the vast majority of products. Manufacturers should thus be able to justify the extra price compared to original milk products, at least to a certain extent.

This special issue brings you, dear readers, again a number of backgrounds and "secrets" of the production of dairy alternatives. We wish you an interesting and rewarding read.

Roland Sossna, Editor

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## Imprint

**Publisher:** B&L MedienGesellschaft mbH & Co. KG Hilden, Verlagsniederlassung Bad Breisig, Zehnerstr. 22 b, 53498 Bad Breisig/Germany, Fax: +49(0)26 33/45 40 99, Internet: [www.international-dairy.com](http://www.international-dairy.com)

**Managing Director:** Harry Lietzenmayer, Stephan Toth, Björn Hansen

**Object Manager:** Burkhard Endemann, Direct line: +49(0)26 33/45 40-16, Email: [be@blmedien.de](mailto:be@blmedien.de)

**Editor:** Roland Sossna (responsible), Office Dülmen/Germany, Direct line: +49(0)25 90/94 37 20, Cell phone: +49(0)170/418 59 54, Email: [sossna@blmedien.de](mailto:sossna@blmedien.de)

Anja Hoffrichter, Office Dorsten/Germany, Cell phone: +49(0)178/233 00 47, Email: [ah@blmedien.de](mailto:ah@blmedien.de)

**Graphics, layout and production:** Silvia Schneider, Office Solingen/Germany, Cell phone: +49(0)170/297 58 64, Email: [s.schneider@blmedien.de](mailto:s.schneider@blmedien.de)

**Advertising Manager:** Heike Turowski, Office Marl/Germany, Direct line: +49(0)23 65/38 97 46, Fax: +49(0)23 65/38 97 47, Cell phone +49(0)1 51/22 64 62 59, Email: [ht@blmedien.de](mailto:ht@blmedien.de)

**Publisher's International representative:** dc media services, David Cox, 21 Goodwin Road, Rochester, Kent ME3 8HR, UK, Phone: +44 845 393 1574, Email: [david@dcmediaservices.co.uk](mailto:david@dcmediaservices.co.uk)

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## MycoTechnology Expansion into Europe

The European Commission has granted Novel Food status to FermentIQ MLL and PTP, two of MycoTechnology’s innovative and highly functional natural plant protein ingredients. FermentIQ ingredients are produced using a patented mycelial fermentation platform that improves the sensory, functional, and nutritional attributes of plant protein. The authorisation follows a positive opinion issued earlier this year by the European Food Safety Authority (EFSA), which said it considered FermentIQ pea and rice protein fermented by shiitake mushroom mycelia to be safe for use in a wide range of food and beverage categories.

With Novel Food authorisation secured, US-based MycoTechnology is set to accelerate its expansion

into Europe, the company’s next major growth frontier. It has hired its first European sales representatives, based in Germany and the Netherlands.



Advertising \_\_\_\_\_

## Versatile filling machines for milk substitutes



Milk substitutes can be filled in cups or buckets in a very flexible way on GRUNWALD filling machines. GRUNWALD’s machines either basic or high-end filling lines are ideally suited to accurately fill your products to create a perfectly presented product in a cup or bucket.



# Completely plant-based and bursting with taste

The secret to successful plant-based dairy alternatives with appealing sensory characteristics



*The main reasons for choosing not to buy plant-based products are the higher price and the taste (photo: Doehler)*

**D**airy products are so popular thanks to their fresh, slightly creamy sensory profile. Until now, few plant-based products have been able to meet consumers' demands in the same way. The global market for plant-based dairy alternatives continues to grow – by 24% over the last five years – particularly in the sector of plant-based drinks and yoghurt alternatives, but also in plant-based ice cream and cheese alternatives<sup>1</sup>. This increasingly dynamic market is a good indication of changed consumption and nutritional behaviour amongst the population.

All over the world, the same considerations are motivating people to buy more plant-based products: growing awareness of environmental and sustainability concerns, animal welfare, and the overriding desire for healthier and more balanced nutrition. The growing number of food intolerances and specific dietary requirements also plays a role in the switch to plant-based nutrition, while the use of natural ingredients is also a decisive factor.

However, particularly when it comes to taste, many plant-based products are yet to fully win over consumers. They often lack a complexity when it comes to taste, as well as the fresh sensory profile that classic dairy products provide.

<sup>1</sup> Source: Euromonitor, Retail Value, global 2017-2021

Doehler is resolving this by offering a portfolio of newly developed ingredients that improve the sensory properties of plant-based products in the most natural way. Based on a targeted fermentation process, Doehler creates natural ingredients and taste profiles that can be added to plant-based recipes for masking certain off-tastes in plant bases, and also to replicate the sensory characteristics of conventional dairy products. As such, they can be used to imbue even plant-based products with the classic fresh taste of milk, or a creamy mouthfeel.

### Consumer requirements for plant-based products

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According to a consumer study conducted by Doehler Sensory & Consumer Science with a total of 1,000 participants from key markets such as Germany, France, Spain and the United Kingdom, the main reasons for choosing not to buy plant-based products are the higher price and the taste. The texture of plant-based products on the market is also frequently criticised. Both aspects are therefore major challenges for product development. Consumers expect plant-based dairy products to offer the same sensory properties as their animal equivalents – a fresh taste profile similar to that of milk, and a creamy mouthfeel.

In order to offer consumers a better taste sensation and increase acceptance of plant-based alternatives in the various target groups, the sensory profile of plant-based recipes therefore needs to be optimised.

### Natural solutions based on innovative technologies

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There are various options which can be considered to optimise the taste of plant-based products and develop solutions with attractive sensory profiles. The choice of the right plant-based raw material, its origin and quality, as well as the way it is processed are all crucial to the basic characteristics in the product recipe. Using (natural) flavours can help to boost the overall sensory impression further. Selected profiles can either cover unwanted off-notes or help change or boost certain sensory properties and parameters. Furthermore, combining and adding different flavour notes, such as vanilla or fruity profiles, can create a harmonious and well-rounded product experience. In this respect, Doehler offers a portfolio of natural Multi-Sense flavours which can be used in a targeted way to improve the taste profile (masking off-tastes, improving the sweet impression etc.), as well as numerous classic flavour profiles to create different top notes.

Another way to create plant-based products with impressive sensory properties is to use future-oriented

technologies, such as targeted fermentation processes. Selective, 100% natural and plant-based raw materials are used to create ingredients that offer enhanced taste complexity, while also masking and mitigating unwanted off-tastes. At the same time, their use makes it possible to create the fresh taste profile and creamy mouthfeel typical of milk – creating sensory properties that absolutely match those of traditional dairy products. Fermentation is therefore arguably the most natural way to create a rounded, harmonious profile. But that is not all: ingredients derived through fermentation processes also provide unique benefits when it comes to product declaration. As they can be claimed “fermented oat and/or rice extract”, they are catering to consumer demand for clean labelling. Their diverse range of uses in various applications, such as plant-based drinks, yoghurt and dessert alternatives, ice cream and plant-based cheese and spreads, also demonstrates the high functionality and applicability of fermented ingredients for the purpose of taste modulation.

Comprehensive expertise in plant-based ingredients, their use in various product applications and a wide-ranging understanding of the challenges in product development allow Doehler to use fermented ingredients to create efficient, bespoke solutions that optimise the sensory properties of plant-based products.

### Meeting application-specific challenges

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Given the large number of product applications and the complexity of the product recipes, flexible solutions are particularly vital for plant-based products. Ferments offer a unique way to replicate this complexity, as they are able to have a positive impact on all crucial sensory impressions such as taste, mouthfeel, acidity and top note – tailored to each application and its unique challenges.

When it comes to plant-based drinks – by far the largest segment on the plant-based market – the challenge is to create a balanced flavour profile similar to that of classic cow’s milk, while also providing a comparably creamy mouthfeel. At the same time, certain tastes of plant-based raw materials, such as bitter or hay-like notes, are not well-accepted among consumers. A balanced nutritional profile is also becoming increasingly important in order to reach the broadest possible target group. When it comes to taste and mouthfeel, the targeted use of fermented ingredients makes it possible to create the sensory properties that consumers want, while they also mask unpleasant off-tastes, thereby generating greater acceptance.

The second largest category, plant-based yoghurt alternatives, is subject to similarly high demands in terms



*There are various options which can be considered to optimise the taste of plant-based products and develop solutions with attractive sensory profiles (photo: Doehler)*

*One way to create plant-based products with impressive sensory properties is to use future-oriented technologies, such as targeted fermentation processes (photo: Doehler)*

of taste and mouthfeel – properties that can be improved significantly through the targeted use of fermented oat or rice extract. These ingredients can also be used as natural, stable acidifiers to adjust the pH value, without the customers needing to have their own fermentation systems or process steps.

The desire for 100% plant-based indulgence is also increasing in the ice cream market. Almost 8% of all global ice cream product launches globally are already plant-based versions and this figure is only set to rise.

Consumers place great emphasis on a delicious, creamy taste particularly when it comes to ice cream, with indulgence the top priority. Here, too, fermented ingredients help to create the taste characteristics of classic dairy ice cream, a creamy mouthfeel and a pleasant texture – for unique moments of indulgence.

Sales of plant-based cheese are expanding at a solid level, with growth of 12% per year expected until 2025. The key topics in plant-based cheese products are optimisation – rounding off the taste profile and masking of unwanted off-tastes – and typification of different cheese profiles. These profiles range from strong, mature taste varieties, to mild ones known from hard and soft cheese, to creamy profiles expected in spreadable cream cheese alternatives.

### **Integrated solutions for first-class plant-based product innovations**

Doehler offers an extensive, modern portfolio of natural plant-based ingredients developed for the whole variety of plant-based dairy products. The portfolio of in-



dividual or all-in-one solutions is based on plant-based raw materials such as various nuts, seeds and coconut, grains such as rice and oats, and additional plant-based protein sources, such as pea and chick pea. In addition, the portfolio includes an extensive range of ingredients such as natural colourings, ingredients that use citrus fibres to provide mouthfeel and texture, components for creating a rounded taste profile, as well as other natural flavour components, such as selected top notes, sweetening solutions, and flavours for masking unwanted taste nuances. The company also provides preparations for individual applications with savoury, sweet or fruity components, as well as cultures for use in fermented products.

As a global producer, marketer and provider of technology-driven natural ingredients, ingredient systems and integrated solutions, Doehler's primary focus is on the development of innovative products and concepts. In line with the company slogan, "We bring ideas to life.", Doehler develops custom complete solutions, processes and innovations for its customers around the world – from the field to the shelves.



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# VeganoProt

ALPMA Process Technology presents line for vegan protein diversity



**Author:**  
*Anita Rhein, Application and Project Manager Plant Based Food*



*ALPMA's Process Technology division combines activities in the field of plant-based proteins under the trade mark VeganoProt.*

**V**egan – plant-based, microbial, alternative ... is this the future of our nutrition?! Plant-based foods have long since ceased to be just a trend. This development is reflected in the increasing popularity of vegan cheese, yogurt and milk alternatives. Consumers are becoming more and more open to alternative products, which leads to a surge in innovation in plant-based foods.

In recent years, the number of new vegan cheeses introduced worldwide has increased significantly year-on-year. This growth is driven by countries such as Germany, the United States and Canada, where the largest food manufacturers are launching plant-based variants alongside their well-known brands.

ALPMA's Process Technology division has been planning, designing and supplying customized process lines for the classic food and dairy industry for decades, and has been transferring this know-how to the plant-based sector for years. These activities are combined together under the brand name VeganoProt.

## Protein fractionation is our strength.

ALPMA Process Technology develops customized plants for the production of plant- or microbial-based products together with the customers. Many years of know-how in the extraction and concentration of natural proteins is available for process development.

Depending on the application, the following technologies are combined:

- » Microfiltration (MF)
- » Ultrafiltration (UF)
- » Nanofiltration (NF)
- » Reverse osmosis (RO)
- » Continuous / batch processes
- » Semi-automatic / fully automatic processes
- » Organic / inorganic membrane systems

The function of fermentation is to produce alternative proteins by cultivating microbial organisms. Depending on the desired product, fermentation is divided into



two processes, biomass fermentation and precision fermentation. In biomass fermentation, the microorganisms (e.g. fungi or algae) that proliferate are themselves the main component of the alternative protein. These microbes are able to multiply rapidly, thus increasing the amount of biomass available in a short period of time. In precision fermentation, individual proteins, e.g. casein and whey proteins, are specifically produced by the microorganisms. The result is an identical copy of the natural protein.

Starch plants are broken down into their individual components – proteins, fibres and starch – by combining different processes. These can then be marketed individually. The dry format, in the form of isolates or concentrates, is particularly common because it offers the manufacturer the following advantages:

- » Long shelf life
- » Small storage space
- » Diverse field of application

Proteins from oil plants, such as lupins, sunflower or soy, offer a variety of ways to meet the increased demand for plant-based substitutes. In the extraction of high-quality oils, the press cake remains as a residue.

***In the future, the ALPMA process lines for microbially produced protein extraction by means of fermentation, as well as processing lines for the manufacture of vegan products from plant-based raw materials, will be combined under the brand name VeganoProt.***

However, this still contains high-quality protein, such as soy protein or lupine protein, which can be extracted from the press cake in a multi-stage process.

ALPMA Process Technology provides multifunctional pilot plants for membrane filtration or microparticulation using CreamoProt pilot plants. These tests can also be carried out with the supervision of an application engineer.

Advertising



**3rd International Conference**

**Plant & Cell-based Alternatives to Milk**

**Current Developments in Israel**

▶ **Virtual format, April 19, 2023**

# Putting plant-based cheese to the test

**M**ore people than ever are buying and trying plant-based cheese. In fact, the cheese alternative segment is expected to reach around \$1.16bn by 2027<sup>1</sup> and there's a good reason why consumers continue to choose these products rather than just substituting different plant-based foods.

Quite simply, people remain in love with the distinctive and authentic taste, smell – and appearance – of dairy cheese. Unsurprisingly, they therefore want (and indeed expect) these qualities to be mimicked in their plant-based cheese alternatives. But very often, they are disappointed. In fact, 52% of consumers are seeking better taste in their alternative options<sup>2</sup>.

This is challenge that DSM Food & Beverage is now tackling (and solving) with an entire portfolio of solutions for plant-based cheese alternatives. Having served the dairy cheese market for more than 150 years now, our people have learned much about how to create the sensory qualities that delight cheese-lovers. Now, this expertise has been broadened to include mastering the art of recreating these complex flavors in plant-based cheese – step-by-step via the same tried-and-tested process that we already use for dairy cheese.

The results have been exciting. So much so, that last December the DSM team decided to make a plant-based splash at the FiE show in Paris by drawing upon our solutions portfolio to create four unique and delicious alternatives cheese concepts to share with visitors. These samples didn't last very long and were very soon eaten. But we can certainly share the ideas behind them ...

*More people than ever are buying and trying plant-based cheese (photos: DSM & Shutterstock)*



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## Cream cheese without the dairy

With cream cheese now representing the third largest offering in the alternative cheese segment<sup>3</sup>, we used the DSM portfolio of authentically creamy, tangy, and milky dairy-type flavors to develop our own prototype version. Indulgent and delicious – without the dairy.

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## Plant-based parmesan that packs a punch

Recreating the classical sweet and bouillon notes and piquant, mature taste of shredded Parmesan cheese for plant-based consumers isn't an easy job. But our portfolio of flavors helped achieve this - with great texture (via our Vertis™ CanolaPRO® plant-based protein); and added nutrition delivered by our tailored premixes.

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## Alternative young Gouda

To mimic the unmistakable taste and texture of young Gouda cheese, DSM flavors were used to create authentic dairy-type taste with a mild, clean and slightly acid profile. This was then complemented by natural gellan gum for smooth and easily sliceable texture –



plus our nature-identical colorants for an appetizing appearance. Finally, nutrition was added with a customized premix.

### Matured Golden Gouda minus the cheese

To create the matured Gouda concept, a similar recipe was followed – except in this case, the DSM team fine-tuned the flavors in our portfolio to recreate the deliciously pungent, complex savory taste of matured Gouda cheese – and with an even deeper and more vivid natural Gouda color.

### Let's make these concepts a reality!

These concepts were created specifically for FiE. But if you're a manufacturer striving to meet the growing expectations of the plant-based generation ... why not allow DSM to do the same for you? If you would like to know more about our concepts – and the solutions and expertise behind them.

Better taste, texture and health in plant-based cheese alternatives is here. Enjoy it all.



- 1 *Euromonitor 2022*
- 2 *FMCG Gurus Meat & Plant-Based – Global Report 2022*
- 3 *Grandreviewsearch.com global vegan cheese market share by product, 2019.*

# Powering the plant-based phenomenon:

FrieslandCampina Ingredients uses 150 years of dairy innovation to drive innovation in plant-based alternatives

One person every 2.4 seconds – that’s how many people pledged to take part in the 10th annual world-famous Veganaury challenge in the first few days of January 2023, according to its organisers. It’s just one indication of the growing global interest in plant-based diets. Meanwhile, data from Mintel shows that packaged goods with a plant-based claim grew by nearly 700% from 2015-21, while new projections suggest the market is set to accelerate at a significant 12.2% between the years 2022-32.

To understand the drivers of the plant-based phenomenon and where the market is heading next, we sat down with Inge van Dalfsen, Market Segment Manager at FrieslandCampina Ingredients to talk all things plant-protein and find out about the company’s latest Plantaris™ concepts.

**What’s driving the plant-based market, and who are the main consumers? Is demand coming from vegans, or is it people reducing their animal product intake?**

**Inge:** The explosion in new plant-based product development is driven by the rise of the flexitarian diet. 42% of people consider themselves flexitarian, while only 4% of the population identify as vegan and 6% as vegetarian. That’s a significant portion of the population.

What’s interesting to me is flexitarianism is becoming a way of life. It’s not about eliminating the things you enjoy, like a frothy dairy coffee at your favourite cafe. Most consumers are reducing their intake because they think it’s healthier, but they also want to enjoy their diets. For lots of consumers, being flexitarian is about having a full and balanced diet that includes animal and plant-based products side by side.



**What product formats are emerging in the plant-based space right now and how is FrieslandCampina Ingredients tapping into these?**

**Inge:** Today’s consumers are health-conscious, so they’re looking for products fortified with nutrients, like protein, to give them added benefits. But they also know that a healthy diet is balanced, and that a tasty treat is good for the soul. For example, research by confectionary giant Mondelez says that 74% of people can’t imagine a world without chocolate!

So, consumers are increasingly swapping out treats like chocolate and snacks for ‘better-for-you’ alternatives that provide both a nutritional boost and healthy indulgence. The demand for protein bars and drinks is a great example of this. And plant protein, with its health halo, is ripe for innovation to meet this need.

To help brands tap into demand for these products, we recently launched two new concepts leveraging our Plantaris™ Pea Isolate 85 A and Plantaris™ Faba

Isolate 90 A ingredients – a tasty chocolate ready-to-drink (RTD) product and a high protein pudding. Plantaris™ has been specially designed to help manufacturers overcome common challenges in plant-based formulation including taste and texture. For brands, this means their 'better-for-you' formulations taste just as good as the real deal, satisfying consumer cravings while also delivering a dose of high-quality protein.

#### ***How do FrieslandCampina Ingredients' Plantaris™ ingredients help overcome formulation challenges?***

**Inge:** This is thanks to our highly specialised production process. One of the key challenges manufacturers face is removing the flavour off-notes present in a lot of plant proteins, which can be unappealing. This is especially important for healthy indulgence products, where taste is paramount. Our Plantaris™ range has been developed to ensure a neutral taste, so it can be used in a range of formulations. In fact, our research shows that products formulated with Plantaris™ perform better than other products for appearance and taste.

Both ingredients also benefit from enhanced powder handling, improved dispersibility, solubility and stability. This makes manufacturing high protein products

more straightforward. For example, optimal powder handling makes transportation and dosing easier. It also improves the product experience – faster dispersibility means improved functionality and texture in applications like shakes.

#### ***Finally, what's next for the plant protein space?***

**Inge:** The buzz around plant protein will continue to grow. Crucially, I think we'll see plant protein break out of its niche in active and healthy nutrition. There will be more mainstream food and drinks fortified with plant protein, which we're already starting to witness. But I also anticipate growing interest in plant protein supplements and even solutions targeting active ageing.

Essentially, in the next few years, the plant protein market will diversify and mature. This will then open up space for innovation with other technologies, such as precision fermentation. The result will be a truly varied and exciting market, including plant, dairy and other novel alternative proteins, that caters to a growing population with a more flexible approach to nutrition.

Discover more about Plantaris™ at [www.frieslandcampinaingredients.com/plantaris](http://www.frieslandcampinaingredients.com/plantaris)



# Improved process control through sugar analysis of oat drinks



**Author:**  
*David Stadler, Product Manager at DirectSens:  
OatSens results are available quickly*

Oat drinks are the most popular plant-based milk alternative in the EU and the No. 2 in the US. Sales figures of oat drinks are experiencing growth rates in the range of 20 – 30 % per year. Due to the increasing consumer demand, growth rates are expected to stay in this range. The sugar concentration and as a consequence sweetness are important quality features for this product category. Sugar concentration must be considered for nutrition labelling and provides important insights into the stability of the production process and the storage stability of the oat drink.

This rapid growth confronts oat drink producers with new challenges, for instance ramping up production capacities as quickly as possible. Especially when producing at several production sites, it is essential that manufacturers ensure the consistent quality and taste of their products. Rapid sugar analysis helps oat drink producers to master these challenges.

## How does the sugar content affect the sweetness of an oat drink?

During oat drink production, starch is predominantly hydrolyzed to the sugars glucose and maltose. These two sugars determine the sugar content and are responsible for the sweetness of the oat drink.

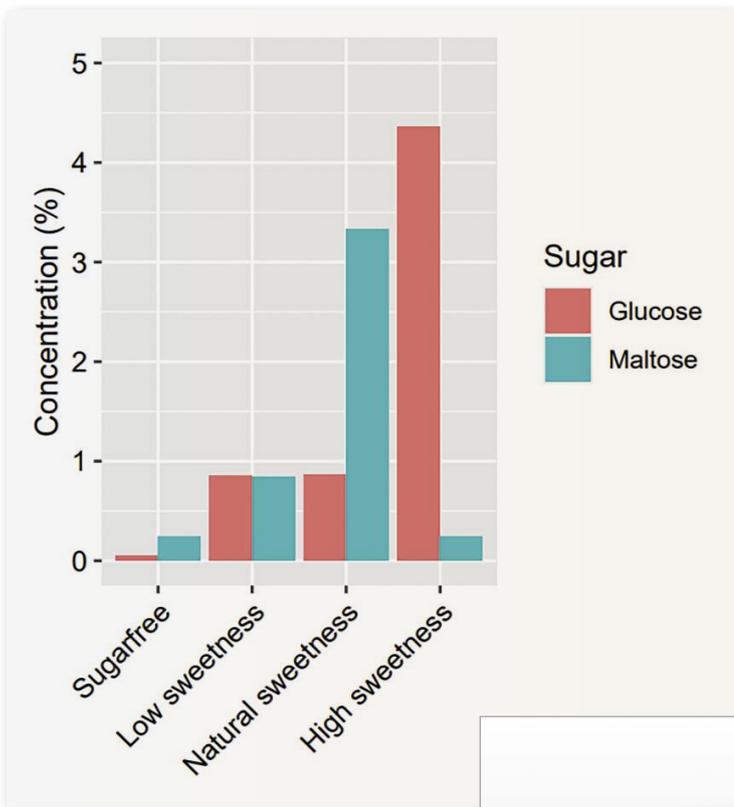
Glucose and maltose differ significantly in their sweetening power. Glucose is characterized by an intense sweetness (comparable to table sugar sucrose). Maltose has a mild, gentle sweetness comparable to milk sugar lactose.

Consumer preferences regarding the sweetness of an oat drink vary (Fig. 1). In Northern Europe, oat drinks with low sweetness (low glucose and little maltose) are preferred. In Central Europe drinks with a mild sweetness (mainly maltose) and in Southern Europe drinks with a high sweetness (mainly glucose) are preferred. There are also oat drink manufacturers that offer sugar-free oat drinks. For sugar-free products the sugar content (sum of the mono- and disaccharides) must be < 0.5%.

Oat drinks can be adapted to customers' taste preferences through changes in the manufacturing process. This can be done by selecting suitable enzymes and adjusting the process conditions.

## Sugar profile provides unique insights into the stability of the oat drink production

The aim of industrial oat drink production is to manufacture a product with consistent properties such as sugar content or sweetness. Fluctuations in the qual-



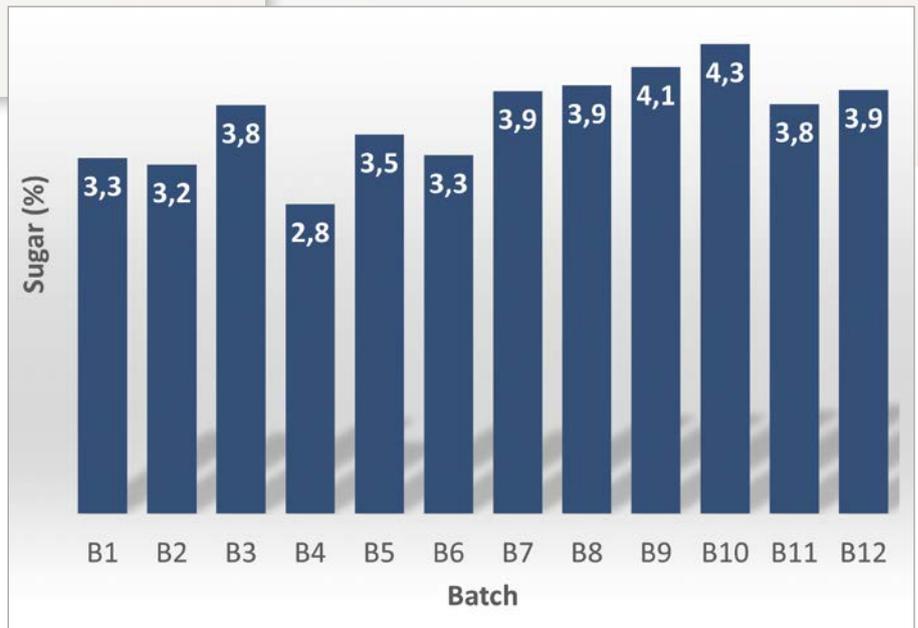
**Figure 1:**  
Sugar content of oat drinks with different sweetness profiles.

ity of the raw materials, the activity of the enzymes and the process conditions can lead to a deviation in the saccharification process. Since some companies do not perform sugar analysis, the repeatability of the process is often unknown. To estimate the fluctuations of the oat drink production, we analyzed the sugar content of 12 different batches of a commercially available oat drink (Fig. 2).

The analyzed batches had a sugar content of 2.8 – 4.3 %. Differences in taste can be perceived when sugars show a fluctuation of approx. 20%. With a sugar content of 3.0 %, a difference in taste is perceived at < 2.4 % or > 3.6 %. For some of the analyzed batches of the same product, a different taste is therefore perceptible.

### Sugar analysis as part of process control

Sugar analysis helps manufacturers to control and improve the quality and taste of their oat drink. The sugar content can be monitored in the following processing steps:



**Figure 2:**  
Sugar content of 12 different batches of a commercially available oat drink.

### Oat base production:

A sugar measurement as part of the in-process control reveals the ideal time for enzyme deactivation. Results that are available within a few minutes allow rapid intervention in case a batch gets too sweet. This type of process control leads to constant sugar concentrations.

### Batch release:

A sugar control during product release ensures that the produced batch meets the specifications. Fast results can reduce storage costs and free up production capacities.

### Methods for sugar analysis in oat drinks

In practice, the accurate quantification of sugars is a major challenge for manufacturers. A sugar measuring system that can be used in routine operation must meet the following requirements:

- » Fast measurement to make decisions within the short process time.
- » Simultaneous determination of glucose and maltose to obtain the most important parameters of saccharification at a glance.
- » Easy procedure, so that personnel without laboratory training can carry out the measurement and errors due to incorrect operation are avoided.

The current methods for determining sugar are inaccurate, complicated or take too long. This shows a clear need for a fast, accurate and easy method for measuring sugar in oat drinks.

### New test kit measures glucose and maltose at all stages of oat drink production

DirectSens develops test kits that are used for the detection of various carbohydrates. One example is LactoSens - a biosensor for detecting residual lactose in lactose-free dairy products. LactoSens has established itself as the industry-leading rapid test method for lactose.

The OatSens test is based on the technology of LactoSens. OatSens is a robust biosensor test kit that delivers reliable results within minutes. OatSens measures the content of glucose and maltose at all stages of oat drink production.

"OatSens is very easy to use," says David Stadler, Product Manager at DirectSens. "The results are available quickly. Process control and product release will take just a few minutes. OatSens enables a new type of process control for oat drink production."

David Stadler, Product Manager at DirectSens

## oatsens

*Intuitive biosensor to measure the sugar content of oat drinks*



DILUTE



CONNECT



SCAN



MEASURE



DECIDE



Easy test protocol



3-minute time to result



Optimized for oat drinks



Excellent accuracy

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How does Germany eat and what do people think about vegan alternative products as part of their diet? The manufacturer of cheese analogues Simply V investigated this question with a representative YouGov survey of 2078 people throughout Germany.

28% of respondents had vegan alternative products such as meat substitutes, vegan cheese alternatives or even plant-based milk alternatives in their fridge at the time of the survey in early December 2022. In the Baby Boomer (20%) and Gen X (29%) age groups, the proportions are proportionally lowest. Among Millennials (75%) and Gen Z (42%), more than a third in both generations have vegan alternative products in their fridge. Of the respondents



(photo: Simply V)

who have vegan alternative products at home, 32% are female and 25% male. 13% of all respondents would like to buy more vegan alternative products in 2023 than in 2022.

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# Plant-based alternatives to fermented milk products

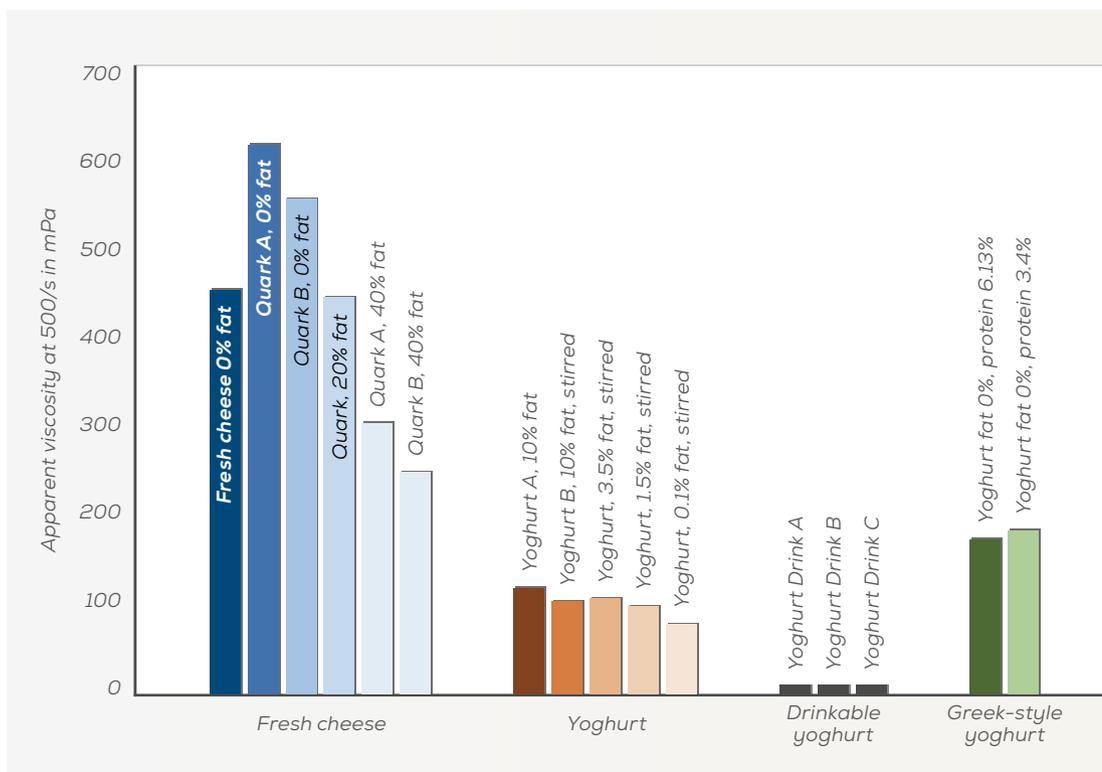
## Raw materials and texture

**Authors:** Anisa Heck and Jörg Hinrichs

University of Hohenheim, Institute of Food Science and Biotechnology, Stuttgart, Germany

The demand and sales of plant-based products as alternatives to fermented milk products, e.g. yoghurt, skyr and fresh cheese, have steadily increased in recent years. More consumers prefer a strict or at least partially plant-based diet. The plant-based raw materials result in products having very different compositions and structures, creating new challenges for processing.

More and more consumers are choosing plant-based foods. The reasons for this change are numerous, but include food intolerances, environmental sustainability, health and animal welfare considerations, as well as social trends. The number of plant-based alternatives to fermented milk products is continuing to increase, increasing the acceptance and adoption of these products.



**Fig 1:** Apparent viscosity at 10 °C of fresh cheeses, yoghurts, drinkable yoghurts and Greek-style yoghurts from the supermarket



(photo: Oleksandr Prokopenko/colourbox.de)

The first questions that arise when talking about plant-based alternatives to products such as yoghurt and fresh cheese are: What characteristics, i.e. texture, flavor and appearance, are important for a plant-based product to be considered a successful alternative product? How can these characteristics be designed, while using plant-based raw materials?

To create a successful alternative product, the ideal characteristics of the original product should first be defined, such as a “gold standard”. In Fig 1, it becomes obvious that the gold standard texture can differ widely. For example, the apparent viscosities of yoghurts are much lower than fresh cheeses, and there are a wide range of apparent viscosities for fresh cheeses, largely depending on the fat content.

The properties most important for consumer acceptance of fermented milk products are a creamy texture, with absence of (or low) syneresis, as well as free from large particles. A range of viscosities should be achievable, mimicking the textures of yoghurt, high-protein yoghurt and spoonable fresh cheeses. A distinction we would like to point out is the texture of spreadable fresh cheeses, e.g. “cream cheese”, which is not discussed in the current article. The typical “sweet/sour” flavor formed during the fermentation of milk products should be present, with no off-flavors or high intensities of aroma notes from the plant material, e.g. beany flavor. Fermented milk products are most often white

in color. That being said, the exact flavors and colors of alternative products may deviate from those of typical fermented milk products, and can still be appealing<sup>1</sup>. The composition and nutritional information should appeal to the consumer, and may not necessarily mimic those of fermented milk products. That being said, anti-nutritive factors should be reduced or, even better, eliminated.

With these characteristics defined, the main principle behind production of alternatives to fermented milk products is to match the desirable characteristics, such as thickness and creaminess<sup>2</sup>. This is achieved using a variety of different ingredients and processing techniques. Ideally, it would be advantageous to use similar processing operations to those used for fermented milk products; however, in practice this is difficult, because plant-based ingredients behave differently from bovine milk. In contrast to one main raw material (bovine milk), there are a number of raw material possibilities, requiring different processing steps to attain acceptable alternative products. In the following sections, we discuss the different raw materials and the types of structures that are formed.

## Raw materials

Raw materials used to produce alternatives to fermented milk products can be classified into two main groups: high starch/low protein and low starch/high protein materials. Materials in the high starch/low protein group

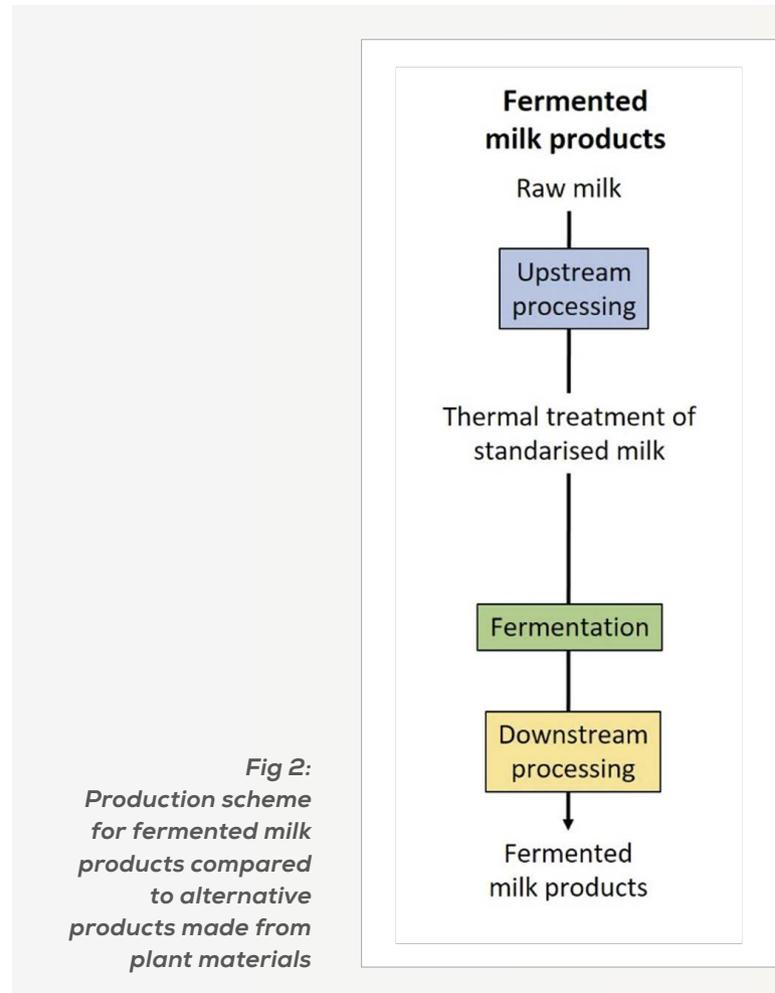
include cereals and pseudocereals (e.g. oat and quinoa). Materials in the low starch/high protein group include legumes and nuts (e.g. soybean, lupine, pea, peanut, almond and cashew). In the typical production of fermented milk products, raw milk is heated, followed by addition of a starter culture and, for some products, a small amount of rennet. As the pH passes below the isoelectric point of caseins, these milk proteins aggregate, forming a gel network. For high protein products, concentration is conducted either upstream (concentration of the milk) or downstream (concentration of the broken milk gel) using, e.g. filtration or separation techniques. In contrast, there are a number of processing options available for plant-based alternatives (Fig 2).

### Plant material dispersion

In contrast to the production of fermented milk products, where liquid milk is the raw starting material, more than one option exists for alternative products made from plant materials (Fig 2). The most basic option is to start with the raw plant material or use material with limited upstream processing. The raw materials are typically soaked in water and then broken down to form a dispersion, referred to as a plant-based paste. Plant-based alternatives to milk (also referred to as “drinks”) are also included in this type of processing, though these differ from plant-based pastes in that solids are typically removed (insoluble proteins and polysaccharides)<sup>3</sup>. The advantage of using a plant-based paste for the production of fermented milk product alternatives is that downstream concentration is usually not required.

A number of studies have been conducted using plant-based milk alternatives, e.g. soy drink, almond drink, coconut milk<sup>4</sup>, and lupine drink<sup>5</sup>. Similarly, several studies describe processes to make plant-based milk alternatives, followed by production of yoghurt alternatives, e.g. using soybeans, lima beans, Bambara nuts<sup>6,7</sup>, coconuts<sup>8</sup>, quinoa<sup>9</sup>, peanut<sup>10</sup>, and tiger nuts<sup>11</sup>. The plant material to water ratio can be used to adjust the protein/starch content of the plant dispersion<sup>12</sup>, though studies on alternatives for spoonable fresh cheese-type products (i.e. high protein) have not been found. That being said, there are already some products on the market.

Upstream processing of the plant material (e.g. isolation, fractionation) can be employed to improve functional characteristics during gel formation. Proteins and polysaccharides are enriched or reduced using liquid (aqueous) extraction, followed by a drying step. Alternatively, dry fractionation can be used for some proteins<sup>13</sup>. The dry fractionated proteins or polysaccharides can then be solubilized in water and blended to create a dispersion for further processing into a gel for the fermented milk alternative product (Fig 2).



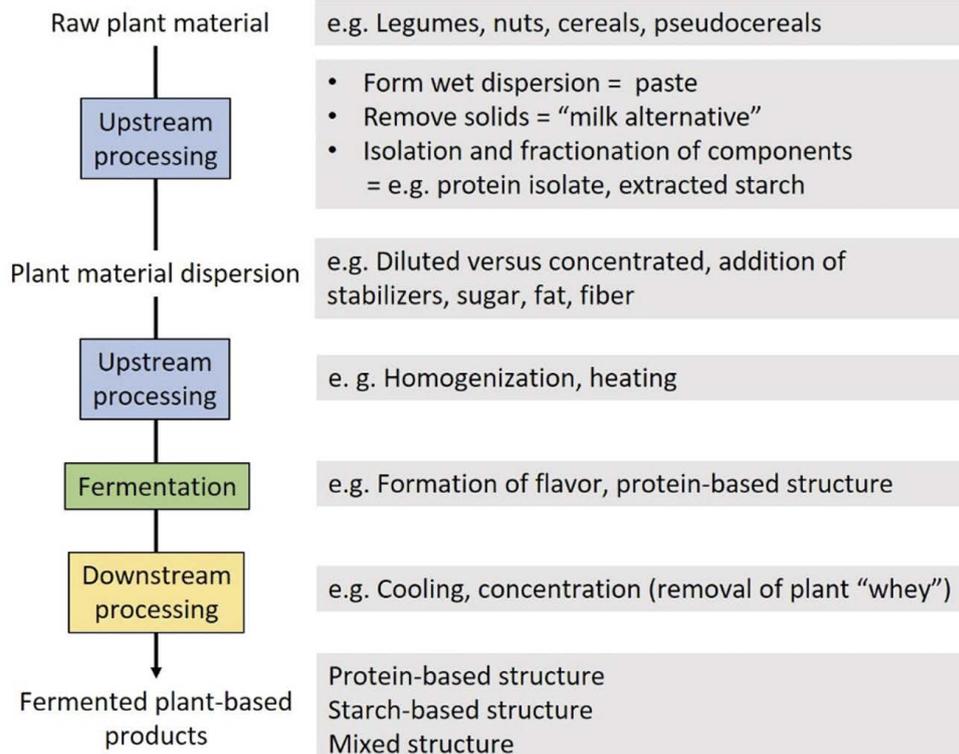
Downstream concentration is usually not required, since required concentrations can be set upstream at the plant material dispersion step. Plant protein isolates are considered as texture improvers, due to high solubilities in water and emulsifying activities<sup>14</sup>. Starches are modified to various degrees to alter their physicochemical and functional properties in plant-based gels<sup>13</sup>.

Compared to plant drinks, considerably fewer studies have been conducted using formulations of plant fractions. Some examples include, oat protein concentrate, oat protein isolate, pea protein isolate, and chickpea protein concentrate<sup>15,16</sup>. Careful examination of the plant fraction should be carried out in terms of composition (i.e. proteins and carbohydrates), since ingredients such as oat protein concentrate contain large fractions of starch<sup>16</sup>. As shown in the next section, this information is important for building the desired structure.

### Structure formation

Once the type of plant material dispersion is selected, the structure of the fermented milk alternative must be formed. To mimic the structural properties of fermented

## Fermented plant-based products (fermented milk alternatives)



milk products, a viscoelastic material should be created. For plant-based alternatives to fermented milk products, this is typically done by forming a gel. The mechanism of gel formation and gel characteristics depend on the raw material(s), i.e. plant origin and upstream processing history.

### Protein-based structure

For high protein/low starch raw materials, a similar gel formation process to fermented milk products can be followed, where lactic acid bacteria (e.g. *Streptococcus thermophilus* and *Lactobacillus delbrückii* subsp. *bulgaricus*) are added and a gel is formed based on a reduction of pH. The proteins aggregate and form a 3D network, analogous to fermented milk products. However, plant proteins are structurally different from milk proteins, e.g. smaller, different binding characteristics and surface chemistries. Therefore, gelling and aggregation behaviors differ from milk proteins.

Plant proteins used in these gels need to fulfill different physicochemical and functional requirements, such as gelation, water holding and flavor pre-cursor

abilities. Critical properties that are important to know are solubility at different pH and ionic strengths, thermal denaturation temperature and ability to form networks that can trap water<sup>13</sup>. The solubilities of plant proteins vary widely depending on the pH. For example, salt-soluble 7S globulins, the main components in legume proteins, have a minimum solubility at pH 4.5 – 7.0 at low ionic strength, whereas a high solubility at more acidic and alkaline values<sup>17</sup>. Denaturation temperatures of legume proteins range between 67 and 114 °C, depending on the raw material source and protein fraction. Potato proteins denature at a range of temperatures from 59 – 68 °C depending on the fraction, pH and ionic strength<sup>13</sup>. In contrast, oat proteins denature at around 110 °C and undergo structural changes at pH values lower than 6<sup>15</sup>. Cashew proteins have a minimum solubility between pH values of 4.0 – 5.0 and are an interesting case, since they also form gels after heating at 100 °C with concentrations of 6.5 – 13.5%<sup>13</sup>. In terms of gel formation, most nut proteins are capable of forming gels at lower concentrations than soy proteins (between 4 – 14 %). For example, gels form by acidification with minimum concentrations of 5 % chickpea protein concentrate, 5 % oat or 5 % pea

protein, where yoghurt alternatives are produced<sup>15</sup>. A few authors have used higher protein contents, e.g. 10 % w/w pea protein, oat protein and chickpea protein<sup>15, 18 19</sup>, though textures are also said to be comparable to yoghurt. Studies comparing gels made of plant-based fractions to fermented concentrated milk products, such as high-protein yoghurt and fresh cheese, have not been found.

During the formation of (plant) protein-based gels, various operations, such as heating or altering the pH, are carried out to facilitate gel formation by improving protein solubility and denaturing proteins<sup>19, 20</sup>. Similar to fermented milk products, the characteristics of the protein aggregates (e.g. size, firmness, and shape), will affect the sensory characteristics. Therefore, knowledge of aggregation behavior is important for the development of acceptable, creamy textures for alternative products.

### Starch-based structure

For high starch/low protein raw materials, the structure is formed in a different way (or made-up differently). In this case, not protein, but starch is the main structure-building material; where gelatinization is induced by heating above the gelatinization temperature in the presence of water, followed by a cooling step. The starch granules absorb water and swell, which leads to an increase in viscosity. Above a particular temperature (the pasting temperature), the granules rupture, releasing starch molecules and a gel is built up. Cooling entraps

liquid and other ingredients into the 3D polysaccharide network. Starch-based gels are typically fermented to improve the cohesiveness of the gel, since a reduction in pH can result in proteins becoming entrapped in the starch-based matrix<sup>14</sup>.

For each raw material, the ratio of the two major forms of starch, amylose and amylopectin, as well as their individual characteristics (e.g. degree of branching) depend on the source of the starch. The pasting temperature depends on the raw material and the amylose-amylopectin ratio<sup>13</sup>. The viscosity of the starch-based gel is affected by the amylose-amylopectin ratio and the starch granule size, where a higher amylose content lowers the pasting viscosity and larger granules, such as those for potato starch, typically result in thicker gels. Different types of starches are commonly combined to obtain desirable gel properties, e.g. blends of rice, soy, and oat flours to produce yoghurt alternatives<sup>14</sup>. Typically, between 15 – 35 % of starchy flours dispersed in water are employed to result in comparable textures after gelatinization to other alternatives and yoghurt.

### Mixed structure

As with many things in nature, finding components, e.g. proteins and starches, in isolation is not common. Therefore, it should be pointed out that protein-based structures can be combined with starch and vice versa. In these cases, it is important to consider the order of operations that induce and affect structure formation. For example, for an oat base containing starches,

## ELOPAK

### Aluminum-free Pure-Pak eSense carton

Spanish beverage producer García Carrión is the first company in the world to launch products in Elopak's aluminium-free Pure-Pak eSense packaging. Under the Don Simón brand, six plant-based drinks have been available in the new aluminium-free Elopak carton since the end of last year. In order to inform about the ecological advantages of the new packaging, Don Simón links the packaging to the virtual world via a QR code.

Pure-Pak eSense contains a layer of polyolefins instead of the aluminium barrier. The Don Simón beverage carton also uses a closure based on renewable PE from tall oil. This reduces the CO<sub>2</sub> footprint by a total of 40 per cent compared to a



*García Carrión is to launch products in Elopak's aluminium-free Pure-Pak eSense packaging (Foto: García Carrión)*

standard Pure-Pak aseptic carton. In addition, the cartons are certified carbon neutral and carry the CarbonNeutral logo.

proteins and a small amount of fat, starch gelatinization prior to fermentation reduces phase separation, based on incorporation of proteins into the 3D network<sup>16</sup>. However, fermentation prior to starch gelatinization results in protein aggregates that more likely act as active fillers within the starch-based network, increasing the firmness of the gel<sup>21</sup>. Furthermore, starter cultures are inactivated.

## Summary

In order to successfully develop plant-based alternatives to fermented milk products, the characteristics of the gold standard product must be defined, e.g. viscosity and yield stress. Once these characteristics are defined, a product with similar characteristics can be developed using plant-based materials. Using plant-based raw materials, the structures that can be built-up are based on protein, starch or a mixture of both. Detailed knowledge of the specific raw materials and the structures formed in the alternative fermented milk products are important, since the processes can then be tailored towards desired textural attributes, e.g. increased firmness of a protein-based gel by protein denaturation. It should be mentioned that there is currently a lack of published data on the important physicochemical parameters of most plant proteins (i.e. denaturation state,

aggregation state, surface chemistry and impurities), which prevents fine-tuning of processing parameters to create the structures desired in plant-based products. What is more, microbiological state of the raw material must be considered, e.g. the presence of phages, since this leads to specific thermal treatment requirements prior to fermentation and may change the state of the proteins and starches as structure-building materials.

## ICL

### Sustainable Protein Ingredients

ICL's AgriFood innovation and investment platform, ICL Planet Startup Hub, has invested €2.75 million in Arkeon. The investment will support Arkeon's innovative and sustainable one-step fermentation bioprocess, which creates completely customizable protein ingredients by capturing greenhouse gas carbon dioxide (CO<sub>2</sub>) and converting it into the 20 proteinogenic amino acids necessary for human nutrition. The resulting alternative proteins are carbon negative and clean-label functional ingredients.

Arkeon's patented process pioneered the harnessing of carbon dioxide to make protein – through the use of archaea, a highly resilient single-celled microorganism – without genetic engineering. Archaea, part of the microbiota of all organisms, naturally feeds on CO<sub>2</sub> and transforms these environmental emissions into nutritious protein – meaning the process is not just sustainable, it is also regenerative.

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# Natural flavour, simple processing, top quality

Coconut juice powder unleashes vegan potential



*The new SternCream Vegan is versatile and simple to work with. (photo: SternChemie)*

to attain a smooth consistency. Another plus point is that as a natural product, unlike coconut flavourings and extracts it is very declaration-friendly, either as coconut cream or coconut juice powder. It's also easier to dose and keeps longer than regular coconut juice.

## Gentle manufacture brings product benefits

To ensure the highest purity of the final product, the extracted coconut juice is doubled-filtered. It is then pasteurized and spray-dried for consistently high quality, which is confirmed by sensory panel testing. With its low water content and oxidation stability, SternCream powder has a shelf life of at least 24 months.

## Raw material supply

With the current bottlenecks in raw material supplies and the general economic situation, factors like cost control, dependable suppliers and raw materials availability play a central role. Here, Sternchemie customers benefit from longstanding relationships with suppliers in Sri Lanka and Southeast Asia.

Consumers expect natural foods to taste good and support their wellbeing. Vegan coconut juice powder is excellent for making purely plant-based drinks and desserts, as a functional alternative to traditional juice products. With coconut juice powder from the SternCream series, Sternchemie has the appropriate product for every application, whether conventional, vegan or organic dishes, for industrial customers as well as the out-of-home market.

The new SternCream Vegan is versatile and simple to work with. Its very high coconut juice content gives it a natural, authentic coconut flavour and a light sweetness. The creamy mouthfeel is especially noticeable in ice cream, praline and wafer fillings, and sweet and hearty snacks. SternCream Vegan also improves the consistency of soups, sauces, creams and dips. Thanks to its very good instant and flow properties, this coconut juice powder quickly dissolves in lukewarm water

# Taste, texture and health

At DSM in Food & Beverage we help you keep up with the ever-changing plant-based dairy alternatives market with our innovative and sustainable solutions. You can create your preferred taste, including dairy flavor, as well as customized texture and mouthfeel with our broad portfolio of ingredients. Together we can create delicious, healthy and sustainable plant-based dairy alternatives.

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DELICIOUS  
NUTRITIONAL  
SOLUTIONS

  
CONVINCING  
TASTE AND  
MOUTHFEEL

  
OUTSTANDING  
CREAMINESS



# Dosing or forming classic and vegan dairy products

Handtmann Maschinenfabrik

**H**andtmann offers automated process solutions to the dairy sector for the production of milk and cheese products and plant-based alternatives. The product categories include cold cheese products (e.g. curd, cream cheese/cream cheese preparation, processed cheese/processed cheese preparation, cheese/cheese preparation), reshaped cheese, creams, desserts, dips, hot cheese products (e.g. processed cheese/processed cheese preparation, imitation cheese, cheese alternatives, pasta filata products), butter/butter preparations and blended fats as well as plant-based alternative products. The core competencies are the production of initial products with subsequent filling, portioning, forming, cutting, co-extruding or dosing.

The production of hot and cold initial products for these end products includes the process steps of mixing, heating/cooling, grinding and emulsifying with the production systems Handtmann VarioMix or processing unit. For the process step of filling and portioning, Handtmann offers vacuum filling machines of type VF 800 with an integrated vane cell feed system suitable for processing all product types, structures, consistencies and temperatures. The vacuum filler models VF 800 D (D = dairy) are available in five performance variants with filling capacities of up to 15,000 kg/hour. The VF 800 D vacuum fillers are certified as compliant with the American "3-A Sanitary Standard 23-06". The fillers boast details such as a closed hopper, product feed e.g. via a closed line, specially treated surfaces for reliable feed and optimum hygiene, which have been



*Handtmann forming systems for the industrial forming of dairy products offer a wide variety of product shapes and designs (photos: Handtmann)*



*Handtmann-Inotec-Universal  
Processing Unit BC  
(photo: Handtmann)*

perfectly adapted to the requirements of dairy applications. As an option, all hopper versions of the VF 800 vacuum filler can be kept at a constant temperature with the aid of a mobile heating unit. To this end, heated water (up to 90 °C) is channelled through the double-wall hopper via a hose connection. A hot or warm product is therefore also kept at a constant temperature during the filling and portioning process. The temperature is set on the vacuum filler's control system and is stored in the product memory. The mobile heating unit features two heating circuits, thus making it possible to connect several vacuum fillers. The VF 800 vacuum fillers form flexible basic modules in the overall process and can be used in combination with auxiliary devices for the subsequent process steps of forming and cutting, free forming, dosing, linking into sausage-shaped products, clipping and pumping/sheeting.

### Forming systems

Handtmann forming systems for the industrial forming of dairy products offer a wide variety of product shapes and designs. Simultaneous portioning, forming and cutting accurate-to-the-gram on up to 24 lanes. On racks,

trays or conveyor belts, the products are transported directly to downstream processing. Product examples include 3D shapes such as mozzarella sticks, goat cheese cubes, butter slices, heart shapes, star shapes and more. Fluid, pasty, viscous and chunky products (e.g. cream cheese, spreads, dips and creams) can be flexibly dosed with Handtmann

depositing systems. The DS 552 depositing system featuring valveless dosing principle achieves a production output of up to 200 cycles per minute on up to 24 lanes. The product can be dosed directly into tray sealers or thermoforming packaging machines. Processed cheese preparation, for example, is portioned with a VF 800 vacuum filler into the corresponding casings and closed with an auxiliary clipper device. Grilled cheese preparation is portioned with a high vacuum filler into casings and closed with an auxiliary clipper device. The closed casings with the grilled cheese are put onto trays, cooked and cut into slices after cooling. The Handtmann ConPro system enables the continuous production of innovative dairy products with edible alginate casing. Product examples include cheese sticks in alginate casing, offered as a snack, or cheese sausages. The ConPro system comprises two vacuum filling machines, which are connected via a co-extrusion head. One of the two vacuum fillers, the master machine, pumps the filling product used to produce the product strand. The slave machine feeds the alginate paste that later forms the casing. The product strand can either be cut or linked into individual portions.

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# How far are we from a real non-dairy cheese?



**Author:**  
**Dr. Ali Sedaghat Doost,**  
*Food R&D Scientist,*  
*Food R&D department of FAM Stumabo*



**Non-dairy cheese needs to have certain properties to be „machineable“ on the FAM Centris 400C (photo FAM Stumabo)**

**T**here are roughly more than 1,000 cheese varieties produced from the milk of different animals. The fact that there are so many cheese varieties also shows the popularity of cheese in our diet. However, there is an increasing recent trend towards manufacturing of plant-based cheese alternatives. So, dairy and non-dairy manufacturers have been launching vegan cheeses which you can find in the market in a response to the growing demand of food consumers.

The consumers are now more sensitive to their diet and seek the healthy and nutritional food products. However, animal milk-based cheese as a complex food is not easy to be imitated because a dairy-free cheese should have similar characteristics to its dairy-based counterparts in terms of taste, appearance, meltability, texture and ease of processing. This is because with normal cheese we usually have milk as the major ingredient but in order to have a viscoelastic product that can mimic the conventional cheese, different materials are mixed which makes the vegan cheese system even more complex.

## FAM Stumabo’s Food R&D Department

In the Food R&D Department of FAM Stumabo, we carry out extensive research on the processing of different plant-based cheese formulations to gain a deep under-

standing about the relation between formulation and processing factors of this future food with our machines.

We are constantly receiving formulations from R&D groups of manufacturers to test if their formulation can be size reduced with our different technologies and if not, what can we provide as feedback to them. This knowledge helps us to develop or design the state-of-the-art technologies.

In our recent cooperation with a specialized colloidal laboratory known as particle and interfacial technology group (PalnT), we have been working on structural



# PLANTARIS™

Realising the full potential of plant-based proteins

People are more aware of their health and well-being than ever – especially the importance of their diet. Not only that, many people are reassessing their choices based on the sources of their foods. Plant proteins have many pros, but there are some challenges to overcome on taste and texture.

Plantaris™ is a new plant-based protein brand, it helps solve these issues, making it a more attractive proposition than alternatives in the marketplace today. We are taking plant-based protein to the next level, helping food brands and manufacturers make the most of the opportunities opening up in this exciting market.

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characteristics of non-dairy cheeses. We found very interesting results that show how changes of a small quantity or type of material can influence the size reduction process of a non-dairy cheese intended to be used for pizza topping applications. Apart from the theoretical knowledge, we also work with our engineering team to develop the size reduction technology or our cutting tools including knives. In the picture, you can see that our pilot vegan cheese has been nicely shredded using FAM Centris™ 400C into oval shreds.

One of the main ingredients of a non-dairy cheese could be protein. The most important functional properties of proteins in these products are emulsification, gelation, water holding, and flavor precursor. The essential properties of plant proteins that cause the difference in their functionality are their differences in the thermal denaturation temperature, the capability of building a network to entrap water and oil, and solubility in different pH and ionic strength conditions.

Our results exhibited that, for instance, the percentage of the plant-origin protein in our formulation, had a critical impact on both stretchability and shreddability of this formulation. The higher the protein percentage,

the more color and accordingly the off-taste could be pronounced. This effect, however, could be interestingly compensated by the addition of the other plant-origin materials.

### Starch and fat

One of the potential materials is starch which is now commonly used in the commercialized formulations. Starch is added to the formulation to build a structure to entrap the water and oil inside by producing a viscoelastic matrix made by starch gelatinization at high temperatures and, subsequently, starch retrogradation during cooling. On the other hand, the addition of starch above a certain threshold has its own obstacles such as non-pleasant chewiness and stickiness after melting for the pizza topping cheeses.

Fat is another vital material in cheese. In order to mimic the functionality of real cheese, the fraction of the solid fat content is an important factor in formulating a non-dairy cheese. Some commercialized formulations are currently using a mixture of plant-based oils and fats to reach the desired melting profile. Although there are many different plant-based fats, there only a few

**A** *Plant-origin protein has a critical impact on both stretchability and shreddability of plant-based cheese alternatives*

**B** *Oval shred from vegan cheese, cut by FAM Centris 400C (photos: FAM Stumabo)*

plant-based fats that can be solidified at room temperature such as cocoa, coconut, shea, and palm oils. Apart from functional, structural and nutritional properties of fat in these cheeses, our results showed that above a certain fat percentage, size reduction process is impossible even if you need to go to a higher percentage of fat because the oiling off or appearance expectations are not yet met after melting.

As we already talked in a previous article published in the Plant-based Special series of IDM, the formulation step must be along with considering of the processing step. It was obvious in our recent project that a formulation with a desirable stretch, melt, and appearance features could not be size reduced or vice versa. This is why the industry is still far from a real plant-based cheese formulation which can meet all the expectations.

One reason could be lack of knowledge in the basic theory of these formulations which are mostly the result of trial and errors. For instance, there is currently a big gap in the understanding of the parameters that affect the final structure of a required cheese in a range of soft to matured hard plant-based cheeses. This knowledge is necessary to design any formulation with different raw materials.

Another aspect that should be considered is the sensory attributes of these cheeses as compared to the conventional cheeses which occurs by the production of aroma profile during fermentation. For instance, some recent studies have shown that inoculation with some microbial communities could not produce the desirable aroma. Moreover, the ageing period for the fermentation also results in unwanted textural changes affecting the processing step of these cheeses.

Therefore, for an acceptable formulation by manufacturers and consumers of this future food, parallel factors need to be investigated. This is one of the projects running in the Food R&D department at FAM Stumabo and we are willing to extend our cooperation with the manufacturers all over the world as FAM industrial food cutting machines are one of the market leaders in the cheese processing industry.

## ICL and Protera Biosciences

### Plant-Based Solutions Using AI

ICL Food Specialties has joined forces with Protera Biosciences, an AI-driven foodTech start-up and designer of novel proteins, which are used to develop sustainable, highly functional protein-based ingredients for food manufacturers. The partnership follows ICL's 2021 investment in Protera via ICL Planet Startup Hub, which is the vehicle ICL uses to invest in and collaborate with innovative companies in foodTech and agriTech on a global basis.

Through this partnership, ICL and Protera will develop and commercialize sustainable protein-based ingredients using precision fermentation. These clean-label ingredients will address current market demands and offer a replacement for chemical additives or less appealing ingredients. They will also improve the sensory properties in plant-based food applications, while positively impacting the world's food security challenges.

Protera is creating impact through madi, a deep-learning platform, which can predict and match the structure and functionality of vegetable proteins. It designs proteins from a database of more than 1.5 billion edible protein sequences and applies precise fermentation parameters for producing them. The results address consumer demand for a short list of simple ingredients on food labels.



*ICL and Protera Biosciences develop plant-based solutions using AI (photo: ICL)*

# Improving plant-based alternatives that intend to resemble cheese

**P**lant-based alternatives that intend to resemble cheese are complex colloidal dispersions consisting of lipid droplets, embedded within a viscoelastic polysaccharide and/or plant proteins network, obtained from a range of base ingredients, such as legumes (i.e., soybeans, lupin, pea protein isolates, chickpea protein concentrates, fava beans protein concentrates), cereals (i.e., oats) or different types of nuts (i.e., cashews, almond pastes) obtained after soaking, mincing, and filtered water addition.

To capture more of the growing plant-based market and maximize sales among consumers, brands should look to optimize the appeal of products by improving their nutritional value (especially boosting protein content) and appealing sensory profiles.

The molecular weights, surface chemistries, and thermal stabilities of globular plant proteins are different to those of globular animal proteins. Some of the most critical properties that are important to know about plant proteins are their solubility at different pH, their thermal denaturation temperature, their ability to form networks that can entrap water and oil, and their susceptibility to enzymatic modifications such as proteolysis and cross-linking.

The proteins commonly used in plant-based alternatives need to fulfil different physicochemical and functional attributes with emulsification, gelation, water holding, and flavour pre-cursor properties being the most important ones. The functionality of a plant protein depends on its biological origin and extraction conditions. Pea, soy, and lupine proteins are susceptible to transglutaminase cross-linking but adverse processing during protein extraction may impair their crosslinking potential.

Common manufacturing processes employed to induce gelation of the plant protein dispersion are thermal treatments and acidification with starter cultures coupled with enzymatic crosslinking (transglutaminase).



Sacco Srl, a member of Sacco System, is a biotech company that since 1934, has positioned itself in the international market as a producer and partner in research areas, scale-up, production, and packaging of selected frozen and freeze-dried microbial food cultures. Sacco's extensive knowledge and expertise support the fermented food industry in the production of healthier foods and trending new consumer needs.

Thus, by carefully controlling the gelation conditions, different structures ranging from soft to hard plant-based cheese alternatives might be obtained.

The mass that undergoes a natural fermentation is then added with other ingredients like vegetable oil (i.e., coconut, palm, canola, sunflower), modified starches (i.e., potato, corn, tapioca), thickeners (i.e., carrageenan, guar gum) and salt among many others (depending on the recipes).

Modified starches are used because of their ability to form a viscous paste or gel upon heating (gelatinization) and cooling (retrogradation/setback), which entraps fluids and other ingredients within the 3D-polysaccharide network formed.

Sunflower, corn, and canola oils contain substantial amounts of unsaturated fatty acids, so tend to be liquid at ambient temperature and cannot form fat crystal networks. Coconut and palm oils form fat crystal networks at room temperature and generate desirable textural attributes in plant-based cultured alternatives that intend to resemble cheese.

The structures formed are typically semisolid emulsion gels, that consist of a continuous protein network that entraps liquids (oil/fat, water) and other ingredients, such as polysaccharides.



Legume-based products tend to smell beany and earthy, due to volatile compounds such as  $\eta$ -hexanol and  $\eta$ -hexanal, which originate from the oxidation of plant lipids catalysed by lipoxygenase and are mainly responsible for this type of off-flavour.

Plant phenols (including anti-nutrients such as tannins and saponins), terpenes, glucosinolates, and flavonoids impart bitter, acrid or astringent tastes, depending on their molecular weights.

Improvement can be achieved in plant-based alternatives that intend to resemble cheese through microbial fermentation since lactic acid fermentation has the advantage of having a positive impact on structure and flavour attributes by metabolizing and transforming plant-derived ingredients into enhanced products with unique flavours, nutritional profiles, or modified textures.

Fermentation decreases the beany flavour of plant-based alternatives, due to the deprivation of  $\eta$ -hexanol and  $\eta$ -hexanal (Wang et al.2003).

Fermentation can result in desirable volatile flavours, for example, diacetyl, which provides a nice butter-scotch-like aroma, during cereal-based fermentation (Peyer et al. 2016).

Acetaldehyde, delivering a pungent, fruity (green apple) flavour with sweet notes, increases in concentration in peanut, cereal and soy during fermentation (Horáčková et al. 2015).

The flavour and taste of plant-based alternatives are also affected by changes in the levels of amino acids (Yamanaka et al. 1970).

Texture in plant-based products that intend to resemble cheese, is a combination of firmness and elasticity. When the plant-based matrix is not flexible, cracks easily. Exopolysaccharide-producing strains are useful in the manufacture of plant-based cultured products that intend to resemble cheese, as they improve texture.

### **Innovation in the plant-based world by fermentation expertise: 4 Choice by Sacco srl**

A dedicated screening of different unexplored microorganisms can lead to identifying the most suitable bacteria not only able to ferment plant-based matrices, but also to improve textural and sensorial properties. Optimal microstructure, hence textural properties, could be created by identifying the optimal Exopolysaccharide structure which could strengthen the binding between the plant-proteins, hence creating a stable and stiff gel network, which in turn will result in reducing the texturizing hydrocolloids used to formulate dairy-alternative products. Moreover, the complexity of the aroma compounds and their perception should be carefully studied to achieve a balance aroma profile, with distinct flavour notes, such as creamy or botanic. Sacco srl. has been working on those topics for almost 10 years, and it is enriching its knowledge by continuing and starting new collaborations with National and International leading Universities, as well as with ingredients producers, and customers.

We are aiming to achieve starter culture solutions which will satisfy all the consumer's needs, in terms of texture and flavours, by keeping the nutritional benefits of consuming fermented products. We believe that the world of plant-based food is in continuous evolution, and we want to bring the scientific knowledge generated in this field into the life of consumers. We will do this by continuing our research and innovation in this field, and by listening to the desires of our customers.

SACCO SYSTEM's technical expertise in strain development and manufacturing know-how to supply live microbial cultures is eager to position 4CHOICE hypoallergenic solutions as the first CHOICE among plant-based product developers, providing solutions for the plant-based industry.

# How to control stability in plant-based drinks



**T**he market for dairy alternative plant-based drinks is evolving quickly, bringing with it plenty of challenges and learning curves for manufacturers trying to match the performance of dairy with authentic, stable products. Lorena Rodriguez, Dairy Applications Coordinator with Palsgaard Mexico explains why adding emulsifiers and stabilisers can make a world of a difference and shares her latest inspirational recipes.

“Suppose you’re experiencing stability problems with your non-dairy alternative drinks. In that case, the first thing to do is to check the formulation balance to ensure your recipe doesn’t exceed the expected range for each ingredient type. Next, take a deeper look at the raw materials and your production process, preferably together with emulsifier and stabiliser experts on hand to help you set up and make sense of testing.”

Lorena Rodriguez,  
Dairy Applications Coordinator  
Palsgaard Ind. de Mexico

## Market drivers

Alternatives to milk such as soy, coconut, almond and rice drinks, have gained in popularity in recent years. These dairy-free options can achieve similar mouthfeel and texture to traditional dairy products but, for example, with fewer calories and lower fat content. But working with such products is far from simple, with formulation and production challenges that are, in some cases, entirely new.

In this article, we’ve chosen to focus on how manufacturers can solve key formulation and production challenges around coconut, rice and almond drinks – three of the most popular non-dairy beverages on the market today. Products of this kind are typically composed of 0.5 to 3% protein, 0.5 – 3% fat, carbohydrates and fibres. The exact balance of such ingredients will depend on the specific nutritional profile the manufacturer aims to achieve.

This article also shines a spotlight on three concept recipes, which demonstrate how Palsgaard can work with producers of plant-based beverages.

## In search of stability

Stability is an important area for manufacturers to focus on. Due to the types of fat (with low saturation to deliver on nutritional claims) used in such drinks, the emulsion is, by nature, very sensitive, with sedimentation, flocculation, and fat separation as constant issues. One only has to think about what it’s like to open a can of coconut milk, for example, to realize that the ingredient’s rapid change from liquid to solid curd is likely to show up as creaming on the surface of a non-dairy alternative drink.

Last year, Palsgaard commissioned extensive consumer research\* into the plant-based market, which included questions about dairy alternative beverages. The research highlighted certain areas where consumers would like to see improvements. For example, they would like to find products with less sedimentation, a longer shelf-life and enhanced texture and creaminess.

With regards to sedimentation, the survey asked consumers whether they had ever seen visible particles in their plant-based beverages and the results were quite striking. A high proportion (70%) said they had noticed

*(photo: Palsgaard)*

this. It also asked consumers how they thought plant-based beverages could be improved and 34% chose “avoiding sedimentation” as one of their top three choices.

### Advanced control

The unsaturated fat in plant-based drinks demands strong emulsification ingredients, especially when long shelf-life products are produced. The introduction of the UHT technology has been incremental in achieving a shelf-life of up to a year, depending on the composition of the product.

Palsgaard’s survey confirmed this is an area where consumers would like to see improvements.

Respondents were asked if they were happy with the length of time plant-based ‘milks’ could be used after opening and 5.5% said they were not happy. This figure was highest in France at 9%. Palsgaard’s stabiliser and emulsifier blends can help keep the product stable and they can considerably extend the shelf-life of plant-based items.

To address formulation and production challenges and exercise an appropriate degree of control over particle suspension and fat stability properties, a careful mix of emulsifiers and stabilisers is recommended. Mono- and diglycerides of fatty acids, made from edible vegetable fats and oils are commonly used as emulsifiers in non-

dairy beverages to stabilise the emulsion and reduce the fat separation. They also improve the creaminess of the drink.

Stabilisers are water-soluble polysaccharides extracted from land or marine plants or from micro-organisms. Adding stabilisers helps create the network required to suspend particles, increase viscosity, and improve mouthfeel. They are used for thickening and stabilising properties.

### Taking a holistic view

Suppose you’re experiencing stability problems with your non-dairy alternative drinks. In that case, the first thing to do is to check the formulation balance to ensure your recipe doesn’t exceed the expected range for each ingredient type. Next, take a deeper look at the raw materials and your production process, preferably together with emulsifier and stabiliser experts on hand to help you set up and make sense of testing.

With vegetable-based drinks (particularly cereals such as rice and oats) you may, for example, need to pay extra attention to upstream and downstream homogenisation, countering the effects of their starch content. For drinks produced using protein isolates, a holistic view of the product is recommended as i.e. protein salts and emulsifiers in interactions give the right, stable emulsion.

## Be inspired by three concept recipes for plant-based beverages

The way consumers interact with plant-based beverages has evolved. People now desire new options that taste good enough to drink on their own, as well as a selection of 'milks' they can choose in place of dairy. They expect high quality, good flavours, and lots of choices, and this makes the market both exciting but also challenging for manufacturers.

At Palsgaard, we have been working hard to keep ahead of market trends, and as a result, we have developed a new emulsifier-stabiliser blend specifically for the plant-based beverage sector. Here, we highlight three recipe concepts to demonstrate how the product we developed – Palsgaard RecMilk 143 – can address several of the issues manufacturers face when working with plant-based solutions, which are often high in fat or starch. The first concept is coconut with almond and the second is rice milk blended with cocoa. We also developed an almond milk-based coffee creamer. These are all popular flavours and the raw materials for these are plentiful in South America where we are (also) based, so that was another reason to work with these blends.

To enhance these recipes and make sure the finished product is top quality requires a careful balance of emulsifiers and stabilisers, and this blend from Palsgaard offers several benefits from suspending particles in the

liquid and preventing sedimentation to enhancing the overall texture. It can also eliminate fat separation and creaming during storage. Overall, it gives the beverage a richer and creamier taste and mouthfeel. Also, because often only low dosages of each are needed, it can offer cost savings.

### Tasty and nutritious: Coconut-Almond drink

When working with different raw materials we face specific challenges with each one, and so blending them together can present concerns with things like mouthfeel and texture. One of the areas we wanted to look at with plant-based beverages is to get good stability in the liquid, so for this first recipe – Coconut-Almond – we had to work with fibres from the protein sources and we needed to ensure we could disperse the heavy particles to prevent sedimentation.

Another issue with this flavour combination is that we had to deal with high levels of fat, and for a beverage, this can mean the mouthfeel is too creamy. We needed to ensure the final product had good viscosity and stability.

We were able to achieve this by using our new Palsgaard RecMilk 143. The emulsifier-stabiliser blend made of mono- and diglycerides of fatty acids (E471), sodium alginate E401 (standardized with sucrose) and gellan gum (E418) helps suspend the heavy particles and ensures the mouthfeel is pleasant for consumers.



*Palsgaard has developed three recipe concepts for plant-based drinks it gladly shares (photo: Palsgaard)*

Coconut-Almond is a blend which is likely to appeal to today's health-conscious consumer because it's high in healthy fats, which can help lower cholesterol. In addition, almonds are high in fibre, which protects the intestinal wall.

### Plant-based indulgence: Rice Drink with Cocoa

The second concept, Rice Drink with Cocoa, is an example of how sedimentation can pose a challenge in the plant-based sector because when cocoa powder is added to a beverage the particles often sink to the bottom over time.

The other issue with this recipe is that rice and oat 'milks' can be very difficult for us to work with because they are high in starch, and this causes high viscosity. Rice can also cause creaming. So, we needed to find a way to suspend the cocoa particles in the liquid to prevent sedimentation and to improve the mouthfeel. But we also needed to get the texture right to make sure the beverage is pleasant to drink.

It's a delicate balance between the stabiliser and emulsifier to suspend the particles and reduce the viscosity, but we were able to create this synergy between all the components in this recipe using Palsgaard RecMilk 143.

The Rice Drink with Cocoa concept does not contain lactose and offers some additional health benefits from the rice, such as Omega 3, calcium and B-12. It is a UHT product with a long shelf-life of six or seven months.

### Luxurious coffee: Almond juice-based coffee creamer

Creating a lactose-free option which still has the mouthfeel and creaminess of coffee creamer is challenging in the plant-based category, so we spent some time developing this third concept.

#### Why you need emulsifiers in plant-based drinks

Emulsifiers such as monoglycerides prevent fat globules from merging together and therefore they form a stable emulsion of fat. They work by reducing the interfacial tension and helping to stabilise the emulsion and they make the fat globules more resistant to coalescence, while at the same time they reduce fat separation.

Emulsifiers improve the product by preventing fat separation and increases in viscosity, and in doing so they help to improve the overall creaminess of the product.

The final recipe is an Almond juice-based Coffee Creamer. Here Palsgaard RecMilk 143 helped ensure that when it is added to coffee, it still provides the creaminess and mouthfeel of dairy, while also offering a hint of almond flavour to enhance the beverage.

### Experience plant-based Palsgaard

In most situations, the best and most reliable path to solving problems with existing recipes or developing new ones is to join forces with specialists in emulsifiers and stabilisers. And, as the inventor of the modern commercial emulsifier, Palsgaard is ideally positioned to help. We've been supplying both dairy and non-dairy producers with high-quality emulsifier systems for decades.

At well-equipped application centres around the world, our teams of application specialists work alongside you to determine the optimal mix of raw materials, recipes and processes to achieve a stable product with the right sensory qualities. And we have the equipment needed to work with pasteurized, UHT-treated and sterilised products, making shelf-life studies covering the entire shelf-life of the beverage.

Palsgaard has developed a series of plant-based recipe concepts to help demonstrate how its emulsifiers and stabilisers can help customers create new products. These concepts form part of our latest plant-based campaign – Experience Palsgaard – which aims to bring together its unrivalled technical knowledge with its network of regional application centres and the latest consumer insights.

*\* Palsgaard commissioned expert researchers to survey a total of 1,307 consumers (from Mexico, France, Russia, USA and Vietnam). The survey was carried out online between 7 – 14 September, 2021)*

#### Why you need stabilisers in plant-based drinks

Stabilisers such as carrageenan and gellan gum help prevent serum separation and sedimentation. They do this in different ways, for example, carrageenan can react with casein micelles to obtain a 3D network, which entraps protein and fat to make the product stable. Gellan gum helps create a gel structure in the solution, which keeps particles in suspension. The gellan network is formed independently of the proteins in the drinks and has only limited influence on the viscosity. Using gellan gum helps to improve the overall mouthfeel and the product's stability.

# On the way to the ideal plant-based "cheese"

Flavour and texture formation



*Wim Engels, NIZO: To achieve the desired flavour and texture properties of cheese alternatives, preferably by fermentation, is a challenge (photo: NIZO)*

**D**utch private R&D company NIZO is working in a number of projects to improve the quality of plant-based dairy and cheese alternatives. While dairy alternatives seem simple to produce, plant-based cheese alternatives are much more demanding if they are to come with sensorial properties that resemble good old dairy cheese. IDM spoke with Dr. Wim Engels who leads several development projects at NIZO about the ideal plant-based cheese-type product.

**IDM:** *Why is it so difficult to get to a cheese alternative that tastes really good, not to say it tastes just like cheese made from milk?*

**Engels:** Well, there are big differences between casein and all the proteins derived from plants. Solubility is just one of many factors here. If you take into account also the huge variety of plant proteins that can be used to mimic cheese, the problem becomes even more complex. During cheese ripening, a lot of volatile and non-volatile flavour components are produced by protein and fat fermentation. Taking plant material as a basis, you not only have to make sure that similar flavour components are created but also that off-flavour components like „beany“ are minimised in the product.



**IDM:** So, fermentation is key for the manufacturing of good plant-based cheese alternatives. What can you say about the microorganisms required for fermentation of plant materials?

**Engels:** You just have to find the right strains for degradation of that plant basis. And remember, we talk about a huge variety of bases like faba bean, peas, soy and such. The solution is probably a mix of strains, either from dairy origin and/or isolates from plant material, as you can also find many lactic acid bacteria that occur naturally on plants. At NIZO we screen from our own collection of more than 4,000 bacteria strains and we can also combine them with cultures supplied by culture houses to get to the desired results.

**IDM:** Can you unveil one result of a NIZO development that is already on the market?

**Engels:** We worked with a Japanese company to develop a fermented soy base as an alternative yogurt drink. We selected a culture that guarantees the right fermentation and EPS formation. The product has been

introduced to the Japanese market and was available in different variants. I tasted the product and it has a really good quality that is very close to what you would expect from a yogurt drink.

**IDM:** What technology would you recommend for manufacturing plant-based cheese analogues?

**Engels:** Looking at cheese production, the essence is to concentrate the protein which means removing a lot of water. Hence, you need curd cutting, scalding and pressing processes, etc. When you start making plant-based „cheese“, you can more easily adjust the protein concentration in the base and no longer need to remove a lot of water. A challenge, however, is to achieve the desired flavour and texture properties, preferably by fermentation.

**IDM:** When will we see plant-based cheese alternatives that have a quality like real cheese?

**Engels:** Cheese flavour consists of up to thousands of flavour components that occur in different concentra-

tions and at different stages of ripening. Some aspects of cheese flavour are already present in plant-based products, or can easily form. Others, like specific desired sulfur compounds are often missing. Getting it all right while making and maturing plant-based cheese is a huge challenge. Perhaps hybrid products offer a solution, as these products still contain a dairy base, allowing flavour and texture to develop more easily.

**NIZO has one of the largest and best-equipped food pilot plants worldwide (photo: NIZO)**



# Well prepared for plant-based milk alternatives

KARL SCHNELL offers processing systems for this product group.

*The trend toward plant-based alternatives for milk and meat products has continued for several years. Food manufacturers, including dairies, are increasingly pushing their activities into this market. One of the suppliers of the necessary machine equipment is KARL SCHNELL. In addition to supplying process equipment, the company has now been able to provide customers with even better support in implementing product ideas since mid-2022 thanks to its own KS Innovation Center.*



*Milk alternatives conquer the market (photo: KS)*

**F**or several years, there has been a trend toward replacing meat and dairy products with plant-based alternatives. Expectations for the new product group are high. By 2030, market analysts expect strong market growth - from 21 billion euros in 2021 to then 40 - 45 billion euros with average growth rates of 10%. However, this is only true under the condition

of raw material availability and clear legal regulations as well as the involvement of the trade, as industry experts explained on the occasion of last year's 2nd International Online Conference on Plant-Based Milk Alternatives held by muva Kempten. The most important reason for the purchase is a vegan diet, but animal welfare and climate aspects also play a role. Many consumers as-

sume that vegan sources represent better nutritional profiles. However, this is still scientifically controversial. New studies come to different conclusions.

Nevertheless, the product range of suppliers of plant-based drinks and alternative proteins is growing steadily. In the dairy sector, however, development is still in the

early stages. Alternative products are mainly offered in the drinking milk, yoghurt and cheese segments. Oats, soy, almonds and rice are the main types used as a basis. In addition, there are nut varieties, such as cashew nuts, and recently also peas and lentils.

### Dairies are stepping up their activities

So far, all of these areas are still niches which, coming from small shares, are recording double-digit annual growth rates. However, according to experts, the strong growth also weakened somewhat recently. One of the reasons for this was high inflation in Germany, which led to a reluctance of consumers to buy. In addition, there have been more or less significant compromises in texture and taste compared to cheese and yoghurt. Though, market analysts are generally assuming further growth in all areas. In a recent survey of 1,000 chefs from around the world, 90 percent of those surveyed stated that they were showing increased visitor interest in alternatives. Roughly a quarter assumes that by 2040 about 40% of all food will be based on alternatives.

### Production systems Made in Germany

The ongoing trend is causing increased demand from food manufacturers for production systems. One of the companies that has been dealing with this topic for some time is KARL SCHNELL GmbH, based in Winterbach, Baden-Württemberg. The focus of activities is on mechanical and plant engineering for the industrial processing of meat products, delicatessen and processed cheese products. But this also includes the area of plant-based alternatives. The production program offers good conditions for this thanks to a complete product portfolio. It ranges from the individual machine to the complete pro-



**Recipe development and sample production live on site (photo: KS)**

cessing line. The company accompanies customers all the way from the vegan product idea to full implementation, as well as "only" when it comes to the delivery of individual machine components.

### KS Innovation Center for product tests and new developments

The Innovation Center newly established last year at the Baden-Württemberg Dairy Agricultural Center (LAZBW) in Wangen im Allgäu is a special asset. With a focus on cheese and delicatessen technology, the mechanical engineering company offers the opportunity there to work with customers to examine and optimize existing processes.

It is also ideal for the development of new products, as it has the complete machinery for the entire process chain. It consists of a Process Automat and Mixer as well as a UHT process line with Silo, Heating Unit and Creaming Tank. A modular design with a high degree of automation allows all relevant processes for the production of alternatives to be mapped. Cold processes are possi-

ble as well as hot processes that require pasteurization or sterilization. Both high shear and low shear processes can be used if required.

The machines are equipped with numerous features such as direct and indirect heating or cooling, vacuum device, circulation and emulsification systems with control of all shear forces, etc.. This enables the production of a wide range of products with a defined degree of fineness, as well as gentle introduction of chunky recipe components.

However, the advantages for customers from the KS Innovation Center are not only the development of new products and the optimization of the existing product range. Sample production on a pilot scale can also be carried out, as the machinery allows reliable scale-up of process parameters and plant design for subsequent industrial production. Validation of the manufactured products can be done on site at any time. Last but not least, the Center, together with the LAZBW premises, also provides a platform for regular training courses and seminars on various topics.



# “Fusion cuisine, hybrid foods and plant-based alternatives - as well as sustainability, health and well-being lead the way“

Hybrid products together with meat-substitute cheeses will be interesting growth areas.

The adding of plant materials to existing products matches consumer trends and taste - while the consistency, color and nutritional profile will be maintained.

Halloumi and paneer are targeting vegetarian and flexitarian consumers. The growth in the market in 2022 was 10%

Both types require new processing equipment that effectively can handle these new products - and traditional dairy products.

More than 10 years ago, NDT developed and delivered its first processing line for production of cheese with up to 90% vegetable fat.

Additionally, a process line was also developed for halloumi and paneer cheeses.

An ambitious dual track development project has now resulted in a new generation of fronted process:

- The Flexcheese line for meat substitute products such as halloumi and paneer targeting vegetarian and flexitarian consumers.

- The X-series line, which can effectively use up to 100% vegetable fat in the production process.

- The X-series line can also be used to produce traditional cheese by a simple plug-in solution.

Both lines provide „best-in-class“ energy efficiency and hygiene standards, with an additional yield of approx. 5% - and service once a year. Both plant types are in full operation with high customer satisfaction. NDT offers both production facilities and process know-how consulting.

**Get more information at [NordicDairy.dk](https://www.nordicdairy.dk)**

## Contact local sales agents:

North America: [nasales@nordicdairy.dk](mailto:nasales@nordicdairy.dk)

South America: [sasales@nordicdairy.dk](mailto:sasales@nordicdairy.dk)

Europe/Asia: [eusales@nordicdairy.dk](mailto:eusales@nordicdairy.dk)

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