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SPECIAL "PLANT BASED ALTERNATIVES"

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4 CHOICE

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Dear readers,

It has become a good tradition that the editors of IDM International Dairy Magazine turn their attention twice a year, in spring and autumn, to the growing market for plant-based alternative products. In terms of volume, of course, this market cannot yet keep up with that of original dairy products, but it represents what has become somewhat rare in the dairy sector in the meantime: market growth, and in some cases very good relative growth rates.

Of course, the plant-based products themselves will not displace real dairy, not even in the long run. From the manufacturer's point of view, it is more about synergies, for example in the utilisation of production capacities or in logistics. Besides, or rather mainly, it is about making existing brands even more competent by also standing for products that are currently en vogue. The development of the market for plant-based alternative products is now so far advanced that every dairy can credibly stand for the new products as well.

We hope that reading this special issue will give you some ideas on how you can implement the topic of "plant-based" in your company.

Your IDM editorial team

photo: Michael/adobe.com

Content

Imprint

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Plant-based milk with Sisterna sucrose esters

Author:
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Milk alternatives based on vegetable raw materials, have become increasingly popular in recent years, with a drastic increase in the availability of varieties and flavours. Sisterna sucrose esters are especially suitable for plant based drinks, as they can emulsify oils very well, and can keep proteins in solution and particles in suspension. And also very important, the taste of plant based drinks will remain as it was meant by nature.

Stable and white

Plant-based milks, with the exception of soy, generally contain far less protein than dairy milk, while they contain some fat/oil that is released when the plant material (e.g. nuts and seeds) are grounded. In some cases, oil is added for extra nutritional value.

In liquid products the use of a powerful oil-in-water emulsifier is crucial to ensure a stable emulsion for the whole shelf life. This is particularly so because most milk alternatives have a long shelf life at ambient temperatures.

Sisterna sucrose esters are water soluble, which is very important to get a stable emulsion. The high HLB value of sucrose esters (up to 16) strongly reduces the surface tension which results in the easy formation of very small oil droplets, thus ensuring stability and whiteness. Small oil droplets do not have a strong upward force (Stoke's Law), and scatter the light in a way that the emulsion appears white.

Smooth and clean

Proteins in many plants are sensitive to coagulation at acidic conditions, near their iso-electric point, similar to caseinate. Sisterna SP70 protects the plant proteins as well as caseinate from coagulation caused by low pH and/or heat.

An overview of the benefits of Sisterna SP70 in milk alternatives like coconut- or almond drink.

Functionality Sisterna sucrose esters	Effect in plant based milk
Emulsification of oil/fat	No oil separation at surface
	Whiter colour
Dispersing particles	Easier to shake to homogeneous drink
Protein protection	No flocculation
	Homogeneous residue on glass (almond drink)

Shaping the future of plant-based yoghurt alternatives

The impact of selected cultures on taste, texture & nutrition

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.

Fermentation represents an effective biotechnological tool to enhance nutritional features (e.g., high protein digestibility, increase contents of bioactive compounds), to lower concentrations of the plant antinutritional factors, as well as to convey safety prolonging the shelf-life (antimicrobial activity), in Plant-based yogurt alternatives.

Food Cultures are living microorganisms (bacteria, yeast, and mold), carefully selected for their beneficial effects, intentionally added to food for a technological purpose (function through multiple modes of action that depend on the food matrix), normally consumed as food, and used as a characteristic ingredient of food.

Food Cultures selected for Plant-based yoghurt alternatives production should provide a fast acidification that lower the chances of endogenous flora to proliferate, as well as prolonging the shelf-life (antimicrobial activity), confer a pleasant aroma, improve the texture through the synthesis of exopolysaccharides, and survive at high cell density in refrigerated storage conditions.

The impact of selected food cultures on taste

Legume-based products tend to smell beany and earthy, due to volatile compounds such as ŋ-hexanol and ŋ-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.

The potential of fermentation in flavour development is double: first it can reduce the off-flavour from the plant-based raw ingredient, for example decreasing the beany flavour of plant-based alternatives, due to the deprivation of ŋ-hexanol and ŋ-hexanal (Wang et al.2003) and second it can boost the intensity of acid and volatile organic compounds often associated to the development of 'dairy'-related flavors, for example, diacetyl, which provides a nice butterscotch-like aroma, during cereal-based fermentation (Peyer et al. 2016) and Acetaldehyde, delivering a pungent, fruity (green apple) flavour with sweet notes, during cereal and soy-based fermentation (Horáčková et al. 2015).

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

Citric acid is also an important precursor for diacetyl and acetoin, and citrate addition has already been explored as a strategy to increase the production of these two compounds.

The impact of selected food cultures on texture

Aiming at formulating products without additives inclusion, leads to specific selections of exopolysaccharide (EPS)-producing bacteria as starters for plant-based yoghurt alternatives fermentation to guarantee optimal textural.

The synthesis of exopolysaccharide (EPS) during fermentation is correlated to LAB sugar metabolism and has been identified as crucial for obtaining optimal texture and sensory characteristics of Plant-based yoghurt alternatives. Exopolysaccharide synthesis is a strain-dependent metabolic characteristic, affected by the composition of the matrix and fermentation settings.

Different types of exopolysaccharides are produced by LAB, classified based on their chemical composition. Heteropolysaccharides are formed through linking of different monosaccharides (mainly glucose, rhamnose, or galactose). Homopolysaccharides have only one kind of polymeric unit (mainly glucose or fructose). The use of the EPS-producing strains as starter for the fermentation of plant-based yoghurt alternatives leads to the improve the cohesiveness of the gel, increase of water holding capacity (WHC), enhancement of sensory and mouth-feel properties.


photo: Shutterstock

The use of EPS-producing LAB does not require the mention of additives in the ingredients list, so the final product is clean-label.

The impact of selected food cultures on nutrition

LAB fermentation contributes to the increase of the concentrations of free amino acids and peptides, soluble fibers, and total phenols thus corresponding to higher protein digestibility.

Biological acidification is also associated to the potential decrease of several antinutritional factors (e.g., raffinose, phytic acid, condensed tannins, saponins, α-galactosides, and trypsin inhibitors), often present at high concentration in plant matrices, such as legumes and pseudocereals or whole grains, which reduce the bioavailability of nutrients (mainly proteins and minerals) and which could also negatively affect the sensory profile of the products.

Legumes contain relevant concentrations of α-galactosides which are not degraded in the upper gastrointestinal tract and fermented in the large intestine, causing gastrointestinal symptoms, including abdominal discomfort, flatulence, and diarrhea.

Studies have shown that Bifidobacterium lactis has the highest α-galactosidase activity among Bifidobacterium, that catalyses hydrolysis of galacto-oligosaccharides in soybean fermented alternatives, eliminating flatulent effects (Havas et al.2010).

Innovation in the plant-based world by fermentation expertise: 4Choice 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.

Top trends

Plant-based yoghurt market in 2023

Author: Johan Cerstiaens, Commercial Director, SVZ, svz.com

Yoghurt has been part of our diet for thousands of years and its consumption shows no sign of decreasing, with an expected market growth of 4.8% per year between 2022 and 2027.[1] In today's world, however, consumer awareness around personal wellbeing and sustainability, along with rising factors such as lactose intolerance, are boosting the demand for non-dairy alternatives, such as plant-based yoghurt.

Besides health and the 'better for the planet' rationale, other elements are also shifting consumers' attention towards plant-based products in general. According to Innova Market Insights, the third reason for their interest in these options, beyond the vegetarian or vegan lifestyle choices, is the desire for diet variation. Which explains why between September 2020 and August 2021 there was a +59% increase in new plant-based products that also carry a premium or indulgence claim, compared to the same period in the previous year.[2]

This is a great opportunity for dairy manufactures to develop plant-based yoghurt alternatives, with different claims and qualities. SVZ can support producers tapping into this fast-moving market – which is expected to reach $3,871.6 million by 2028 and is projected to grow by approximately 20% per year during the forecast period.[3] Here we explore the top 4 trends we predict will inspire the industry in 2023.

Tasty, but healthy: enhancing flavour and colour of plant-based yoghurts with natural ingredients

While flavour and colour are often associated primarily with sensory appeal, they are fast becoming even more important as a way for consumers to determine how healthy these products are. When it comes to plant-based dairy, however, consumers still expect taste to match – or even exceed – its traditional counterpart.

A recent study found that people who viewed plant-based options as replacements for traditional dairy products, rather than new experiences in themselves, expressed greater dissatisfaction with their taste.[4] Against this backdrop, how can brands streamline consumers' transitions to a plant-based diet? One way is to play with flavours they are already familiar with, like strawberry, raspberry and blueberry which, particularly in Asia, are relatively rare in plant-based alternatives.[5] By adding high-quality raspberry or strawberry juice concentrates into a coconut or soy-based yoghurt, producers can give sceptical consumers the same sweet taste they know and love. A notable example is Silk's strawberry soyjuice dairy-free yoghurt with strawberry juice concentrate.


(photo: SVZ)

Consumers' growing health and environmental consciousness is also reflected in their preference for colours that come from natural bases.[6] Colour is key when it comes to deciding whether a product is appealing and appetising. Obtained from fruits, vegetables and plants, natural colours from fruit and vegetables tick all of the boxes. Solutions such as Aronia berry ingredients make a great example, as they are natural, clean-label and applicable to vegan and plant-based dairy.

A variety of nutritional benefits

According to recent research from the International Food Information Council (IFIC), over one in three survey participants ranked health benefits (38%) and nutritional value (37%) in their top three reasons – after taste – for consuming yoghurt.[7]

Whether it's strengthening the immune system or supporting digestive health, when switching to plant-based alternatives, consumers are looking for similar functional benefits as traditional dairy yoghurts. This trend opens up a world of opportunities for manufacturers of plant-based yoghurt to target mainstream consumers by offering products with a unique mix of nutrients.

One simple way for brands to achieve that is to leverage the nutritional and health benefits typically associated with fruit and vegetable ingredients. Berries and kiwi, for instance, play a significant role thanks to their good nutritional profile as they're high in fibre, vitamin C, and antioxidant polyphenols. Danone, one of the largest global dairy companies, has recently launched its first almond and oat-based Actimel range, known to help supporting the immune system, with blueberry and mango-passion fruit flavours. The Forager Project 'cashew yoghurt + oats & seeds with mixed berry' also offer a good example.

Indulgence without the added sugar

In the wake of rising consciousness around what is introduced into our body, sugar reduction has become a top priority among health-savvy consumers. Not to mention the growing number of legislative actions aimed at reducing the sugar intake. The recent proposed rule from the Food and Drugs Administration ("FDA") on sugar and saturated fat, for example, is intended to exclude some flavoured dairy products from being able to claim that they are 'healthy' due to their added sugar content.[8]

Manufacturers are thus faced with the challenge of finding a suitable replacement without compromising on taste and texture. Some have opted for alternative sweeteners like stevia and aspartame. However, as demand for clean label and 'better for you' products is on the rise, the ideal way forward is to ditch refined sugar or other sweetening agents, in favour of the natural sweetness of fruit and vegetable ingredients. For instance, sour cherry or blackcurrant ingredients are a great label-friendly addition to formulations with no added sugar.

Brands should leverage the nutritional and health benefits typically associated with fruit and vegetable ingredients (photo: SVZ)

Sustainable sourced ingredients

As concerns for the environment and the ethics of supply chains intensify, customers have developed a new mindset and are changing their consumption behaviour to back up their own stances on issues like sustainability. Now more than ever, food manufacturers are called to meet the demand of an increasingly well-educated and forward-thinking consumer base, in a transparent and trustworthy way. According to a recent study commissioned by Deloitte on sustainability and health in food and the way we shop, although health remains the priority in terms of importance when compared to price, it is striking that more than 70% of consumers are willing to pay at least 5% more for organic foods, foods that are sustainably and locally sourced, and fair trade.[9]

Plant-based yoghurt producers have a unique part to play here, and SVZ can support them with its portfolio of 100% natural, sustainably sourced fruit and vegetable ingredients, which are ideal to add colour, flavour and sweetness – without the guilt – to this type of NPD. In addition, SVZ has launched its c2030 vision which aims to inspire the whole food and beverage industry to move towards a more sustainable future. In this way, we can all implement real, positive change across the sector.

1 *Mordor Intelligence, Yogurt market - growth, trends, covid-19 impact, and forecasts (2022 - 2027).*
2 *Innova Market Insights, 'Shared Planet', 2022.*
3 *Vantage Market Research, Plant Based Yogurt Market Global Industry Assessment & Forecast, 2022.*
4 *Adamczyk, D.; Jaworska, D.; Affeltowicz, D.; Maison, D. "Plant-Based Dairy Alternatives: Consumers' Perceptions, Motivations, and Barriers–Results from a Qualitative Study in Poland, Germany, and France". Nutrients 2022, 14, 2171. https://doi.org/10.3390/ nu14102171*
5 *Mintel, Report: A year of innovation in plant-based drinks, yogurt & ice cream, 2021*
6 *Nielsen Global Health and Ingredient Sentiment Survey, 2016.*
7 *International Food Information Council, " Understanding Dairy Consumers' Purchasing Behaviors and Habits", 2021.*
8 *https://www.federalregister.gov/documents/2022/09/29/2022-20975/food-labeling-nutrient-content-claims-definition-of-term-healthy*
9 *Deloitte, "The conscious consumer – connecting with their health and sustainability prior", 2021.*

Milk and cheese alternatives

A realistic view

In the area of ingredients, too, intensive work is being done on alternatives produced by fermentation (photo: FrieslandCampina Ingredients)

According to Global Market Insights, the global dairy alternatives market will grow at an average rate of 9% (CAGR) over the next decade and will reach an estimated value of US$68 billion in 2032. This represents an increase of $40.5 billion, for comparison, the market valuation for 2023 is $27.5 billion. The US accounted for $8 billion in sales of plant-based dairy alternatives in 2022 (Good Food Institute, GFI).

Across Europe, plant-based dairy sales saw double-digit growth between 2020 and 2022, according to GFI. Milk substitutes were up 19%, spreads were up 40%, plant-based ice cream was up 14% and cheese substitutes were up 56%. But sales growth slowed to single digits, with plant-based milk substitutes posting a more modest 7% growth, plant-based ice cream at 8% and cheese at 4%, spreads at 13%. Plant-based yogurt alternatives – which grew 8% over the 2020-2022 period – even saw a slight 0.4% decline in sales.

While this slowdown is largely due to inflationary pressures, the overall situation is changing. Richard Scheper, who works for RaboResearch Food & Agribusiness with a focus on the European dairy sector: "When you walked into a supermarket five years ago, you had roughly three choices: organic milk, branded products and private label products. And if you go to the same supermarket today, you might find 10 options - including alternatives, but also new concepts - for example those that advance specific sustainability issues. This is because liquid milk is a low-margin business and there is an incentive for processors and distributors to diversify."

Scheper continues: "Milk alternative products are established and will not disappear. The market will continue to grow, particularly in the plant-based segment, but probably not in double digits."

In the case of a cheese substitute worthy of the name, development is currently in its infancy. A replacement for Parmigiano Reggiano etc. is far from in sight (photo: Consorzio Parmigiano Reggiano)

Milk and yogurt substitutes are the easiest to make. By 2033, the market share could reach 20% in Europe (photo: COLOURBOX)

From a consumer perspective, the most important factors in this market development are price, along with taste and perhaps nutritional value. Overall, taste and price parity remain the most important factor for plant-based products. Dairy alternatives is not a black and white story or alternatives versus dairy. Hybrid products in particular still offer many opportunities for the future.

Scheper wouldn't be surprised if the market for liquid alternatives in Western Europe was close to 20% by 2033. As alternative dairy achieves price parity, brands and retailers could attract a larger group of consumers – particularly the hybrid consumer who consumes both dairy and alternatives.

Price parity is key

More and more dairy companies are entering the alternative market, but achieving price parity remains a challenge. Competition has increased, some big brand names have slashed per-unit margins, indicating a mature market. Now it's about which companies will prevail, with economies of scale and efficiency.

Plant-based ice cream coming

Aside from beverages, another category that can be leveraged by alternative dairy producers is ice cream. According to GFI, alternative ice cream can appeal to both those in search of indulgent foods and those who prefer wholesome and wholesome foods. And also those who have sustainability on their shopping list. According to Rabobank, an important new market could open up here.

Cheese alternatives

When it comes to cheese substitutes, things are more complicated: milk and yoghurt alternatives are also relatively easy to produce technically, but real cheese substitutes are not. This is due to the complexity of the product. It is currently becoming apparent that hybrid cheese alternatives are being developed specifically for the catering trade - nothing new in itself, if you think of the analogue cheese that has been produced for many years as a pizza topping etc. However, it is unlikely that Parmigiano Reggiano will be replaced in the near future. Here and also with other cheese specialties, maturing plays an enormously important role, a process that is currently not comprehensible on a plant basis.

The nutritional value of cheese alternatives is also a major hurdle. If you look at the plant-based cheese substitutes, they are usually high in coconut oil and high in starch, but rather low in protein.

Precision fermentation

In addition to the purely plant-based market, Scheper assumes that further opportunities will arise in the area of precision fermentation. It delivers products that are fully comparable to milk in terms of taste, nutritional value and functionality. Of course, the question of scaling is at the top here.

For food companies, one reason they are interested in precision fermentation is to reduce their carbon footprint. This can be achieved by replacing certain dairy ingredients with non-animal products. Scheper: "For example, we could see hybrid products, plant-based products that contain milk-identical proteins. In the future, however, precision fermentation will probably remain in the premium segment until enough volume can be moved."

A completely new market segment may be opening up for plant-based ice cream alternatives (photo: COLOURBOX)

Given the cost, the growth of precision fermentation products could also be hampered by the unpredictable economic environment. Investors are in crisis while regulatory hurdles remain challenging in many markets. Approval could take years while capital anymore is not as plentiful and investors are now also showing impatience.

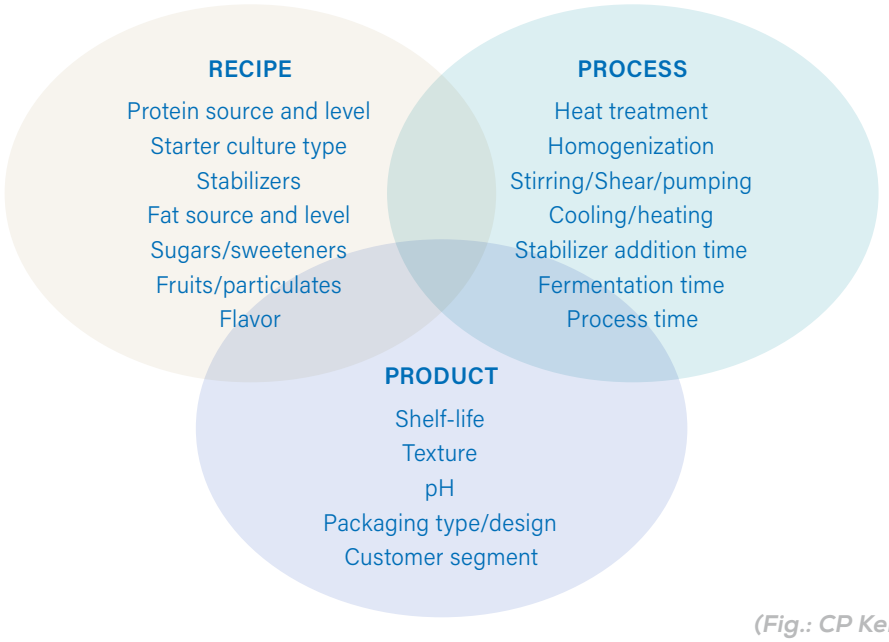
Shelf-stable Vegurts

Cooperation between Chr. Hansen and CP Kelco

Key elements to consider when developing ambient vegurts

WATCH OUT FOR THE CHOICE OF

1. **PROTEIN**
2. **CULTURE**
3. **STABILIZER**



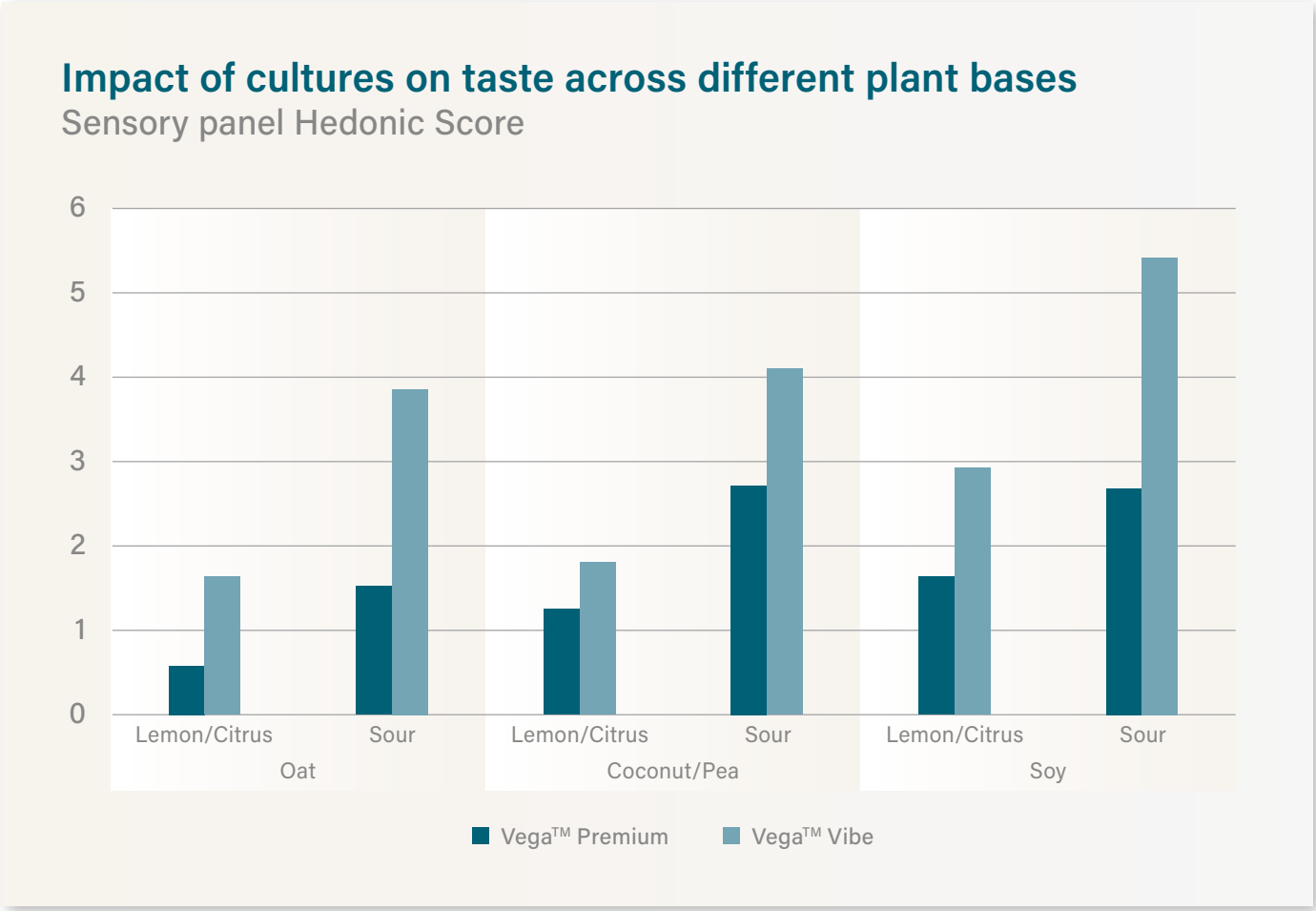
(Fig.: CP Kelco)

Chr. Hansen and CP Kelco have been co-developing plant-based dairy alternatives for two years. The focus was on fermented "Vegurts", i.e. plant-based yoghurt alternatives with a long shelf life. Both companies were inspired by the Chinese market, where long-life yoghurt products are a real heavyweight with annual sales of 1.9 million tons.

The production of long-life yoghurt alternatives has various advantages. From the consumer's point of view, the focus is on safety and convenience, as well as sustainability and healthy eating. On the other hand, manufacturers have the opportunity to significantly expand the distribution radius and possibly also benefit from the increasing e-commerce sales. In addition, products can be tailored to the respective consumption occasion. Last but not least, a longer shelf life also means less food wastage. All of this is against the background that food retailers continue to look for innovations worldwide.

Complex raw materials

Vegetable raw materials are complex raw or semi-finished products whose composition can vary not only from supplier to supplier, but even from batch to batch. Ross Crittenden, Senior Director for Commercial De-



Taste formation through cultures in different raw materials (Fig.: Chr. Hansen)

velopment at Chr. Hansen, also points to food safety. Vegetable raw materials are significantly more microbially contaminated than milk, for example. On the one hand, this places certain demands on the processes, on the other hand, temperature and heating time can also have a negative effect on the quality of the end product.

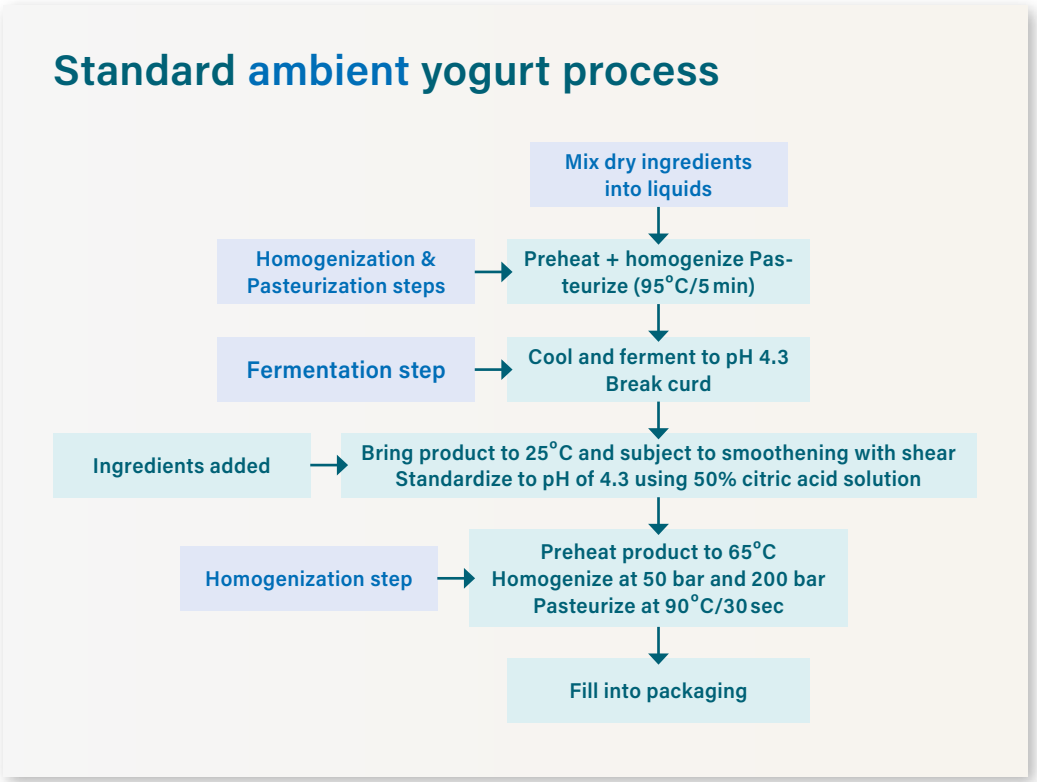
In any case, plant-based alternatives must meet consumer demands in terms of taste, texture, appearance, nutritional value and shelf life. In view of the variety of raw materials and their very different properties, mastering this could definitely be described as the supreme discipline. Even more so if shelf-stable products are to be manufactured in the end.

The key is always the vegetable proteins. Tora Jorn, Manager of EMEA Labs within Sales Technical Service at stabilization specialists CP Kelco, say that it should be clear to anyone looking to produce Vegurts that these proteins come with huge differences re. isoelectric point, texture, solubility, hydration behavior, molecular weight and amino acid profile. All this determines the process to be chosen and its parameters. While milk provides the full spectrum of amino acids, plants do not, and multiple sources may need to be combined (e.g. coconut and peas) if the end product is to have adequate nutritional value.

Special cultures

Under the "Vega" brand, Chr. Hansen has developed a whole series of cultures specifically for the fermentation of vegetable substrates. These differ in the composition of the culture organisms (simple to complex) and, depending on the raw material, deliver very different results in terms of creaminess (EPS formation) and aroma formation or when masking off-flavor. In order to achieve the desired fermentation result more quickly, three booster cultures were also developed.

Products made from plant-based raw materials can often also show a tendency to syneresis or sedimenta-



In some areas, normal dairy processes have to be adapted to plant-based raw materials (Fig.: CP Kelco)

tion of particles. This is where CP uses Kelco's expertise to stabilize long-lasting products comes into the game. One can choose from pectins, citrus fibers, gellan gum or carrageenan, all with different specs and effects.

However, it is not only cultures and stabilizers that are necessary for the production of shelf-stable vegurts. Rather, the processes must also be adapted. Keywords are mixing, heating and holding time, homogenization and much more.

Four basic concepts

Chr. Hansen and CP Kelco have jointly developed four concepts for six-month shelf life vegurts with different textures and protein percentages. Soy, coconut, almonds and peas serve as raw materials, the finished products can be set as spoonable or drinkable variants. These concepts are not intended for plug & play implementation, but serve as the basis for customer-specific product development.

M&S

Oat drink in beverage cartons

Marks and Spencer has launched a plant-based milk alternative in cartons similar to those holding cow's milk. The British oat drink products are part of the vegan Plant Kitchen range and come in semi and whole varieties. The cartons cost around £2 for a liter. Products are fortified with calcium, iodine, vitamin D, and vitamin B1.

M&S decided to launch the product due to customers asking for vegan milk alternatives in larger size and packaging.

M&S has introduced oat drinks in beverage cartons to the British market (photo: M&S)

The perfect shred

The science behind vegan mozzarella substitutes

Author: ***Dr. Ali Sedaghat Doost - Food R&D scientist, Food R&D Department of FAM STUMABO***

Replicating cheese characteristics in plant-based alternatives is no easy feat, presenting a unique challenge to food scientists and manufacturers alike. FAM STUMABO's research on the shreddability of vegan mozzarella substitutes is a crucial step in this process.

Vegan mozzarella alternatives, in particular, is one product that is anticipated to remain in the ever-increasing market. This segment has seen significant growth in recent years, with many companies stepping up to offer innovative and high-quality products.

The many facets of vegan cheese shreddability

'Shreddability' is a term that refers to several aspects related to shredded cheese. It includes how easily the cheese block can be processed through a shredder, the shape and quality of the cheese shreds, and their tendency to stay separate or clump together after shredding. When making imitation cheese, it's important for manufacturers to avoid producing fine shreds (small particles) to achieve optimal quality.

The machinability (e.g., shreddability) of any cheese is influenced by two categories of parameters: formulation components, like fat, protein, and moisture, along with textural properties, fall under the first category. The second category, processing parameters, includes factors like cutting technology. Among these, the aging of cheese is a formulation factor that needs to be controlled for a better size reduction process. This is why FAM STUMABO researched how the storage time of vegan cheese influences its shreddability. They have gained interesting results on how the shape of the shred could affect the quality of the shredding.

The role of storage time in shreddability

Most of the plant-based cheese alternatives present in the current market are starch-based. The functional properties of these starch-based cheeses mainly depend on the properties of the starch network within them. FAM STUMABO's research found that storage time can lead to significant changes in the texture of these cheeses due to starch retrogradation, thereby influencing their shreddability. Storing the cheese a few days shorter or longer can lead to considerable changes in the textural properties of the cheese, which in turn affect its shreddability.

The findings of FAM STUMABO have implications for future formulation strategies and can help in enhancing the quality and performance of these cheeses in the food industry.

FAM STUMABO's research found that storage time can lead to significant changes in the texture of plant-based cheeses alternatives (photo: COLOURBOX)

Plant-based (vegan) cheese alternatives

How to create an authentic cheese taste

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Taste is clearly the most important purchase criterion for consumers when it comes to choosing food. This is the result of the Nutrition Report of the German Federal Ministry of Food and Agriculture (BMEL) and remains unchanged since the first survey. According to the report, 93% vote for taste as the main motivation for reaching for the shelves. Animal husbandry and fair trade are also mentioned among the top three arguments (BMEL Nutrition Report 2022, p. 20).

Young consumers in particular are therefore increasingly turning to vegetarian or vegan alternatives (BMEL Nutrition Report, p. 8). Consumers of vegan products are not necessarily living the vegan lifestyle. Flexitarians consciously choose a limited consumption of animal products. This includes not only meat but also dairy products (ProVeg 2021). A simultaneous consumption of animal and plant products is therefore quite possible. Compromises on taste are accepted less and less. Now that plant-based alternatives to cow's milk (made from soy or oats) are part of the standard range in every supermarket, cheese alternatives are also becoming increasingly popular with many consumers. Leading manufacturers and suppliers expect a strong increase in the market share of cheese alternatives in the next few years. The exact development remains to be seen. One thing is certain, however: cheese alternatives are here to stay. The decisive factor for long-term product success is taste. Only what tastes good will be bought repeatedly (BMEL Nutrition Report, p. 10).

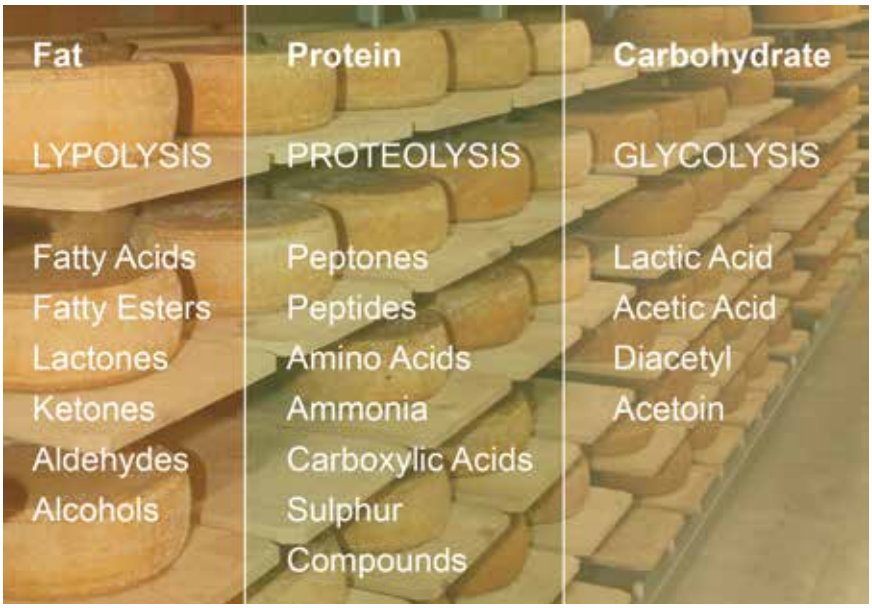
Currently, various manufacturers are therefore faced with the challenge of giving vegan foods an authentic taste. In the field of cheese alternatives, diverse stages of development can be observed. Initially, the milk protein was replaced by starches in purely plant-based products. In the meantime, however, vegetable proteins are also more frequently used as an ingredient, as many consumers want a diet with a high protein content. The animal milk fat is replaced by vegetable fats such as coconut fat. These dry matter components are finally mixed with water to form a homogeneous mass. In addition, some companies are already researching cell-based cheese alternatives that are produced by precision fermentation (Utopia 2021). All alternatives have one thing in common. The taste of the base mass has nothing to do with cheese. So the decisive argument for repeated purchase is missing. But how is a typical cheese taste created in the first place and what makes it so special?

Cheese taste is extremely multifaceted and complex. Many hundreds of components are responsible for the characteristic cheese flavour and are therefore also difficult to recreate.

During traditional cheese ripening, the dry matter (fat, protein and lactose) is broken down by enzymes and bacteria. This metabolism creates flavour components. A multitude of these flavour components results in the balanced cheese flavour. For example, lipases break down fat into various fatty acids. These give many types of cheese their characteristic cheese flavour. The typical taste of blue cheese also comes from the breakdown of milk fat into ketones. Another example is the breakdown of proteins (albumen) by proteolysis. This process can be understood very well in the ripening of traditional Camembert. If stored for too long, the interior of the cheese becomes liquid due to the breakdown of the protein structure. The pungent ammoniacal smell is unmistakable. Numerous sour milk products get their characteristic sour, but also buttery and creamy taste from the targeted degradation of lactose by lactic acid bacteria. Molecules such as lactic acid or diacetyl are responsible for this.

The conditions in ripening cellars (e.g. temperature, water, salt content) are not ideal for microorganisms. After extensive research, the specialists at Jeneil have succeeded in finding the ideal "working conditions" for the bacteria and enzymes. Due to the optimised ripening conditions, the microorganisms produce a concentrate of the desired flavour components within one to five

Vegan cream cheese spread on bread



Biochemical changes during cheese ripening

From cheese to cheese concentrate

days. This has a much higher concentration than traditionally matured cheese or classically produced dairy products. The obtained "natural cheese flavour" can be offered in different consistencies, depending on the customer's wishes. Free-flowing and thus pumpable, paste-like or dried in powder form.

Due to the high concentration of flavour components, even comparatively small dosing quantities of one to three percent are sufficient to give a wide variety of foods a balanced, authentic, intense and also long-lasting flavour. Examples of this are: Processed cheese, sauces, dressings, dips and numerous other products where a cheese flavour is desired.

The addition of the cheese flavouring to the product is usually extremely simple. The most important thing is an even distribution in the base mass of the respective food. High temperatures are almost always detrimental to the flavour of a food, especially in combination with longer heat retention times. This is also the case with Jeneil flavour concentrates. Therefore, the concentrates should be added as late as possible in the production process. If a closed production line requires the addition of the natural flavours at the beginning of the process, this is also possible. The concentrates are comparatively heat-stable and are already being used successfully today, for example in UHT processes.

For many years, the Jeneil company has been investigating how the flavour profiles of the most diverse cheeses are composed in order to harmonise ideally with each other. Cheese flavours are systematically researched. This knowledge is the basis for mixing plant-based flavour components in such a way that a balanced cheese flavour profile is created. The plant-based raw material (e.g. sugar cane, coconut, maize) is fermented with selected microorganisms after harvesting. This allows the desired flavour components to be extracted in a targeted manner. To concentrate these components, the ferment is distilled or filtered. Finally, the aroma purities obtained in this way are combined to create a unique cheese flavour. Concludingly, the dosage of the aroma in the respective food must be chosen correctly. Depending on the base mass and the production process, a variation of several percent is possible here. Ideally, this not only creates a balanced cheese flavour, but also conceals the undesirable off-flavours of other ingredients such as vegetable fat or stabilisers.

One thing is certain: Suppliers who want to be successful in the strongly growing segment of plant-based cheese alternatives in the long term must offer their consumers a convincing taste. The addition of natural flavours supports this. Leading companies, such as Jeneil, offer these in all facets. Many years of experience and specialisation in various cheese flavour profiles make it possible to produce a wide range of the most popular cheeses Gouda, Emmental, Cheddar and Parmesan, but also specialities such as goat cheese or Camembert on a vegetable basis. In this way, the company is capable to contribute to giving products such as vegan cheese alternatives an authentic cheese taste.

Application diversity of natural flavours

1 *Bundesministerium für Ernährung und Landwirtschaft (BMEL). (2022). Deutschland, wie es isst: Der BMEL-Ernährungsreport. Ostbevern: MKL Druck GmbH und Co. KG.*

2 *Proveg. (2021). Von https://proveg.com/de/pflanzlicher-lebensstil/vegan-trend-zahlen-und-fakten-zum-veggie-markt/ abgerufen*

3 *Utopia. (2021). Von https://utopia.de/ratgeber/zellbasierte-milchprodukte-eine-nachhaltige-alternative-zu-echter-kuhmilch/ abgerufen*

Surprising, natural & vegan

Innovative concepts with added value

At BIOFACH 2023, exhibitor HERZA Schokolade was focusing on three topics: organic vegan, natural sweetness and food pairing. With its three trending organic product lines, this specialist in small chocolate pieces provides creative variety for muesli, snacks, ice cream and baked goods. Trade fair visitors could find out about them at the HERZA booth.

Organic vegan alternatives to milk and white chocolate

The demand for organic vegan alternatives to milk and white chocolate pieces continues to grow. The big challenge is to get the familiar creamy and milky flavour, and that is exactly what HERZA has done with its new products. These organic vegan alternatives to milk chocolate are based on sunflower protein, and come in flavour combinations with amaranth or salty caramel, and as Double Chips with a brown coating around a white core. HERZA uses oat flour as the basis for its organic vegan white chocolate alternatives. In the varieties white chocolate with coffee nibs, vanilla caramel and lemon grass matcha, they enable new product ideas for the booming plant-based market.

Natural sugar alternatives

Natural indulgence is more in demand than ever, as more and more consumers choose products that don't contain white sugar, be they fitness foods like muesli or treats like ice cream, desserts, snacks or baked goods. Consumers want alternative sweeteners, ideally from natural sources. One example is coconut flower sugar, whose malty, caramel-like notes harmonize perfectly with chocolate. HERZA proves this with its new "Inspired by nature" organic product line. This features chocolate pieces with highly varied fruit and crispy components. For example, banana flakes give creamy milk chocolate leaves a special crunch, while sour cherry powder lends dark chocolate leaves a unique, delicately tangy fruit note. A total of eight different combinations are on offer.

Another example is the new organic date chocolate, which contains just three ingredients and thus meets customer requirements for clean label products. This dark chocolate is 50% cocoa, and is made of cocoa mass, powdered dates and cocoa butter. The natural date powder gives it a light fruity sweetness, and consists of 100% dried and finely ground dates. A nutritious sugar substitute, dates are also rich in fibre. This organic date chocolate, which can be used in many different ways, is ideal for muesli, snack mixes, healthy baked goods and children's products.

Food pairing: alternative flavour experiences

Food pairing is an ongoing trend in haute cuisine. This combines foods that at first glance would not seem to go together, for example dark chocolate and kale, white chocolate and caviar, or chocolate muffins with bleu cheese. These combinations are not random. They are based on shared flavours of the paired products, as determined by scientific research, and they offer a starting point for unusual creations. HERZA has developed three different compositions for muesli, ice cream and snack mixes – thick leaves of milk chocolate with a coffee caramel note, chopped bits of white chocolate with strawberry and lemon grass, and dark chocolate leaves with cardamom and rum – and naturally all are organic.

Advertorial

dsm-firmenich's Plant Power Toolkit

A formulators best friend

(photo: Moyo Studio/iStock)

In today's dynamic market, the global demand for plant-based dairy alternatives has surged to an impressive €18 billion, with a steady annual growth rate of 4.5%.[1] Despite these promising projections, many plant-based fermented dairy alternatives fall short when it comes to taste and texture. The problem lies within the relatively complex web of ingredients necessary to create plant-based alternatives, contrary to their dairy counterparts, which require minimal ingredients. The extended recipe necessary for plant-based products complicates the delicate balance of flavor and texture. As such, 44% of European consumers stated that better taste or reduced after taste would improve their plant-based yogurt experience and 35% of US consumers said a creamier texture would also do this.

Beyond the realm of taste and texture, 67% of European consumers also expressed concerns about missing out on essential nutrients when choosing plant alternatives over dairy products,[2] highlighting a space in the market for plant-based solutions with enhanced nutritional value. But how can brands overcome the complexities of plant-based formulations to create the next generation of fermented products? Continue reading to explore dsm-firmenich's unique toolkit to satisfy consumer's plant-based cravings.

Plant Power toolkit: Unlock plant-based fermented formulations

Overcoming complex challenges in the plant-based space has never been more accessible with dsm-firmenich's Plant Power toolkit. The company has used its in-depth knowledge of the fermentation process, ingredient interactions and substrate variations to demystify the intricate world of plant-based formulations. The innovative toolkit brings together ingredients with the necessary formulation expertise to improve and fine-tune the taste, texture and nutritional benefits of plant-based fermented dairy alternatives.

The toolkit is fueled by dsm-firmenich's Delvo®Plant enzymes for optimal solubility, mouthfeel and natural sweetness, which help create the perfect base for every product. Taking innovation a step further, the toolkit includes four new groundbreaking Delvo®Plant starter cultures that accelerate fermentation, enhance flavor and finetune freshness and mildness. These cultures also play a pivotal role in building viscosity and smoothness, allowing manufacturers to achieve the desired taste and texture. Whether your brand seeks a mild, fresh or uniquely flavored profile, these cultures provide the flexibility to tailor acidity levels and texture, aligning perfectly with your vision. What's more, the toolkit uses hydrocolloids to further perfect the mouthfeel, creaminess, shine, stability and overall shelf life of plant-based fermented products.

Redefining plant-based nutrition

While many alternative foods and beverages lag behind their dairy-based counterparts in terms of nutritional content, dsm-firmenich's toolkit is closing this nutritional gap by introducing more nutritionally functional ingredients to the world of plant-based products. Wondering how? The company's innovative toolkit is specifically designed to supplement plant-based applications with essential nutrients commonly found in dairy but often lacking in plant-based alternatives, such as calcium, vitamins B6, B12, and D. This breakthrough means that consumers who choose plant-based alternatives don't have to miss out on important health benefits.

Inspiring plant-based innovation with ready-to-go concepts

dsm-firmenich's toolkit offers a range of tastes, textures and health benefits in a variety of popular bases such as coconut, canola, oat, pea and soy. This infinite versatility allows brands to co-create plant-based fermented products customized to their needs. But for brands looking for a nudge in the right direction, dsm-firmenich's portfolio of ready-to-use concepts can inspire innovation. Take the Plant Power Protein PLUS concept as an example. It features a high-quality, complete protein formulation derived from Vertis™ CanolaPRO® and pea proteins, offering a mild-to-fresh taste, smooth texture and all the essential amino acids, at the right levels, to be a complete protein. Whereas the Plant Power Oat concept featuring an oat base provides a convenient nutrient premix of A, B6, B12, D2 and calcium, thus supporting an innovative health positioning.

Not only can brands leverage the toolkit to co-create innovate plant-based products, but they can also benefit from dsm-firmenich's ability to streamline the formulation process. Instead of individually testing each of the up to 15 ingredients in a plant-based fermented application, benefit from pre-tested combinations that showcase how these ingredients best work together, helping you get your vision to market faster than ever before.

Want to find out more? Talk to a member of the dsm-firmenich team today.

1 Mintel, Plant-based dairy alternatives, Europe, 2022
2 FMCG Gurus, Identifying Key Trends in the USA and Europe, Plant Based Dairy Market, 2021

Future Market Insights

The global plant based milk market

The global plant based milk market size is expected to reach a valuation of US$ 19.8 billion by 2023. It is likely to accelerate with a CAGR of 9.9% from 2023 to 2033. Plant based milk sales are set to account for a significant part of demand in the global food market. By 2033, the market for plant based milk is estimated to reach US$ 47.2 billion.

Plant based milk is currently receiving considerable attention since it is essential for maintaining the overall health of people. As demand from various industries such as supplements and nutritional beverages is soaring, key players in the field of plant based milk are focusing on increasing their production capacity.

Rapidly expanding usage of plant based milk in food & beverages such as dietary supplements and nutraceutical supplements is another factor fueling expansion in this industry. Due to their potential uses in the fields of agriculture and food science, there is also a bright future for the use of non-GMO or genetically modified organism plants.

As a result, to maintain customer attention, important companies must constantly innovate and adapt to alternative products competing for market dominance. They are also aiming to invest in research that yields and sustains product innovations.

Driving factors

One of the main factors driving market expansion is rising prevalence of chronic lifestyle diseases and hypersensitivity to animal protein. Popularity of vegan eating habits on a global scale is also encouraging plant based milk sales.

Due to high awareness of animal welfare among millennials and rising cases of lactose intolerance worldwide, there is a shift in people's preferences toward healthy plant based milk products. Numerous individuals in Asia and Africa, according to the National Institute of Diabetes & Digestive and Kidney Diseases (NIDDK), are lactose intolerant. Northern Europe is one region where lactose intolerance is a little less prevalent. The disorder affects more than 35% of people in the USA.

Lucrative until 2033

Future Market Insights projects the global market to remain lucrative throughout the forecast period 2033. It is anticipated to exhibit growth at 9.9% CAGR between 2023 and 2033, in comparison to the CAGR of 7.9% recorded between 2018 and 2022.

Key manufacturers operating in the global market are set to readjust their strategies as consumers shift toward a healthy lifestyle. Rising prevalence of lactose intolerance and dairy allergy across the globe is another factor encouraging consumers to adopt vegan diet and dairy alternatives.

Oats, almond, coconut, flaxseed, rice, and soy drinks are among the most widely used commercial plant based milk substitutes. Their popularity has increased over the past few years.

Future Market Insights confirms constant growth in the global market for plant based milk. Increasing awareness and rising trend for healthy living are set to incline millennials toward natural and organic food products.

Plant based milk alternatives contribute to healthy eating habits and provide more nutritional value, vitamins, minerals, and healthy fats, as compared to animal-derived alternatives.

Top trends pushing plant based milk sales across the globe

Among millennials, awareness of the adverse effects of food additives, chemicals, antibiotics, and other substances on health is rising. They purchase more natural and organic products than generation z. Millennials are expected to be the most vocal buyers of organic plant based milk.

Vegan diets, which completely exclude dairy meals or beverages, are becoming increasingly popular among young people and sports enthusiasts, which has further surged demand for plant-based commodities and dairy alternatives. Rising knowledge of animal welfare is another barrier preventing them from purchasing products made from animals.

Popularity of vegan eating habits on a global scale is encouraging plant based milk sales (photo: Coral N/peopleimages.com/stock.adobe.com)

Why is the USA exhibiting increasing plant based milk demand?

The USA is considered to be a lucrative market for plant based milk. Future Market Insights mentions that the USA plant-based milk market is expected to register a significant CAGR of 13.4% from 2023 to 2033. The country has seen a rising demand for plant-based milk options as health awareness increases. This trend is part of the USA Trends in Eating and Nutrition Declarations. It refers to forecasts made by the USA Department of Agriculture that determine consumer eating habits and preferences.

High demand for plant-based milk alternatives can also be attributed to increasing lactose intolerance, as well as a general focus on healthy eating habits. The most popular alternative milks are found from soy, almond, oat, coconut, and hemp.

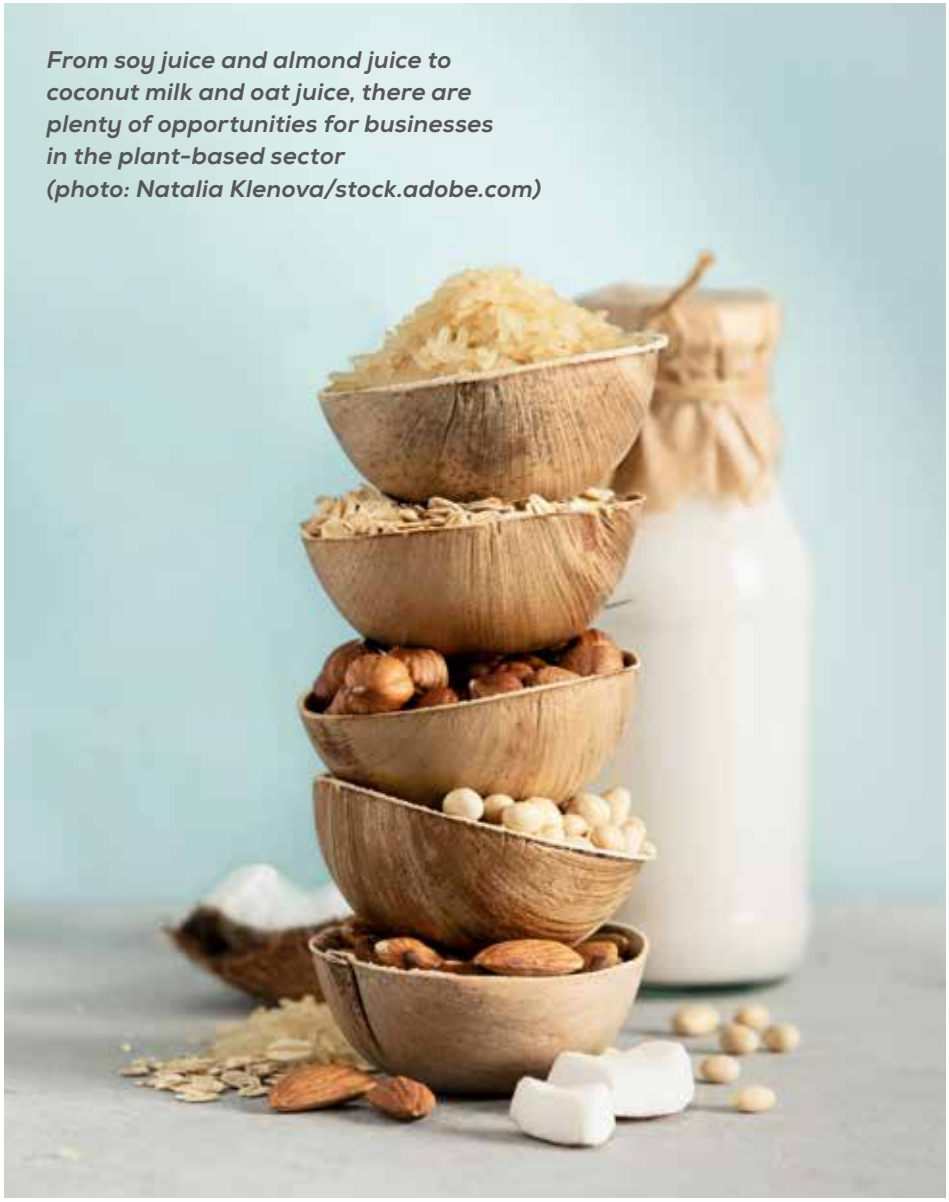
The plant based milk marketshare in Germany is expected to surge rapidly in the next ten years (photo: Mickis Fotowelt/stock.adobe.com)

All of these have become widely available due to increased demand over time. With rising health awareness and interest in lactose-free alternatives, there is no doubt that this growth will continue to boost the food & beverage industry throughout the USA.

Growth in Germany as well

The plant based milk market share in Germany is expected to surge rapidly in the next ten years. By 2033, the market is projected to showcase a CAGR of 10.9%. With rising health and environmental consciousness among millennials in the country, the plant-based milk business is expected to continue its growth. According to Future Market Insights, Europe market is estimated to witness around 11.7% CAGR from 2023 to 2033.

From soy juice and almond juice to coconut milk and oat juice, there are plenty of opportunities for businesses in this sector. Numerous of these products have become staple items in modern households as more people adopt a vegan lifestyle or look for healthy choices without compromising on taste.



From soy juice and almond juice to coconut milk and oat juice, there are plenty of opportunities for businesses in the plant-based sector (photo: Natalia Klenova/stock.adobe.com)

Category-wise Insights

The online retailers sub-segment under the indirect sales segment is expected to remain at the forefront and exhibit a CAGR of 11.8% in the next ten years. Availability of a wide range of high-quality products through online platform, including offers and heavy discounts is likely to drive the segment. Changing online sales regulations, as well as introduction of large e-commerce platforms in developing countries would also propel the segment.

Competitive Landscape

Top multinational plant based milk makers are focusing on new breakthroughs, industrial design, and product implementation in order to spur their businesses globally. Key companies are keen to commit to mergers, collaborations, and business acquisitions in order to expand their market presence. These companies also aim to maintain their competitive advantage through innovative marketing strategies and technology improvements.

Will India move toward plant based milk products by 2033?

The market for plant based milk in India is expected to expand at a CAGR of 6.2% in the estimated time frame. Demand for plant-based milk products is increasing across India as consumers become highly conscious of their health and eating habits. This trend has been further propelled by rising disposable income and improved quality of products available in the market.

With healthy eating habits becoming a priority for numerous households in India, there is an increased demand for plant-based milk that is free from artificial additives and preservatives. Plant-based milk also offers a high nutritional content that includes essential minerals and vitamins, which makes them a healthier alternative to traditional dairy milk.

For instance:

» In February 2020, 12 limited-edition drink packets of wholesome, protein-rich soy juice were introduced by Vitasoy International Holdings Limited. On the company's 80th anniversary, these products were introduced. Classic VITASOY, malt VITASOY, reduced sugar VITASOY, and low sugar malt VITASOY are among the available product variations.

» In October 2019, the new clean recycling education initiative for beverage cartons was introduced by Vitasoy International Holdings Limited. The program includes collecting and recycling beverage cartons in addition to teaching nearby residents and schoolchildren about packaging recycling. It also encourages waste reduction and clean beverage carton recycling.

Vegetable-based cream

Complex subject requires sound problem solutions

Cream puff with whipping cream

Cooking and whipping cream based on vegetable fat have multiple advantages over conventional cream. They store better, keep longer and have cost benefits. Also, vegetable fat is normally available all the time. Another important factor is that the end products are more stable and feature special properties. It is thus no wonder that vegetable-based cream is the most popular category on the Hydrosol website by a wide margin. However, stabilization is a very complex issue, as Katharina Schäfer, Team Lead Product Management Hydrosol, explains.

With the Stabimuls ICR stabilizing and texturing systems, manufacturers can make whipping creams that have substantially higher whipping volume and a firmer foam structure than conventional cream. Freeze-thaw stable variants are also possible. The systems of the Stabisol Vega range give cooking creams with flexible 10-30 percent fat contents. These are heat- and acid-stable and won't flock out, even in the presence of alcohol. There is also a version that combines both benefits, making it good for cooking as well as whipping.

As simple as it sounds in theory, things are much more complex in practice, and the potential for mistakes is relatively high, as Schäfer reports: "There's a lot you can do wrong. It starts with the raw materials. One key factor is the fat quality. The melting range and solid fat content at a certain temperature play a major role in giving the final product a pleasant melt in the mouth."

Further important factors are the type of sugar, the proteins, and the emulsifiers. Even the hardness of the water can influence the final product. Here there are many potential sources of defects. The same goes for the technology. "When making a vegetable-based cream, due on the composition it's best to homogenize only after heating. But for many producers that is not an option. We have therefore developed a solution that circumvents the problem, so that vegetable-based creams can be made in upstream processes without issues," says Schäfer.

Stabilization is a very complex issue, as Katharina Schäfer, Team Lead Product Management Hydrosol, explains.

The filling temperature is especially critical. If it is higher than 10°C – as is the case with many manufacturers – fat crystallization is hindered. This in turn leads to problems in the product. "To be on the safe side, we developed special stabilizing systems that permit filling even at temperatures up to 18°C. Thus we can solve two key problems, upstream homogenization and filling, with just one system. We can adjust the functional systems to meet customer desires and market needs."

More and more dairies are benefiting from this success. Due to unused capacity or for cost reasons many are starting to add vegetable fat-based products to their portfolio. "Milk fat is an expensive commodity that is limited in quantity and is used for many other things, like butter, cream cheese and the like. Also, vegetable-based cream is an ideal alternative in regions where there is no fresh milk," explains Schäfer. "The products themselves are stabler than dairy cream. They keep their stability for a long time after whipping. This is something that is very important in markets like East Europe and Asia, where cakes are heavily decorated with cream."

Market-ready solutions are always in demand. Vegetable-based creams are usually sold refrigerated, but in some regions like Latin America there is rising demand for products that can be stored at room temperature. "We have the ability, due to the composition of the formulation and the right technology, to make a final product that is filled cool, but can be stored at room temperature up to 25°C," says Schäfer. "So it doesn't need refrigeration capacity, which has a positive influence on energy costs." Another plus point is that the vegetable fat creams can even be whipped at room temperature, depending on the formulation. They do not have to be cooled first. "This is an enormous advantage, and we don't know of any comparable product in existence on the market. This convenience aspect is important for retail as well as consumers. The refrigeration chain need no longer be upheld, and the cream can be whipped at the spur of the moment, at any time."

Yet storage is also one of the potential sources of problems. As Schäfer explains, "A customer had the problem that the liquid phase had thickened, in other words had formed a large clump. That can happen if the fat droplet distribution is not homogeneous. In such cases, small fat droplets tend to stick to larger ones, gradually forming a clump. The problem often arises under warm storage conditions." As this example shows, Hydrosol is not just a developer of customer-specific stabilizing and texturing systems, but is even more in demand as a problem-solver for special requirements. "Customers come to us fairly frequently with special problems. These can come up when the specified formulation or process steps are not followed," says Schäfer. "If you do one thing wrong, it often ruins the batch. For example, if you fill at too high a temperature, that's usually the end of it. These are exactly the things you need to be aware of."

Companies usually do not have the requisite knowledge. To build up and make use of this knowledge takes expertise in stabilizing systems. "At Hydrosol we've been doing research in this area for years. Based on numerous test series, we have extensive knowledge with enormous depth of detail, enabling us to establish ourselves on the market as experts in vegetable-based cream."

APAC

Consumers do not mix up plant-based and original dairy

(photo: MaddieRedPhotography/stock.adobe.com)

The APAC plant-based dairy industry believes that controversy surrounding the use of dairy terms for plant-based product labelling is unlikely to happen in this region despite contention in other markets, citing differences in local consumption drivers as amajor factor.

Plant-based product labelling has been a major problem for the food and beverage sector in markets such as the United States and Europe. This has been less of an issue in the Asia-Pacific (APAC) region, and according to industry experts such as Good FoodInstitute APAC MD Mirte Gosker, this is likely due to existing consumer familiarity with such products. Asian consumers are wise enough to understand that the 'milk' category includes both plant-based products and APAC consumers have a deeper familarity with plant-based milk, said Gosker citing the example of soy milk. East Asian cultures do not have as deep a history of cow's milk consumption as the West.

According to the Euromonitor International, the APAC plant-based milk alternative market generated sales of US$9.8bn in 2022, followed by Europe with US$4.1bn and the US with US$3.6 bn.

Plant and cell-based alternatives for the dairy industry

Options for the future

Dr. Monika Knödlseder, *muva kempten, welcomed more than 100 participants.*

After two virtual event years, the 4th International Conference on the Importance of Plant- and Cell-Based Alternatives for Dairy Farming was held again in attendance at the LVFZ für Molkereiwirtschaft Kempten on 13-14 June.

Equal drivers for dairy alternatives are health, sustainability and animal welfare, according to co-organizer Georg Herbertz, Herbertz Dairy Food Service.. The worldwide market volume for milk alternatives was about 22 billion euros in 2002; by 2030, a growth to about 40 - 40 billion, in some cases even up to 60 - 70 billion euros is predicted. A market that will continue to grow, albeit at a slower pace. Global food producers are already participating in the most promising start-ups. Overall, however, policymakers still need to define the regulatory framework more comprehensively. "The major players in the market will be Asia and the USA, and only then Europe," says Herbertz.

Cell-based products are also on the rise. Here, however, research and development are still in their infancy. The European Food Safety Authority EFSA is working on the approval of cell-based agriculture products. New technology such as cell culture, tissue engineering or precision fermentation can produce new foods and ingredients such as milk proteins from microorganisms.

"The dairy industry will change, we will continue to need dairy products - more sustainably produced and better in line with animal welfare requirements," says Herbertz. Alternative products based on plant raw materials will take a firm place in nutrition. Cell-cultured products for the production of milk proteins and growth in the bioreactor will be an alternative. There is considerable market potential associated with the plant-based milk alternatives segment. More and more manufacturers - especially dairy companies - have recognised this and are in the process of establishing products on the market.

Climate

One world, one climate and one (last) chance was the topic of Dr. Udo Engelhart, The Climate Task Force - a division of ansvar 2030. He impressively illustrated that the world is already "scraping" against the climate catastrophe. The marine biologist presented the development of the global climate with the help of numerous scientific data and graphics. He sees the basic cause for the climatic problems in the sharply increased concentration of CO_2 in the atmosphere, which has resulted from the burning of coal, oil and gas. "We need to move away from fossil fuels," Engelhardt said.

He named the ice melt at the poles, changes in ocean currents, the death of coral reefs and a weakening of the Gulf Stream, among other things, as climatic tipping points. For Europe, the latter would mean increasing drought and extreme temperatures in both directions - summer and winter. The thawing of the permafrost will not only release CO_2, but also methane, which will destroy the Earth's atmosphere much more aggressively.

"Currently we are at 1.5 - 2 °C warming, but we are heading towards 3.2 °C here. We need a social tipping point," Engelhardt said. In order to find a way out of the climate crisis, responsibility must be assumed and joint action taken. "Renewable energies are feasible, the money is there, but the political will is missing. The 2020s are the all-important period," Engelhardt said.

Plant-based drinks

To investigate whether plant-based drinks are the healthier and more ecological alternative to milk, 27 products from eight categories were compared with whole milk at Agroscope, Switzerland. According to Dr Barbara Walther, this included the measurement of ingredients and nutrients, physical-chemical properties, sensory characterisation, life cycle assessment, consumer tests and process analyses.

Nutrient requirements may differ in different regions or different diets. For this purpose, the new Index Substitute Index 20 (FSI20) was developed at her institute. The scientist concludes that from a nutritional and environmental perspective, cow's milk can be sustainable compared to plant-based beverages. The choice of milk production system (e.g. feed composition) can influence the results The geographical origin of plant-based raw materials needs to be further researched.

Focus should be strategically directed towards crops with low environmental impact, if possible. The

"The major players in the market will be Asia and the USA and only then Europe", said ***Georg Herbertz, Herbertz Dairy Food Service.***

Dr. Udo Engelhardt, *The Climate Task Force, made it clear that the world is already "scratching at the surface" of the climate catastrophe.*

Dr. Barbara Walther, *Agroscope Switzerland, addressed the question of whether plant-based drinks are a healthier and more ecological alternative to milk.*

choice of nutrient indicators can affect the results. It is important to consider the framework for differentiation, says Walther.

Overall, depending on their basic ingredients, dairy alternative products offer a variety ofof nutritional profiles that differ greatly from those of dairy products. Walther: "From a nutritional point of view, dairy alternative products are not a complete substitute for dairy products. In order to optimise the introduction of dairy alternative products, the overall diet must be taken into account. In addition, the environmental impact of dairy alternatives must be interpreted taking into account the nutrients added."

Alternative drinks and custard powder

Markus Löns, Brabender, dealt with the question of how alternative drinks affect the viscosity properties of pudding. For this purpose, various small-scale tests were conducted with plant-based, unsweetened products. Here it was found that the viscosities are relatively similar at the beginning, but change significantly at the end of the test period. Löns' conclusion: Manufacturers of vegan cooked products made from oat drinks need to know the influence on gelatinisation and viscosity properties. Unlike with milk, however, packaging instructions with processing recommendations for oat drinks are difficult.

Analytics

"Plant-based foods - how are they analytically evaluated in the laboratory" was the topic of Dr. Anna Fichtner, muva kempten. Due to increasing demand, muva offers proficiency tests for quality assurance (EPQS) for vegan drinks and vegan spreads. The main parameters are fat, dry matter and protein. Further

*Soy is the only milk alternative whose natural protein content is comparable to milk, said **Werner Müller**, Doehler.*

***Corinna Faustmann**, Prolupin, dealt with the blue sweet lupin.*

products are in planning. "In the area of EPQS for vegan products, there is no reference method so far and thus no evaluation criteria," says Fichtner. In Kempten, the Horwitz-Thompson model is used. Plans for the future include the inclusion of other vegan products such as cooking cream. In addition, further parameters are to be introduced and sensory suitability tests are to take place. For the standardisation of reference methods, one will actively participate in committees.

Fermented plant-based alternatives

"In Europe, the main raw materials for plant-based yoghurt alternatives remain coconut and soy, with oats trending and almonds and peas on the rise," says Werner Müller, Doehler. While Germany is mostly in the lead for plant-based drinks and milk alternatives, there is still growth potential for plant-based yoghurt alternatives. Doehler offers various product solutions based on plant-based ingredients and nutrients. One of them is soy, which the speaker took a closer look at. "Soy is the only milk alternative whose natural protein content is comparable to milk," Müller said. Here, a change in texture is possible through natural fermentation and without artificial additives.

Together with its partner Sacco, Döhler is developing plant-based solutions for fermented vegetable applications. According to Dr Kilian Daffner, Döhler, the advantages of these plant-based fermentation products include accelerated acidification and the achievement of lower pH values, an improvement in the sensory profile of plant-based products and reduced off-flavours as well as a smooth texture, full-bodiedness and a pleasant mouthfeel.

Lupins

Corinna Faustmann, Prolupin, dealt with the blue sweet lupin. The spin-off of the Fraunhofer Institute produces various milk alternatives under the brand name "Luve". Sweet lupine can be grown on poor, very dry soils. It accumulates nitrogen in the soil and does not require fertilizer. Compared with cow's milk, CO_2 emissions from cultivation are seven times lower, land consumption is halved and five times less water is required. "We also produce lupine isolate with a protein content of over

*The production of alternatives to dairy products from the perspective of a mechanical engineering company was demonstrated by **Florian Stauber**, Krones and **Alexander Scheidel**, Steinecker.*

*Stabilisation technologies of plant-based milk alternatives was the topic of **Tanja Wüstenberg**, CP Kelco Germany.*

90 %. We want to market this industrially in the food industry in the future," says Faustmann.

The spray-dried protein powder is easy to process. Due to its neutral taste, no taste maskers or flavourings are required, which contributes to a short ingredient list. Faustmann: "The excellent solubility and low viscosity are suitable for protein fortification in milk alternatives. It helps with emulsification and combines easily with other plant proteins."

Herbs

A taste journey through the herb garden was made by Katharina Greiwe, Darégal Gourmet Germany. The family-owned company claims to be the number one in frozen herbs worldwide. In five factories, 600 employees process 90,000 tonnes of fresh herbs. The product range includes 61 different herb varieties in dried, IQF frozen, Dairy and Culinary herb preparations as well as infused oils.

Stabilisation technologies

Tanja Wüstenberg, CP Kelco Germany, dealt with stabilisation technologies for plant-based milk alternatives. The challenges with vegan applications are manifold. Viscosity/body/mouthfeel is lacking, protein protection is required and classic fermentation cultures no longer work. The vegetable "aftertaste" or bitter notes need to be masked and protein and calcium added to adjust nutritional values. "A rethink is needed here, i.e. a completely new set-up for recipe and a modification of the technology," says Wüstenberg.

After an overview of the use of functional hydrocolloids, the speaker presented examples of vegan milk alternatives.

Afterwards, Michael Koenen, Alexander Krauskopf and Roland Gianotten, Zentis, presented complete solutions for dairies and the entire food industry.

Sensory perception

The production of alternative products based on rice and field beans and the improvement of sensory perception through functional dietary fibres was the topic of Christan Bauer, Beneo. In addition to various products and concepts in this area, he also presented the combination of rice products, field bean protein and functional soluble dietary fibres to achieve different textures in the end product.

Mechanical engineering

The production of alternatives to dairy products from the perspective of a mechanical engineering company was demonstrated by Alexander Scheidel, Steinecker, and Florian Stauber, Krones. "Plant-based technologies are well established and new products based on microorganisms are gaining in importance," said Stauber. Among other things, he presented an oat drink production line.

For Scheidel, hydrolysis is the key process for final product quality and yield. "The selection of the appropriate enzymes is decisive for the balance of the final product in terms of sweetness, mouthfeel and yield. Preliminary tests are necessary to define the desired end product," says Scheidel. For the production of oat drinks, Steinecker uses the functional principle of his mash vessel with Pillow Plates inside. The advantages are the reliable, homogeneous mixing and thus efficient extraction of the oats, as well as low

inlet temperatures, which enable an efficient energy recovery concept.

Ultimately, alternative foods place new demands on the plant technology. However, basic methods and processes as well as the technological know-how are available in the food and beverage industry. "For the economic production of food, an industrialisation of the processes is necessary," says Scheidel.

Scale-up

According to Florian Klein, Ruland Engineering & Consulting, in order to understand vegan production systems as a whole, planners need to know the exact product requirements and understand the behaviour of the product. The production process must be fully described and critical factors identified. Finally, in scale-up, the processes are implemented with industrial technologies on a pilot scale. Finally, the entire production plant is planned and executed.

Jaap Harkema, Royal Avebe, then dealt with texture solutions for plant-based foods with "clean label" products based on potatoes. He presented these using plant-based alternatives for cheese and yoghurt.

Cell-based fermentation

GEA is developing technologies and processes for the commercial production of alternative forms of protein. To this end, according to Dr. Matthias Hobbie, GEA Group, the company is researching processes that can produce bioidentical proteins without the use of animals. Bioreactors play a crucial role in scaling up production, according to Hobbie. So far, however, these processes have not yet been approved in Europe.

The 5th International Conference is already being planned and is scheduled to take place in Kempten from 11 to 12 June 2024.

Max&Bien

Plant-based cheese assortment "Gouda style"

Max&Bien has improved its Gouda alternatives (photo: Max&Bien)

Amsterdam-based plant-based cheese producer Max&Bien is launching an improved plant-based cheese line, including a new flavour: "Tomato & Olive". By switching to local ingredients, the cheese substitute has become much more sustainable and is now even finer and smoother. The range consists of the flavours: 'Truffle', 'Herbs & Garlic' and the new flavour: 'Tomato & Olive'.

Max&Bien was the first company in the world to launch plant-based cheese alternatives in Gouda-style loaves and focuses on developments within the very traditional cheese world. For vegans, the products are fortified with vitamin B12.

The 150g pieces have a price comparable to that of a traditional piece of dairy cheese. You don't have to go to the vegan shelf for Max&Bien's plant-based cheeses; the cheeses can be found among the traditional cheese specialities on the fresh shelf.

Making better plant-based products in a more sustainable way

Author: ***Pranav Shah,***
Global Market Director for Dairy and Plant-Based Beverages, SPX FLOW

While it may seem plant-based beverages area recent development, sourcing drinks from plants, like soy, dates as far back as the 17th century. It's no wonder the dairy industry, which has its own lengthy history, has been able to adapt to help fulfill the growing demand for these beverages as many traditional dairy processors expand their productions to include alternatives.

Though modest, the plant-based market is showing signs of growth. According to a report by Custom Market Insights, "plant-based milk market size and share was valued at approximately USD 15 Billion in 2022 and is expected to reach USD 16.87 Billion in 2023."

Reasons for choosing plant-based products vary as widely as the customers themselves, whether it's environmental, ethical or nutritional.

Why worry about sustainability?

With growing concern and focus on eco-friendly production – with many companies instituting specific carbon pledges and deadlines – businesses are looking for any and every way they can add sustainable practices to their processing. Yet, it does not change the consideration of factors like quality, taste and consistency needed in the manufacturing.

Increasing sustainability should not mean a sacrifice in quality. The plant-based industry has the options to improve areas like energy efficiency, waste reduction and product longevity while maintaining the standards that customers have come to expect.

Applications

The growing demand for plant-based alternatives necessitates sustainable production practices, efficient equipment, and reliable technologies. Those equipment manufacturers focused on helping customers meet their sustainability goals, like SPX FLOW, offer a range of multipurpose equipment solutions that enable the production of plant-based beverages, fermented products, and protein isolates while prioritizing sustainability, cost efficiency and high-quality output.

In soy-based beverage processing, UHT systems like infusion and infusion plus, technologies ensure the production of clean, pure and high-quality soy beverages (photo: SPX FLOW)

SPX FLOW's Nexus, used to make plant-based margarine product, is a scraped surface heat exchanger that uses carbon dioxide as refrigerant (photo: SPX FLOW)

For example, in soy-based beverage processing, advanced extraction, mixing and UHT systems, like infusion and infusion plus, technologies ensure the production of clean, pure and high-quality soy beverages.

In oat milk production, efficient extraction, homogenization and optimum thermal processes not only enable resource optimization and waste reduction but also help manufacturers maintain the creamy, smooth texture many customers expect.

By choosing the right equipment for almond milk production, processors can utilize multipurpose equipment that facilitates efficient almond soaking, grinding, mixing and thermal treatments contributes to resource conservation and waste reduction.

Fermented products can provide another set of unique challenges, particularly when using pea-based ingredients. Yogurt and cheeses require reliable and adaptable equipment for the fermentation process that provides controlled conditions and efficient microbial growth. This ensures consistent product quality, taste and texture, while reducing production time and minimizing waste. Additionally, aseptic and hygienic pigging systems save maximum finished product, water and CIP chemicals.

Installation & Maintenance

To ensure optimal performance and maximum efficiency, both equipment selection and maintenance play large roles.

Selecting the correct size, speed and setup for your specific application is key. Equipment sized adequately can aid in energy efficiency and help reduce operating costs. Efficient motors and up-to-date valves, particularly those with advanced cleaning features to minimize energy and waste during clean-in-place (CIP), are good choices.

Additionally, taking advantage of the latest technology, such as automation and IO-link, can cut energy consumption and increase efficiency. It also helps monitor systems to ensure maintenance is timely and precise.

To ensure low-cost cycle costs, equipment's durability and reliability contribute to a longer lifespan, ensuring

low maintenance and replacement costs, ultimately benefiting the manufacturer's eco-friendly practices and bottom line.

Innovation

While rooted in a rich history, both dairy and plant-based processors and the companies who supply the equipment, like SPX FLOW, continue to strive for innovation with innovation centers located in each region around the world.

One example is SPX FLOW's Nexus – used in plant-based margarine product, a scraped surface heat exchanger that uses carbon dioxide as a refrigerant rather than the traditional freon or ammonia. Data shows that when customers began using the Nexus, each line improved its heat transfer by approximately 30% compared to other refrigerants. The data also confirms the product quality improved compared to lines using other refrigerants.

Another example is state-of-the-art membrane technology that gives producers more control and flexibility while providing a greater yield, higher single-source protein content and a more sustainable process compared to other alternatives available in the market.

Sustainability has benefits across the board, from eco-friendly production to improved quality to cost-saving measures for manufacturers. There are exciting things to come in this evolving industry.

(photo: M.studio/stock.adobe.com)

New report

MENA Vegan Cheese Market to reach US$ 303 million by 2028

A report by RationalStat titled "Middle East & Africa Vegan Cheese Market Analysis and Forecast 2019-2028" assesses the MENA market based on the basis of cheese type, source, form, end user, application, sales channel, and region. The MENA Vegan Cheese Market is to reach US$ 303 million by 2028, primarily driven by the growth of Continental Restaurants and Cafes. The Middle East & Africa vegan cheese market is expected to grow at a CAGR of 12.2% in the forecast period of 2022-2028. Middle East & Africa is expected to account for a meager share of 5% by the end of the forecast period.

Julienne Bruno

Consumers don't like vegan labels

Consumers are less likely to choose food products that carry 'plant-based' or 'vegan' labels, according to research commissioned by dairy-free cheese alternatives brand Julienne Bruno. Almost half (45%) of consumers would order more 'planet friendly' food if the ingredients were listed instead of being labelled as 'vegan' or 'plant-based'. Plant-based' has become more deterrent than the term 'vegan' with two in five (37%) consumes now disliking the term compared to just under a third (32%) for 'vegan'.

Consumers are less likely to choose food products that carry 'plant-based' or 'vegan' labels (photo: Julienne Bruno)

Cultures create safety and taste

What matters in the production of alternative products

> **"Fermentation can minimise intrinsic flavour, aroma and taste properties and texture in plant-based dairy alternatives"**
>
> Jonathan Herrmann, Technical Sales Manager – Dairy Alternatives at Chr. Hansen

The motto "Know how to do it" also applies to the production of plant-based dairy alternatives. As a specialist in cultures for many years, Chr. Hansen has accompanied and helped shape the development of fermented plant based products from the very beginning. IDM met Jonathan Herrmann, Technical Sales Manager - Dairy Alternatives, for a conversation about the challenges of producing alternative products.

IDM: *How long has your company been supporting producers of plant-based dairy alternatives and what can you now offer your customers?*

Herrmann: For several years we have been working intensively in this field and have now built up a worldwide network of regional specialists as well as our own R&D department and application technology at our headquarters in Hoersholm, Denmark. We are in close contact with all the relevant producers worldwide and can thus also see which developments are underway or which are target-oriented for our customers.

IDM: *Chr. Hansen has developed its own range of cultures for the fermentation of plant based raw materials. What should we know about it?*

Herrmann: Our VEGA range is aimed at companies that want to ferment plant-based raw materials. It includes starter cultures, three booster cultures and additional cultures as well as another three individual cultures with probiotic strains. All these cultures are adapted to different raw materials, but also work with combinations of such bases. We have mastered the fermentation of raw materials as diverse as soy, coconut, oats, but also peas and faba beans. It would be a dead end to specialize in just one of them, given the enormous variety and combinations of plant bases.

IDM: *What are these culture strains like and what are the requirements for them to grow?*

Herrmann: These are all thermophilic strains, as it is necessary to ferment fast to an acidic pH range due to the quite high microbiological load of the raw materials. This is also a food safety requirement. Among our culture strains you will find e.g. Lb. plantarum, quite different strains from those used to ferment milk. As always the requirement for the growth of our cultures is a sufficient and usable source of carbon and nitrogen in the substrate.

IDM: *However, the fermentation is probably not only supposed to produce acid, otherwise you could also add citric acid to the mix.*

Herrmann: Exactly. Fermentation can and should, for example, minimise inherent flavour, as we know it from beans. In addition, fermentation also provides certain aroma and flavour characteristics that you want, and it also provides the texture in plant-based yoghurt alternatives.

IDM: *When you look at plant-based alternatives, you always come across complicated product declarations. Can you help here as well?*

Herrmann: In fact, we also have success in reducing ingredients when we rely on our cultures. We have already been able to develop a cream cheese alternative that only needs five ingredients and still tastes great.

IDM: *What really matters when choosing a Plant based raw material?*

Herrmann: That can be summarised very simply: The raw material must be available in the required quantity, it should be easy to process and also cost-effective, and it should not develop an extraneous flavour in the end product. It is true that alternative products can also be positioned on the market as independent, but at the end of the day it is always the taste that decides on consumer acceptance.

IDM: *Do you do all the development work yourself?*

Herrmann: In principle, yes, but when it comes to detailed questions and absolute expertise, we also seek advice from specialists. Our cooperation in the area of product stabilisation with CP Kelco would be an example of this.

IDM: *So far we have talked more about alternatives for yoghurt and cream cheese. What about cheese?*

Herrmann: Here we really come to the supreme discipline. We and the producers are working intensively on cheese alternatives. Cheese alternatives are an unbelievably complex product where flavour, texture and taste have to meet particularly high standards. We are already seeing the first fermented products leading in the right direction, and I think we will certainly see a leap in the variety and quality of products in the next three years.

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