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The plant protein trend in Norway

Market overview and future perspectives

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Report

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<p><i>Summary/recommendation:</i> In a short period of time there has been a rapid increase in the market for Norwegian branded plant protein processed products, among which some are imported, others produced in Norway. Other countries have a much more developed market from both a producer, technology, and product diversity point of view. Norwegian producers are using already <i>available machinery</i> for the production processes, and <i>mainly imported ingredients</i> such as soya or pea extracts. Norwegian produced <i>potatoes</i> and <i>egg whites</i> are also used. In order for plant protein products to succeed in Norway, we identify some key factors: One is <i>increased knowledge</i>, about both production processes and consumer needs and preferences. The industry also needs to be willing to <i>think more disruptively</i> in order to achieve innovations in this market segment. Furthermore, both the industry and policy makers can put a much stronger effort into <i>educating consumers</i>, in order for consumers to familiarize themselves with plant protein products and their benefits concerning health and the environment.</p>	<p><i>Project No.:</i> 11946</p>
<p><i>Summary/recommendation in Norwegian:</i> På kort tid har det vært en rask økning i markedet for norske planteproteinprodukter, noen importeres og andre blir produsert i Norge. Andre land har et mye mer modent marked når det gjelder til produsenter, teknologi og produktportefølje. Norske produsenter benytter maskiner som allerede er tilgjengelige for produksjonsprosessene, og hovedsakelig importerte ingredienser som soya- eller erteprotein. Norskproduserte poteter og eggehvite brukes også. For at planteproteinprodukter skal lykkes i Norge, ser vi tre viktige faktorer:</p> <ol style="list-style-type: none"> 1. Økt kunnskap om både produksjonsprosesser og forbrukerbehov og preferanser 2. Bransjen må også være villig til å tenke mer banebrytende for å oppnå innovasjoner i dette markedssegmentet 3. Næringslivet og myndigheter kan legge en mye større innsats i å informere forbrukerne, slik at de kan bli kjent med planteproteinprodukter og deres fordeler med hensyn til helse og miljø. 	

Summary

There is increasing global awareness about the unwanted negative environmental effects of livestock production, as well as possible negative health effects of animal-based food compared with plant-based foods. This awareness can explain the increased sales of plant protein products such as meat analogues, which is observed in many countries. At the same time, surveys show that a growing number of people refrain totally or partially from the consumption of meat or animal-based products, as either vegans, vegetarians or meat reducers.

These trends are met with an increasing market supply of plant-based products, which makes it easier for consumers to replace animal protein with plant proteins in their diet. In this study, we analyze the market for different types of plant protein products in Norway. We aim to identify market trends and evaluate the various possibilities that lie in product development in Norway, with a particular focus on products made from Norwegian produced raw materials. For this purpose, we have conducted semi structured qualitative interviews with eight different Norwegian and Swedish firms, as well as desktop studies on national and international market numbers, product development and detailed product and process information. In-store visits in Norway, Sweden, Germany, France, and Spain were used to analyze the product types, communication, and compositions.

We find that in a short period of time there has been a rapid increase in the supply of Norwegian branded plant protein processed products, among which some are imported, others produced in Norway. Norwegian producers are using already available machinery for the production processes, and mainly imported ingredients such as soya or pea extracts. Norwegian produced potatoes and egg whites are also used by some producers. The products are often sold with claims of being sustainable, and from their labelling they are often marketed towards those who want to eat vegetarian, if only once a week. There is also an increasing amount of foreign branded imported plant protein products available at the Norwegian market, among which there are products based on other processes, such as wet texturizing, in order to obtain a meat like structure. Internationally, a large number of different and more innovative types of plant protein products is available, but still not in Norway.

When it comes to pulses, which are plant products with a high natural level of proteins, producers claim that there has been an increase in the demand for peas and beans in Norway, and there is statistical evidence that imports of beans and lentils have increased over the last few years.

The Norwegian industry is expecting a further growth in the market for plant protein products, and further development of new products can also be expected. According to interviewees successful new products should have a good taste and a low price. For some, but not all, it is important that they not only can replace meat in various dishes, but they should also resemble meat in taste and texture as much as possible. Getting a good texture, not too soft and not too dry, is important, but challenging. Using Norwegian ingredients is an aspiration, but as the raw material is a key determinant of the final price of the product, Norwegian commodities that are not protected by tariffs from import competition have a disadvantage. When it comes to pulses such as peas, and especially beans, the Norwegian production is presently low and dried pulses for human consumption are not protected by import tariffs. Oats, in contrast, have a high domestic production level, and are protected from international competition by import tariffs.

In order for plant protein products to succeed in Norway, we identify some key factors. One is increased knowledge, about both production processes and consumer needs and preferences. The industry also needs to be willing to think more disruptively in order to achieve innovations in this market segment. Furthermore, both the industry and policy makers can put a much stronger effort into educating consumers, in order for consumers to familiarize themselves with plant protein products and their benefits concerning health and the environment. For instance, public authorities could ensure that school children are taught about how to use protein rich plants in cooking classes. Lastly, as the green shift towards more plant proteins is still a rather new trend, there is a strong need for more research in this field.

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1 Introduction

What people choose to eat impacts our environment and health. Food production is one of the largest sources of pollution, and contributes significantly to global emissions of greenhouse gases (GHG) (carbon dioxide, methane and nitrous oxide). Agricultural land usage can also lead to soil erosion and loss of biodiversity. High water consumption from irrigation is another potential negative effect of agriculture. Some of these problems can to some extent be solved or mitigated by implementing measures at the production level. But in many cases it is more cost efficient if people choose to eat the food products with the least negative impact [Smith et al 2013]. Different food types have different impacts, but in general the production of animal-based foods has a more negative impact than plant-based foods, in terms of both land usage, water consumption, and GHG emission (see figure 1).

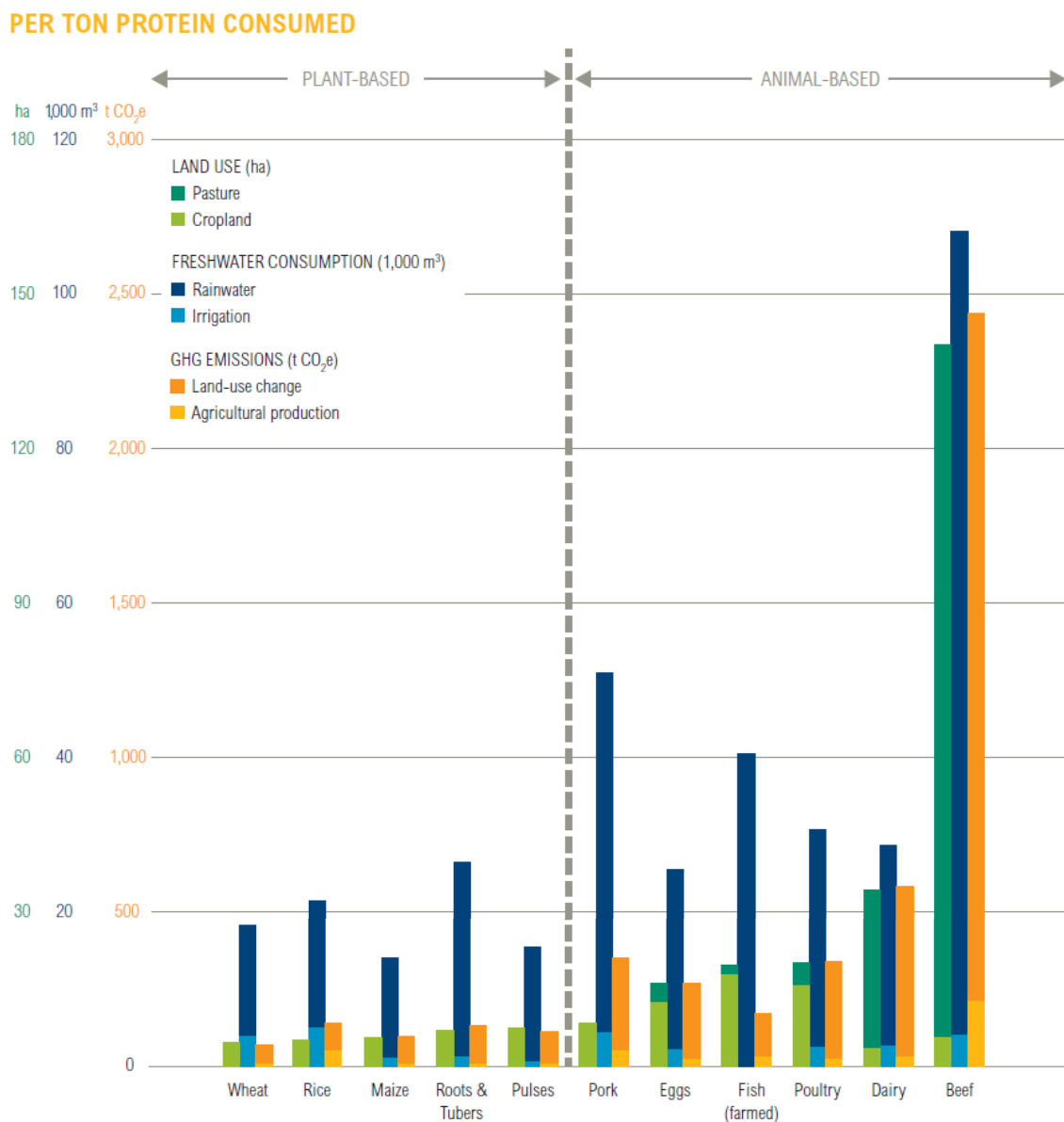


Figure 1 Resource use and impact for plant versus animal protein production [Ranganathan et al. (2016)]

Availability and consumption of animal proteins is predicted to rise by more than 20% globally until 2030 and even more beyond that, as shown in Figure 2. Over 70% of that increased consumption will happen in developing countries [OECD/FAO 2016]. In Norway meat consumption has increased by 45% since 1989 [Helsedirektoratet 2017].

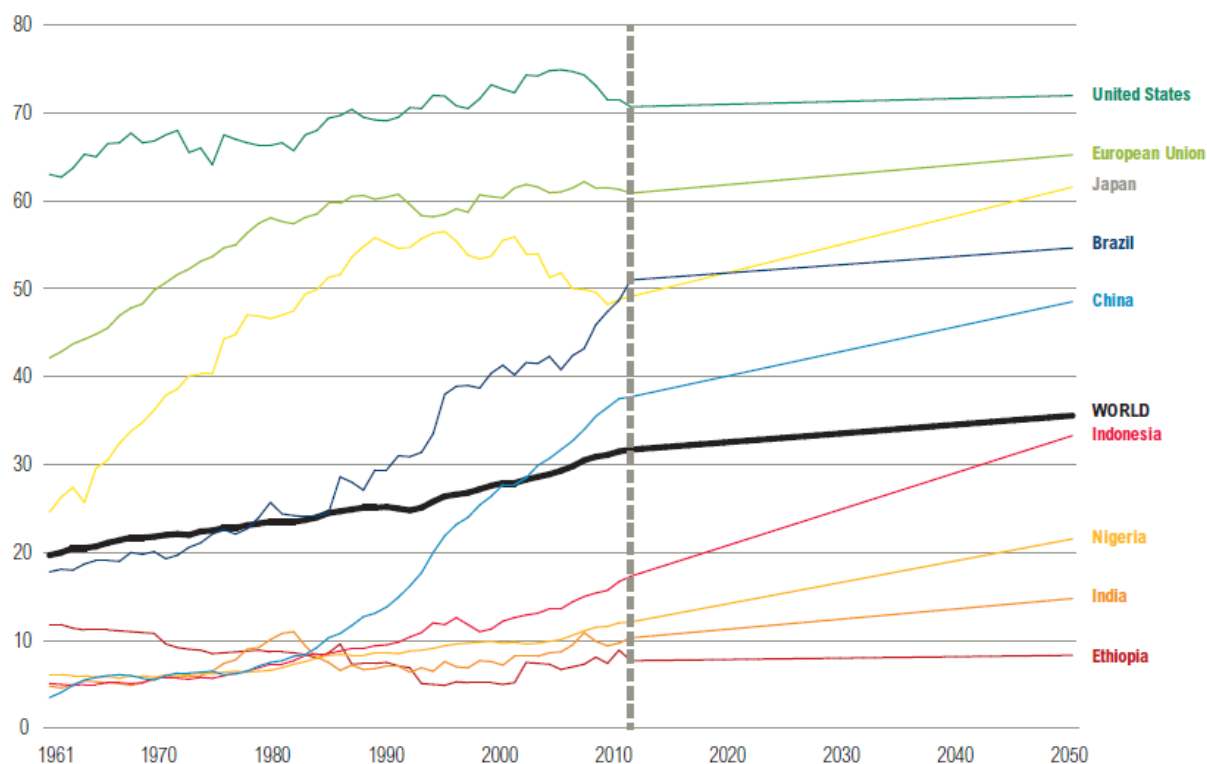


Figure 2 Per capita Availability of animal-based protein is on the rise (g/capita/day) [Ranganathan, Janet et al. (2016)]

High levels of meat consumption will not only have a negative environmental impact and reduce the planet's ability to feed its growing population. Meat consumption is associated with several negative health effects such as cancer and cardiovascular diseases, and it has been estimated that a transition towards more plant-based diets could reduce global food related mortality by 6-10% compared with a reference scenario in 2050 [Springmann et al. 2016].

However, in the developed world there has lately been a trend towards more consumption of plant based foods, most likely driven by an increased concern for both personal health and the planet. This trend has also reached Norway, and it is therefore important to build up relevant knowledge according to new market demands, particularly since meeting this demand can benefit both public health and the environment.

In the research project FoodProFuture (NRC Bionær project 267858) we aim to develop a knowledge platform for optimal production and processing of Norwegian plant raw materials into tasty, healthy and attractive plant-based food products with high protein content. An increased production and utilization of plant protein bioresources in food products will lead to a desirable shift to more plant

based diets. More sustainable food choice by consumers will have a positive environmental impact, and improve value creation in the circular bioeconomy.

For this report we conducted **semi structured qualitative interviews with eight different Norwegian and Swedish firms along the food supply chain** (equipment suppliers, ingredient manufacturers, growers, food producers and retailers). We also conducted **desktop studies on national and international market numbers, product development and detailed product and process information**. **In-store visits** in Norway, Sweden, Germany, France, and Spain were used to analyze the product offers and product types and compositions.

2 Demand for plant proteins

2.1 Increased demand for vegetarian products

Worldwide there is a trend of increased consumer demand for and production of processed food products based on plant protein, which is also gaining foothold in Norway. Some of these are so-called meat substitutes, or meat analogues, which means that they have similarities with meat and can be used in the same dishes as meat, but they are in fact vegan or vegetarian (meaning that they may contain egg or milk products).

Figure 3 and 4 show that in both the United Kingdom and Germany there have been a substantial growth in the sales of plant based meat replacement products since 2010, with a particularly steep increase the last two years.

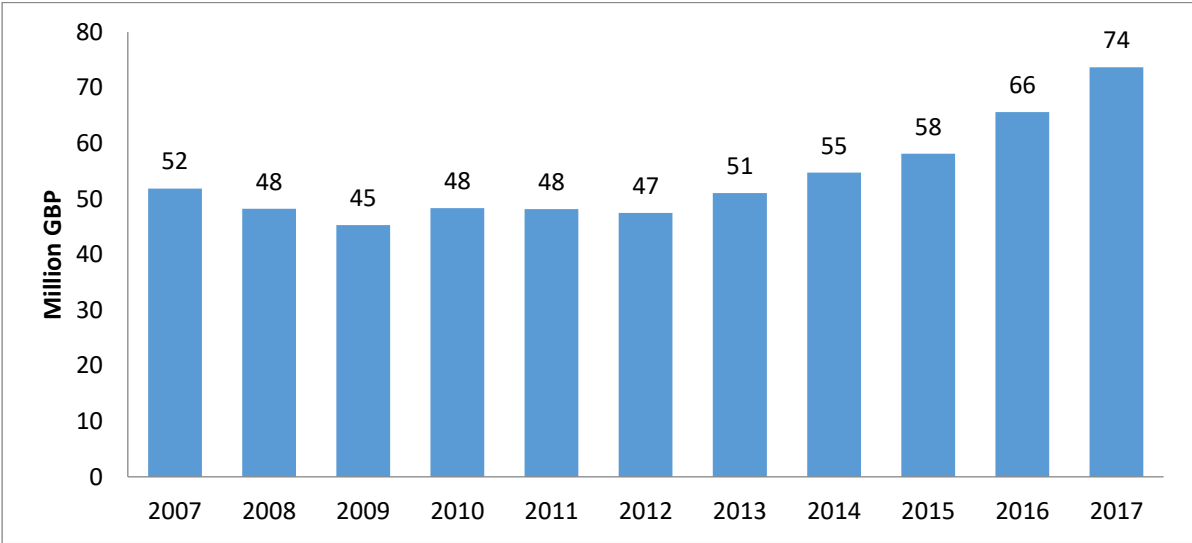


Figure 3 Chilled vegetarian foods: Market value in the United Kingdom 2007-2017; Source: Chilled food association. Statista.com

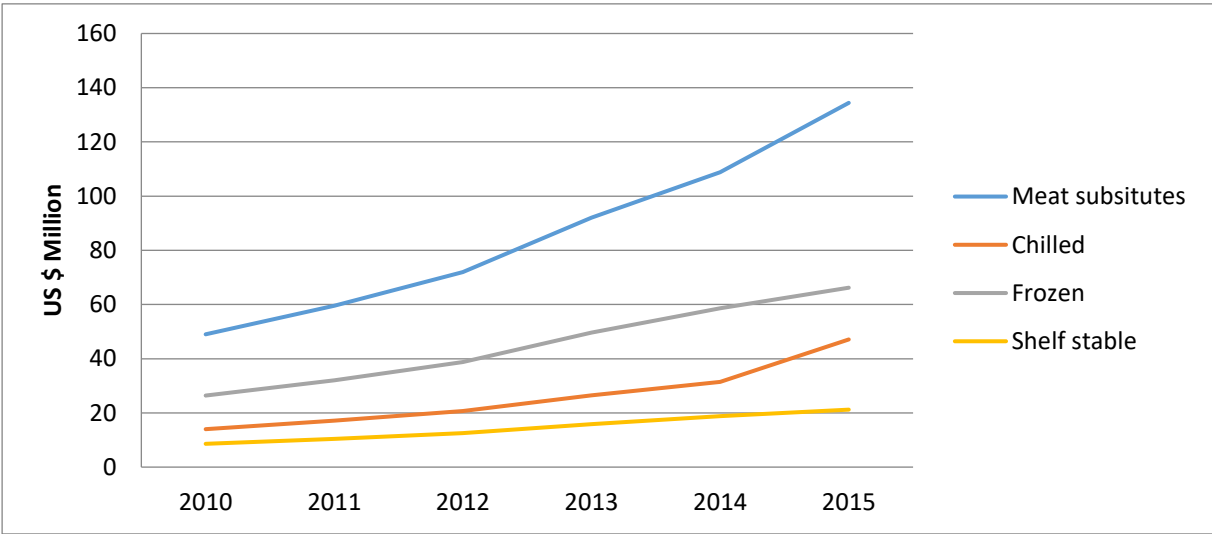


Figure 4 Meat substitute sales in Germany 2010-2015; Source: Agriculture and Agri-Food Canada. Statista.com

However, compared to sales of meat products the sales of meat substitutes are very low. In Germany meat substitutes grew from 0.3% of the sales of processed meat in 2010, to 0.9% in 2015. So far the available statistics do not reveal any tendency of a substantial or exponential growth of meat substitutes that is noticed by the meat industry today.

The plant protein trend is nevertheless manifesting itself clearly, and it has been noticed by the Norwegian food industry. Several Norwegian firms, as they learned about the trend in other European countries, responded by starting to sell meat replacement products under their own brand names. One of the first movers launched their first (imported) vegetarian burger under their own brand name in the spring of 2016. The product was exhibited at the ANUGA food fair in fall 2015 as novelty. Other firms launching their own products quickly followed this. Product development is still taking place, and new plant-based products are launched regularly from several firms and retail chains. According to one interviewee market growth in Norway was approx. 80% from 2016 to 2017, but as in other countries, the share of alternative products vs. meat is low and in the range of 2%.

Plant proteins are not only used for meat substitute products. In the EU, pea proteins are also used in other products, such as bread and bread products as shown in Figure 5. The figure also shows that most of the new pea protein products launched between 2010 and 2014 were used as meat extenders and functional ingredient in poultry and other meat products.

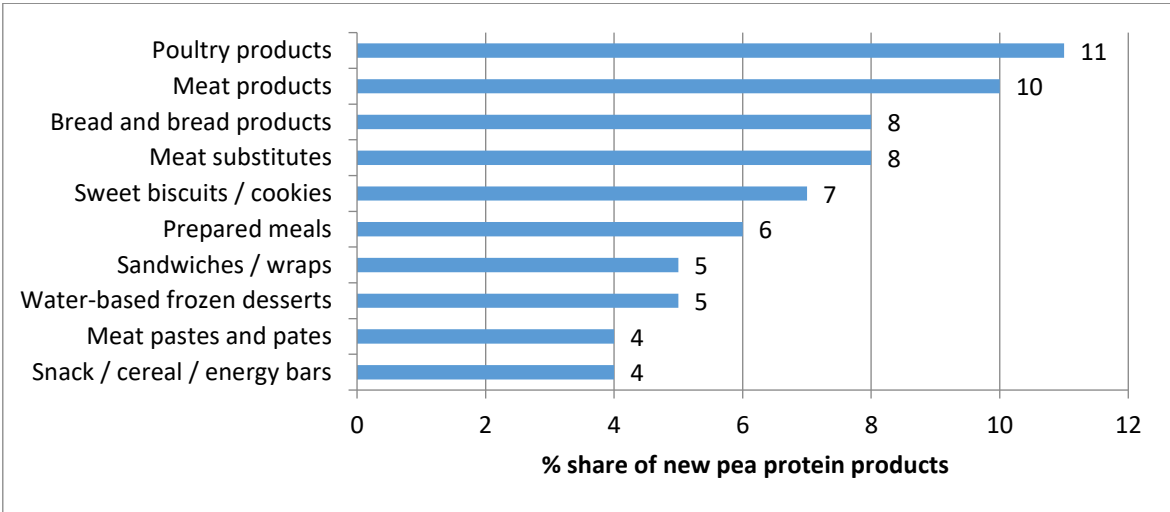


Figure 5 Share of new products with pea protein launched in the European Union from 2010 to 2014, by category. Source: Agriculture and Agri-Food Canada; Mintel

Furthermore, global new launches of dairy free milk products have a 20% compound annual growth rate (CAGR) of 20% in the period from 2012-2016 [Innova market insights 2017] compared to 14% CAGR of meat substitutes in the same period.

In this report, the main focus will be on **meat substitutes or meat analogues, dairy substitutes, and unprocessed pulses**. The reason for not focusing more on other products is that there is less product development in the Norwegian industry for other plant protein products, and from a climate and health perspective products that are not used as substitutes for meat or dairy are less relevant.

2.2 Who eats plant proteins?

The increase in the sales of meat substitutes is likely linked to an increase in the number of people who want to reduce their meat consumption, completely as vegetarians or vegans, or partly either as so-called flexitarians or meat reducers. In a recent trend study it was found that in Germany the number of consumers following a low-meat diet increased from 26% in 2014 to 44% in 2017 [Report Buyer 2017]. In the same period, the number of vegans in the US increased from 1 to 6% (Ibid).

A survey from the UK in 2017 found that the percentage of respondents saying they have reduced their red meat consumption increased from 9 to 14% from 2016 to 2017, and the number of vegetarians increased from 7 to 9% [Ethical Consumer 2017].

In Norway, survey data from Norsk Monitor show rather stable numbers for people who claim to never eat meat for dinner (around 4%). From 1987 to 2011 there was a clear decrease in the percentage of the Norwegian population who claimed to eat meat for dinner only 1-2 times a week (shown in Figure 6) or 2-3 times a month. However, the numbers from the last years show a slight increase, from 38% in 2011 to 41% in 2015.

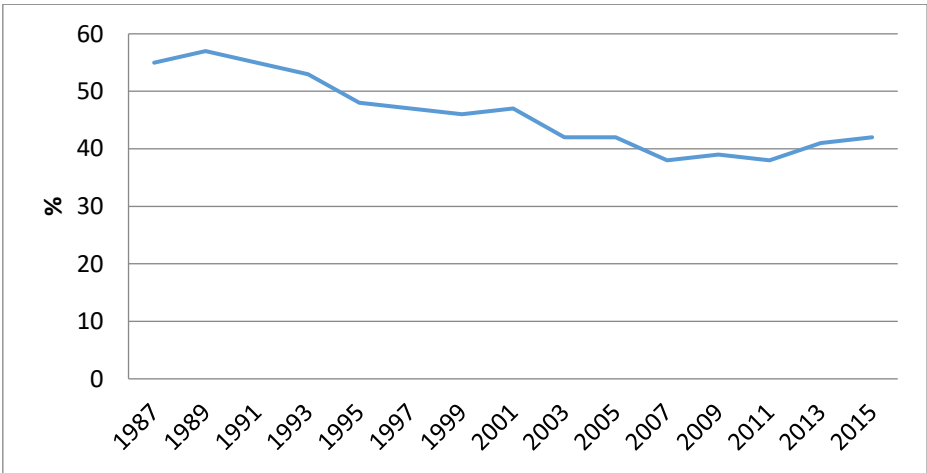


Figure 6 Share of Norwegian population eating meat for dinner 1-2 times a week; Source: Norsk Monitor

Important motivations to reduce meat intake are related to health, environment and animal welfare. An increasing number of medical studies find links between meat consumption and health problems such as cancer and cardiovascular diseases [Richi et al. (2015), Boada et al.(2016)]]). In 2011 the Norwegian Health Authorities added a recommendation to their dietary guidelines about not eating more than 500 grams of red meat per week, which is above the Norwegian average consumption. The WHO made similar official statements. This information is likely to have increased the popular awareness of the adverse health effects of a diet based on a high level of meat consumption.

There is also increasing awareness of the negative effect meat consumption has on the environment, and it is particularly ruminant meat that has the highest effect. Ruminants emit methane, which is a greenhouse gas approximately 25 times more potent than CO₂. In addition, as animals are higher up the food chain than plants, they require more land and water, and compared to plants their impact is generally higher for both global food security and biodiversity (see figure 1 earlier in the report).

But some surveys reveal that people also reduce meat for other reasons than health and environment, such as animal welfare. Saving money is another possible motivation, but according to a Nordic survey from 2015, economic reasons were the least important motivation for meat reduction in all countries except Denmark [YouGov 2016]. In a Dutch survey where people were asked why they sometimes eat vegetarian, the alternative that got the most answers was “variety in meals” [Stichting Natuur en Milieu 2017].

There are also some demographic differences between people who choose to eat less meat and those who do not. The figure below is based on data from a survey by Norsk Monitor from 2015, with 3981 respondents. As can be seen, women under the age of 25 are overrepresented among those who have low meat consumption, in this group there are 7% who never have meat for dinner, and 11% who have meat for dinner only once a month or less, compared to 4% and 7% for the total population. The difference is statistically significant.

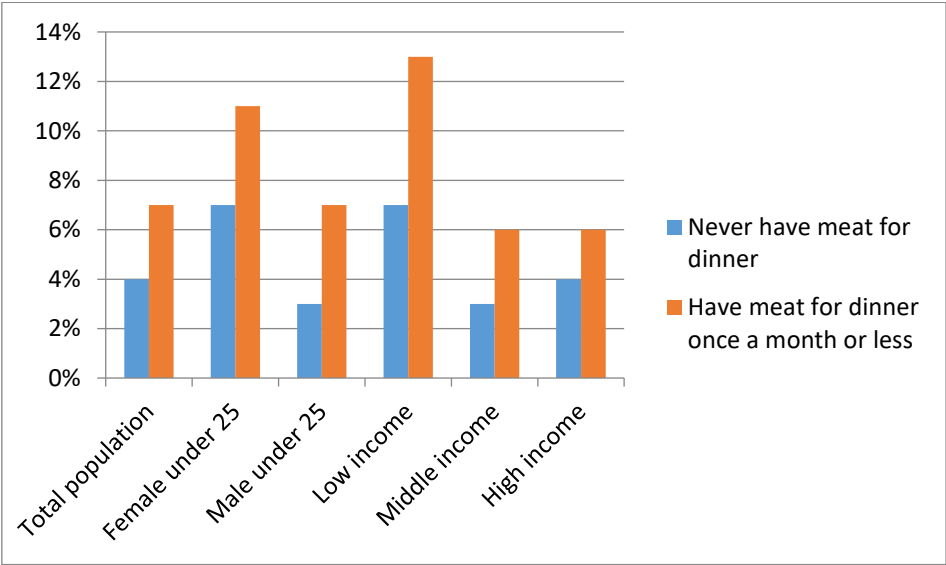


Figure 7 Share of population with low meat consumption Norway 2015; Source: Norsk Monitor

The data also shows that the share of people consuming little meat among people with low total household income (less than 400 000 NOK) is higher than for middle (400 000-1000 000 NOK) or high income (above 1 000 000 NOK) groups. This could be an indication that Norwegians have low meat consumption or reduce meat consumption for financial reasons, but the question needs to be analyzed further before any conclusion can be drawn.








According to our interviews, a concentration of high turnover of meat free/dairy free products is generally observed in urban environments, often in proximity of universities where many young and highly educated consumers live and work. Less interest and sales in the new product categories is currently seen in rural areas. The interviewed companies also describe a tendency towards younger and female consumers as being the ones most interested in the new plant protein products.

3 Plant protein products in the Norwegian and international market

3.1 Norwegian branded products available in Norway

As mentioned above, there is already a substantial number of plant-based products available in the Norwegian retail market. Some of these have Norwegian brand names and are produced especially for the Norwegian market, either in Norway or abroad. In December 2017 we find 23 different fresh or frozen vegetarian meat substitute products (sausages, burgers etc.), plus different kinds of cold cuts, cheese and vegetarian ready-made dishes with meat substitutes, altogether 36 vegetarian products under Norwegian brand names. The majority of the products are made from egg protein (9 products) followed by soya (8 products). In addition, an unknown, but certainly increasing, number of imported vegetarian meat substitutes is now available in Norwegian mainstream supermarkets, both frozen and fresh.

Table 1 Examples of Norwegian branded meat replacers and plant-protein rich products (images from store visits & company websites)

Coop vegetardag series	Norwegian produced meat replacers based on <i>egg white and pea protein</i> but also some products produced abroad (vegetarburger, bean pasta) https://coop.no/merkevarer/dagligvare/coop/coop-vegetar/DetteerVegetardag/	
Meatish (Nortura)	Minced meat, burger, and bites made from – <i>Norwegian egg white and imported soy protein</i> produced in Norway sold at Rema 1000	
Meatfree weekday (Finsbråthen)	Nuggets, burger and meat balls based on <i>soy protein</i> sold in MENY stores (production location unknown)	
litt mat (Fjordland)	Small salad dishes with <i>grains, beans, and lentils</i>	
Bare Bra (Orkla)	Super rice with <i>quinoa, buckwheat and black beans</i> from Toro	
Liv laga vegetarburger (Hoff)	Burgers made form potatoes and brown lentils, produced in Norway https://livlaga.hoff.no/	
Havregryn (Axa)	Protein oatmeal from Norwegian oats with added pea protein	

There are many ready-made dishes that are vegetarian but come from large suppliers and deliver products under established brands, i.e. Findus' ready meals under 'World Selections - 100% Greens', Fjordland's chick pea dish; Unil's (Norgesgruppen) 'Fersk og ferdig digg vegetar' ready meals.

In Norway the market is still comparably small, though with increasing attention and many new product launches addressing the increasing consumer interest in reducing their meat consumption. Historical data is not available as the categories are very young and products are often hidden in other product categories in the existing databases. We therefore conducted our own data compilation based on the retail chains sales numbers and product codes. As can be seen in Figure 8, meat replacers are a very small category of products so far. Unprocessed legumes are high in volume but low in retail value. The highest value products in the market are meat replacers and cereal bars as well as new chips/snack types. Breakfast cereals and snacks&nuts categories are likely overrepresented in the chart because it was not possible to sort out only the plant protein ones.

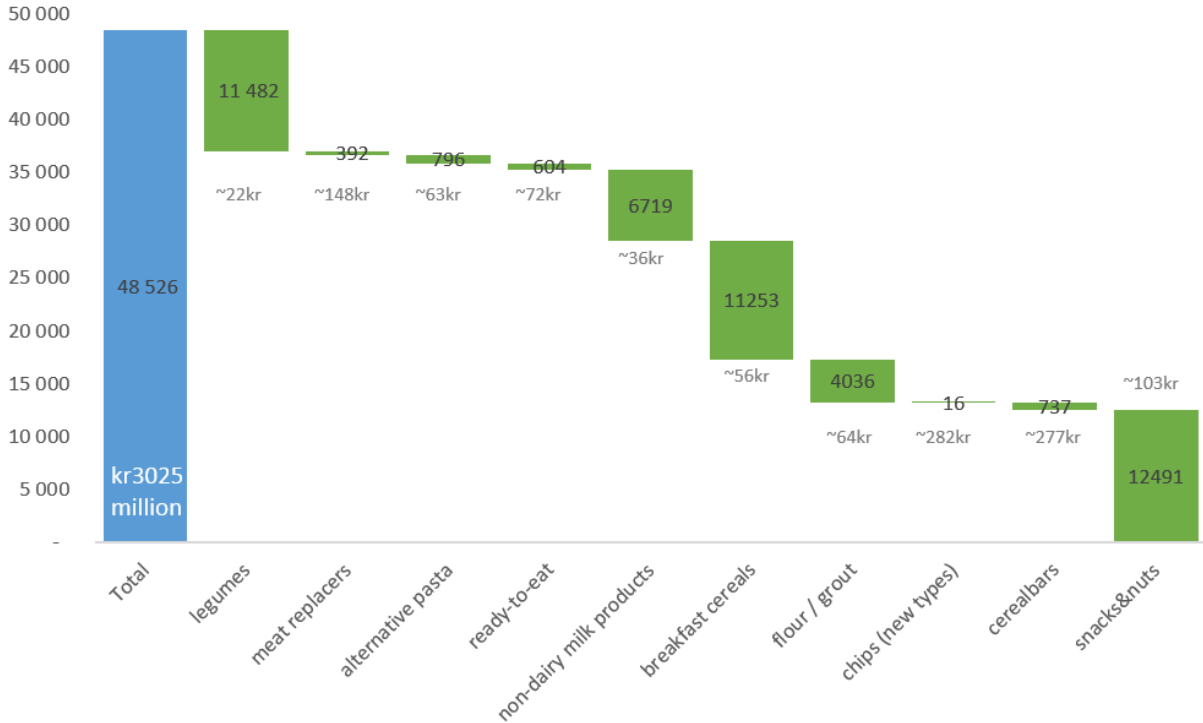


Figure 8 Sales of products containing plant proteins in Norway (retail, service, large-scale kitchen) in 2016 in tons, numbers in grey are average prices in kr per kg; Source: Flesland Markedsinformasjoner AS









3.2 Internationally branded products available in Norway

Imported meat and dairy substitute products have been available in Norwegian supermarkets for many years, but it is impossible to detect any numbers from the SSB import statistics, as they are categorized under different classifications gathering many different types of products, among which many are not plant protein products. It is therefore not possible to state anything about the import development in this market segment using numbers from SSB.

The below table gives an overview over products we found during store visits and desktop research activities. Soy protein seems to be the most commonly used protein source but the variation ranges

from oats, lupine, wheat protein (gluten) to mycoprotein. Products generally aim at replacing traditional meat or dairy products with a modern twist on brand image, packaging design, and exciting tastes.






Table 2 *Examples of internationally branded meat replacers and plant-protein products* (images from store visits & company websites)




<p>Vegme</p>	<p>Burger, meat balls, minced meat made from <i>soy protein</i> produced in Sweden and exclusively used and distributed by Bama in Norway for their food service business and MENY http://www.vegme.se/</p>	
<p>Oatly</p>	<p><i>Oat-based</i> milk, drinks, yoghurt, and ice cream products made in Sweden www.oatly.com</p>	
<p>Anamma (Orkla)</p>	<p><i>Soy protein</i> and one <i>chickpea</i> product produced in Sweden, introduced by Orkla for the Norwegian retail and food service market https://www.anamma.eu/</p>	
<p>Oumph! (FoodforProgress)</p>	<p>Meat chunks from <i>soy protein</i>, produced in Sweden, product of the year 2017 in Norway, sold in Norgesgruppen stores https://oumph.se/en/</p>	
<p>Likemeat</p>	<p>Beef strips and chicken chunks made from <i>soy protein</i> produced in German and sold in Norgesgruppen stores https://likemeat.de/en/homepage-en/</p>	
<p>Vivera Vega</p>	<p>Minced meat, filets, burgers, meatballs, and bytes made from <i>US soy protein and dutch lupine protein</i> in the Netherlands sold mainly in Norgesgruppen stores https://www.vivera.com/en</p>	
<p>Hälsans Kök (Nestle)</p>	<p>Nuggets, minced meat, meat balls etc. from <i>soy and wheat protein, chick peas</i> sold in Coop, Spar, Norgesgruppen https://www.halsanskok.no/</p>	
<p>Quorn (Marlow Foods)</p>	<p>Minced meat, filets, and bytes made with Mycoprotein™ from <i>fusarium venenatum</i> and <i>egg white</i>, produced in the UK www.quorn.no</p>	

3.3 Internationally branded products not available in Norway

We extended our product search and analysis to products that are not available in Norway in order to expand our insights and knowledge and possibly discover some similarities and differences, which could translate to opportunities in Norway.

Table 3 Examples of meat replacers and plant-protein products not available in Norway (images from store visits & company websites)

<p>Beat (FoodforProgress)</p>	<p>Paste based on Swedish <i>faba beans</i> for mixing into food products (service market) and ready cakes and bean balls (private market) produced in Sweden https://www.eatbeat.se/</p>	
<p>LUVE (Prolupin)</p>	<p>Milk, icecream, desserts, sour cream made from <i>lupin protein isolate</i> www.madewithluve.de www.prolupin.com</p>	
<p>Rügenwalder</p>	<p>Meat replacement products charcuterie, spreads, and snacks based on <i>soya, wheat, peas or eggs</i> produced in Germany https://www.ruegenwalder.de/en/vegetarian-products</p>	
<p>Beyond meat</p>	<p>Burger, chicken strips, minced meat based on <i>soy protein, pea protein (isolates), amaranth, and yeast extract</i> produced by wet extrusion in Missouri, US www.beyondmeat.com</p>	
<p>ROBI (Eurobi)</p>	<p>Burger, minced, filet, bacon, sausage based on <i>wheat protein and beetroot</i> produced and sold in Czech Republic http://eurobi.cz/eng/</p>	

Pulled oats (Gold&Green Foods)	Pulled meat replacement based on Nordic oats 21%, European pea protein 21%, and faba bean protein 11% produced in Finland http://www.goldandgreenfoods.com/	
Impossible Burger (Impossible Foods)	Burger made from wheat protein, potato protein, soy protein, yeast extract produced in the US only sold in selected restaurants in the US (California), leghemoglobin gives meat like color and color change during preparation www.impossiblefoods.com	
Vegetarian Butcher*	Burger, minced, filet, bacon, sausage, charcuterie made from soy protein, wheat protein, egg protein produced in the Netherlands sold in Europe https://www.thevegetarianbutcher.com/	

* found in some niche market specialty stores in Norway

3.4 Production and consumption of pulses in Norway

Pulses such as beans, peas and lentils have been available in the Norwegian market for a long time. These are plant products with a high content of protein, and can be used as replacements for animal products in various dishes. According to some of the interviewees, there seems to be an increase in demand for pulses in Norwegian supermarkets, but the trend is far less evident than for the meat analogues.

Both peas, snowpeas and beans are produced for use as food in Norway¹. The main types of beans produced in Norway are French beans, broad beans, green beans, haricot beans and wax beans. According to a Norwegian bean producer, Norwegian beans such as wax beans and haricot beans have a better taste than imports, probably because it needs more time to ripen due to the colder climate. But with a short growing season it is also a challenge for the beans to become ripe before the weather gets too cold. The peas and beans are sold to both supermarkets, commercial kitchens and industry. Producers of beans and snow peas have experienced some increased demand over the last few years. Norwegian snow pea producers are competing mainly with imports from so-called LDCs (least developed countries) whose commodities do not have tariffs when sold to Norway.

The figure below shows Norwegian import of beans, peas and lentils in the period 2011-2016. In this period, the total import of beans increased by 57%, lentils by 31%, while import of peas went down by 7%. Peas are used traditionally in Norwegian cuisine as a side dish to fish and meat, or as a traditional soup with meat stock. The decrease in pea consumption may possibly be explained by a shift of generations as cohorts eating more traditional food are replaced with new ones who have adopted new food habits. Nevertheless, information about both Norwegian production and imports of pulses indicate that there is a tendency for increased consumption of these products.

¹ According to Totalkalkylen, the amount of garden peas produced in 2017 was 3770 tonnes, and the amount of beans 812 tonnes (<http://nilf.no/statistikk/totalkalkylen/2017/BMgrupper/Totalkalkylen-Hagebruksprodukter>).

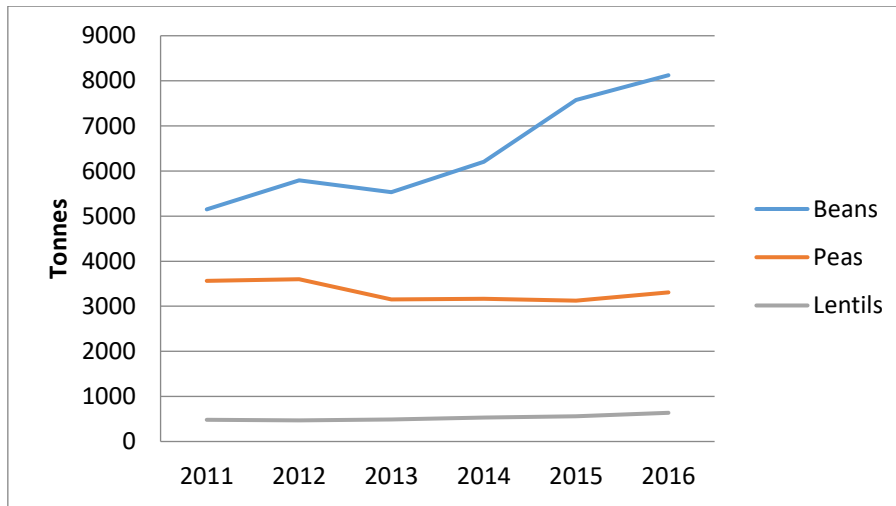


Figure 9 Norwegian import of beans, peas and lentils in the period 2011-2016; Source: SSB, import statistics

4 Production of plant protein products

4.1 Necessary qualities for a successful product

Most of the interviewed firms had at some point been doing their own product development, or they were in the process of developing new products. Most of those interviewed were focusing on meat analogues. The advantage of these products is that they resemble products that most consumers are familiar with, such as burgers, sausages, nuggets etc. This can make the switch easier for those who want to eat less meat and more plant based, but who are unfamiliar with how to prepare vegetarian food.

When asked which qualities would characterize a successful plant protein product, most firms mentioned good taste and low price. Concerning meat analogues, it was also by some seen as important that the products are handy and easy to prepare, just like ready-made meat products. Several also mentioned that getting the right texture was important, but challenging. Feedback from consumers is that they want something to chew on, a “bite”, meaning some resistance in the texture, so the product should not be too soft. It is also important that the product does not get too dry, which, according to one of the interviewed, can be the result if there is too much protein in the product. Many producers solve this by using a texturizing process on protein extracts in order to get the right structure and mouthfeel and resemble meat. Meat replacement products that are not based on this process seem to get their coarse texture from bits of vegetables or other processes.

An interesting question is whether products that resemble meat are more popular than those who do not. Many products are similar to meat to the extent that one almost cannot tell the difference (as claimed in the review of the product “Meatish” [Dagbladet 8.3.2017]). But sales are also going well for products that clearly define themselves as vegetable based and make no claims of resembling meat other than by their shape and way of preparation (such as Hoff’s “Liv Laga” burgers and balls and Coopss “Vegetardag” burgers, whose main ingredients are either potatoes, beetroot, mushroom or green haricot beans). A survey from the Netherlands from 2017 found that 50% of the respondents answered that meat substitutes not distinguishable from real meat would give them incentives to eat them. For consumers who like meat, but want to cut down their consumption on it, being able to eat these types of products might be a good solution. But those who dislike meat might also dislike meat analogues resembling meat. An informal survey made at the Facebook page for vegans or people interested in vegan food (“veganerpreik”) showed that a small majority of the respondents preferred products that did not resemble meat at all.

Some interviewed firms also mention that product claims may increase the attractiveness of the products. These are attributes of the product that cannot be perceived directly, but that give it added value, such as environmental friendliness, healthiness or use of Norwegian and local ingredients. Such claims are to some extent used on the packaging or advertisement for the existing products. For instance, the names of the product series “Meat free weekday” by Finsbråten, and “Vegetardag” by Coop are clearly an indication that the products are meant as vegetarian alternatives to meat. Most of the “Vegetardag” products have the claim “sustainable” marked on the package. Hence, the producer is trying to convey a message that the product has other values than what can be perceived directly from consuming it. To a less extent, the producers claim that the vegetarian products are healthier than meat based products, and several of the interviewees insinuate that it is more difficult

to make evidence-based claims concerning the health benefits of eating meat analogues instead of meat, than claims about environmental sustainability.

It is important that the plant-based products are healthy and natural, which for instance means it should not have too many additives. But as explained by one of the interviewed, this is a general trend for all products and not specifically for meat and dairy replacement products. Another interviewed firm was concerned about creating products that were not too salty, as they participate in a campaign with Norwegian Health Authorities to reduce salt intake in the population (“Saltpartnerskapet”).

Another aspect to take into account is whether one should develop a product that caters for those who are strictly vegan or not. Vegans will not purchase products that contain milk or egg, and although they represent a small share of the population, they can turn out to be the most loyal customers. Some of the interviewed said this was a factor that they had taken into account, and one said that negative feedback from vegans made them decide to not add cheese to one of their burgers. However, although catering for vegans or vegetarians is seen as important, it may not necessarily be strategic to label the products as such. In an international context there seems to be a beginning trend to move away from vegetarian labelling and claims towards a “plant based” claim in order to appeal to a broader spectrum of consumers and not just vegetarians and vegans [Foodnavigator 2018].

4.2 Product development and production processes

Most of the interviewed producers said they had the idea of starting to produce their plant-based products from trend reports or visits to international food fairs. Some also said they had developed the product in collaboration with the supplier of the raw material. They had chosen different strategies: Produce their own product in Norway, import products and brand them with their own name, or import products already belonging to a foreign brand name such as Koolen or Oumph!. In one case, a firm had recently bought a foreign company producing meat analogues, in order to gain a market share in this product category.

The products manufactured in Norway today are mainly produced using the same machines and technology that are used for other products produced at the same factory. This means that there is no investment costs for new machinery. Elaborated ingredients such as soy protein extracts are imported from abroad. There are at least two factories for milling and processing pea protein in Norway. One of them produces pea protein concentrates for one of the Norwegian vegetarian product series. Hence, there are already established factories in Norway with the capacity to deliver ingredients for plant-based products that require more advanced processes, such as the fractioning of peas into protein, fiber, and starch. Presently there are no factories in Norway doing the wet texturizing (extrusion) process, which is used to create the fibrous meat texture. The products made today particularly for the Norwegian market are based on simpler processes known in the respective industry, using the same machines as the ones used for producing processed meat products. However, imported texturized products (such as Oumph! and Quorn) are available under foreign brand names.

The competency regarding raw materials and product development is in many cases obtained through suppliers (from outside Norway) and there is a clear need to build up knowledge in Norway to enable further product innovation.

4.3 Production costs and sales price

The prices of meat analogues in Norwegian supermarkets vary, but in general they are priced as high or higher than meat from animals. More specifically, meat analogue prices are generally higher than processed meat products, but lower than high quality meat products such as beef rib steak. A low price is an important driver for increased demand, and factors influencing costs and sales price are important to understand.

When asked what the most significant cost factors in the production of meat analogues were, most of the interviewees said it was the raw material used as ingredients. Labor costs may also play a certain role, and one of the interviewed indicated that there might be economies of scale in the production process, as the quantities produced presently are quite small, but still requires a given number of employees. According to a manufacturer of machines used in the production of meat analogues, it is typical that for producers who are in the first stages of building a market, labor costs will be more significant, since using labor instead of investing in machines gives more flexibility. For already established factories producing larger quantities, production processes might be highly automated, there are possibilities for increased production without adding employees, and labor costs are therefore less important.

Costs and sales price can also possibly increase because the product series are small and therefore transport and other distribution costs per unit are higher than for larger series. This effect should decrease with larger quantities produced. Another reason for high sales prices for meat analogues is the high willingness to pay among the buyers of these products. In this study, we have not searched for, and hence not found any evidence of overpricing of Norwegian meat analogues taking place. However, if this is the case, more competition in this market should reduce the producers' and distributors' possibilities for taking higher margins on these products than for other food products.

This indicates that on the one hand, a producer selling larger quantities may lead to lower unit costs because of possible economies of scale in production and distribution. However, if the producer has a large market share and there is little competition for customers, it is more likely that overpricing will take place.

Concerning technological development, it is claimed that the machines used for producing meat analogues have been around for 30-40 years, and although there have been improvements; the machine technology has not changed very much. The process where there has been most change is in the die process, where the final shape of the products is made. In addition, the price of machinery has been pretty stable.

The fact that there is no custom payment/tariff for imports of processed plant protein products makes it easy to import products either under Norwegian brand name or as a foreign brand. Production capacity in Europe is large and growing. Under these conditions, it is considered risky to build up large new production capacities in Norway, which may explain the preferred use of existing capacity, equipment and product concepts.

4.4 Raw material

The interviewed producers use a range of different ingredients as raw material for their products. Egg protein, soya and pea protein are the most commonly used ingredients, but one of the main Norwegian vegetarian series is based on potatoes. Only the egg protein and the potatoes are produced in Norway. The rest, including the peas, are imported.

Important factors influencing the choice of raw material used for the Norwegian meat analogue product series are, naturally, the qualities as ingredients giving the best taste and texture, and price. However, there is an interesting ongoing debate about soya. The ingredient seems to have a negative connotation due to its reputation of being, firstly, largely GMO modified, and secondly, produced on previous rainforest land, and therefore attributed the negative consequences of rainforest logging. The comparison with palm oil, an ingredient explicitly boycotted by many consumers and therefore removed from many products, is being made. However, since soya has some valuable qualities as an ingredient in meat analogues it is still largely in use. There are some indications that peas do not have the same qualities as soya, because the pea protein does not provide the same texture as soy protein, and also the pea taste is a challenge. However, some of the interviewed seem to believe that soy-free products are preferred by many customers, such as Coop who is labelling their “Vegetardag” series with “No soya”. It has also been insinuated that soy is preferred to peas because of its lower price, but this is questionable. The graph in Figure 10 below shows that the world average producer price of soy and peas has followed each other closely since 1990, but that pea prices have been higher since 2006. The difference was largest (21%) in 2011. We do not know if this is a lasting trend.

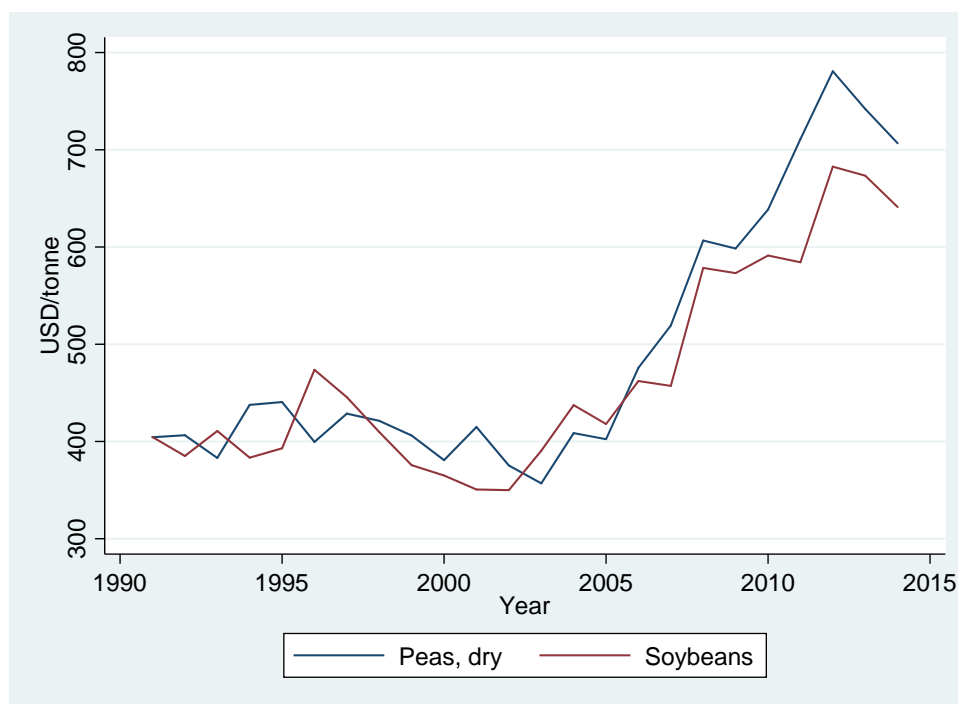


Figure 10 Global pea and soy bean price development; Source: FAOSTAT, average producer prices USD/ton

The price of the raw material is highly important, as many see it as one of the main cost factors in the production process. The question of raw material price is therefore essential in the discussion about whether or not Norwegian raw materials are interesting for producers of plant protein products. Agricultural production costs are higher in Norway due to climatic conditions and higher labor costs,

and Norwegian produced raw material will therefore generally be higher. Being able to use a “Nyt Norge” branding on the product may increase willingness to pay by customers, but there is uncertainty about how much more they are willing to pay, especially for processed products where quality differences in raw material are difficult to detect. Some Norwegian agricultural products are well protected from import by high tariffs, and for some vegetables, the tariffs vary with the season in order to give Norwegian products a competitive advantage during the period they are available. But this is not the case for all products. Fresh peas and beans have a tariff (9.29 or 5.31 kr/kg respectively), but dry peas and beans do not, except the ones used for animal fodder [Tolltariffen 2018].

This means that for Norwegian produced dried peas and beans to be used as ingredients in processed plant protein products, they have to be produced at prices that are competitive with international market prices. There are vegetables produced in Norway that are not benefitting from tariffs, such as broccoli. But this is a fresh, easily perishable product, and this gives Norwegian broccolis an advantage because of the shorter travel distance. This is not the case for dried products.

The graph below shows the development in the price for dried peas, on average in the EU and Norway since 2001. Except for a short period around 2007, the Norwegian prices have been approximately 50% higher than the average EU prices.²

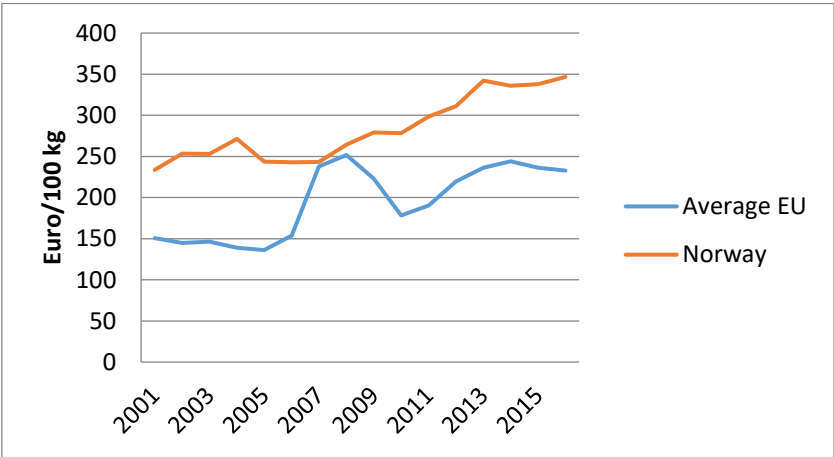


Figure 11 Price development peas; Source: Budsjettnemda/Totalkalkylen and Eurostat

Another product that might be used as an ingredient in processed plant protein products such as meat analogues, are oats. Oats are protected with a tariff of 1.52 kr/kg year round. In 2016 Norway produced 343 000 tons oats [Totalkalkylen 2018]. Of this only approximately 12% is sold as food, the rest is used as fodder for animals [Eldby and Thuen 2016]. The amount of peas sold the same year was only 5000 tons for peas sold as fodder, and 3700 tons for garden peas. A production of approximately 4000 tons of peas are expected for 2017/2018 [Landbruksdirektoratet 2018]. The low level of pea production in Norway is a major reason why Norwegian firms producing and using pea protein are using import instead of domestic peas. Faba beans are currently produced mainly for animal feed and in 2012 the production was 3250 tons [Stabbetorp and Lundon 2013].

² The Eurostat database misses data on dried peas from many countries, and the average is not complete. Most of the countries which have a complete list for all years are Eastern European. It has also not been clarified to what extent the two data sources are comparable, except that in both cases the data concern dried peas.

As shown in the figure below, oats has a similar price development as peas, and on average through the period, the Norwegian prices are 60% higher than the EU prices.

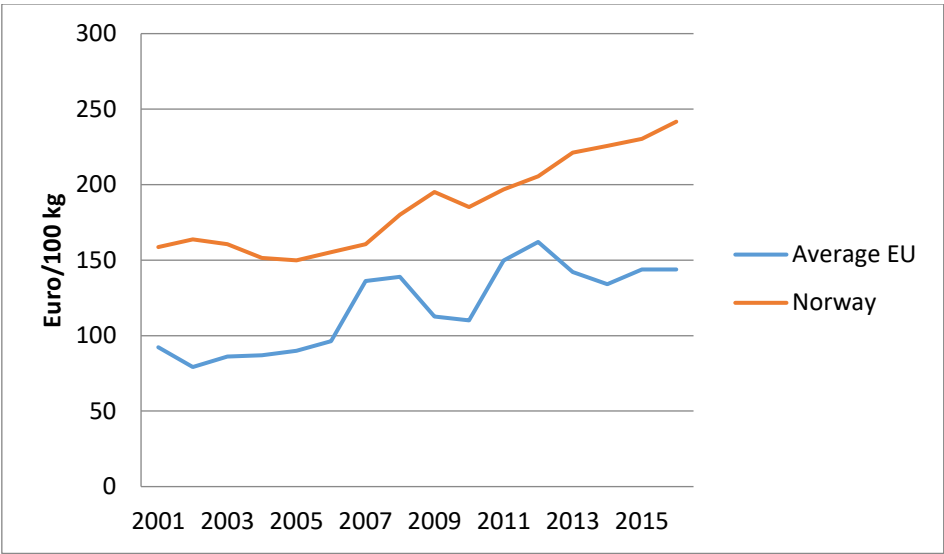


Figure 12 Price development oats; Source: Budsjettnemda/Totalkalkylen and Eurostat

If Norwegian produced peas and oats are compared, oats has two advantages: One is that oats are produced in much larger amounts than peas, the other is that, although the producer price of Norwegian oats is higher than in the EU, oats are benefitting from import protective tariffs, which dried peas for human consumption are not, only fresh peas.

5 Expectations concerning future market development

Most of the interviewed companies claim to be satisfied with the market development for their plant protein products so far. The only exception is a firm catering to commercial kitchens, who experienced that their inability to meet demand quickly enough opened up for other competitors in the field, thereby making them lose market shares. The interviewees expect a further growth in the vegetarian meat analogue and plant protein sector, but they do not expect this to grow “into the sky”. This reflects the growth charts shown at the beginning of the report, where high, but not exponential growth is seen in this market over the last few years. Nevertheless, several interviewees point out that in the future the necessity to replace meat with other protein sources will inevitably manifest itself, which makes it unlikely that these types of products will turn out to be just a flop. In the shorter term, the extent to which there is a strengthened focus on health and sustainability will determine the growth magnitude of this market segment.

The extent of further growth also depends on the product’s price, and whether or not it will be low enough to be affordable also for those with low income (typically the young people who are overrepresented among adherents to vegetarian or low-meat diets). The price of meat is also mentioned as a contributing factor. An increase in meat prices will give plant based meat analogues a competitive advantage and may contribute to further growth in demand.

What happens to product development is also important, and one factor mentioned by several, is whether one is able to develop meat analogues with a beef texture. The chicken texture is easy to imitate, but “plant based beef” is today only produced as minced meat but not as whole meat. Work is being done to also be able to produce products with the same texture as beef.

Product development for plant protein products other than meat analogues is another important factor. Pasta, bread, and snacks containing proteins from pulses have recently entered the market, and may gain larger market shares with time. As it is still uncertain whether these types of products are used as replacement for animal based products, or just in addition to animal based products, we do not know if this will have a positive environmental impact in the form of meat reduction.

Some of the interviewees mention that plant protein products also in the form of drinks etc. are interesting not only for the regular consumer but also for particular consumer groups such as hospital patients or elderly people, with a need for nutrients, but a lack of appetite. This market segment may prove interesting for producers of plant protein products.

Regarding plant proteins in the form of whole beans, peas and other pulses, there seems to be expectations of market growth also in this segment. One of the interviewees indicates that beans and peas sold whole, and not in processed products, might have an advantage because they are perceived as safer and more natural, because they are unprocessed and there are no ingredients that are invisible to the consumer.

Another interesting question for the future is whether or not it will be worthwhile to use Norwegian raw material as ingredients for plant protein product. This relates to the future price development and availability of these ingredients, and the consumer willingness to pay extra for products with Norwegian ingredients. Presently oats exceed pulses by far in terms of availability, and oats have a more competitive price due to the fact that it is protected by import tariffs and because it is more

difficult to produce pulses than oats in Norway due to the country's geographic location and climate conditions. Bean and pea production might increase in the future, and it will be interesting to see the development in the market for fresh peas and beans, which seem to be increasing. However, dry beans and peas for human consumption have the disadvantage of not being protected with import tariffs, and it is difficult to compete with products from countries where production costs are lower than in Norway.

6 Discussion: What is needed for plant protein products to succeed in Norway?

As we have seen, there is already a large amount of plant-based products on the Norwegian market, and even more products so far only sold in countries outside Norway. The Norwegian industry will need to compete with imports in order to gain larger market shares with their own products. Here we present some of the key factors that we believe are important in order for them to succeed.

6.1 Knowledge on markets, technologies, raw materials, and consumers

Although plant protein products have been on the market for many years, it is only recently that they have become mainstream and available in most supermarkets all over the country. Not many years ago, they were products mainly found in specialty stores. There is therefore not much knowledge yet about these products among producers and consumers. Norway is a late arriver at this market segment, and those who have started to produce within the country are using simple technologies and purchasing processed ingredients from abroad. Knowledge in Norway about both old and new technologies for processing plant protein is therefore lacking. The same can be said for knowledge about raw materials as ingredients and their properties and interactions in a final product. This includes knowledge about nutritional and sensorial values, as well as functionality. Without this knowledge, it is difficult to build up a large-scale domestic production of plant protein products. In order to be able to use Norwegian ingredients in these products, or to increase the variety of pulses that can be consumed fresh, it is also important to gain more knowledge about optimal production methods. This includes for instance more knowledge about how the protein content of oats can obtain the levels that are necessary in order to be a functional ingredient in processed products.

Furthermore, it is also important for the industry to gain more knowledge about consumer preferences towards plant protein products. This concerns both what types of products the consumers are interested in, how the products should be presented in order to consumers to be interested in purchasing them, and what are the barriers that prevents consumers from trying these products and from repurchasing them. For instance, it should be further explored what consumer preferences are concerning meat replacement products, and to what extent it is important to develop products with a high similarity with real meat. These products will for some consumers appear unnatural and therefore not healthy, and these consumers might prefer products with more unprocessed ingredients, such as whole beans. In addition, protein deficiency is not a problem in the developed world today, and by using the whole bean instead of only the extracted protein, you create a product with other qualities such as a higher fiber content, which has important health advantages. Another interesting aspect to explore is consumer preferences towards organic plant protein products. In countries such as Spain and Germany processed plant protein products are mainly found in the organic market segment, while in Norway the products are mainly conventional. This knowledge is important for the industry in order to develop the type of products that there is demand for in the market. Norwegian preferences are likely to be different from consumer preferences in other countries, and it is not sure that just copying other countries' product is the best strategy.

On the other hand, there is also a lack of knowledge among consumers about these products. Many Norwegian consumers are unfamiliar with plant proteins from for instance pulses as alternatives to

animal based proteins, contrasting with consumers further south in Europe, where beans and lentils are used more frequently. There is a need to increase consumer knowledge levels about both the nutritional values of these products, and about how to prepare them.

6.2 Innovation outside the comfort zone

The many varieties of different plant protein products, and the fact that new varieties are still appearing at the market regularly, indicate that there is still a lot of room for innovation in this market segment. Innovations are necessary both in terms of improved taste, texture and other quality aspects, on economic production technologies, use of different raw materials etc. However, in order to be innovative, it is sometimes necessary to have some radical thinking outside the “comfort zone”. If only the established companies dominate the market, it may be difficult to achieve this. It is worthwhile to note that many of the plant based products with the biggest international market success stem from research projects and/or newly established companies. Examples of this are some of the earlier mentioned products and companies from both Sweden and Germany:

- *Food for Progress* was founded by two people in Sweden in 2012 with the mindset of changing the food system logic and use co-creation as fuel for innovation. Today their products sell successfully throughout Scandinavia and won the “product of the year prize” in Norway in 2017.
- *Oatly* was founded in the 90's after researchers at Lund University made the revolutionary discovery that natural enzymes can transform fiber-rich oats into nutritious liquid foods, perfectly adapted to humans.
- The company *Prolupin* producing the lupine based product series LUVE was established 2010 as spin-off from Fraunhofer Institute for Process Engineering and Packaging IVV).
- The mycoprotein based product *Quorn* from Marlow Foods was developed at the Rank Hovis McDougall (RHM) Research Centre when they investigated converting their waste starch into a protein-rich food for human consumption.
- The German meat product company *Rügenwalder* has disrupted their own market of charcuterie and spreads by producing vegetarian alternatives based on soy, pea and egg protein. In 2016, the company has had a 20% share of revenue from sales of their vegetarian products and these products are mainly responsible for their growth.

Where is the Norwegian disruptor for plant based products?

6.3 Facilitation of positive change through policy

The growth of the market for plant-based proteins in Norway also depends on what interventions are being made by the industry or public authorities. As already mentioned there is a lack of knowledge about plant protein products among consumers, and efforts can be made in order to change this situation. The industry itself can do more to campaign for the products. The impression is that the producers mainly seek publicity by paying so-called “bloggers” to write about the products, or through posts on social media such as Facebook and Instagram. Extensive publicity campaigns through other media (television, newspapers, paid internet advertisements) have, to our knowledge, not been made so far. One possible strategy for increased demand is to have more supermarket demonstrations, where customers are allowed a small taste of the new plant based products. This

might potentially be very important, as most consumers are unfamiliar with these products and therefore skeptical.

In addition, public authorities and policy makers can contribute to increased knowledge levels about the benefits of plant proteins. To some extent, Norwegian health authorities, communicating strong, positive, preventive health effects of an improved diet containing more healthy plants, are already doing this. Nevertheless, the information could be more targeted towards plant proteins. Media campaigns are one possibility; another one is to integrate sustainable food choices into children's education. Norwegian school children have home cooking education in both primary and secondary school, but presently the teaching material used by many are cooking books offered for free by the information office for meat and eggs, an organization financed by Norwegian meat and egg producers. In order to familiarize both teachers and children with plant based proteins as alternatives to those coming from animals, it is necessary to work more strategically both in terms of elaboration of teaching material, and with teachers. Other types of public interventions that could increase demand for meat analogues and other plant protein based food products are policies to create more favorable prices for these products. For more examples and evaluations of types of interventions to increase the consumption of plant-based food, see Mittenzwei et al. (2017).

So far interventions to change food consumption patterns for environmental reasons have not been very high up on the political agenda. However, Norway has a political goal to reduce GHG emission by 40% in 2030 compared to 2005 (<https://www.regjeringen.no/no/aktuelt/slik-skal-norge-na-klimamalene-for-2030/id2557549/>). A shift to more plant based foods are among the possible strategies to achieve this. Interventions to reduce consumption of red meat has also been found to be highly cost efficient for society, mainly because of the health benefits obtained [Pettersen et al. 2017]. It is not impossible that in the future there will be more political willingness to implement such policies.

6.4 Further research

There is a need for more research and development at several levels. There is a need for more knowledge on consumer preferences and attitudes, in order for both policy makers and the industry to understand how to create more positive attitudes, and how to produce and market plant protein products that consumers want to purchase. There is a need for more research on how to cultivate high quality pulses efficiently in Norway. This will not only have a potential positive effect on consumer health and the carbon footprint of the Norwegian diet: Production of pulses in combination with cereal production is in itself a benefit, as nitrogen fixating pulses work as natural fertilizer. There is also a need for more technical knowledge on how to produce attractive, processed plant protein products in Norway. This means products with an attractive taste and texture, which can compete with imports. But these products should also, ideally, have a lower carbon footprint and be healthier than similar animal based products, in order to have a positive impact on health and the environment. The possibilities for using Norwegian ingredients should also be explored. This may not only increase the consumer interest for these products and generate a higher willingness to pay. It may also potentially have a positive effect on public opinion and policy makers, as it would mean that a switch away from Norwegian produced animal-based products will not automatically lead to increased imports, but just increased consumption of Norwegian produced plant based products.

The aim of the research project FoodProFuture is to make research contributions in all these aspects. Nevertheless, there will still be a need for more future investigations, to explore various options and possibilities both in terms of agricultural methods, product development and consumer and market understanding and interventions beyond this particular research project.

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