Food Ingredients
A Danish position of strength

The Institute for Food Studies & Agro industrial Development – IFAU for the Ingredients Forum
2013
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Ingredients in World Class

In 2012 Danish ingredients companies represented 14% of the world market for ingredients in the food and drinks industry, and this share is expected to rise to approx. 15% by 2015. From 2007 to 2012, right in the middle of a period of crisis, the industry increased its turnover by 27%.

This shows something about the industry’s potential by virtue of its knowledge and expertise in such areas as health, sustainability and food safety. The government’s Growth Team for Food has also called attention to the ingredients industry as a position of strength that can contribute solutions to the considerable global challenges existing in the areas of health, food and nutrition. The potential is strengthened by the rising world population with a larger middle class able to buy food products with ingredients that can benefit general public health and promote the shelf-life of products.

It is therefore expected that the industry will continue to grow in the next few years, by a minimum of 5% per year. However, in order for the solid potential to be of benefit to Denmark, an effort is called for.

Many of the ingredients producers in Denmark today are global market leaders in their segments and are closely associated with developments in the global food sector. In order to maintain and strengthen market position on the global market, these companies are represented in many places around the world. In Denmark the sector employs 6,000 people, while 12,000 are employed outside Denmark.

If this growth is to be of benefit to Denmark, it requires that companies continue to regard Denmark as a good country to produce in and that to an increasing extent young people become aware of the interesting career opportunities which exist in the business. Among other things, this analysis shows that the ingredients industry is "too much of an unknown" outside the business itself, and that "the ingredients industry is not something you receive a training in".

With this report, drawn up by the Institute for Food Studies & Agro industrial Development (IFAU) on behalf of the Ingredients Forum, we would like to put the Danish ingredients industry on the agenda and shed some light on its potential. At the same time, we wish to emphasize the importance of ensuring the existence of the ingredients industry in
the future, so Denmark and the rest of the world can benefit from the knowledge and growth which the industry represents.

Good reading!

Asger Jacobsen

CEO, BHJ Ingredients

Chairman of the Ingredients Forum in Danish Food and Drink Federation
Summary

The Danish ingredients industry has considerable development potential that can be realized over the next few years. The major companies indicate that they expect positive growth rates at a minimum of 5% per annum over the next few years. The growth can lift turnover in the ingredients industry from DKK 32 bn in 2011 to approx. DKK 37 bn in 2015 measured in current figures.

Several of the major Danish companies are global market leaders in segments like enzymes, emulsifiers, cultures, natural colorings, specific animal proteins, special fat stuffs for chocolate and so on. In general, the ingredients industry in Denmark includes all segments of ingredients for food and drink products.

The following key figures show the importance of the Danish ingredients industry:

- Turnover in 2012: approx. DKK 33 bn.
- Sales to global markets: 95-98 % of turnover
- Share of the world market for ingredients in 2012: 14 %
- Growth in turnover (current prices) for 2007-2012: +27 %.
- Expectations for the industry’s growth in turnover in the next few years: minimum 5 % per annum
- Employs approx. 18,000 persons in 2012, of whom approx. 6,000 work in Denmark
- Activities in Denmark: production, administration and research & development

Overall the food sector, including the ingredients industry, has a considerable rub off effect on employment in a number of other industries. As a rule of thumb, it is said that 100 jobs in the manufacturing industry and food industry create 35 jobs in other industries. To this can be added the fact that the ingredients industry is a springboard for a number of new potential business areas, not least in the field of biotechnology, where new jobs may also be created.

The global market for ingredients is growing rapidly. In Asia and South America the growth in itself is very strong. Here there is a growing middle class who are very willing to pay for improved food products, and part of the strong growth in Danish ingredients results from the Danish ingredients industry having invested in, and been present on, the growth
markets.
At the same time, there will be more mouths to feed in the future. This involves the need for a stable and adequate supply of raw materials to the world's food producers. In the ingredients industry, ingredients are produced which can promote the shelf-life of products so making a contribution to the struggle for reducing food waste.

The development of new ingredients which may benefit general public health is a position of strength for Danish ingredients companies, too. This applies to pro-biotic cultures, fat stuffs with healthier fatty acid compositions, vitamin compositions for particular nutrition and so on.

Innovation is absolutely central for ingredients companies, which use up to 7% or more of their turnover on Research and Development (R&D). For comparison, the Food Industry in the EU uses only 0.4%. In other words the ingredients industry works in a targeted way to research in and generate new knowledge which is actively transformed into new products, improved applications of existing products, and development of new processes and technology platforms.

Framework conditions and co-operation structures that can create a good, strong foundation for the Danish agro-food industrial complex and the biotechnological industry are central to the sector's possibility of creating future growth and employment. In this context, the report concludes that a number of conditions are essential in order to carry on the ingredients business in Denmark. For example, more PhDs need to be created in the field of food products or ingredients, and the authorities (state, regional and local) need to be experienced by the industry as partners.
The Size of the Ingredients Industry and its Companies

The typical Danish ingredients company has been founded in Denmark. It is also characteristic that the company has production facilities in Denmark, and for many companies the largest (or only) research and development department is situated in this country. The fact that the company is not under Danish ownership does not affect its being regarded as a Danish ingredients company in this report.

In 2012 companies in the Danish ingredients industry had a turnover of approx. DKK 33 bn.¹ Figures for the industry’s turnover are based on interviews with companies, key figures from the companies’ annual reports for 2011 and 2012 and from websites. As a comparison, the turnover of the ingredients industry in 2007² was approx. DKK 26 bn. That is a growth of approx. 27% for the period 2007-2012 measured in current figures.

The ingredients industry has demonstrated a significantly stronger growth than developments in the Danish economy in that Danish GNP "only" grew by 5.7% in the period 2007-2012 measured in current prices³. 

Interviews with Danish ingredients companies indicate that the industry expects positive developments in sales; several companies mention growth rates of at least 5% per annum for the next few years.

Therefore, it may be supposed that with growth in the Danish ingredients industry at a minimum of 5% annually, turnover can be increased to approx. DKK 38 bn by 2015⁴.

It has been estimated that the global market for ingredients for food and drink products was worth DKK 230 bn in 2012⁵. Danish ingredients

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¹ The figures do not include Dupont’s purchase of Solae in 2012
² Hamann, 2008
³ Figures from Statistics Denmark
⁴ Calculated in current prices. The purchase and sale of companies have not been taken into account
⁵ Business Insights 2012.
companies represented approx. 14% of the global market for ingredients. Thus Denmark is the largest ingredients supplier in the world measured per inhabitant.

Figure 1: The distribution of companies in the Danish ingredients industry by main segments 2012

<table>
<thead>
<tr>
<th>Segmenter</th>
<th>Virksomheder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enzymer</td>
<td>Novozymes, DuPont, Chr. Hansen</td>
</tr>
<tr>
<td>Kulturer</td>
<td>Chr. Hansen, DuPont</td>
</tr>
<tr>
<td>Naturlige sødemidler</td>
<td>DuPont</td>
</tr>
<tr>
<td>Naturlige farvestoffer</td>
<td>Chr. Hansen</td>
</tr>
<tr>
<td>Vitaminer, fedtsyrer mv.</td>
<td>BASF, Fortitech</td>
</tr>
<tr>
<td>Animalske og vegetabiliske proteiner</td>
<td>BHJ, Arla Foods Ingredients, Solae, Scanflavour</td>
</tr>
<tr>
<td>Olier og specialfedtstoffer</td>
<td>AAK</td>
</tr>
<tr>
<td>Aroma, ekstrakter, essenser og smagstilsætninger, krydderier</td>
<td>Dairy Fruit, Orana, Agrana, SFK-OTZ Holding, Kerry Ingredients, Lactosan-Sanovo Group, Einar Willumsen</td>
</tr>
<tr>
<td>Stivelser, hydro-kolloider</td>
<td>KMC, Cargill Nordic, CP Kelco, DuPont</td>
</tr>
<tr>
<td>Emulgatorer mv.</td>
<td>Palsgaard, DuPont</td>
</tr>
</tbody>
</table>

Expectation for increasing market share

In 2015 the global market for ingredients is expected to reach a value of DKK 250 bn corresponding to a growth of approx. 3% annually for the period 2011-2015 measured in current figures. With average growth in the Danish ingredients industry at a minimum of 5% annually over the next few years, the companies will presumably have increased the share to approx. 15% of the global market for ingredients by 2015 – individual companies can probably achieve an even stronger presence on the global market. Many of the companies draw attention here to Asia and South America as the most important regions for growth.

In the analysis, enzymes, cultures, natural sweeteners, natural colorings and vitamins are gathered in the category bio-ingredients on account of
the data base\textsuperscript{6}. The largest segment in the ingredients industry is bio-
ingredients with a total turnover of DKK 16.4 bn, of which enzymes for
the food industry constitute a minimum of DKK 5 bn. The next largest
segments are emulsifiers with DKK 5.9 bn and proteins with DKK 3.5 bn,
Figure 2.

**Figure 2: Turnover of ingredients by segment, 2011, in DKK millions**

![Pie chart showing turnover of ingredients by segment, 2011, in DKK millions.](chart)

A comparison of the development per segment from 2007 to 2011\textsuperscript{7} in
Figure 3 shows that the turnover in bio-ingredients, the largest segment,
has grown by 23\% in the period. Companies in this segment state that
growth rates for the next few years are expected to be up to 10\% annually; that is higher than the average growth of the ingredients
industry\textsuperscript{8}.

**Figure 3: Development in turnover per segment 2007-2011, in DKK millions**

\textsuperscript{6} No data later than 2011 is available. IFAU comment.

\textsuperscript{7} Distribution of companies among segments in 2007 and 2011 is identical and figures in Figure 4 for the two years are
comparable. No data later than 2011 is available. IFAU comment.

\textsuperscript{8} Interviews, companies, 2013
The growth in bio-ingredients is driven by a growing food production particularly in Asia and South America and with it a rising demand for enzymes and cultures for food production. Another equally important driver is the growing market for health promoting foods, where there is a demand for such products as pro-biotic cultures, natural sweeteners and vitamins.

The largest growth in turnover is seen in the protein segment, which has shown an increase of 67% in the period 2007-2011. Interviews with companies indicate that the most important factors for increase in sales is a globally rising demand for protein for use in meat products and convenience foods and a growing market for whey proteins. Sales of hydro-colloids and starches have grown by 25% since 2007. The companies in this segment have worked intensively with innovation, including new areas of application for the products. This has resulted in increased sales of products for non-food applications such as toiletries and healthcare.

Another important reason for the growth in starch and hydro-colloids is the work of companies in developing products that can move sales of ingredients from bulk goods to specialty ingredients⁹. The latter are often developed in close co-operation with a customer in the food industry, for example, and in this situation ingredients companies stress that it is absolutely central for them to have both development and production at Danish sites.

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⁹ Interviews with companies.
Figure 4 shows the number of companies in the ingredients industry distributed according to turnover in 2007 and 2012. It can be seen that the number of companies with a turnover of over DKK 900 million has increased, whereas the number of companies with a turnover of under DKK 600 million has fallen. In 2007 companies with a turnover of over DKK 900 million represented 84% of the ingredients industry’s turnover, and in 2012 this figure had risen to 90%. The largest companies have increased their turnover considerably since 2007, and this has in particular occurred in markets in Asia (China), South America and Eastern Europe/Russia.

Figure 4: The number of ingredients companies distributed according to turnover (DKK million)

The fall in the number of companies with a turnover of under DKK 600 million is due to the difference between the company populations that form part of the data base for the 2007 survey and this analysis. The difference between the two company populations will not have a noticeable influence on the total turnover of the ingredients industry. The most important differences between the populations are:

- India-Dan (spices) has been sold to a German owner and there is only a small sales office in Denmark. The company no longer forms part of the population.

10 Hamann, 2008
• Puratos is no longer included as the company sells its goods to bakers, not to the food industry.
• OTZ-Holding and SFK Foods were purchased by a capital fund in 2011 and now count as one unit.
• Lactosan and Sanovo have reformed as the Lactosan-Sanovo Group and count as one company.
• Fortitech does not form part of the 2007 population.
Jobs and Competences

It has been estimated that the ingredients industry employed approx. 18,000 persons in 2012, of whom approx. 6,000 worked in Denmark. Here the companies employ administrative personnel, employees in R&D and innovation, and employees in production. Interviews show that in most cases companies expect stable employment at the sites in Denmark, while the number of employees abroad is expected to rise. It is particularly the increased effort of companies in production, development and sales in areas like China and South America that creates an increased need for manpower outside Denmark.

By far the majority of ingredients companies make use of automated process equipment so that manual handling through the production process is drastically reduced. This development makes demands on employees in production with regard to competences in IT, operation of robots, and increased knowledge of food safety. For instance, employees in the production are usually skilled workers like process technologists, robot operators or dairymen. Some companies point out that an important competitive parameter is the making of products of high, uniform quality, and that it is therefore necessary for employees to be constantly trained to ensure this quality. This applies to upgrading qualifications in areas such as knowledge of raw materials, composition of raw materials, process parameters and operation of advanced IT for the production processes. Other respondents point out that customer (food industry) requirements for certification like BRC contribute to raising the competence requirements for employees in the production. These include increased competence in documentation, food safety, quality and process understanding.

There are many examples showing that employees in Danish ingredients companies remain in the industry when they change jobs, and in this way knowledge is circulated in the industry to the benefit of development in the companies. This model of “active knowledge sharing” applies to both employees in production, in administration and in the development departments, and the model is drawn attention to by several respondents as being an important element in raising the general level of competence.

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11 Interviews, 2013
12 Interviews, 2013
13 Interviews, 2013
in the Danish ingredients industry.

**The Ingredients Industry - part of the agro-food industrial complex**

There is a long tradition for producing ingredients and processing aids in Denmark, and individual companies, like Chr. Hansen for example, were founded more than 100 years ago, Figure 5.

**Figure 5: Examples of how ingredients companies were started in Denmark.**

- **Chr. Hansen A/S** was founded in 1874 on the basis of a method for cleaning out and standardizing calf rennet for use in the production of cheese. The business quickly expanded to include natural colorings for cheese and butter.

- **Palsgaard A/S** was founded in 1908 and took out the first patent in the USA for an emulsifier for the production of butter in 1917. The emulsifier has subsequently been the company’s core business on the global market.

- **Lactosan** was founded in 1942 and in 1950 the company had been the first to develop a technology for the production of cheese powder from processed cheese.

- **CP Kelco**, or Københavns Pektinfabrik as the company was called formerly, was founded in 1947 for the purpose of extracting pectin from the waste from the citrus industry. CP Kelco’s raw material supplies include orange peel from all over the world, which is transported to Lille Skensved, made into pectin and sold to the global market.

- **BHJ**, formerly Danexport, began as a trading company in sales of animal by-products for pet food. This has been the basis for developing a business with functional protein for use in the food industry.

- **Andelskartoffelmeleckentralen KMC** was established as a sales organization for members of the potato starch co-operative. The business has subsequently expanded with the development and production of starch derivatives for food and non-food applications, and most recently with potato protein for use in the food industry.

The drying of cheese whey for whey proteins is the basis for the **Arla Food Ingredients company**. It was (and is) fundamental to the co-operative movement to think in value chains and therefore natural to think of making use of waste products and in this context whey was a good starting point. The same pattern can be seen for lactose.

- **Dairy Fruit** was established as a subsidiary of Arla Foods with the purpose of producing flavor additives and fruit ingredients for dairy products.

- **BASF**, formerly Danochemo, developed a method of producing vitamins in powder form; first for animal feed and subsequently for the food industry. Danochemo was a specialist in vitamins for food products and subsequently for **nutritional foods**.
For a number of ingredients companies, the agricultural sector has been the starting point of their business, cf. Figure 5 and interviews with companies. The availability of raw materials from agriculture (e.g. potatoes and residual products from dairies and abattoirs) has been of considerable importance for companies such as KMC (starch potatoes), BHJ (animal by-products) and Arla Food Ingredients (cheese whey). Companies like Arla and Danish Crown have by virtue of their size, their importance for agriculture and the food industry, and by working together with research institutes related to the industry, played a decisive role in creating critical mass. This has been a powerful contributory factor in driving the development of ingredients companies.

In the same way, close co-operation with buyers in the food industry has contributed to driving innovation and customer understanding\(^\text{14}\).

For other companies, like Chr. Hansen and Palsgaard for example, the development of the dairy industry has meant a rising demand for cultures, emulsifiers and natural colorings. Finally there are examples of ingredients that are made from agribusiness products. This applies to Lactosan and Kerry Ingredients (formerly Cremo Ingredients), for example, which both make cheese powder, and to AAK, which makes special fat stuffs from Nordic rapeseed oil.

Denmark has traditionally had considerable exports of agricultural goods and food products and companies in the food industry have needed to adjust to demands from new markets, such as demands on the products’ composition or taste. Requirements from food authorities for high veterinary standards have contributed to the ingredients industry having established an international position of strength. This can be explained by the fact that foreign customers, for example from the USA and Japan, want Danish ingredients precisely because the raw materials used are of a high hygienic and veterinary standard\(^\text{15}\).

The internationalization of food companies has meant that from an early stage the ingredients industry has worked together closely with food companies on the challenges of the new markets. This has enabled ingredients companies to service foreign food companies, and thus the basis for international sales and establishment has existed for the Danish ingredients companies. This pattern of development is the basis for Danish ingredients companies being present on every continent today.

\(^{14}\) Interviews, 2013

\(^{15}\) Interviews, 2013
Furthermore, many of the companies today obtain 95%-98% of their turnover from sales to global markets.

Developments in the food industry towards more processed products, more international companies and a generally higher process technological level have also contributed significantly to the ingredients industry having developed into what it is today. There are several technologies in which Danish suppliers of process equipment have been leading the way, like spray-drying technology, for example. This is a technology originally developed for use in making milk powder and other dried foods, where development of the technology has made it competitive for use in the ingredients industry. Work still continues on refining the technology; not least in relation to innovation in the ingredients companies and thus to their demand for new technological solutions.

It has been known for very many years that naturally occurring enzymes influenced processes, like tenderizing or bleaching. The growing demand from the food industry for processes that were (relatively) inexpensive, effective, and natural, and which led to even better results than any known process technological solution, has prepared the way for a globally growing market for enzymes for food and drink production. In addition to this, there is a considerable and rising demand for enzymes for bio-energy and other technical applications. Intensive research, refining of the production technology and global presence has led to the leading positions that Novozymes, DuPont and Chr. Hansen have on the world market for enzymes for the food industry and other applications.

Denmark has several large companies that make use of biotechnology in production or in connection with development work, for instance Carlsberg, Novozymes, Novo Nordisk, Chr. Hansen, DuPont and CP Kelco.

Companies like those mentioned above are among the largest takers of employees at Ph.D. level. Interviews show that the industry (e.g. the above-mentioned companies) could easily employ many more people with Ph.D.s, but they are not available as Danish-trained graduates today. Furthermore, the interviews indicate that demand by the above-mentioned companies for Ph.D trained employees has been absolutely central in creating an interest in a Ph.D. training in relation to food,
drinks and ingredients\textsuperscript{16}.

The above examples show there is a clear tendency that the higher the demand a (food) company puts on a supplier of technological solutions, the more innovation the supplier demonstrates; this applies to suppliers of both ingredients and process technology. In this way, a many-year-long structure of working together, including across business lines, has been established between the companies, and this co-operation leads to dynamic technological development.

**Research, Training and Co-operation with Universities**

Interviews with ingredients companies and a review of annual reports indicate that between 6\% and 14\% of turnover is used on R\&D and innovation. The corresponding figure for the European food industry is approx. 0.4\%, which indicates that the ingredients industry stakes a considerable amount on research, development and innovation\textsuperscript{17}. Development of new products and building up markets are very important activities in order to ensure the future of the ingredients industry. As an example, products that had been developed within the last 3 years constituted 14\% of the turnover in the 2011-2012 accounts of Chr. Hansen\textsuperscript{18}. Other ingredients companies state that they have expanded an existing range, of proteins for example, with new varieties, or by using new raw materials\textsuperscript{19}.

Several respondents among the companies state that “as a knowledge-heavy company, good co-operation with research institutes and universities is very important”. Furthermore, it is stated that the biggest of the ingredients companies have established a ”receiver” to be able to work together with universities, in that the companies employ graduates at Ph.D. level and through that have incorporated the same language and methods that researchers at universities make use of. Working together with universities is relevant in order to obtain a sufficiently large number of well-qualified new graduates for the ingredients industry. The companies state that they would like to see more graduates trained in

\textsuperscript{16} Interviews, 2013

\textsuperscript{17} FoodDrinkEurope, 2011

\textsuperscript{18} Chr. Hansen Annual Report 2011-2012

\textsuperscript{19} Interviews, 2013
Denmark.

Furthermore, companies are very open towards foreign applicants for positions in Denmark, and would also like to see Danish graduates take work at sites abroad. This "exchange model" for building competences is seen by companies as essential for continued development of the business and for the benefit of the industry as a whole.

Companies state that there is a real need to get new employees into the ingredients industry in order to ensure a continued high professional level. Here the projects between company and university, for example at Ph.D. level, could be an opportunity. Furthermore, it is stated that it is desirable for the universities to be more aware of the opportunities that exist for employees with Ph.D.s in companies and how employees with Ph.D.s could be of benefit to the development of a company.

Finally, the ingredients industry is looking to the universities to launch projects directed towards the specific needs of the industry and its wishes for research and development. At the same time working together with the universities could help to create more cohesion in the industry.

Today, an established structure for co-operation does not exist between the ingredients industry as an industry and the universities in that by far the most co-operations is bilateral and takes place within the framework of projects. Furthermore, it is stated in the interviews that considerably more research could take place at the universities with a focus on developing a "growth layer" that could become ingredients companies of the future.

Without production there is no company, and therefore there must be investment in the right training for employees in the production and applications area. In this context, the companies draw particular attention to upgrading skills in process control, IT proficiency and understanding of the whole process. Furthermore, there are interviews that indicate there is a need for more communication, and communication of a positive nature, about the opportunities that exist for jobs and careers in the ingredients industry; this is about attracting committed employees to every function in the companies. It is also necessary here to consider medium length training, like laboratory technicians and technologists for example, and skilled workers in the

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20 Upgrading the qualifications of employees

21 Interviews, 2013
food sector (e.g. dairymen). It is therefore relevant to consider increasing and upgrading the critical mass of well-trained employees at all levels of functions in the ingredients companies.
The Ingredients Industry in International Perspective

It is characteristic of the ingredients companies that they have a very high share of exports. Export here is defined as company sales to other markets than Danish, notwithstanding where the product is made\textsuperscript{22}. For enzymes, cultures, colorings, emulsifiers, proteins and starches, it can be seen that sales to the global market constitute 95-98\% of turnover. The ingredients industry has worked on the global market for many years, and this has led to a very strong market position as shown in the outline below\textsuperscript{23}.

**The internationale market position of Danish companies, 2012**

- Palsgaard is globally leading supplier of emulsifiers to the chocolate and cake industry.
- DuPont: no. 1 or no. 2 in each segment (emulsifiers, enzymes etc.) the company operates in.
- There are ingredients from DuPont in approx. half of the world’s ice cream and one quarter of the bread.
- DuPont and Novozymes together have approx. 75\% of the world market in enzymes for food products; Novozymes alone has over 40\%.
- Chr. Hansen and DuPont together have 80\% of the global market in cultures.
- There are Danish cultures in 3 out of 4 cartons of yoghurt and in half of the world’s cheese slices.
- CP Kelco in Lillo Skensved is the world’s largest pectin factory.
- BHJ is globally leading in functional animal proteins.
- AAK has 40\% of the world market in special fat stuffs for use as cacao butter substitutes.
- Chr. Hansen is the world’s largest in natural colorings.
- Dairy Fruit is northern Europe’s leading supplier of aseptic flavor additives to the food industry.
- Einar Willumsen is the only Nordic flavor house.
- Lactosan is among the world’s leading actors in cheese powder.

\textsuperscript{22} IFAU comment

\textsuperscript{23} Data based on Hamann, 2008, and updates from annual reports and newsletters plus interviews with companies 2013.
The ingredients companies have established production in many places abroad and many of the companies have also established R&D departments or applications centers abroad, Figure 6.

**Figure 6: Examples of Danish ingredients companies’ production sites and R&D and applications centers**

<table>
<thead>
<tr>
<th>Company</th>
<th>Production facilities</th>
<th>R&amp;D or applications center</th>
</tr>
</thead>
<tbody>
<tr>
<td>DuPont</td>
<td>Denmark and several other places in the world – global presence</td>
<td>France, USA, China and more – global presence</td>
</tr>
<tr>
<td>CP Kelco</td>
<td>Denmark (the Huber Group also has production facilities in Finland, Germany, China, the Philippines, USA and more)</td>
<td>Denmark and other countries</td>
</tr>
<tr>
<td>Palsgaard</td>
<td>Denmark, Malaysia (under construction), Holland, Mexico</td>
<td>Mexico, Singapore, Denmark</td>
</tr>
<tr>
<td>Chr. Hansen</td>
<td>Denmark (3), Argentina, Australia, Brazil, China, the Czech Republic, France, Germany, Italy, Mexico, Peru, Turkey, USA</td>
<td>R &amp; D in Denmark, Germany, France, USA. Applications centers in 20 countries incl. Asia and Russia</td>
</tr>
<tr>
<td>BHJ</td>
<td>Denmark (2), Sweden, UK, Germany</td>
<td>Denmark</td>
</tr>
<tr>
<td>Novozymes</td>
<td>Denmark (3), USA, China and more</td>
<td>Denmark and other countries</td>
</tr>
<tr>
<td>Arla Food Ingredients</td>
<td>Denmark, Argentina, Germany</td>
<td>Denmark, Argentina</td>
</tr>
<tr>
<td>AAK</td>
<td>Denmark (AAK as a group has global production)</td>
<td>Denmark</td>
</tr>
<tr>
<td>Orana</td>
<td>Denmark, Vietnam, Egypt, India, Malaysia</td>
<td>-</td>
</tr>
<tr>
<td>Agrana</td>
<td>Denmark, Poland</td>
<td>-</td>
</tr>
<tr>
<td>Lactosan-Sanovo Group</td>
<td>Denmark, China, Germany, Uruguay</td>
<td>?</td>
</tr>
<tr>
<td>Einar Willumsen</td>
<td>Denmark, Sweden</td>
<td>Denmark (R &amp; D and applications), Sweden (applications)</td>
</tr>
</tbody>
</table>

**Investments abroad**

Among the latest investments in production facilities abroad, the Arla Food Ingredients factory in Argentina and the Lactosan-Sanovo Group factory in Uruguay may be mentioned. Palsgaard are building a large factory in Malaysia for production for the Asian market; the factory is expected to open in the middle of 2013. Orana, which produces fruit-based ingredients for the baking, dairy and juice industry, opened a production facility in Egypt in the summer of 2012 with their sights on
supplying the African market\textsuperscript{24}. It should also be mentioned that AAK opened sales offices in Shanghai and Düsseldorf in 2012, and that Lactosan has established its own sales organization in China. It is emphasized in interviews that the internationalization of the ingredients companies is a process that is very hard to stop, and that internationalization is a step by step process which takes a very long time. There are companies which started in China, for example, in 2000 and which at the present time do not yet have plans to establish production there\textsuperscript{25}.

**Global presence**

A general tendency in the global food industry is that food producers expect global presence and service from their suppliers. Large food companies work actively with innovation and this often means that ingredients need to be developed to solve a particular technological problem for precisely the new product. In order to meet the customers’ demands, the largest Danish ingredients companies have established applications centers in many markets abroad. It can be mentioned, for example, that Palsgaard has established applications centers in Mexico and Singapore, Arla Food Ingredients has in Argentina and DuPont has an applications center in China, cf. Figure 6. Most recently Chr. Hansen opened an applications center in connection with the company’s office in Moskva in 2012.

Besides the BRIC countries and other growth markets (e.g. the Next Eleven countries), the ingredients companies are good at seeing development opportunities on new markets or in local production. Already in 2010, DuPont, for example, tested cultures intended for traditional Indian dairy products in co-operation with local dairies\textsuperscript{26}, and in 2012 DuPont launched cultures for the east European cheese type known as Tvarog. Chr. Hansen launched new enzymes in Kenya in 2012, which are specially developed for the production of cheese from camel milk\textsuperscript{27}.

**Development of the food industry**

Developments on the neighboring markets, like northern Europe for example, can have great significance for Danish ingredients suppliers. A respondent states that as result of the closing down of food companies in

\textsuperscript{24} www.food-supply.dk

\textsuperscript{25} Interviews, 2013

\textsuperscript{26} Annual Report Danisco 2009/2010

\textsuperscript{27} www.foodingredientsfirst.com (Jan. 2013: Chr. Hansen Initiates camel cheese project and DuPont Danisco to offer mesophilic cultures for tvarog)
the Nordic countries, the company’s customer base has moved to other places such as Britain or Eastern Europe. Despite increased initiatives by ingredients companies in customer service and fast dispatch of orders, they have not succeeded in maintaining their turnover. This demonstrates that changes in the food industry in the neighboring markets can have major consequences for the Danish ingredients companies.

**Foreign Acquisitions in the Danish Ingredients Industry**

Over the last few decades, foreign companies have bought up several companies in the Danish ingredients industry. The arguments most commonly advanced for foreign interests buying up companies in the Danish ingredients industry are:

- Access to the competences and technical knowhow of the companies;
- Access to the customers and markets of the companies;
- Reduction in competition;

As an example, it is said that the American LGI’s purchase of BHJ in 2004 was motivated by BHJ’s unique competences in functional heavy proteins, a competence area that supplemented LGI’s own knowhow in animal proteins. When German BASF bought up Danochemo in 1992, it was to get access to a technology for making vitamins in powder form, a technology that Danochemo had developed.

One of the most recent and biggest purchases in the Danish ingredients industry is the purchase of Danisco in 2011 by the American DuPont. DuPont states that they were motivated by Danisco’s attractive enzyme business and the fact that Danisco’s bio-ingredients would fit in well with DuPont’s technology platform in Applied Bio-science and Health & Nutrition. The purchase would strengthen both companies’ global business areas in sustainable solutions for food products, bio-energy, bio-chemicals and bio-materials.

Among the main challenges associated with foreign companies buying...

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28 Interview, 2013

29 Hamann, 2008 and interviews, 2013

30 Press release, DuPont’s website 2011.
up Danish ingredients companies is the question of continued production in Denmark. The foreign owner in reality buys the technology, knowhow and goodwill which has been built up in the Danish company, but there is no guarantee that the investment will lead to (more or maintenance of) jobs or knowledge building in Denmark. Interviews with companies in the ingredients industry indicate that there is a likelihood of foreign owners choosing to place an investment in production in another place than Denmark, in as much as a decision on this will be made on the basis of financial calculations as to where it will be most commercially viable to be established. If the calculations are not in Denmark’s favor, it may mean that in the long-term production will be moved away from Denmark, and when production moves, so also in time do R&D and innovation. For the ingredients industry, which is deeply dependent on knowhow and innovation, the consequences at worst will be that the industry is sharply reduced in relation to the ingredients industry today, for which Denmark is internationally known and respected.

31 Interviews, 2013
What Drives Development in the Ingredients Industry

Developments in the ingredients industry are closely connected with developments in the food industry. In a global perspective, there will be 9 bn people in 2050, all of whom will need more and better food. This means that the world is forced to increase food production, which requires improved agricultural production, increased utilization of food products, improved process technology and an extended distribution system.

Challenges for the food industry

The western world is struggling with considerable health challenges for the inhabitants. Illnesses such as cancer, obesity and lifestyle-related illness play a major role in the health and life expectancy of the inhabitants. These are tendencies that are also gaining ground in many emerging markets such as Mexico, China and India. WHO estimates that in 2050 approx. 40% of the world’s population will be overweight, already in 2015 2 bn adults will be overweight. In sharp contrast to this, WHO also expects that malnutrition will still be a major problem – particularly in developing countries\textsuperscript{32}.

Health-promoting ingredients

Several sources indicate that in future the food industry will be assigned an even greater responsibility for people’s health than is the case today. A report from 2009 estimates that the market for health-promoting foods will increase by 5% annually in Europe and by 6% annually in the USA over the next few years. These are growth rates that are more than double those for food products in general\textsuperscript{33}. There are thus good arguments for developing new health-promoting ingredients. Here are some examples that Danish ingredients companies have launched\textsuperscript{34}:

- Pro-biotic cultures
- Fat stuffs with a healthier fatty acid composition

\textsuperscript{32} WHO figures in Danisco Annual Report, 2010-2011
\textsuperscript{33} DI Food with figures from Business Insights 2010
\textsuperscript{34} Annual Reports of Chr. Hansen, AAK and Danisco 2010-2011
• Enzymes that can split lactose

Another very important tendency in the food industry over the whole world is an increasing demand for more processed foods and key words in the consumers’ choice of processed food are taste, price, health and convenience – in that order.\(^{35}\)

**Ingredient solutions for processed food products**

Processed food is characterized by many production parameters. It counts, for example, that the product looks fresh for a long time, condensation in the packet is avoided, breading must not be wet, the product must keep its taste after heating, ice cream must have the right melting function, and other technological parameters. Danish ingredients companies offer an increasing number of solutions for processed food, for instance those shown below.

• AAK launched a fat stuff for the ice cream industry with a minimum of saturated fat and one for non-dairy creamer, also without trans fat.\(^{36}\)
• DuPont has launched an enzyme that enables bread to keep fresh for up to 7 days. Thus this enzyme may also contribute to reducing food waste.\(^{37}\)
• BHJ launched functional proteins for use for in fat reduced composite meat products.\(^{38}\)

**Ingredients and food safety**

Finally, food safety is an absolutely essential area in the development and production of food products. Chr. Hansen, for instance, has launched a culture that can give feta cheese a longer shelf-life and other cultures that function as bio-protectors (cultures that protect the product and thus improve keeping qualities).\(^{39}\) KMC is working on developing a modified potato starch to spread on top of bakery goods which can give the same brown color after baking as when they are brushed with egg. The advantage of using the new starch is that the food safety risk of using eggs is avoided.

An overall theme in food production is making products in a better and easier way, with greater utilization of raw materials and at a lower price.

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\(^{35}\) Chr. Hansen, 2010

\(^{36}\) Annual Report AAK, 2011

\(^{37}\) Annual Report Danisco 2010-2011

\(^{38}\) Interview, 2013

\(^{39}\) Annual Report Chr. Hansen 2011-2012
Several companies draw attention to the fact that the discount wave will have an even more powerful influence on the food industry in the next few years, and this will mean that food producers will be forced either to produce goods more cheaply or to increase output for the same production costs. In order for this to succeed or simply to be optimized, a technological effort is required, whether of process equipment, ingredients, raw materials or packaging. In particular, enzymes and cultures have shown themselves to be important in making processes more effective, less demanding on resources and more natural. The following new solutions launched by Danish companies can be mentioned:

- An enzyme that keeps Chinese bread types fresh for longer.
- An enzyme that breaks down cell walls in fruit so utilization in the fruit industry is increased.
- An enzyme that helps to optimize the filtering process in wine making.
- A culture that increases output in cottage cheese production.
- A culture that can control the process of forming holes in Swiss cheese.

For the whole of the agricultural and food sector, sustainability is a key word—in the next few years, as well. This means that there is considerable focus on increasing utilization of available raw materials and on developing new processes based on other raw materials and waste products. The bio-energy industry is an example of this development, which to a great extent has been driven by innovation supplied by the ingredients industry, in particular enzymes for breaking down biomass. There are also examples of developing enzymes and cultures to promote root formation in plants that grow under unfavorable conditions (e.g. saline soil or drought) so they can produce an improved yield. Sustainability also involves reduced environmental impact from production, and regarding this in 2011 Chr. Hansen launched solutions that are able to help reduce the amount of refuse (e.g. from retail outlets) by reducing the decomposition of food products and thus lengthening their shelf-life.

The analysis of the companies in the ingredients industry indicates that the food and drinks industry continues to be absolutely central for the development of the ingredients industry, but there are other growth segments which are also very relevant to the ingredients industry. This applies, for instance, to agriculture (cultivation and livestock), pets,

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40 Novozymes Annual Report 2010
environmental conditions, bio-energy, materials (e.g. biodegradable plastic) and other industries (e.g. pharmaceutical industry). Several of the large companies in the ingredients industry paint a clear picture of this development model. As an example, Chr. Hansen\textsuperscript{41} describes itself as "a global bioscience company that develops ingredient solutions for the food, nutritional, pharmaceutical and agricultural industries". Correspondingly, a spread of the business to other enzyme platforms than the original ones for food products, washing powders and technical enzymes can be seen at Novozymes and DuPont. The new platforms are bio-energy, agriculture and waste water treatment as well as bio-pharmaceutical ingredients\textsuperscript{42}. AAK, which specialize in fat stuffs, and CP Kelco (with competence in hydro-colloids) have both established platforms with knowhow and products in such areas as the cosmetics industry, health care and other technical industries.

**Investment in the Ingredients Industry**

The ingredients industry today is a markedly technology-heavy industry, where manual handling of products has been minimized considerably. Companies in the industry have invested in automation of processing plants and IT for process control, and this type of investment is expected to be undertaken on an ongoing basis. Interviews indicate that companies with foreign ownership have invested heavily in existing production plants in Denmark. For instance, investment has been made in new production equipment, energy reduction, greater sustainability in the process or regular expansion activities. Furthermore, it is stated that Danish infrastructure and the organization of companies are factors that have contributed to drawing investment to Denmark rather than to Asia, for example\textsuperscript{43}. This indicates that it is a high priority for foreign-owned companies to retain Danish production plants, but also that future investments must be considered in each individual case, as the following examples illustrate.

In 2012 it became clear that the DuPont-owned company Solae (production of soya-based ingredients) would close down production and development at the plant in Aarhus. This would lead to a loss of approx. 116 jobs. DuPont justifies the closing with "a challenging market situation and increased pressure on competitive ability in the global

\textsuperscript{41} www.chr-hansen.com (January 2013)

\textsuperscript{42} Novozymes, 2011 Key Facts

\textsuperscript{43} Interviews, 2013
environment”. Furthermore DuPont states that “Denmark continues to be a central country in DuPont’s growth ambitions”\textsuperscript{44}. Agrana\textsuperscript{45} (formerly Vallø Saft), which produces concentrates for the drink industry, among others, has announced that the company is shutting down Danish production in February 2013. Production of concentrates is to be moved to Agrana’s production plant in Poland, so that in the future there will only be receipt and freezing of berries at the plant in Denmark. The reasons given for the move are falling cherry production in Denmark as well as rationalization of the production structure in that costs are 30\% lower in Poland\textsuperscript{46}. The above-mentioned examples illustrate how international conditions may influence decisions about production in the ingredients industry in Denmark.

It is stated by a wide circle of respondents that investment in R&D and improved productivity are absolutely essential in order to preserve the ingredients industry as a constantly competitive factor in an international context. Companies like Chr. Hansen, DuPont, Arla Food Ingredients, CP Kelco and Novozymes have substantial R&D units in Denmark and investments will be made here in developing new technologies, new platforms and improvements of existing products\textsuperscript{47}. The reasons for investing in R&D in Denmark are partly that the central development facility of the company is situated here, and partly that organized co-operation with universities is the basis for developing new high value products that are to sustain growth in the future. It is further stated by one respondent that it is a very considerable strength for an ingredients company to have a large R&D department in combination with a production plant in Denmark in that there are a number of advantages connected with this, Figure 7\textsuperscript{48}:

\textsuperscript{44} www.business.dk October 2012.
\textsuperscript{45} Agrana forms part of the Südzucker Group and is an international player in fruit concentrates and juice
\textsuperscript{46} Christensen, January 2013
\textsuperscript{47} Annual reports for companies 2011
\textsuperscript{48} Interviews, 2013
Figure 7: Advantages in having both production and research in Denmark

- new products can be developed and adjusted as there are both researchers and engineers in the R&D department
- new processes can be developed or existing processes adjusted
- production units can be adjusted
- new products and production can be tried out in full scale
- the company can work more strategically long-term when there are both development and production; if there is only production, work is planned with a more short-term horizon.

Investment abroad

A review of the annual reports of ingredients companies with Danish ownership and interviews indicate that in the next few years investment will be made in new or increased production abroad. The arguments for this include being closer to raw materials or closer to markets. Several respondents mention a doubling in the number of employees abroad, both in production and sales. There are also several examples of Danish ingredients companies extending production in Denmark, Figure 8.

Figure 8: Investment in ingredient production in Denmark

Chr. Hansen is building the world’s largest freeze-drying factory for pharmaceutical probiotic cultures in Roskilde. It is an investment of over DKK 100 million. Production at the factory will start in the spring, 2014, and jobs will be created in Roskilde.

Arla Food Ingredients will invest DKK 900 million in a lactose factory in Nr. Vium. The factory is to be built in connection with an existing production plant and will be finished in the autumn of 2014. From 2016 the new factory will be able to produce 85,000 tons of lactose annually. It is expected that the new plant will create approx. 20 new jobs.

Arla Food Ingredients has doubled its production capacity for whey proteins at the Danish plant. The new line is to open in February 2013.

The above examples demonstrate that investment continues to be made in production in Denmark. To the question of which factors can encourage companies to increase investment in Denmark, the following conditions may be mentioned:

- Stable conditions for running a business

Interviews, 2013
- Lower level of salaries and costs incl. lower taxes
- Prospect of stable and preferably increased agricultural production and thus more raw materials
- More flexibility in the requirements by the authorities for the production or the companies
- Shorter case handling times for such things as approvals
- More give and take from the authorities with regard to dialogue with companies and in finding solutions.

Several respondents stress that they would like a more positive and constructive dialogue with the authorities (at state level as well as with local authorities), and that companies would preferably see the authorities as "fellow players". It should be emphasized here that the companies clearly wish the ingredients industry to continue to be trustworthy so it is not a question of “tinkering with the rules”.

There are several respondents that refer to long case handling times, for instance, or the authorities’ focus on the administration of rules rather than on finding solutions in co-operation with companies, seeing these conditions as extremely negative when considering investment in Denmark. A company with a foreign owner states that "it is difficult to understand that Denmark can have rules involving other conditions for production than exist in all the other EU countries". Finally, there are respondents that draw attention to examples from Sweden and Holland where the local authorities function as sparring partners for the industry for the purpose of finding the most constructive solutions within the given framework.

The above statements suggest that companies (Danish and foreign-owned) desire clear signals from the authorities on whether investment in production jobs in Denmark is desired. Furthermore, companies seek stable framework conditions so they can think in the long-term. A respondent expresses it thus: "We are not nostalgic about keeping production in Denmark – we run a business that must be commercially viable". Another respondent states: “an investment in Sweden will be 15-20% cheaper than a corresponding investment in Denmark”.

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Interviews, 2013
Where is growth to come from

New business concepts or new products are typically the basis for creating new companies. Development of new ingredients is usually subject to strict requirements and regulations regarding certification and documentation, particularly if it concerns claims (e.g. health claims) for the ingredient. Several sources and interviews indicate that it is precisely regulations and procedures in connection with certifications and approvals which are very wide-ranging and severely limiting for development in the ingredients industry. According to the ingredients companies, other reasons that come into play as factors limiting the growth layer of new companies include access to financing growth and establishing the company plus the fact that "ingredients" or "the food sector" in general is not seen as a career path or growth industry in line with high technology and biotechnology.

From interviews with the ingredients companies, it appears that to a great extent growth in the industry is taking place among the present players. The established (particularly the large) companies focus on the development of new business areas and new technology platforms, and commercial success from this type of concentrated effort is the most widely used road to growth in the ingredients industry. Medium-sized companies naturally have fewer resources for R&D then large companies, but the need for development of the business is no less. Interviews show that medium-sized companies focus to a greater extent on being leaders within core competences, which constitute one area of their total field of activity. Precisely by focusing on core competences, the medium-sized companies can differentiate themselves in competition with the large ingredients suppliers (within the same segment) and with that be an attractive partner for the large food producers.

Sometimes new technologies are developed within companies; at other times this happens in co-operation with outside bodies such as Copenhagen University, DTU or foreign research institutes. By strengthening co-operation between university and company in the development of new ingredients (e.g. as research projects) and by extending the project to a commercialization phase, a growth layer of new companies can be created (cf. chapter 2). Some examples of this are Fluxome with resveratrol (naturally occurring antioxidant in red grapes)

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51 Interviews, 2013
and Glycom with human-milk-oligosaccharides (HMOs), Figure 9. Fluxome’s activities regarding resveratrol in Denmark were purchased by the Swiss biotech firm Evolva in 2012. Both Fluxome and Glycom were started at DTU.

**Figure 9: Glycom – ingredients for breast milk substitute is only the beginning**

Glycom was started in 2005 at DTU’s Department of Chemistry with the purpose of synthesizing and commercializing a number of sugars naturally found in breast milk. The sugars (HMOs) were to be used initially in breast milk substitutes, and in the long-term a number of possibilities were opening up in preventive and curative uses e.g. in the combating and prevention of infections.

With help from Seed Capital, Glycom has now established production in Hungary and the USA and at DTU’s Department of Chemistry. At the production plant in Hungary, HMOs can be produced in ton-scale. Glycom works together with a network of researchers and has industrial co-operation with Nestlé on breast milk substitute.

Today, Glycom is able to produce a handful of HMOs, of which more than a hundred different ones are found occurring naturally in breast milk. The company states that HMOs are in a grey zone between food products and products with a health effect (such as functional foods) and this influences how the product is to be labeled and with that the marketing. Glycom today expects clarification from the authorities about this before HMOs can be marketed for any other use than breast milk substitute.

The ingredients industry today is a high technological industry developing new ingredients from a scientific platform and producing ingredients with the use of high technological processing plants. Thus the ingredients industry is in the same "category" as the brewery industry, the production of pharmaceutical products or the bio-energy sector, for example. This emphasizes the potential of the ingredients industry for being a strong driver of development in the Danish biotechnology sector and through this of creating growth, innovation and employment. A considerable barrier for the ingredients industry in relation to utilizing the potential that biotechnology offers is the very restrictive access with which Denmark has chosen to work with gene modified organisms.

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52 www.evolva.com
53 Vindfeldt, 2013
54 Interviews, 2013
A group of companies in the Zealand Region established the biotechnological cluster Biopro (www.biopro.nu) in February 2013 with the purpose of creating jobs and making bio-technological production more competitive. The provisional 2-year development should lead to improvements in bio-technological production by reducing energy consumption and raising yield. Biopro comprises co-operation between CP Kelco, DONG Energy, Novo Nordisk, Novozymes, DTU and Copenhagen University. Biopro is financed through the European Social Fund, Zealand Region and partners. Biopro is situated at Novozymes and Novo Nordisk in Kalundborg, project management is situated at CAT Science Park in Roskilde, and the initial project budget is DKK 40 million. The project is described as internationally ground-breaking in that:

- The partners behind the project are substantial players in the biotechnological industry, and their participation in the project provides opportunity for carrying out trials on industrial scale;
- There is close co-operation between industry and research;
- The project is interesting for attracting foreign companies and researchers who can strengthen development of the biotechnological cluster;

Examples of projects that are going to be carried out in Biopro include: improvements in technologies for distillation and fermentation, and the establishing of networks consisting of internationally leading researchers, universities and companies.

The Biopro project is an example of how the ingredients industry can get on the agenda in the bio-technological industry, including in an international perspective.

**Positive and negative conditions in running the ingredients business from Denmark**

Ingredients companies in Denmark are responsible for many major decisions that influence a great number of people all over the world. The influence of the companies on the global ingredients industry is clear in that Danish companies are estimated to have approx. 14% of the global ingredients market – and many of the companies are market leaders in their segments. This means that ingredients companies with headquarters in Denmark have a considerable influence on decisions about production, investment, employment and innovation for Danish and foreign locations. This applies to companies such as Novozymes,
Chr. Hansen, DuPont and Palsgaard. For companies where the activities in Denmark primarily comprise production plants, strategic decisions are usually made by the foreign owners.

Interviews with ingredients companies indicate that there are a number of conditions that contribute in a positive or a negative way to running ingredients companies from Denmark. The points are summarized below and have been reviewed earlier in this report.

**Conditions that contribute in a positive way to running the ingredients business in Denmark:**

- High veterinary standard that opens up access to many markets all over the world
- Danish goods and Denmark have a good reputation on the world market
- Strong and long-lasting co-operation within the food industry complex: co-operation with food producers and manufacturers of process equipment.
- Several of the large ingredients companies have their headquarters and central development department in Denmark
- Research-heavy ingredients companies co-operate well with universities – but there is room for improvement
- Access to competent and well-trained employees for positions at all levels in the companies
- Production in Denmark is rational and automated today.

**Conditions that contribute in a negative way to running the ingredients business in Denmark:**

- There are not enough people trained to Ph.D. level in food and ingredients
- Restrictive framework conditions for working in biotechnology
- Cost-heavy production (pay, tax, duties) compared with abroad
- Duties on such things as energy, NOx and waste water make production in Denmark unnecessarily expensive
- The authorities (state, regional and local) are perceived as opponents of industry; not as positive fellow players
- Production limitations on agriculture may lead to a shortage of raw materials for the ingredients industry
- Too expensive and too long case handling times
Perspectives

The Danish ingredients industry still has considerable development potential which can be realized over the next few years. The major companies indicate that they expect positive growth rates for the next few years at a minimum of 5% annually. This growth can lift the turnover in the ingredients industry from DKK 32 bn in 2011 to approx. DKK 37 bn in 2015 measured in current figures.

The challenge is to realize the potential for growth driven by developments in the global food industry and new process technology, so the Danish ingredients industry continues to be attractive for investment that creates growth in Denmark. Here it is important to make clear that today the production of ingredients already takes place on fully automatic production lines and this production structure is moving towards even greater automation. This means that the jobs the ingredients industry can generate in Denmark in the future will be a limited number of production employees (e.g. robot operators) and a rising number of employees in technology development and applications as well as administration and business development.

The competences and ideas of employees are important to ensure development in the ingredients industry, and it is therefore necessary for the industry to be able to attract interested, capable and committed employees. Several interviews indicate that the ingredients industry is "too unknown" outside the industry itself and that "the ingredients industry is not something you receive a training in". Furthermore, the analysis shows that the ingredients industry is not perceived clearly as a career option. In other words, there is a need to put the ingredients industry on the agenda in order to make clear which opportunities the industry can actually offer new employees. Furthermore, a possibility could be to create a professional identity which is characteristic of the ingredients industry. A career alone cannot do it; there also needs to be an adequate critical mass of talent for the ingredients industry to be able to expand and develop new ingredients. Therefore the talent mass needs to be increased in all employee groups, particularly in groups that have to drive the development of future ingredients and technology platforms.

Danish ingredients companies today are strongly export oriented, and only about 5% of the total ingredients production, or less, is sold to the Danish food industry. Therefore developments in the global food sector are absolutely crucial for Danish ingredients companies. Developments
in the global food industry demonstrate a movement towards fewer large international companies and a rising number of smaller, local food producers. The multinational companies in the food industry act globally and naturally expect the same of their suppliers, including Danish ingredients companies. The consequence is that Danish companies must be present on foreign markets with at least a sales office or agency; and in many cases with production, too. This development has resulted in the fact that the major players in the Danish ingredients industry are actively present on every continent today.

The analysis has shown that investment in production is undertaken in both Denmark and abroad. Furthermore companies emphasize that if production moves out of Denmark, in the long term R&D will also move out. When the production has gone and R&D moved out, there will be no basis for keeping the ingredients industry in Denmark. The moving out of production is a very long-term process, which cannot be stopped without any fuss. Therefore framework conditions must be established that will delay this move to the widest possible extent. Furthermore, it is necessary to communicate clearly that "Denmark wants production jobs".

**Denmark should be the companies’ base for development, but growth in turnover is to be gained on the global market.**

The ingredients industry forms part of the agro-food industrial complex, and therefore tendencies in the global agricultural and food sector are of major significance for the development of the ingredients industry. The most important tendencies in agricultural and food production are sustainability, renewal, effective utilization of resources, environmentally friendly production, pure and healthy products, and new production technologies. Close and dynamic co-operation has developed over many years between ingredients companies, food companies and suppliers of process technology, and both the ingredients industry and the food industry have close connections with agriculture. This is the cohesive force that is necessary for the agro-food industrial complex to be able to develop new companies, new products and create growth and employment. On this basis, it is clear that when the ingredients industry is reduced, the agro-food industrial complex loses an important competence area in that much development takes place across industries and companies.

The front runners in the Danish ingredients industry are still major players in that the companies account for by far the chief part of the turnover in the industry. It is important to see the large companies as
those who are able to innovate and create new products as well as develop markets and new technology platforms. It is not the universities who do this job. The competitive advantages of the large companies such as knowledge of markets (e.g. in the BRIC countries), customer base, technical knowhow and production volume are able, with the right collaboration, to create the optimal lift into the market for a new company or a new ingredient. This means that there ought still to be focus on the fact that it is large companies that are going to drive development of the Danish ingredients industry in an international perspective. However, the development should be arranged so that the collaborative interface between companies and other interested parties, for example new companies and universities, is optimized.

The analysis provides a couple of examples of new companies that have their source in an idea and have been established with help from DTU’s facilities, including access to capital. The examples illustrate that it is possible to start an ingredients company in Denmark and that it is often a long haul from idea to commercial success. By making it even easier and more attractive to start a new company, a growth layer of young companies can be developed that can contribute to strengthening the development of the Danish ingredients industry, and the universities can contribute greatly to this process through collaboration on projects.

The above analysis of the Danish ingredients industry shows that it is a globally oriented industry with roots in the Danish agricultural and food sector. The ingredients industry has demonstrated that it can develop new technologies and products in step with market and customer demands and that the industry is able to operate internationally with Denmark as its starting point. Furthermore, the ingredients industry has shown that companies have extended their range of products to include ingredients for animal feed, health promoting ingredients for people and animals, and solutions to non-food applications such as plant production, toiletries, energy and environmental conditions. The global demand for agricultural products and food products will continue to increase in the next few decades and there will thus be a constantly growing market for solutions to processing food and drink products.

The combination of company competences with optimal framework conditions, adequate number of capable employees, facilities, institutions and co-operation structures is a strong foundation for making Denmark into a global competence center for the development and production of ingredients for the food sector. This is what we have to live from in the future.
Definitions

Definition of ingredients

In this report ingredients are defined as products that are added to food products and drink products and as processing aids that are added to the food and drink production process, Figure 10. The report deals only with ingredients for food products and drink products, which is why ingredients for animal feed and pet food do not form part of the work.

Figure 10: Definition of ingredients

**Products that are added** to food products or drink products in order to achieve a particular effect such as consistence, color, texture, absorption of water, emulsification, changed pH, increased health, longer shelf life, less oxidation or other desired effects or properties.

**Products that are added as part of the food or drink production process.** Technical processing aids do not form part of the finished product. Enzymes are defined as technical processing aids.

Definition of concepts

The agro-food industrial complex: the coherent value chain (or complex) from farm to table consisting of companies, research institutes, technology, other suppliers and services. The complex is based on agricultural and food production and can be extended with associated production such as bio-energy or materials.

Applications center: The ingredients company’s facility where customers (e.g. food companies) can come and try out how an ingredient or processing aid affects a food product. Applications centers are widely used in the development of specific solutions for customers.

Technology platform: Knowhow, strong competences and any patent in a specific area (e.g. cultures or emulsifiers). The technology platform can include several production technologies, but it is characteristic for the platform that it is the foundation for further development of a technology, application or the base for new products.
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www.biopro.nu
www.business.dk
www.food-supply.dk
www.foodingredientsfirst.com
www.nutritionhorizon.com

And web sites of the companies in the ingredients industry.
Appendix: Methodological Approach

The approach to the analysis in the report is both qualitative and quantitative. Data collection has included gathering statistics and descriptive material on the industry (at company and industry level) as well as on innovation and development tendencies in the global food industry.

It has been endeavored to provide quantitative material on the size and structure of the ingredients industry in the year 2012, but in several cases the statistical base has been too slight or non-existent such as when companies do not wish to reveal figures for turnover or investments.

As far as possible, all figures (turnover, number of employees and export share) have been gathered at group level but there are exceptions:

- For companies where ingredients for food products only comprise part of the total business, only figures for the food ingredients part (e.g. Novozymes) have been included.
- For companies where the company in Denmark is a subsidiary of a foreign group, it is figures for turnover and employment in the Danish subsidiary that forms part of the data for the analysis (DuPont, BASF, AAK, CP Kelco and Kerry Ingredients).

IFAU has approached the most important players in the Danish ingredients industry for interviews, Figure 11. Respondents have been managing directors, sales and marketing directors or similar resource persons. Common to the companies that have taken part in the interviews is the fact that they have been very positive and open in a discussion of their company and the ingredients industry. Individual companies have been contacted several times without success in arranging an interview.

The purpose of the interviews has been to obtain the company’s assessment of the development potential in the ingredients industry, to obtain the most important drivers and barriers and their significance, and to obtain key figures and more detailed information on the company’s connections with Denmark. Interviews have been carried out by IFAU on the basis of an open question framework. A priority has been that, altogether, the interviews carried out have represented companies of different sizes, Danish and foreign-owned companies, and companies within the various segments (colorings, emulsifiers, enzymes etc.).

Jointly, it is judged that the written sources and the interviews together provide a good and detailed basis on which to assess the growth potential which the ingredients industry in Denmark possesses.
### Figure 11: Interviews with ingredients companies 2013

<table>
<thead>
<tr>
<th>Segment</th>
<th>Company</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proteins</strong></td>
<td>BHJ</td>
<td>Adm. Dir. Asger Jakobsen</td>
</tr>
<tr>
<td></td>
<td>Arla Food Ingredients</td>
<td>Chief Executive Officer Henrik Andersen</td>
</tr>
<tr>
<td><strong>Hydro-colloids, starch</strong></td>
<td>CP Kelco</td>
<td>Factory Director Jørn Stryger</td>
</tr>
<tr>
<td></td>
<td>KMC</td>
<td>Man. Dir. Nikolai Hansen</td>
</tr>
<tr>
<td><strong>Emulsifiers</strong></td>
<td>Palsgaard</td>
<td>Man. Dir. Jakob Thøisen</td>
</tr>
<tr>
<td><strong>Enzymes and cultures</strong></td>
<td>Chr. Hansen</td>
<td>Man. Dir. Lars Frederiksen Director Knud Vindfeldt</td>
</tr>
<tr>
<td></td>
<td>DuPont Health &amp; Nutrition</td>
<td>Ole Søgaard Andersen, Vice President – Sales, Applications and Marketing</td>
</tr>
<tr>
<td><strong>Vitamins</strong></td>
<td>BASF Danmark</td>
<td>Man. Dir. Preben Sørensen</td>
</tr>
<tr>
<td><strong>Flavours,</strong></td>
<td>Einar Willumsen</td>
<td>Man. Dir. Jan Grøndal</td>
</tr>
<tr>
<td></td>
<td>Lactosan-Sanovo</td>
<td>Sales and Marketing Director Jesper Olsen</td>
</tr>
</tbody>
</table>

All amounts in the report are given in DK Kroner.
The following exchange rate has been utilized as of January 2013:

100 EUR = 745 DKK; 100 USD = 570 DKK
Question Framework for interviews with ingredients companies

About the company
Turnover, growth, employment
Production plants in Denmark and abroad, development in number of plants
Range and developments in range
Strategies for company development, including change in strategy
Ownership and changes in ownership (including consequences of foreign ownership)
Company growth abroad contra growth in Denmark
Company connection with Denmark (e.g. access to raw materials)

Employment
Number of staff and development
Expected employment split into production, research and administration
Skills requirements for employees in production

Investments
Which factors are significant for company decisions on future investment in production and research
How large a part of the turnover comprises investment, and developments in this
How are the investments distributed between 1) fixed installations/production and 2) research and innovation
What conditions can get the company to increase investments (in production) in Denmark

The Ingredients industry in Denmark
How is the ingredients industry segmented respectively in additives or processing aids, other
Why do we have a large ingredients industry in Denmark
Which developments are seen for the industry as a whole and for specific segments
Which factors are the most important for the international competitiveness of the ingredients industry
Drivers for the ingredients industry (including consideratons on the global food industry, sustainability, price conditions, market developments etc.)
Which drivers have the greatest influence on the company
Which drivers have the greatest influence on the Danish ingredients industry
What is the significance of the health and wellness tendency for development in the Danish ingredients industry (e.g. new ingredients, major growth potential)
How does the company act in order to utilize the global drivers optimally

**Barriers for the ingredients industry**

Which barriers in Denmark have the most considerable significance for the company’s development (e.g. competitive power, price, falling customer base, fewer raw materials etc.)

Which barriers outside Denmark have the most considerable significance for the company’s development

Which barriers are the most considerable for development of the Danish ingredients industry

**Perspectives for the ingredients industry in Denmark**

What will the company look like in 5 and 10 years

Which framework and factors can enable the company to achieve its goals – preferably with information as to how Denmark is taken into consideration

What will the Danish ingredients industry look like in 5 and 10 years (structure, range, internationalization etc)

Which strengths and weaknesses does the industry have (e.g. decision centers, strong research units etc)

Which opportunities and threats are seen for the ingredients industry

How can the ingredients industry play an important role for growth in the Danish food industry, also in the future

**Recommendations for initiatives that can strengthen the ingredients industry in Denmark**

**Recommendations as to how the ingredients industry can strengthen growth in the Danish food industry**

**Other comments**