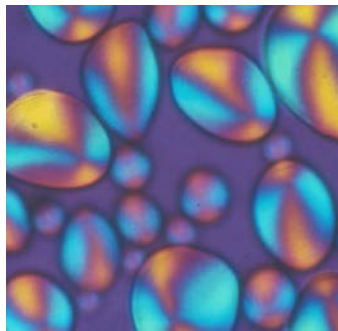


International
Starch
Institute

THE ECONOMY OF POTATOES FOR INDUSTRIAL PROCESSING

TM15-6e



Starch Technology

CULTIVATION.

62 % of our land is under plow. Out of 2.665.000 ha plowable land 42.000 ha is cultivated with potatoes (2012) with a yield of 1.664.000 t potatoes ~ 40 t/ha. (Source: Fakta om erhvervet, Landbrug & Fødevarer).

App. 1.100.000 - two third - are industrial starch potatoes yielding 208.000 t potato starch (2013). Approx. 95 % of the starch is exported to over 80 countries. Potato starch contains 80 % starch and 20 % water.

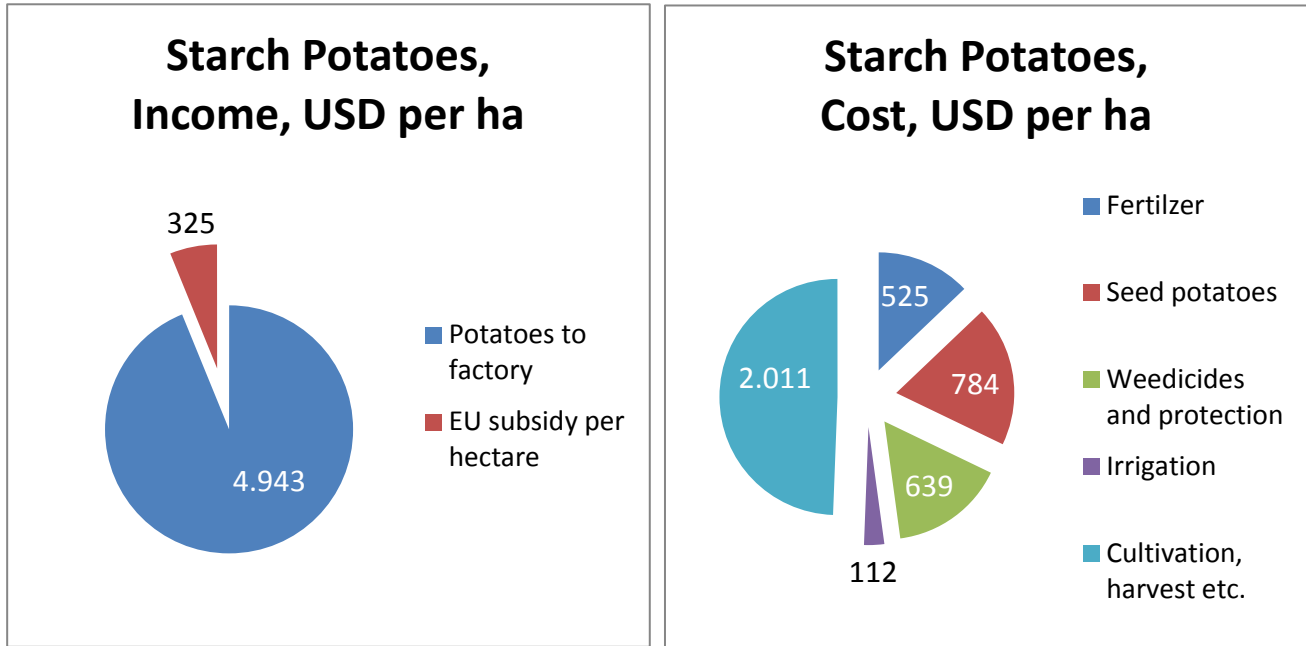
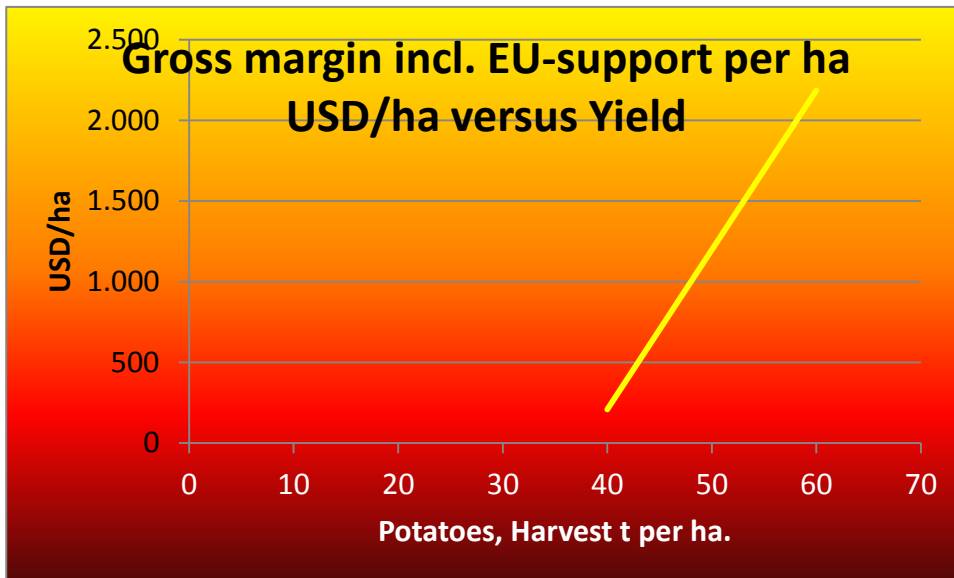


Figure 1. From 2012 EU subsidies are added to the production value as a subsidy per hectare. Total average cost incl. labor and machine cost is 25.077 DKK/ha and income incl. EU subsidy is 32.450 leaving a gross margin of 7.372 DKK/ha. This calculation is based on a yield of 50 t potatoes per ha. Only members can deliver potatoes to the factory and the price of shares is typically equivalent to 12.500 DKK / ha, which - together with the land 142.000 DKK / ha - shall be remunerated out of the gross margins.

Exchange rate 01.01.2015: 6,16 DKK/USD.



The profit depends very much on yield and dedicated skilled farmers may do quite well.

As a safeguard against plant diseases potatoes can only be grown in the same soil every four years and crop rotation is a must and has to be taking into account as part of the economy.



Figure 2 KMC Head Quarter in Brande

PRESS RELEASE - KMC ROUNDS A BILLION!

At the General Meeting 21 November 2014 KMC's Chairman Peter C. Petersen reported for the first time in company history a turnover of DKK 1 billion - exactly DKK 1.089 billion. This corresponds to an overall revenue increase of 16 % compared to the year before.

Since the potato harvest in the rest of the EU were affected by unfavorable weather conditions KMC experienced high demand with prices stable at a high level throughout the year. KMC has increased sales of highly processed ingredient products. This has led to revised growth expectations for this important business.

The activity in the potato powder has also performed better than expected. This applies to both production and sales, which did set new records.

In recent years, KMC has invested heavily in the ingredients area. These continued into 2013/14 and a new spray tower for refined starches has been put into use. Furthermore, more development resources for the ingredients area has been added and new sales offices opened in Dubai and Hong Kong.

Overall, KMC earned a profit of DKK 108,6 million, which the President designated as "very satisfactory".

KMC is the Danish starch sales organization and is jointly owned by the three Danish Potato Starch Factories "Midtjylland" in Brande, "Sønderjylland" in Toftlund and "Karup Kartoffelmelfabrik" in Karup. The company is a leader in the production, development and sale of potato-based ingredients for the food industry. 95% of production is exported to over 80 countries in the world.



Figure 3. Karup Potato Starch Factory put campaign record in 2013/2014 with 325,000 tons of potatoes from growers. Source: 24.08.2014, Claus Worup, Maskinbladet.dk.

About 80 percent of Karup Kartoffelmelfabriks suppliers are located within a radius of 40 km. They had an income of about DKK 30,000 per hectare. The growers delivered together 325,500 tons of potatoes, which were converted to 75,100 tons potato starch and 3,200 tons of protein - all of which is a new record for the factory.

The entire year's production is produced in the period from August to January - a period called the campaign - where the 300 farmer members supply potatoes to the factory. The finished product is stored in three large silos that can continuously handle potato starch to customers throughout the year. The general meeting in June 2014 showed a net profit of DKK 87.3 million.



Figure 4. Potato starch factory "Midtjylland" in Brande is producing native starch most of which is modified in the neighboring modification plant owned by KMC.



Figur 5. The general Assembly 2014 of Potato Starch Factory "Sønderjylland" in Toftlund voted for an expansion of the production capacity. The management wanted to finish the production campaign before Christmas. This will save frost protection in the field and loss of starch through breathing.

The capacity increase will be installed by International Starch Institute A/S during 2015 and take the capacity to 30 t of starch per hour. Present installation was also put in operation by us. It was in 1989. The capacity was then lifted from 4 to 12 t per hour of starch. The new plant will have lower consumption figures which will strengthen the competitive edge.



Figure 6 Potato Starch Factory "Sønderjylland" in Toftlund.



Figure 7 . Landspreading of Protamylasse

POTATO STARCH PRODUCTION

The production takes place during a campaign from late August to early January. Starch is extracted, refined and dried. Protein is precipitated from the fruit water (combined juice and process water) and dried. The protein is used for animal feed and in the fermentation industry. The residual water is evaporated to protamylasse - a kind of syrup with 32-40 % dry matter - used as organic fertilizer on farmland in the growing season and in biogas plants. Part of the condensate is reused for washing potatoes. The residual condensate and potato wash water is disposed of on farm land. The trend is towards the use of less water and no sewage at all. Cellulosic fraction may be processed into dietary potato fiber containing only 12 % water. Residual pulp is made up of about 13 % solids and used as is for feeding ruminants.

End products for sale:

Potato starch,	80 % DM
Potato protein,	90 % DM
Potato pulp, wet	13-14 % DM
Protamylasse, app.	33-40 % DM

Consumption figures for the manufacture of one t potato starch, 80 % DM for sale (2013/2014).

Consumption figures	Unit	QTY	QTY
Potatoes as is incl. 5 % dirt	t	4,6	
Clean potatoes incl. 18,93 % starch DM	t		4,3
Ground water for production	m ³	2,2	
Ground water for other purposes	m ³	0,3	
Ground water, Total	m ³		2,5
Electricity for Starch	kWh	140,5	
Electricity for Protamylasse	kWh	55,5	
Electricity for Potato Protein	kWh	19,1	
Electricity, Total	kWh		215,1
Natural gas for starch	Nm ³	24,3	
Natural gas for Protamylasse	Nm ³	0,7	
Natural gas for Protein	Nm ³	8,1	
Natural gas for central heating	Nm ³	0,7	
Natural gas, Total	Nm ³		33,8
Natural gas, Total 11 kWh/Nm ³	kWh		371,9
Sodium bisulfite as anti-oxidation	kg		3,8
Antifoam for washing of potatoes	kg		0,5
Sulfuric acid for protein precipitation	kg		1,9
Sodium hydroxide for CIP	kg		5,2
Labor & administration staff	hour		0,77

Output for each one t of potato starch for sale (2013/2014):

Output	Unit	QTY
Potato Starch 80 % DM for sale	t	1,0
Potato Pulp 13 % DM for sale	t	0,64
Potato Protein 90 % DM for sale	t	0,04
Protamylasse 40 % DM for sale	t	0,35
Condensate ¹ from protamylasse evaporation	m ³	3,8
Water used for washing potatoes	m ³	2,0
Dirt (30 % sand and stones, 70 % soil)	t	0,3

Estimated prices / costs 2013/2014:

Potatoes cleaned,	18,93 % starch DM	107 USD/t
Starch,	80 % starch DM	576 USD/t
Potato protein,	90 % DM	1.094 USD/t
Potato pulp, wet	14 % DM	16 USD/t
Protamylasse,	33 % DM	94 USD/t
Electricity		0,12 USD/kWh
Natural gas		0,45 USD/Nm ³
Chemicals, various		5 USD/t of starch
Personnel, average ²		67.500 USD/man year
Personnel, average		41 USD/h
Exchange rate 01.01.2015		6,16 DKK/USD

Competition

Potato starch is a food starch per excellence. On the world market, however, it competes with cassava starch with similar rheological properties. The production costs of various tuber / root starches are similar, but the cassava industry enjoys a longer production campaign and less storage costs. The cassava juice is, however, lower in protein and protein precipitation does not pay off.

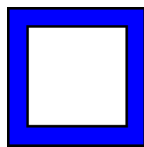
Technical Memoranda

The Danish Starch Industry	TM07-7e
Potato Starch	TM05-5e
Potato Protein	TM27-1e
Potato Juice	TM03-5e

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¹ App.25 % of the condensate is reused for washing potatoes. The residual is disposed of on farm land.

² 1.650 working hours per year.



... a member of the International Starch Group

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