

Carbohydrates

Carbohydrate crops are potatoes, sugar-beet and cereals. Cereals are the major crop in the Baltic Sea countries, however all three carbohydrate crops are of significance for the Baltic Sea farmers.

Production of carbohydrate crops in the Baltic Sea countries
(1000 tons)

	Food cereals	Feed and industrial cereals	potatoes	Sugar beet
Germany 1997	24.517	17.830	11.443	25.864
Denmark 1997	2.217	6.425	1.617	3.300
Sweden 1995	4.261	2.478	1.074	2.478
Finland 1997	1.374	2.383	754	1.354
Estonia				
Latvia				
Lithuania				
Poland 2000	17.657	4.684	24.238	13.134

Poland and Germany are by far the largest producers of carbohydrate crops. Germany has a very large sugar beet production, and Poland is not only the leading potato producer in the region, but also number 2 in Europe and number 3 in the World.

There are considerable variations in crop yield from country to country and within the individual countries, which is due to a number of factors such as crop variety, soil quality and input of pesticides and fertilisers. The relatively extensive production on rather large areas of land gives an indication of a very large potential for an increased carbohydrate crop production in the Baltic Sea area, should the need arise.

This seems however not to be the case, at least not in the near future. Recent expert projections indicate thus that surpluses of especially cereals will be significant, unless major action is initiated to prevent their accumulation.

Cereals

Cereals represent a major component of the human diet worldwide; either directly in breakfast foods or as baked goods derived from flour, or indirectly as components of animal feed.

Surplus production of cereals in the EU countries has led to an increased interest in alternative applications of cereals, and for the last ten years extensive research has resulted in a number of new cereal-based technical products such as:

- ❑ Biodegradable plastics and packaging materials
- ❑ Solvents
- ❑ Personal care products
- ❑ Liquid fuels
- ❑ Adhesives
- ❑ High fructose syrup

There are wheat starch factories in Germany and Poland, and in Finland starch is produced from barley, which is rather extraordinary. The growth conditions in the northern Finland seem to be well suited for barley, and high starch contents can be obtained. More than 270.00 tons of barley is used for non-food purposes in Finland.

Potatoes

Most of the potatoes grown in the Baltic Sea area are used for direct human consumption. An increasing amount, however, is processed into potato snacks, chips etc. and starch.

The potato starch factories in the Baltic Sea area are faced with at least five inter linked problems Those limit the profitability and possibilities for expansion.

- ❑ Most of the factories are small compared with competing wheat and maize starch factories, and therefore they do not have the economic advantage of scale.
- ❑ Production limitations due to the quota system (EU countries only)
- ❑ Increased competition from cereal starches due to quality improvements and cost reductions
- ❑ Seasonal production and thus poor utilisation of processing equipment
- ❑ Environmental problems (huge amounts of waste water)

Native potato starch and starch derivatives are preferred to maize and wheat starch in many applications in spite of a higher price. This is due to the fact that potato starch has better functional properties for a number of applications than the other starches. The quality of both wheat and maize starch is however constantly being improved. It is therefore necessary for the long-term expansion/survival of the potato starch industry that also potato starch qualities are being improved, and/or the production costs are reduced. The latter might be achieved via complementary productions during the off-season periods and by an optimal utilisation of all components in the potato crop (biorefining). Some of the potato starch factories are actually extracting the protein from the wastewater and using it for food and feed purposes.

In principle a potato crop is a main producer of protein. Only Soya and alfalfa produce more protein per ha than potatoes. Potato protein is neutral in taste and has a biological value that is comparable with meat and milk protein. The functional properties are excellent. Potato protein may also be used for non-food purposes such as glues, adhesives, edible coatings and plastic films. A few of the potato starch factories in the Baltic Sea area are producing potato proteins.

Apart from starch and protein potatoes also contain a pectin rich fibre component that has many potential applications, both food and non-food.

The residue from the protein extraction (fruit water) or the fruit juice is an excellent fertiliser, and it can be used as fermentation medium for production of e.g. amino acids. A plant for production of the essential amino acid –lysine, is under consideration in Denmark.

Sugar beet

The major part of the sugar production is used for human consumption, and quotas regulate the production in the four EU countries.

The potential non-food market is large, provided the right price. Sugar (sucrose) is an excellent fermentation feedstock, which is of special interest for Baltic Sea area with its high concentration of

fermentation industries including pharmaceutical companies. The industrial produced sucrose is a very pure carbohydrate source and it has the advantage that the microbial count is very low. Currently it is however doubtful whether pure beet sugar can compete with cheap imported alternative feedstocks such as cane sugar, corn syrup, maize steep liquor etc.

The presence of eight hydroxyl groups in the sucrose molecule provides a theoretical possibility of a very large number of sucrose derivatives. Such derivatives are used for production of detergents, emulsifiers and adhesives. These products are relatively expensive and cannot compete with the commonly used detergents in major household and industrial detergent formulations. They are therefore mainly used in specialist applications such as cosmetics. The sucrose derivative sorbitol is used in relatively large amounts in production of urethane foam.

Sugar beets are the most efficient carbohydrate producers measured in tonnes per ha, however, the main carbohydrate competitor, starch, has the advantage that the long chain polymeric nature of starch imparts properties that are not matched by sucrose, leading to substantially higher usage of starch. Both products are readily hydrolysed, starch to glucose and sucrose to glucose and fructose. Both compete with each other for use in a large range of fermentation productions. Sucrose, tonne for tonne, has a 5 % higher carbon content than glucose, however the price difference is normally not in favour of use of sucrose (sugar) instead of glucose (starch).

The by-product from sugar production – molasses – is to some extent used as a cheap, but impure, fermentation medium. However, most molasses is used as animal feed.

Sugar beets cannot be stored for a significant period of time without biological spoilage. Sugar factories must therefore be situated close to the growing areas, and they are relatively restricted in size by crop transport considerations. They are, as potatoes, restricted to campaign type operation during the harvesting period, a further important cost factor, though this has been improved by modern techniques like thick juice storage