Europe 1992

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THE DANISH

BIOTECHNOLOGY

INDUSTRY

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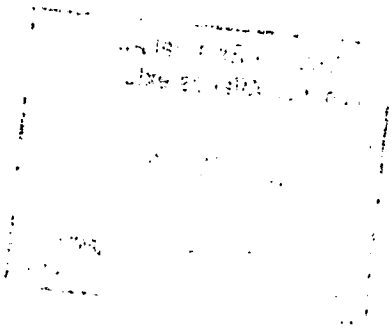


This report was prepared by a private consultant on behalf of the Canadian Embassy in Denmark. The opinions expressed in this report are those of the author and do not necessarily represent the past or current policy of the Government of Canada.

FROM THE GOVERNMENT OF CANADA

External Affairs and International Trade Canada (EAITC) is pleased to offer the Canadian biotechnology community, as part of the Going Global trade strategy, this overview of the Danish biotechnology industry. This project was undertaken by the Canadian Embassy in Copenhagen under the Going Global European Initiative Fund, an initiative of the European Community Division of EAITC. This fund is part of the Europe 1992 Awareness Campaign.

Europe 1992 is happening now. The European Community's ambitious Single Market program has already dramatically changed the way Europeans are doing business. The process is irreversible; the pace is rapid and accelerating. If Canadian businesses are to profit from the opportunities that this enormous market will bring, they must be well-informed.

Other publications that are currently available from the series 1992 Implications of a Single European Market include: Agriculture and Food Products; Telecommunications and Computers; Automotive Industry; Minerals and Metals; Forest Products; Defence, Aerospace and Transportation; Specialty Chemical Products, New Materials, Pharmaceuticals and Biotechnology; Industrial Products and Services; Financial Services; Fisheries Products; and Professional and Consulting Services - Law and Accounting. Other reports include European Economic and Monetary Union; Company Law; Competition Policy; Standards; Freight Forwarding; 1992 and Related Issues; Intellectual Property; Europe 1992 and Canada's Ocean Industry; Europe 1992 and Canada's Environmental Industries; Europe 1992 and Canada's Value-Added Wood Products; Europe 1992 and the Canadian Software Industries; Europe 1992 and the Canadian Telecommunications Industry; Moving into Europe; and LINK '92 - The Experience of Successful Canadian Companies in Europe.

For more information on publications available, please contact the EAITC InfoExport hotline, 1-800-267-8376.

Further information on export and strategic alliance opportunities in Denmark are available from the Western Europe Trade, Investment and Technology Division (Tel: 613-995-9401; Fax: 613-995-6319) and the Canadian Embassy in Copenhagen (Tel: 011-45-33-12-22-99; Fax: 011-45-33-14-05-85).

DANISH BIOTECHNOLOGY INDUSTRY

1. Introduction

During the last several decades it has been recognized internationally - both within OECD and the European Community - that research and technological development are key factors in the achievement of improved international competitiveness. This has been the case for individual countries as well as for communities of countries, such as the European Community. In this regard biotechnology has already attracted great attention and it can be expected that biotechnology will attain a very central position in future industrial developments.

This introductory article will provide an overview of the biotechnology sector in Denmark, both with regard to public R&D and private enterprise R&D and production. Some of the larger Danish biotechnology companies will be briefly presented but the emphasis will be on the setting in which they operate, emphasizing the advantages created by the unique agricultural and industrial "complex" in Denmark, the excellent research community, and the public sector which supports and regulates the biotechnological enterprise in Denmark.

Attached is a list of some of the leading Danish commercial organizations and research institutes involved in biotechnology research, development or manufacturing. It should be borne in mind that this is not an exhaustive coverage of Danish organizations carrying out biotechnology R&D. However, it is apparent that there is a significant increase in R&D expenditure by the public as well as the private enterprise sectors and that biotechnology is a young and expanding industrial activity in Denmark.

The Danish biotechnology industry encompasses a diverse group of companies that range widely in size, technologies used, and markets served. The common thread that binds them is their primary mission: to use biological processes to develop products for human health care, agriculture productivity, animal health, food safety and nutrition, and environmental improvement. Also included are those companies and research institutes whose primary mission is to supply technology-based research products to other biotechnology companies. Although several companies from the traditional industries in Denmark (pharmaceuticals, chemicals, agriculture, food, energy, etc.) employ biotechnological processes, this is not their primary activity; therefore, these companies are not included in the report.

2. Biotechnology industry in Denmark

Exhibit 1

The following are the most important industrial sectors in Denmark influenced by biotechnology:

Animal and Plant Husbandry	**Pharmaceuticals**
	Fine Chemicals
Food and Beverages	**Environmental Technology**

Denmark is known for its agricultural basis; yet, manufacturing, contributing 28% to gross domestic output, is 6 times as important as agriculture. In fact, chemicals/pharmaceuticals are almost as important as the entire agriculture sector.

For centuries, agriculture has been the backbone of Denmark. Denmark has no other raw materials and no basic industries to draw resources away from agriculture and the activities originating from diversification from the strong agricultural foundation. First and foremost the food industry, such as dairies and meat processing plants, has made Denmark a major supplier to the world of quality foods - and of starch, protein and animal tissue for such drugs as insulin, heparin and penicillium, which account for two-thirds of Danish drug export.

Milk and meat processing demand accurate instrumentation and thus a number of instrumentation and electronics companies have emerged and created the basis for a substantial medico-technical industry, which goes hand-in-hand with drug production and monitoring. A workforce trained in the handling of food is also equally well qualified for the stringent demands of the pharmaceutical industry. In addition, an educational system based on research and development in agriculture, biology, microbiology, food chemistry and food processing is an excellent "knowledge pool" for modern biotechnological research and manufacture. And finally, a public body of veterinarians and health authorities familiar with the regulation of food, food ingredients, nutrients, etc., is also able to cope with biotechnology.

It is common to group together what could be termed **"The Danish Bio-Industrial Complex"**, encompassing that part of manufacturing which processes or produces food/beverages, fine chemicals, and pharmaceuticals as well as machinery and instruments specifically aimed at such industries. Considered this way, more than 40% of Danish industry is interlinked, drawing on the same pool of know-how, stimulating and supporting each other and creating a favourable environment and structure for fine foods, fine chemicals and pharmaceuticals.

The export rate is high across the entire sector. Denmark has 1/10 of a percent of the world population, yet accounts for 1% of world trade. The health industry alone commands 3-5% of the world trade in health products, which secures for Denmark a position among the ten most important suppliers of such goods on the international arena. This has been accomplished by companies 80% of which employ fewer than 100 people. This illustrates another important element of the infrastructure of the Danish biotechnology industry. Like Canada, Denmark has a large small--to-medium sized enterprise (SME) industrial base. These companies take advantage of the ability of the small firm to adapt to changing conditions, utilize developing technologies and meet changing market demands. As a result of this industrial structure, Danish exports have been a lead factor in the development of niche production to overcome competition from major industrial neighbours.

Exhibit 2

Several of the companies within the Bio-Industrial Complex are well established on the world market and form a strong base of the Danish biotechnology industry. This is particularly the case for companies such as the Carlsberg breweries, the Danisco concern, Chr. Hansen Laboratories and Novo Nordisk.

Danisco is one of Denmark's foremost, international industrial groups. With net sales of CAD 2.3 Billion, the company is the largest Danish supplier of ingredients, products, packaging, and technology to the international food industry. The business units in Danisco's sector for food and beverages include Danish Sugar and Danish Distillers. The food ingredients sector comprises Grindsted Products and Danisco's biochemical research division now merged with the company Maribo to become the unit where long-term biotechnological research and development is carried out. The Danisco Group produces a range of well-known, high-quality foods and brands which are marketed in Denmark and on selected European and global markets.

Already in 1874, the Chr. Hansen Laboratories were the first in the world to market pure cultures of bacteria and enzymes for industrial production of cheese. Today the company has diversified into diagnostics and the production of food ingredients. The products are marketed throughout Europe and North America, with annual sales of CAD 200 Million.

Novo Nordisk is one of the world's leading biotechnology companies. It is a major force in insulin manufacture and diabetes treatment and is the world's largest producer of industrial enzymes. In 1923, just one year after the discovery of insulin, Denmark became the first country to mass-produce insulin from pig pancreas. Today Novo Nordisk produces 50% of the world's insulin. The company also manufactures and markets a variety of other pharmaceuticals and bioindustrial products.

Novo Nordisk accounts for almost 70% of the total Danish pharmaceutical industry, yet, measured on turnover, it is only 15% to 20% the size of one of the world giants. Headquartered in Denmark, Novo Nordisk employs more than 10,000 people in 30 countries. Group net turnover is CAD 1.8 Billion. The Bio Industrial Group (enzyme production) alone accounts for CAD 550 Million in sales.

The importance for the Danish economy of the bio-industrial complex can be seen from the export figures, where this sector accounts for 27% (approximately CAD 11 Billion) of total Danish export value. More than half of the export revenue comes from the foodstuff industry, while insulin, penicillium and enzymes alone account for one-third of total exports from the chemical/ pharmaceutical sector. In terms of production and export value per capita, Denmark holds a leading position relative to other OECD countries.

3. Government research and development programs

Cooperation between private enterprise and public research in Denmark has always been excellent. Government support to industrial R & D consists of two main elements: (1) Support for the technological infrastructure in order to assist small and medium-sized firms; (2) Co-financing schemes and programs aimed at high technology promotion, and collaboration among firms, particularly in selected industrial sectors. Several schemes or programs are in progress, among these are: the Biotechnology Research Program; the Food Technology Development Program; and support for Danish participation in EUREKA projects.

Public research is performed at universities and at sectoral research institutes under the auspices of various governmental ministries. Of special importance are a number of independent, non-profit research institutes under the Academy of Technical Sciences serving primarily the private sector.

Danish overall R & D efforts have increased from just under 1% of GDP in 1979 to 1.52% of GDP in 1989 with the major increase in R & D effort taking place in the private enterprise sector. Half of the total Danish R&D expenditure of CAD 2.2 Billion in 1989 was financed by the private enterprise sector.

Biotechnology is one of the most internationally oriented areas of Danish industry, where R&D is on an international level and well above the average for Danish industry as a whole. This, together with a strong national tradition in basic research in biology and the increasing application of biotechnology in many sectors, places Denmark in a favourable position. For this reason, efforts to boost both basic research and strategic research in biology and biotechnology will continue.

The first Government program aimed at supporting the biotechnology R&D program was conducted from 1987 to 1990 with a total funding of CAD 90 Million; this has resulted in a considerable strengthening of Denmark's potential in this important area. On the basis of a review of this program, the Government has appropriated additional CAD 85 Million for the period 1991 to 1995 towards additional efforts in the biotechnology research program.

The main purpose of the program is to support 12 centres of research which are not new institutions but rather a formalized association of research teams in existing institutes and the private enterprise sector. This construction is a new concept in Denmark which is meant to encourage collaboration among university institutes, service network institutes, and the private enterprise sector. These centres have been called "research centres without walls". Common financial control within the respective centres has allowed flexibility in resource utilization and considerable savings in administration.

To strengthen the position of the Danish food industry on international markets, the Government has set aside CAD 100 Million for a research and development program that runs from 1990 to 1994. The private enterprise sector within the food industry is expected to contribute a similar amount, bringing the entire funding of the program to CAD 200 Million.

The program is aimed primarily at the private enterprise sector in the food industry and at R&D environments at universities and other centres of expertise. As with the biotechnology research program, the overall policy is to intensify university/industry R&D cooperation. Three university research centres will be established under this program, where emphasis is placed on quality, international competitiveness and participation in international cooperation.

As a member of the European Community, Denmark participates in the EEC research programs, including the biotechnology programs (BRIDGE), the preventive medicine program, the agricultural research program, and the ECLAIR (agro-biotechnology) and FLAIR (food biotechnology) programs. Denmark participates in Nordic research collaboration as well, a collaboration which also includes a biotechnology program. Denmark is a member of EMBL, the European Molecular Biology Laboratory in Heidelberg. Denmark is actively taking part in EUREKA, the European cooperation program for industrial R&D, under which a number of Danish companies are involved in EUREKA projects in biotechnology.

4. Private Enterprise R&D Expenditures

There is no information publicly available on the total level of Danish private enterprise investments and R&D expenditures in biotechnology. There is, however, no doubt that it is a high growth area and that the massive public R&D efforts corresponds to a massive effort in the private enterprise sector, not only in R&D but also in production facilities and marketing. The sector is highly internationalized and a number of companies, especially Novo Nordisk, invest also in production facilities in other countries, including Japan and the USA.

Exhibit 3

Several Danish companies involved in biotechnology have reported information on R&D expenditures to the Ministry of Education and Research, which is the legislative power for the Government's R&D programs. Exhibit 3 summarizes the R&D expenditures in biotechnology in 1989 based on the companies which reported this information. The number of companies and research institutes involved in biotechnology R&D between 1987 and 1989 has increased by 16% (from 43 to 50). The majority is in the small firm category. Typically, biotechnology companies, or the research groups within large companies, are small.

The summary figures by reporting companies indicate that the total biotechnology R&D effort in 1989 was CAD 190 Million, of which the private enterprise sector accounted for 56%. Biotechnology accounts for approximately 9% of the total Danish R&D effort.

5. Government Legislation and Regulation of Biotechnology

In 1986, a Gene Technology Act was passed by the Danish Parliament as the first of this type of legislation in the EEC. Its purpose is to protect nature, the environment, and public health, including nutritional quality in connection with the application of recombinant DNA. This legislation resulted for the first time in the EEC in acceptance of continued use of transgenic organisms in industrial research but special exemption is required on a case-by-case basis for deliberate release of genetically modified organisms. Despite a contentious debate before the passage of this law, industry has found the law rather easy to live with. It is certainly not deterring either the pharmaceutical or the food industry from continued R&D within genetic engineering. The first exemption was granted in 1989 to Danisco for testing a genetically engineered sugar beet.

6. Public Opinion in Denmark on Biotechnology

The attitudes of the Danish population toward gene technology have been monitored through three representative interview surveys during 1987 to 1990. In each survey, attitudes differed systematically with age, sex, and level of education. Although about 60% of the respondents did not have a clear-cut opinion, young well-educated men seemed to accept gene technology to a higher degree than women, whereas poorly educated persons and older people tended to resist it. Also, attitudes were clearly dependent on respondents level of political interest and partisan choice. This observation was somewhat surprising since the subject had been ranked low on the political agenda.

Between 1987 and 1990, public opinion shifted markedly towards a more favourable view of gene technology. The Danish Government sponsored a biotechnology information campaign in 1990 which reached 20,000 persons, or 0.4% of the total population, who attended lectures and took active part in discussions and dialogues. Two-thirds of the attendants were women.

EXHIBIT 1

BIOTECHNOLOGY INDUSTRY

INDUSTRIAL SECTORS

ANIMAL AND PLANT HUSBANDRY

FOOD & BEVERAGES

PHARMACEUTICALS

FINE CHEMICALS

ENVIRONMENTAL TECHNOLOGY

PRODUCTION VALUE

	CAD Billion (1988)	
MANUFACTURING INDUSTRY IN TOTAL	54.2	100.0 %

BIO-INDUSTRIAL COMPLEX

MEAT PROCESSING	5.3	9.8
FOOD & BEVERAGES	10.7	19.8
CHEMICAL INDUSTRY	3.1	5.8
PHARMACEUTICALS	1.3	2.4
INSTRUMENTATION	1.6	3.1
TOTAL	22.0	40.9

EXHIBIT 2

BIO-INDUSTRIAL COMPLEX

LEADING COMPANIES

	NET SALES CAD Million	EXPORT	R & D	STAFF
DANISCO	2,300	85%	2.5%	13,500
CARLSBERG	1,900	75%	—	11,500
NOVO NORDISK	1,800	94%	15%	10,200
CHR HANSEN	200	90%		1,400

EXPORT VALUE

	CAD Billion (1990)
DENMARK TOTAL	40
BIO-INDUSTRIAL COMPLEX TOTAL	11

EXHIBIT 3

R & D EFFORTS

		CAD Million (1989)
TOTAL DANISH R & D EXPENDITURE		2,200
TOTAL BIOTECHNOLOGY R & D		190
GOVERNMENT SECTOR	83	
PRIVATE ENTERPRISE SECTOR	107	

INSTITUTE PROFILE

Centre for Biotechnological Process Research
Technical University, Copenhagen

1. Head office

Center for Bioteknologisk Procesforskning,
Instituttet for Bioteknologi,
Bygning 221,
Danmarks Tekniske Højskole,
DK-2800 Lyngby,
Denmark.

Tel: +45 45 93 30 66
Fax: +45 42 88 49 22

2. Management

Mr John Villadsen, Professor, Managing Director
Ms Tove Secher, Research Secretary

3: Indicators (1990)

Annual turnover: CAD 3 Million
R & D expenses: CAD 3 Million

4. Principal Activities

Primary goal of basic and applied research is optimization of design and functionality of bioprocesses.

Activities are divided into following disciplines:

* Microbiology,
* Protein chemistry,
* Fermentation,
* Down stream processing,
* On-line analysis and mathematical modelling.

5. History

The Centre was established in 1987 as a part of the Danish national biotechnology research and development programme initiated in 1987. Funding 1991 - 1995 is CAD 14 Million.

6. Biotechnology activities

Current research fields include:

* Engineering aspects of microbial physiology
* Development of integrated bioprocesses
* Immuno technology in bioprocesses
* Modelling of the fermentation process for penicillin
* Growth and metabolism of metanotrophe bacteria
* Biotechnological wastewater treatment

7. Desired alliance with other research institutes and firms

Collaboration with research institutes and enterprises for research, development and evaluation of new products within the core research of the Centre

INSTITUTE PROFILE

Biotechnological Center for Animal Husbandry and Fish
Royal Veterinarian and Agricultural University, Copenhagen

1. Head office

Bioteknologisk Center for Husdyr og Fisk
Institut for Anatomi og Fysiologi
Kongelige Veterinær- og Landbohøjskole
Bülowsvej 13
DK-1870 Frederiksberg C
Denmark

Tel: +45 35 28 25 40
Fax: +45 35 28 20 79

2. Management

Mr Torben Greve, Managing Director

3: Indicators (1990)

Annual turnover: CAD 1.5 Million
R & D expenses: CAD 1.5 Million

4. Principal Activities

Basic and applied research with the aim of improving the health and production capabilities of domestic animals and fish.

The research is carried out within the following areas:

* Gene mapping,
* Immuno genetics and disease resistance,
* Reproduction biology,
* Molecular biology concerning infectious diseases,
* Fish biology.

5. History

The Centre was established in 1987 as part of the Danish national biotechnology research and development programme initiated at that time. Research activities are closely coordinated with other university institutes within the fields of animal husbandry and fish biology. Total funding during 1991 - 1995 CAD 7.4 Million.

6. Biotechnology activities

The Centre is conducting biotechnological research within its principal areas of interest. Specific activities include

* Disease resistance
* Vaccines against parvo virus
* Disease resistance of poultry
* Bovine growth hormone (BGH), porcine growth hormone (PGH)
* Fish biology and disease resistance

7. Desired alliance with other research institutes and firms

Research collaboration with other research institutes and industry for research, development and evaluation of new products within the core research fields of the Centre.

INSTITUTE PROFILE

Centre for Marine Biotechnology, Technical University, Copenhagen.

1. Head office

Rammeprogram for Marin Bioteknologi
Fiskeriministeriets Forsøgslaboratorium
Bygning 221
Danmarks Tekniske Højskole
DK-2800 Lyngby
Danmark

Tel: +45 42 88 33 22
Fax: +45 42 88 47 74

2. Management

Ms Lone Gram, Managing Director
Mr Carsten Christophersen, Research Manager

3: Indicators (1990)

Annual turnover CAD 400.000
R & D expenses: CAD 400,000

4. Principal Activities

Research, development and education within the field of marine biotechnology with the purpose of improving the possibilities for industrial utilization of marine organisms and bio-active compounds.

5. History

The center was established in 1987 as a part of the Danish national biotechnology research and development programme. Research activities are closely coordinated with other research institutes within the national programme, such as the Technological Laboratory of the Ministry of Fisheries, Department of Biotechnology at the Technical University. Total funding during 1991 - 1995 CAD 1.5 Million.

6. Biotechnology activities

Research & Development activities are concentrated within the following four projects:

* Biological active compounds from marine organisms
* Bioactivity of psykrotrophe bacteria of aquatic origin
* Kinetic regulation and stability of marine enzymes
* Detection of Shewanella nutrefaciens based on enzyme and immuno chemical principles

Education: Postgraduate programmes.

7. Desired alliance with other research institutes and firms

All forms of research and development cooperation in the field of marine biotechnology with special attention to the core research projects in the research programme.

INSTITUTE PROFILE

Centre for Food Research, Technical University, Copenhagen.

1. Head office

Center for Levnedsmiddelforskning ved DTH
Instituttet for Bioteknologi
Danmarks Tekniske Højskole
Building 221
DK-2800 Lyngby
Denmark

Tel: +45 45 93 30 66
Fax: +45 42 88 49 22

2. Management

Mr Jens Adler Nissen, Professor, Managing Director
Ms Tove Secher, Research Secretary

3. Indicators (1990)

Annual turnover: CAD 2.7 Million
R & D expenses: CAD 2.7 Million
Employees: 33
R & D Employees: 33

4. Principal Activities

Research activities are concentrated within the following areas:

* Quality and quality assurance in the food industry
* Development and design of food technology processes
* Fermentation and biopreservation of foods
* Oxidation and utilization of poly-unsatured fatty acids
* Starch and fibres

5. History

The Centre was established in 1991 for a four year period as part of the national Danish food technology research and development programme. The Centre represents food science research from several institutes at the Technical University, in particular the Department of Biotechnology. Total funding CAD 10.5 Million for the period 1991 - 1995.

6. Biotechnology activities

Research & Development:

* Mycology
* Food allergenics
* Physiology of gram-negative bacteria responsible for tainted foods
* Quality and quality assurance of frossen fish
* Characterization of structure and aroma of fresh meat
* Food process technology and design
* Fermentation and biopreservation of non-dairy products
* Lipid oxidation
* Poly-unsatured fatty acids
* Functionality of poly saccharides
* Characterisation of proteins
* Mycology, including taxonomy and characterisation

7. Desired alliance with other research institutes and firms

As a public research institute the Centre is interested in research cooperation with public as well as private research partners within the core research fields.

INSTITUTE PROFILE

Centre for Lactid Acid Bacteria Research, Technical University, Copenhagen

1. Head office

Center for Mælkesyrebakterier
Laboratoriet for Mikrobiologi
Building 221
Danmarks Tekniske Højskole
DK-2800 Lyngby
Denmark

Tel: +45 45 93 34 22
Fax: +45 45 93 28 09

2. Management

Ms Karin Hammer, Managing Director

3: Indicators (1990)

Annual turnover: CAD 1 Million
R & D expenses: CAD 1 Million

4. Principal Activities

Basic research in the field of lactid acid bacteria cultures, their physiology and applications in the food sector (dairies, vegetables, fruits and meat products).

5. History

The center was established in 1991 for a four year period as part of the national research and development programme in food technology. Total funding CAD 4 Million.

6. Biotechnology activities

Research & Development:

The basic approach to the research carried out at the Centre is a combination of physiology and genetics of lactid acid with the species Lactococcus lactis as the common denominator. The aim is to improve the knowledge of and the possibilities to develop phage resistent lactid acid bacteria species.

Special attention is devoted to research in the genetics and physiology of bacteria phage, a special type of virus causing considerable problems for the utilization of bacteria cultures in the dairy sector.

Education:

Graduate and postgraduate programmes and courses.

7. Desired alliance with other research institutes

Research cooperation in the problems of genetics and physiology of lactid acid bacteria cultures. The research is primarily basic research.

INSTITUTE PROFILE

Center for Food Research, Royal Veterinarian Agricultural University, Copenhagen.

1. Head office

KVL Center for Fødevareforskning,
Thorvaldsensvej 40,
DK-1871 Frederiksberg C,
Denmark.

Tel: +45 31 35 17 88
Fax: +45 31 39 04 23

2. Management

Mr Leif Skibsted, Managing Director
Ms. Dorthe Petersen, Research Secretary

3: Indicators (1990)

Annual turnover: CAD 2.4 Million
R & D expenses: CAD 2.4 Million
Employees: 30
R & D Employees: 30

4. Principal Activities

Basic and applied research within the following fields:

* Food chemistry
* Food technology
* Microbiology
* Nutrition

5. History

The center was established in 1991 for a 4 year period as part of the national research and development programme in food technology. Total funding for the period CAD 10 Million.

6. Biotechnology activities

Most of the research carried out at the Centre for Food Research is not directed towards biotechnology as such but is of a more general character. The following research activities include biotechnology:

* Texture of food products
* Prevention of oxidation of food products
* Development of flavour production in food products including application of starter cultures in meat products
* Food microbiology including detection of harmfull bacteria cultures in food processing

Education: Graduate and postgraduate courses.

7. Desired alliance with other research institutes and firms

Basic and applied research cooperation with public as well as private research partners within the principal areas of activity of the Centre.

INSTITUTE PROFILE

The Biotechnological Institute, Denmark

1. Head office

Agro-Industrial Technology Section
Holbergsvej 10
P.O.Box 818
DK-6000 Kolding
Denmark

Tel: +45 75 52 04 33
Fax: +45 75 52 99 89

Molecular Biotechnology Section
Lundtoftevej 100
Building 227
P.O.Box 199
DK-2800 Lyngby
Denmark

Tel: +45 45 87 66 99
Fax: +45 45 93 28 88

Food Technology Section
Ellemarksvej 49
P.O.Box 440
DK-8100 Aarhus C
Denmark

Tel: +45 86 14 44 77
Fax: +45 86 14 74 77

2. Management

Mr Claus Christiansen, Managing Director
Molecular Biotechnology Section

Mr Günther Nissen, Director, Agro-Industrial Technology Section
Mr Finn Holm, Director, Food Technology Section

3: Indicators (1990)

Annual turnover: CAD 11 Million
R & D expenses: CAD 7 Million
Employees: 150
R & D Employees: 85

4. Principal Activities

The Biotechnological Institute is a self-governing research institution associated with the Danish Academy of Technical Sciences as well as being part of the public Danish technology support infrastructure.

The principal activities include technical services and research and development activities within biotechnology, food/feed technology and molecular biology.

5. History

The institute was established in 1991 as the result of a merger of 3 individual institutes representing the present three sections.

6. Biotechnology activities

Research & Development:

R&D activities are in the fields of diagnostics, development of enzyme production and antigen production, vaccines, non-invasive analysis of food/feed products, development of food processes.

Other activities include laboratory services, graduate and postgraduate courses, and individually designed courses for companies, government agencies, etc.

7. Affiliations

The Biotechnological Institute consists of three sections placed at different locations in Denmark.

8. Desired alliance with other research institutes and firms

The Biotechnological Institute offers development work, contract R&D and laboratory services within its core activity.

The Biotechnological Institute has established a close alliance with the Danish biotechnology and food technology network as well as being partner in several EC research programmes, i.e. Bridge, Flair and Sprint. The Biotechnological Institute provides an excellemt access to Danish biotechnology industry in general.

INSTITUTE PROFILE

The Technological Laboratory, Ministry of Fisheries, Copenhagen.

1. Head office

Fiskeriministeriets Forsøgslaboratorium
Danmarks tekniske Højskole
Building 221
DK-2800 Lyngby
Denmark

Tel: +45 42 88 33 22
Fax: +45 42 88 47 74

2. Management

Mr Torger Boerresen, Managing Director
Ms Jette Nielsen, Deputy Director
Mr Hans Henrik Huus, Chief Microbiologist

3: Indicators (1991)

Annual turnover: CAD 4 Million
R & D expenses: CAD 3.3 Million
Employees: 50
R & D Employees: 40

4. Principal Activities

The principal activities of the Laboratory are research, development and consultancy work for the Danish fishing industry. The current research and development activities include the following areas:

* Catch handling
* White fish processing
* Microbiological aspects including quality assurance, health aspects and biopreservation
* Utilization of by-products
* Biotechnology

5. History

The Laboratory was established in 1931 at the Technical University in Copenhagen as a public institute to promote Danish fisheries. Presently, the Laboratory is an affiliation of the Ministry of Fisheries, partly based on public funding but with an increasing degree of private sector funding.

6. Biotechnology activities:

Following biotechnology research and development activities are carried out at the Laboratory:

* Fish oil refining
* Enzymatic transesterification
* Oxidation of fish oil
* Marine Enzymes
* Antioxidants
* Technical and laboratory service for the sector

Education: Postgraduate courses for 6-8 students per year.

7. Desired alliance with other research institutes and firms

The Laboratory can offer cooperation on a pre-competitive basis within the fields of biotechnology mentioned above. Particularly, within marine enzymes and marine microecology.

It should be noted that the Laboratory was established with the purpose of promoting Danish fishing industry. This may prevent the Laboratory from being involved in other activities than those of pre-competitive and basic research nature.

INSTITUTE PROFILE

Danish Meat Research Institute, Roskilde

1. Head office

Slagteriernes Forskningsinstitut
Maglegårdsvej 2
DK-4000 Roskilde
Denmark

Tel: +45 42 36 12 00
Fax: +45 42 36 48 3

2. Management

Mr K.B. Madsen, Managing Director
Mr Børge Sørensen, Technical Secretariat
Mr Svend Vahlun, Deputy Director, Measuring Methods
Mr Jørgen Zink, Deputy Director, Technical Development
Mr Viggo Clausen, Deputy Director, Production Technology
Mr Niels Jakob Nielsen, Deputy Director, Quality Assurance

3. Indicators (1990)

Annual turnover: CAD 24 Million
R & D expenses: CAD 20 Million
Employees: 225
R & D Employees: N.A.

4. Principal Activities

The Institute is a joint research and development institute for the Danish meat industry. The projects carried out at the Institute cover a wide range of activities from quality parameters of live animals, transport, stunning, slaughter technology and processing to external environmental problems of the meat sector comnpanies.

Following six areas have high priority:

* Optimization of raw material production and processing
* Development of methods for on-line measurement and control of quality parameters
* Application of information technology
* Mechanization and automatisation
* Development of new process technology
* Consultancy work

5. History

The Institute was established in 1954 as a joint quality control institute for the Danish meat sector. Currently, the Institute is increasingly involved in research and development in the fields of biology and process technology.

6. Biotechnology activities

Research & Development:

Fermentation and application of bacteria cultures and enzymes in processing of traditional and new meat products.

Biopreservation:

Selection, isolation and production of natural bacteria cultures for modification with the aim of production of biopreservation products.

Monitoring:

The international development of i.e. growth promoters, probiotics and feed additives are monitored and evaluated.

7. Desired alliance with other research institutes and firms

Contract work and consulting services are offered within the principal activities of the Institute.

CORPORATE PROFILE

THE CARLSBERG GROUP, Copenhagen

1. Head office

Carlsberg A/S
100 Vesterfælledvej
DK-1799 Copenhagen V
Denmark

Tel: +45 31 21 12 21
Fax: +45 31 22 86 11

2. Management:

Mr Poul J. Svanholm, President and CEO
Mr Sven G. Petersen, Executive Vice President
Corporate Research and Development

3. Indicators (1990/91)

Annual sales: CAD 1,900 Million
R & D Expenses: N.A.
Employees: 13,500
R & D Employees: 150

4. Principal activities

The Carlsberg Group ranks among the largest brewing groups in the world, and with the beer brands of Carlsberg and Tuborg enjoing the highest reputation. The principal activity of the group is beer brewing.

5. History

The Carlsberg Group incorporates two of the oldest and largest Danish breweries: Carlsberg Breweries founded in 1847 and Tuborg Breweries founded in 1873.

The Carlsberg Group is unique among world brewing groups by its commitment to science through the Carlsberg Laboratory founded in 1876. This laboratory with status equivalent to a university institute is the origin of basic and applied research essential for the perfection of brewing.

6. Biotechnology activities

Research and Development:

The research and development of the Carlsberg Group is organized partly in the Carlsberg Laboratory, where the basic research is located, and partly in the Carlsberg Research Laboratory with focus on applied brewing process oriented research.

Basic research is concentrated on brewing related issues with barley and yeast and is organised in the following departments:

* Department of Chemistry
* Department of Physiology,
* Department of Yeast Genetics

Applied research is organized within the following 4 project areas:

* Raw Materials
* Malting and Brewing
* Fermentation
* Barley Molecular Biology

7. Affiliations

The Carlsberg Group has 81 subsidiaries in 13 countries.

8. Desired alliance with other biotechnology firms

R & D projects on raw material quality, malting, brewing and fermentation, as well as barley and yeast breeding.

CORPORATE PROFILE

The Chr. Hansens Laboratory Group.

1. Head office

Chr. Hansens Laboratorium A/S
Bøge Allé 10-12
DK-2970 Hørsholm
Denmark

Tel: +45 45 76 76 76
Fax: +45 45 76 55 76

2. Management:

Mr Poul Hansen, CEO
Mr Vagn Dinesen, President, Chr. Hansens Laboratorium Danmark A/S
Mr Gunnar Mogensen, Director, Research & Development
Mr Aage Nyholm Thomsen, President, Chr. Hansens Bio Systems A/S
Ms Elsebeth Budolfsen, President ALK, Allergologisk Laboratorium

3: Indicators (1990/1991)

Annual sales: CAD 200 Million
R & D expenses: N.A.
Employees: 1,400
R & D Employees: n.a.

4. Principal Activities

Manufacturing of enzymes, i.e. animal rennets, bacterial cultures, natural colours and flavours for the dairy and food industry; natural control mechanisms, including lactid acid cultures, applied in the animal and plant production; allergen extracts and diagnostics tests.

5. History

Chr. Hansens Laboratorium was founded as early as in 1874 utilizing a new method for production of purified and standardized animal rennets for industrial cheese production. Since then the Company has grown and diversified to be a world wide supplier of high quality ingredients to the food industry, with interests in the agricultural and pharmaceutical sectors as well.

6. Biotechnology activities

Research & Development:

The CHL Group is a determined biotechnology corporation with R&D based on enzyme chemistry, protein chemistry and microbiology. R&D is directed towards new enzymes, colours and lactid acid bacteria cultures with high specific activities applied to the food and agricultural sector. New allergen extracts and diagnostics methods are of central R&D interest as well.

Manufacturing:

Cultures for the dairy, meat and other food industry sectors; Enzymes for use in the dairy and food industry; Natural colours for food applications; Feed additives and Human Care products based on Probiotics; Beneficial insects; Allergen extracts and specific allergological tests.

7. Affiliations:

The CHL Group has 38 affiliations and sales offices in 20 countries including Canada:

Chr. Hansens Laboratory Limited
1146 Aerowood Drive
Mississauga, Ontario L4W 1Y5

Tel: (416) 625-2560
Fax: (416) 625 8157

President: Tim Brunton

8. Desired alliance with other biotechnology firms

The CHL Group is interested in cooperation in all areas of biotechnology applied to the food ingredients sector.

CORPORATE PROFILE

DAKO A/S

1. Head office

DAKO A/S
Produktionsvej 42
DK-2600 Glostrup
Denmark

Tel: +45 44 92 00 44
Fax: +45 42 84 18 22

2. Management

Mr Torben V.S. Jørgensen, President
Mr Bengt G. Johansson, Technical Director

3: Indicators (1990)

Annual sales: CAD 31 Million
R & D expenses: N.A.
Employees: 167 (parent company only)

4. Principal Activities

DAKO A/S is a well established and highly reputated producer of diagnostic reagents. The principal activities are development and production of diagnostic reagents for the university and medical sector as well as for numerous industrial applications.

5. History

The Company was founded in 1966 under the name Dakopatts a/s as a spin-off from a Danish/Swedish university research cooperation.

6. Biotechnology activities

Diagnostic reagents and test kits for the pharmaceutical and food industry as well as the university and medical sectors.

7. Affiliations

The company has 8 affiliations in 7 countries.

8. Desired alliance with other biotechnology firms
Relationship with companies producing diagnostic reagents.
DAKO's foreign affiliations are responsible for alliances.

CORPORATE PROFILE

DANISCO A/S

1. Head office

Danisco A/S
Langebrogade 1
P.O.Box 17
DK-1001 København K
Danmark

Tel: +45 31 95 17 00
fax: +45 31 54 36 50

2. Management:

Mr Palle Marcus, President and CEO

Business Sectors:

* Danish Distillers: Mr Aage Petersen, President
* Danish Sugar: Mr Palle Marcus, President
* Frigodan: Mr Claus B. Heinze, President
* Grindsted Products: Mr Otto B. Christensen, President
* Maribo: Mr Leif Kjærgaard, President

Corporate Biotechnology Research and Development:

Mr Peter Olesen, Professor

3: Indicators (1990/91):

Annual sales: CAD 2.300 Million
R & D expenses: CAD 55 Million
Employees: 13,500

4. Principal Activities

Danisco's activities are divided into four sectors within the food and food related area: Food and beverages; Food ingredients; Packaging; and Technology and machinery. A fifth sector encompasses other activities.

* The food and beverages sector is the biggest business sector consisting of 4 business units for the production of the following products: Sugar, spirits and yeast, frozen vegetables, and snacks.

* The food ingredients sector consists of Grindsted Products and Maribo. Grindsted Products is among the world leading producers of functional ingredients, i.e. emulsifiers and stabilizers.

The main activity of Maribo is production of sugar beet seeds. Furthermore Maribo is the biotechnology research centre for the Danisco Group.

* The packaging sector consists of two companies: Danish Paper Packaging involved in paper based packaging, and Raackmann involved in plast based packaging.

* The fourth sector is Technology and Machinery with Niro A/S as a leading supplier of processing equipment for the food industry worldwide.

5. History

Danisco A/S is a 3 year old merger among the following well established Danish companies now with the status as business units in the Group: Danish Sugar Factories, Danish Distillers and Grindsted Products.

6. Biotechnology activities

Research & Development:

The biotechnology research in Danisco is concentrated in the business unit Maribo. The focus of R&D is on plant biotechnology, in particular sugar beets and rape seed, with the purpose of development of new varieties and food ingredients. Also yeast is a research area of special attention.

Manufacturing:

Danisco is a world leader in sugar refining.

7. Affiliations

The Danisco A/S group consists of 145 companies in 25 countries worldwide including the following Canadian affiliates

Novenco Fans Inc.
P.O.Box 850
555 Conestogo Blvd.
Cambridge, Ontario N1R 5X9

Tel: (519) 621-71111
Fax: (519) 621-0801
President: Thomas Kubik

Grindsted Products, Inc.
10 Carlson Court, Suite 580
Rexdale, Ontario M9W 6L2

Tel: (416) 674-7340
Fax: (416) 674-7378
President: Brian A. Jones

8. Desired alliance with other biotechnology firms

The Danisco Group offers cooperation in the fields represented by the individual business units: foods and beverages, food ingredients, packaging and food technology and processing. The business units within the Danisco Group are responsible for potential alliances, cooperations etc.

CORPORATE PROFILE

Kem-En-Tec A/S

1. Head office

Kem-En-Tec A/S
Haraldsgade 68, 3th. floor
DK-2100 København Ø
Danmark

Tel: +45 39 27 17 77
Fax: +45 31 20 01 78

2. Management

Mr Henrik Christensen, President
Mr Gunnar Aas, Managing Director
Mr Allan Lihme, Senior Researcher

3. Principal Activities

Kem-En-Tec A/S develops, manufactures and markets processes and products related to protein analysis, protein fractionation and protein purification.

4. History:

The company was founded in 1983 by a team of scientists from the Protein Laboratory at the University of Copenhagen. Staff: 17.

5. Biotechnology activities.

Research & Development:

Development of a new upfront chromatography concept for Down Stream Processing. The concept provides Kem-En-Tec A/S with the possibility to develop unique down stream processes related to specific needs of industrial users.

Manufacturing includes the following three product categories:

* biochemical products including affinity matrices, enzymes and peptides.
* equipment for electrophoresis and peptide synthesis.
* digital image processing software for protein analysis.

6. Affiliations:

In the Summer of 1990 Ken-En-Tec A/S formed a fifty-fifty owned R&D joint venture with a major Danish producer of antibodies.

7. Desired alliance with other biotechnology firms

Kem-En-Tech is seeking collaboration with Canadian companies in the following fields

* development of upfront chromatography based down stream processes
* marketing of the company products, in particular a fully automatic computer controlled peptide synthesis machine designed for solid phase synthesis of peptides in the 10-1000 milligram scale (MK III).

9. Comments:

Kem-En-Tec A/S is located in the Symbion Science Park affiliated with the Copenhagen Unversity. The company is a typical biotechnology start-up company with the fundamental concept of applying the ideas and results of basic research to new and improved processes and products.

CORPORATE PROFILE

MD Foods amba

1. Head office

MD FOODS amba
Skanderborgvej 277
P.O.Box 2400
DK-8260 Viby J
Denmark

Tel: +45 86 28 10 00
Fax: +45 86 28 16 91

2. Management:

Mr Ernst Werner Skødt, President and CEO
Mr Jørgen Lyngsøe, Vice President, Corporate R&D

3: Indicators (1990):

Annual sales:	CAD 2,375 Million
R & D expenses:	CAD 12 Million
Employees:	5,500

4. Principal Activities

To receive, process and market milk, milk based and related manufactured products, i.e. butter, cheese, canned milk, juice and protein.

5. History

The parent company was founded in 1970 and has become the dominant Danish dairy corporation through mergers and acquisitions within the Danish dairy sector.

6. Biotechnology activities

Research & Development:

Screening of bacteria responsible for the maturing of cheese with thee purpose to select attractive bacteria cultures for biopreservation and aroma formation.

Manufacturing includes a wide range of different dairy products, such as cheese, fermented milk products, i.e. yoghurts, etc.

7. Affiliations

15 companies in 7 countries including

MD Foods Canada Ltd.
Toronto,
Canada.

8. Desired alliance with other companies in the dairy sector

Commercial alliances within the core business areas of MD Foods.

CORPORATE PROFILE

Novo Nordisk A/S

1. Head office:

Novo Nordisk A/S
Novo Allé
DK-2880 Bagsvaerd
Denmark

Tel: +45 44 44 88 88
Fax: +45 44 49 05 55

2. Management:

Mr Mads Øvlisen, President and CEO
Mr Kurt Stenager, Director, Health Care Group
Mr Steen Riisgaard, Director, Bioindustrial Group
Mr Ulrik V. Lassen, Director, Corporate R&D
Mr Knud Austrup, Director of Research, Industrial Biotechnology

3: Indicators (1990)

Annual sales:	CAD 1,800 Million
R & D expenses:	CAD 270 Million
Employees:	10,200
R & D Employees:	1,900

4. Principal Activities:

Novo Nordisk A/S is a world leading biotechnology corporation with production of insulin, other pharmaceutical products, industrial enzymes, bio pesticides and other bioindustrial products as the principal activities. It is a major force in insulin manufacture and diabetes treatment and is the world's largest producer of industrial enzymes.

5. History:

The corporation was founded in 1989 as a merger between the two Danish companies Novo Industri A/S (1925) and Nordisk Gentofte A/S (1923).

Biotechnology activities

Research & Development:

* Insulin and diabetes care
* Growth regulators and blood products
* CNS-products
* Industrial enzymes
* Biopesticides

Manufacturing:

* Human Insulin
* Human Growth Hormon
* Blood products
* Industrial enzymes
* Biopesticides

7. Affiliations

Affiliations in 33 countries as well as close relations to public sector research all over the world.

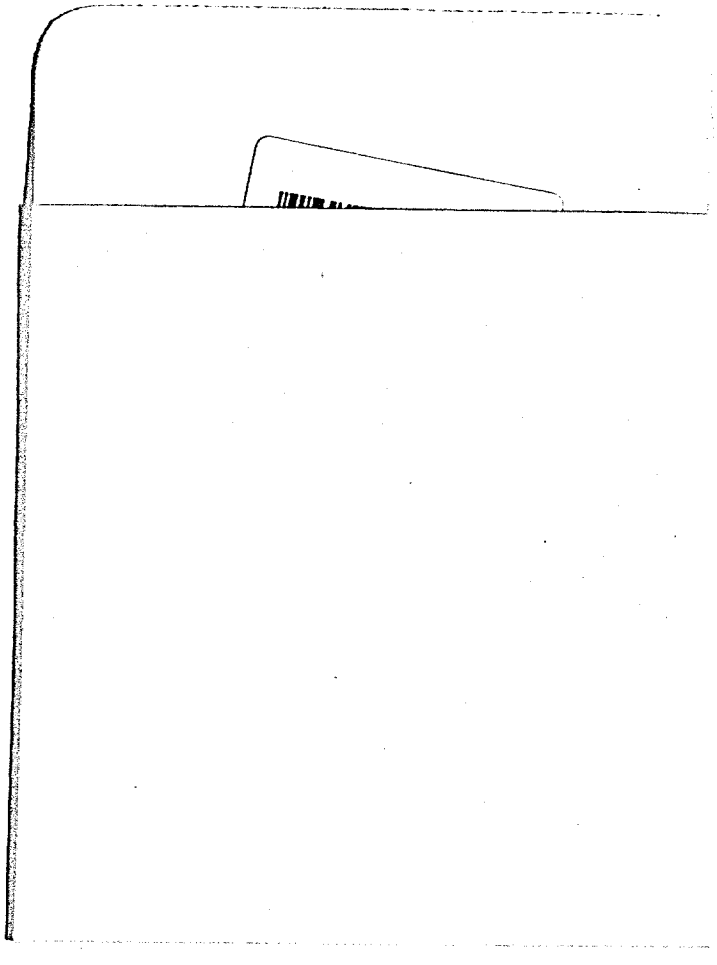
Affiliation in Canada:

Novo Nordisk Canada, Inc.
2700 Matheson Blvd East
3rd. Floor, West Tower
Mississauga, Ontario L4W 4X1

Tel: (416) 629-4222
Fax: (416) 629-8662
President: Rick Podsiadlo

8. Desired alliance with other corporations

Cooperation is offered to potential partners from the public as well as the private enterprise sectors on a commercial basis within the pharmaceutical and the bioindustrial business areas.



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