

UPDATE: MEAT RESEARCH IN THE NORDIC COUNTRIES

by
Ole Braathen*

SUMMARY

The various institutions in the Nordic countries carrying out meat research are described. Their addresses, research budgets, number of employed and research projects are mentioned.

Quite a few not too important research projects are mentioned in order to give the reader an impression of the level at which the research is carried out and of the many tasks of a meat research institution in Northern Europe.

All except two of the institutions mentioned were visited during the preparation of this paper. It is my hope that this paper may contribute to a better cooperation between the meat researchers working on the same or related projects.

Introduction

Scandinavia is the expression used for the countries Denmark, Iceland, Sweden and Norway. Finland is among the Nordic countries and has very close relationship to the Scandinavian countries.

Meat research is carried out in many institutions in these countries. A description of the different projects of the different institutions will be given later.

The organization of the meat research differs between the different countries and the size varies from the big Danish Meat Research Institute down to the smaller ones. The meat products are very similar. Some of the countries have a surplus of meat and others have to import from them. Denmark is a large meat exporting country, especially known for its bacon, and Sweden as well as Finland, exports meat. Finland exports meat and meat products to the Soviet Union.

Iceland exports large quantities of Icelandic lamb, and Norway yearly imports meat. The import to Norway in 1978 was 17000 metric tons.

All the institutions have several things in common: The research is based upon almost the same animals, the races and breeds used are almost the same all over Scandinavia and Finland.

Even if the geographic conditions vary from one Scandinavian country to the other, the problems for the meat industry and the animal breeder are almost

the same. Some of the countries have large distances between the slaughterhouses while other countries have a much denser animal population.

The animals, which are in the focus of the Scandinavian meat research, are: Pig, cattle, horse, sheep, goat, reindeer and poultry. The research on seal is organized by the Ministry of Fisheries at least in Norway. Institutions doing research on rabbit meat are not reported.

The different institutions.

Denmark is the first country to be mentioned if you look at the alphabetical order, but it was also the first country among the Nordic countries that established food research. The Danish meat research is, and, has always been, of great importance to the other Scandinavian countries and to the rest of the world. This is also one reason for mentioning so many of its research activities in this paper.

Denmark.

Name: The Danish Meat Research Institute.

National name: Slagteriernes Forskningsinstitut

Address: Maglegaardsvej 2, DK-4000 Roskilde, Denmark.

Telephone: 45-03-36 12 00.

Total number of employees: 208 corresponding to 161 full time employees.

Owned by: Cooperative and Private Slaughterhouses Foundation for the Meat Research Institute and The Meat Trade School.

Financed by the meat industry (no government support).

Total budget 1979: US dollar 6 million.

From pork 20,9 million Danish kroner.

From cattle 2,6 million Danish kroner.

Own earnings: (Contracts, etc.): 7,4 million Danish kroner.

*O. BRAATHEN

*Director, Norwegian Meat Research Laboratory,
Lorenweien 37 - Postboks 96, Refstad, Oslo 5,
Norway.*

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The Danish Meat Research Institute is situated in the town Roskilde 30 kilometers outside the capital Copenhagen, and started its activities October 15th 1954. (25 years).

The managing director is A Toft Fensvig and the executive staff is Svend Vahlund, Borge Sorensen, Steen Schneider and K. B. Madsen.

The research is based upon permanent project groups. One group is, for instance, working on problems concerning pig slaughtering. This group is assembled of people having knowledge of pig slaughtering, meat quality, transportation, stunning, etc.

The different proposed research programmes are calculated and prioritated. Proposals are discussed by a group put together from the industry, from the consultative group concerning pig slaughtering and from the management of the institute as well as from the group itself.

Research projects.

A visitor is impressed by all the research projects being worked on in Roskilde. The SPF pig production program gives a great impression.

This program is part of the disease prevention and control program.

The development of SPF (Specific Pathogen Free)-system.

Piglets are taken by caesarean from selected elite breeding sows. It is the plan to continue this activity for some years to ensure that the best breeding material can continue to be used.

A method for the production of antibodies from colostrum has been developed in order to prevent problems when the artificially reared primary SPF-pigs are being adapted to natural surrounding.

SPF health control.

The Institute has established a serology laboratory for the routine serological examination for Haemophilus parahaemolyticus infections in blood samples.

An investigation is under way to examine if it is possible to utilize the same serological method (complement fixation test) for the diagnosis of Mycoplasma suis pneumoniae infection.

Diarrhoea in piglets.

Two investigations are in progress involving vaccination against E.coli-diarrhoea in piglets. Commercial vaccination is tested to see the effectiveness

on diarrhoea at weaning. In another investigation pregnant sows are given a live culture of E. coli in their feed in order to stimulate their antibody production and the level of specific immunoglobulins in their milk, in order to give the piglets sufficient antibodies to protect them against diarrhoea.

The institute works in close cooperation with the Danish state veterinary institutions and laboratories.

MEAT QUALITY.

Progeny tests.

The work on controlling the color of the meat and pH-measurements is being supervised by a member of the institute's staff and carried out in the town Horsens.

Blood groups/enzyme types.

The relationship between blood groups and enzyme types in pigs, and meat quality and other properties is under investigation. A connection between meat quality in pigs, the H blood group and the PHI-enzyme-type is found.

Crossbred pigs.

A large crossbreeding experiment with various combinations of Danish Landrace, Large White, Norwegian Landrace, Hampshire and Duroc, shows that the breed of the boar is of great importance for the meat quality. It is not yet possible to give comments as to the properties of all the crosses.

Foreign pig breeds.

Meat quality investigations of purebred Hampshire and Duroc pigs have shown that pigs of these breeds have a lower frequency of both PSE- and DFD-meat than Danish Landrace pigs.

Feeding experiments.

Feeding with rapeseed meal influenced neither the quality of the meat and backfat nor the flavor of bacon. An experiment involving rapeseed cakes with a higher oil content has not yet been completed. Grass juice influenced neither the color of back fat nor the flavor of pork chops or bacon.

PIG SLAUGHTER TECHNOLOGY AND BACON PRODUCTION.

Transport and lairage conditions.

An investigation of the effects of different treatments of the pigs on the day of slaughter has been brought to its conclusion.

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The main results from one experiment showed that pigs exposed to an extremely considerate treatment had a higher frequency of pigs with PSE-meat than the normally treated control group. No pigs with DFD-meat were found in the experimental group, which had their lairage in the slaughterhouse in a very short distance from the stunning area.

From these results we must obviously continue to recommend that pigs are treated with consideration, but it will still be necessary to employ other techniques, too, to reduce the frequency of PSE-meat through measures involving transport and lairage conditions.

Feeding the day of collection and the length of time the pigs were kept in lairage have a decisive influence on meat quality.

The institute has continued the registration of mortality of pigs during transport and lairage and finds approximately of 1 %/00.

Vehicle design.

A specially equipped pig transport lorry with mechanical ventilation, having air inlets 6" above the floor via ducts positioned in double sides, has been built and is being tested.

Stunning of pigs.

The aim of the institute's work in this area is to combine a complete loss of consciousness with minimal carcass problems and low running costs. Preliminary investigations on an alternative method for electrical stunning gave results, which were so disappointing, that it was decided in the spring of 1978 temporarily to discontinue experiments on electrical stunning. But new impulses from Holland have inspired the Institute to reopen experimental work on electrical stunning. The institute is currently evaluating some possibilities for better electrical stunning under Danish conditions.

Blood collection.

The institute continue to participate actively in the design and installation of blood collection systems in bacon factories as well as in cattle slaughter plants. A blood collection system for pigs blood for edible use is now in daily operation.

Automatic meat/fat measuring system-classification.

In connection with the installation of an electronic connection between the carcass weighing machine and the meat-fat measuring system in pig slaughter-

ing plants, the institute has obtained a great deal of know how.

The weight and other data registered at the weighing station are transferred automatically to the meat-fat measuring system. All data from weighing and classification are thus printed out together.

SLAUGHTER TECHNOLOGY.

Scalding of pigs.

Canal scalding tanks proved to be very efficient both on pigs of bacon-size and on sows. The hairs on all areas of the rind were loosened. The removal of hairs by a double "Billfred" dehairing machine has been found to be excellent. All pigs are well rinsed at the end of the dehairer.

The institute is researching a project to reduce the cost of final rind treatment. The keeping quality of uncured carcasses and bacon sides has been checked regularly and it shows that pigs treated in a mechanical "white scraping" unit has as good a keeping quality as traditionally treated pigs.

Slaughter line of the future.

The proposals for the slaughter line of the future have been discussed with a group of bacon factory employees and with slaughter line supervisors and the institute. Some of the ideas in the report are under development.

The institute has other projects on equipment for extraction of the blade bone, automatic splitting of pigs, mechanical pickle injection, tank curing and a dry salting machine.

Work is also going on in development of equipment for neck cleaning, etc.

Utilization of the waste heat from the singeing oven is done by installing a complete draught proofing kit, which also reduces the oil consumption by 10%.

Work has also been carried out on controlling the temperature of the water for scalding with an accuracy of 0,1°C.

The Danish Meat Research Institute advices the factories how to save energy and the Danish government gives grants for energy conservation projects.

BEEF AND CATTLE RESEARCH.

In collaboration with the National Institute of Animal Science, work has been concentrated on cross-breeding experiments where 15 different beef breeds have been crossed with Danish Red cattle or Frie-

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sians. New feeding materials such as maize silage and silage from whole barley are also being tested.

Nutritional value.

An investigation of the nutritional value of various cuts of beef and veal has been started in collaboration with the National Food Institute.

CANNED MEAT AND PRODUCED MEAT PRODUCTS.

Blood protein for edible use.

The institute continues its research in this area and new centrifuges which are easier to clean and are particularly useful for smaller installations, have been evaluated. The institute works on an industrial research project on the decolorisation of the red cell fraction through enzymatic hydrolysis of the haemoglobin.

Combination products.

The research on this area has been centered around attempts to use soluble vegetable protein in connection with the curing process.

Mechanically separated meat.

Investigations to evaluate the properties of this type of raw material has been carried out. Binding capacity and particle size of the bone content and the dependance of these factors on the separator-type and type of bone have been studied.

Temperature conditioning of frozen meat.

Fast thawing of frozen raw materials by use of microwaves without deterioration of quality has been investigated. The equipment is good for the temperature conditioning of raw materials for hamburgers and salami sausages

INEDIBLE BY-PRODUCTS

Sources of odor.

The institute has analysed the sources of odour in rendering plants. The volume of exhaust air from ventilation or from venting of individual pieces of equipment can be measured and analysed by a dynamic olfactometer.

EFFLUENT, ENVIRONMENTAL MEASURES

Assistance has been given both on effluent treatment measures within the plants and in matters regarding connection to public sewers and effluent treatment plants.

Removal of ammonia.

The institute has participated in the operation of a pilot plant installation, for the biological removal of ammonia from the effluent of rendering plants.

Working environment.

As a result of pressure from internal safety committees, and, in some cases, from the Factory Inspectorate, a number of factories have requested investigations of the ergonomic conditions at individual work stations.

A development project for the purpose of removing or reducing the noise problems from saws is being prepared in collaboration with the Technical University of Denmark.

Factory planning.

Further development of the "sock-chilling" (fabric tube) system for refrigerated work rooms, equalization of cold store rooms etc. is carried out.

Courses, meetings, publications.

The experimental results are brought to the industry by different means such as:

- 1) Meetings for the different categories of leaders in industry.
- 2) Publications of different types from detailed reports to brief summaries.
- 3) Most important – a close personal contact at all levels between industry and institute.

THE ROYAL VETERINARY AND AGRICULTURE UNIVERSITY, DEPARTMENTS OF MEAT TECHNOLOGY, COPENHAGEN.

National name: Den Kongelige Veterinær- og Landbohøjskole, Afdelingen for Kodteknologi.

Address: Howitsvej 11, 2000 København F, Denmark.

Telephone: 45-01-87 04 41.

J. Wismer Pedersen, which is a very wellknown meat researcher is the head of the institute.

The department has 8 people employed.

Education of students is the most important part of the work in the department.

RESEARCH PROJECTS.

Blood protein.

Production of globine from blood from slaughter

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animals and its use in food for humans has been brought to an end. This important research was financed by the State Technical and Scientific Research council.

The investigations have shown that an enzymatic hydrolysis of hemoglobine may be used for production of white hydrolysate which may be used as protein enrichment in food.

Basic research is carried out on the use of blood in food. This project has resulted in use of blood in bread biscuits and meat products. Consumers have reacted favorably to the product and its possibility. The work has been carried out together with the Danish Meat Trade School in Roskilde, which is well worth a visit.

Beef cooking.

Another interesting project is optimalization of the cooking of beef.

The aim of the project is to find out what biochemical and biophysical methods should be used to characterize the structure in beef in order to find what method should be used to estimate the best cooking method for beef in industrial operation. This project includes speed of the cooking, temperature, collagen content in the beef as well as cooking of cold shortened beef.

Content of vegetable protein in cooked meat products.

This project, as well as the above mentioned, is lead by J. Wismer Pedersen and it is financed by the Danish States Research Council for Agriculture and Veterinary Science.

The aim of the project is to find methods which could be used for quantitative determination of vegetable proteins in cooked meat products, SDS. Acrylamide gel electrophoresis is used and it is hoped that this method could be used in the protein control of meat products. A defatted extract of the meat product is added to the acrylamide gel and the bands near the meat protein are analysed.

Determination of myofibrillar proteins in beef.

The break-down of the myofibrillar proteins in beef during ripening results in appearance of a 30.000 Dalton component. The content of break-down product will be related to the changes in tenderness (consistency) after slaughtering.

Color of beef.

A small project is dealing with the color and color

stability of ground beef added blood from slaughter animals. The color stability of the ground beef is investigated during storage in cooler.

Characterizing aroma components in cured meat products.

In this project a lot of volatile components from cured and fresh pork is determined.

The composition of fatty acids and the change in glyco- and phospho-lipids during storage are investigated.

X-ray defraction technic is used to characterize the composition of collagen crosslinks. The variation between breeds and animals in collagen and tenderness is investigated. The support for this project is coming from the State Agriculture- and Veterinary Science Research Council.

In the next meeting in Budapest for the European Meat Research Workers results from this work will be published.

DANISH MEAT PRODUCT LABORATORY, COPENHAGEN.

National name: Landbrugsministeriets Slagteri- og
Konserves-laboratorium
Address: Howitzvej 13, 2000 Kobenhavn F, Denmark.
Telephone: 45 - 01 - 87 11 33. Telex 16 1 74 Mealab
dk

Head of the institution is Mogens Jul, also a very well known meat researcher.

Total number of employees: 86.

Owned by: Ministry of Agriculture.

Financed by: 90% from the Danish State, 9% from the University, 1% from contracts.

Budget 1979: US \$2 million corresponding to Danish kroner: 8. 080.000.

Five percent of the total budget is used for research.

Twenty-five percent of the work is bibliography, fifteen percent is education, fifty percent is applied industrial food research and ten percent is technological industrial food research.

The research field includes the meat industry and poultry slaughtering.

The research reports are published in a limited number. The reports are sent to the industry and to institutions in Denmark and some reports are presented to congresses and in periodicals.

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The institution works in cooperation with The Danish Meat Research Institute, and the Danish Research Institute for Poultry Processing in Hillerod.

The institute has to a certain extent a common program with the following: Bundesanstalt für Fleischforschung, Kulmbach. Meat Research Institute, Langford, Bristol, England. Food Research Institute, Norwich and Spelderhold, Beekbergen, Holland.

The institute was built and started its work March 9th, 1938.

Research projects.

Freezer storage of cured meat products.

The institution in cooperation with Flemming Lindelov has worked intensively on freezing of cured meat products.

The storage life of such products is evaluated, and recommended storage times have been made available.

The effect of packaging, PPP, on storage life of frozen meat.

Hamburgers in different packaging material have been stored in a frozen state and research is carried out in order to recommend storage times.

Also pork loin has been packed in MSAT-film and found to have a shelflife of 18 months at minus 18°C. When using vacuum packaging the shelflife was increased by 30%.

The institute has in fact done much work on PPP-factors (product-process-packaging).

Electric stimulation of pigs.

The acceleration of glycolysis and the combined pH-drop might be a way of reducing the frequency of dark, firm and dry meat in pig carcasses. The study was carried out in a modern abattoir with a capacity of 227 pigs per hour and 100 pigs were stimulated and compared to 100 control animal. The stimulation was carried out after scalding and about 15 to 20 minutes after stunning. The voltage was 500 and the frequency 25 pps, and the stimulation time 60 seconds.

It was concluded that electrical stimulation of pig carcasses might be a way of guiding the post-mortem glycolysis also in order to reduce the frequency of carcasses with low pH 24 hours post-mortem.

Consultative work.

It must be mentioned that the institution act as consultants to the Danish meat industry especially in questions concerning the export to different parts of the world. This work is of considerable size and value then the Danish export of meat products is considerable.

The staff in the laboratory include several food technologists, veterinarians, chemists and other category workers.

Important in the consultative work is Ann Brinck-erds paper: "Review of European legislation on vegetable protein in meat products," a typical type of work carried out. We also find: "Comparison of methods of determination of the water content of deep frozen chicken and hen" and "The keeping quality of vacuum packed sliced products," as well as: "Airborne infection in poultry processing plants."

Mogens Jul, former director of Danish Meat Research Laboratory, is often an invited speaker at meetings in Scandinavia and elsewhere in Europe. We would like to mention: Vegetable protein in meat products — problems and possibilities, quality of pig meat and using blood for human food.

The institute has been working on pasteurization and sterilization on meat and fish products and on electrical stimulation of chickens as well as the influence of aging on the tenderness of pork. Also the effect of storage in retail cabinets of frozen foods has been evaluated by research workers in the laboratory in cooperation with the Food Technology Laboratory, Copenhagen.

The electric stimulation of chickens showed, in the work carried out of the Danish Meat Products Laboratory, to have very little effect on quality of the carcasses.

Authorization for export.

The Danish Meat Products Laboratory is the institution which give authorization for export to USA to the Danish Canning Factories. As Denmark is a member of the European Economic Community (EEC) a lot of advicery work is carried out by the institute in that connection.

Quality control.

Besides the work carried out in connection with product development and advicery service, especially on labeling and registration, the institution is carrying out quality control for the Danish exporting meat industry.

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The quality control is carried out on:

1. Canned meat products for export.
2. Frozen meat products for export.
3. Canned meat products for the Danish market.

The quality control include sensoric, bacteriological and chemical analysis as well as the cooking control. The institution also inspects the storage rooms as well as the cartons containing cans. Production and quality control is also carried out for the Danish Ministry of Agriculture of those products given from Denmark to the world food program.

All plants exporting meat products are under control of the institution and producers of frozen meat products have to send their information about the frozen food production to the Danish Meat Products Laboratory every week. Any visitor will be impressed by the serious quality control carried out for the Danish Meat Export Industry by this institution.

STATE VETERINARY MEDICAL INSTITUTE, FINLAND.

National name: Valtion Elainlaaketieteellinen Laitos.
Address: Hameentie 57, Helsinki 55, Finland.
Telephone: 358 - (9)0 - 73 60 46.
Number of employees: 90.

The director of this institute situated in the city of Helsinki is professor Esko Nurmi.

The state owns the institute and gives the principal support for the whole institute. Some money are coming via funds and the Finnish Academy of Science gives money for the salmonella research.

The budget for 1979 is 8700000 Finnish Marks, corresponding to US \$2,3 million.

About 5 to 10% of the budget for 1979 is used for meat research.

The institute is carrying out research and import control of meat and meat products. It acts as a reference laboratory for the meat inspection service and the food control laboratories throughout Finland.

The Food Research Foundation in Helsinki is supporting one research project.

In 1972 the director of the institute came up with a very interesting idea which later was used for prevention of salmonella infections in broilers. Bacteria from the intestines of broilers are cultivated and then given to one-day-old broilers. The flora is competing with the salmonella bacteria, preventing these pathogenic bacteria from growing in the digestive tract of the broiler.

In this connection it must be mentioned that the director Esko Nurmi took his doctoral degree on the addition of a combination of lactobacillae and micrococcae as starter cultures to dry salami sausages. It has been shown also that here bacteria may compete with the existing flora in the meat and prevent pathogenic bacteria from growing in the salami sausages.

I myself am so happy to be colleague of the veterinarian professor Esko Nurmi. We studied together at the Veterinary College in Oslo, Norway, and it is quite interesting to see that many of his ideas are of great value to the meat industry.

Research is done on the occurrence of salmonella in Finnish deep-frozen broilers. The project leader for this investigation is Dr. M. Raevuori.

The percentage of deep-frozen broilers having salmonella bacteria is present under investigation.

Dr. M. Raevuori is also doing technological tests to see what effect the wheat protein, gluten, has in fresh sausages.

A project led by Mag. Eva Karppanen based upon analytical studies using high pressure liquid chromatography is to find how much muscle protein and connective tissue are present in meat products.

Mag. Eva Karppanen is also leading a project on the occurrence of Ochratoxin A in pig kidneys.

Mycotoxin gives a white color to the glands which indicates that the meat itself also may contain Ochratoxin A.

Yersinia enterocolitica is investigated in meat and meat products because this bacteria could also be a problem for human beings.

Professor E. Nurmi is continually doing work on starter cultures in order to develop better starter cultures for use in meat products, especially dry sausages (salami).

TECHNICAL RESEARCH CENTER OF FINLAND FOOD RESEARCH LABORATORY

National name: Valtion Teknillinen Tutkimuskeskus
Address: Biologinkuja 1, SF-02150 Espoo 15, Finland
Telephone: 358 (9) 0-4561
Number of employees: 86

The institution is owned by The Government of Finland, ministry of trade and industry.

The research is paid by the state, whereas, the food industry pays for requested research projects.

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The total budget is 5.400.000 Fmk, corresponding to US \$1.85 millions, and 3% of this amount is used for meat research.

Since there are special meat research institutes in Finland, the activities of the Food Research Laboratory in the Technical Research Center is in this sector restricted to certain technological applications and general analytical preparation.

Research projects:

A new method has been developed to decrease the cooking time of skinless sausages.

The present device consists of a tube having eight electrical heating sections. A current is conducted to the heating units through graphite electrode rings and two water-jacketed surface heat exchangers. A rough mathematical model has been developed for this process and it has been simulated by a computer.

In laboratory tests, dry sausages were treated with potassium sorbate aerosols for times varying from 5 to 60 minutes in order to prevent growth of moulds during ripening. The sorbic acid concentration on the surface of the treated sausages was determined.

Hydroxyproline has been analyzed by two methods, namely by amino acid analysis and chemically.

A method is under investigation for the determination of meat content in various foods. The method is based on the determination of 3-methylhistidine as its 2,4-dinitrobenzene derivative by HPLC-chromatography.

THE MEAT RESEARCH CENTER,
HAMEENLINNA, FINLAND.

National name: Lihateollinen Tutkimuskeskus.
Address: Postbox 56, 13101 Hameenlinna 10, Finland.
Telephone: 35 8 917.
Numbers of employed is 45.

Owner of the institute is The Cooperative Slaughterhouse Organization, and the head of the institution is director Mauno Kannari who has his office in Helsinki at the address: Gamla Vintervagen 5, pl. 7, SF-00501 Helsinki, Finland. The telephone number of Mauno Kannari is: 90 71 7911.

The economic support is coming from payment for consultative services and income from the spice service department of the institute.

The budget for 1979 is 3.725.000 Finnish Mark which is US \$1 million. About 10% of the budget is used for research.

Research projects under investigation in Hameenlinna are interesting:

The Danish method for testing the fat layer on bacon pigs is under evaluation to see if this KSA test may be used in Finnish bacon carcasses.

A bigger research project is going on to determine the influence of fat content, protein content and water content, as well as collagen content, on the quality of cooked sausages. The relationship between these contents in different amounts in sausages is evaluated.

Pre-salting

The effect of pre-salting is investigated. The results obtained until now indicate that a pre-salting period of 48 hours is most efficient. The pre-salting effect is reduced when the pre-salting lasts up to 72 hours.

Separated meat.

The mechanical separation of meat from bones is worked on and a Protecon machine is used as well as a method named "Herta-KS." This equipment is installed in a slaughterhouse in Aabo.

The stability of fresh mechanical separated beef and pork is investigated and it has been found that in a fresh state the FFA-content has increased beyond the recommended limit which is set to 0,5%.

Also the bacteriological quality during storage in cooler of such separated meat has been investigated.

Production of emulsions.

A recommendation is given to the slaughterhouses in which it is told that the lean, the salt, phosphates and water should be added before skimmed milk powder, potato starch and spices. It has been found that the process with a usual meat cutter gives a weight loss which is 1,7% less than using blending line.

Hygienic quality of beef and pork carcasses.

It has been shown that different parts of the carcasses are more contaminated than other parts. By the contact plate method it is shown that the same parts of the carcasses are most contaminated in different slaughterhouses.

This above mentioned contamination test is done the day of slaughter and after one day in the chiller. It is very difficult in many countries, including Finland, to get skilled slaughterhouse workers today.

Starch breakdown in cooked sausages.

This is a bigger project which is supported by the State. The breakdown of starch by amylase is studied

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under different conditions and in different sausages made from different recipes.

Rapid water binding test.

Water binding capacity in the forcemeat determined prior to finishing the cutting process:

During the cutting process it is of interest to know how much water could be added totally. The institute is working on a method in which excess water is added to the forcemeat before adding starch and dried skimmed milk powder. By heating in a microwave oven it might be possible to determine the water holding capacity of the half finished product before adding the last ingredient before stuffing.

The test is carried out on a sample taken out from the cutter containing only the lean, the salt and the water with 0,2% phosphate included.

This test is also to be done on raw materials which have been pre-salted the day before the cutting process.

Bacteriological quality tests of liver, spleen, kidneys, etc. are carried out in order to determine the shelflife of such products.

Storage stability of "Christmas hams."

The main dish for Christmas in Finland and in Sweden is cooked cured ham.

This means that the industry has to store fresh hams in the freezer a long time from May-June until December. It has a shortage of hams and this means that they have to take care of all the hams they can get.

In September, and after finishing the curing, the cured hams are frozen and stored until they are sold just before Christmas time.

The salt content may cause rancidity and ways of preventing this is looked for in a project going on where chemical analysis and sensoric tests are included.

DFD-measurements are carried out in Finland as well as in many other countries where DFD-problems in cattle are quite considerable. Measurements are carried out in order to find to what extent the different slaughterhouses have this problem and to which extent measurements have to be taken to prevent the occurrence of DFD-meat.

Machine testing projects.

The institute have been testing different equipment

for use in the meat industry as for instance IWEMA and HOBART F 101 fat analysers.

Different additives are continuously tested as the institute has its own spice blending department. The product "Pokelferment" consisting of a mix of freeze-dried bacteria meant for ham curing is tested for use in curing reindeer meat.

Different air ionization units have been tested in the slaughterhouses for their effect on moulds and bacteria growth.

Hygienic standards in the slaughterhouses and meat packing plants.

In addition to agar contact plates the institute has introduced the use of photographs in visualizing places in the plants which have not been cleaned satisfactorily. The idea seems very effective.

Correlation between production cost and quality.

Five times a year the institute is relating sensoric and chemical as well as bacteriological quality to the real production cost of the products. Interesting results are sent back to the industry in this connection.

Additives and helpstuffs.

Products based on soyprotein or sodium caseinates are being tested for quality and they are related to each other and their prices are also related.

Courses throughout the year.

The institute is running courses for different types of personnel dealing with microbiology, packaging, meat quality, classification of meat, etc.

Altogether 565 people enjoyed the courses on the topics mentioned above and 751 people enjoyed the courses for people working in the meat department in retail shops.

Mechanically separated meat.

The limit of addition of mechanically separated meat is 3% of the total sausage.

Sodium reduced meat products.

In Finland where the sausage consumption is quite high, the institute is now planning a reduction of the sodium content in the sausages in two ways: By using a sodium reduced salt in the product and by reducing the total salt content in the sausages.

The results from investigations carried out in this connection shows that a reduction of salt content

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from 2,2% down to 1,5% does not influence to any practical extent the quality and the weight loss of the finished emulsion products.

THE INSTITUTE OF MEAT TECHNOLOGY, UNIVERSITY OF HELSINKI.

National name: Lihateknologian Laitos, Helsingin Yliopistossa.

Address: 00701 Helsinki 71, Finland.
Telephone: 358-90-378011.

The head of the institute is professor P. F. Niinivaara.

The institute has 15 people employed and is financed by the Finnish State.

The State and different private funds is supporting the research. The DFD-research carried out is paid by the Finnish Meat Industry.

Seventy-five percent of the budget is from the State.

Forty percent of the total activity is meat research and about fifty percent education of students, which means it is typically a university institute.

The Finnish Academy is supporting the project on water binding capacity of cooked sausages which will be mentioned later.

To be mentioned among the research projects going on at the institute are:

A new method for measuring the water holding capacity is under development. The water holding capacity of cooked sausages is measured when using different raw materials, different additives, as, for instance, phosphate, and helpstuffs, as, for instance, starches, from different sources. The many technological processes may influence the water holding capacity and the quality of the finished cooked sausages so these processes are related to each other. Dr. Puolanne is leading this interesting project.

The DFD-occurrence in Finland in beef cattle is estimated and five people in the institute are working on this project. DFD-meat has been found in bulls and in milking cow carcasses as well.

The influence from such meat on the shelflife of the products in which they are used as raw material is tested and the water holding capacity of such meat is related to normal meat.

Reindeer meat is very expensive in the consumers shops but relatively cheap in the parts of the country where reindeer are kept. A better utilization of reindeer meat is the aim of one project. The aim is to use

reindeer meat in new industrial products. The project is also including market analyses.

Back in 1955 the institute started investigations on starter cultures. The institute and its leader professor Niinivaara is well known for the basic knowledge brought up on this field. Today the institute work on developing the existing starter cultures into better ones.

A rapid method taking about two hours for determining the activity of lactobasilli has been developed by the institute. This method is very useful when using starter cultures in the practical operation in dry sausage factories.

The nutritive value of meat and meat products, especially, sausages, is estimated. By taking the total volumes of food in the different geographic areas it has been estimated how much protein, fat and vitamins comes from the sausage consumption in Finland. The content of meat protein, less valuable collagen protein and protein from milk (skimmed milk powder added to the sausages) is estimated as well as the fat content of the products.

THE SWEDISH MEAT RESEARCH CENTER, KAVLINGE.

National name: Kottforskningsinstitutet.
Address: POB, S-244 00 Kavlinge, Sweden.
Telephone: 046-46-73 22 30

Total number of employees: 90
Owned by: The Farmers Cooperative.
Financed by: The Meat Industry.

Budget 1979: US \$: 3,2 mill., corresponding to Swedish kroner: 14,3 millions. About 40% is used for meat research.

The institution may be known to many of the readers as the 23rd. Meeting of European Meat Research Workers visited the institution when they arranged the meeting in Malmo, Sweden, under the leadership of the head of the institute professor Kurt Ostlund.

The institute was started in 1967.

Persons inside the cooperative slaughterhouse organization act as board of directors and draw the lines for the activity.

A research committee is taking care of the research – and development program.

The institute is divided into four sections: Research, technology, quality control and administration.

A great part of the activity is going on in project groups. Parallel to the dividing into sections it is a project organization built over it which coordinate

the cooperation between the different units within the institute.

Research projects.

The main areas are meat science and microbiology.

Questions concerning meat quality is one of the most important areas. The results from the research is the base for increasing the efficiency and quality of pork and beef.

The research on microbiology is aimed on the use of starter-cultures for sausage products which are smoked.

The nutritional value of different meat products are also worked out in the research section as well as work on enzymatic analytic methods.

"Food Hygiene and you."

An important research project is, in fact, the work on information about hygiene and the importance of microorganisms on spoilage for the people working in the food industry.

The aim here is to provide information about hygiene which will make the demand for good hygiene when handling foods clearly understood. The effect of this information technique will be measured as the material is spread throughout the food industry. Videocassettes, also in foreign languages, are being made in this connection.

Christian Nickels is responsible for this project like many other projects in the research program of the institute.

Blood protein.

Research is carried out for the technical optimization and economical aspects of making edible protein from blood.

The decolorization of blood and blood concentrate with acetone-acetic acid is evaluated together with optimization of acetone-hydrochloric acid process parameters.

Classification of bacteria.

There are data based classification systems for bacteria of medical importance, but not for bacteria in the food microbiology. The aim of this project is a combination of selection principals and data based numeric analyses to develop a classification system for bacteria present in foods.

Nutritional value.

The different results of the chemical analyses of raw materials and analyses of meat and meat products will be put together in tables.

Carbon dioxide.

Research is carried out in order to see the effect of carbon dioxide on the activity of microorganisms. The project is a joint project in cooperation with another Swedish research institution, Kemicentrum in Lund.

The storage life of meat and meat products may be increased by using carbon dioxide.

The practical possibilities for using carbon dioxide will be evaluated in this project which is lead by Goran Molin.

The development for starter cultures for sausages.

Inger Erichsen, a charming Norwegian lady, is head of this project.

The aim of the project is to find what types of bacteria are dominating the flora in fermented sausages of superior quality. The bacteria will be isolated, identified and classified and these starter cultures will be used in fermented products in order to control and lead the fermentation process in the right direction.

Fatty acids.

By gaschromatographic methods analyses are carried out on long- and short chain fatty acids. A method may be used for gaschromatographic analysis of fatty acids with one up to six carbon atoms. The separation between the different fatty acids shall be increased.

Taste of baked liver paste.

The aim here is to propose a process for baked liver paste and recommend the most practical equipment which might give the most rational production and give a liver paste in a pack which will get the best acceptance on the market.

PSE and DFD.

Stefan Fabiansson and his group will try to find the best method for determining the PSE and DFD frequency by measuring ATP/IMP-content in the meat, also, a method for determining the water holding capacity of meat, raw material containing PSE-meat will be worked out, especially for use in raw materials for export.

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Elk-moose

The chemical content in moose meat is going to be evaluated in order to determine, among other things, iron, calcium and phosphorous as well as the composition of fatty acids and amino acids, in this game meat which represents many tons in Sweden, Finland and Norway.

Packaging system for consumer cuts.

The aim of this project is to develop a packaging system which may give the packed beef a shelflife, plus good color keeping properties, for 6 days.

Among other projects we have to mention: Identification of chemotherapeutics and other foreign substances in beef carcasses as well as non-enzymatic brown colouring — Maillard-reactions which is a literature study.

Boar taint.

A chemical analysis method for scatol will be evaluated as well as a sensoric analytic method for boar taint. A correlation will be made between the content of scatol and androstenon content and other tests.

One project is dealing with the production of meat products by means of *Pediococcus*-cells of standardized quality.

A method for determining the cooking loss during frying will be evaluated. Also the effect of carbon dioxide on the bacteria flora on fresh meat will be evaluated in a project lead by Goran Molin.

Hot-boning.

The aim of this project is to evaluate the technical, hygienic ergonomic, as well as the quality aspects of hot-boning in Swedish slaughterhouses. The aim is to propose a good technique for hot-boning of pork and beef.

The temperature drop in beef — the cold-shortening and the water holding capacity will be evaluated during different cooling rates for beef. In this project also, the effect of electrical stimulation, and its effect on the time and temperature during chilling will be studied. Also it will be the aim of the project to propose the right time and temperature drops which should be used for preventing cold-shortening.

Cooler storage of fresh beef — a microbiological research area.

In this connection the Swedish Meat Research Center want to get into contact with other researchers dealing with the same problem.

The Swedish company Husquarna has made a microwave unit, model 502, for determination of water content in meat products. This equipment will be tested under the leadership of Kurt Kolar.

Karin Svensson is project leader on a project whose aim is to get biochemicals and pharmaceutical products from the by-products in the slaughter-houses.

Destruction of bacterial spores by thermal methods.

This project is aiming for a publication in the book: "Principles and Practice of Disinfection, Preservation and Sterilization."

A new test method for isolation and quantification of anaerobic bacteria will be evaluated.

The institution has what they call "preliminary research projects" and the words mentioned in this connection might be of interest: Bacon, measuring methods for meat quality, separation of hemoglobin, stunning, Maillard reaction, micro-elements in meat, liver and kidneys, chilling of fat from fatmelting, test of a new method for determination of anaerobic bacteria, study of the nutritional value of connective tissue, microbiology of DFD-meat, vacuum packaging of beef, proposal for a central control of meat products marketed with the trade mark SCAN, alternative slaughter methods, standardization of raw materials from meat.

QUALITY CONTROL.

Analysis and quality control.

The Swedish Meat Research Center has a very qualified chemical analytic department and they do much work on centralized quality control of meat products marketed under the trademark SCAN, which is a trademark belonging to the Cooperative Slaughterhouse Organization. Evaluating new methods is part of the activity in the quality control department.

Information and education.

Christian Nickels mentioned that research should be done on "in what way research results should be used." He was very occupied with "rapid methods for quality control, and tests of the production during the process."

Kurt Ostlund mentioned, during my visit, his interesting ideas about what he called "fine chemicals" like phosphatides and swingomyelins in the brain. These products are very difficult to synthesize and, therefore, he meant it would be necessary, also, in the

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future, to take these products from the stunned animal during the slaughter process.

In Sweden, as in other countries, the tendency is that the meat operation now is going from being handwork to industry operation, said Kurt Nilsson, chief of the technological department in Kavlinge. The consumer in Sweden is asking more and more for quality products, so that the industry has to concentrate on quality and rationalization. In this connection he mentioned production processes in closed systems which require CIP (clean in place), and special knowhow which will be expected to be available in the meat research.

SWEDISH UNIVERSITY OF
AGRICULTURAL SCIENCES.
FACULTY OF VETERINARY MEDICINE.
DEPARTMENT OF FOOD HYGIENE.

National name: Sveriges Lantbruksuniversitet.
Veterinärmedicinska fakulteten.
Instituten for livsmedelshygien.

Address: 750 07 Uppsala 7, Sweden.
Telephone: 46-018- 11 12 00.

Total number of employees: 25.
Owner: The Swedish State.
Financed by: The Swedish Government.

Total budget 1979: 1 million Swedish kroner, US \$230.000.

The institution is moving from Stockholm to Uppsala and the research activity is at the moment very low.

The head of the department for food hygiene is professor doctor vet, Torsten Nilsson.

The institution will be moved and integrated into the University of Agriculture in Uppsala as a special faculty. The institution is in the same building as the institute of Pathology of the Veterinary Faculty and this makes research cooperation easy.

Research projects.

Professor Marie-Louise Danielsson is the project leader of the project named: Enterotoxinproducing gram-negative bacteria in meat and meat products. The occurrence of gram-negative enterotoxinbuilding bacteria in different types of food from the raw material to the finished products will be evaluated. Different products will be infected experimentally by LT- and ST-building E.-coli.

The influence of various storage conditions on the microbiological changes in meat is another project with Torsten Nilsson as a leader. The storage life at

cooler temperature in controlled atmosphere will be studied.

Antibiotic residues in slaughter animals.

This project is carried out in cooperation with the Swedish Meat Research Center in Kavlinge.

Scalding of pig and its influence on meat quality.

Bernt Jones is head of this project which is carried out in cooperation with the Institute for clinical chemistry at the Veterinary Faculty as well as with the Meat Research Center in Kavlinge.

Radioactive isotopes will be used for determining the spreading of scalding water in the arteries and veins in pig carcasses.

The new building and the new research center in Uppsala will be well worth a visit in the future.

SWEDISH UNIVERSITY OF
AGRICULTURAL SCIENCES.
FACULTY FOR ANIMAL HUSBANDRY
AND GENETICS.

National name: Sveriges Landbruksuniversitet.
Institutionen for Husdjurforadling och Sjukdoms-
genetik.

Address: 750 07 Uppsala 7, Sweden.
Telephone: 46-018-10 20 00.

Total number of employees: 7.
Owned by: The Swedish State.
Financed by: The Swedish State.
Budget 1979: For meat research: Swedish kroner:
350.000. – which corresponds to US \$24.000.

The meat research of the faculty is coordinated by Ingemar Hansson.

All the facilities of the section – office, laboratories, lairages and dissecting rooms are situated near the public abattoir at Uppsala. The staff of the section are, therefore, able to follow the carcasses during the slaughtering process to take samples and to register the different carcass traits. The lairage are especially equipped for experiments with regard to environmental treatment prior to slaughter. The dissecting room is equipped with measuring units and balances for automatic registration of data. Both OCR-prints and magnetic tapes are used.

The research program is divided into two parts: Experiments concerning the assessment and evaluation of carcasses which are carried out on beef animals, pigs and lambs. The main purpose of the work is to obtain good estimate of the lean meat content of the carcasses. Carcasses are dissected into lean meat, fat, tendons and bones.

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The second part of the research program is dealing with experiments concerning yield of slaughter by-products and effect of different environmental treatments prior to slaughter on carcass quality. An investigation dealing with different parts of the "fifth quarter" was started in the section in 1977. The weight of liver, heart, kidneys, tongue, lungs, tail, etc., have been recorded on slaughter pigs, sows, cattle and lambs of different ages, breeds and sex. The relationships between growth data, carcass composition and the weight of different by-products may be of great interest.

Another project deals with the effect of different environmental treatments on the ultimate carcass and meat quality.

The University has its own blood typing laboratory and different breeding experimental sections for poultry as well.

THE SWEDISH FOOD INSTITUTE.

National name: SIK – Svenska Livsmedelsinstitutet.
Address: Fack, S-400 23 Gothenburg, Sweden.
Telephone: 46 - 31 40 01 20

Head of the institute is professor Nils Bengtsson.

Total employees: 90

The institute is supported jointly by the Swedish government and an industry foundation with some 63 Swedish and foreign member companies.

The annual budget is 3,5 million US \$ where the Swedish government and the industry foundation contribute with 50% each.

Fifteen percent of the budget is used for meat research.

The institute has their own library and information secretary.

The director of research Cai Eriksson mentioned that the institute has reference groups, expert groups which give guidelines to the research. These people come from the industry.

A three-year program of research is always being evaluated.

The scientists in the institute also give lectures in the Chalmers University of Technology and in the University of Gothenburg. This gives the institute and its scientists the possibility to educate in food science at the university and, thereby, bring to the industry the possibility to receive educated people.

This also, in a way, gives a good contact between the research and the industry.

Research projects.

Usefulness of animal fats.

Lard tallow and other animal fats used in the industry are not given as good handling and treatment as the other meat raw materials. This means that such fatty tissue often is more contaminated and, therefore, often turns rancid faster than other raw materials. The free fatty acid number of the different raw materials are determined and new methods for treating these by-products will be developed. The institute is working on developing new quality testing methods for these raw materials.

By-Products, process water and losses.

Waste meats containing bone and muscles from the effluent treatment plant are mixed with carbamide and treated at low temperature (minus 5 to +20°C). The proteins are precipitated and textured. The solution of carbamide is mixed with carbonates like ethanol or sugar and the *Geoticum Candidum* is growing in the product giving a biomass which is used for feeding cattle.

MEAT RESEARCH IN ICELAND.

In Iceland, as in many other countries, the agriculture plays an important role. Iceland is self supporting in dairy products and exporting considerable amounts of Icelandic lambs.

Unfortunately Iceland has not been visited before the preparation of this paper.

The Agricultural Research Institute deals with animal breeding nutrition, veterinary medicine, food technology and food hygiene. This central institute also has a number of laboratories and field stations.

VETERINARY COLLEGE OF NORWAY, DEPARTMENT OF FOOD HYGIENE.

National name: Norges Veterinaerhogskole, Institute for Naeringsmiddelhygiene.

Address: Box 8146, Dep. Oslo 1, Norway

Telephone: 47-02-69 36 90

Total number of employees: 32

The institution is owned by the Norwegian state, and is financed by the Government and the Agricultural Research Council.

Head of Department of Food Hygiene is Prof. Bjarne Underdahl.

Among the main working areas are: teaching, research-work, microbiological, chemical and toxicological analysis of food.

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The laboratory acts as a reference laboratory in this connection.

Information work is also important.

Research projects which relate to meat and meat products:

1. Microbiological methodology
2. Microbiological criteria for meat products
3. Food-borne infections and intoxications
4. Residues of therapeutics and environmental contaminants
5. Food additives

THE NORWEGIAN FOOD RESEARCH INSTITUTE.

National name: Norsk Institutt for Naeringsmiddel-forskning.

Address: Postbox 50, 1432 Aas - NLH.

Telephone: 47-02-94 08 60.

Number of employees: 80.

Head of the institute is professor Anton Skulberg.

The institute is owned by the Society for Research of Agricultural Food Products, founded in 1971.

The financial basis of the society is a levy on certain agricultural products used by the food industry. The society may finance relevant agricultural food research projects in any Norwegian research institution.

The levy amounts 0,3% of the value of all types of meat and vegetables, berries and eggs used as raw materials in the food industry.

For meat research the budget is US \$776.000 for 1979.

Research projects on meat and meat products:

Studies of protein behaviour during different types of heat treatment.

These studies include proteins like ovalbumin, serum albumin and meat proteins as well as protein from shark muscles. This work will give increased knowledge about the changes of food proteins during thermal treatment. DSC-analysis is used.

Temperature conditions during carcass chilling.

The institute has worked on how to chill carcasses in order to get the best hygienic and eating quality of the meat. The experiments include tests with different temperatures, humidity and air velocities.

Porcine stress syndrome.

The main object of the investigation is to clarify the extent of PSS condition in Norwegian pigs and recommend measures to reduce this condition to a minimum.

Protease activity in muscles.

An enzyme inhibitor of the calcium activated protease has been isolated. Indications are that muscle atrophy and muscle tenderness may be closely related processes.

Preservation of by-products from abattoirs.

These studies have mainly been concentrated on the lactic acid fermentation of by-products in order to develop a non-perishable animal feed with high nutritive value.

Studies on the properties of blood and blood plasma.

A comprehensive report is issued by the institute on the addition of blood plasma to emulsion products. Improved utilization of other by-products will contribute to the reduction of severe pollution from meat packing plants.

Meat from boars.

Utilization of meat from boars is interesting since this meat is leaner than meat from barrows and boars also grow faster. It is anticipated at the institute that the ordinary consumer will hardly be able to distinguish between meat and fat from boars and barrows when consumed without any heat treatment.

Studies of cancerogenic substances in smoked meat products.

The occurrence of PHC from smoke generators is studied. The results indicate that the temperature should not exceed 450°C. A prototype smoke generator, where the temperature under practical circumstances may be regulated within $\pm 15^\circ\text{C}$, has been developed.

Automation and regulation of processes.

Extensive microbiological and biochemical studies are carried out in order to establish a basis for the regulation and automation of the process for making dry sausage. These studies involve many different researchers in the institution.

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NORWEGIAN MEAT RESEARCH LABORATORY,
OSLO.

National name: Norges Slakterilaboratorium.

Address: Lorenveien 37, Postbox 96, Refstad, Oslo 5,
Norway.

Telephone: 47-02- 15 05 10.

The main tasks of The Norwegian Meat Research Laboratory are: To extend knowledge about meat and meat products and to solve problems of the meat industry, to find better methods for utilization of the carcass and to give assistance to the meat industry.

The research is financed partly from a marketing fee on meat. This fee amounts to US 3 cent per kilo (15 ore per kilo) and is administrated by The Marketing Council. The Norwegian Farmers Meat Marketing Organization also support the research and also requested work as, for instance, quality control, etc.

The annual budget is: 2,8 million Norwegian kroner corresponding to US \$540.000.

Total number of employees in the laboratory itself: 20 + 15 part time.

The institution has several services common with The Norwegian Farmers Meat Marketing Organization: Postal distribution, telephone switchboard service, social services including medical, salary office, bookkeeping, engineer services, machine workshop, electrician, etc.

Head of the institution is Ole Sigmund Braathen.

Research projects:
Meat tenderness.

Meat tenderness has been a long term project. Many different ideas have been tested to provide knowledge about what is taking place in the meat after slaughtering.

A patent has been applied for on electrical stimulation of hot-boned meat. The equipment which also detects DFD-meat gives the possibility to "save" the "hot-boned meat" water binding capacity.

The hot-boned raw material for meat emulsions is kept apart from the electrical stimulation line. In connection with the development of the equipment, work is carried out in order to find out how long after post-mortem a muscle reacts upon electrical stimulation. Also, the effect of different types of electrical stimulations on the tenderness itself is evaluated.

The stress problems in slaughter animals.

Much attention is paid to the stress of slaughter animals taking place between the farm stable and the de-bleeding in the slaughterhouse. Questions related to pre-slaughter handling, stunning methods and processing of carcasses are evaluated in the slaughterhouse nearby.

Effluent water.

One department routinely control slaughterhouse effluent water for BOD₇, COD, suspended matter and phosphorus content.

Stunning of pigs.

Stunning of pigs by electricity is done better by higher voltage than that used in Norway today, and, new and more safe equipment to the operators is under development in cooperation with an electro-technician and a company making equipment for the meat and dairy industry.

Tests will be carried out in order to see if any negative effect is on the neck meat from the stunning current, through the neck muscles of the animal, if the electrical stunning tongue with the voltage on, is kept on too long in order to keep the animal immobilized.

Special floors in the slaughterhouse stables.

The effect of sloping floors upon the behaviour of pigs will be tested. Will the pigs turn themselves towards the higher levels of the floor and make them easier to drive into the stunning area? If the lairage floors are made like this it might perhaps be possible to reduce the stress problems to some extent.

Fermented products.

Work is being carried out on the microbiological and enzymatic processes going on in dried cured hams and dried salami during drying and ripening. The enzymatic processes need to be better evaluated.

The effect of starter cultures which are bought from West-Germany and used in Norwegian salami sausages and other dry sausage products are tested routinely for effectiveness also in relatively high temperatures.

Raw material knowledge.

The thawing of fresh meat and the texture of raw meat and fat at different temperatures just below the freezing point of meat is of interest. Is it useful to

carry out temperature conditioning of materials for use in for instance salami production?

An apparatus named Fat-Tester is used for determining the fat content in mixed coarse ground raw materials for emulsions and we look for similar equipment for this purpose.

Emulsion products.

The shelflife of emulsion type sausages made from raw materials containing different amounts of DFD-meat and, at the same time, added different amounts of starch, is evaluated. The amino acids in the proteins might be destroyed earlier if it is a lack of "sugars."

Salt containing reduced amounts of sodium is tested in different emulsion products in order to see the effect upon taste and water binding capacity in relation to the use of normal salt. In the future a demand for meat products containing low amounts of sodium in order to reduce blood pressure might be made.

Mechanically separated meat.

One question we hope we may be able to answer in the future is: What is the water binding capacity of mechanically separated beef and pork after different freezer or cooler storage periods?

Vegetable versus animal fats.

One of the main projects during the recent years has been trying to get more knowledge about animal fats versus vegetable fats spread to interested people. Literature concerning the advantages of animal fats is translated and sent to newspapers and health organizations. One of the articles to be mentioned is written by professor A. M. Pearson, Michigan State University.

Emulsion products.

The effect of storage upon raw forcemeat before stuffing into bologna and Vienna types sausages will be evaluated.

Research is going on in order to find the best way to use tissue containing relatively high amounts of collagen. We will try to find any connection between the shelflife of emulsion type sausages and the collagen content.

By microscopy we find if a sausage product is added textured soy protein. This addition is not legal in Norway.

Work is started on finding any correlation between Instron measurements and taste panel scores for consistency of emulsion products. The effect of the degree of fineness of the emulsion containing different amounts of collagen is studied. The addition of papain to the water used for reheating sausages before consumption is evaluated.

Cooking of meat products.

The temperature and the heat convection in cooking chambers are evaluated in order to find what is the optimum humidity to be used in cooking chambers for bologna and Vienna-type sausages. In this connection work is carried out on the problem with black pudding being red instead of black due to unsatisfactory coagulation of the blood during the cooking process.

Packaging.

The CO₂-gas production in packages containing bologna-type sliced sausages as well as different dried, cured sausages is measured.

A simple method is evaluated in the institution for testing the oxygen permeability and, thereby, the quality of the whole finished deep drawn packages used for packaging meat and meat products. The packaging industry seems to have little information about their own laminates after different degrees of "deep drawing."

Contact with the industry.

A small newsletter, LABINFORM, is issued every second month. It contains a summary of the information given inside in the list of contents on the front page. It is hoped that this makes it possible for the busy reader to get an impression of the "messages" in a hurry.

The research staff joins meetings of the persons being in charge of the production at the various plants, and by taking part in the discussions, try to inform about new research developments as well as older basic facts.

The staff gives lectures at industry courses, act as speakers at The School of Food Technology, etc. Very important for maintaining a good communication is answering inquiries made by the telephone and paying visits in the meat processing plants in order to discuss with practical people.

Information is given to the local laboratory staffs in the meat packing plants and in central courses. Two-way communication is, in our opinion, a very important way of putting new research results into prac-

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tical operation in the meat packing plants. We have, to a greater extent than other meat research institutions, simplified the information given to the meat industry and others, and we hope this will turn out to be for our benefit in the future.

Contact with other meat research institutions.

It is the philosophy of the institution that very much valuable research knowledge is available around the world and that these important scientific facts should be the base for the practical operations in the Norwegian meat industry.

An important task is to translate research results from various foreign languages into a very easily understood Norwegian language without sophisticated expressions and words. In this work Donald M. Kinsmans International Meat Science Dictionary, to which we have contributed, is very useful.

The research staff has participated in many national and international scientific conferences in

order to obtain new knowledge about various fields of research. New ideas for research projects are more and more difficult to find and, therefore, valuable.

We also try to find the most practical way for obtaining scientific results and put them into practical operation. Difficult questions, which are not answered by searching in the literature, are sent to various institutions around the world with the promise that a copy of all the answers we get will be sent to the institutions trying to answer our questions. To date, the reactions of the various meat research institutions to our questions have been very positive.

It is my hope that this presentation of the meat research in Scandinavia and Finland here in the United States may contribute to a better coordination of the meat research around the world. This, I hope, will be to the benefit of meat research, the single meat researcher as well as the whole meat industry and the world population, the consumers.