THE ACTIVITIES OF THE CENTRAL FOOD RESEARCH INSTITUTE

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Summary

A survey is given on the role and tasks, research results and future plans of the Central Food Research Institute.

Role and tasks

The Central Food Research Institute was founded in 1959.

The foundation document defines the tasks of the Institute as follows.

— Scientific and technological research covering the food industry as a whole or several branches of the industry
— Food industrial research-econometric and microeconomic tasks
— Coordination of the food scientific and food technological research in Hungary
— Comparative analysis of results in national and international research and in management
— Information, data provision

Thus, the activity of the Institute covers several branches of the food industry and besides research provides also coordination and information in the fields of food industry and food science. Within the framework of this work, the Institute organizes the programmes for national long- and medium-range research development plans and the main trends of development which affect food production, as a whole and controls and coordinates their implementation.

As the Institute conducts its research activity in an open manner, it makes its research facilities available to users, and it participates in solving research, technical-development, instrumental measuring, computer application tasks or in developing new products, technologies or measuring methods.

The tasks determined in the foundation document are performed by the divisions, sections and target laboratories within the framework of the organization.

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The tasks are coordinated by the Section for Scientific Planning and Information. The Central Library, the Library of Food Economy Division, the Section of International Relations, the Management and Maintenance sections largely contribute towards ensuring research activity.

In Hungary out of the around 1400 people involved in food research about 270 (20%) work at the Central Food Research Institute. About 80 researchers with assistants are engaged in the scientific activity in the Institute and 1130 in other 14 institutes which belong to different branches of the food industry. The Institute's 35 filed patent applications can be considered as a sign of successful research.

Research results

In the following a short survey is given of the research results that have been achieved in the past years, which have either already been implemented or which are available for implementation.

Food industrial technologies, process and product development

New type pastries of higher biological value have been produced at reduced production cost. The possibility of using locally made soya flour and ultrafiltered milk proteins in industrial meat products was examined. It was found that part of the meat may be substituted by soya flour having not only nutritive but also technological advantage. The products tested answered the standard requirements, the meat substitute did not cause nutritive damage nor was the microbiological substance of the product impaired.

To increase the range of the variety of dietetic food products, flavoured cheeses poor in fat were produced. The products contain 20% fats to dry matter.

With the combined dehydration technology consisting of vacuum evaporation and vacuum-drying, powdered products have been prepared from the pulpy and filtered juices of different foods and vegetables. These powders meet the requirements of the instant products. Apart from internal utilization the production of new good quality products opens up export possibilities for the industry as well.

With the technology developed in the Institute, from extracted sunflower grits an isolate with 80% protein content can be produced under industrial conditions. A pilot plant was designed by a cooperation where sunflower protein isolate can be produced on the basis of this procedure. This product may be used for different industrial products as well as fodders.

The cryogenic freezing procedure developed for the prefreeze grinding of spices has reduced grinding losses (weight and also volatile oil), the energy consumption, and at the same time the output of the grinding equipment increased.

Similarly by applying the method of cryogenic freezing—in collaboration with cooperatives—a new, large scale on-site freezing method of raspberries was developed resulting in about 40% relative quality increase in raspberries. This procedure has been patented.

As a result of several years of research work, we have also constructed multipurpose membrane separation devices, the necessary membranes were also produced.

The high frequency treatment which is a good form of heat treatment widely used in the food industry has also been developed. Besides maintaining the biological value this treatment has the advantage of increased yield. For the applications elaborated for the meat-, canning-, and candy industries, procedures have recently been added that have been worked out for the pastry industry.

In the field of sewage purification, mobile water cleaner and waste containers were designed. A cleaner on an industrial scale was installed with a favourable water flow in half the space required by the traditional equipment, thus greatly reducing the investment cost. Also devices of different capacities have been developed for extracting fats, proteins and carbohydrates from sewage with methods for their utilization.

The application of the enzyme technique

The technology of enzymatically hydrolysed milk protein concentrate was also elaborated. The product is known as Sportrobi and besides sports and medical nutriment purposes it can be used also in the food industry as an additive. To increase the nutritive value of the product it is also enriched with amino acids and magnesium.

To substitute the imported milk clotting enzymes necessary for cheese making, a technology was developed for producing germ-origin enzyme preparations.

To reduce the problems of supplying milk to lactose intolerants the industrial possibilities of enzymic (soluted and fixed lactose) lactose hydrolysis was examined for utilizing dairy products poor in lactose and dairy by-products. Preserved milk treated with lactase, flavoured condensed milk and creamed cottage cheese were produced.

Research has been carried out for the production and utilization of pectolytic enzymes. A method for applying the patented enzyme, the

macerating effect in tomato processing has been elaborated. As a result, the juice quantity increased, the straining loss and concentration time decreased which in turn increased the capacity of the production. This enzyme was used also for the production of fruit- and vegetable juices. The enzymic liquefaction results not only in more valuable juices from the point of view of nutrition but also in less processing wastes. The importance of this technology is that from the same amount of material, 20—40% more end-product can be obtained at a reduced production cost.

The possibilities of utilizing food industrial wastes were also investigated. Different solid and semi-solid methods were worked out to increase the protein content and digestibility of the food industrial and agricultural ligno-cellulose containing wastes (straw, corn stalk, etc.). With a new drum fermentor developed in connection with the research, biofermented corn stalk with 9—11% protein content and 50% less lignin content was produced than the starting value. The protein enriched corn stalk with improved digestibility can be used substituting a significant part of the more valuable, higher protein content fodder (e.g. lucerne).

From food industrial wastes, e.g. dry bread available in big cities in great quantities—was used as a carbon source for the cultivation of *Pleurotus fungi* with close to 50% protein content.

In order to increase the protein biological value, experiments were performed to increase the methionine content desirable in the case of direct human consumption (SCP-Single Cell Protein) on yeast base.

Successful experiments have been carried out for modifying proteins by plastein reaction. With this enzyme-catalysis controlled procedure the biological value of proteins can be increased by building in the missing essential amino acids. During the experiments with the proteolytic hydrolysate of casein and serum albumin a plastein reaction was performed with chymotrypsin as catalyst in the presence of α-methionine-methylester (S-methyl ^{14}C).

With the plastein reaction, methionine was successfully built into soya protein and certain meat industrial by-products and raw materials, besides casein, too. The goal of the experiments was to increase the nutritive value with the help of enzyme reactions.

Several enzyme-based analytical methods were developed also for food analytical purposes and for controlling the quality of the new products.

Storage physiology

A procedure was developed for following the quality changes of foodstuffs and for determining the shelf-life by an objective mathematical-statistical method. On the basis of the tested nearly 4000 industrial food products and

product groups—including spices—respectively, it was possible to set up equations to predict the quality changes during the storage by which the shelf-life of even new products can be determined by calculations.

The interaction between the foodstuffs and packing materials was examined during storage so as to ensure that the stored product keeps its quantity, biological and sensory value till consumption with as little change as possible. A financial analysis was also performed in which temporary storage, distribution and time of consumption were considered in order to choose the cheapest packaging form.

An irradiation technology was elaborated to decrease the storage decay of different agricultural products. The ionizing radiation (50 Gy) performed 4—6 weeks after harvesting completely inhibits sprouting but even during later treatment it is significantly delayed and decreased. The operating cost of the radiation equipment does not exceed 10% of the wholesale price in Hungary. By processing it to dry material the sorting cost of the irradiated dried products decreases by more than 50%.

Some irradiated foodstuffs were submitted to wholesomeness test. Examination of the mutagenic effect (e.g. irradiated spices) in rat feeding experiments (e.g. with meat industrial spice mixtures) with the dominant lethality test (DLT) showed no genotoxicological damage on the basis of the pre- and post implantation descendant loss and the mutagenic indices.

Food analysis

Experiments have been carried out to detect the flavour components of different products. By the gas-chromatographic analysis of all volatile compounds and by the thin-layer-chromatographic analysis of the carbonyl components, differences were found both in the quantity and in the quality of the products tested.

Quality control can be performed by measuring the quality indices of fruit aroma preparations used for the flavouring of different industrial products.

Research work was performed for the objective qualification of fruit brandies. The gas- and thin-layer-chromatographic procedures applied for the analysis of a great number of brandy samples of different fruit origin enabled us to determine the quality of fruit brandies with great certainty.

Analytical methods enabling the detection of additives and the determination of their quantity are indispensable both from a financial point of view and also for the sake of the consumers. The methods worked out are suitable for the quantity control of the additives in bakery products.

On the basis of research in recent years, by measuring the physical parameters in a non-destructive manner, quick information can be gained

about the main components of food products. Discovering the correlation between the quality characteristics of the materials tested and values measured at certain wavelengths in the reflection or transmission spectra recorded in the infrared wavelength range, it has become possible to increase the number of the methods and the instruments and to reduce the time required. Composition measuring instruments were developed also to identify the "classical" physical characteristics, for example the continuous butter composition measuring and beverage composition measuring instruments.

Using the NIR (near infrared) technique methods were developed for measuring the composition of food products such as fresh meats, fruits, vegetables, wheat flour, sunflower seed, dried pastries, cocoa, coffee, wine and butter.

By inviting external experts, the experiments were extended from optical spectroscopy, and NIR technique to opto-acoustic spectroscopy, "PAS" technique, expecting a greater number and more reliable information about the food components if both the "optical" response to the radiation and the "acoustical" (sound) response are taken into consideration.

The widely used dye-binding method has also been adopted from literature descriptions.

The advantage of the dye-binding method compared with the traditional one is that the time is less, and as no amino acid catalyst is necessary for the measurement, the method is more easily performed.

Experiments have been carried out to determine the F-2 toxin from meat and corns. A thin-layer-chromatographic semiquantitative method suitable for the detection of F-2 toxin in maize was worked out. The method proved especially good in serial analyses with no standard toxin present (0.1 μg toxin is still detectable).

Food industrial economics

In this special field mainly the effectiveness of food industrial research is investigated, furthermore activities of some food industrial branches and enterprises are to be economically evaluated to promote, on the one hand, the success of the innovation factors that help to improve enterprise effectiveness by analysing costs, prices and profits, through changing labour-demands and work power composition, and on the other hand, to analyse the internal management and determine the practical utilization of the energy resources.

— Elaboration of an economic base for the development of packaging of foodstuffs; investigation of the interaction between the packaging (metals, plastics) and the foodstuffs during storage
— Identification of losses in the food industry

— Economic problems concerning further improvement of an enzymically hydrolyzed protein
— Economic evaluation of using meat substitutes of high protein content
— Operational conditions of food industrial data collection
— Suitable methods for utilization of R+D activities covering some food industrial branches

The main target of future

Most of the research work is oriented towards implementing the targets specified in the governmental long range research programmes, in the ministerial level medium range scientific research programmes and participation in programmes of industrial branch level.

Research activity includes the following main subject groups:

Development of new techniques

— NIR technique
Developing technique suitable for the characterization of products of animal and plant origin
Methodological research in processing and evaluating food physical measurements
— Enzyme technique
Further development of enzyme analytical methods for control of foodstuffs
In case of heterogeneous suspensions application of some food industrial enzymes and enzyme systems based on kinetic examinations
Application of enzyme technique in food industrial processing and storage
Investigations to reduce and to utilize food industrial wastes
Bio-engineering research

Material research

— Protein research
Application of protein sources of plant and animal origin for the purpose of increasing the protein content and the nutritive value of foodstuffs
Investigation of the protein nutritive value of new food products by in vivo experiments
— Investigation of technological additives and ingredients
Development of modern instrumental and sensory evaluation methods suitable for the analysis of aroma preparations

Investigation of the applicability of additives from the point of view of developing new food products meeting the demands of nutritive necessity
Application of modern techniques for ensuring the high quality of Hungarian red pepper

Technical-economic research

— Establishment of new technologies
Research on food-industrial processes based on material- and energy saving
Economic support for food technology research
Food industrial application of biotechnological procedures
— Economic research
Current business management problems concerning some food industrial enterprises and branches
Preparation of middle and long-term developing plan

Scientific coordination

— Organization and coordination of food industrial research including international co-operation.

Information activity of the Institute

Being a central institute and having programme-coordinating responsibility, the information activity is very much emphasized. Library and documentation provide the information base for the research work. Another important part of the information activity is the outgoing information that not only publishes the tasks and the achievements but is intended to promote the information flow within the entire food scientific and food technological research work. The means of both oral and written distribution of information are utilized.

Programmes

— Food scientific conferences (every second year)
— Food scientific colloquia (monthly)
— Subject discussions (every second week)
— Product introduction (occasionally)
— Exhibitions (occasionally)

Information material

— Food scientific journal "ACTA ALIMENTARIA" is a quarterly publication in English
— "Az élelmiszeripar gazdasági kérdései" (Economic problems of food industry) is a quarterly. The first chapter contains food research results, the others contain abstracts of articles on food economics abroad.
— "Research results" report on the results of finished research work in a study form in order to facilitate the application
— "Research reports", bibliography on the research report prepared at the Institute, with indices.
— "Summaries of colloquia" contain the summaries of lectures held within a year with indices.
— "Institute report" is a short introduction of the Institute written in Hungarian and English.
— "Library accession list" informs on the yearly library acquisitions.
— "List of publications" is a bibliography on publications by the members of the Institute.

Possibilities of co-operation

The many years' professional practice and research achievements qualify the Central Food Research Institute to accept various research tasks in the following themes:

In the interest of exploring and utilizing more effectively raw materials of plant origin, the Institute analyses the following:

— production of protein isolates used as food products or for feeding purposes,
— defines the nutritive- and biological value based on in vitro and in vivo methods,
— examines the applicability of extruder procedures for process development and the extension of the variety of products
— the applicability of materials (fats, whey, technological waste waters, etc.) which have so far found hardly any application, or which could be used on a wide scale.

All personal and instrumental conditions are available at the Institute which are necessary for the development and further improvement of new analytical methods and devices. In this framework, it is possible to determine the consistency, physical, chemical, sensory and microbiological characteristics of food industrial raw materials, semi-finished and endproducts.

In the interest of developing the products and the technological processes in the different branches of the industry the Institute develops different food

industrial products with more favourable range of nutrition that meet the requirements of some diets.

It is possible to elaborate new cryogenic-liquid freezing procedures for quick freezing at the location of growth or for large scale production of ready-to-serve foods.

Results are available to advise anti-corrosion coatings and also concerning the analyses of the suitability of coatings.

The computing centre of the Institute performs technical-economic calculations, Personal Computers and Professional Personal Computers are being introduced in the food industry, the computing centre undertakes the installation of this equipment, obtains the hardware configuration and prepares and installs the necessary software, and trains the professional staff.

Process control systems are being developed for modernizing the food industrial production equipment and processing lines by utilizing the results of computer technique.

It is also possible to perform research concerning the applicability of enzyme preparations in the various fields of food industry.

Irradiation and irradiation combined preservation methods are being developed for an ever greater sortiment of food products.

Business management and microeconomic tasks are also accepted.

The introduction and utilization of results achieved are of common interest. When utilizing the results to a given development task, the rate of payment depends upon the size of the work performed.

Apart from the above mentioned subjects, the Central Food Research Institute is always available in any other questions concerning food research.

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