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ASSISTANCE TO THE FOOD INDUSTRY RESEARCH INSTITUTE (FIRI)

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VIETNAM

Technical report: Follow-up on the project development*

Prepared for the Government of Vietnam
by the United Nations Industrial Development Organization,
acting as executing agency for the Untied Nations Development Programme

based on the work of Kresimir Sepic, consultant
in food research programme and project development

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Vienna

* This document has not been edited.

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SUMMARY

According to his duties, as described in the job description, the consultant, during his assignment, was expected to deal particularly with food testing and quality control methods, food canning and food storage technology. The equipment, for which requisitions were finalized in December 1988, has not yet been delivered and therefore there was no possibility to assist in introducing some physical and chemical methods of analysis. It was possible however, to review the list of various products with which FIRI (Food Industry Research Institute) is expected to deal, and to determine what methods of analysis may come into consideration to be introduced in future. Based on this, some of the necessary additional equipment was determined and specifications prepared for possible purchase. One of the problems appear to be that the present activities of FIRI are not fully developed as yet and there is no clear picture on the priority products and laboratory methods with which the staff will be dealing in future, particularly in relation to the products development and pilot plant operation. Microbiology field appeared to be better defined however, this was not the subject dealt with by the consultant.

It was understood that arrival of some equipment has been announced for late May and the preparations for its installation should be initiated soonest possible. There will certainly be a number of minor items (such as glassware and chemicals) which may have to be ordered before real activities could be started. Some progress has been noted but more is yet to be done.

On food canning, or packaging in general, necessary equipment and methods were reviewed. It was not certain whether FIRI will be involved in tinplate testing and therefore, no specific testing methods were determined. It would be possible, however to suggest some methods in order that necessary materials could be obtained later on. In order to introduce food canning on a pilot plant scale, two major pieces of equipment are to be obtained: can seaming machine and autoclave for sterilization.

Great interest was shown for lectures in food preservation, quality control, canning, meat by-products utilization, etc. and consultant took an opportunity to give four lectures on these topics.

More details on the topics mentioned above, as well as on others, are elaborated in the report. Some technical information is also provided because it was felt that staff of FIRI is short of such information.

The consultant wishes to express his appreciation for good co-operation with counterpart staff which has shown great interest in the project and its activities.

INTRODUCTION

According to the project document, the immediate objectives of the project are to strengthen the capacity of the Food Industry Research Institute (FIRI) in: carrying out applied research programme in bio- and fermentation technology applied in food industry; transfer of know-how to the industrial plants through the provision of direct support to industry; and training of technical personnel from industrial plants and units in specific processing techniques, testing and quality control, products development, production management, etc.

The Consultant in Food Research Programme and Project Development was expected to work on the:

- testing and quality control of various food products (beverages, alcohol, beer, meat, fish products, canned fruits and vegetables);
- preparation of a programme for canned food products processing on a laboratory and pilot scale;
- selection of laboratory instruments and equipment for physical, chemical and sensory evaluation of food products;
- identification of action to be taken in improving overall operation of selected plants;
- introducing modern food storage technology.

The above mentioned activities were expected to be carried out in co-operation with the National Project Director (Director of FIRI), technical staff of FIRI and CTA (Mr. N. Okafor). The mission of the consultant coincided with the mission of CTA who was absent from Hanoi for several days. The Director of FIRI was also absent for ten days, however, other staff members were present so the work was possible to carry out, although not fully in line with the duties of the consultant as described in the Job Description. There were however, other complementary activities for which the staff of FIRI has shown great interest.

Since this is the second assignment of the consultant within the project, it is in a way a return mission, this report may partly be considered as a continuation of the previous report dated 10 November 1988. It is not intention to review here all activities carried out within the project, this is expected to be dealt with by CTA who is involved in coordinating all activities. There will be some points, however, which will be mentioned and which deserve attention of the project staff. It may be noted that the project is still at its preliminary phase, major equipment has not yet arrived, only one study tour has taken place so far, no definite detailed plan has been finalized on the FIRI's activities, no details are available on the selection of products to be dealt with and a number of points are still being discussed, etc. One important aspect has been noted and which may influence future

activities of FIRI to some extent. It appears that the authorities support some changes in the economic policy which is expected to be more open and which may require certain adjustment of the FIRI's activities to be less basic research oriented but more applied research with the purpose of improving the operation of the existing industry. Also, it may well happen that FIRI will have to secure additional financial resources from industry by charging its services and carrying out some activities which may bring some income. At this stage however, the consultant could not enter into this subject, except discussing it in general terms, but this should be kept in mind in planning future activities.

The following departments of FIRI are to be directly involved, according to the project document, in R & D activities related to the immediate objectives of the project: Microbiology, Industrial Biotechnology, Food Processing and Aromatic and Additives. Quality Analysis and Control Department was not specifically emphasized in this context, however, it became obvious that food analysis and quality control (chemical-physical methods and sensory evaluation) is and will be an important activity of the Institute. It may not be necessarily concentrated in one single Department because within the activities of different Departments each one may need to carry out some analysis. It would be advisable, however, that organizational setup foresee some kind of a coordinating role of one single Department. This particularly refers to the selection of analytical methods, location of some equipment to be used by staff from other Departments and collection of official standards and technical information. Some analysis of course, may be carried out within other Departments themselves, particularly if this would not involve purchase of more expensive equipment and duplication.

Of the methods of food processing and preservation, particular interest was shown for canning because this technology may be applied for a variety of products both on a small and large scale. A number of industrial plants in the country are canning different food products, particularly in the South, and the results of any products development work may have good chances to be introduced in industry on an industrial scale. Packaging in general is one of the activities of FIRI which will be most probably expanded, not only in tinplate canning but in packaging in polyethylene bottles and containers as well. Although it was not clarified to what extent testing of tinplate and tinplate cans will be introduced on a regular basis, it would be good to introduce some methods, particularly if no sophisticated and expensive equipment is involved. Visit to some food canning plants would give a good picture of the present condition in this industry and whether the Institute, if becoming capable, could contribute to better operation of individual plants and in improving the quality of products.

From the keen interest shown by FIRI staff for given lectures, it seems that they may be lacking not only practical experience but also better knowledge on the subjects which were touched upon during the lectures. Or, if having some knowledge, this may be more theoretical and less directly related to the actual application in industry.

ACTIVITIES AND RECOMMENDATIONS

The activities of the consultant during this short assignment were related to different aspects of the project but more to food analysis (testing and quality control) and canning (food preservation) than to action to be taken in improving overall operation of selected plants and modern food storage technology. Some views on these topics are mentioned in this report and some technical information is provided as well.

Food Testing and Quality Control (Food Analysis)

One of the first points raised was what specific food products FIRI will be dealing with and for which some laboratory (chemical, physical or sensory) analysis will have to be introduced. Although bacteriological control is of equal importance, particularly for some products, this field was not covered during the mission, except in general terms, because it is not within the field of the consultant's competence. The methods of analysis may be grouped into general ones which may be applied for a variety of products, and specific ones which are common only for specific products. First question raised was whether the country's legislation defines the quality of products intended for human consumption, their composition and declaration (labeling, content of packages, etc.). This is an important aspect to which staff of FIRI will have to pay definite attention if involved in products development and quality determination. Since the country is very much interested in promoting export, this is even more important and may involve studying legislation and standards of the importing countries in order to avoid that the export market becomes closed if the products do not meet requirements of the importing country. In this respect, it would be advisable to define what products the country may be interested in exporting and to what market. Based on this, action may be taken to obtain information and corresponding official documentation on standards and quality regulations from the importing countries. Should such information be already available with the existing exporting organizations or government bodies, the Institute should obtain them. It may create great problem if a product considered suitable for export is found not suitable by importing country, or if results of laboratory analysis are different just because different methods of analysis were applied. It is not only that a certain market may be closed for a considerable period of time but also that large costs may be involved if certain quantity of a product is to be returned back or even destroyed. This subject was touched upon during one of the lectures given.

Of the general methods of analysis, one could mention methods for determination of:

- moisture, by vacuum oven method, drying in vacuum desiccator, toluene distillation, dielectric method, conductivity method, drying with infra-red heat or in micro-wave oven; some other may also be considered although they may be less important (Fischer titration method or Calcium Carbide method);

- fat and oil content, by dry extraction or wet extraction;

- protein, standard or more advanced Kjeldahl method;

- ash, strait combustion or modified methods;

- fiber, by acid and alkali digestion;

In principle there are many physical-chemical methods used in food analysis and with the development of new techniques and equipment there is always something new in this field. Specific gravity may be determined by pycnometer, Westphal balance, hydrometers. There are refractometry, colorimetry, polarimetry, saccharimetry, chromatography, ion exchange, polarography, viscosimetry, as well as some more advanced methods, such as nuclear magnetic resonance, etc. Only in chromatography there has been much development from the basic paper chromatography to HPLC or gas chromatography, etc. There is a considerable technical literature on the subject, including on the standard methods of analysis, which should be obtained.

Dairy products: milk, cheese, butter and some other dairy products, such as yoghurt or milk based baby food, appear to be of interest although it is not yet clear to what extent they will be dealt with by FIRI. The following methods may come into consideration:

- specific gravity of milk determination, with special hydrometers and pycnometer are most common;
- total solids in milk, by drying or calculating from the lactometer reading and butter- fat content;
- butter-fat in milk and other milk products, Babcock or Gerber method;
- acidity, by titration with NaOH solution;
- protein in milk and milk products, standard or modified Kjeldahl method, determination of casein and albumen;
- lactose in milk and milk products, by Munson-Walker method, saccharimetric method, colorimetric method;
- added water in milk, by cryoscopic method, $CuSO_4$ serum refraction method;
- test for milk pasteurization, phosphatase test;
- moisture in dried milk, by toluene distillation;
- sucrose in condensed milk, by polarimeter;
- butter analysis for foreign fats, Reichert-Polenske value, thin-layer or gas-chromatography method.

Fruit and vegetable products: this is an important group of products because the country has an abundance of them and some are export items, such as fruit juices, bottled and canned. The following determinations may be mentioned:

- net content and drained weight of canned products;
- viscosity of fruit juices, viscosimeter method;
- moisture content in different products, various methods are suitable to different products;
- soluble solids, by refractometer;
- ash determination, by combustion;
- vitamin C content, by indophenol solution method;
- Na, K, P, Mg, Mn, S and Cl determination, may eventually come into consideration applying different methods

(spectrophotometric for Na, gravimetric for K, volumetric or spectrophotometric for P, gravimetric for S, gravimetric for chlorides, etc);
- acids, titration and determination of specific acids, such as citric, malic or other organic acids;
- sugars (reducing), by inversion method;
- essential oils content, wet extraction method;

Alcoholic beverages: these include beer, liqueurs, may be wine and other products. The following may come into consideration:
- ethanol content, by distillation and specific gravity determination;
- methanol and higher alcohols content, by spectro photometric method;
- acidity, titration with NaOH;
- colour, photometric or spectrophotometric method;
- specific gravity of beer, by picnometer method;
- glycerol in beer, dichromate oxidation method;
- diacetyl (colorimetric), unconverted starch (iodine reaction), protein (Kjeldahl), CO_2 content (manometric or foam collapse rate), Ca (titrimetric), Cu (Cuprethol method), SO_2 (colorimetric), bitterness and other determinations in beer;
- non-sugar solids (sugar inversion method), Cl, Cu, Fe, Na, K, tartaric acid, lactic acid, tannin, CO_2, sorbic acid in wine, etc.

Meat and fish products: meat and fish products appear to be of secondary interest for the time being and no laboratory analysis of these were considered at this stage. It was noted however, that some staff members are interested in edible products development based on meat by-products, such as liver, intestine (for sausage casings), fatty tissue, lungs, stomach, etc. For this reason, it may well happen that some methods will have to be introduced for the analysis of raw materials used or of products developed by FIRI. The following may come into consideration:
- protein content (Kjeldahl method);
- free fatty acids (extracted and titrated with NaOH);
- nitrites and nitrates (spectrophotometric method);

Cereal products: cereals, particularly rice, represent staple food in the country and are major item in the daily diet. Most of rice however, is consumed, without any particular processing on an industrial scale, except milling. The following methods may be considered:
- microscopic identification of flour or starch origin;
- acidity of flours (water or alcohol extraction and titration with NaOH);
- ash (combustion in muffle furnace);
- Fe in ash (spectrophotometric method);
- moisture (standard drying methods);

Sugar: consumption of sugar per caput is rather low, cane sugar industry exist in the country but there was no indication that FIRI will deal with sugar production as such. Sugar is however, an important component of many products (soft drinks, liqueurs, wine, sweets and cookies, etc.) and the analysis of sugar content in many of these products is very common:

- white sugar content (polarization method);
- invert sugar (Knight and Allen or Berlin Institute method);
- moisture, ash (standard methods);
- sugars identification (thin-layer chromatography);
- acidity (titration with NaOH).

Oils and fats: oils and fats appear to be on the list of products do be dealt with, either as such or as components contained in other products, such as cereals or soya. The following are some determinations:

- saponification value (saponification with NaOH);
- Iodine value for unsaturated glycerides (titration with starch as indicator);
- peroxide value (by titration);
- there are various tests for specific oils identification.

Other products: there are many other products which may be analyzed by chemical and physical methods, some may be intended for human consumption (sauces, baby food, breakfast cereals, prepared foods, spices, tea, coffee,etc.) some as animal feed and some may be used for other purposes (for brewing, as additives, etc.). In addition to this, research activities related to fermentation, biotechnology, enzymes, organic acids, etc. may require application of analytical methods commonly used for food products.

Detailed description of the above and many other methods of analysis are contained in various publications. One of them, series of Manuals of Food Quality Control (published by FAO) has already been provided to FIRI and can be used as a basic source of information on the subject.

Based on the selection of analytical methods indicated above, it should be possible to identify laboratory equipment, glassware and chemicals required. Some of these have been identified and are listed in the Annexes. Since some equipment and chemicals have already been ordered from the project funds, some were available in the Institute from before and the other may be obtained locally, it is important that the staff members involved, or to be involved, in laboratory analysis make an inventory of the selected analytical methods, equipment, glassware and chemicals available or ordered, and determine whether there is anything else required for carrying out laboratory procedures. Also, it might be advisable to consider possibility of assisting in introducing some of the subject analytical methods in case that the staff of FIRI does not posses adequate experience.

Interpretation of results obtained by laboratory analysis is also one important aspect of food quality control. It is not enough to determine certain component in the product but to know also whether the content is too high or too low. Or even, whether a certain component should not be present in the product at all, in some cases it may happen that it must be present. If FIRI is going to develop gradually its capacity to assist industrial food processing plants in improving their operation or quality of products, it should also be able to advise, on the basis of laboratory tests, what changes should be introduced in the production in order to overcome identified shortcoming. This means

that definite knowledge and experience in industrial food processing may be required and that close co-operation with technical personnel in industry should be established. One example may illustrate what is meant by this. If receiving a tinplate can containing some food products and which is swollen, it is not sufficient to determine that the can is swollen but to determine also **why** it is swollen. The reason may be inadequate sterilization, formation of gases due to reaction of acid, contained in the product, with tinplate or due to seam leaking due to improper can seaming (closing). By identifying the reason for swelling one should be able to advise the plant management on the action to be taken.

Food Canning

Under food canning it was usually understood preservation of food in sealed metal (tinplate) containers (cans) which are sterilized in autoclaves. In addition to tinplate, there are other packaging materials (aluminum, chromium plated steel, plastic foils, glass jars and bottles, etc.) which are used today. It is more proper to call this technique therefore, as preservation in air-tight containers treated by heat (sterilized). In case of aseptic packaging, the content is sterilized before being packed and package may not be necessarily sterilized by heat (H_2O_2 is also used to some extent in packaging milk). The canning technology, using one packaging material or the other, is applied for many food products and has an advantage that the products may keep well for an extended period of time at room temperature. It is particularly suitable for products development and it is fully understood that FIRI is interested to establish small, laboratory or pilot plant, facility for canning. There are two main pieces of equipment required: can seaming (sealing) machine and sterilizer (autoclave). Preparation of products for canning in most cases may be done with simple equipment which might be available or by hand (filling of cans). On an industrial scale of course, one can use all kind of special equipment for each processing operation, such as blanchers, mixers, cutters, cookers, extractors, concentrators, fillers, as well as all kind of equipment for peeling, shelling, de-stoning, grading, sifting, kneading, etc.

On canning technology, equipment required and procedures for various products, some technical literature has been provided to FIRI by the consultant. Including also on home canning, both in tinplate cans and glass jars. One of the lectures given was devoted to canning and it appeared that there is definite interest in this subject. More details on this are given elsewhere in the report.

Sterilizer (autoclave) has already been discussed by CTA with the staff of FIRI, UNIDO has obtained an offer and it is only the question of deciding on the model to be purchased. In principle, it should be suitable for sterilization of canned food products up to the normal working temperature of 122° C.

Seaming machine specification has been prepared and once offers are received, definite selection may be made. When placing order, supplier should be informed on the height and diameter of cans to be closed in order that the rollers (first and second one),

lower plate (for placing cans), upper plate (for pressing down the cover) and rollers' guide plate be selected accordingly. At present, three sizes of round cans are considered, height between 49.4 to 126 mm, and diameters between 73 and 100 mm. Samples of can covers (three of each size) have been provided to the project backstopping officer at UNIDO. The model of the seaming machine to be selected should be rather simple, with hand loading of cans and hand or foot lifting of lower plate. Seaming itself (rollers rotation) should be driven by electric motor.

Since FIRI should not enter into can making in order to produce own cans from tinplate, it should have a steady supply of cans from one of the existing can making plants. This should not represent any difficulty because it is not a question of large quantities and only common sizes may be used. This point was thoroughly discussed.

Tinplate testing and quality control is an activity which may also gradually be developed by FIRI. Selection of tinplate thickness for different size of cans, selection of tin coatings for different products, determination od tin coating, porosity, resistance of tinplate to different products, testing of lacquer quality in lacquered cans, etc. may all be introduced. Two publications from the Tin Research Institute were provided to the Institute: Tinplate Testing (Chemical and Physical Methods) and Tinplate Handbook. Several tinplate testing methods were discussed and for the time being it is strongly suggested that at least some are introduced:

- determination of tin coating or coating weight measurement by Clarke's Test: dissolving free tin and alloy layer in a solution consisting of concentrated hydrochloric acid and antimony trioxide;
- thiocyanate test for porosity;
- sulphide stain test;
- lacquer adhesion test;
- SO_2 test for rust resistance;

There are also other testing methods which might be of interest primarily to the can making plants. However, in case that some of them would be of interest to FIRI, they could be introduced without great difficulty. They are all described in detail in one of the publications mentioned above.

Lectures

Four lectures of three full hours each were given to some 25 staff members of FIRI on their request.

Food inspection and technology lecture covered various aspects of:

- principles of the responsibility of authorities and regulatory agencies to secure that the food products put on the market correspond to certain quality requirements;
- responsibility of food processing technologists in producing food products meeting certain requirements;
- responsibility of veterinary and sanitary inspection services; control of meat products for possible animal diseases, control of sanitary conditions in food plants;
- relation between quality control and production technology;

- general methods of quality control and interpretation of results from technological point of view;

Food analysis:
- general methods suitable for a variety of products;
- specific methods and quality control of milk and dairy products, cereals, fruit juices, alcoholic beverages, oils and fats, food additives;

Food preservation:
- principles of food preservation;
- refrigeration and freezing;
- pasteurization, sterilization;
- concentration, dehydration;
- smoking, salting, pickling, effect of added alcohol, chemical preservatives, acids;

Food canning:
- packing in air-tight containers, different materials: tinplate, aluminum, polyfoil, PET, etc.;
- difference between low pH and neutral or alkaline products on sterilization process (temperature-time relation);
- reference to Cl. Botulinum for determining sterilization conditions;
- home canning in glass jars of fruit and vegetable products;
- physical-chemical methods and sensory evaluation;

Other activities

Sausage casings.

There was interest shown in how to make sausage casings which then could be used for a pilot production of various types of sausages, particularly from less valuable meat and by-products, such as liver, lungs, fatty tissue, skin, etc. Since some intestine was made available, the consultant demonstrated how to clean intestine from fat and other tissue and make casing.

Liver paste (bread spreads).

Several samples of liver paste and meat bread-spread were demonstrated and their production from meat by-products discussed. Meat industry in more advanced countries utilizes practically everything, from intestines and stomach, to liver, bones and hair. Meat industry by-products utilization is rather broad subject and should FIRI be interested to develop some activities in this field, it would be possible to provide some information material. Unfortunately, the consultant has not visited any slaughterhouse or meat processing plant in the country and therefore was not able to judge to what extent this sector of food industry may be developed in future. One general impression is that the consumption of meat and meat products is relatively low and that almost only fresh meat is consumed, without any industrial processing. Neverthless, there are always some by-products which may be utilized one way or the other, in edible or non-edible form. In fact, nothing should be considered as waste. The following is approximate composition of two samples demonstrated and which may serve as a guidance:

Meat spread: pork, fatty tisue, liver 12 %, bouillon (clear soup

from meat), inner parts up to 8 %, emulgator 2 %, salt with addition of nitrate;

Meat breakfast: pork, beef, fatty tisue, inner parts 13 %, skin, starch, low-fat soybean flour, poliphosphates, sodium nitrite;

In general: Sodium nitrite is usually added up to 0.008 %, liver is added up to 15 %, but milk powder and spices may also be contained in this type of products.

Use of sorbic acid as preservative

During the discussion on the use of various preservatives in food procesing question was raised on the use of sorbic acid and sorbitol. Since no information was available at hand, the consultant has collected some information based on the documentation from one manufacturer and this is contained in the ANNEX III.

Determination of CO_2 in beer

This subject was also discussed and it appears that FIRI would like to introduce a method or methods, for determination of carbon dioxide i beer and possibly other beverages. One method described in a book available at FIRI, uses special equipment for measuring the pressure in bottles after piercing the crown-cap, and calculatiing the carbon dioxide content on the basis of the pressure. Since it might be difficult to obtain the subject piece of equipment, interest was expressed in introducing some other methods and in obtaining equipment for that purpose. One method for beer and another for wine, are described in the **Official Methods of Analysis** (14-th edition) of the **Association of Official Analytical Chemists** (USA). For beer, piercing apparatus (optional, for bottles or for cans), absorption buret and leveling bulb, connected with glass and rubber tubing, are required. Volume of carbon dioxide and air is determined by graduated buret which is, as well as connecting tubes, filled with water before the bottle or can is pierced. If the buret is fiiled with NaOH (15 %), carbon dioxide will be absorbed and one can determine the volume of air present in the bottle or can (headspace). The headspace may also be determined by weighing the bottle or can with beer and again after filling it with water. More detail on various methods will be provided to FIRI separately.

Refrigerated storage

Refrigerated storage, freezing and frozen storage, is one of the very common methods of food preservation applicable to many food products, particularly meat and dairy products, fruit and vegetable, as well as to various food preparations and ready-made meals. Although the subject was not discussed in detail, it appears that this technology is of interest to some staff members of FIRI. It was not clarified to what extent FIRI may be involved in refrigeration (as a modern storage method) and freezing, is it only to obtain some general knowledge (walk-in cooler is being purchased) or it is that some staff members wish to gain full knowledge and competence in this field, both in technology and engineering. This points should be clarified in order to determine what kind of assistance, and whether at all, may be provided within this project. It is assumed that some general knowledge would be useful but that FIRI would not enter into the design and technical

operation of cold storage and freezing plants. At this stage, it would be useful to have at least information on the storage conditions and storage time for some products. Should FIRI be interested in more than this, UNIDO should be informed accordingly and in drafting job description for the return mission of the consultant, or any other short-term expert, this may be taken into consideration, keeping in mind that one mission may be devoted only to this subject. Some information on the refrigerated storage of various food products is contained in ANNEX IV.

FUTURE ACTIVITIES

There are several points to be mentioned regarding possible return mission of the consultant and on other activities to be carried out by FIRI. Some of these points have probably been raised by CTA already, however there is no harm to mention them here as well. What is indicated here is in no way exhaustive.

Possible return mission. It is not sufficient to define duties of the consultant in the job description (and this is valid for any other expert/consultant to be engaged within the project) but to prepare also, adequate programme for the whole period of the mission and to assign staff member/members of FIRI who will be working together with the expert/consultant during the whole period of his assignment.

Timing of the mission should be determined well in advance in order that necessary arrangements (travel and visa) could be made accordingly. Duration of the mission should be defined as to whether travel time is included or not.

Since no laboratory equipment has arrived until the time of the mission, it was not installed and no practical introduction of various methods was possible. It is indicated that the delivery is expected to take place, at least for some equipment, as of the end of May 1989 and immediate action should be taken to make necessary arrangements for its installation. Once the major equipment is received, the expert/consultant services may be envisaged to assist in introducing various physical/chemical methods in the laboratories. The same is applicable to the pilot plant equipment, particularly for canning (sterilizer and seaming machine) which, most probably, will be available only during the first half of 1990. In both cases, information should be provided on the specific equipment and methods, or in case of canning on specific products to be canned, on which the consultant is expected to assist. It should be noted that these two fields are rather broad and it is not possible to cover everything within a few weeks of consultant's mission.

Regarding visits to various industrial food processing plants in order to determine their condition and possible co-operation with FIRI (consulting services, products development), the following action is recommended:

- to determine priority sectors in which individual plants may be selected;
- to select individual plants and discuss with the management specific problems and possible future co-operation; FIRI of course, can not impose co-operation, this should be of mutual interest and based on a specific programme or specific problems in

solving of which FIRI should be able to assist;

- once the plants are identified, a joint visit of the consultant with 2-3 staff members of FIRI, may take place to 2-3 food processing plants in order to determine the specific technical, technological, quality control or any other problem, on which the action to be taken then could be defined; it should also be defined whether consulting services and co-operation is to be limited to technical and technological matters or organizational, production costs, production programme and other matters are also to be dealt with; preliminary identification of plants and their production programme should be made known to the consultant in time in order that he could prepare himself and collect corresponding documentation on the specific processing techniques or products; similar exercise may then be repeated to other plants later on until the staff of FIRI gains necessary experience to continue with this type of activity on their own, taking into consideration of course, professional background and experience of the staff; it is suggested that tinplate can making and canning of various products be also considered as potential fields of interest.

Inventory not only of requisitions and purchase orders but also of all equipment, glassware and chemicals, regardless whether they already exist or will be purchased from the project or local funds, should be regularly updated. This should include an inventory of physical and chemical methods of laboratory analysis to be applied in the Institute, technological processes in which they may be involved, and particularly of standards and regulations both of Vietnam and countries which are potential importers of processed food products. Although bacteriological control of food products has not been much emphasized in this report, it is not less important. Well known Swiss handbook on microbiological methods in food control (Schweizirische Lebensmittelbuch, Microbiologie) would be very useful, it is available with the consultant and if it is of interest to the staff of FIRI, it may be jointly reviewed, some method selected and possibly translated. Since the consultant was involved in drafting official regulations on food products in his own country, his experience in this field may be of interest.

Subject: DP/VIE/86/013 - Assistance to the Food Research Institute.

Specification of equipment to be purchased.
Note: The preparation of requisitions is being dealt with by CTA.

Item	Quantity	Description	Est. Cost US $
1	2	Infra-red single driers Temperature range +70 to +170°C, standard model with one radiation unit, 220 V, 50 Hz, electronic regulator, timer, 250 W bulb, Voltmeter 30 - 250 V.	
2	4	Spare infra-red bulbs, 250 W for single drier.	
		Total:	1,570
		Ref. Karl Kolb 1987, p. 310, items 276-000, 276-080	
3	6	Butyrometers: two each: Gerber 0 to 3 % for whole milk Gerber 0 to 8 % Gravimetric for butter 0 - 90 %	
		Total:	80
		Ref. Karl Kolb 1987, p. 614, items 447-750, 447-752, 447-764.	
4	6	Specific gravity bottles, Pycnometers 50 ml.+/-0.016 ml. clear borosilicate glass, polished stopper, class B accuracy	
		Total:	130
		Ref. Karl Kolb 1987, p.822, item 656-206	
5	1	One set of 14 hydrometers, specific gravity, total range 0.6000 to 2.000 g/ml, range of each 0.001 g/ml, length 300 mm.	
		Total:	280
		Ref. Karl Kolb 1987, p. 308, item 275-765	
6	1	Polarimeter, semi-circle, Tungsten lamp, readability 0.1' of the arc	

		by vernier, range -90 to +90°, half-shadow angle 9°, with magnifying lens, transformer, tungsten lamp, 220 V.	
7	2	Polarimeter tubes, 200 mm, two screw caps,	
8	2	Spare tungsten lamps.	
		Total:	1,570
		Ref. Karl Kolb 1987, p. 422, items 340-200, 340-220, 340-230.	
9	3	Melting point determination apparatus, According to Thiele, range 0 to 250°C, with stoppers, thermometers, capillary holders.	
10	3	Spare rubber stoppers for above,	
11	200	Melting point determination capillaries.	
		Total:	156
		Ref. Karl Kolb 1987, p.510, items 380-850, 380-859, 380-860.	
12	20	Porcelain dishes, evaporating: - 10 pcs 110 mm diameter, 225 ml, - 10 pcs 125 mm diameter, 285 ml.	
		Total:	150
		Ref. Karl Kolb 1987, p. 748, item 578-210, 578-211.	
13	13	Melting crucibles, porcelain, high form: - 10 pcs. 75 ml., 50 mm top diameter, glazed without cover; - 3 pcs. 75 ml., 50 mm top diameter, glazed with cover.	
		Total:	70
		Ref. Karl Kolb 1987, p. 745, items 577-558, 577-578.	
14	9	Pipettes - 3 for milk testing 11 ml., - 3 for sulphuric acid 10 ml., - 3 for amyl alcohol 1 ml.	
		Total:	60
		Ref. Karl Kolb 1987, p. 613, items 447-624, 447-626, 447-628.	

15	15	Piston pipettes, 3 of each: 1 ml, 2 ml, 5 ml, 10 ml and 25 ml.	
		Total:	200
		Ref. Karl Kolb 1987, p. 815, items 654-871, 654-872, 654-873, 654-874, 654-875.	
16	2	Aromatic oil determination apparatus, Acc. to KOOLHAAS de VOOS Incl. condenser, 500 ml round bottom flask, ground joints;	
17	2	stands for above,	
18	2	forked clamps for above.	
		Total:	650
		Ref. Karl Kolb 1987, p. 883, items 679-010, 678-322, 678-342.	
19	2	Volatile acids in fats and oils determination apparatus (reichert-meissl, Polenske Numbers); Incl. glass receiver 100 and 110 ml. graduation, cooling jacket, distilling glass, 500 ml. boiling glass, ground joints;	
20	2	Stands for above,	
21	2	Forked clamps for above.	
		Total:	500
		Ref. Karl Kolb 1987, p. 883, items 679-050, 678-322, 678-345.	
22	2	Water determination apparatus, for xylene (DIN 51582); Incl. round bottom 500 ml. flask, condenser, sockets and cones, ground joints;	
23	2	Support rodstand clamps for above;	
24	2	Spare measuring tubes for above.	
		Total:	600
		Ref. Karl Kolb 1987, p. 885, items 680-050, 680-068, 680-070.	
25	1	High speed corundum stone mill; output 10-50 kg/hr, hopper capacity 7 l., fineness down to 0.01 mm., 380 V, 3-phase, 50 Hz., with on/off switch and motor protection, inc. cable and plug;	

26	1	Spare pair of grinding discs for above;	
27	1	Set of spares for two years operation.	
		Total:	12,500

Ref. Karl Kolb 1987, p. 365, items 314-200, 314-216 and 314-207.

GRAND TOTAL: 18,516

Subject: DP/VIE/86/013 - Assistance to the Food Research Institute.

Specification of equipment for which information material and indicative price is required before selecting specific model.

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1 — 1

Centrifuge - separator,
for bacteria cream separation, 1,000 l/hr capacity, 220/380 V, 50 Hz., Alfa-Laval type for butter/cream separation from milk, with a 'bowl' consisting of an assembly of conical disks mounted on a vertical spindle.

Potential suppliers:
Alfa - Laval, Sweden,
Westphalia, F.R.G.,
Sharpless, U.K.

2 — 1

Air compressor, oil free,
3,000 l/min. capacity, maximum working pressure 4 bar, air-cooled, with approx. 2,000 l. tank, 220/380 V., 50 Hz, with safety valve, pressure gauge, automatic switch.

3 — 1

Tinplate can seaming (closing) machine;
For laboratory/pilot plant use, hand feeding of cans, hand or foot lifting of bottom plate with placed can, seaming roller driven by electric motor, for round cans with side seam or deep drawn, height between 49 and 126 mm, diameters of cans approx. 73, 84 and 100 mm., tinplate thickness to 0.35 mm.

Potential suppliers:

H.Sudry & Fils, Rue Beausejour, Nantes, France
FMI, Via Giantur[illegible] 31, Napoli, Italy.
Clemens & Vogl, Braunschweig, F.R.G.

Reference may be made to the supplier of similar seaming machine within the project DP/EGY/78/002.

4 — 1

Offset printing equipment, manual operation, 3-4 colours, for printing labels of approx. size up to 120 x 200 mm.

SORBIC ACID

"Scrbic acid and potassium sorbate are especially suitable for the preservation of food because, if applied correctly and in the right amounts, neither substance will affect the taste or odour of the food.

The two substances are effective in all acid products up to a pH value of approx. 6 and may therefore be used to preserve even faintly acid, mild-tasting products, so popular among consumers these days."

"Potassium sorbate when incorporated into acid foods release its preservative component, sorbic acid. Although different amounts of potassium sorbate and sorbic are used, both preservative have same degree of efficacy. They combat mainly mould and yeasts and their action against bacteria is only limited. Potassium sorbate is of advantage in cases where ready solubility in water is important or where concentrated stock solutions of preservatives are employed because they are more convenient to apply"

"It is absolutely essential that the preservative should be well distributed in the food. This can be achieved quite simply by intensive stirring or pumping. As with all preservatives, certain minimum concentrations are essential to adequate preservation. Brief heating will not affect sorbic acid or potassium sorbate. If, however, goods are boiled intensely for prolonged periods it is advisable to add the preservative after boiling so that it does not in part escape with the steam.

The amount to be used is determined by both the water content and the pH value of the food. The lower the pH value of the product, i.e. the greater its acidity, the smaller the quantity of sorbic acid or potassium sorbate required. The pH value may in many cases be adjusted by the addition of such acids as citric acid or vinegar.

The amount of preservative needed also depends on the type of raw material and the processing conditions. Of course, sorbic acid and potassium sorbate will protect food from subsequent microbial attack only if strictest conditions of hygiene are observed during processing. Highly contaminated food, or food that is already in the process of decomposition, can no longer be preserved."

"Food processors using sorbic acid or its salts are recommended to inform themselves about the food regulations currently valid in respective countries."

"Delicatessen: Sorbic acid and potassium sorbate are effective against mould, fermentation and microbial rancidity in emulsion-like delicatessen, such as mayonnaise, Russian and similar salads, sauces, mustard and aspic. Sorbic acid and potassium sorbate are also very effective for delicatessen with low vinegar content as these are generally very difficult to preserve.

For the preservation of mayonnaise, 0.08-0.15 % sorbic acid or 0.1-0.2 % potassium sorbate are usually adequate. The sorbic acid may be suspended in the oil or alternatively added during the early stages of manufacture, the mayonnaise being completed

in the usual way. Potassium sorbate may be added direct in the form of 10 %, 20 % or more concentrated aqueous solutions."

"Pickled preserves: Potassium sorbate, if incorporated into vinegar-containing solutions, will prevent the development of surface mould, yeast layers and the softening of sterilized, pickled cucumbers, gherkins, beetroot, onions, horseradish, mixed pickles, and other pickled preserves. Vinegar and other solutions containing 0.08-0.13 % potassium sorbate calculated on the solution will remain clear, even after prolonged storage. Cucumbers will remain hard and crisp. This effect may be reinforced by and addition of calcium formiate.

The amounts of potassium sorbate required to maintain the fresh, natural taste of the goods and it is particularly recommended for mild-tasting products. Sugar will not interfere with its preservative effect.

When preparing solutions, the potassium sorbate should first be dissolved together with the salt, the vinegar being added afterwards.

In the case of sterilized, pickled cucumbers and gherkins, potassium sorbate, like other preservatives, becomes fully effective only once the food is well saturated. It is advisable, therefore to allow sufficient time to elapse after sterilization.

Sauerkraut, pickled cucumbers and other vegetables preserved by lactic acid fermentation, can be protected from the attack of mould, fungi and yeast layers by addition of 0.06-0.1 % potassium sorbate. The addition can be made either before fermentation or before the goods are finally bottled. The above quantities of sorbic acid and potassium sorbate will not affect the lactic acid bacteria but will largely inhibit surface mould and undesirable yeast layers."

"Fruit products: Potassium sorbate is suitable for the preservation of fruit purée, pure natural fruit juice and similar products because it is highly effective against the type of mould and yeasts that occur in these foods and their constituents and will not affect the taste, odour or color of the products.

In certain fruit products it may be of advantage to combine potassium sorbate with small amounts of sulphurous acid as this will prevent fruit from turning brown through the action of atmospheric oxygen or through fermentation.

For fruit products, potassium sorbate should be added in the form of a 10-30 % stock solution. This should be well mixed in by stirring or pumping to ensure proper distribution.

An addition of 0.07 % potassium sorbate will generally be adequate. Juices that are particularly susceptible to microbial attack, such as cherry or lemon juice, may require higher doses. Again, where prolonged storage is intended, quantities of 0.1 % potassium sorbate are advisable.

Jams, marmalade and jellies can be protected from mould by adding 0.05-0.08 % sorbic acid immediately after boiling, or by surface treatment with approx. 1-2 % potassium sorbate solution."

"Base products for the soft drinks industry: Many raw materials and semi-finished products for the soft drinks industry require additions of preservative in order to prevent the formation of

mould and undesirable fermentation. The use of potassium sorbate is particularly suitable for these products, since being readily dissolved in water, it can easily be applied in the required doses. If the pH value of the product is sufficiently low, 0.06-0.1 % potassium sorbate are usually adequate.

The required quantity of potassium sorbate is best dissolved in a little water and than added to the batch with intense stirring or pumping."

(The above text is taken from a brochure **Sorbic Acid, the preservative akin to food, from Farbwerke HOECHST A.G, Frankfurt-Hoechst, F.R. of Germany)**

Recommended Conditions for Storage of Perishable Foodstuffs

The following are recommendations for some products taken from the publication of the Commission IV, of the International Insitute of Refrigeration:

Commodity	Temperature °C	Expected Storage Life
Fruits:		
Apples	2 to 8	depends on the variety
Apricot	-1 to 0	two to four weeks
Avocado	5 to 10	two to four weeks
Banana - green	11.5 to 14.5	10 to 20 days
- coloured	14 to 16	5 to 10 days
Cherry	-1 to 0	1 to 4 weeks
Citrus fruit		
- lemon green	11 to 14.5	1 to 4 months
- lemon coloured	0 to 4.5	3 to 6 weeks
- lime	9 to 10	3 weeks
- orange	2 to 7	1 to 4 months
- grapefruit	4 to 15	3 to 12 weeks, depends on region
Grape	-1 to 0	3 weeks to 6 months depends on variety
Litchi	0	5 to 6 weeks
Mango	10	2 to 5 weeks
Melon	4 to 10	1 to 4 weeks
Papaya	10	2 to 3 weeks
Peach	-1 to 1	1 to 4 weeks
Vegetables:		
Artichoke	0	3 to 4 weeks
Asparagus	0 to 0.5	2 to 4 weeks
Bean, fresh	0 to 2	1 week
Beet - bunch	0	10 to 14 days
- topped	0	1 to 3 months
Broccoli	0	10 to 21 day
Cabbage	0	2 to 4 months
Carrots, topped	-1 to 1	4 to 6 months
Cauliflower	0	2 to 3 weeks
Cucumbers	11.5	1 to 2 weeks
Eggplant	7 to 10	10 days
Mushroom, cultivated	0	5 days
Onion	-3 to 0	6 months
Pea, green	-0.5 to 0	1 to 3 weeks
Potato, - early	3 to 4	a few weeks
- late	4.5 to 10	4 to 8 months
Pumpkin	10 to 13	2 to 6 months
Sweet potato	13 to 15	4 to 6 months
Tapioca (tubers)	0 to 2	6 months
Tomato -ripe	0	1 to 3 weeks
-green	11.5 to 13	3 to 5 weeks

Watermelon	2 to 4	2 to 3 weeks
Animal products:		
Beef	-1.5 to 0	4 to 5 weeks
Veal	-1.5 to 0	1 to 3 weeks
Lamb	-1 to 0	1 to 2 weeks
Pork	-1.5 to 0	1 to 2 weeks
Bacon	-3 to -1	1 month
Lard, refined	-1 to 0	4 to 6 month
Poultry	0 to 1	7 to 10 days
Eggs in shell	-1.5 to 0	6 to 7 months
Dairy products		
Milk, pasteurized	2 to 4	several days
Butter	4 to 6	2 to 3 weeks
	0 to 2	4 to 5 weeks
Cream	0 to 2	several days
Dried milk	16	6 months or more

Note: in addition to the indicated storage temperature, relative air humidity should be kept within certain limits, for most products it is recommended 80 to 90 %; in some cases ventilation is required. If required, more detailed information may be provided as well as some technical literature.