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THE ACTIVITIES OF FOOD RESEARCH AND DEVELOPMENT CENTER IN THE ETHIOPIAN FOOD CORPORATION**

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C O N T E N T S

1. INTRODUCTION

The role of research and development towards the development of an indigenous scientific and technological capability is tremendous. It would be too obvious to say that, the so-called underdeveloped countries are still in the infantile stage regarding research and development, in almost all fields of activity. The same holds true for Ethiopia, except the agricultural sector where research establishments have been in existence for a long time. But, regarding this the industrial sector seems to be far behind.

Amongst other indicators, the low level of research and development is manifested by the lack of an indigenous scientific and technological base. The industrial sector is still mostly a buyer of technologies as one package, within considerable or no locally manufactured components. Many raw materials, semi-processed products, ingredients, etc., are still purchased from abroad and processed into finished products. But, many of these raw materials and inputs could have been availed locally, if the necessary studies and researches to develop them were conducted.

Being one of the Corporations within the Ministry of Industry, the same state of affairs also prevails within the Ethiopian Food Corporation (EFC). Nearly all the machinery and equipments within the factories are imported. The plants newly being established are still purchased as one package. The way to produce traditional foods with

modern technologies is not yet studied, and those food items which are adopted from elsewhere and produced are not made to conform to the dietary habits of Ethiopians. The varieties of food items produced by EFC are very much limited and do not contribute much of the daily food intake of an ordinary Ethiopian.

Because of the above and various many other reasons, EFC has launched a program since 1979 E.C. to establish a Food Research and Development Center (FRDC), whose main objectives would be the preparation, organizing and execution of research and development activities within the food sub-sector.

This paper will deal with the potential role of the FRDC in shaping the future of the food sub-sector and is structured in the following manner. First, a brief overview of EFC is given with an exposition of the main processes and technologies encompassed within it. Second, the establishment of the FRDC and its objectives are treated. Thirdly, the performance, problems and achievements of FRDC since its establishment are analysed, and lastly the potential role and future programs of FRDC are dealt with.

2. THE ETHIOPIAN FOOD CORPORATION

The Ethiopian Food Corporation (EFC) is a state owned Corporation within the Ministry of Industry (MOI) dealing with the production and distribution of food items produced mainly from cereals and oilseeds. The main products from these raw materials are wheat and maize flour, pasta, macaroni, bread, biscuits, galleta, edible oil and vegetable ghee.

In addition to the EFC, there are also other state organizations, which deal with the processing of food and related products. They are distributed in various Ministries and Corporations. For example, fruits and vegetables are processed by The Horticultural Corporation in the Ministry of State Farms Development, meat and diary production by the Ethiopian Livestock and Meat Corporation in the same Ministry, and sugar by The Ethiopian Sugar Corporation in The Ministry of Industry.

The private sector also makes a sizable contribution in the processing of food. Forexample, in (1985/87 G.C.) 1977/79 in a survey conducted by The Handicrafts and Small-Scale Industries Development Agency (HASIDA), there were 10,000 - 20,000 small grain mills, with an average employment of 2 to 3 people and an average capacity of 2 tons/day. There are also small private enterprises engaged in baking, oil milling, dairy products, coffee preparation, etc.

The EFC at present owns some 45 plants, out of which: 20 are for flour milling; 13 are for vegetable oil processing; 5 are for producing baked food products, such as bread, biscuits and galleta; 5 are for producing extruded food products, such as, pasta and macaroni, 1 is a baby foods plant (FAFFA), and 1 is a spice extraction plant. To elucidate further the technologies and processes within EFC, the main product lines are discussed in detail, as follows.

2.1 FLOUR MILLING

The grain as it comes from the field is impure and contains foreign materials, like pebbles, mud balls and other seeds. The wheat seed from the local farms may contain upto 15-20% dirt. This is precleaned using vibrosifters, destoners and magnetic separators. The seeds are separated using difference of volume, width, length and shape.

The machinery used for cleaning are varied depending on the specific requirement. Flat vibrating sieves (oscillating or rotary), cylindrical screens, trieurs, disc separators, inclined surface separators, etc. are used.

The dust should be exhausted using aspiration systems. This is done by a set of fans, cyclones and trunking of metallic parts. This is a very fundamental operation from health and safety point of view. Dust explosion is always a threat in flour mills.

The wheat is then conveyed to what are called tempering bins, where water is added until the right amount - which is between 14-18% - of moisture is attained. There are first and second stages of tempering. The tempered grain is taken out of the bin using vibro-dischargers. The grain is then conveyed to the mills using pneumatic or mechanical systems.

Horizontal roller mills are used in modern mills. These are cast iron or cast steel heavy rollers with surface hardened (in many cases fluted) designs. The rollers are mounted on roller frames. The rollers rotate in pairs and as the grain falls between the rotating rollers, it is broken up.

The basic idea in flour milling is the separation of the bran (12%) and the germ (3%) from the endosperm (85%). That is also the tragedy. With the bran and the germ nearly 70% of the minerals, vitamins, fibreous substances that are so useful are lost. And so, the so-called "premium flour" of very low extraction (65% or thereabouts) is nutritionally less desirable.

There are three stages in the milling section:

a) Break system: The grinding and sifting of the wheat into skin and its heart using coursely fluted heavy rollers is done in this system. The stock is then separated into different grades using plansifters and purifiers.

(b) Scratch System: This is made of rolls of finer flute. Endosperm that still adheres to the bran after the brake system is separated here.

(c) Reduction System: This is the last stage where the purified stock is given the required fineness with least damage to gluten and starch granules.

The flour is then separated into different grades, packed and dispatched. The flour qualities for pasta, bread and biscuits are different, and in similar manner, the types of wheat to get these specific flour types are also varied.

2.2. VEGETABLE OIL PROCESSING

In conventional vegetable oil processing, oilseeds are first subjected to the process of screw pressing, and secondly the oilcakes produced are solvent extracted.

(a) Screw Pressing:

Oilseeds are first cleaned upon receipt or before being expelled. Having cleaned the oilseed, it is necessary to prepare it for the next operation. The preparation depends upon the type of oilseed, and it is the process, wherebye, oilseeds are delinted, decorticated, dehulled, reduced in size and flaked, as the case might be. These processes are done by delinting and decorticating machines, roller and flaking mills.

The flaked seed is then conveyed to the screw press. The press is basically a slow rotating sturdy screw inside a casing lined with hardened and exchangeable lining bars. On top of the screw press is usually mounted a cooker which heats the seed mass to about 70°C. This is to reduce the viscosity of the oil, to coagulate the proteins, and also to stop enzymatic activity, or else the FFA in the expeller cakes grows quite high.

The crude oil produced is then filtered and passed into batch or continuous neutralization system, where the FFA is removed. Before neutralizing, the FFA of the crude oil is determined to add the correct amount of caustic soda solution which is needed to neutralize the crude oil. The soapstock, which is the reaction product of the neutralization process, is separated by centrifugal separators in a continuous system or by settling in a batch neutralizer. The neutral oil is then washed to remove residues of dirt and soap. Both systems are found in EFC plants.

The neutralized oil is dried using vacuum systems. The neutral oil is then bleached by means of a bleaching earth to attain the required colour of the oil. After the completion of bleaching, the bleaching earth is separated from the oil by filteration, and the oil is passed to the

deodorization process. The purpose of this process is the cleaning of the oil from odour giving substances like ketones, aldehydes, etc., and is performed by subjecting the oil to high temperatures (about 200°C) under vacuum.

The deodorized oil is then cooled, filtered and is ready for consumption.

Some oils are winterized before deodorization. This process is necessary, because these oils - like cottonseed oil - have cloudy appearances at room temperatures. This occurs because of the presence of some saturated fatty acids, such as stearin which begin to solidify at room and lower temperatures. During winterization, such oils are cooled to low temperatures and filtered, separating the solidified saturated fatty acids, wherebye, the oil will get a clearer appearance.

The addition of hydrogen (hydrogenation) to unsaturated fatty acids (as are present in cottonseed and rapeseed oil, for example) helps us to get shortenings and margarines. The margarine is post refined for better quality and taste.

(b) Solvent Extraction:

One of the screw press products called oilcakes or expeller cakes contain on average 7-15% oil and 35-50% protein. The oil is extracted chemically, using the solvent extraction process, at the Modjo Edible Oil Factory. The solvent used for this purpose is food grade hexane.

The oilcakes are first broken down into small bits, passed through roller mills and are charged into a 'Carrousel Extractor', where hexane is showered from the top. The miscella (as the mixture of hexane and oil is called) after being collected at the bottom of the extractor is passed into the distillation system, where it is distilled in three consecutive stages by means of steam, to separate the crude oil and hexane. The hexane vapour from the distillation columns is condensed and recirculated, The crude oil produced, is passed into the refinery, where it is neutralized, bleached and deodorized, as stated in 2.2 (a).

The oilcake from the extractor (now called meal) is conveyed to a 'Desolventizer-Toaster' for driving off the hexane entrained in it, by using steam, applied directly

and indirectly. And here also the hexane vapour is condensed and recirculated. The residual oil content in the meal after desolventizing should be around or preferably less than 1%.

In this way, extra oil is obtained from oilcakes, and the meal made more suitable for animal feed after blending it with other feed stuffs in various recipes.

2.3 BAKED FOOD PRODUCTS

Because of its gluten content, wheat is prefered for breadmaking. The basic operations of breadmaking are flour sifting, dough mixing (mixing of the flour, water, salt, sugar and other ingredients), fermenting, dividing, rolling, proofing and high temperature (250-300°C) baking. The addition of improvers such as ascorbic acid improves the bread quality (volume, crust, tenderness, etc.), while calcium propionate increases the shelf-life.

There are various kinds of breads with their own characterstic recipes and baking procedures. Some of them are: Whole wheat bread, Italian bread (Grissini, Rosette), French bread, Italian toast bread, etc.

Different recipes are also used for biscuits, depending on the type and kind desired. Pressure rolls are used for sheeting the dough,

but no proofing is necessary in this case. Galleta is prepared similarly, except that little cream and less sugar are used. But this has its own technique.

Composite flour (20% maize and 80% wheat flour) is used for making bread, but the bread so far, has little success in the market. Recently 10% maize with 90% wheat flour is being tried.

2.4 EXTRUDED FOOD PRODUCTS

Pasta and macaroni are extruded, i.e., the wheat dough is forced to pass through dies, cut into sizes and passed into: Pre-dryer (shaker); Dryer; Cooler and Conveyance stages. Semolina is most suitable for extruded food production.

The process takes 20-48 hours, depending on the system of technology. The purpose is to achieve uniform rate of cooling through the cross-section. The gallery should be completely insulated from the surrounding atmosphere with the inside temperature and humidity rendered regulable. Egg slurry and milk, as well as other flavourants can be added on the dough mixing unit. The length of a pasta line can vary between 50-100 metres. The production hall must have a well-controlled atomsphere.

2.5 BABY FOOD

The Faffa Foods Plant is the only one of its kind in the country. Its process is simply blending different types of flour (wheat, chick peas, soyabean, field beans, sugar, salt, vitamins, minerals, etc.), in well established proportions. There are pre-cleaning, cleaning, grinding, sifting, grading, and storing bins. There are also accurately dozing machine mixers, weighers and packaging lines. Pre-cooked food is also prepared using rotary cookers.

The recipes are developed using locally available food-stuffs with the exceptions of vitamins and minerals. Local organizations like The Ethiopian Nutrition Institute (ENI) have played a considerable role in the development of many of these products.

2.6 SPICE EXTRACTION

The processing techniques of Oleo-resins from red-pepper is pretty much the same as the solvent extraction process on oilcakes. The solvents are hexane and methanol. The spent (the residue of red-pepper after extraction) is further treated with high heat pepper mix and this can render the spent edible. The oleo-resin has good demand in the world market. The machinery employed are: dryers, pulverizers, extractor, distillation units, refinery equipments, vacuum system and heat economizers. Because of a recent achievement, it is now possible to separate the paprika from the oleo-resin capsicum.

3. THE ESTABLISHMENT OF A FOOD RESEARCH AND DEVELOPMENT CENTER

As pointed out earlier, the food processing sector in Ethiopia in general and that of EFC in particular is at a very low level of development. The product range is limited. It is stream-lined along with the European system of food preparation. Even this mimicry is done badly. There is very little attempt to subject traditional food items to modern production techniques, which is the unmistakable sign of underdevelopment. Many of the products are also of inferior quality, and in many instances are produced in unhygienic circumstances. The utilization of available resources optimally is not given enough attention, and the performance so far is low.

3.1 PROBLEMS FACING EFC

While EFC has indeed shown serious attempts to modernize its old factories and, in parallel, launching and implementing programs of new investment, the scope of activities and the standards of its operations are far from edequate. It lacks the support of an indigenous scientific and technological base, which will enable to broac the frontiers of its objectives and to create new ways for the improvement of current operations and for diversification of products. Some of the opportunities that can be tapped and the problems seeking solution are outlined in the following paragraphs.

(1) EFC's operations are focused on limited range of products, and lack the food varieties which are required by consumers in their ordinary dietary behaviour. As a result, consumers continue to depend mainly on home-made foods that are prepared using traditional and local technology.

(2) EFC's cereal food products are mainly wheat based, and the raw materials are being largely imported as there is not enough local production to support existing operations. Conversely, there are other types of cereals, as well as pulses, which can be considered as alternative raw materials.

(3) The quality of most of the products is not satisfactory enough. The production processes need be controlled with the goal of achieving good quality at lower costs of production.

(4) There are not enough number of food technologists or specialists in the food processing industry, due to lack of appropriate training programs in the country.

(5) EFC is still mainly a buyer of foreign food technologies, with little being done to build an indigenous scientific and technological base within the food sub-sector.

(6) Strong workshop facilities and engineering capabilities are not generally available within and outside the sub-sector, and the imported processing machinery and equipment lack proper maintenance.

While the foregoing briefly introduces the general environment under which EFC manuvers itself, the establishment of a Food Research and Development Center is considered as an ideal approach to overcome not only the existing and identified problems, but also those which may arise due to the fast changing and dynamic nature of modern technology. Accordingly, EFC has taken up the initiative to establish such a Center, and this is fitting as EFC is a focal point of development in the food industry of the country.

3.2 OBJECTIVES OF THE FRDC

The objectives of the Center are set as follows:

(1) Undertake food research works to develop new products, improve existing products or processes and adapt technologies and foods developed in other parts of the world.

(2) Prepare production engineering designs to promote industrial production research of results of new foods, improvements on existing products and adopted technologies.

(3) Administer and provide training on food technology, food chemistry, food engineering, plant maintenance and operation for food processing enterprises.

(4) Provide maintenance services on food machinery and equipments requiring special facilities and high level of skill.

(5) Serve as depository of information related to food and associated technologies, and disseminate same to the factories of EFC and other parties that wish to make use of it beneficially.

(6) Provide advisory services on the transfer of food technology.

(7) Perform all other activities contributing to the status of the professional authority of the center.

With the mentioned main objectives as the focal points, a proposal to establish a Food Research and Development Center (FRDC) was submitted to the Ministry of Industry by the middle of (1986 G.C.) 1979 E.C. The Ministry has approved the request and EFC has commenced to establish the Center since then.

Primarily, the senior technical staffs of EFC selected from factories and the head office, made surveys on the capabilities of factories within EFC, and local Institutes like the Addis Ababa University (AAU), Alemaya University, Institute of Agricultural Research (IAR), and the Ethiopian Nutrition Institute (ENI), to assess their activities and potentials regarding research and development. The survey reports were compiled at the moment.

The acquisition of some facilities for the Center has started from its very inception. Classroom equipments, such as, armchairs, tables and drawing tables were ordered to be constructed. An authomatic copier together with a binder were purchased. Workshop equipments, such as, rolling machine, a binding machine and a shearing machine were also bought. The action plan for (1987/88 G.C.) 1980 E.C. was also set.

The Center has been performing a wide range of activities in (1987/88 G.C.) 1980 E.C. The results achieved and problems encountered during this period are discussed in the following section.

4. THE PERFORMANCE OF FRDC IN (1987/88 G.C.) 1980 E.C.

The Ministry of Industry has launched a program to conduct science and technology projects, since the (1987/88 G.C.) 1980 E.C. The Ethiopian Food Corporation has also started to prepare and implement such projects starting from the said budget year. The Food Research and Development Center of EFC, at the moment deals with the preparation, follow-up and implementation of the science and technology projects undertaken by EFC. The projects to be implemented in the (1987/88 G.C.) 1980 E.C. were divided into five main groups, and they are:

- 8 Projects on Research and Development
- 5 Projects on Technological Information
- 3 Projects on Training of Technologies
- 1 Project for Establishing FRDC

The performance of the Center in (1987/88 G.C.) 1980 E.C. in the execution of these projects and the problems encountered are given as follows.

4.1 PROJECTS ON RESEARCH AND DEVELOPMENT

In the (1987/88 G.C.) 1980 E.C. budget year , 8 projects on Research and Development were planned to be implemented. The research ideas arose, either from existing problems in the operation of EFC plants, or from the substitution of some imported materials by their local equivalents.

4.1.1 HYDROGENATION OF NIGERSEED OIL

Nigerseed is indigenous to Ethiopia and grows only in very few countries like India, and is not well known in other parts of the world. Thus, the taxonomy, extraction of oil and its derivative products are not well investigated. It is with this in mind and the marketing problems of nigerseed oil produced in Bahir Dar Edible Oil Factory that, FRDC started to study the hydrogenation of nigerseed oil.

Primarily, relevant informations were collected from abroad and local resources and the oil was obtained. After setting the necessary processing conditions, the test was conducted in Asmara National Oil Industry, and the hydrogenation of nigerseed oil was accomplished successfully. The rate of hydrogenation was compared to that of cottonseed oil, and it is found out that, the consumption of hydrogen is slightly more in the case of nigerseed oil. The baking effect of the shortening is also found to be quite good.

Further studies on the selective hydrogenation of nigerseed oil are planned to take place in the (1988/89 G.C.) 1981 E.C.

4.1.2. UTILITY OF RAPESEED MEAL

The presence of the toxic compound known as 'GLUCOSINOLATES' in rapeseed extracted meal is a major hindrance for its use as cattle-feed. The level of glucosinolates in Ethiopian varieties of rapeseed

is not yet fully known, and thus, the appropriate proportion of the meal to be given for cattle feeding is not determined. Because of this problem, the solvent extraction plant at Modjo has a very chronic problem for the disposal of the extracted rapeseed meal. To find alternate uses for the meal, studies are being conducted to utilize it as fuel for domestic purposes, and as a soil improving fertilizer.

(a) Fuel: The combustibility of the meal has been ascertained by mixing it with various other combustible substances. And, the t[illegible] to produce the meal in the form of briquettes has also be[illegible] successful. Tests on the calorific value of the meal, have also shown it to have values within the range of some common domestic fuels. Further tests to detect the presence of toxic gases in the smoke of rapeseed meal are being conducted. This is done by chemical analysis of the smoke and by subjecting experimental mice to the smoke.

According to the chemical analysis performed on the smoke of rapemeal fuel, the presence of hydrogen sulfide (H_2S) is confirmed. The other hypothesis was, the presence of cyanide $(CN)^-$, and thiocyanide $(SCN)^-$, but these gases have not yet been detected.

Discussion was held with the energy committee of The Ministry of Mines and Energy, on the use of rapemeal, as an ingredient of the fuel planned to be produced from different

'wastes'. Another important discussion was also held with the Inspection Department of The Ministry of Labour and Social Affaris on the reduction of toxic gas hazards in the working areas.

(b) Fertilizer: In collaboration with IAR (Institute of Agricultural Research), the meal is being tested for its soil improving qualities on different plots. From literature survey and tests conducted, the N_2 content of the meal is 6-9%, and there is information that the Japanese are using it as a soil improver, and also that it is widely used in China and India. Some aspects of its use as a fertilizer are still under study, like:

- the economical aspect: how much of it can be used per hectare?
- how much nitrogen will be available from the meal to the soil?
- how soon will the N_2 be released from it? etc.

4.1.3. TESTS ON LOCAL BLEACHING EARTH

The research on native bentonites and diatomites as bleaching agents for edible oils, is to find out naturally active clays. To be active, a clay should have specific physical and chemical properties.

The local and naturally occuring bentonites and diatomites were collected in collaboration with The Ministry of Mines and Energy. Some of the physical properties of the samples were determined, and they were tested for their bleaching activity, on different kinds of oils with different colours. The results of the tests indicated the local clays to be as good as the imported ones, if they are activated. For the determination of their detailed chemical properties, and to perform other required tests some essential apparatuses are ordered from abroad.

4.1.4. RESEARCH PROJECTS IN FAFFA FOODS FACTORY

At the Faffa Foods Factory, 4 research and development projects have been started.

(a) Shelf-Life study On Cerifam: This study focuses on the determination of the rate of deterioration of the pre-cooked baby food known as 'Cerifam', upon long and inappropriate storage conditions. The study is still going on and is done by placing samples in various Localities and checking for any deterioration.

(b) Cerifam from Wheat-Maize Mixture: The objective of this study is, to produce a new type of pre-cooked baby food from a mixture of wheat and maize. The project is in the preparatory stage.

(c) Banana-flavoured Cerifam: The objective of this project is also, to produce a new-cooked baby food, which has the flavour of banana. The first trial of the product has not been successful, and studies are being conducted for further improvements.

(d) Sorghum FAFFA Project :- The objective of this project is, to prepare the baby food known as 'FAFFA' from Sorghum. The project has started in 1974 (1981/82 G.C.) and has been completed, and now it is at the market-study level.

4.1.5 DETERMINATION OF THE LEVEL OF GOSSYPOL AND AFLATOXIN IN COTTONSEED OIL AND MEAL

This project is being conducted in the Chemistry Department of AAU, in accordance with the co-operation program between AAU and MOI. According to the terms of agreement reached between EFC and the Chief Investigator, Dr. Ermias Dagne of AAU, Chemistry Department, the preliminary report on the status of the project is submitted. Gossypol is reported to be found in the cottonseed, the expeller cake and the crude oil, but it is not detected in the refined oil. More samples are given to be tested, and it is expected that the study will be concluded in the very near future.

4.2 PROJECTS ON TECHNOLOGICAL INFORMATION

One of the projects planned to e implemented in 1980 E.C. was the collection of informations on spices. A good deal of information gathering was done on various spices.

A group of specialists have made a tour to spice growing localities in South and South-West Ethiopia. The group has gathered such important informations as the types of spices grown and, the quantity, quality, yield, etc., of the spices. Laboratory analyses on the composition of the spices was also conducted at the Ethiopian Spice Extraction Factory, on spice samples collected by the study group. The result has been quite rewarding. Detailed study on a couple of spices is planned for (1988/89 G.C.) 1981 E.C.

4.3. PROJECTS ON THE TRAINING OF TECHNOLOGISTS

As is well known, machinery, men and materials, or the so-called "3M", are the major factors responsible for the output and quality of products in any manufacturing process. To get an increase in production, or improvements in quality, one, two or all of the three factors must be changed in someway. Of the three factors, FRDC is now actively engaged in upgrading the skills of the senior staff, supervisors and production workers in the plants within EFC, by conducting thraining programmes.

The Center has plans to conduct training programs for senior technical and production personnel in edible oil processing, flour milling, and baked food products sectors. The senior staff includes such plant personnel as production and technic managers, engineers, chemists, quality controllers and supervisors. The medium and lower level production workers are then to be trained by the senior staff within each plant, with the assistance of FRDC.

The 1st training program was conducted in edible oil technology, in which 44 senior technic and production personnel from all edible oil factories within EFCOR were trained in three consecutive rounds. Various literatures on the technology, chemistry, process techniques, quality control, etc., of edible oils were prepared and distributed to each training participant. The main topics included in this training program were:

- Storage and handling of oilseeds and products.
- Preparation, extraction and refining methods
- Quality control and quality improvement methods
- Minimization of losses during processing
- Proper recording and reporting methods
- Training methods, and communication techniques.

Though it is too soon, to say that, the training program is a success or a failure, there are many indications, that some of the points emphasized during the training sessions are being put into practice. The relations between production and quality control

are progressing. The significance given to quality control of products is improving and its role increasing. Recording and reporting methods are being established, changed or improved. The avoidance or minimization of losses, by controlling the production processes is being given serious attention.

Two good examples are, Teramaj and Modjo Edible Oil Factories. In these factories the senior staff after returning from the training in FRDC, have prepared and conducted trainings for the medium and lower level production workers within their own factories. In Teramaj, they have even prepared a manuscript in Amharic, to be used as a reference by their trainees.

The other training program that is being conducted is that on baked food production technology. 15 senior personnel from bakeries within EFC have participated in the first training session. In this case also, various literatures on the technology, processing and quality control of baking were prepared and distributed.

The main topics included in this training program are:

- Origin and storage of flour.
- Chemical improvers and natural aging of flour.
- Common ingredients of bakery products and their functions.
- Principles of dough and bread making and processing.

- Baking machinery and equipments.
- Quality control, recording and reporting methods.
- Training methods, and communication techniques.

The second group of trainees on baked food products will be trained shortly. Preparations to conduct trainings on the process of flour milling are also underway.

4.4 ESTABLISHMENT OF FRDC

More than 18,000 m^2 of land, where the Center is to be established has been acquired, and the fencing of the land has started. Preparations to begin the design of the civil work for the Center are underway.

Apart from the projects discussed in the preceeding sections, the Center has also started to create contacts with various local research establishments, such as, the AAU, IAR and the ENI. It is also being attempted to establish contact with some foreign research institutions, and reknown personalities.

4.5 PROBLEMS ENCOUNTERED

Even though the Center has tried to accomplish the above stated tasks, its performance cannot be said is very satisfactory. This, of course, is not as bad as it seems to be. Because, this is

the first time for such activities to be attempted, and the many problems that cropped up while executing the programs. The major problems that were encountered while implementing are:

(a) The general lack of experience and co-ordination in implementing research and development activities.

(b) The inadequate number of skilled and professionally competent manpower for the execution of the programs. Many of the engineers and science graduates within EFC are, those that are trained in general engineering and science subjects, with no specialized trainings. The purpose of the training programs is, of course, to change this.

(c) The project leaders of research and development programs in factories within EFC perform their research and development assignments in addition to their daily routine. This has proved to be a major hindrance to the timely progress of the work.

(d) Lack of facilities to perform laboratory tests, and carry out pilot projects.

(e) The personnel to run the activities of FRDC were assigned quite lately and are few in number, and the Center is not yet sufficiently provided with required facilities.

5. THE POTENTIAL ROLE OF FRDC

The potential role of FRDC in developing an indigenous scientific and technological capability within the food subsector is visualized to adhere to the following main points.

(1) To initiate a program of self-reliance, FRDC has already started studying the technological and maintenance capability of EFC by organizing a committee of experienced engineers, with the goal of designing and manufacturing of some components and simple machinery within the sub-sector.

(2) FRDC will have close contact with the scientists and researchers in the agricultural sector, to improve the quality, variety, yield, nutritional aspects and other desirable characterstics of agricultural commodities, such as, cereals and oilseeds.

(3) Manpower of acceptable quality and quantity is an essential component of the technological development process. Bearing this in mind, FRDC will train the production personnel, quality controllers, supervisors, technicans, etc., of the factories and will keep them upto-date by supplying them with recent technological informations in the food sub-sector.

(4) FRDC will spearhead studies and researches on the ways to produce traditional foods by modern techniques.

(5) FRDC will play major roles in the adaptation of foreign-food habits, and in the choice of transferring technologies within the food sub-sector.

(6) The present habits of food preparation of Ethiopians are primitive, labourious and time-consuming. FRDC will conduct studies for better and simple ways to prepare food. Studies on the preparation of pre-cooked and fast foods will be given serious attention.

(7) EFC's range of products is limited and few in number. FRDC will conduct studies on the diversification of products, either by adopting them from other countries, or developing traditional foods.

(8) FRDC will institute and implement programs for the development of professional and competent manpower in the specialized fields of food processing.

(9) The FRDC will work on the techno-economics of bye-products utilization from different manufacturing lines.

(13) FRDC will collect, document and distribute information for researchers and food technologists. It will establish a library of publications dealing with food sciences, food engineering, and related topics. It will also establish an information and data bank.

6. CONCLUSION

The FRDC is expected to play a vital role in the food sub-sector. It will pioneer, set pace and indicate new activities. It will also advise methods to improve the older and traditional techniques. The Center will play a particularly prominent role with regard to the development of indigneous scientific and technological capabilities.

The developing of science and technology within the food sub-sector is a very vast and highly intricate task. The selection of priorities, and the setting of clear goals and future paths of development for the Center are of prime importance. For this, the experiences of similar institutions in other countries, and the assistance of experts from relevant sources would be highly helpful. The conducting of a study to determine the potential role of R & D in the food sub-sector, and the setting of the immediate and future activities of the Center seems to be timely.

A far-reaching and profound scientific and technological undertaking can be accomplished successfully only by specialists in that respective field of activity. And because of this, to develop and institute a sound and reliable scientific and technological system within the food sub-sector in Ethiopia, the development of manpower should be given the utmost attention. The training and specialization of the future scientists and technolcgists of the research Center should be started urgently.

In the previous sections, the accomplishments, problems, role, etc., of the FRDC have been outlined briefly. FRDC will follow a similar course of line for sometime, and the main activities the Center will focus at, are summarized as follows.

(a) Establishment of the Center:- This task includes the designing and building of facilities of the Center, such as, office, laboratories, classrooms, workshops, etc.

(b) Follow-up and Implementation of S & T Projects:- The Center will continue with the preparation, follow-up and implementation of S & T projects within EFC, until its own research facilities are readied.

(c) Training of Manpower:- This activity has already been started by training the senior production and technic personnel in oil milling plants and bakeries. Next, training programs are being planned to take place for the personnel at the supervisory and operation level. 2 oil milling plants at modjo and Termaj have already conducted trainings for their supervisory staff.