COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
(CSIR)

FOOD RESEARCH INSTITUTE (FRI)

2001 ANNUAL REPORT

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EXECUTIVE SUMMARY

The Council for Scientific and Industrial Research of which the Food Research Institute is one of the affiliate institutes is striving to become a Centre of Excellence in R&D by generating appropriate technologies that are responsive to demands of the Private Sector and socio-economic development. The mission of Corporate CSIR is to generate and apply innovative technologies, which efficiently and effectively exploit S&T for socio-economic development in critical areas of agriculture, industry, health and the environment and improve scientific culture of the civil society. Technologies developed will be commercialised for Private Sector Development in Ghana and abroad

The Food Research Institute's vision is to be recognised, nationally and internationally, as an S&T Institution that is playing a key role in the transformation of the food processing industry to be internationally competitive with particular reference to product safety, quality and presentation. The FRI's mission is primarily, to conduct market oriented applied research and provides technical services and products profitably to the Private Sector and other stakeholders. The overall goal of the Institute is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within the micro, small, medium and large scale food industry; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

In line with its mandate, the main programmes of the Institute during the year were centred on R&D activities for the solution of postharvest problems. Most of the research activities were on-going projects with a sizable percentage being linked to PhD programmes. Most of the projects were donor funded and almost all the projects were on schedule. The FRI was charge with the responsibility of coordinating the agro-processing aspect of the Agricultural Sub-Sector Improvement Project. Nine projects were approved under the agro-processing programme.

Activities aimed at getting microbiology, mycotoxin and chemistry laboratories of the Institute accredited under ISO 17025 Quality System continued with the appointment of a Quality Manager.

The Business Development and Information Division was renamed the Commercialisation and Information Division (CID) to reflect the Division's proper role and functions. The Commercialisation process of the Institute continued and the following areas were the major sources of income:

- Consultancies
- Collaborative Research
- Equipment fabrication & Hire of Facilities
- Sale of Research By-Products
- Technical and Analytical Services
- Training

The year under review saw Training Programmes becoming an important source of income. However Analytical and Technical services was still the major source of income. The percentage of Internally Generated Fund (IGF) as percentage of subvention was 4.4%. Although Collaborative Research does not directly contribute to the calculated IGF it was the mainstay of the Institute and was 45.96% of subvention.

The year under review so the appointment of Dr. Wisdom Annorsey Plahar as the Director of the Institute. The total staff strength at the end of the year stood at 174. Several promotions were announced for all categories of staff. Ten research grade staff were employed to various positions.

The Institute played host to a number of high level visitors: They include Professor D. K Fobih, Minister of Environment Science and Technology; Dr. Andrew Graffham, Mr. Keith Tomlins, Tony Swetton, Lynda Hammonds, Chris Collision all of the NRI, UK. Dr. Peter Moller of KVL, Klotoe Agossou, Fred Kruit and Savi Adolphe all of PTAA/INRAB, Benin among several others.

PART I - GENERAL MATTERS

Chapter 1

ADMINISTRATION DIVISION

1.1 Introduction

The Administration Division continued with it support services to the institute under the constraints of limited staff and lack of some basic office equipment.

1.2 Staff Strength

The staff strength of the Institute stood as follows:

Research staff	-	39
Senior staff	-	42
Junior staff	-	93
Total	-	**174**

1.3 Appointments

The year under review so the appointment of Dr. Wisdom Annorsey Plahar as the Director of the Institute. Dr. Plahar was born on June 15, 1949 at Big Ada, Ghana. He is married with two children. Dr. Plahar holds the BSc (General), BSc (Hons) and MSc degrees from the University of Ghana and the PhD from the Washington State University. He is a *Chief Research Scientist* (a full Professorial Grade). He was employed as *Assistant Research Scientist* in August 1975, promoted to *Research Scientist* in August 1976, then to *Senior Research Scientist* in October 1983, to *Principal Research Scientist* in October 1988 and to *Chief Research Scientist* in October 1996. Dr. Plahar had been the Deputy Director of the Institute since 1993; Member: FRI Management Board since 1984; Head of Food Chemistry Division and member, National Committee on Soybean Production and Utilization in Ghana. His research field of interest are:

- Applied Research on the problems of Grain Legumes storage, processing and utilization with emphasis on the physicochemical, nutritional and sensory aspects.
- Development of high Protein-Energy foods and weaning foods through fortification of cereal products with plant protein sources.
- Assessment and upgrading of traditional processing techniques for improved nutrient quality.
- Consultancy and advisory services for the food processing industries.

He has over hundred (100) scientific publications to his credit

There were several other appointments including four Research Scientists, a Junior Assistant Librarian, five Assistant Research Scientists and a Senior Clerk. Please see appendix for details. Mrs. K. Kpodo was appointed to the temporary Headship of the CID.

1.4 Promotions

The promotion of Dr. W. Amoa-Awua to Principal Research Scientist was announced to take retrospective effect from 1st March 1998. The announcements of several promotions were also made to take effect from 1st January 2001. See appendix for details. Mrs. Charlotte Oduro-Yeboah and Mrs. Patience Larweh were confirmed as Assistant Research Scientists.

1.5 Termination

The appointment of Mr. Mustapha Kraku was terminated for gross insubordination. His termination took effect from 1st December 2001.

1.6 Retirement

The following Staff retired in the year under review
Mr. Nathan Addo Asare; Mr. Awudu Guo; Mr. Yobo Dagarti

1.7 Transfers

Mrs. Angela Addy was transferred from FORIG to FRI. Mr. M. A. Amenu was transferred to the Animal Research Institute. Mrs. A. Osei-Yaw was also temporarily transferred from FRI to the CSIR Secretariat. Mr. J. Mintah was also transferred from the Plant Genetic Resources Centre to FRI to replace Mr. Amenu

1.8 Resignations

The following members of staff resigned from the Institute for personal reasons:
Ms. Vivian Doh; Mr. Humphrey Anansah; Mr. Nash Appiah; Mr. Dieu Donne Ocloo; Ms. Joyce Owusu-Bennoah

1.9. Miscellaneous

- An entrepreneur in the person of Ms. Felicia Akita started operating canteen services for the staff at the Okponglo site. The restaurant goes by the name "Scallop Foods"
- Two of the Staff i.e. Miss Faustina Somuah and Miss Joyce Owusu-Bennoah got married.
- Two ex-employees of this Institute i.e., Dr J. Dei-Tutu, Principal Research Scientist and Mr. S. K. Nkansah, Chief Stores Superintendent passed away

PART II – DIVISIONAL REPORTS

Chapter-2

COMMERCIAL AND INFORMATION DIVISION

2.1 Introduction

The Commercial and Information Division (CID) formerly known as the Business Development and Information Division (BDID) continued its basic task of coordination of the commercial activities of all the other divisions in the Institute in order to raise income for the Institute. Generally, for the year under review, a greater awareness and sense of responsibility was generated in staff members concerning the objective of raising a certain percentage of our financial needs internally.

2.2 Staff Strength

By the end of the year 2001, the staff strength of the division stood at 15. The Clients Service Unit has 5 members of staff, Food Economics and Utilization Unit 7, Information and Publications 2 and 1 driver.

2.3 Staff Transfers & Movements

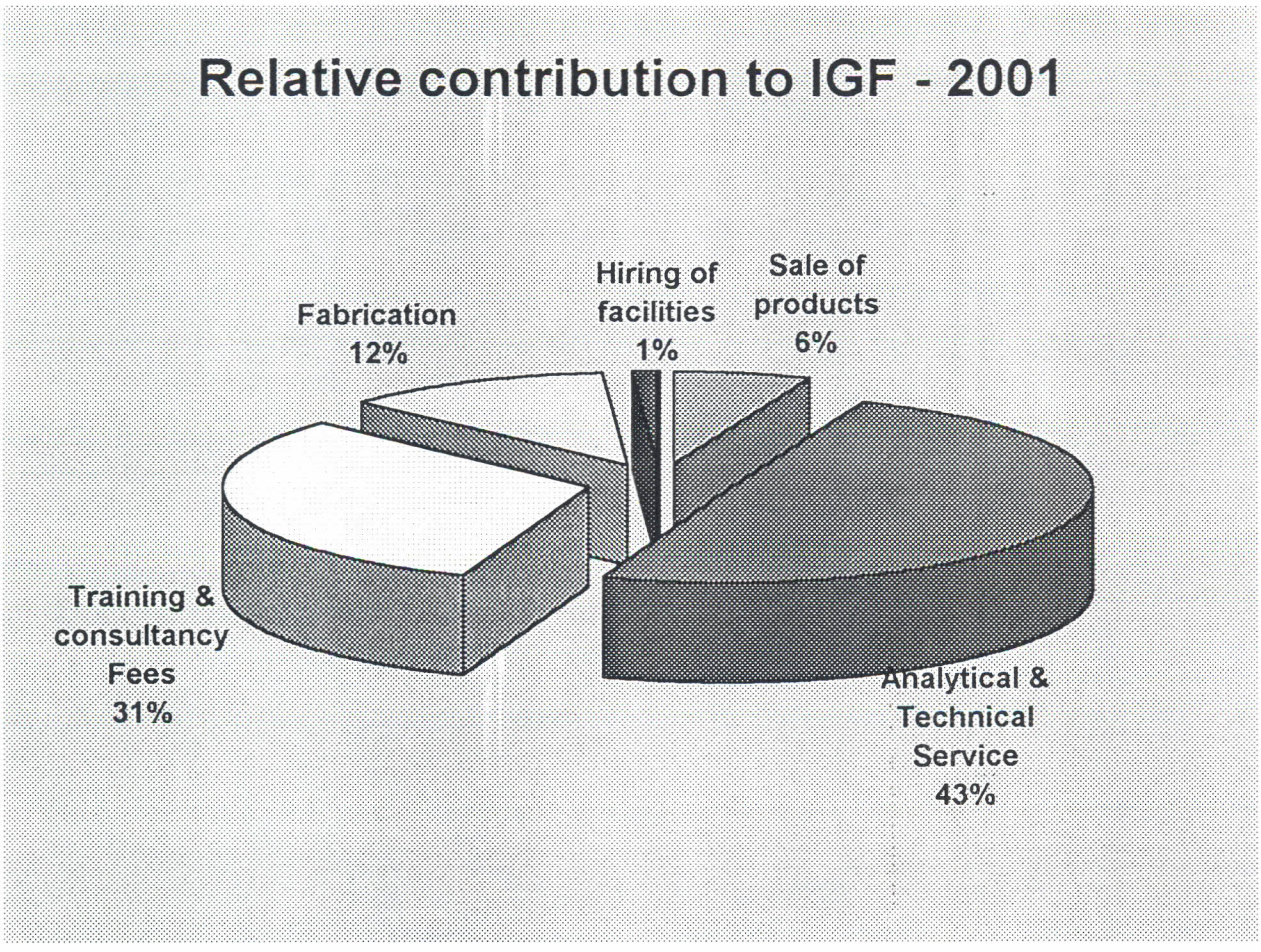
For the year under review, 2 new staff were employed to the Division, namely Mrs. Emelia Clement and Ms. Vivian Doe; however Ms Doe resigned before the end of the year. Ms. Joana Dzikunu was also moved from the Administration to join the Clients Service Unit of the Division. The substantive Head of the Division Mrs. Osei Yaw, was transferred to the central CID at the Head Office to facilitate work going on there. Mrs. Wilhelmina Quaye returned from school after successful completion of her MPhil programme in Agric Economics. Mrs. Phoebe Lokko is still on study leave.

2.4 Commercial Services

The main commercial activities carried out for clients included analysis of samples, training and transfer of technology, use of Institute facilities and sale of research by-products. A total number of 154 clients were attended to in the year 2001. Analytical Services continued to form the bulk of services rendered. For the year 2001, the Institute received 1700 samples for analysis. Total charges for these analyses were **¢182,253,955.00**. It must be noted that this figure represents charges made and not actual income realized.

The Institute carried out 6 training programmes for the year under review. These were training in:

- Sensory Evaluation and Analysis at Cocoa Processing Co. Ltd.
- Processing and Preservation of Fruits and Vegetables
- Mushroom Cultivation
- Processing and Preservation of Spices
- Laboratory analyses for students of the University of Development Studies and Accra Polytechnic.



The total amount earned under collaborative research was as follows: **$87,145.64** and **£30,603.75**. This amounted to 45.96 % of total Government Subvention.

Chapter – 3
FOOD CHEMISTRY DIVISION

3.1 Introduction

The Food Chemistry Division consists of the Industrial Service and Mycotoxins Units. Apart from carrying out research projects it provided analytical services and quality control jobs to government and non-governmental organizations.

3.2 Industrial Service Unit

During the year, 363 samples of food commodities were analysed. These were identified as cocoa butter, chocolate products, cookies, fish meal, biscuits, alcoholic drinks, spices, maize, cowpea, palm kernel cake, sesame seed, ice cream, ginger wine, cassava chips, salad oil, poultry feed, agushie, sheanut, oyster shell, among others. The clients were UNHCR, Cocoa Processing Co., Technoserve, Pioneer Food Cannery, GHABICO, Food and Drugs Board, Edoil Co. Ltd., Elsa Foods Ltd., Macbells Co. Ltd., Vincom Processing Ltd., First Love Enterprise, Fairbon Biscuits Ltd., Crop Science Department, University of Ghana, West African Mills Co. Ltd., Ghana Inspection Ltd., among others.

3.3 Mycotoxins Unit

During the year 25 samples of food commodities were analysed for aflatoxin. These consisted of maize, peanut paste, coffee, fish meal, groundnut cake, Jasmine Rice, agushie and perfumed rice. The clients were Food and Drugs Board, Edoil Co. Ltd., Saagar Impex, Agrotropics Ltd., Owuchi Co., University of Cape Coast, Gablin Ltd., and Korankye Farms Ltd. Quality Food Processing Co. Ltd.

3.4 Research Study

A research study on the mycoflora and aflatoxin contents of millet on sale in markets in the Greater Accra Region was initiated.

3.5 Accreditation Programme

During the year, the Industrial Service and Mycotoxin Units were considered for accreditation stati under the accreditation body, Alfred Jorgenson Laboratory (AJL) from Denmark. In preparation for tl accreditation exercise the Laboratories were cleaned up and renovated. In February 2001, personn from AJL held a meeting with staff and inspected the Laboratories. A document on Methods Chemical Analysis involving the parameters for which accreditation was sought was presented to AJ Accreditation Programme Committee meetings were held once weekly to discuss the preparation

manuals. Staff of the Chemistry Division participated in seminars on the Accreditation Programme held on the 16th and 25th May 2001.

3.6 Analysis For High Court Case

Between October and November 2001 the Chemistry Division was invited by the High Court to analyse two samples of cocoa based products. The final report was entitled 'Report on analysis Power Chocolate and Slim Chocolate produced by Body Sense Foods Ltd.'

3.7 Supply of Equipment

In March 2001, glassware worth 17.8 million cedis was purchased for the Laboratory by management. A refrigerator was also purchased for the Laboratory in May 2001.

3.8 Staff Training

Messrs. E. Allotey, W. Amevor and N. Amey, were trained in the use of computer at the CSIR Secretariat from April 2 – 13, 2001.

3.9 Recruitment

Mr. G. Anyebuno joined the Mycotoxins Unit as a Research Scientist in February 2001.

3.8 Training Programme

The period marked the highest activity throughout the year of training of students drawn from five tertiary institutions in the country i.e. from University of Ghana, University of Cape Coast, Kwame Nkrumah University of Science and Technology, the University of Development Studies and Accra Polytechnic. The training activity promoted the commercialisation programme of the institute. The first course on food analysis was organized for 54 Science Laboratory Technology students from Accra Polytechnic between 22nd February and 1st March, this continued in June 2001. During March 2001, 20 students from the Department of Community Nutrition of the University of Development Studies, Tamale, were trained on Food analysis. In September 2001, ten students from this group continued with the training. In May 2001, 4 students from Accra Polytechnic carried out their project work in the Chemistry Laboratory. One student from the University of Cape Coast also did his research in the Mycotoxin Laboratory. Between June and September 2001, one student from the University of Ghana, 4 Biochemistry students from KNUST and 4 Science Laboratory Technology students from Accra Polytechnic underwent 8 weeks practical training courses. In November 2001, a graduate from the University of Ghana started his National Service with the Division. A student from Accra Polytechnic also reported for vacation training during the same period.

Chapter - 4

FOOD MICROBIOLOGY DIVISION

4.1 Introduction

The Division continued with its task of providing analytical support to both research and industry. Research activities during the year included studies on food fermentation and mushroom cultivation. Activities aimed at getting the laboratories of Division accredited under ISO 17025 Quality System continued with the appointment of a Quality Manager.

4.2 Staff

During the year under review, two Research Scientists were employed. The staff strength of the Division now stands at 12 and it is made up of one Principal Research Scientist, one Senior Research Scientist and Five Research Scientists in the research grade. The others are technical grade staff.

4.3 Industrial Unit

During the year, a total number of 1,312 samples were received for quality assessment and safety analysis.

4.4 Mushroom Research Unit

Training programmes were conducted to popularise the mushroom technology and the consumption of mushrooms. The reactivation of cultures in the National Mycelium Bank continued.

4.5 New Laboratory

The Division started work on establishing a molecular Biology Laboratory to accommodate all work carried out in the Division in the area of molecular biology involving PCR, Pulse Field Gel Electrophoresis, etc

4.5 Research Activities

The main research activity of the division is the *Capability Building For Research Into Traditional Fermented Food Processing In West Africa.* The project is being funded by DANIDA and it started in 1991. The immensity of the research activities carried out during the course of the year under review formed part of the PhD work of some of the project team members.

4.5.1 PhD Programmes

Mrs. Kafui Kpodo: The study is on *Fusaria* and *Fumonisms* in maize and maize products.

Ms Mary Halm: The overall objective of the programme is to investigate the effect of pH and organic acids on the microbial successions and microbial stability of fermented maize dough (kenkey).

Mrs. Nana Annan: The study is on aroma components in fermented maize meal.

Mrs. Hodari-Okae: The study is on the effect of fortification with soybeans on the microbiological and biochemical changes associated with the fermentation of cassava dough into Agbelima.

Chapter – 5

FOOD PROCESSING AND ENGINEERING DIVISION

5.1 Situation and Movements

5.1.1 Study Leave: Three officers in the division namely Messrs E. C-T Tettey, Nanam Dziedzoave and J .T Manful continued with their PhD programmes at the University of Ghana and the University of Greenwich, UK. Mr. L. D. Abbey (PhD), Mrs. G. Nerquaye-Tetteh (MPhil), and Mr. J. Gayin (MSc.) returned to the Division after completing their respective programmes. Mr. D. Blay returned to the Division after his one-year leave without pay on the 1st of December 2001. Mr. Yeboah of the Engineering Unit requested for a year's leave without pay to attend to some family problems.

5.1.2 New Officers: Three new Scientists of the research grade, Messrs G. Komlaga, D. Abusah and Elvis Baidoo joined the Division in the course of the year.

5.1.3 Visits by FRI Officers: A number of officers of the division undertook research –related visits outside the country during the course of the year.

5.1.4 Sick Colleagues: Two technical staff of the Division, Mr. Akyea of the Engineering Unit and Mr. Christopher Sogbey of the Cassava Processing and Demonstration Unit were absent from work for the greater part of the year because of ill health.

5.1.5 Death: The Division as well as the Institute lost its former head, the late Dr. John Dei-Tutu. May his soul rest in perfect peace.

5.2 Consultancy Service of the Division

The three main units of the Division, Pilot-Scale Production, Cassava Processing and Demonstration and Engineering Units continued to render normal services to the public.

5.2.1 The Pilot-Scale Production:

The Unit rendered services mainly in drying, roasting and milling to the public, in addition to producing items for the Institute's tuck shop. Among commodities dried for clients include Cassava (both chips /slices and fermented dough), fermented, maize, onion, garlic, mushroom, yam, plantain, fruits (pineapple, papaya and mangoes), grated coconut, and cassava starch. Coffee and groundnut were items brought in for roasting. Other items were vegetables and herbs.

For the FRI tuck shop, the following items were produced in the course of the year: 4 bags groundnut paste, 2 mini bags of fermented maize meal and banku mix, 3 mini bags of cocoyam fufu, 8 mini bags of plantain fufu. In addition, 100 tubers of yam were processed into fufu flour.

5.2.2 The Cassava Processing and demonstration Unit:

The Unit continued with its services of producing the various brands of FRI Cassava products.

5.2.3 The Engineering Unit:

During the year under review, the unit continued with its functions of installations of newly acquired machines and equipment, repair and routine maintenance of machines and equipment located at the offices and laboratories at the Broz Tito Avenue compound, the Pilot Plant Complex and the Cassava Processing Demonstration Unit (CPDU) at Pokuase.

❖ *Broz Tito Avenue Compound*

All operational air conditioners located at the Broz Tito Avenue Compound were routinely serviced. Faulty electrical equipment, socket outlet and lighting systems were also repaired. Installation jobs carried out here include the following:

- Air conditioners at the Director's and Administrative Officer's Offices.
- Ceiling fan at the Library.

A major repair job was carried out on the main gate to the compound.

Staff members of the unit undertook the labelling of the Library shelves and some documents, files of newly employed staff and doors at the Pilot Plant for easy identification.

❖ *Pilot plant*

All operational air conditioners at the pilot plant were also routinely serviced. The generating plant, ice flaking machine, slicing machine and the two water tanks at the boiler room were all repaired. The Cowpea Processing Plant at Ohawu was relocated to the pilot plant. This involved the following activities:

- The dismantling of all the units of the plant.
- Transporting the cowpea plant to the pilot plant.
- Rehabilitation and reconditioning of the cowpea plant.
- The installation of the cowpea processing at the dry processing hall of the pilot plant.

- *Cassava Processing Demonstration Unit*

Routine maintenance and repair works were carried out on the processing equipment. A significant achievement chalked at the unit was the rehabilitation of the Awilla dryer and its installation and commissioning.

- *Special Assignments*
  - A 16- million cedis dryer was construed for Reiss and Co. to present to CSIR as part of the equipment supplied to CSIR under Private Sector Development Project.
  - Four sets of Cassava Processing Machines were designed, Constructed and installed at four different locations in the Greater Accra Region. These are Mantsi, Doblo-gono, Brofoyedur and Beposo Nkran.
  - Obsolete machines and equipment were identified and listed out for auctioning.
- *Best worker*

The best worker for the year showed a very good example of dedication, commitment and love for his work. His prize was 50,000 cedis and he was in the person of Mr. Tettey Ablorh.

5.3 Training for Local Food Entrepreneurs

Two training workshops were organized during the course of the year in collaboration with the CID. The first was a 3-day workshop on "*Processing Of Pepper And Ginger For Local Food Exporters.*" This was held from the 11th to the 13th of June, and the second was on a 5-day workshop on "*Processing Of Fruits Into Juices, Drinks And Concentrates For Local Food Processing Entrepreneurs*" from the 16th to 20th of July. Both workshops were to provide some basic information on the underlying principles, methods and techniques involved in the production of desired end- products. Whilst the first workshop, being the second in the series of training in processing of spices for two year running, had 15 participants, the second attracted as many as 35 participants. In both cases people of varied educational backgrounds attended the workshops.

5.4 Visits by Project Collaborators

During the year under review, the division played host to a number of our collaborators on a number of foreign funded projects. They include Dr. Andrew Graffham for the DFID/NRI/FRI Cassava projects, Mr. Keith Tomlins for the Street Food Project, Tony Swetton and Lynda Hammonds for the DFID/NRI/FRI Rice Parboiling Project and Chris Collision the DFID/NRI/FRI Fufu Flour Project.

PART III – RESEARCH ACTIVITIES
Chapter – 7
AGRICULTURAL SUBSECTOR IMPROVEMENT PROJECT

7.1 Introduction

Scientists in the National Agricultural Research Systems (NARS) are undertaking the Agro-processing Programme under the research component of the 1st phase of the Agricultural Subsector Improvement Project. This Agro-processing component is being coordinated by the FRI. Nine projects were approved under the component. None of the projects was initiated during the period under review.

7.2 Goal

To contribute to national efforts at reducing the post-harvest losses at the farm-gates and in the fishing industry, improving food security, improving nutritional security as well as improving the socio-economic status of all Ghanaians and also improve export of non-traditional products to help reduce Ghana's balance of payment.

7.3 Purpose

To reduce post-harvest losses of food staples of Ghana as well as improve the socio-economic development through development and diffusion of appropriate technologies, which will add, value to agricultural and fish produce.

7.4 Technical and sensory evaluation of rice varieties from various improvements programmes in Ghana

7.4.1 Purpose

To improve the local rice industry in Ghana through improvements in the post-production operations and identification of acceptable varieties

7.4.2 Outputs

- Milling, physical, nutritional and parboiling characteristics of released varieties established.
- Sensory evaluation and consumer acceptability of released rice varieties established.

7.5 Improving the hot-air processing of fresh fish using the Chorkor smoker

7.5.1 Purpose

To improve the efficiency of the Chorkor smoker through improvements in the energy and ergonomic characteristics as well as reduction/elimination of the tar usually associated with fish processed by the smoker

7.5.2 Outputs

- The energy and ergonomic efficiencies of the Chorkor smoker improved.
- The tar content of Chorkor-smoked fish reduced.
- Transfer of technology to at least 20 artisanal fish processors

7.6 Studies on the characteristics, development and utilization of food products from groundnuts varieties grown in Ghana.

7.6.1 Purpose

To screen available and newly released varieties of groundnut for the specific uses and thereby help promote its greater uses in Ghana.

7.6.2 Outputs

- The quality and shelf life of groundnut products improved.
- Various forms of utilising groundnut in Ghana documented.

7.7 Improving the post-harvest processing of prawn, shrimps and lobsters to access the export markets.

7.7.1 Purpose

To improve the income earnings of exporters of shellfish from Ghana through improvements in the post-harvest handling and quality assurance systems

7.7.2 Outputs

- The processing and quality of exportable prawns, shrimps and lobsters improved.
- Improved technology for processing of the three commodities for export transferred.

7.8 *Development of diesel/kerosene operated drying machines for food-grains for small- and medium-scale producers.*

7.8.1 Purpose

To alleviate the problems farmers, traders and processors face with the drying of food-grains after harvest through the provision of a low cost, yet effective and appropriate on-farm dryer.

7.8.2 Outputs

- Appropriate drying machine for food-grain industry in Ghana designed, constructed and test-ran.
- Techno-economic assessment on the developed dryer

7.9 *Improvements in the preservation and utilization and promotion of some traditional leafy vegetables to access the urban markets.*

7.9.1 Purpose

To improve the availability and utilisation of micronutrient-rich traditional leafy vegetables through improvements in the post harvest management and cooking methods in order to promote their use in the urban areas of Ghana.

7.9.2 Outputs

- Appropriate technologies for improving the preservation of selected TLVs developed.
- Cooking methods for selected TLVs modified and new recipes developed and transferred.

7.10 *Varietal screening of soybean, bambara and cowpea for anti-nutritional factors and suitability for specific uses.*

7.10.1 Purpose

- To screen all newly released varieties of bambara, cowpea and soybean for their chemical, functional, nutritional and anti-nutritional characteristics.
- To evaluate released varieties of bambara, cowpea and soybean for their processing characteristics and specific food uses.

7.10.2 Outputs

- Detailed quantitative data on compositional, functional and anti-nutritional characteristics of released bambara, cowpea and soybean in Ghana.

- Suitable cultivars of bambara, cowpea and soybean varieties and made available to farmers.
- Effective processing techniques and suitability of bambara, cowpea and soybean cultivars for specific food uses established for the use of legume processors.

7.11 Quality evaluation of fresh pineapples stored under freight environmental conditions.

7.11.1 Purpose

Development of appropriate agronomic, postharvest technologies and freight conditions for sustained pineapple production and export

7.11.2 Outputs

- Appropriate freight conditions for maintenance of good physical, chemical microbiological and sensorial characteristics established and transferred.
- A computer model for fruit quality developed for freighting of pineapple under different conditions developed.
- Fact sheets provided.
- Technology transferred to target groups

7.12 Hot-smoke fumigation of maize against insect and fungal attack

7.12.1 purpose

To reduce the effects of insect and fungal pests associated with storage of maize at the farm-gate through provision of a low-cost but effective alternative insecticide and fungicide.

7.12.2 Outputs

- Smoke fumigation boxes designed and constructed.
- Maize preserved at laboratory level using smoke fumigation boxes technology.
- Smoke fumigation cribs designed, constructed and field-tested.

Chapter – 8
DONOR FUNDED PROJECTS

8.1 Capability Building For Research Into Traditional Fermented Food Processing In West Africa

The project is being funded by DANIDA and it started in 1991. The project has seen several expansions and the current collaborators include:

- Dept. of Dairy & Food Science, Royal Veterinary & Agric. Univ., Copenhagen, Denmark
- Alfred Jorgensen Laboratory Ltd., Copenhagen, Denmark
- Dept. of Food Technology, IRSAT, CNRST, Burkina Faso
- Dept. of Biological Sciences, UDS, Tamale, Ghana
- Dept. de Nutrition et Sciences, Universite de National du Benin (DNSA/FSA)
- Dept. of Nutrition & Food Science, University of Ghana, Legon

8.1.1 Project Objectives:

To strengthen the local capability in research for production of fermented foods; establish scientifically based and controlled processing techniques for traditional fermented foods and create the basis for national biotechnology laboratories

8.1.2 Rationale

The rationale for initiating the project was to develop a national capacity in Ghana to research in great depth into fermented foods such as kenkey, Agbelima and Pito. These foods form a significant proportion of foods consumed in Ghana and yet there was lack of detailed scientific information of the fermentation processes which is necessary for eventual industrialisation of these products

8.1.3 Major Results

- The roles of lactic acid bacteria, yeast & moulds in maize and cassava dough fermentation have been defined.
- The occurrence of mycotoxins in maize and fermented maize products has been established.
- The dominant, lactic acid bacteria and yeast in maize fermentation have been identified, characterised and typed to subspecies level by molecular techniques.
- Obtained sufficient background information on the use of starter cultures for maize fermentation, which will help in selection of strains for starter culture production.
- Twelve (12) publications in international journals, several reports and conference papers have been published under the project

8.1.4 Major Impact

- The capability of FRI has been greatly enhanced and the FRI scientists are playing a leading role in the training and networking activities in African research institutions involved in food fermentation.
- The microbiological and chemical laboratories at FRI are well equipped and have techniques available for fermentation studies, aroma analysis by GC & GC/MS, molecular techniques for identifying and typing of microorganisms, mycotoxin analysis by HPLC.
- The basis for the development of small-scale maize fermentation into industrial scale fermentation has been created.
- A pilot plant for kenkey production has been established for training and demonstration purposes.

The project was extended up to January 2004. The project is currently sponsoring four officers on their various PhD programmes

8.2 Agro Food Enterprise Development Of Cassava Processing

The main activities carried out under the project were the construction of processing units, fabrication and installation of processing machines. Work on the Cassava Processing Plant at Manchie was completed during the year. The project and the Ga District Assembly were jointly funded this. The building was completed and installation of the processing machines begun. Installation of processing machines at Doblo Gono Cassava Processing Plant was also completed. The building at Doblo Gono was constructed by an NGO, "Africa 2000 for the Community". The buildings for the two processing plants at Brofoyedru in the Central Region and Beposo Nkran in the Western Region were also constructed concurrently. These were jointly funded by the project and an NGO "Global Non-Traditional Exporters and Producers Association (Global NTEPA).

8.3 Development And Improvement Of Local Millet Processing Methods And Products

No major research activities were carried out during the year under review. A joint meeting of the West and Central African Sorghum and Millet Research Networks (WCASRN & WCAMRN respectively) was held in Bamako, Mali in April 2001. The objective of this meeting was to discuss a possible merger of the two networks, which are both hosted by ICRISAT. However, this did not materialize, as the sorghum network was not positively

disposed to the merger. A follow up meeting was held by the heads of agricultural research institutions in the sub-region in June in Gabon. A definite decision on the merger was taken and the two networks were instructed to put in place mechanisms to ensure that they merge by July 2002 at the latest. Subsequently, no fresh research activities were commissioned for the coming year. All scientists involved in the network activities were requested to round up current ongoing activities.

8.4 Biological Degradation Of Aflatoxins In Fermented Maize And Sorghum Products

This project is being funded by the European Union and has the following Partners/Collaborators:

- Federal Institute of Industrial Research (FIIRO), Nigeria
- Federal Research Centre for Nutrition, Germany
- Royal Veterinary and Agricultural University, Denmark (KVL)
- University of Stellenbosch, South Africa
- World Association of Industrial and Technological Research Organization (WAITRO)

8.4.1 Major Goal/Overall Objective

To improve the safety of tradition African fermented foods by developing detoxification methods against aflatoxins particularly in maize and sorghum products.

8.4.2 Objectives of the Project

- Identification and collection of cultures of bacteria and yeasts capable of transforming or degrading the aflatoxin molecule.
- Design maize and sorghum fermentations using the identified bacteria and yeasts capable of degrading aflatoxins as starter cultures.
- Development of a routine screening method for monitoring aflatoxin degradation during maize and sorghum steeping and fermentation suitable for use in industrial production sites.

Results of earlier studies conducted under this project identified various organisms capable of reducing aflatoxin B1 in buffer systems. Further experiments by various partners showed that the reduction in aflatoxin levels was due to the aflatoxin molecules binding to the cells. The toxin was therefore not being degraded but being bound and this was not acceptable to the EU. The project was therefore extended for another year and all the partners involved in the project were again tasked to search for an organism or organisms capable of degrading the aflatoxin molecule. During the year under review the following laboratory studies were conducted:

8.4.3 Preparation of cell-free extract of bacterial cultures

A method for producing cell-free extract from various bacteria cultures was developed and fine-tuned. The method involved incubation with agitation of inoculated cultures, centrifugation, washing and disintegration using a French Press. The disintegrated cell suspension was centrifuged and the filtered supernatant used for subsequent experiments.

8.4.4 Degradation of aflatoxin B1 by cell-free extract

The ability of cell-free extracts of four selected organisms to degrade aflatoxin B1 under different incubation times and temperatures was studied. A specific amount of cell-free extract of each organism was added to aflatoxin B1 and the mixture incubated at various temperatures ranging from 10 to 40°C for various lengths of times (1-24 hr). All the four extracts showed very promising results at the temperatures around 30°C. Variations in the levels of degradation of aflatoxin B1 were observed for the various extracts. The best organism showed over 90% degradation of aflatoxin B1 after only 4 hours incubation at 30°C. These results appear to be a break-through and plans are far advanced at the Federal Research Center for Nutrition in Germany with the collaboration of WAITRO for the patenting of these finding.

8.4.5 Further work

All the studies reported above have been conducted in buffer systems. The next stage of work is to repeat these experiments in the solid-state fermentation of maize. This work is currently in progress.

8.5 Improving the Utilization and Commercialisation of Soy Processing Technologies: Micronutrient Enrichment of Soy Products

Darkruby Enterprise, a beneficiary enterprise of a project initiated under the Technology Transfer Grant (TTG) programme of SAFGRAD received collaborative assistance from the Food Research Institute to upgrade its operations for improved product quality and processing efficiency. Samples of soymilk, soyflour and soypowder were analysed from each batch production for nutrient composition, sensory and microbiological quality. The nutritional quality of soy products remained fairly constant throughout the period of assessment. The entrepreneur was able to maintain a low level of anti-nutritional factors indicating adequate heat treatment for processing was being used. Some microbial contamination with coliforms occurred in one batch production, which was effectively eradicated in subsequent productions. This indicated some ability of the entrepreneur to

control points of hazard occurrences in his operations. As part of its final objective the project will establish a HACCP (Hazard Analysis Critical Control Points) system for the processing of soyproducts by Darkruby enterprise. A second progress report has been prepared and submitted.

8.6 Improving the Efficiency of Rural Parboiling Enterprises to Produce Consistently High Quality Rice

Activities under the above project continued in with 48 samples of variably parboiled rice milled and the colour and physical quality determined. Twenty (20) samples of parboiled rice were generated from women in the Northern and Upper East Regions. Storage trials were undertaken on these samples with imported raw milled parboiled samples as checks. These samples were stored at 75% RH in two and four week intervals for moisture, colour, and free fatty acid contents as well as microbiological properties. Sensory evaluation was also carried on these samples in three monthly intervals. It was suspected that nature or quality of water used in parboiling affects the eventual quality of the final product. As a result, samples of water from various sources in the Northern and Upper East regions were taken for chemical and microbiological analyses. Based on the experience gathered in the field, a prototype rice parboiler was developed at Food Research Institute. A laboratory rice-parboiling vessel was also constructed and is available at the Institute. A mid project workshop to took place on 18th July 2001.

8.7 Increasing Sorghum Productivity In Ghana

This project was started in 1999, embracing five West African countries, all within the Sahel. The countries are Burkina Faso, Ghana, Mali, Niger and Nigeria. The main aim of the project is to reduce poverty and alleviate hunger in the dry savannah ecozone of Ghana through increasing the production of sorghum by testing the best bet technologies and improving the uptake of these technologies. During the year under review, the main activities carried out were:

- The 2nd National Stakeholders' meeting. This was held on the 19th of January at the Fishery Resource Centre. At this meeting, collaborators presented reports on activities carried out in 2000. Some of the collaborators are SARI, ARI, MOFA, ActionAid, Sorghum farmers and malters/brewers.

- The National Co-ordinator's Meeting was held in Mali, Bamako from the 19th to 22nd of February. This meeting was for national coordinators to present progress reports on activities.
- Laboratory analysis on some of the physico-chemical properties some new sorghum varieties produced by SARI.

8.8 Marketing and Processing of Bambara Groundnuts (W. Africa)

This is a two-year collaborative project with the purpose of developing and effectively promoting strategies, which improve food security of poor households through, increased availability and improved quality of cereals and pulse foods, and better access to markets. The second quarter of the year under review marked the beginning of the second year of the Project within which it was expected that the following milestones would be achieved:

- Test new technologies for bambara utilization in the field
- Optimise technologies as a result of field experience
- Conduct participatory evaluation with farmers and produce extension material
- Hold stakeholders' workshop

During the year new methodologies developed for reducing cooking time of bambara for small-scale farm families, and improving its utilization, were field-tested. Results of field studies with 40 respondents in Southern Ghana indicated that 85% liked the use of the rock salt technique as a tenderiser for bambara. The remaining 15% were indifferent. Those who accepted the technology confirmed that between 1 and 1 ½ hour was required to cook bambara with kawe instead of about 4h without it. They however indicated that soaking with the salt was not necessary. In the Northern part of the country, 60 farmers and 7 field staff were identified with the involvement of two NGOs, CAPSARD and OIC, who participated in the testing of the new methods to enhance bambara utilization. It was also realized that improved bambara flour production and utilization would be the most appropriate to test and promote in the North.

Chapter – 9

ROOT AND TUBER IMPROVEMENT PROGRAMME

9.1 Introduction

The RTIP is a national programme under the Ministry of Food and Agriculture. The FRI is coordinating the Post Production and Marketing Component of the programme.

9.2 Production and Utilization of Cassava Flour in the Sogakope District

In collaboration with Mrs. Elizabeth Agbodeka of the Ministry of Food and Agriculture who was also a student of the University of Cape Coast, a small pilot project was set up in the Sogakope District involving the production and utilization of unfermented cassava flour.

- Farmers in Dorplorma, village near Akatsi were trained in the production of unfermented cassava flour and assisted to set up a small production unit consisting of a cassava dough press and drying racks. The farmers rely on the use of customer service mills in the village for the grating of cassava tubers and milling of cassava flour.
- Bakers in Sogakope who rely on flour produced by the farmers in Dorplorma were trained in the use of the cassava flour for the preparation of pastries, bread and other bakery products.

9.3 Installation of Improved Gari Roasting Stoves at Kweiman and Damfa Near Ayi-Mensah

Seven improved gari roasting stoves based on the design of the stoves at the Cassava Processing Demonstration Unit were constructed for beneficiaries at Kweiman and Damfa. The beneficiaries were two traditional gari producers at Kweiman and one cassava-processing group at Damfa. The beneficiaries contributed towards the construction of the stoves by producing the mud bricks used for construction.

9.4 RTIP World Bank Support Mission

A World Bank support mission evaluated all RTIP activities nationwide during the year.

Appendix 1
FOOD RESEARCH INSTITUTE MANAGEMENT BOARD - 2001

1.	Prof. A. Ayensu Dep. Director-General, INSS/CSIR P. O. Box M.32, Accra	-	Chairman
2.	Dr. J. A. Otoo Director, Crops Research Institute (CRI) P. O. Box 3785, Kumasi	-	Member
3.	Professor S. Sefa-Dedeh Head, Dept. of Nutrition & Food Science University of Ghana, Legon	-	Member
4.	Mrs. Rosetta Annan Women In Agricultural Development (WIAD) P. O. Box M.37, Accra	-	Member
5.	Mr Timothy Osei Oduro, Adiya, Osei & Co. SEDCO House P. O. Box 5712, Accra-North	-	Member
6.	Mr. Kwasi Nkansa Director, Ghana Standards Board P. O. Box M.245, Accra	-	Member
7.	Ms. Sherry Ayittey 31st December Women's Movement P. O. Box 065, Osu-Accra	-	Member
8.	Mrs Leticia Osafo-Addo Processing Foods & Spices Ltd. P. O. Box 186, Community 2, Tema	-	Member
9.	Mr. Ebenezer Barnor P. O. Box 295 Mamprobi - North	-	Member
10.	Dr. Esther Ocloo Sustainable End of Hunger Campaign	-	Member
11.	Dr. W. A. Plahar Director, Food Research Institute (FRI) P. O. Box M.20 Accra	-	Member

APPENDIX II
FRI SENIOR STAFF LIST (2001)

Directorate

W. A. Plahar BSc (Gen.), BSc (Hons) MSc Fd. Sci. (Ghana) PhD (Washington)	-	Director (Chief Research Scientist)
R. M. Yawson BSc. (Hons) M. Phil. (Biochem) Ghana Post Grad. Cert. Fd. Mgt. (Jerusalem)	-	Scientific Secretary (Research Scientist)
J. Aggrey -Yawson	-	Snr Admin Asst.

Food Microbiology Division

W. K. Amoa-Awua BSc (Ghana) MSc. App. Sci. (New South Wales) PhD (Ghana)	-	Principal Research Scientist (Head of Division)
M. Halm (Ms) BSc (Gen.) BSc (Hons), MSc Botany (Ghana) Post Grad. Dip. Rural Fd. Tech (Netherlands)	-	Senior Research Scientist (Substantive Head of Div.) (On Study Leave)
M. Hodari-Okae (Mrs.) BSc Microbiology, MSc Fisheries (ABU, Zaria)	-	Research Scientist
M. Obodai (Mrs.) BSc (Hons), MPhil. Botany (Ghana)	-	Research Scientist
Charles Tortoe BSc (Hons), MPhil. Botany (Ghana)	-	Research Scientist
Patrick K. Feglo BSc (Hons), Zoology (Ghana) MSc, Clinical Microbiology (UST)	-	Research Scientist
Margaret Owusu BSc (Hons), MPhil. Botany (Ghana)	-	Research Scientist
Josephine Cleland-Okine (Ms) BSc (Hons), Biology (UST)	-	Asst. Res. Scientist (Temp.)
D. K. Asiedu	-	Chief Tech. Officer
B. Amoako	-	Prin. Tech. Officer
J. Anlobe	-	Prin. Tech. Officer

Peter Addo	-	Prin. Tech. Officer
D .K. Baisel	-	Technical Officer

Food Chemistry Division

E. K. Ankrah B.Sc. (Gen.) Ghana MSc Food Quality Control (Reading)	-	Prin. Research Scientist (Head of Division)
K. Kpodo (Mrs.) BSc (Gen.) BSc (Hons) Ghana MPhil. (West Indies)	-	Senior Research Scientist
N. T. Annan (Mrs.) BSc (Hons) Fd. Sci. (Ghana), MSc Fd. Sci. (Nova Scotia)	-	Senior Research Scientist
N. A. Asare	-	Chief Tech. Officer
E. A. Allotey	-	Chief Tech. Officer
S. Antonio	-	Prin. Tech. Officer
W. K. Amevor	-	Prin. Tech. Officer
P. A. Addo	-	Prin. Tech. Officer
Mensah Toku	-	Senior Tech. Officer
D. N. A. Ankrah	-	Technical Officer
N.Y. Amey	-	Technical Officer

Commercialization & Information Division

A. Osei-Yaw (Mrs.) BSc (Gen.), Ghana, MSc. Fd. Sci. & Nut. (Washington)	-	Principal Research Scientist (Head of Division)
P. Lokko (Mrs.) B.Sc. (Gen.) BSc (Hons) Biochem (Ghana) MSc Biochem (Ghana.) Dip. Fd. Sci. & Nut. (The Netherlands)	-	Senior Research Scientist
B.A. Mensah MSc. Fd. Press. Tech. (Kransnodar, USSR)	-	Research Scientist
Mrs. Emelia Clement BSc (Hons), Fd. Sci. & Nut. , MPhil. (Ghana)	-	Research Scientist
Ms. Vivian Doh BA (Hons) French & Linguistics MA Library Studies (Ghana)	-	Junior. Assist. Librarian

W. Quaye (Mrs.) B.Sc. (Hons) Agric. Econs. (Ghana)	-	Assistant Research Scientist
P. Larweh (Mrs.) B.Sc. (Hons) Home Sci. (Ghana)	-	Assistant Research Scientist
Ms. Joyce Owusu-Bennoah B.Sc. (Hons) Home Sci. (Ghana)	-	Asst. Res. Scientist (Temp.)
A. Andoh	-	Chief Tech. Officer
I. A. Tamakloe (Mrs.)	-	Prin. Tech. Officer
B. Awotwi	-	Prin. Tech. Officer
R. Kavi	-	Senior Lib. Assistant
S. A. Garbrah	-	Admin. Assist.
B. P. Osae	-	Technical Officer
P.O. Baidoo	-	Technical Officer

Food Processing & Engineering Division

P. N. T. Johnson BSc (Hons), Biochem. (UST) MSc. Agric. Eng. Tech. (Cranfield) PhD Food Tech. (Reading)	-	Research Scientist (Ag. Head of Div)
G. Nerquaye-Tetteh (Mrs.) BSc (Gen.) BSc (Hons) Ghana	-	Senior Research Scientist (On Study-Leave)
D. Blay MSc Chem. Eng. (Moscow)	-	Research Scientist
P. Adu-Amankwa (Mrs.) BSc (Hons) Biochem (UST) MSc. Fd. & Mgt. Sci., PhD Post-Harvest Physiology (Lond.)	-	Research Scientist
E. C. Tettey BSc (Hons) Agric (UST) Post-Grad. Dip. Fd. Tech., MPhil, (Humberside, UK)	-	Research Scientist
N. T. Dziedzoave BSc (Hons), Biochem. (UST) Post. Grad. Dip. in Fd. Sci. & Nut., (Gent, Belgium) MSc Fd. Sci. & Tech. (UST)	-	Research Scientist

L. D. Abbey BSc (Hons), Biochem. (UST) MSc. App. Sci. (Fd. Tech.) New South Wales	-	Research Scientist
C. K. Gyato Nat. Dip. in Agric. Mech. (Ghana) MSc Agric. Eng. (Bulgaria)	-	Research Scientist
J. T. Manful BSc (Agric), Dip. Ed. (Cape Coast) MPhil Biochem. (UST)	-	Research Scientist
K. A. Vowotor B.Sc. Zoology Dip. Ed. (Cape Coast) M. Phil. PhD Crop Science (Ghana)	-	Research Scientist
S. K. Noamesi BSc (Agric) MSc Fd. Sc. (Ghana)	-	Research Scientist
Mr. J. Gayin BSc (Hons) Biochem (UST)	-	Assistant Research Scientist
Charlotte Oduro-Yeboah (Mrs.) BSc (Hons) Biochem (Ghana)	-	Assistant Research Scientist
Mr. G. A. Komlaga BSc (Hons) Biochem (Ghana) MSc Fd. Sc. & Tech. (UST) Awaiting Results	-	Assistant Research Scientist
Mr. David Abusah BSc (Hons) Chem. (UST) MSc Chem. Eng. (UST) Awaiting Results	-	Assistant Research Scientist
Mr. Elvis Alfred Baidoo BSc (Hons) Biochem (UST)	-	Asst. Res. Scientist (Temp.)
J. K. Magbo	-	Chief Tech. Officer
S. A. Sampare	-	Chief Tech. Officer
K. Opoku-Acheampong (Mrs.)	-	Prin. Tech. Off.
J. R. Addo	-	Snr. Tech. Off.
E. Ablorh	-	Snr. Tech. Off.
S. A. Tagoe	-	Snr. Technical Officer
J. A. Asafu-Adjei	-	Prin. Works Supt

R. Y. Anthonio	-	Snr. Works Supt.
C. T. Yeboah	-	Works Supt.
G. K. Akleih	-	Works Supt.
R. M. Mawuli	-	Works Supt.
J. L. Lamptey	-	Works Supt.

Accounts Division

J. Mintah	-	Prin. Accounting Asst. (Head of Accounts)
C. Aïkins Tutu	-	Snr. Accounting Asst.
S. Y. Nkansah	-	Prin. Stores Supt.
S. O. T. Oddoye	-	Snr. Stores Supt.
J. Mintah Nakotey	-	Prin. Stores Supt.
G. O. Gyamfi	-	Stores Supt.

Administration Division

E. Atta-Sonno BA Hons. (Cape Coast) Specialist Teachers Cert. in English	-	Snr. Admin. Off. (Head of Division)
J. F. Asigbey	-	Chief Admin. Asst.
E. A. Larbi	-	Prin. Works Supt.
L. Codjoe	-	Admin Asst.

Appendix III
PROMOTIONS ANNOUNCED IN 2001

The following promotions were announced during the year under review:

Dr. W. Amoa-Awua	-	From Senior to Principal Research Scientist (Effective 1998)
Raphael Kwame Kavi	-	From Snr. Library Asst. to Prin. Lib. Asst.
Rhodes Y. Anthonio	-	From Snr. Works Supt. To Prin. Works Supt.
Philip O. Baidoo	-	From Accounting Asst. to Snr. Asst. Asst.
Nelson Amey	-	From Technical Officer to Snr. Tech. Officer
Ben Patrick Osae	-	From Technical Officer to Snr. Tech Officer
Richard M. Mawuli	-	From Works Supt to Snr. Works Supt.
Ben Adu	-	From Driver Grade I to Driver Inspector
Isaac Hammah	-	From Tradesman Grade I to Foreman
Joseph Akoto	-	From Tradesman Grade I to Foreman

APPENDIX IV
APPOINTMENTS

The following members of staff were appointed into the FRI family during the year under-review:

Mr. Patrick Feglo	-	Research Scientist
Mr. George Anyebuno	-	Research Scientist
Mrs. Emelia Clement	-	Research Scientist
Ms. Margaret Owusu	-	Research Scientist
Ms. Vivian Doh	-	Junior. Assist. Librarian
Mr. G. A. Komlaga	-	Assist. Research Scientist
Mr. David Abusah	-	Assist. Research Scientist
Ms. J. Cleland-Okine	-	Assist. Research Scientist (Temporary)
Mr. Elvis Alfred Baidoo	-	Assist. Research Scientist (Temporary)
Ms. Joyce Owusu-Bennoah	-	Assist. Research Scientist (Temporary)
Ms. Joana B. Dzikunu	-	Snr. Clerk

APPENDIX V
2001 SCIENTIFIC REPORTS AND PUBLICATIONS

A. Refereed Journal publications

1. Wareing, P. W., Wesby, A., Gibbs, J. A., Allotey, L. T., and **Halm, M.,** (2001) Consumer Preferences and Fungal and Mycotoxin Contamination of Dried Cassava Products from Ghana. *International J. of Food Science and Technology* **36**:1 – 10 **CSIR-FRI/JP/WPW/2001/001**

2. **Johnson, P-N. T.,** Adjei, R. K. & **Quaye, W.** (2001) Post-harvest practices and perception of loss among tomato retailers at five marketing centres in Accra. *J. Ghana Science Association,* **3** (1) 70 - 75. **CSIR-FRI/JP/JPNT/2001/002**

B. Technical Reports

1. **Annan, N. T., Plahar, W. A.** and **Tamakloe, I. A.** (2001). Development of improved legume flour production technology for enhanced Bambara utilization in Ghana. FRI/NRI/DFID Project on Marketing and Processing of Bambara. Food Research Institute, Accra, Ghana. **CSIR-FRI/RE/ANT/2001/002**

2. **Annan, N. T., Plahar, W. A.** and Swetman T. (2001). Effect of `Kawe' treatment on water absorption and cooking characteristics of Bambara groundnut varieties. FRI/NRI/DFID Project on Marketing and Processing of Bambara. Food Research Institute, Accra, Ghana **CSIR-FRI/RE/ANT/2001/001**

3. **Annan, N. T.** and **Plahar, W. A.,** 2001. Quality monitoring of processing techniques and soyproducts by Darkruby Enterprise. A Technology Transfer Report under FRI/SAFGRAD PROJECT on Improving the Utilization and Commercialization of Soy Processing Technologies: Micronutrient Enrichment of Soy Products. Food Research Institute, Ghana **CSIR-FRI/RE/ANT/2001/003**

4. **Larweh, P. M, Johnson, P-N. T** and **Quaye, W.** (2001) Participatory Rural Appraisal (PRA) Report on the Preservation and Utilisation of Traditional Leafy Vegetables in Selected Areas in Northern Ghana. IDRC/FRI Project. FRI, Accra, Ghana. **CSIR-FRI/RE/LPM/2001/004**

5. **Annan, N. T., Plahar, W. A.** and **Clement, E.** 2001. Formulation and quality characteristics of a sorghum malt-based weaning food. A Project Report submitted under the IFAD/FRI/ICRISAT Sorghum Improvement Project. Food Research Institute, Accra, Ghana. 23pp. **CSIR-FRI/RE/ANT/2001/007**

6. **Obodai M** and Apertogbor M. (2001). An ethnobotanical study of mushroom germplasm and its domestication in the Bia Biosphere Reserve. A project report submitted to the Man and the Biosphere project, EPA, Accra. **CSIR-FRI/RE/OM/2001/005**

7. **Yawson R. M.** (2001) "The need for ISO 9000 Application in Ghanaian Food Industries" Project Report Submitted to the Hebrew University of Jerusalem, **CSIR-FRI/RE/YRM/2001/006**

8. Gyasi, O **Quaye, W.,** Obeng-Asiedu, P. **& Johnson, P-N. T** (2001) marketing systems of traditional leafy vegetables and some socio-economic considerations: a case study at Bawku, Tamale and Kumasi Markets. IDRC/CIAT Small Grants Fund Project. 2000/2001

9. **Johnson, P-N. T, (2001)** Preliminary studies on improving the shelf life of three traditional leafy vegetables, *Amaranthus viridis, Cochorus olitorius and Hibiscus sabdariffa.* IDRC/CIAT Small Grants Fund Project.

10. **Johnson, P-N. T, Manful, J. T., Abusah, D. D. & Abbey, L. D.** (2001) Shelf-life characteristics of two bakery products from composite flour of wheat and millet. West and Central African Millet Research Network/FRI/SARI Project 2000/2001.

11. **Johnson, P-N. T, & Komlaga, G.** (2001) Some physico-chemical parameters of four newly released sorghum varieties in Ghana. In: Farmer Participatory Testing of Technologies to increases sorghum production in Ghana. 2nd Year report IFAD/ICRISAT Sorghum Development Project 1999/2002

12. **Johnson, P-N. T, Manful, J. T.,** Koyiri, G., Saanziri, J & Asenso, M. (2001) Participatory evaluation of four newly released sorghum varieties at processor's level. In: Farmer Participatory Testing of Technologies to increase sorghum production in Ghana. 2nd Year report IFAD/ICRISAT Sorghum Development Project 1999/2002

13. **Tomlins, K. I., Myhara, R. M., Johnson, P. N., Obeng-Asiedu, P. and Greenhalagh, P. (2001)** Enhancing the food security of the peri-urban and urban poor through improvements to the quality, safety and economics of street-vended foods, Final Technical Report, R No 7493 (ZB0199), NR International, Chatham, UK.

C. Conference Papers

1. **Lokko, P.,** and Anson, S., 2001 Post -adoption impact of the introduction of the Chorkor Smoker to four fishing villages. A Ghana Science Association conference paper- Journal of the Ghana Science Association. **CSIR-FRI/CE/LP/2001/001**

2. **Dziedzoave, N. T.**, Graffham, A. J., Westby, A. and **Plahar, W. A.** (2001). Preliminary assessment of kudeme - a traditional cassava-based inoculum - for amylolytic and cellulolytic enzyme activities. In: Cassava, an ancient crop for modern times: food, health and culture. Proceedings of the 5th International Scientific Meeting of the Cassava Biotechnology Network. Missouri, USA. Nov. 4-9, 2001. **CSIR-FRI/CU/DNT/2001/001**

3. **Johnson, P-N. T., (**2001) Overview of street-food vending in Accra Roundtable conference on Street Food in Ghana Reseau Ghaneen of SADAOC Foundation, Accra, Ghana 6th September 2001 **CSIR-FRI/CU/JPNT/2001/002**

4. **Johnson P. N. T.,** (2001) "Street-food vending in Accra:Problems and Prospects" a paper presented at the International Meeting on future strategies of CPHP on Food Safety. Harare, Zimbabwe. 21 – 22 September 2001 **CSIR-FRI/CE/JPNT/2001/002**

5. Myhara, R, Tomlins, K, **Johnson, P-N. T,** Obeng-Asiedu, P, & Greenhalgh, P. (2001) Implementation of quality management systems to control food safety hazards of street-vended foods in Ghana. DFID/NRI/FRI CROP POST HARVEST PROGRAMME PROJECT. **CSIR-FRI/CU/MR/2001/003**

APPENDIX VI
INTERNALLY GENERATED INCOME

Income flow for the year is as follows:

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual (Total)
Income	47,212,100.00	68,829,89.00.	122,863,660.00	67,650,860.00	306,556,500.00
Less Direct Cost	35,166,890.00	46,869,957.25	103,336,751.86	44,657,850.00	230,058,449.00
Net Income	12,045,210.00	21,932,922.75	19,526,908.14	22,993,010.00	76,498,050.89

Total Net Income		**¢76,498,050.89**
15% CSIR	¢11,474,707.63	
85% FRI	¢65,023,343.26	
		¢76,498,050.89

In-Flows from Donor Funded Projects for the Year Ending 2001
As Compared to Previous Years

Component	1999	2000	2001
Dollar	140,723.52	104,603.89	**87,145.64**
Pound	5,215.00	29,515.00	**30,603.75**

Appendix V11
FRI STAFF TRAINING - 2001

	NAME OF STAFF	DESIGNATION	COURSE	INSTITUTION OF STUDY
1.	M. Halm (Ms.)	SRS	PhD (Microbiol.)	UG / KVL, Denmark
2.	P. Lokko (Mrs)	SRS	PhD (Nutrition)	University of Ghana
3.	M. Hodari-Okae (Mrs)	RS	PhD (Food Microbiology)	University of Ghana
4.	L. D. Abbey	RS	PhD (Fd. Sc.)	University of Ghana
5.	N. T. Annan (Mrs)	SRS	PhD (Fd. Sc.)	UG / KVL, Denmark
6.	J. Gayin	ARS	MSc Fd. Sc.	Univ. of Gent, Belgium
7.	K. Kpodo (Mrs)	SRS	PhD (Fd. Sci)	UG / KVL, Denmark
8.	E. C. T. Tettey	RS	PhD (Fd. Sci)	Univ. of Ghana,
9.	N. T. Dziedzoave	RS	PhD (Fd. Sci. & Tech.)	NRI
10.	C. Tortoe	RS	PhD (Fd. Sci. & Tech.)	NRI, Univ. Of Greenwich
11.	M. Amoo-Gyasi	Snr. Tech Asst	HND Lab. Tech.	Univ. of Ghana, Legon
12.	A. Antonio	Snr. Tech. Officer	HND Microbiology	Univ. Of Ghana
13.	B. Amoako	Snr. Tech. Officer	HND Microbiology	Univ. Of Ghana
14.	N. Amey	Technical Officer	HND Lab. Tech.	Univ. Of Ghana
15.	R. Takli	Snr. Tech. Asst	HND Lab. Tech.	Univ. of Ghana, Legon
16.	C. Reynolds	Snr. Tech. Asst.	HND Lab. Tech.	Univ. of Ghana, Legon
17.	Emmanuel Allorsey	Snr. Tech. Asst.	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
18.	K.K. Essel	Univ. of Ghana, Legon	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
19	A. I..Nyarko.	Tech Asst. Gd. I	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
20.	L. Botchie (Mrs)	Snr. Accts. Clerk	BSc (Admin) Acct. Option)	Univ. of Ghana, Legon

Appendix VIII

CONFERENCES, COURSES, WORKSHOPS AND SEMINARS ATTENDED BY FRI STAFF IN 2001

Conferences/ Courses/ Workshops/Seminars	Participants	Designation	Venue	Date/Duration	Organisers
Post Graduate Certificate Course	R. M. Yawson	Sci. Secretary	Rehovot, Israel	Jan – Feb., 2001	MASHAV/HUJI, Israel
Workshop for Implementing Agencies of IFAD/WECARD/IITA	Dr. W. Amoa-Awua	Prin. Res. Scientist	Ibadan, Nigeria	29 – 31, Jan., 2001	IITA
West & Central African Millet Research Network Meeting	Mr. J. T. Manful	Res. Scientist	Niamey, Niger	23 - 27 April 2001	W/A Millet Network
IBC USA`s BioInvestment Forum	R. M. Yawson	Sci. Secretary	Boston, USA	13 –14, June 2001	IBCUSA Conferences Inc.
Workshop on Quality And Safety Issues Of Street Foods In Africa	Dr. P. N-T. Johnson	Snr. Res. Scientist	Accra, Ghana	17-23, Sept. 2001	DFID
5th International Scientific Meeting of the Cassava Biotechnology Network	Dr. W. Amoa-Awua N. T. Dziedzoave	Prin. Res. Scientist Res. Scientist	Missouri, USA.	4-9, Nov. 2001	Cassava Biotechnology Network
Short Course on Food Microbiology	K. Kpodo (Mrs.)	Snr. Res. Scientist	Copenhagen, Denmark	Jan. 8 – May 4, 2001	DANIDA/KVL
Roundtable conference on Street Food in Ghana	Dr. P. N-T. Johnson	Snr. Res. Scientist	Accra, Ghana	Sept., 6, 2001	Reseau Ghaneen of SADAOC Foundation
Regional Conference on Food Safety Issues of Street-Vended Foods in Africa.	Dr. P. N-T. Johnson	Snr. Res. Scientist	Harare, Zimbabwe	15 – 22, Sept. 2001	DFID/UK Government
Workshop on Xanthan Gum Technology Development in Africa	Dr. W. Amoa-Awua	Prin. Res. Scientist	Dakar, Senegal	1 – 3 Oct., 2001	ECA