Council for Scientific & Industrial Research

Food Research Institute

2002 ANNUAL REPORT

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APPENDICES

EXECUTIVE SUMMARY

The Food Research Institute (FRI) is one of the affiliate institutes of the Council for Scientific and Industrial Research (CSIR). The CSIR 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 recognized, 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 preservation. 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 spite of the multidisciplinary approach, FRI presently operates under Seven Divisions – Food Chemistry, Food Microbiology, Food Processing & Engineering, Nutrition & Socioeconomics, Commercialisation & Information, Administration, and Accounts.

The Nutrition and Socioeconomics Division was created during the year under review. This was in line with the Institute's objective of strengthening its core competence in Nutrition and Socioeconomics studies. The Administration Division caters for the secretarial, personnel, establishment, estate and transport matters of the Institute. The Accounts Division controls expenditure and caters for all financial transaction of the FRI. It prepares the annual estimates, annual accounts and financial statements, and maintains books and documents involved in all these activities.

The Microbiology and Chemistry Divisions continued with their task of providing analytical support to both research and industry. The Food Processing & Engineering Division continued with its functions of conducting applied research into the processing, preservation, packaging and storage of food as well as the development of new products from available raw materials. The Pilot Plant Unit of the Division conducted pilot scale studies into products developed by the FRI. The Commercial and Information Division coordinates the commercial activities of all the other divisions of the Institute in order to raise the income of the Institute. 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 percentage of Internally Generated Fund (IGF) as percentage of subvention was 3.57%. Although Collaborative Research does not directly contribute to the calculated IGF it was the mainstay of the Institute and was 38% of subvention.

The year under review so the appointment of Dr. Wisdom K. A. Amoa-Awua as the Deputy Director of the Institute on a two-year rotational basis. Several other appointments were made including three Assistant Research Scientists. The total staff strength at the end of the year stood at 167.

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. 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. Most activities began in June 2002 after an initial delay with the disbursement of funds for the project. Activities in preparation for the accreditation of 14 Microbiological methods to ISO 17025 Quality System continued throughout the year.

The year under review saw a high number of participation in local and international conferences by staff. The Institute played host to very important visitors.

PART I - GENERAL MATTERS

Chapter 1

ADMINISTRATION DIVISION

1.1 Introduction

In spite of the multidisciplinary approach, FRI presently operates under seven divisions – Food Chemistry, Food Microbiology, Food Processing and Engineering, Nutrition and Socio-Economics, Commercialisation and Information, Administration, and Accounts. The detailed existing organisational structure of FRI is given in Appendix IX. The Administration Division caters for the secretarial, personnel, establishment, estate and transport matters of the FRI. The division continued with these 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 at 167 and the breakdown is as follows:

Category of Staff	Number of Females	Number of Males	Total
Research staff	15	20	35
Senior Staff	3	39	42
Junior Staff	20	70	90
Overall Total	38	129	**167**

1.3 Promotions

Several promotions were announced for all categories of staff notable among them were: Dr. Pearl Adu- Amankwa from Research Scientist to Senior Research Scientist with effect from 1st January 2000 and Mr. Nanam Dziedzoave from Research Scientist to Senior Research Scientist with effect from 1st July 2000. Please see appendix for details

1.4 Re-designation

All Scientific Officers were re-designated as Research Scientists in accordance with the "*Kusi Declaration*" of the Annual General Meeting of the Research Staff Association

1.5 Retirement & Resignations

Mr. E. K. Ankrah started his terminal leave prior to his retirement on 2nd May 2002 from the service of the Council on 1st June 2002. Mr. Takyi–Yeboah of the Engineering Unit, Processing Division resigned from the service of the Council. Mrs E. Clement of the Nutrition and Socio Economic Division also resigned to join her husband outside the country.

1.6 Training

Several members of staff continued with their training and other staff from the various categories started their training programmes within the year. See appendix for further details.

1.7 Back to Post

The following staff returned to their posts after successfully completing their studies:

Mrs P. Lokko from the University of Ghana, Legon

Mrs W. Quaye from the University of Ghana, Legon

Ms. C. Ketsie from Institute of Management Studies

Ms. Faustina Somuah from the Accra Polytechnic

1.8 New Heads of Divisions

The following Officers were appointed Heads of Division/Units

Mrs. P. Lokko	-	Head, Nutrition & Socio Econs Division with acting oversight responsibility for the Commercial and Information Division (CID)
Mrs. K. Kpodo	-	Head, Food Chemistry Division
Mrs. G. Nerquaye-Tetteh	-	Head, Food Processing & Engineering Division
Mrs. M. Ottah-Atikpo	-	Head, Industrial Service Unit of the Microbiology Division
Dr. P. N. T. Johnson	-	Head, Cassava Processing & Demo. Unit of the Processing Division

1.9 Appointments

Dr. Wisdom Amoa-Awua was appointed for a two-year rotational position of Deputy Director of the Institute. Several other appointments were made including three Assistant Research Scientists. Please see appendix for details.

1.10 National Service Posting to the Institute

The following national service personnel were posted to the Institute:

Ms. Peggy Abena Parry	-	Food Microbiology Division
Ms. Matilda Tetteh	-	Nutrition and Socio-Economics Division
Ms. Bernice Kudjawu	-	Nutrition and Socio-Economics Division
Mr. Jeremy Lartey Brown	-	Food Chemistry Division
Mr. Derick Nicco-Annan	-	Food Chemistry Division
Mr. Ampim Darko Bonsu	-	Food Engineering & Processing Division
Mr. Seyram Dango	-	Food Microbiology Division

1.11 Attachments

The following had their attachment at the Institute as indicated:

Marian Quaye	-	Commercialisation & Information Division
Bernice Antwi	-	Administration Division
Patience Mensah	-	Administration Division
Belinda Adjin	-	Food Chemistry Division

1.12 Internal Transfers

Mr. J. F. Asigbey from Administration to CPDU, Pokuase

Mrs Rose Agorkor was transferred from the CPDU to the Mycology Unit

Mr. Emmanuel Tetteh was transferred from the Microbiology Laboratory to the Mycology Unit.

PART II – DIVISIONAL REPORTS

Chapter - 2

COMMERCIAL AND INFORMATION DIVISION

2.1 Introduction

The Commercial and Information Division continued its basic task of coordinating the commercial activities of all the other divisions of the Institute in order to raise the income of the Institute.

2.2 Staff Strength

By the end of the year 2002, the staff strength of the division stood at 9. The Client Service Unit had 4 members of staff and a national service person; the Library and Information Unit had 3, and 1 driver. Mr. Augustine Andoh and Mr. Richard Kavi, both of the Library & Information Unit are on study leave.

2.3 Commercial Services

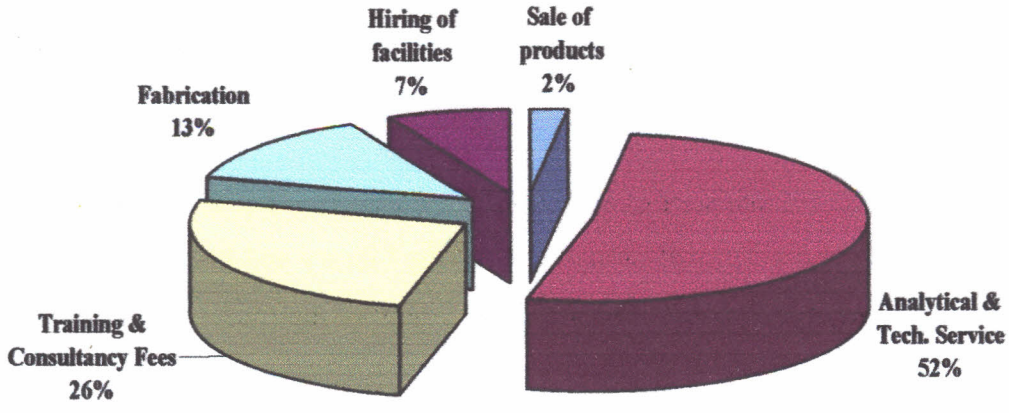
The main commercial activities carried out for clients included analyses of samples, training, transfer of technology, use of institute's facilities and sale of research by-products. A total number of 416 clients were attended to during the year. Analytical services, made up of Chemistry (Industrial Services), Chemistry (Mycotoxin) and Microbiology continued to form the bulk of services rendered. A total number of 1,450 samples were received by the client service unit, for analyses by the Institute. Total charge for these samples was **¢373,528,931.00** It must be noted that this figure represents charges made and not actual income realized. A total of 7 training programmes were carried out by the Institute for the year under review. These were in:

- Mushroom cultivation;
- Laboratory analyses;
- Soybean processing;
- Cassava processing;
- Salt Iodation

2.4 Collaborative Research

The total amount received for collaborative research was as follows: $**68,593.51** and **£45,956.48** This amounted to **38%** of total Government subvention. The Major donors were DFID/NRI, DANIDA, EU, IFAD, SAFGRAD, Purdue University, and Alabama A&M University both of the USA among others.

Relative contribution to IGF - 2002



2.5 Constraints

The Division faced several constraints. The staff strength was very low. The following recommendations were made:

- A member of staff who is a computer literate should be stationed at the pilot plant, to collect client money among other duties.
- Another person was needed at the Library and Information Unit to help in the library
- There was the need for someone to be in charge of the costing of our services and products.

Chapter - 3

NUTRITION AND SOCIOECONOMICS DIVISION

3.1 Introduction

The Nutrition and Socioeconomics Division was created during the year under review. This was in line with the Institute's objective of strengthening its core competence in Nutrition and Socioeconomics studies. The main responsibility of the Division is to conduct surveys and feasibility studies into the economic operation of plants and projects, from plant/project organisation to the marketing, distribution, consumer demand and the utilisation of food. It is also to conduct community nutrition studies. The Division has two units: The Nutrition Unit which runs a Test Kitchen that conducts sensory test on products developed by the FRI; and the Socioeconomics Unit.

3.2 Staff Situation and Movements

The Division began the year with staff strength of 9 made up of one Senior Research Scientist, one Research Scientist, three Assistant Research Scientists, one Principal Technical Officer, two Senior Technical Assistants and a Technical Assistant Gd. II. During the course of the year, Mrs. Patience Larweh, Assistant Research Scientist, Ms. Constance Boateng and Mrs. Alice Padi, both Senior Technical Assistants, proceeded on study leave. Mrs. Emelia Clement, Research Scientist, resigned from the Institute. Mrs. Mina Quaye, Assistant Research Scientist proceeded on leave without pay. By the last quarter of 2002 only 4 members of staff remained at post. Two national service personnel joined the division during the last quarter.

3.3 Services Undertaken by the Division

During the year under review, the division continued with its basic task of supporting research activities, training, recipe development and sensory studies.

3.3.1 Sensory Studies

- Sensory evaluation of raw and cooked samples of fortified cassava dough
- Development of recipes from cassava glucose syrup and sensory evaluation of such recipes
- Sensory evaluation of cassava flour bread from WIAD
- Sensory evaluation of 4 samples of cassava dough fermented spontaneously by starter cultures.
- Sensory evaluation of 21 samples of fufu flours.
- Sensory evaluation on improved fufu flour,
- Sensory evaluation of 5 samples of corn dough porridge.

3.3.2 Training

- One individual was trained in the production of soybean products i.e. milk flour and paste
- 12 people participated in a 2-day salt iodation workshop
- The division was involved in supervision of polytechnic students and training of 1 MPhil student from the University of Ghana.
- The division also trained 10 panellists in rice sensory attributes and subsequent evaluation exercise.

3.3.3 Recipe Development

- Raw and cooked samples of cassava dough
- Glucose syrup
- Cassava flour bread (GAFCO, WIAD)
- Cassava dough fermented with starter culture
- Cassava flour
- Corn dough porridges

3.3.4 Socioeconomics Studies

Members of the division conducted baseline socioeconomic studies and rural appraisal studies for several ongoing projects in the institute.

3.3.5 Future Plans

The Division is organizing and studying ways to actively generate money for the Institute.

Chapter - 4

FOOD MICROBIOLOGY DIVISION

4.1 Introduction

The Food Microbiology Division is made up of the Mycology Unit and the Microbiology Services Unit; and it is in the process of strengthening its capacity in Food Biotechnology. The Division continued with its task of providing analytical support to both research and industry.

4.2 Staff Strength

The staff strength of the Division stood at 16 at the end of the year and it was made up of one Principal Research Scientist, one Senior Research Scientist, Five Research Scientists and two Assistant Research Scientists on temporary appointment. The others are technical grade staff.

4.3 Microbiology Services Unit

4.3.1 Analytical Services

The Microbiology Services Unit analysed a total number of one thousand two hundred and nine (1,209) samples during the year. Over 40% of the samples were received from Pioneer Food Cannery. The samples analysed included pre-cooked Tuna loins, Milk of Magnesia, water samples from factories and bottled water, swab sites, canned foods, fruits and vegetables products, cocoa products, catering products, cereals and grain legumes, confectionary etc.

4.3.2 Laboratory Accreditation

Activities in preparation for the accreditation of 14 Microbiological methods to ISO 17025 Quality System continued throughout the year.

4.3.3 New Equipment

The Microbiology Services unit received some major equipment from the World Bank under the Private Sector Development Programme and MOFA. These included:

- Two (2) 10 litre capacity Wagtech (Dixons Surgical) autoclaves
- One (1) 50 litre capacity Prioclave autoclave
- Two (2) Memert (Gmoh) Model IGP 600 incubators
- One (1) Envair lamina flow chamber
- Two (2) balances (Adams Equipment) of 210g (0.0001g) and 1000g 90.01) capacities respectively.

4.3.4 Reinstallation of Water Tank

The water tank, which was installed in the previous year to serve only the microbiology laboratories, was reinstalled in the third quarter of 2002 to serve the microbiology laboratories as well as the adjacent Engineering and the Processing blocks. This solved the persistent cuts in water supply previously experienced in those blocks.

4.3.5 Student Attachments

One student from the University of Cape Coast and three from Accra Polytechnic were attached to the laboratories for a period of one month each. Two newly completed HND students from Accra Polytechnic were assigned to the Microbiology laboratories for National Service period of ten months each starting November 2002. Five students from the Accra Polytechnic were supervised to conduct their project work and prepare their reports on the following topics:

- A comparative study to determine optimum conditions for the vegetative growth of two strains of Pleurotus tuber-regium mushroom.
- Determination of some optimum conditions for the vegetative (mycelia) growth of two strains of *Volvariella volvacea* (VVL and V238).
- Use of Bambara chaff additive on the yield and morphological characteristics of the growth of *Pleurotus ostreatus*.

4.3.6 Appointment of Unit Head

Mrs. Margaret Ottah-Atikpo was appointed unit head of the Microbiology Services Unit with effect from April 2002.

4.4 Mycology Unit

4.4.1 Strain Multiplication

The Mycology Unit produced a total of 4,911 bottles of oyster spawn, 72 bottles of wood ear, 7, bottles of monkey seat and 609 bottles of oil palm mushroom spawn for sale to growers throughout the country.

4.4.2 Extension and Training Activities

The Mycology Unit organized a two-day introductory course and a one-week intensive course on Mushroom production during the year. A total of 57 participants were trained. The Mycology Unit assisted the Christian Rural Aid Network (CRAN) to set up a compost bag unit at Woete in

the Volta region. Two members of the Mycology Unit served as resource persons at two training courses organized by the Mushroom Production and Biodiversity Training Centre, Kumasi in October and December 2002 during the year under review.

4.5 New Employment

Two Technologists and one Technical Assistant on temporary employment were assigned to the division in the persons of Ms. Matilda Dzomeku (Mycology Unit), Theophillus Annan (Microbiology Services Unit) and Pearl Asigbey (Microbiology Services Unit).

4.6 Problems Encountered during the year

A few problems were encountered during the year. These were as follows:

1. Delays in procurement and supply of media and reagents for microbiological analysis
2. Difficulties in communication as a result of protracted faulty intercom facilities in the Division
3. Delays in typing of analytical reports

Chapter - 5

FOOD CHEMISTRY DIVISION

5.1 Introduction

The Food Chemistry Division comprises two units namely the Mycotoxins Unit now renamed the Toxicology Unit and the Industrial Services Unit.

5.2 Staff Strength

The Division had staff strength of 12 as follows:

Two Senior Research Scientists
One Research Scientist
One Chief Technologist
Four Principal Technical Officers/Technologists
One Senior Technical Officer/Technologist
One Senior Technical Assistant
One Technical Assistant Grade
One Temporary Staff (Mr. Charles Diako)

Two National Service Persons were also assigned to the Chemistry Division during the year.

Mr. E. K. Ankrah, Principal Research Scientist and Head of Division retired from the Institute on 1st June 2002.

5.3 Analytical Services

During the year under review, the Division continued with its basic task of offering analytical services to industry and individuals to generate income for the Institute. A total of 285 samples were received by the Industrial Services Unit for chemical analysis. The samples consisted of cocoa cake, cocoa powder, animal feed, alcoholic beverages, fruit drinks, edible oils, pepper sauce among several others. The clients included University of Ghana, U.N.H.C.R., Cadbury Ghana Ltd., Edoil Co. Ltd., Ghabico, Kosher Feed Mills, West Africa Mills Co. Ltd., Agricare Ltd., May-Just Ltd., Morgan Farms etc. Total charges for the 285 samples analysed amounted to ¢29,235,000.

During the year, 57 samples were received and analysed for aflatoxins by the Toxicology Unit. The samples included soybean powder, peanut kernels, peanut butter, Burger Peanut snack (Nkatie Burger), Corn grits and Wheat bran. The clients included Sitos Ghana Ltd., Ghana Inspections Ltd., GNPA, Burger Food Industries, Korankye Farms, May-Just Industries, Joe Carl Ent. Ltd., as well as individuals. Total charges for aflatoxin analysis amounted to ¢6,900,000.

5.4 Equipment Received

During the year, the Chemistry Division received the following equipment for Institutional Capacity Building through the Roots and Tubers Improvement Program (RTIP).

i. Kjeltec Auto Distillation unit with Digestor (Protein Analyzer)

ii. Fibertec System (Fibre Analyser)

iii. Amino Acid Analyser

The research capability of the Institute is expected to expand with the acquisition of this equipment.

5.5 Practical Training and Supervision of Project Work

In line with the Institute's commercialization efforts, staff of the Division engaged in the training and supervision of project work of students from some of the Country's Polytechnics and Universities.

Practical Training

a. Sixty-seven (67) students from the School of Applied Science (Science Laboratory Technology Department) of Accra Polytechnic under-took a Practical Training course in Biochemistry at the Chemistry Division in April and July 2002.

b. Ten students from the Community Nutrition Department of the University of Development Studies, Tamale also undertook a one-week training course in Food Composition Analysis at the Chemistry Division of the Institute in June 2002.

The net income generated from the two Training courses amounted to ¢5,184,800.

Supervision of Project Work

Seven students from the Accra Polytechnic undertook their Project Work in the Chemistry Division during the year under review.

Practical Attachment

a. Five students from the Accra Polytechnic undertook their 3-month practical attachment programme from 12th August to 12th November 2002.

b. One student from the University of Cape Coast also had his Practical Attachment training from 23rd July to 6th September 2002.

c. Three students from the University of Science and Technology also had their attachment training during the year.

5.6 Accreditation

Under the DANIDA funded project, "Capability Building for Research into Traditional Fermented Foods" efforts are under way to have the Chemistry Laboratories accredited. In this regard, some selected staff of the Division participated in meetings pertaining to this subject from 17th to 19th July 2002. An audit of the two Chemistry laboratories was conducted by a team which included an external auditor in the person of Ms. Annette Lillie from Denmark. The audit was conducted on 18th July 2002.

5.6 Training and Conferences

Mrs. Nana T. Annan continued with her PhD studies and registered at the University of Ghana, Legon. Mrs. Kafui Kpodo participated in a Workshop on Mycotoxins in Maryland, USA from 22nd to 26th July 2002. The Workshop was organized by the Food and Drug Administration (FDA) of the United States of America. She also attended a World Health Organisation (WHO)/Food and Agriculture Organisation (FAO)/International Agency for Research in Cancer (IARC) Working Group Meeting in Lyons, France from 21st to 23rd November 2002.

Chapter -6

FOOD PROCESSING AND ENGINEERING DIVISION

6.1 Introduction

The functions of the Food Processing & Engineering Division are to conduct applied research into the processing, preservation, packaging and storage of food as well as the development of new products from available raw materials. The Pilot Plant Unit of the Division conducts pilot scale studies into products developed by the FRI. It also provides services such as dehydration to industry.

6.2 Staff Situation and Movement

a. Study Leave

Mrs Charlotte Oduro-Yeboah joined three other Research Scientists of the Division who were already on study leave to pursue an MPhil Programme at the University of Ghana, Legon. The three others were Mr. E. C-T Tettey who is pursuing a PhD Programme at the University of Ghana, Legon, Mr. Nanam Dziedzoave and Mr. J. T. Manful who also continued their PhD Programmes at the University of Greenwich UK. Mr. Godwin Armah attended the 19th Junior Technical Supervisory Management Course at the Institute of Technical Supervision Weija Accra from 15th April 2002 to 29th September 2003 he was adjudged the overall best participant.

b. Sick Leave

Two Technical Staff of the Division – Mr. Akyea of the Engineering Unit and Mr Sogbey of the CPDU, Pokuase were on sick leave.

c. Visits Undertaken by Officers

From 19th to 22nd February 2002, Dr. Johnson attended the National Coordinator's Meeting of the IFAD Sorghum Development Project in Bamako, Mali. Mr. L. D. Abbey attended the first meeting on EC INCO Project ICA4 – 2001 – 10032 on improving the utilization and Quality of Low – Value Fish by Processing held at the University of Surrey Guildford UK, from 25th March to 4th April 2002 he subsequently undertook laboratory studies at the same University from 19th August to 19 October 2002. Dr/Mrs Pearl Adu-Amankwa represented the Institute at the Ghana Export Promotion Council at a meeting on Production, Expansion, Processing and Packaging of selected spices for export and Post-harvest handling, processing and marketing of selected vegetables on July 2nd 2002. She was also on a study tour of Indonesia and Thailand on project management of community demand – driven initiatives, integration of agro-processing in poverty alleviation interventions and the role of farmer-based organizations in agricultural development from September 20th to October 13th 2002.

Mr S. K. Noamesi represented the Institute at the Sweet Potato Field Day at Ohonwu in the Volta Region on October 18th, 2002. The field Day was organized by the Crop Research Institute. The day's highlight was the linking up of Research Scientists and school children to help select high beta-carotene varieties of sweet potato to combat vitamin A deficiency which occurs all over Ghana. As part of his PhD work, Mr. J. Manful undertook a 2-month study tour of the United States from February 8th to April 7th 2002. The Institutions visited were the Food Science Department of Purdue University and USDA Research laboratories in Georgia and Louisiana. He also presented a poster entitled "Effect of artisanal rice parboiling methods on milling yield and starch characteristics "at the annual meeting of the American Association of Cereal Chemists (AACC) from October 13th to 17th 2002 in Montreal Canada. Mr. Joseph Gayin attended a workshop on the "Utilisation of by-products and waste materials in the sugar industry" from October 13th to 31st 2002 at the Assiut University in Egypt.

6.3 Services Undertaken by the Division

During the year, the three Units of the Division, the Pilot – Scale Production Unit (PSPU), the Engineering Unit and the Cassava Processing Demonstration Unit (CPDU) rendered various services to the public and the Institute

a. Pilot Scale Production Unit

The Unit offered various services to 22 companies during the year. The services rendered include Milling, Drying, Roasting, Packaging, Processing of Fufu Flours and Groundnut Paste. The products handled included spices, maize and cassava dough, plantain, cocoyam and yam fufu, hausa koko, and vegetables. In addition to services offered to clients, Groundnut Paste, Fufu flours, Fermented Maize and Banku Mix were produced for the CID shop.

b. Engineering Unit

During the year under review, the unit continued with one of its functions of repair and routine maintenance of machines and equipment located at the Broz Tito Avenue compound, the Pilot Plant Complex and the Cassava Processing Demonstration Unit at Pokuase. The Mechanical section of the unit, in addition to the routine maintenance on machines and equipment at the CPDU, Pokuase and the Pilot Plant at Okponglo undertook the following jobs during the first quarter of the year under review:-

- Construction of a 36-footer Solar Dryer at CPDU.
- Completion of the installation of the Cowpea Processing Plant which was transferred from its original location at Ohawu to the Processing Hall of the Pilot Plant.
- The development of a Mixer for the FRI/SAFGRAD/Micro Nutrient Project commenced

In the second quarter, a Cassava Slicer with capacity of 800 kg/hr and a Centrifugal Sifter with capacity of 4 ton/day were constructed. A 68 Tray Dryer size 6'x 8' was also constructed for the CID. The contractor of the *Rolls Royce* Dryer at the Pilot Plant Processing Hall was replaced. The Float Valves in the Overhead Aluminium Tanks at the Boiler Rooms at the Pilot Plant were repaired. In the fourth quarter, the burglar proofing was constructed and installed at the Fishery Resource Centre. The design, construction and installation of water reservoir to supply water the Engineering/Processing/Microbiology Blocks at the Pilot Plant Complex also took place.

For the Electrical and Refrigeration Section, apart from carrying out routine maintenance on air conditioners, refrigerators, electrical equipment and lighting systems, also carried out the following:-

- Installed and tested new air conditioner in the Director's and Administrative Officer's Offices, the Library, Room C5 and the Reception, all at the Broz Tito Avenue Premise.
- All the 4 Halogen bulbs at the Pilot Plant compound were replaced and their control box serviced in the first quarter.
- The Cold Room at the Pilot Plant Processing Hall was rehabilitated for rental to Ottofio Foods Limited in the fourth quarter.
- The restoration of electrical power supply to Block C at the Broz Tito premises was undertaken.
- The Engineering Unit carried out a thorough investigation and study of the Furnace at the Chemistry Laboratory and proposed the design of a new control system for it. The new design will cost the Institute only 20% of the cost of repair of the original system.

6.4 Equipment Received.

The Division received a Hammer Mill from the CSIR Secretariat stores the fourth quarter. It is yet to be installed

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 (AgSSIP). This Agro-processing component is being coordinated by the FRI. Most activities began in June 2002 after an initial delay with the disbursement of funds for the project.

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

Purpose

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

Project Objectives

- To characterise the milling, physical, nutritional and parboiling properties of at least 5 released varieties.
- To determine the sensory and consumer acceptability of these varieties.

Outputs

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

Research Activity in Progress

- Optimisation of the soaking times and steaming temperatures for artisanal rice parboiling.
- Evaluation of the milling and parboiling characteristics of rice samples

Constraints

The cereal laboratory does not have a test polisher so all polishing (i.e de-branning activities) have to be carried out at the Irrigation Development Authority laboratories at Ashaiman.

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

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

Project Objectives:

To develop an improved smoker which reduces heat loss, eliminates the interchanging of tray positions thus making fish smoking less laborious, as well as reduction/elimination of the tar usually associated with fish processed by the original Chorkor smoker.

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

Research Activity in Progress:

Construction of the improved smoker is 60% complete and in progress.

Outstanding Achievements

The draft design of the improved smoker was presented to the team members for discussions and corrective measures incorporated in the final draft which is completed.

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

Purpose

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

Project Objectives

- Investigate the storage stability of groundnut products.
- Investigate the effect of processing and variety on anti-nutritional factors
- Investigate the effect of additives (sugars, stabilizers etc.) on the rheological properties.
- Document recipes using groundnuts.

Outputs

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

Research Activity in Progress

Compilation of groundnut recipes existing in the country and testing the recipes in progress

Outstanding Achievements

Twenty-five groundnut dishes have been complied and prepared in the kitchen so far. The results have been documented.

Constraints

SARI has not provided us with the different varieties yet. We are hoping to work on the 4 main varieties consumed in the country when we receive them from SARI.

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

Purpose

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

Project Objectives

- To establish the extent of quality-defect characteristics of the three shell-fishes.
- To examine the effect of live-holding of the three shell-fishes on their quality.
- To determine the effect of local processing and frozen preservation of lobsters on its quality
- To adapt the HACCP applications in lobster processing plants.

Outputs

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

Research Activity in Progress

- Identification of major species and ecology in Ghana including major fishing grounds and landing sites
- Problems encountered by fishermen and exporters
- Type of holding containers for life catches
- Major exporters and quality criteria used
- Quantities exported and revenue gained as foreign exchange

Outstanding Achievements

- Major catching and landing sites and activities have been documented
- Exportable main species in Ghana have been identified
- Handling, grading processing, packaging storage, marketing and export criteria have been noted.
- Major exporters of the species have been located

Constraints

Shrimpers and exporters unwilling to disclose information on some activities until induced financially.

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

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.

Project Objectives:

- To develop low cost, affordable and yet efficient food-grain drying machines (diesel/Kerosene operated) for small & medium scale producers, processors and marketing agencies
- To allow early harvesting of food-grains (maize, cow-pea, etc.) thus eliminating on farm moulds and pests infestation due to delayed harvesting.
- To enhance storage (shelf-life) of food-grains
- To achieve high quality products (maize, cowpea, etc.) to meet the export market requirements.

Outputs

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

Research Activity in Progress

- Establish the design considerations based on scale of operation and production.
    - Surveys have conducted in some of the major maize growing areas and organizations to ascertain types and capacities of existing dryers, and levels of production and handling.
    - Surveys covered Ejura Farms Limited in the Ashanti region, food Distribution Corporation – Sunyani and Wenchi in the Brong – Ahafo region, The Nkwanta-Kpasa district, the Krachi-Dambai district, the Hohoe and Kpandu district in the Volta region.
    - Surveys will be continued to cover the maize, rice and cowpea production areas in the Eastern, Northern, and remaining parts of Volta, Brong-Ahafo and Ashanti regions.
- Design and construct prototype atomizer.
    - Design work on the prototype atomizer is about 75% complete, and some of the items for the construction have been purchased. Construction will start as soon as the rest of the materials are purchased.
- Design and construct heat generator.
    - Design work on the heat generator is about 50% complete.
    - Some of the construction materials for the heat generator have been purchased due to the continuous sharp increases in the prices of the construction materials.
- Outstanding Achievements
    - 50% of the basis for the design of a prototype dryer has been established.
    - Design work on the prototype atomizer is 70% complete.
    - Design work on the heat generator is 50% complete.

Constraints

- Work could not start in April as planned due to the late release of funds.
- Only about 30% of the funds needed was released.
- Not all the materials needed were readily available on the market

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

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.

Project Objectives:

- To investigate the post-harvest physiology relevant to shelf life of selected traditional leafy vegetables.
- To developed an appropriate technology for increasing the shelf-life
- To assess the market potential

Outputs

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

Research Activity in Progress:

Investigation of the post-harvest physiological indices (CO_2, O_2 and water stress) of *Amaranthus viridis*. For this activity, the production of fresh *A. viridis* on the campus of the FRI has been contracted out to vegetable farmer.

Outstanding Achievements

Data on post-harvest physiological indices of *A. viridis* almost completed. Thus about 75 % of the anticipated work for the on-going activity completed.

Constraints:

Late release of money for project affected the timing for the production of fresh *A. viridis* needed to begin the project. This is because at the time the first trench of money was released most vegetable farmers in and around Accra had already used up their land to cultivate maize.

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

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.

Project Objectives

- Conduct surveys to identify and collect all newly released varieties of bambara, cowpea and soybean in collaboration with the CRI.
- Determine the physiochemical, functional and anti-nutritional characteristics of released bambara, cowpea and soybean varieties.
- Evaluate selected varieties for their processing characteristics and specific food uses.
- Disseminate developed processing technologies through seminars and training workshops.

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.

Research Activity in Progress

- Surveys are being undertaken to identify and collect new varieties of bambara, cowpea and soybean that have been released to formers by the Crops Research Institute, Kumasi and the Savannah Agricultural Research Institute, Nyankpala.
- Determination of the physico-chemical characteristics of some of the new varieties is in progress.

Outstanding Achievements

Four new varieties of soybean and two new varieties of cowpea have been identified to be characterized in terms of their physico-chemical, functional and anti-nutritional properties.

Constraints:

Funds released for the project inception was grossly inadequate

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

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.

Project Objectives

- To study the efficacy of smoke from certain plants against *Sitophilus zeamays*, *Fusarium moniliforme* and *Aspergillus flavus*.
- To use smoke from a plant identified in 1) above to preserve maize in smoke fumigation boxes.
- To construct and evaluate, at the farm gate, cribs that will utilize smoke.
- Study the nutritional and organoleptic properties of smoke treated maize

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.

Research Activity in Progress

Construction of smoke fumigation boxes is underway; Glass ware, thermometers, media and other materials needed to accomplish objective 1 have been purchased; *In vitro* testing of smoke against fungi and insects using the smoke fumigation boxes is about to commence.

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.

8.1.5 Seminars

During the year under review, the project hosted the 6th International Seminar on Traditional Fermented Foods from 1 – 5 July. Participants came from 13 African Countries and others from Denmark, Germany and Malaysia. More than 30 scientific papers were presented including 7 papers from FRI team members.

8.1.6 Laboratory Accreditation

Activities in preparation for the accreditation of the Microbiology, Mycotoxin and Chemistry laboratories to ISO 17025 Quality System continued during the year under review. Ms Annette Lille from Denmark conducted an audit of the Institute's Quality System. A number of nonconformities were identified including several major ones. The conclusion of the audit was that the Quality System was only implemented to a limited extent in the laboratories. Upon the recommendation of the auditor, a steering committee with the responsibility to further develop and implement the Quality System to a level where accreditation is achievable was set up. Two working groups were also set up i.e. Microbiological Technical Committee and Chemistry Technical Committee. These three groups held several meetings during the year to address most of the nonconformities identified in the audit.

8.2 DFID/NRI/FRI Project on Improved cassava chip processing to access urban market

8.2.1 Collaborating Institutions

National Resource Institute, University of Greenwich, UK and Food Research Institute, CSIR, Ghana

8.2.2 Background

Originally, this was a project on improving the post-harvest technology and marketing of cassava and cassava chips. It initially involved the Ministry of Food and Agriculture (MoFA) and National Resource Institute (NRI) of the UK. This was as a follow up to a needs assessment studies carried out by MoFA and the NRI. The study established the need for cassava farmers in several regions of Ghana to diversify their market outlets as a means of increasing incomes and improving their livelihoods. As a result, studies on a number projects aimed at identifying opportunities for marketing cassava products such as the flours and starches began. It was followed by studies on the development and orientation of cassava mini-chip production in relation to national and international markets for food consumption and animal feed in Ghana.

During the year under review, Research International (RI), a local marketing research company in Ghana, was contracted by the NRI to investigate the potential markets for cassava chip and other cassava products. In their findings, they identified fufu flours and kokonte as possible products likely to have tremendous markets both domestically and internationally. They however catalogued a number of complaints, by consumers, with the present crop of cassava products being sold in some of the supermarkets in Accra. These were, in summary, the cost and some adverse sensorial properties. It was at this stage that the FRI was contacted to join the project. A number of technical interventions were suggested aimed at addressing the problem of cost of the production as well as some of the consumers' concerns as enumerated by the RI survey.

8.2.3 Progress Report

Functional properties (water binding capacity, swelling capacity and swelling power) of all formulated fufu samples have been compiled and compared with the functional properties of commercial fufu flours available on the Ghanaian markets.

An in-house sensory evaluation by 15 FRI staff has been completed to compare formulated fufu products with commercial ones. Key sensory attributes monitored were texture, taste, mouth feel, aroma, colour and overall acceptability. In general, formulations containing cassava flour

from the *Abasa fitaa* variety scored equally or better than commercial products prepared with cassava starch. This indicates that cassava flour made from *Abasa fitaa* is an acceptable (and cheaper) alternative to cassava starch in the formulation of instant fufu. Products formulated with cassava flour from *Gblemo duade* variety were also highly rated, but sensory parameters showed greater variation than product made from *Abasa fitaa* flour.

Factory location testing has been conducted with one of the participating manufacturers, *So Fine Ventures Ltd.* The manufacturer tested the FRI cassava flour in his commercial formulation and testified that it compares very favourably with the standard formulation. An order for 1000 kg of the cassava flour to incorporate into his products was supplied.

A baseline quality assurance audit was conducted at the premises of one of the participating manufacturers, Praise Export Services Ltd.

8.3 DFID/FRI Project on 'Sustainable Uptake of Cassava as an Industrial Commodity'

8.3.1 Project Highlights

The project has adapted and fine-tuned a technology for the production of glucose syrup for use in the manufacture of biscuits, confectionery and other food products. Samples of the product have been supplied to various end-users for individual assessment. The product in its current form has met the specifications of biscuit manufacturers. Trials are also under way to further improve the product quality so as to meet the specifications of the confectionery industry, which is the largest single consumer of glucose syrup in the country.

The project has in collaboration with other partners also produced three high quality training manuals for training in the production of glucose syrups, high quality cassava flour and cassava-based bakery products. The Ministry of Food and Agriculture in appreciating the quality and value of these manuals has made a formal request – through the NBSSI - for a quantity supply of the manuals for distribution to extension staff under the RTIP project to facilitate training of farmers and small-scale processors.

8.3.2 Contribution to National Economy

No industry in Ghana currently produces glucose syrup. Meanwhile over 100,000 metric tons of glucose syrup is imported annually into the country for use in various industries. In building the

capacity of the afore-mentioned industries to produce glucose syrup the project is saving the country a huge amount of foreign exchange that can be re-channelled to other areas of the economy. In addition end-users of glucose syrup are going to have a ready local supply of the product and would therefore not need to lock up capital in stocks of glucose syrup. This would release their capital for use in other ventures that would promote the economy at large.

The local production of glucose syrup would be a source of employment within the country, which apart from generating income for the citizens would also help reduce crime rates in the country. The use of the training manuals produced under the project would also equip rural farmers and processors with practical skills that would enable them generate income and improve their livelihoods.

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

Work in the laboratory on the optimization of the parboiling process continued. Using an X-ray diffractometer, the percent crystallinity and x-ray diffraction patterns were determined for both parboiled and raw milled samples. The percent crystallinity is a very good indicator of the severity of parboiling as it measures the levels of crystalline amylose present in the sample. Severely parboiled present samples tend to have low percent crystallinity.

The percent crystallinity of the raw sample was 24.6% and this level of crystallinity decreased as the severity of parboiling increased. Sample 30-4 had been soaked in water at 30 C and steamed for 4 minutes. The soaking of the paddy in water at 30 C was not expected to affect the degree of crystallinity so the change in crystallinity from 24.6% in the raw to 22.6% in sample 30-4 was entirely due to the steaming of the sample for 4 minutes. Changes in relative crystallinity for most of the laboratory parboiled rice samples, 90-8 and 90-12 that had relative crystallinities of between 20.0% and 22.6%

X-ray diffraction patterns showed that the raw sample had a distinctively A-pattern and although this changed towards the V-pattern as a result of parboiling, the changes were not pronounced, even for sample 90-12. This means that the amount of heat applied even to the 90-12 was not enough to change the A-diffraction pattern in the raw sample to a distinctively V-pattern. X-ray diffraction patterns reported by Becker *et.al.*, (2001) showed that the A-pattern got totally

disrupted at heating maize grits at 140 C for 10 minutes and a distinctively V-pattern appeared only after heating the maize grits at 140 C for 20 minutes.

The commercially parboiled rice sample, *Tilda*, had a percent crystallinity of 5.5% and was unique when compared to the others. It had distinctively V-diffraction pattern as a result of the strong heat treatment it had received. The amylose peaks aren't detected and the V-pattern appeared.

8.4.1 Aroma of Cooked Rice

Several aroma compounds were identified by solid phase micro-extraction (GC-MS). These are 2-decenal, linoleic acid, nonanal, acetic acid, palmitic acid, hexanal, benzenacetaldehyde, benzadehyde, 1-octen-3-ol, 2-heptenal, 2-pentylfuran and 1-hexanol. The analysis carried out was qualitative and not quantitative. As a result it is the relative abundance of the compound that are reported and not the absolute amounts present.

Compounds like linoleic acid, palmitic acid and 1-hexanol had very high relative levels in the raw sample and this diminished on parboiling. These compounds could therefore be contributing significantly to the characteristic aroma of the raw sample used and the parboiling process reduced them to relatively low levels. On the other hand, 2-decenal and 2-heptenal had low levels that dramatically increased on parboiling. These two compounds could therefore to be important contributors to the characteristic aroma of parboiled rice. The levels of these compounds were highest in the commercially parboiled "tilda" sample and the more severely laboratory parboiled samples of 90-12 and 90-8.

The situation with the other volatile compounds found on the rice samples was somehow mixed. On parboiling, the levels of nonanal, acetic acid, hexanal, benzenacetaldehyde, benzaldehyde, and 1-octen-3-ol increase slightly but levels in the commercially parboiled sample (Tilda) were considerably higher. This increase could have taken place over time during storage, as the commercial sample was older than the laboratory samples. These compounds although believed to build up in storage nevertheless are also important contributors to the aroma of parboiled rice. For 2-pentylfuran, the levels decreased on parboiling but just like others, the level in the "tilda" sample was higher. The compounds above that build up in storage could also be responsible for

the characteristic off-flavours of parboiled rice that have been stored for long periods at ambient temperatures.

8.4.2 Differential Scanning Calorimetry

The gelatinisation temperature is actually a narrow temperature range at which starch granules begin to swell, loose crystallinity and increase in viscosity. The exact temperature at which starch begins to undergo these charges is the gelatinisation onset temperature. The gelatinisation onset temperature for the raw rice sample was 71.5 C. This temperature was the one with parboiling. The sample with the mildest parboiling treatment was the one that had been soaked in water at 30 C and steamed for 4 minutes (sample 30-4).

This sample had an onset temperature of 76.5% C. Since the soaking temperature of 30 C was significantly below the onset gelatinisation temperature of the raw rice of 71.5 C, it can be said that soaking at this temperature did not contribute to pre-gelatinisation of the starch in this sample. As a result, it can be said that, it was the steaming of this sample for 4 minutes that was solely responsible for the increase in the gelatinisation temperature from 71.5 C to 76.1 C. During this steaming, the starch granules in the sample that were easier to gelatinise were gelatinized and as a result not available to be gelatinized in this parboiled rice sample in the calorimeter. The only difference between sample 30-4 on one hand and 30-8 and 30-12 on the other is that the latter sample had been steamed for 8 and 12 minutes respectively as against 4 minutes for 30-4. The increased time of steaming increased the onset gelatinisation temperature for 30-8 and 30-12 to 76.9 C and 77.3 C respectively. The peak temperature is the temperature at which the majority of the granules are gelatinized and the conclusion temperature, the temperature at which the starch is completely gelatinized. These indices also increased with parboiling. The raw sample had a peak temperature of 77.0 C and a conclusion temperature of 86.3 C. The 30-4 and 30.8 samples had identical peak and conclusion temperatures of 81.0 C and 89.8 C respectively. Peak gelatinisation temperatures ranged between 80.1 C and 82.3 C among the parboiled rice samples. Although the highest peak gelatinisation temperature was obtained for the samples that had been given the severest parboiling treatment (sample 90-12), there was no clear trends between the samples for this parameter. The same can be said for the conclusion temperatures. Conclusion temperatures ranged from 87.8 C to 90.4 C for the parboiled rice samples as against 86.3 C for the raw samples. In this also, the highest conclusion temperature was recorded for the 90-12 samples but no clear trends emerged.

The pattern of change in the gelatinisation onset temperatures was similar to the enthalpies of gelatinisation. The enthalpy of gelatinisation is the energy per gram (dry matter) needed to completely gelatinize ungelatinised starch present in the sample. While the gelatinisation onset temperatures increased with the intensity of parboiling, the enthalpy of gelatinisation decreased with parboiling intensity. The enthalpy of gelatinisation for the raw sample was 5.31 J/g while that of the mildest parboiled sample, 30-4, was 3.73 J/g. Generally, gelatinisation enthalpy decreased as the soaking temperature increased from 30 C through 50 C and 70 C to 90 C. At any particular soaking temperature, gelatinisation temperatures decreased as steaming times increased from 4 and 8 minutes to 12 minutes. There were however some overlaps e.g sample 30-12, which was soaked at 30 C and steamed for 12 minutes had a lower enthalpy than sample 50-4, which was soaked at 50 C and steamed for 4 minutes. This means that sample 30-12 was more severely parboiled than 50-4. The same was the case for sample 50-12, which had a lower enthalpy than sample 70-4 and sample 70-12, which had a lower enthalpy than sample 90-4. The enthalpy of gelatinisation for the severest parboiled sample in the laboratory, 90-12 was 1.72J/g. The enthalpy of gelatinisation for the commercially parboiled sample was 0.34 J/g. The gelatinisation curve for the commercially parboiled sample was so flat that the calorimeter could not detect the exact gelatinization temperature.

8.5 FRI/NRI/DFID Marketing and Processing of Bambara Groundnuts (W. Africa)

This is a two-year collaborative project. The purpose of the project is to develop and effectively promote strategies that improve food security of poor households through increased availability and improved quality of cereals and pulse foods, and better access to markets. The expected outputs are that improved methods for cooking bambara, which significantly reduces both time and resources required, are developed for small-scale farm families, and production and market potential for bambara assessed. Research activities undertaken in pursuance of the set objectives include:

- a nation-wide survey of the production, processing and marketing of bambara groundnut in Ghana,
- studies to determine market potential of bambara in Africa and elsewhere,
- studies on the use of a local rock salt, *kawe*, as a tenderizer for bambara to reduce cooking time,
- development and quality evaluation of an acceptable high quality bambara flour,

- farmer participatory testing of the high quality bambara flour, as well as
- development and testing of recipes based on the high quality bambara flour.

During the first quarter of the year under review, a one-day stakeholders' workshop was held on the 26th of February 2002, in Tamale, Northern Ghana on marketing and processing of bambara groundnuts, as a final activity of the project. The theme for the workshop was *"Making Better Use of Bambara to Help Address Livelihood Constraints of Farmers"*. The purpose of the workshop was to provide a forum for information exchange to promote new processing techniques for bambara. The programme consisted of an opening session, followed by a technical session. An exhibition of bambara foods was mounted by traditional food processors/cooked food vendors in Tamale who participated in the field tests conducted on the high quality bambara flour developed under the project.

With the completion of the project, an 83-page final Technical Report was prepared and submitted to the CPHP secretariat. A total of eleven publications were produced as major technical outputs of the project.

8.6 *DFID/NRI/CSIR/NARO Institutionalizing IMPACT Orientation: Building a performance management approach that enhances the impact orientation of research organizations*

'Institutionalizing Impact Orientation' was a 16-month inception project designed to introduce performance management concepts and build the performance management capacity of a pilot group of agricultural research organizations. The project was the first phase of a larger initiative to develop and implement effective performance management systems in public research institutions. Two organizations in Ghana, the CSIR-Crops Research Institute and CSIR-Food Research Institute, and the National Banana Research Programme in Uganda, participated in the project.

8.6.1 Demand for the Project

The demand for this project was based on recognition that the public policy reforms associated with donor aid delivery, particularly poverty reduction strategies and associated expenditure frameworks, require research and development organizations to have clear, accountable and attributable measures of performance to demonstrate their impact. Moreover, the emphasis now being placed on client orientation through decentralized programmes implies a need for 'joined-

up' monitoring and evaluation (M&E) systems that not only incorporate broader perspectives and clientele, but also focus more closely on results and service delivery. This pressure is keenly felt in agricultural research organizations, where funders' perceptions of a lack of evidence for the uptake and impact of products and services are questioning the organizations' efficacy and existence.

8.6.2 Monitoring the Right Things

In attempting to address this situation, the project focused on the need within agricultural research organizations for systems that monitor changes over which the organizations and their employees have direct control or a manageable interest, rather than on systems which measure longer-term outcomes and impacts over which they have less direct influence. The balanced scorecard was adopted as the central approach for developing a performance management system. It has proven successful within private sector corporations and is increasingly being used in the public sector. The scorecard provides a 'balanced' view of an organization's performance across four perspectives; employee, business, client and financial. It stresses a balance between monitoring internal processes and the views of the clients and other stakeholders; both are seen as crucial to an organization's survival within an increasingly complex and competitive global environment, and should be internalized within any performance management system.

8.6.3 Conclusions

The project set out to develop and institutionalize performance management systems that enhance the impact orientation of research organizations. This goal involved conducting activities within this phase, and a future phase. On reflection, the project team felt that it has moved a considerable way in the direction of achieving this goal – having identified, contextualized and built upon a performance management approach that is relevant to the R&D sector. The core principles – participation, iteration and reflection – were central to the progress made in institutionalizing ideas and approaches during this inception phase.

8.6.4 Future Actions

The aim of the project team is to move forwards in two directions, i.e. with the CSOs – the main focus of activities to date – and with dissemination to, and engagement with, other stakeholders to broaden the knowledge and experience base.

Chapter – 9

ROOT AND TUBER IMPROVEMENT PROGRAMME

POST-PRODUCTION AND MARKETING COMPONENT

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. The specific objective of RTIP which the Post-Production and Marketing (PPM) component seeks to achieve is to improve access of resource-poor farmers, farmer groups and rural communities, including women to improved post-production technologies. This is being pursued through:

- Research involving sourcing and documentation of information on post-production technologies for root and tuber crops;
- Production of identified technologies by disseminating information through training of staff, potential users and beneficiary groups; and
- Adoption of post-production technologies through production and storage facilities.

During the year under review, the component sought to achieve the following:

- Identification and dissemination of locally adapted processing technologies and equipment for target groups;
- Promotion of recipes of root and tuber crops;
- Promotion of good storage technologies for processed root and tuber crops, and
- Building capacity to promote post-production and marketing of rood and tuber crops, and investigate PPM issues.

9.2 Establishment of Cassava Flour Pilot Plants

The construction of four Cassava Flour Pilot Plants, which was commenced in 2001 at Adidwan (Ashanti Region), Gomoa (Central region), Sokode (Volta Region) and Amanase (Eastern Region) had been completed by 31 December 2002. All pilot plants had been supplied with grater and press. The Amanase plant came into operation and the group, which is also engaged in the processing of cassava into gari, had started processing cassava into flour after being trained by FRI.

A private group, The Amasa Cassava Processors Association at the Motherwell Farms, Ayikai Doblo were also assisted to establish a cassava processing plant.

9.3 Construction of improved gari stoves for beneficiary groups

Participatory Rural Appraisal were carried out in 4 towns in near Ho in the Volta Region. Eight improved gari roasting stoves were constructed for gari processing and women's groups in the four Tanyigbe towns.

9.4 Research projects

Research on producing agbelima using unfermented cassava flour was accomplished successfully. Fermentation of the unfermented cassava flour was carried out by both spontaneous fermentation and through the use of a starter culture.

Research on using cocoyam and cassava peels to grow both oyster and oil palm mushroom were carried out. The use of cocoyam peels proved more successful and appreciable yields were obtained.

Chapter – 10

FRI/MoFA/ADB FOOD CROPS DEVELOPMENT PROJECT

10.1 Introduction

The Food Crops Development Project is being executed by the Ministry of Food and Agriculture with funding by the African Development Bank. The project which is located in eight districts within four regions of Ghana will be of 5 years duration, and it aims at increasing the overall production of maize, sorghum, cowpea, Groundnuts and soybean with a view to raising household incomes, improving the overall nutrition and food security of small holder farmers. One area the project seeks to promote is the processing and utilization of soybean. Soybean is cultivated on a small scale in Ghana because of its limited utilization but it is a crop with the potential to reduce protein deficiency in the diets of Ghanaians.

10.2 Goals

The project intends to promote soybean processing and utilization in the project districts through the identification of appropriate processing technologies for the small-scale farmer. The Food Crops Development seeks to encourage the utilization of soybean through an understanding of the potential use of soybean in Ghana at the level of the smallholder farmer. To achieve this objective the FCDP has given the Food Research Institute, as the lead organization, the responsibility to undertake a study on soybean processing and utilization at the level of the small-scale farmer in Ghana.

10.3 Objectives

The main objectives of the project are:

- To determine the level of production and utilization of soybean in human and animal diet in the target areas
- To collect and investigate information on methods of processing soybeans, including the making of flour, milk, oil, animal feed and soap
- To determine the appropriateness of the operations to Ghana and especially at the household level.

During the year, a combination of semi-structured survey questionnaires and check list/discussion guides together with Rapid Rural Appraisal/Assessment techniques and focus group discussions were used to collect data in all the ten selected districts. The districts covered include: Nkwanta and Krachi in the Volta Region, Wenchi and Nkoranza in the Brong Ahafo Region, Ejura Sekyedumasi and Sekyere East in the Ashanti Region and West Gonja (Damongo) and East Dagomba (Yendi) districts in the Northern Region. Additionally two major soybean producing and/or consuming districts one from the Upper East Region

Appendix 1
FOOD RESEARCH INSTITUTE MANAGEMENT BOARD - 2002

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 G. S. Ayernor Head, Dept. of Nutrition & Food Science University of Ghana, Legon	-	Member
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5.	Mr Timothy Osei Oduro, Adiya, Osei & Co. SEDCO House P. O. Box 5712, Accra-North	-	Member
6.	Mr. Alex Ntiforo Ghana Standards Board P. O. Box M.245, Accra	-	Member
7.	Mrs Leticia Osafo-Addo Processing Foods & Spices Ltd. P. O. Box 186, Community 2, Tema	-	Member
8.	Mr. Ebenezer Barnor P. O. Box 295 Mamprobi - North	-	Member
9.	Dr. W. A. Plahar Director, Food Research Institute (FRI) P. O. Box M.20 Accra	-	Member

Appendix II
FRI SENIOR STAFF LIST (2002)

Directorate

1. W. A. Plahar - Director
   BSc (Gen.), BSc (Hons) MSc Fd. Sci. (Ghana)
   PhD (Washington) (Chief Research Scientist)

2. W. K. Amoa-Awua - Deputy Director
   BSc (Ghana) MSc. App. Sci. (New South Wales)
   PhD (Ghana) (Principal Research Scientist)

3. R. M. Yawson - Scientific Secretary
   BSc. (Hons) M. Phil. (Biochem) Ghana
   Post Grad. Cert. Fd. Mgt. (Jerusalem) (Research Scientist)

4. J. Aggrey -Yawson - Snr Admin Asst.

Food Microbiology Division

1. M. Halm (Ms) - Senior Research Scientist
   BSc (Gen.) BSc (Hons), MSc Botany (Ghana)
   Post Grad. Dip. Rural Fd. Tech (Netherlands) (Head of Division)

2. M. Ottah-Atikpo (Mrs.) - Research Scientist
   BSc Microbiology, MSc Fisheries (ABU, Zaria)

3. M. Obodai (Mrs.) - Research Scientist
   BSc (Hons), MPhil. Botany (Ghana)

4. C. Tortoe - Research Scientist
   BSc (Hons), MPhil. Botany (Ghana)

5. P. K. Feglo - Research Scientist
   BSc (Hons), Zoology (Ghana)
   MSc, Clinical Microbiology (UST)

6. M. Owusu (Ms.) - Research Scientist
   BSc (Hons), MPhil. Botany (Ghana)

7. J. Cleland-Okine (Ms) - Asst. Res. Scientist (Temp.)
   BSc (Hons), Biology (UST)

8. Matilda Dzomeku (Mrs.) - Asst. Res. Scientist (Temp.)
   BSc Biological Sciences (UST)

9. D. K. Asiedu	-	Chief Tech. Officer
10. B. Amoako	-	Prin. Tech. Officer
11. J. Anlobe	-	Prin. Tech. Officer
12. Peter Addo	-	Prin. Tech. Officer
13. R. Takli	-	Technical Officer
14. D .K. Baisel	-	Technical Officer
15. Theophillus Annan	-	Technical Officer

Food Chemistry Division

1. E. K. Ankrah B.Sc. (Gen.) Ghana MSc Food Quality Control (Reading)	-	Prin. Research Scientist (Head of Division)
2. K. Kpodo (Mrs.) BSc (Gen.) BSc (Hons) Ghana MPhil. (West Indies)	-	Senior Research Scientist
3. N. T. Annan (Mrs.) BSc (Hons) Fd. Sci. (Ghana), MSc Fd. Sci. (Nova Scotia)	-	Senior Research Scientist
4. G. A. A. Anyebonu BSc (Hons), MPhil. Botany (Ghana)	-	Research Scientist
5. C. Diako BSc (Hons), Fd. Sci & Nut. (Ghana)	-	Asst. Res. Scientist (Temp.)
6. N. A. Asare	-	Chief Tech. Officer
7. E. A. Allotey	-	Chief Tech. Officer
8. S. Antonio	-	Prin. Tech. Officer
9. W. K. Amevor	-	Prin. Tech. Officer
10. P. A. Addo	-	Prin. Tech. Officer
11. Mensah Toku	-	Senior Tech. Officer
12. D. N. A. Ankrah	-	Technical Officer
13. N.Y. Amey	-	Technical Officer

Nutrition & Socio-Economics Division

1. P. Lokko (Mrs.) - Senior Research Scientist
   B.Sc. (Gen.) BSc (Hons) MSc Biochem (Ghana) (Head of Division)
   Dip. Fd. Sci. & Nut. (The Netherlands)

2. W. Quaye (Mrs.) - Research Scientist
   BSc (Hons) MPhil. Agric. Econs. (Ghana)

3. P. Larweh (Mrs.) - Assistant Research Scientist
   BSc (Hons) Home Sci. (Ghana)

4. I. Johnson-Kanda (Ms.) - Asst. Res. Scientist (Temp.)
   BSc (Hons) Fd. Sci & Nut. (Ghana)

5. I. A. Tamakloe (Mrs.) - Prin. Tech. Officer

Commercialization & Information Division

1. A. Osei-Yaw (Mrs.) - Principal Research Scientist
   BSc (Gen.), Ghana, (Substantive Hd. of Division)
   MSc. Fd. Sci. & Nut. (Washington) (On Secondment to CSIR)

2. P. Lokko (Mrs.) - Senior Research Scientist
   B.Sc. (Gen.) BSc (Hons) MSc Biochem (Ghana) (Ag. Head of Division)
   Dip. Fd. Sci. & Nut. (The Netherlands)

3. A. Andoh - Chief Tech. Officer
4. B. Awotwi - Prin. Tech. Officer
5. R. Kavi - Prin. Lib. Assistant
6. B. P. Osae - Technical Officer
7. P.O. Baidoo - Technical Officer

Food Processing & Engineering Division

1. G. Nerquaye-Tetteh (Mrs.) - Senior Research Scientist
   BSc (Gen.) BSc (Hons) Ghana (Head of Division)
   MPhil (UST)

2. P. N. T. Johnson - Senior Research Scientist
   BSc (Hons), Biochem. (UST)
   MSc. Agric. Eng. Tech. (Cranfield)
   PhD Food Tech. (Reading)

3. D. Blay - Research Scientist
MSc Chem. Eng. (Moscow)

4. P. Adu-Amankwa (Mrs.) - Senior Research Scientist
BSc (Hons) Biochem (UST)
MSc. Fd. & Mgt. Sci.,
PhD Post-Harvest Physiology (Lond.)

5. E. C. Tettey - Research Scientist
BSc (Hons) Agric (UST)
Post-Grad. Dip. Fd. Tech.,
MPhil, (Humberside, UK)

6. N. T. Dziedzoave - Senior Research Scientist
BSc (Hons), Biochem. (UST)
Post. Grad. Dip. in Fd. Sci. & Nut., (Gent, Belgium)
MSc Fd. Sci. & Tech. (UST)

7. L. D. Abbey - Research Scientist
BSc (Hons), Biochem. (UST)
MSc. App. Sci. (Fd. Tech.) New South Wales

8. C. K. Gyato - Research Scientist
Nat. Dip. in Agric. Mech. (Ghana)
MSc Agric. Eng. (Bulgaria)

9. J. T. Manful - Research Scientist
BSc (Agric), Dip. Ed. (Cape Coast)
MPhil Biochem. (UST)

10. K. A. Vowotor - Research Scientist
B.Sc. Zoology Dip. Ed. (Cape Coast)
M. Phil. PhD Crop Science (Ghana)

11. B.A. Mensah - Research Scientist
MSc. Fd. Press. Tech. (Kransnodar, USSR)

12. S. K. Noamesi - Research Scientist
BSc (Agric) MSc Fd. Sc. (Ghana)

13. J. Gayin - Research Scientist
BSc (Hons) Biochem (UST)
MSc Fd. Tech. (Gent)

14. G. A. Komlaga BSc (Hons) Biochem (Ghana) MSc Fd. Sc. & Tech. (UST)	-	Research Scientist
15. D. Abusah BSc (Hons) Chem., MSc Chem. Eng. (UST)	-	Research Scientist
16. C. Oduro-Yeboah (Mrs.) BSc (Hons) Biochem (Ghana)	-	Assistant Research Scientist
17. E. A. Baidoo BSc (Hons) Biochem (UST)	-	Asst. Res. Scientist (Temp.)
18. J. K. Magbo	-	Chief Tech. Officer
19. J. F. Asigbey	-	Chief Admin. Asst.
20. S. A. Sampare	-	Chief Tech. Officer
21. K. Opoku-Acheampong (Mrs.)	-	Chief. Tech. Off.
22. J. R. Addo	-	Snr. Tech. Off.
23. E. Ablorh	-	Snr. Tech. Off.
24. S. A. Tagoe	-	Snr. Technical Officer
25. J. A. Asafu-Adjei	-	Prin. Works Supt
26. R. Y. Anthonio	-	Prin. Works Supt.
27. C. T. Yeboah	-	Works Supt.
28. G. K. Akleih	-	Works Supt.
29. R. M. Mawuli	-	Works Supt.
30. J. L. Lamptey	-	Works Supt.

Accounts Division

1. J. Mintah	-	Prin. Accounting Asst. (Head of Accounts)
2. J. Mintah Nakotey	-	Chief Stores Supt.
3. C. Aikins Tutu	-	Snr. Accounting Asst.
4. S. O. T. Oddoye	-	Snr. Stores Supt.
5. G. O. Gyamfi	-	Stores Supt.

Administration Division

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

Appendix III
PROMOTIONS ANNOUNCED IN 2002

Name	From	To
Dr. Pearl Adu- Amankwa	Research Scientist	Snr. Research Scientist
Nanam Dziedzoave	Research Scientist	Snr. Research Scientist
Mr. David Baisel	Snr. Techn. Off.	Principal Techn. Off.
Mr. D.N.A. Ankrah	Snr. Techn. Off.	Principal Techn. Off.
Mr. S.K. Akleih	Snr Works Supt.	Prin. Works Supt.
Mr. Richard Takli	Techn. Assist. Gd. 1	Techn. Off.
Mr. Michael Amoo-Gyasi	Techn. Assist. Gd. 1	Techn. Off.
Mr. Isaac Nyarko	Techn. Assist.	Snr. Techn. Assist.
Ms. Victoria Alambire	Clerk Gd. 1	Snr. Clerk
Mrs. Buellah Sallah	Clerk Gd. 1	Snr. Clerk
Mr. Reuben Tetteh	Driver Gd. II	Driver Gd. I
Mr. Alimayao Gariba	Driver Gd.II	Driver Gd. I
Mr. Anthony Sevor	Driver Gd. II	Driver Gd. I
Mr. Samuel Odjao	Driver Gd. II	Driver Gd. I
Mr. Derrick Ashley	Tech. Assist. Gd. III	Tech. Assist. Gd. II.
Mr. Samuel Asiedu	Tech. Assist. Gd. III	Tech. Assist. Gd. II.
Mr. Eklu Azalekor	Jnr. Foreman	Foreman.

Appendix IV
APPOINTMENTS

Name	Designation
Ivy Johnson- Kanda (Ms.)	ARS
Matilda Dzomeku (Ms.)	ARS
Charles Diako	ARS
Theophilus Annan	Technical Officer
Patrick Minta	Technical Officer
Cosmos Awadzi	Accounting Assistant,
Christian Amegah	Accounting Assistant,
Stephen Atta-Sonno	Library Assistant Gd. II,
Justina Thompson (Ms.)	Tech Asst. Gd.II
Pearl Asigbey (Ms.)	Tech. Asst. Gd. II

Appendix V
2002 SCIENTIFIC REPORTS AND PUBLICATIONS

A. Refereed Journal Publications

1. **Plahar, W.A.,** Okezie, B.O. and **Gyato, C.K.** 2002. Development of a high protein weaning food by extrusion cooking using peanuts, maize and soybeans. Plant Foods for Human Nutrition. In Press.
   CSIR-FRI/JP/PWA/2002/001

2. **Plahar, W.A.**, Okezie, B.O. and **Annan, N. T.** 2002. Nutritional quality and storage stability of extruded weaning foods based on peanuts, maize and soybeans. Plant Foods for Human Nutrition. In Press. **CSIR-FRI/JP/PWA/2002/002**

3. Nti, C.A., **Plahar, W.A**. and **Larweh, P.M.** 2002. Impact of adoption of an improved fish processing technology on household income, health and nutrition. Int. J. of Consumer Studies. 26(2): 102-108.
   CSIR-FRI/JP/NCA/2002/003

4. **Obodai, M.** & **Johnson, P-N. T.** 2002 The effect of nutrient supplements on the yield of *Pleurotus ostreatus* (strain jacq. Ex. Fr. kummer) grown on composited sawdust of *Triplochiton scleroxylon. Trop. Sci.*, 42, 78 - 82. **CSIR-FRI/JP/OM/2002/**

5. Smith D. R., Editor **Amoa-Awua W. K., Noamesi S. K.**, and **Yawson R. M.,** contributors (2002) "Institutionalising Impact Orientation – Building a Performance Management Approach that Enhances the Impact Orientation of Research Organizations" A Book Published by ITDG Publishing, Chatham UK, NRI, Greenwich University

6. Dakwa S., **Amoa-Awua, W. K.,** and Sakyi-Dawson E. 2002. The role of Bacillus species in the development of the characteristic aroma of traditional fermented soy-dawdawa *Ghana Journal of Science*. In Press

B. Technical Reports

1. Entsua-Mensah, M., deGraft-Johnson, K. A. A, **Atikpo, M. A. O.,** and **Abbey, L. A.,** 2002 The Lobster, Shrimp and Prawn Industry in ghana (Species, Ecology, Fishing and Landing Sites, Handling and Export) FRI/WRI Project Report **CSIR-FRI/RE/EMM/2002/001**

2. **Plahar, W. A., Annan, N. T., Larweh, P.M.,** Coote, C. and Stevenson, S. (2002). Making Better Use of Bambara to help address Livelihood Constraints of Farmers. A report of a Stakeholders Workshop held at the VRA conference room, Tamale, Ghana. February 26. **CSIR-FRI/RE/PWA/2002/002**

3. **Plahar, W.A**. 2002. Marketing and processing of bambara groundnuts (W. Africa), Final Technical Report, Project R7581. Food Research Institute (FRI), Accra, Ghana. 83pp.
   CSIR-FRI/RE/PWA/2002/003

4. **Johnson, P-N. T., Plahar, W.A., Blay, D.** & **Komlaga, D.** (2002) Determining the optimal mixing conditions for fortifying dehydrated fermented maize meal (DFMM) with a micronutrient premix. . MI/SAFGRAD/FRI Micronutrient Project. **CSIR-FRI/RE/JPNT/2002/**

5. **Quaye, W.**, Ameleke, G. and **Dziedzoave, N. T.** (2002). Economic Feasibility of Maltose Production in Ghana. Report on project Output 1.6 of the NRI/FRI collaborative project on 'New Markets for cassava'.

6. **Dziedzoave, N.T.**, **Gyato, C., Andah, A., Lokko, P.G.** and **Quaye, W.** (2002). The promotion of environmentally benign small and medium-scale cassava processing enterprises in Ghana. Final Technical Report on the IDRC/ARCT/FRI 'Agrofood enterprises project'.

7. **Johnson, P-N. T,** (2002) Report on Institutions Assisting the Micro-Small-Medium-Scale Food Manufacturing Companies in Ghana. An Inception Report for the Food Component Project of the Integrated Program of United Nations Industrial Development Organisation, Accra.

8. **Johnson, P-N. T,** Essel, K., E. T, Atupra, F & **Gayin, J.** (2002) Report of the baseline audit of the food safety and quality management system of Rush Farms and Processing Company Ltd. Consultancy Report for United Nations Industrial Development Organisation, Accra.

9. **Johnson, P-N. T,** Essel, K., E. T, Atupra, F & Gayin, J. (2002) Report of the baseline audit of the food safety and quality management system of Praise Products Ltd. Consultancy Report for United Nations Industrial Development Organisation, Accra.

C. Conference Papers

1. **Plahar, W.A. Annan, N.T., Larweh, P.M.,** Coote, C. and Stevenson, S. (2002) Making Better Use of Bambara to help Address Livelihood Constraints of Farmers. Volta River Authority Conference Room, Tamale, Ghana, 26 February 2002. **CSIR-FRI/CU/PWA/2002/001**

2. **Yawson R. M**. (2002) "The Place of Technology Based Incubators in Ghana's Economic Development" Paper presented at the International Conference on *Building an Innovation-Based Economy*. Paphos, Cyprus 7 –10 May 2002 **CSIR-FRI/CE/YRM/2002/001**

3. **Yawson R. M.** (2002) "Intellectual Property and Technology Commercialisation – Ghana's Experience" Paper presented at the international Congress of Technological Research Organisations. Porto Alegre, Brazil, 8 – 11 Sept., 2002
   CSIR-FRI/CE/YRM/2002/002

4. **Yawson R.** M. (2002) "Technology Commercialisation and Intellectual Property Rights in Ghana" Paper presented at the International Conference on TRIPS – Next Agenda for Developing Countries. Hyderabad, India 11 -12, Oct. 2002.
   CSIR-FRI/CE/YRM/2002/004

5. **Dziedzoave N.T.,** Graffham, A.J., **Mensah, B.A.,** and **Gyato, C.** (2002). Use of cassava flour in paperboard adhesives. In: 'Potential of root crops for food and industrial resources'. Proceedings of the 12th Symposium of the International Society for Tropical Root Crops (ISTRC), Tsukuba, Japan. Sept. 10-16, 2000. pp. 95-99. **CSIR-FRI/CE/DNT/2002/003**

6. **Annan, N.T.,** Poll, L., Jakobsen, M. and **Plahar, W. A.** (2002). Volatile compounds in Ghanaian fermented maize dough. A paper presented at the sixth biennial seminar on African fermented foods held in Accra, Ghana. July 2 - 4. **CSIR-FRI/CU/ANT/2002/002**

7. **Annan, N.T.,** Poll, L., Sefa-Dedeh, S., **Plahar, W. A.**, and Jakobsen, M. (2002). Aroma volatiles in Ghanaian fermented maize dough and the influence of added starter cultures. A paper presented at the sixth biennial seminar on African fermented foods held in Accra, Ghana. July 2 - 4. **CSIR-FRI/CU/ANT/2002/003**

8. **Annan, N.T., Plahar, W.A.** and Swetman T. (2002). Effect of `Kawe' treatment on water absorption and cooking characteristics of bambara groundnut varieties. Paper presented at the Stakeholders workshop on marketing and processing of bambara groundnut (FRI/NRI/DFID DPHP Project), held at the V.R.A. conference room, Tamale, Ghana. February 26. **CSIR-FRI/CU/ANT/2002/004**

9. **Atikpo, M. A. O.**; Amoa-Awua, W. K. A.; Lange-Mϕller, P.; Sefa-Dedeh, S. and Jakobsen, M. (2002). Phenotypic and genotypic characterization of yeasts during fermentation of soybean and cowpea fortified cassava dough. Sixth International Seminar on Traditional African Fermented Foods, held at Miklin Hotel, Accra, Ghana. July 2-5, 2002.

Appendix VI
INTERNALLY GENERATED FUNDS (IGF)

ANNUAL STATEMENT OF ACCOUNTS FOR THE YEAR ENDED 31ST DECEMBER, 2002.

INCOME	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER	TOTAL
Refund	6,000,000.00				**6,000,000.00**
Sale of Products	14,717,000.00	18,204,000.00	12,490,500.00	14,771,700.00	60,183,200.00
Analysis and Tech.Services	44,154,640.00	73,439,700.00	27,856,200.00	38,971,400.00	184,421,940.00
Training Fees	2,900,000.00	14,800,000.00	-	19,042,000.00	36,742,000.00
Fabrication	4,350,000.00	-	-	16,000,000.00	20,350,000.00
Miscellaneous	6,767,400.00	6,563,700.00	30,498,441.00	28,002,250.00	71,831,791.00
TOTAL INCOME (a)	**72,889,040.00**	**113,007,400.00**	**70,845,141.00**	**116,787,350.00**	**373,528,931.00**
LESS : DIRECT COST					
Production - Raw Materials	20,162,100.00	22,205,000.00	13,160,193.00	14,282,740.00	69,810,033.00
Fabrication Expenses	3,380,500.00	5,100,000.00	-	27,700,000.00	36,180,500.00
Chemicals	3,566,250.00	1,015,000.00	6,750,000.00	25,061,677.00	36,392,927.00
Operational Expenses	30,560,085.00	21,751,725.00	31,691,105.00	23,801,873.00	107,804,788.00
Training Expenses	-	5,463,200.00	-	10,459,122.00	15,922,322.00
Stationery Expenses	-	304,000.00	-	-	304,000.00
Refund - Composit Bag	-	1,400,000.00	-	-	1,400,000.00
TOTAL DIRECT EXPENSES (b)	**57,668,935.00**	**57,238,925.00**	**51,601,298.00**	**101,305,412.00**	**267,814,570.00**
NET INCOME (a-b)	**15,220,105.00**	**55,768,475.00**	**19,243,843.00**	**15,481,938.00**	**105,714,361.00**

DISTRIBUTION OF NET INCOME

NET INCOME		**105,714,361.00**
15% - CSIR	**15,857,154.15**	
85% - FRI	**89,857,206.85**	
		105,714,361.00

In-Flows from Donor Funded Projects for the Year Ending 2002
As Compared to Previous Years

Component	1999	2000	2001	2002
Dollar	140,723.52	104,603.89	87,145.64	**68,593.51**
Pound	5,215.00	29,515.00	30,603.75	**45,956.48**

Appendix V11
FRI STAFF TRAINING - 2002

	NAME OF STAFF	DESIGNATION	COURSE	INSTITUTION OF STUDY
1.	M. Ottah-Atikpo (Mrs)	RS	PhD (Food Microbiology)	University of Ghana
2.	L. D. Abbey	RS	PhD (Fd. Sc.)	University of Ghana
3.	N. T. Annan (Mrs)	SRS	PhD (Fd. Sc.)	UG / KVL, Denmark
4.	E. C. T. Tettey	RS	PhD (Fd. Sci)	Univ. of Ghana,
5.	N. T. Dziedzoave	SRS	PhD (Fd. Sci. & Tech.)	NRI
6.	C. Tortoe	RS	PhD (Fd. Sci. & Tech.)	NRI, Univ. Of Greenwich
7.	M. Obodai (Mrs.)	RS	PhD (Food Microbiology)	Univ. of Nottingham. UK
8.	C. Oduro-Yeboah (Mrs.)	ARS	MPhil (Fd. Sci)	Univ. of Ghana, Legon
9.	P. M. Larweh (Mrs.)	ARS	MSc (Fd. Sci)	Dalhousie Univ. Hallifax, Canada
10.	E. Allorsey	Snr. Tech. Asst.	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
11.	R. Kavi	Prin. Lib. Asst.	BSc (Info. Studies)	Univ. of Ghana, Legon
12.	A. Padi (Mrs.)		Dip. in Catering & Hotel Mgt	Graduate School of Management, Accra
13.	C. Boateng (Ms)		Dip. in Catering & Hotel Mgt	Graduate School of Management, Accra
14.	K.K. Essel	Tech. Asst.	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
15.	A. Andoh	Chief Tech. Officer	Post Grad Dip. In Marketing	GIMPA
16.	A. I..Nyarko.	Tech Asst. Gd. I	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon
17.	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 2002

Conferences/ Courses/ Workshops/Seminars	Participants	Designation	Venue	Date/Duration	Organisers
Workshop for Stakeholders on Marketing and Processing Of Bambara Groundnuts	Dr. W. A. Plahar N. T. Annan (Mrs.) R. M. Yawson W. Quaye (Mrs.) P. Larweh (Mrs.)	Director Snr. Res. Scientist Sci. Secretary Asst. Res. Scientist Asst. Res. Scientist	VRA Conference Room, Tamale	February 26, 2002	DFID/CPHP/FRI
Annual Review Meeting of the Poverty Alleviation Project – Yam Improvement Technologies	Dr. W. Amoa-Awua	Dep. Director	Lome, Togo	4 – 8, Feb., 2002	IFAD/IITA
National Coordinators Meeting of IFAD/ICRISAT/FRI Sorghum Project	Dr. P. N-T. Johnson	Snr. Res. Scientist	Bamako, Mali	18 – 22, Feb., 2002	IFAD/ICRISAT
Project Preparatory Workshop on Peanuts	P. Lokko (Mrs.)	Snr. Res. Scientist	Purdue, USA	14 – 21, Feb., 2002	Purdue University
Project Meeting on Improving the Utilisation and Quality of low value fish by processing	L. D. Abbey	Res. Scientist	Surrey, UK	25 – 27 March, 2002	University of Surrey
Workshop on Facilitating Agricultural Innovation Process	Dr. K. Vowotor	Res. Scientist	Nairobi, Kenya	15 – 29, April, 2002	ISNAR
ISSY 22 Conference	M. Halm (Ms.) M. Ottah-Atikpo	Snr. Res. Scientist Res. Scientist	Bloemfontein, South Africa	25 - 28 April, 2002	Dept. of Microbiology and Biochemistry, University of the Free State, RSA
Workshop on Building an Innovation-Based Economy. The European, Commonwealth and Worldwide Experience on High Technology Based Incubators.	R. M. Yawson	Sci. Secretary	Paphos, Cyprus	7 – 10 May 2002	Commonwealth Science Council/WAITRO
Steering Committee Meeting of IFAD/ICRISAT/FRI Sorghum Project	Dr. W. A. Plahar Dr. P. N-T. Johnson	Director Snr. Res. Scientist	Bamako, Mali	8 – 12, April, 2002	IFAD/ICRISAT
Exhibition and Demonstration on Diversification of Sorghum Utilisation.	I. Tamakloe (Mrs.)	Prin. Tech. Officer	Ouagadougou, Burkina Faso	June 2002	IFAD/ICRISAT

6th International Seminar on African Fermented Foods	Dr. W. Amoa-Awua M. Halm (Ms.) K. Kpodo (Mrs.) N. T. Annan (Mrs.) M. Ottah-Atikpo	Dep. Director Snr. Res. Scientist Snr. Res. Scientist Snr. Res. Scientist Res. Scientist	Miklin Hotel, Accra	1 – 5 July, 2002	WAITRO/EU
International Workshop on Mycotoxins	K. Kpodo (Mrs.)	Snr. Res. Scientist	Maryland, USA	22 –26, July, 2002	FDA and University of Maryland
Workshop on Building Capacity in Performance Management	Dr. W. Amoa-Awua S. K. Noamesi R. M. Yawson	Dep. Director Res. Scientist Sci. Secretary	Coconut Grove Hotel, Elmina	8 – 10 July 2002	DFID/NRI
International Congress of Technological Research Organisations	R. M. Yawson	Sci. Secretary	Porto Alegre, Brazil,	8 – 11 Sept., 2002	WAITRO
Short Course on Food Flavour in fermented Foods	N. T. Annan (Mrs.)	Snr. Res. Scientist	Copenhagen, Denmark	17 Aug.- 1 Nov. 2002	DANIDA/KVL
International Conference on TRIPS – Next Agenda for Developing Countries	R. M. Yawson	Sci. Secretary	Hyderabad, India	11 -12, Oct. 2002	Shyamprasad Institute for Social Service
Study Tour to Thailand & Indonesia	Dr. P. A. Adu-Amankwa	Snr. Res. Scientist	Thailand & Indonesia	Sept. 23– Oct. 5, 2002	World Bank, Ghana
Meetings with the CPHP of DFID on existing Collaboration Issues	Dr. W. A. Plahar Dr. P. N-T. Johnson	Director Snr. Res. Scientist	Kent, UK	Sept. 28-Oct. 3, 2002	DFID/CPHP/NRI
Meeting of the International Agency for Research on Cancer	K. Kpodo (Mrs.)	Snr. Res. Scientist	Lyons, France	21 – 23, Nov., 2002	WHO
Study Tour as part of PhD Programme	J. T. Manful	Res. Scientist	Georgia & Louisiana, USA	Feb., 8 - April 7, 2002	NRI/DFID
Annual Meeting of the American Association of Cereal Chemists	J. T. Manful	Res. Scientist	Montreal, Canada	13 –17, Oct., 2002	AACC/IFS
Workshop on the Utilisation of By-products and waste materials in the Sugar Industry	J. Gayin	Asst. Res. Scientist	Assiut, Egypt	12-31 Oct., 2002	Arab Industrial Development and Mining Organisation
Study Tour on soybean utilization	I. Tamakloe (Mrs.)	Prin. Tech. Officer	Nigeria	2 – 11 Dec., 2002	Food Crops Development Project

Appendix VIII

CONFERENCES, COURSES, WORKSHOPS AND SEMINARS ATTENDED BY FRI STAFF IN 2002

Conferences/ Courses/ Workshops/Seminars	Participants	Designation	Venue	Date/Duration	Organisers
Workshop for Stakeholders on Marketing and Processing Of Bambara Groundnuts	Dr. W. A. Plahar N. T. Annan (Mrs.) R. M. Yawson W. Quaye (Mrs.) P. Larweh (Mrs.)	Director Snr. Res. Scientist Sci. Secretary Asst. Res. Scientist Asst. Res. Scientist	VRA Conference Room, Tamale	February 26, 2002	DFID/CPHP/FRI
Annual Review Meeting of the Poverty Alleviation Project – Yam Improvement Technologies	Dr. W. Amoa-Awua	Dep. Director	Lome, Togo	4 – 8, Feb., 2002	IFAD/IITA
National Coordinators Meeting of IFAD/ICRISAT/FRI Sorghum Project	Dr. P. N-T. Johnson	Snr. Res. Scientist	Bamako, Mali	18 – 22, Feb., 2002	IFAD/ICRISAT
Project Preparatory Workshop on Peanuts	P. Lokko (Mrs.)	Snr. Res. Scientist	Purdue, USA	14 – 21, Feb., 2002	Purdue University
Project Meeting on Improving the Utilisation and Quality of low value fish by processing	L. D. Abbey	Res. Scientist	Surrey, UK	25 – 27 March, 2002	University of Surrey
Workshop on Facilitating Agricultural Innovation Process	Dr. K. Vowotor	Res. Scientist	Nairobi, Kenya	15 – 29, April, 2002	ISNAR
ISSY 22 Conference	M. Halm (Ms.) M. Ottah-Atikpo	Snr. Res. Scientist Res. Scientist	Bloemfontein, South Africa	25 - 28 April, 2002	Dept. of Microbiology and Biochemistry, University of the Free State, RSA
Workshop on Building an Innovation-Based Economy. The European, Commonwealth and Worldwide Experience on High Technology Based Incubators.	R. M. Yawson	Sci. Secretary	Paphos, Cyprus	7 – 10 May 2002	Commonwealth Science Council/WAITRO
Steering Committee Meeting of IFAD/ICRISAT/FRI Sorghum Project	Dr. W. A. Plahar Dr. P. N-T. Johnson	Director Snr. Res. Scientist	Bamako, Mali	8 – 12, April, 2002	IFAD/ICRISAT
Exhibition and Demonstration on Diversification of Sorghum Utilisation.	I. Tamakloe (Mrs.)	Prin. Tech. Officer	Ouagadougou, Burkina Faso	June 2002	IFAD/ICRISAT

Appendix IX
ORGANOGRAM