Food Research Institute of the Council for Scientific and Industrial Research (CSIR-FRI)

ANNUAL REPORT 2010

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Council for Scientific and Industrial Research

(CSIR-FRI)

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LIST OF ACRONYMS

AGORA	-	Access to Global On-line Research on Agriculture
AGRIS	-	Agriculture Research Information System
BFGs	-	Business Focus Groups
C: AVA	-	Cassava: Adding Value in Africa
CAFPAG	-	Cassava Flour Producers Association of Ghana
CID	-	Commercialization & Information Division
CPC	-	Cocoa Processing Company
CRI	-	Crops Research Institute
CSIR	-	Council of Scientific and Industrial Research
CSU	-	Clients Service Unit
CTA/SDI	-	Technical Centre for Agriculture and Rural Cooperation/ Selective Dissemination
EU	-	Engineering Unit
FAO	-	Food and Agriculture Organization
FAPAS	-	Food Analysis Performance Assessment Scheme
FCD	-	Food Chemistry Division
FDB	-	Food and Drugs Board
FMD	-	Food Microbiology Division
FNSED	-	Food Nutrition and Socio-Economics Division
FPED	-	Food Processing & Engineering Division
FRI	-	Food Research Institute
GIMPA	-	Ghana Institute of Management and Public Administration
GIZ	-	German International Cooperation
GoG	-	Government of Ghana
GPCs	-	Good Practice Centres
HQCF	-	High Quality Cassava Flour
IGF	-	Internally Generated Funds
INSTI	-	Institute for Science and Technological Information
IPS	-	Institute of Professional Studies
KNUST	-	Kwame Nkrumah University of Science and Technology
LPPRU	-	Library, Publications and Public Relations Unit
MiDA	-	Millennium Development Authority
MOAP	-	Market-Oriented Agriculture Project
MoFA	-	Ministry of Food and Agriculture
MU	-	Mushroom Unit
PSPU	-	Pilot Scale Production Unit
RTPDU	-	Root and Tuber Products Development Unit
SANAS	-	South African National Accreditation System
SMEs	-	Small and Medium Scale Enterprises
STEPRI	-	Science and Technology Policy Research Institute
TBSU	-	Technological Business Service Unit
TEEAL	-	The Essential Electronic Agricultural Library
UNICEF	-	United Nations International Children's Education Fund
WFP	-	World Food Programme
WAAPP	-	West African Agricultural Productivity Programme

CSIR-FRI MANAGEMENT BOARD MEMBERS

1.	Dr. Osei Boeh-Ocansey	Director-General, PEF	Chairman
2.	Dr. P-N.T. Johnson	Acting Director, FRI	Member
3.	Dr. E.B. Hagan	Director, IIR (Cognate)	"
4.	Dr. (Mrs.) R. Entsua-Mensah	Deputy Director-General CSIR	"
5.	Mr. Timothy A. Osei	Chartered Accountant	"
6.	Prof. Josephine Nketsia-Tabiri	Director, BNARI, GAEC	"
7.	Mr. Charles Debrah Asante	Deputy Managing Director, CPC	"

MEMBERS OF CSIR-FRI INTERNAL MANAGEMENT COMMITTEE

1.	Dr. P-N.T. Johnson	-	Acting Director
2.	Dr. W.A. Amoa-Awua	-	Head, FMD
3.	Ms. J. Aggrey-Yawson	-	Acting Head, Administration
4.	Mr. C. Tutu-Aikins	-	Acting Head, Accounts Division
5.	Dr. K.A. Vowotor	-	Acting Head, CID
6.	Dr. N. T. Dziedzoave	-	Acting Head, FPED
7.	Dr. (Mrs.) K. Kpodo	-	Head, FCD
8.	Mrs. W. Quaye	-	Head, FNSED
9.	Mr. J. Gayin	-	Acting Head, PSPU-FPED
10.	Mr. D. Blay	-	Head, EU-FPED
11.	Dr. (Mrs.) M. Ottah Atikpo	-	Head, ISU-FMD
12.	Mrs. M. Glover-Amengor	-	Head, NU-FNSED
13.	Mrs. C. Oduro-Yeboah	-	Head, RTPDU
14.	Mr. P. Addo	-	President, Local RSA
15.	Mr. D. Asiedu	-	Chairman, Staff Welfare Committee
16.	Mr. B. Awotwi	-	Chairman, SSA-FRI
17.	Mr. M. Amoo-Gyasi	-	Chairman, TUC
18.	Dr. L. D. Abbey	-	Quality Manager
19.	Mr. S. Nketia	-	Scientific Secretary

EXECUTIVE SUMMARY

Food Research Institute (FRI) is one of the thirteen (13) Institutes of the Council for Scientific and Industrial Research (CSIR) which continues to be a centre of excellence in food research and development. It generates technologies that are aimed at meeting the demands of the private sector and socio-economic development. CSIR-FRI's vision is to be the leading research institute in the country. It provides technical, analytical services, research and consultancy services to governmental, industry and international development agencies. The Institute still maintained its accreditation status to ISO 17025 test methods under the South African National Accreditation System (SANAS). Its mission is primarily to conduct market-oriented applied research and provide technical services and products profitably to the private sector and other stakeholders. The overall and primary 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 industries; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

In the area of food product development, CSIR-FRI continued with its development of cassava, plantain, cocoyam, yam, *kokonte*, cowpea, soybean, fermented flours, among others. The Institute also continued with its design and fabrication of food processing equipment such as, solar dryers, energy efficient solar/gas dryers, cassava processing machines, hammer mills etc. It organized training programmes on mushroom cultivation and spawn production, microbiological safety and quality control of foods and also trained potential entrepreneurs in technologies it developed. The Institute provided a wide range of consultation and out-sourcing services, such as the establishment of Hazard Analysis and Critical Control Point (HACCP) system for food industries.

Under accreditation activities, the Institute continued to offer comprehensive chemical and microbiological analytical services to the local beverage, food, feed and brewing industries. Under chemical analyses, commodities tested included: fish and fish products, chocolate and cocoa products, water, fruit juices and soft drinks, biscuits, toffees, dairy products, poultry products, spices, flavorings, condiments and vegetables. The microbiological analyses included: quality control of raw materials, intermediate and finished products, determination of indicator organisms, pathogenic micro-organisms such as *Salmonella* and *Vibrio* and specific spoilage organisms, identification of bacteria, yeasts and moulds, testing for sterility and evaluation of efficacy of disinfectants in food hygiene.

As an output of scientific research, seventeen (17) scientific articles were published in eleven (11) refereed journals. The Institute in collaboration with the German International Cooperation (GIZ) and the Market Oriented Agriculture Project (MOAP) created an Incubation Center for SMEs under its technology incubation programme. In line with the above, an efficient energy saving grain dryer was fabricated to enhance the private-public partnership concept. As an initiative to aid the growth of mushroom cultivation, income generation and improvement of waste management, CSIR-FRI researched into the utilization of dried pineapple rind in the cultivation of mushroom and the comparative and morphological studies on 13 strains of oyster mushroom *Pleurotus* species. This is to increase the biological efficiency of the mushroom which presently stands at 75% to 100% and will be of enormous benefit to the mushroom farmers that

have been trained over the years. The Institute continued to participate in the Root and Tuber Improvement and Marketing Programme (RTIMP) by setting up two Good Practice Centres (GPCs) as demonstration centres for root and tuber processors to adopt and improve on their processing activities. In line with the above activity, the Institute upgraded the Progressive Women's Processing Enterprise at Wusuta in the Volta Region and constructed an Ex Novo GPC at Agona Mankrong in the Central Region.

Under the Millennium Development Authority (MiDA) project, CSIR-FRI trained over 2,600 farmers in 53 Farmer Based Organizations (FBOs) in the West Mamprusi and Savelugu-Nanton Districts of the MiDA Northern Intervention Zone. The project brought about an increase in agriculture production in the region and gave a new twist to farming where farmers now see the venture as a commercial entity and not just a way of life.

The Cassava: Adding Value in Africa (C:AVA) project has enabled farmers generate extra income through mopping up of surplus cassava for new markets. This helped to improve foreign income savings through the availability of alternative raw material source for plywood and bakery industries. The C:AVA project also generated four technical manuals on cassava processing to aid processors in their activities. It also strengthened the cassava value chain in Ghana where processors have been taught to incorporate at least 10% of High Quality Cassava Flour (HQCF) into bakery products. The CORAF-WECARD project in this regard also trained a number of farmers and processors in improved cassava and rice processing to aid poverty alleviation. Under the Moringa project, the booklet "Growing and processing Moringa leaves" was produced to educate Moringa users on the crop's efficacy.

Major collaborators of the different projects carried out at the Institute included the Ministry of Food and Agriculture (MoFA), World Food Programme (WFP), Food and Agriculture Organization (FAO), Natural Resources Institute (NRI) of the UK, United States Agency for International Development (USAID), German International Cooperation (GIZ) and some CSIR Institutes.

As part of the Institute's income generation effort, the Institute generated a net total income of GHS 396,408.84 which represented 6% increase over that of 2009.

The Institute received a number of visitors including the Minister of Environment Science and Technology, Honourable Sherry Ayittey, the Director-General of CSIR, Dr. Abdulai B. Salifu and the Chairman of the CSIR Council, Prof. E. H. Amonoo-Neizer, to acquaint themselves with activities of the Institute and improve science and technology output. A delegation from Korea also paid a visit to the Institute in order to interact with scientists.

1.0 ADMINISTRATION DIVISION

Introduction

The Administration Division is responsible for providing administrative support for the research and technological programme of the Institute. The Division also assists with the day-to-day running of the Institute.

Staff Strength

The staff strength stands at 174. This is made up of the 3 categories of staff (Table 1.1). Details of staff and their positions are shown in Appendix I

Table 1.1 Staff Strength

Category of staff	Number
Senior Members	45
Senior Staff	64
Junior Staff	65
Total	**174**

Appointments

Interviews for new appointments were conducted in July and August, 2010. Nine persons (Table 1.2) were offered appointments and have all assumed duty.

Table 1.2 New Appointees

Name	Position	Division
Mr. Moro Adam	Research Scientist	FPED
Mr. Daniel Anang	Research Scientist	FPED
Mrs. Ruth Pobee	Research Scientist	FNSED
Mr. Hayford Ofori	Research Scientist	FCD
Mr. Eric Owusu Sarpong	Research Scientist	FNSED
Ms. Edna Mireku	Technologist	FPED
Mr. Emmanuel A. Saka	Technologist	FPED
Mr. Frank Kwesi Dogbey	Technical Officer	FCD
Mr. Ebenezer Tawiah	Technical Officer	FCD

Temporary appointments were given to the following:

Ms. Mariam Yakubu - Technologist

Ms. Gloria Ghansah - Clerk Gd. I

The following staff also had their appointments regularized during the period (Table 1.3).

Table 1.3 Regularized staff

Name	Position	Division
Mr. Evans Agbemafle	Asst. Res.	FMD
Mrs. Nina Ackah	Asst. Res.	FMD
Ms. Angela Adam	Technologist	FMD
Mr. Desmond Mensah	Technical Officer	FPED
Mrs. Dorothy Narh	Technical Officer	FCD
Ms. Emefa Gblende	Technical Officer	FCD

New appointments to Heads of Divisions/Units

New Heads were appointed for the underlisted Divisions/Units (Table 1.4).

Table 1.4 Newly appointed Heads of Divisions/Units

Name	Division/Units	Date of Appointment
Dr. K. A. Vowotor	Ag. Head of the CID	1st January 2010
Mrs. Charlotte Oduro-Yeboah	Ag. Head/RTPDU (Pokuase)	1st January 2010
Mrs. Wilhemina Quaye	Head of FNSED	1st April, 2010
Mrs. Mary Glover-Amengor	Head of Nutrition and Food Utilization Unit of FNSED	1st April, 2010

Promotions and Upgrading

Eight (8) Senior members, eleven (11) Senior staff and eight (8) Junior staff were promoted (Appendix II). Eight (8) staff members were upgraded on attaining higher qualifications.

Human Resource Development/Training

The Institute continued to grant training opportunities to staff to enable them acquire skills and expertise needed to enhance their

performance. Staff who completed their training and those who are still under training are shown in Appendix III. A number of conferences and courses were attended by staff (Appendix IV).

Resumption of Duty after Study Leave

Mr. Apollonius Isaac Nyarko, Ms. Mercy Fianu and Ms. Margaret Owusu returned to post after successfully completing their various courses of study.

Attachment Training

As part of the Institute's activities, opportunities were provided to students from tertiary institutions such as Kwame Nkrumah University of Science and Technology (KNUST), University of Ghana, University of Education, University for Development Studies (UDS), Institute of Professional Studies (IPS), and Polytechnics in Ho, Cape Coast, Accra and Kumasi to undertake their industrial training and projects in the various Divisions especially the Food Chemistry and Food Microbiology Divisions.

National Service

The Institute had a total of fourteen (14) National Service personnel for the 2009/2010 service year. Ten (10) personnel from the previous year had their service period extended for another year to end in August 2011 and one (1) person was employed after the service period.

Fig. 1.1: Students on attachment training

Mr. Ransford Addo, a Principal Technical Officer and Mr. Micheal Mensah, Security man who are experiencing ill health are on sick leave.

Retirement

Two (2) staff members compulsorily retired from the Institute. They are:

Mr. E.A. Larbi	-	Chief Works Supt.
Mr. J.K. Abalansah	-	Snr. Security Asst.

Visitors

The Institute hosted the following visitors: Prof. E.H. Amonoo-Neizer, Chairman of the CSIR Council on 2nd March, 2010; Hon. Sherry Ayitey, Minister for Environment, Science and Technology (Sector Minister) on 21st April 2010; a 3-member delegation from Korea on 6th September 2010; Hon. Dirk Niebel, the German Minister of Economic Cooperation and Development who inspected on-going projects funded by GIZ on December 8, 2010 as well as other Institutions (including schools) and organizations.

Other Activities

There was a press briefing on the Accra Institute of Technology and the Open University at the Institute on 21st January, 2010. The Day of African Scientific Renaissance was marked at the Institute on 30th June, 2010.

2.0 ACCOUNTS DIVISION

Introduction

The Accounts Division is responsible for maintaining effective and efficient accounting and financial systems. The Division ensures that the Institute is in compliance with the CSIR stores and financial regulations and other statutory legislations. The Division supports all the other Divisions to carry out their financial obligations for the smooth running of the Institute. It prepares the financial statement, annual budgets, and administers funds from donors. There are two (2) main sections of the Division: Finance and Accounts, and Stores sections. The Finance and Accounts section undertakes the ledger, payroll, final accounts and cash activities. The Stores section carries out procurement duties, receives and issues items procured for effective running of the Institute. These items include chemicals, media, stationery, etc.

Major Activities

The major activities of the Division include:

- Preparation of Financial Statements for the Institute,
- Preparation of financial report on Government of Ghana (GoG) funds and disbursements,
- Ensuring that funds from donors comply with programmed budgets,
- Ensuring compliance with taxation and other financial reporting regulations,
- Management of the payroll function to ensure efficient processing systems and better control mechanisms,
- Overseeing both internal and external auditing of books, review and analyzing reports and give recommendations when appropriate, and
- Preparation of monthly and quarterly financial reports to CSIR Secretariat and other statutory bodies.

Accounting System

The accounting system of the Institute was assessed to be in line with the stores and financial regulations of the CSIR. The system established was satisfactory for capturing financial data i.e.

Table 2.1 Financial Overview

Items	FRI Budgeted Income (GHS)	Actual Income (GHS)	Actual Expenses (GHS)	Difference (GHS)
Personnel Emoluments	2,295,941.00	1,789,179.00	2,301,008.00	(511,829.00)
Admin. Expenses	381,300.00	112,677.00	153,301.00	(40,624.00)
Service Activities	150,525.00	-	-	-
Investment Activities	75,375.00	-	-	-
IGF (Income)	-	396,409.00	264,246.00	132,163.00
TOTAL	**2,903,141.00**	**2,298,265.00**	**2,718,555.00**	**(420,290.00)**

revenue, expenditure, assets and liabilities. Segregation of duties was found to be adequate and well spelt-out with different staff responsible for different functions e.g. pay-roll, final accounts, cash receipts and payments, procurement, etc.

The total receipts for the period amounted to GHS 2,298,265.00, representing 82% of government subvention for personnel emolument and administrative expenses with the remaining 18% coming from the Internally Generated Fund (IGF) (Table 2.1)

Internally Generated Fund (IGF)

The total Internally Generated Fund (IGF) yielded a total income of GHS 396,409.00 representing 18% of the total income for the year (Appendix VI). The total expenses were GHS 264,246.00 which included depreciation provision of 10% on income. The net income from IGF was GHS 132,163.00.

3.0 COMMERCIALISATION AND INFORMATION DIVISION

Introduction

The Commercial and Information Division (CID) coordinates the commercial activities of all the other Divisions in the Institute in order to generate income for the Institute. The Division has 2 Units namely the Clients Services Unit (CSU) and the Library, Publications and Public Relations Unit (LPPRU). A new unit to be known as the Technological Business Services Unit (TBSU) is being proposed to be involved in the business development activities of the Institute.

Clients Services Unit (CSU)

The Clients Services Unit (CSU) is the interface between the Institute and its clients for analytical services in Chemistry, Microbiology and Mycotoxin and other services such as drying of food products, transfer of technology, hiring of Institute's facilities, organization of training programs, sale of research by-products and compilation of client database. For the Chemistry, Microbiology and Mycotoxin laboratories, two thousand three hundred and ninety four (2,394) samples were analyzed from 396 clients (Table 3.1)

The major clients for mycotoxin analyses were Ghana Standards Board, Ghana Inspection Ltd, C&S Foods Ghana Ltd and Burger Foods while those for chemistry analyses were Ghana Inspections Ltd, Ghana Standards Board, Agricare Ltd, Loders Croklaan and Dry Food Processing. For microbiology, the major clients were Cadbury Ghana Ltd, Pioneer Food Company, Aviation Handling Services, Burger Food Industries, Promasidor Ghana Ltd, Aquafresh Ltd, Myroc Foods, Afrotropic Cocoa Processing and West African Mills Company Ltd. Table 3.2 shows the gross revenue generated by the other Divisions and Units.

Table 3.2 Gross revenue generated by the other Divisions and Units and major projects in 2010

Division/Unit/Major projects	Gross Revenue (GHS)
Food Nutrition and Socio-Economics Division	249.00
Pilot Scale Production Unit	17,044.30
Root and Tuber Processing Demonstration Unit (RTPDU)	13,364.00
Engineering	41,678.00
Millennium Development	10,000.00
Mushroom Unit	17,021.75
Training	7,590.00
Library	1,619.55
Total	**108,566.60**

Table 3.1 Gross revenue generated by Service laboratories of Chemistry, Microbiology and Mycotoxin laboratories

Laboratory	No. of Clients	No. of Samples	Gross Revenue
Mycotoxin	52	246	30,703.50
Chemistry	174	688	57,912.55
Microbiology	170	1460	197,881.60
Total	**396**	**2,394**	**286,497.65**

Library, Publications and Public Relations Unit (LPPRU)

The library is one of the important libraries that provides and disseminates information in the field of food science and technology, nutrition, food microbiology, and mycotoxin, agricultural economics and food engineering in the country.

The library has about 4000 and over 200 back issues of scientific journals in its stock. It currently has a subscription for 10 scientific journals. The clientele of the library has extended beyond the Institute's research and technical staff to include students from universities and polytechnics. It is also patronized by lecturers, farmers, industrialists, journalists, civil and public servants, consultants and many others

Queries received during the year can be categorized into processing and preservation of various crops (maize, cassava, palm kernel, sorghum, soybean, potato, cashew nut, coconuts, cowpea and fruits and vegetables) fish and meat products. Requests were also on shelf life studies of Ghanaian foods, flours, post harvest handling and storage of a number of crops and their products, as well as analysis and composition of numerous Ghanaian foods. Others were on mushroom cultivation as well as snail and grasscutter rearing.

The library users had various information materials provided for their use. These included books and journal articles that were acquired from Access to Global On-line Research on Agriculture (AGORA), Technical Centre for Agriculture and Rural Cooperation/Selective Dissemination of Information (CTA/SDI) Service and The Essential Electronic Agricultural Library (TEEAL) Collection. There is also an institutional repository on major research findings in the country. Under the in-house repository of Agricultural Research Information System (AGRIS), there are 179 journal articles, 24 conference papers and 2 manuals and handbooks. However, the library needs to replenish its stock with up-to-date publications. There is also the need for the provision of more electronic resources as well as the acquisition of more computers for use as an internet café.

There were a number of exhibitions during the year. These were the 14th Ghana International Trade Fair, the exhibition in connection with the launch of National Science and Technology Policy and the forum for a Green Revolution in Africa. The Institute hosted the Ministry of Environment, Science and Technology's Day of Scientific Renaissance of Africa. The Institute also hosted an exhibition for the launch of the CSIR-FRI/GIZ/MOAP Incubation project.

Technological Business Services Unit (TBSU)

Technological Business Services Unit (TBSU) is a proposed Unit which will be involved in the business development activities of the Institute's technological products and services, creation of marketing strategies and generation of sales. It will use a combination of strategic analysis, marketing, and sales in its operations. The Unit will also identify new business opportunities—new markets, new partnerships with other businesses, new ways to reach existing markets, or new product or service offerings to better meet the needs of existing markets—and then to go out and exploit those opportunities to bring in more revenue. TBSU will carry these activities through writing up of factsheets, leaflets, brochures or handbooks which are to be sold to clients documenting technologies available of new food businesses. Some issues to be included in the write-ups could be:

(a) Market and technology research,
(b) Formulation of strategy,
(c) Distribution channel analysis and development,

(d) New product development planning and management,
(e) Technology transfer, licensing, partnerships assessment and development,
(f) Marketing and advertising and promotion planning,
(g) Sales organization planning and development,
(h) Import/export development,
(i) Business planning,
(j) Health and safety adherence issues.

Media Exposure during the year

Several articles were published in the major Ghanaian newspapers. Some of these were: "Towards Scientific Renaissance of Africa", "Accreditation towards quality products", "United against Hunger: 29th World Food Day". There was also a publication in the newspapers that advocated for raising the pension age from 60 to 65 years. The Research Staff Association has over the years called for the change. A few reports were posted on the CSIR and FRI websites.

4.0 FOOD PROCESSING AND ENGINEERING DIVISION

Introduction

The Food Processing and Engineering Division (FPED) is made up of three (3) Units. These are Engineering Unit (EU), Pilot Scale Production Unit (PSPU) and Root and Tuber Products Development Unit (RTPDU). The Divisional Annual Work Plan targeted work in seven distinct strategic areas namely:

- Research and Development
- Service to Clients
- University Partnership
- Equipment design and Fabrication
- Quality Control and Plant Sanitation
- Public Private Partnership and
- General Management of the Division

Research and Development

Research and Development activities were as follows:

- Extension of food fortification with micronutrients technology using a manually operated mixer designed and fabricated at the CSIR-FRI to twelve (12) communities in the three (3) Northern regions of Ghana.
- Training programmes organized for farmers in commercial agriculture and crop productivity under the Millennium Development Authority (MiDA) Project.
- Effective coordination of the activities of six (6) NGOs, over thirty (30) SMEs and five (5) technical service providers has resulted in significant impact along the cassava value chain under the Cassava: Adding Value in Africa (C:AVA) Project. Farmers adopted the use of high yielding cassava varieties. Some biscuit manufacturers also adopted the use of High Quality Cassava Flour (HQCF) in their manufacturing operations. Furthermore:
  - Over $100,000 extra income generated for cassava farmers through mopping up of surplus cassava for new markets, as well as through increases in yield.
  - Trade Relationships were established between processors through the formation of Cassava Flour Producers Association of Ghana (CAFPAG).
  - Sustainable supply of improved cassava planting material for farmers ensured through the establishment of planting material multiplication farms.
  - Easy access to raw material supply (for processors), and raw material sales outlet (for farmers) ensured through the creation of six (6) Business Focus Groups (BFGs).
  - Foreign exchange savings through availability of alternative raw material source for plywood and bakery industry.
  - Job creation through enterprise development along the value chain.
- A Honey Sieving and Bottling Equipment was developed by Engineering Unit.

Service to Clients

Services to clients included drying and/or roasting of crops and products such as *moringa*, soyabean, ginger, mango, corn dough, plantain fufu, *hausa koko*, cassava, neem leaves and groundnuts. Analytical Services provided by the Process Control Laboratory of the PSPU included the following: water activity, physical quality, moisture and colour determination, pasting characteristics, milling & sieving, vacuum packaging and amylose determination.

University Partnership

Twenty six (26) students of the Kwame Nkrumah University of Science and Technology (KNUST) Kumasi were taken through various practical scientific demonstrations and experiments by staff in all the Units of the Division.

Equipment Design and Fabrication

A number of equipment were fabricated and installed. These included:

- A 3-ton capacity LP gas / solar water heater grains dryer at FRI for the FRI/GIZ Grain Drying Project.
- A 3-ton capacity LP gas bin dryer for the Ghana National Procurement Agency at Bawjiase in the Central Region.
  One Set of Honey filtering and bottling Machine was designed and constructed for a client.
- A Honey Centrifuge Machine for extraction of honey without crushing the honey combs was designed, installed and is in operation at Savanna Pure Honey-Tamale.
- An Ethanol Distilling Plant was constructed and was at 80% completion by the close of the year.
- Seventeen (17) tons of raw cassava into *kokonte*, starch, *agbelima* flour and dried agbelima grits produced at RTPDU, whilst the PSPU continued to produce *banku* mix, fermented maize meal, fufu flours, groundnut paste for sale to the general public.

Fig 4.1: Packaged products of CSIR-FRI (Flours)

Quality Control and Plant Sanitation

An action plan for ensuring quality control of research by-products produced by the PSPU and RTPDU, plant sanitation and for the implementation of Good Manufacturing Practice in the Division's Units was developed and flagged for implementation in 2011.

Public Private Partnership: Technology Business Incubation Centre

The Technology Business Incubation Centre was reconstructed. Equipment were installed and commissioned by the Government of Ghana and German International Cooperation. The project was to support the initiative of public private partnership between CSIR-FRI and private food processing entrepreneurs under the CSIR-FRI/GIZ/MOAP Incubation Project. This zero waste food processing facility is designed in such a way that apart from the main technology of processing fruits and vegetables, the waste from the raw materials is used to produce biogas as supplement to the expensive liquefied Petroleum gas and the effluent from the biogas digester plant is used to irrigate the fruit farm. The first beneficiary of this Technology Business Incubation Centre is Nature's Best Fruits and Juices Limited.

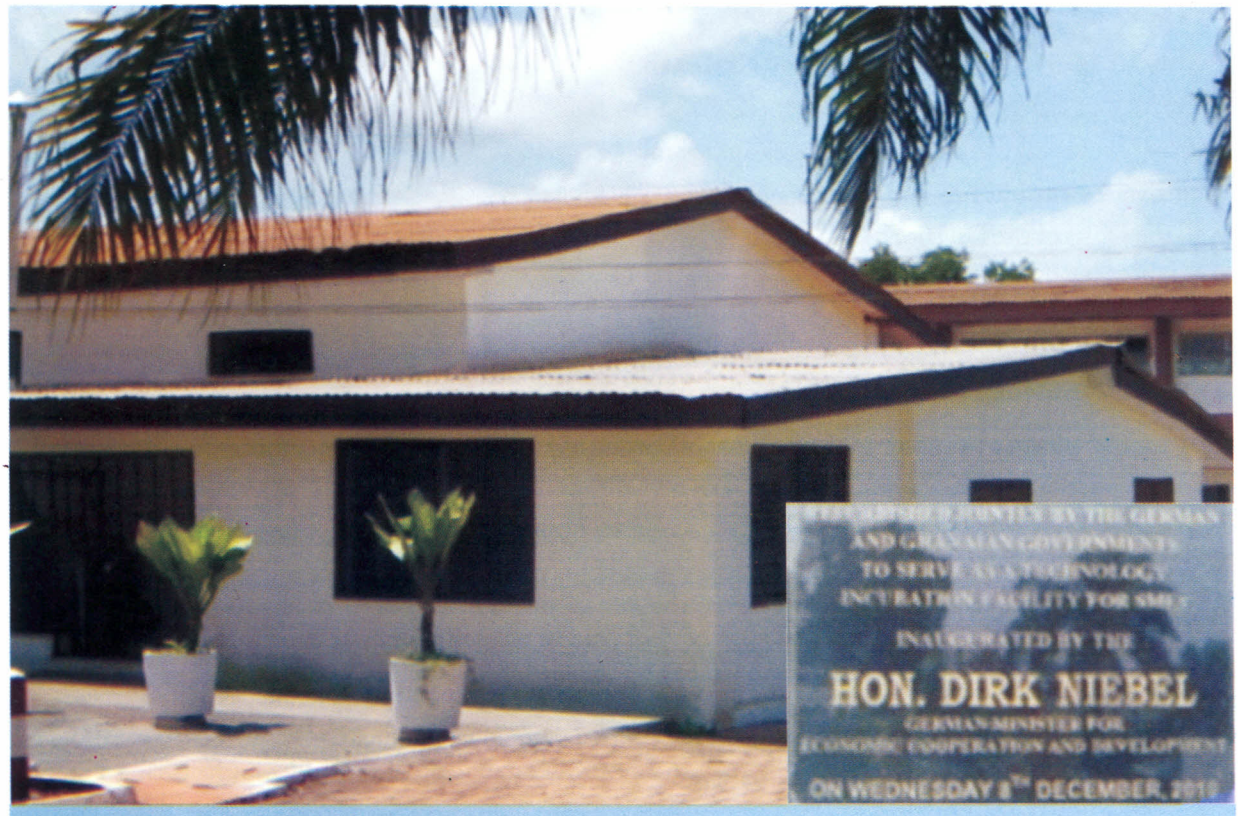

Fig 3.1: Incubation Centre (Insert: Plaque)

Fig 3.2: Processed dried mango and dried coconut

General Management of the Division

Five (5) performance improvement teams to address issues to enhance efficiency in all the activities of the Division were established. The teams were:

- Research and Development
- Quality Management
- Information Management
- Market Development and
- Equipment and Installations

Actions plans for the teams have been developed and have been earmarked for implementation in 2011.

5.0 FOOD CHEMISTRY DIVISION

Introduction

The Division conducts applied research relating to chemical contaminants (mycotoxins) in foods and feeds as well as food flavour (aroma) analyses. The Division also offers consultancy services and advice to clients. It also supports the commercialisation activities of the Institute by offering analytical services to Industries, local and International students, as well as training of students. The Division comprises of two Units namely the Food Toxicology Unit and the Industrial Services Unit.

Analytical Services

The Division offered analytical services to several companies, establishments and individuals. A total of 688 samples were received by the Industrial Services Unit for analysis, represents a 20.9% increase over the 569 samples received in 2009.

The samples analyzed included sesame seeds, whole milk powder, iodated salt, soya bean flour, corn soya blend, pepper sauce, dried pepper, snails, yoghurt, sweet potato, maize and maize products, moringa leaves, groundnut and groundnut products, almond milk, fish meal, palm drink, cocoa powder, fruit juices, pasta, taro and wheat flour composite cookies, *hausa koko*, yam, plantain chips, biscuits, wheat flour, poultry feed, evaporated milk, cocoa liquor, plantain *fufu* powder, sugar, Earl Grey Tea and luncheon meat, among others.

The Toxicology Unit received a total of 246 samples for aflatoxin analysis as against 230 samples for the year 2009. This represents an increase of 7% over the previous year. The samples consisted of peanut and peanut products, maize and maize products, rice, natural cocoa liquor, raw cocoa beans and cake, egusi, pasta, fermented cassava dough, gari, wheat flour, soy meal, layer mash, Neat plantain fufu, potato chips, khebab powder, wheat bran, oats, fish meal, granola bars, sheanut cake among others.

Industrial Attachment and Practical Training

Three (3) Accra Polytechnic, one (1) student each from the University for Development Studies and University of Cape Coast benefited from Industrial Attachment/Practical training in the Division.

Students Project Work

The following students from various institutions did their project work with the Division:

Jennifer Quao (University of Ghana): Changes in biochemical constituents and flavor precursor development during fermentation of pulp pre-conditioned Ghanaian cocoa beans (9/4/2010 – 20/4/2010).

- George Crabbe (Accra Polytechnic): Proximate analyses of three varieties of mushroom (9/6/2010 – 6/7/2010)
- Yvonne Obiri and Winifred Wadie (University of Ghana): Survey on consumer Labels (7/6/2010 – 16/7/2010)

Training

Staff of the Division were involved in the Internship Programme for 3rd Year students from the Food Science and Technology Department of Kwame Nkrumah University of Science and Technology (KNUST) from 11th January to 19th February 2010. The students were trained on chemical analyses of foods and demonstrated the use of specific analytical equipment in the laboratories.

6.0 FOOD MICROBIOLOGY DIVISION

Introduction

The Food Microbiology Division's main role is to undertake research and development activities in food safety and quality assurance to staple foods in Ghana. The Division is made up of the Industrial Service Unit (ISU) and the Mushroom Unit (MU). ISU conducts important microbiology analytical services to food industries in Ghana and Food exporters. MU serves as biotechnology center for mushroom research and development. It host the national mushroom spawn bank that is constantly being updated and reengineered to serve the good number of mushroom growers in the sub region.

Activities carried out in the Division

The main activities carried out by the Division were:

- Analytical services to clients (income generation).
- Quality control of analysis: ISO 17025 accreditation.
- Mushroom Unit: Mushroom spawn and compost bags production and sales (income generation).
- Research activities.

Industrial Services Unit: Analytical services carried out for customers

The Division continued with its routine analytical services carried out for clients through the CID. A total 1,458 samples were analyzed for clients in 2010 as against 1,493 samples analyzed in 2009 (Fig 6.1). The total number of individual analysis carried out for 2010 were 7,311 as against 8,207 individual analysis carried out in 2009 (Fig 6.2). The most important clients during the year were Cadbury Ghana Ltd. and Pioneer Food Cannery.

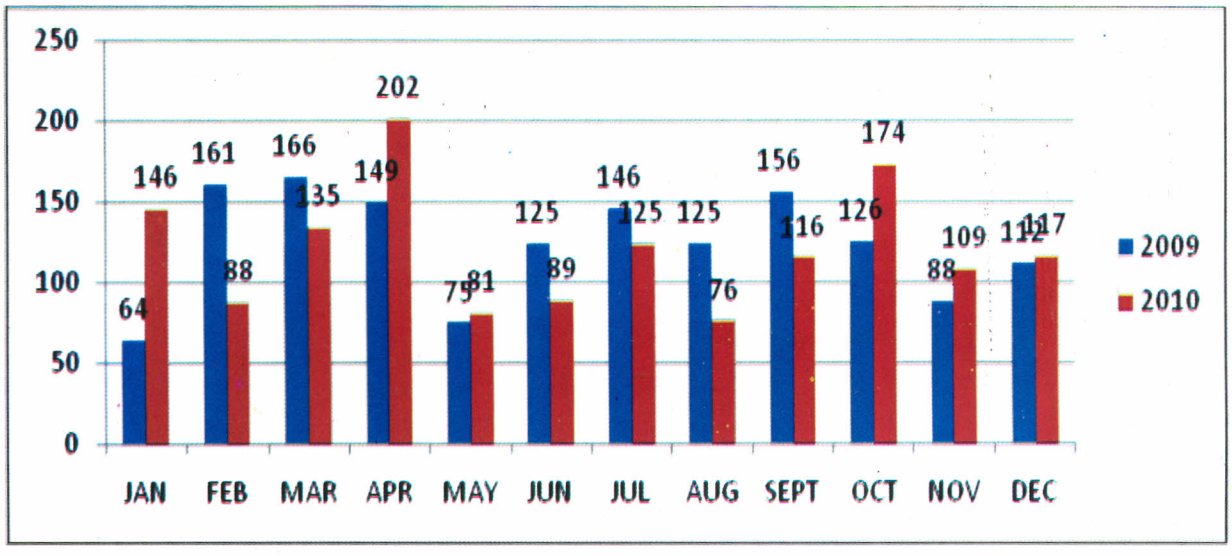

Fig 6.1: Number of samples analysed for clients in 2009 and 2010

The most important clients of the Food Microbiology Division in 2010 were: Cadbury Gh. Ltd., Airways Catering Ltd., Pioneer Food Cannery Ltd., Burger Food Industries, Cocoa Processing Co. Ltd, Euro Food Gh. Ltd, West Africa Mills Ltd., Ghana Inspection Ltd. and Promasidor Ghana Ltd.

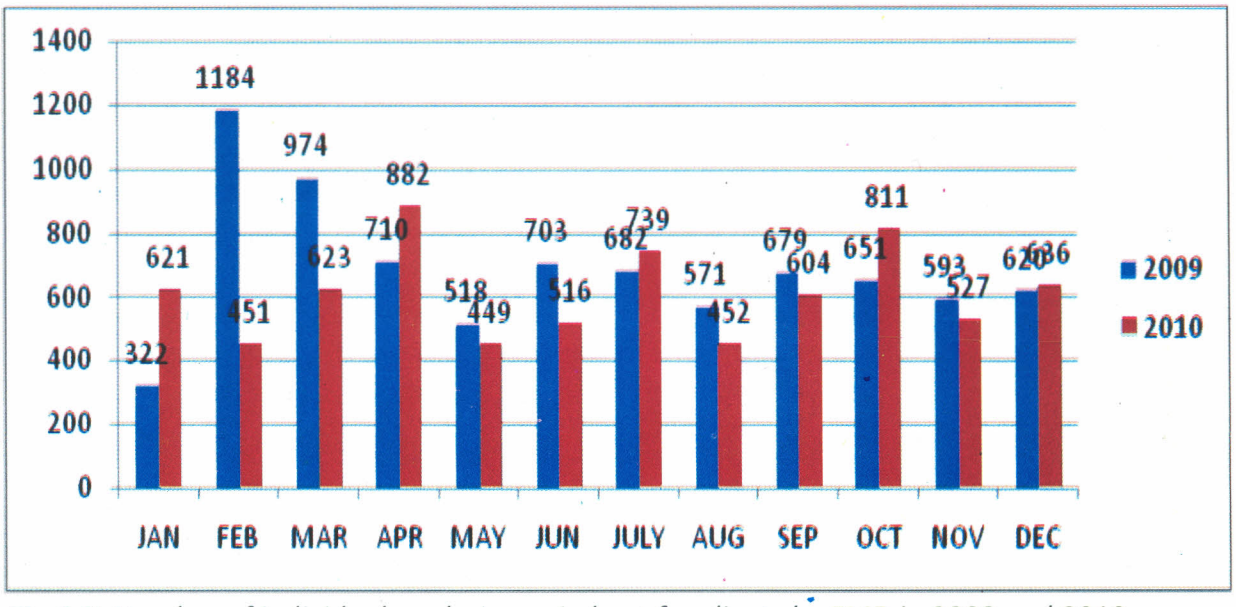

Fig 6.2: Number of individual analysis carried out for clients by FMD in 2009 and 2010

The gross revenue generated by analytical services carried out for clients in 2010 was GHS 212,435.60.

Mushroom Unit: Production and sale of mushroom spawns and compost bags

The Mushroom Unit produced bottled spawns and compost bags for sale to mushroom growers as it has done in previous years. The number of bottled spawns and compost bags produced and sold monthly to mushroom growers are shown in Figs 6.3 and 6.4. The production volumes for 2009 are also shown in the Figures.

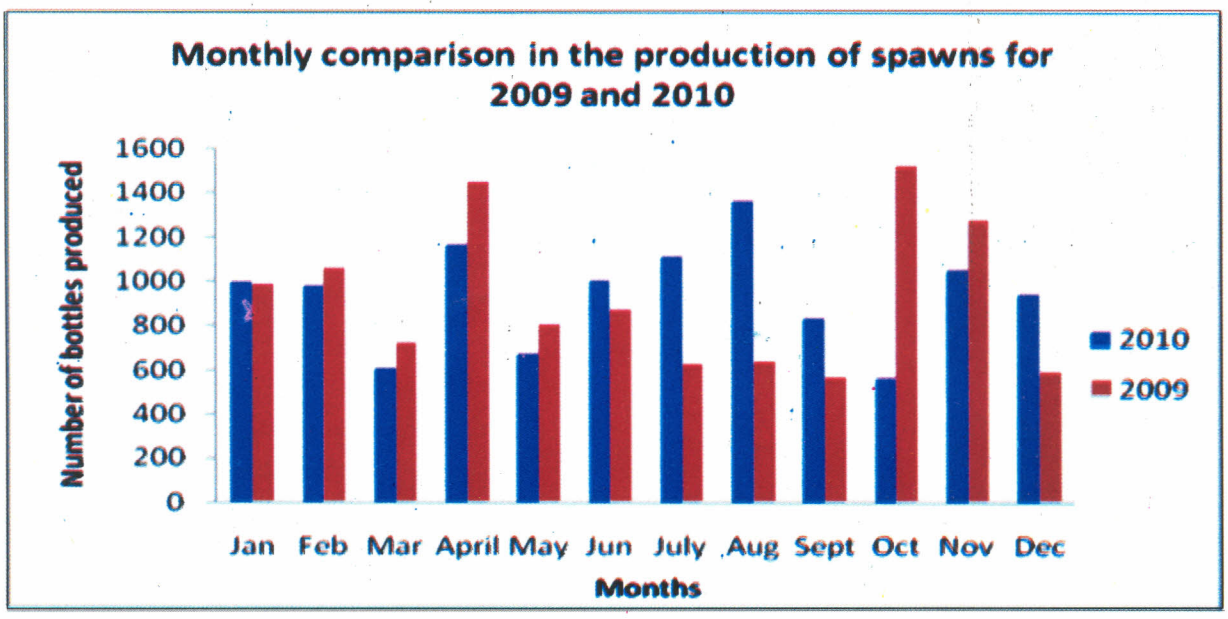

Fig 6.3: Monthly production and sale of bottled spawns to mushroom growers in 2009 and 2010 by the Mushroom Unit .

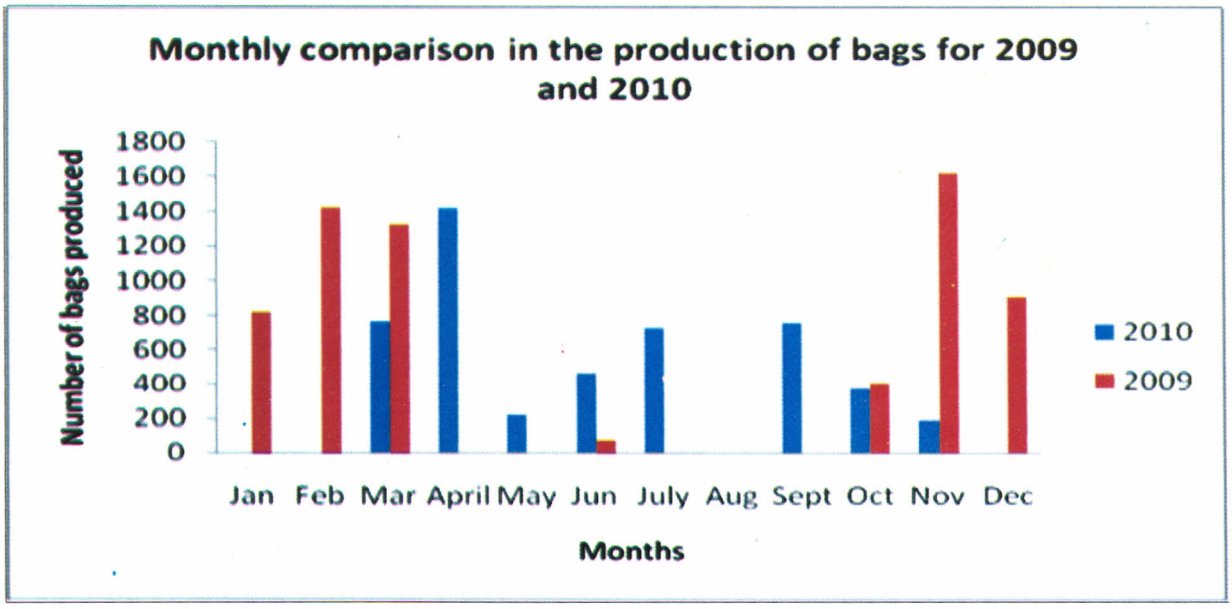

Fig 6.4: Monthly production and sale of compost bags to mushroom growers in 2009 and 2010 by the Mushroom Unit.

Research projects carried out

Several research projects were carried out in the Division. These are listed below:

1. Microbial quality of iced *kenkey* sold in selected markets in Greater Accra. (Amy Atter and Michael Amoo-Gyasi).
2. Microbial quality of sausage *khebab* sold in selected areas in Greater Accra. (Amy Atter and Angela Adam).
3. Risk of cross contamination of foods prepared in some chop bars in the Ashiaman township. (Nina Nkrumah and Evans Agbemafle).
4. Predominant microorganisms associated with fermentation of millet into *maasa* (Akyaa Ackaah-Gyasi, Wisdom Amoa-Awua , Kwaku Tano-Debrah and G. Annor).
5. Industrialization of the *Ga kenkey* production process. (W.K. Amoa-Awua, Ama Konadu-Amponsah, Peter Addo and Theophillus Annan).
6. Microbiological and biochemical changes which occur during the fermentation of *brukutu* an alcoholic beverage. (Amy Atter, M.Phil project)
7. Microbial species responsible for the fermentation of dehulled maize into kenkey, *nsihu*. (Theophillus Annan, M.Phil project).
8. Growth and yield performance of different species and strains of *Pleurotus* cultivated under Ghanaian conditions (Completed).
9. Studies on the use of various cropping techniques for the cultivation of oyster mushrooms (Completed).
10. Effect of substrate formulation of rice straw *(Oryza sativa)* and sawdust (Triplochiton scleroxylon) for the cultivation of *Pleurotus ostreatus* strain EM-1. (Completed).
11. The efficacy of sorghum and millet grains in the production of spawns of *P. ostreatus* strain EM-1. (Completed).
12. Development of high yielding strains of *Pleurotus* species through hybridization (On-going).

13. Utilization of dried pineapple rind in the cultivation of the oyster mushroom – *Pleurotus ostreatus* (Jacq.ex.fr) Kummer (On-going).
14. Characterization and domestication of the Termite mushrooms (*Termitomyces* species). (On-going).
15. Diversity, molecular phylogeny and evolution of tropical African *Thelephorales* (Basidiomycota, Fungi). (Collaborative project with Ludwig-Maximilians-Universität München, Germany).

Training programmes organized

- Training in spawn production was organized for 1 participant from 28th April -5th May, 2010.
  An intensive training course on mushroom cultivation was organized for 6 participants from 26th -30th July, 2010.
- An intensive training course on mushroom cultivation for 9 participants from 25th-29th October, 2010.
- Students visits:
- Forty (40) students and two teachers from Enchi Senior High School visited the Unit on 14th November, 2010.
- Thirty (30) students from the Accra Polytechnic in addition to 45 students and 2 lecturers from the Lab Tech Department of the Cape Coast University visited the Unit on 1st December 2010.

Vacation training

Five (5) students from the University of Ghana, University of Development Studies, KNUST and University of Cape Coast were attached to the Food Microbiology Division during their long vacation.

7.0 FOOD NUTRITION AND SOCIO-ECONOMICS DIVISION

Introduction

The Food Nutrition and Socio-economics Division (FNSED) consists of the Socio-economics and Gender issues Unit as well as the Nutrition and Food Utilization Units. The Socio-economic and Gender issues Unit is responsible for socio-economic baseline and impact studies of development related projects, Gender issues and techno-economic feasibility studies as well as market and consumer demands surveys. The Nutrition and Food Utilization Unit conducts applied research on food utilization, community and human nutrition studies as well as offers nutrition advisory services to the general public. The Division also runs a test kitchen which conducts sensory tests on products developed by the CSIR-FRI and industry. Specific activities carried out by the Division were as follows:

Research Activities

TELFUN Project (Tailoring Food Science and Technology to endogenous patterns of food supply)

Cowpea diversity assessment on the Ghanaian markets was conducted. This survey covered traders, food vendors and cowpea consumers patronizing selected markets in Kumasi and Accra. Cowpea samples were collected from various markets visited for morphological characterization in collaboration with cowpea breeder from CSIR-Crops Research Institute. Investigations into the organization of cowpea breeding activities in Ghana over the past 20 years were conducted to find possibilities for improving small-holder farmers' access to domestic market.

Total utilization of pineapple in the food industries

Trials of pineapple cakes and bread using pineapple syrup and flour with sensory evaluation conducted in collaboration with some students from the Netherlands.

Tuskegee/CSIR-FRI Project

Orange-fleshed sweet potato products were formulated and sensory evaluation carried out on them.

Products development

The following product development activities were carried out:

- Recipe development and standardization of *jollof* rice, *garifoto* and soups. Also carried out were dried *jollof* rice sample from Ebenut Ltd and packed soups from Home Food Ghana Limited.
- Use of varieties of yam in the formulation of yam porridge from yam flour.
- Supplementation of Moringa in infant foods.

Research Proposals

The Division has submitted a research proposal to Global Alliance for Improved Nutrition (GAIN) (Complementary Food Acceptability Test) Project which is under review.

Training

Cassava: Adding value in Africa (C:AVA)

Recipe development to expand products under High Quality Cassava Flour (HQCF) usage was carried out under the C:AVA project for which a number of training programmes were conducted for domestic bursars and bakers for selected senior

high schools in Volta and Greater Accra Regions. In addition to regular training under C:AVA, the Division conducted monitoring of HQCF uptake and shelf life studies of some composite flour biscuits. There were periodic sampling and evaluation of some biscuits such as *Obama*, *All time, Coreen*, and *Bansa* digestive.

WFP/UNICEF

As part of WFP/UNICEF joint project on: "Tackling Malnutrition in Northern Ghana", technology of cereal flour fortification with micronutrient (vitamin/mineral) premix was transferred to 12 rural communities in the Upper East, Upper West and Northern Regions of Ghana. A hand operated mixer designed and fabricated at the CSIR-Food Research Institute was employed for the mixing process. The training sessions were also facilitated by the use of a poster which showed step-by-step procedures both in graphic and words. A group discussion approach was adopted to help participants feel a sense of ownership of the programme and to also appreciate the intervention.

Training Manuals

The Division was involved in the development of the following training manuals:

- Environmental and Sanitation Control during Production of High Quality Cassava Flour.
- The Production Process of High Quality Cassava Flour.
- Quality Control during Production of High Quality Cassava flour and Specification for Cassava Roots, Cassava Wet Cake and HQCF.
- Equipment Operation and Maintenance for the Production of High Quality Cassava Flour.
  Growing and processing Moringa leaves.

Internship and Supervision of Student Projects

The Division supported the training of the third year students from Kwame Nkrumah University of Science and technology (KNUST) Food Science and Technology Department who were under internship for two months. The students were trained in the preparation of products from HQCF and were involved in the organization of sensory evaluation for their acceptability. Students from the following institutions were also supervised: University of Ghana, University of Cape Coast and Ho Polytechnic.

Exhibitions

Various products were formulated and exhibited at the Africa Day of Scientific Renaissance celebration. The Division participated in International Exhibition on Sustainable Agriculture in Ouagadougou, Burkina Faso in August 2010 under West African Agricultural Productivity Programme (WAAPP).

Commercial Activities

Commercial activities of the Division include the production and sale of Weanimix, soya products, cowpea flours and Moringa leaf products.

8.0 PROGRAMMES AND PROJECTS

In the course of the year, the programmes and projects undertaken were on Accreditation, food safety and quality assurance programme, Improving post-harvest quality and packaging of rice, Sorghum/Millet and cassava products to enhance marketability in West Africa, Development of a hybrid gas and solar powered grain dryer. Other projects were: Cassava: Adding Value for Africa – C:AVA-Ghana, Total utilization of pineapple in the food industries, Development and optimization of choco-peanut spread, Comparative and morphological studies on 13 strains of *Pleurotus* species, Investigations into alleged problems associated with the production of salted-dried fermented fish (*Koobi* and *Momone*) using iodized salt. The rest were: Improving snail meat processing methods in Ghana, AFTER (African Food Tradition Revisited by Research), Value-added processing of underutilised savannah tree seeds for improved food security and income generation in West Africa, Root and Tuber Improvement and Marketing Programme (RTIMP), Tackling Malnutrition in Northern Ghana-Cereal Flour Fortification and Utilization of dried pineapple rind *Ananas comosus* var. MD2 in the cultivation of oyster mushrooms *Pleurotus ostreatus* (Jacq. ex. Fr.) Kummer. The above projects are all on-going.

8.1 ACCREDITATION, FOOD SAFETY AND QUALITY ASSURANCE PROGRAMME

Introduction

A quality management system has been established and is being implemented according to ISO/IEC 17025: Standard since August 2001. The main objective is to maintain accreditation for 4 chemical, 1 mycotoxin and 13 microbiological methods to ISO/IEC 17025: Standard. This was to ensure that the Institute's Chemistry and Microbiological laboratories produce technically valid analytical results that can be internationally accepted by customers.

The Institute obtained accreditation for 11 microbiological and 4 chemical methods from the South African National Accreditation System (SANAS) in May 2007. Since then the Institute has continued to maintain its accreditation status.

Outcome of Surveillance visit (2009)

Upon receipt of satisfactory documented evidence of completed non-conformance reports from both Microbiology and Chemistry, SANAS granted continued accreditation for all the methods. Consequently, a new SANAS accreditation certificate bearing a new logo was received. As a follow-up to the External Audit conducted by SANAS on the 24th and 25th November 2009, two new Technical Signatories (Messrs Ankrah and Amey) were confirmed for the Chemistry Division.

Activities

Internal Audits

Two internal audits were conducted in each of the three laboratories i.e. Chemistry, Mycotoxin and Microbiology; the Client Services Unit of the CID and the FRI Stores to verify whether the operations comply with the requirements of FRI Quality Management System and the International Standard ISO/IEC 17025 and if defined methods, procedures and instructions as stated in the documents are properly carried out. The two audits were conducted in March and the other in November. The audits were conducted by Dr. Charles Tortoe and Mr. Elvis Baidoo of the Processing and Engineering Division and

Dr. Lawrence Abbey (Quality Manager).

(1) March 2010 Internal Audit findings

Microbiology Laboratory

Seven (7) minor non-conformances (NCs) were found in the March audit of the Microbiology laboratory.

Chemistry Laboratory

The Chemistry laboratory recorded four (4) non-conformances.

Mycotoxin Laboratory

There was one non-conformance identified in the Mycotoxin laboratory.

Stores

One (1) non-conformance was identified at the Stores.

Commercialization and Information Division

Two (2) minor non-conformances were identified at the CID.

(2) September 2010 Internal Audit findings

Microbiology Laboratory

All the non-conformances identified during the previous March 2010 audit were addressed. However, six (6) non-conformances were identified in the September Audit.

Chemistry Laboratory

Three (3) non-conformances were identified at the Chemistry laboratory.

Mycotoxin Laboratory

One (1) non-conformance was identified at the Mycotoxin laboratory.

Stores

Non-conformances identified were mainly due to incomplete entries.

Commercialization and Information Division

Two non-conformances were identified at the CID.

Management Review Meetings

Management Review Meetings were held twice in the year to ensure the continuous suitability and effectiveness of the quality management system and to introduce necessary changes and improvements. Two meetings were held on 17th June, 2010 and 1st December, 2010. The main matters discussed were: Status of work in the Divisions; Problems and difficulties encountered; Suggestions for improvements; Internal /External Audit findings; Corrective and preventive actions; Results of Proficiency tests and Internal quality controls; Purchasing/Procurement; Customer feedback and Complaints; Resources and Staff training and other matters. Members of the Management Review Meeting included the Director (Chairperson); Deputy Director and Heads of Microbiology Division, Chemistry Division, Commercial and Information Division; Accounts and Stores Division, Administration Division and the Quality Manager as Member/Secretary.

Participation in proficiency tests/inter laboratory comparisons

Proficiency Tests

By the Quality Manual, the methods in use have to be subjected to proficiency testing once every year. The Divisions placed the orders for the test materials at the end of 2009 and the tests were conducted in June and November 2010 by the two laboratories. The Testing Body used was the Food

Analysis Performance Assessment Scheme (FAPAS) of the Central Science Laboratory of the United Kingdom. The laboratories performed satisfactorily in these tests.

Notification of surveillance

The Quality Manager received a notification of surveillance assessment from SANAS on the 11th of December, 2010. This assessment was scheduled for January 11th, 2011. However, the scope of assessment would be on the implementation of the Management System as described in the laboratory documentation and with regard to the interface with the Microbiology and Chemistry laboratories.

Technical activities which would be assessed would focus on the Microbiology Laboratory. These would include a vertical audit, witnessing of laboratory capabilities, quality document compliance and the implementation thereof against the requirements of our own Quality Manual, ISO/IEC 17025:2005 and additional SANAS requirements.

8.2 Utilization of dried pineapple rind Ananas comosus var. MD2 in the cultivation of oyster mushrooms *Pleurotus ostreatus* (Jacq. ex. Fr.) Kummer

This project considered the use of different agricultural by-products and additives to improve the biological efficiency and nutrient content of the oyster mushroom *Pleurotus ostreatus* (Jacq. ex. Fr.) Kummer which has been an area of continuous research in Ghana. This is to increase the biological efficiency (BE) of the mushroom which presently stands at 75% to 100% and will be of enormous benefit to the mushroom farmers that have been trained over the years. The project aim was therefore to evaluate the use of dried pineapple rind of *Ananas comosus* var. MD2 on the BE and nutrient content of *P. ostreatus*. It was observed and concluded that dried pineapple rind can be used as an additive to wawa sawdust at 5% concentration, for the cultivation of P. ostreatus.

8.3 Development of a hybrid gas and solar powered grain dryer

GIZ in partnership with CSIR-FRI developed an energy efficient local dryer which uses an energy efficient hybrid heating system (LPG and Solar), that reduces the quantity of gas usage as well as improving the efficiency of drying. The gas burner, which is the primary source of energy, is coupled with an auxiliary solar heating source to form the hybrid heating system that can save about 40% of the quantity of gas normally used in such drying.

8.4 Cassava: Adding Value for Africa – C:AVA-Ghana.

Through an initiative led by the University of Greenwich's Natural Resources Institute, UK, in close partnership with the CSIR-Food Research Institute, Ghana, the Bill and Melinda Gates Foundation is funding a 3 year "Cassava: Adding Value for Africa" (C:AVA) project in Ghana. Four other African countries: Nigeria, Uganda, Tanzania and Malawi are also beneficiaries of this initiative. The project aims to significantly boost the incomes of small-scale African farmers by linking them to new markets. This goal is expected to be achieved through the use of innovative interventions to capacitate farmers, village processing units and market intermediaries to competitively deliver high quality cassava-based products to a well sensitized market.

As part of its achievements, C:AVA has prepared, printed and distributed to trained stakeholders, two thousand (2000) copies of four (4) different training manuals. In the Volta and Brong Ahafo regions, sixty (60) farmer-processor groups and eleven (11) medium/large scale cassava processors have been trained in HQCF processing. The

kitchen staff of ten (10) senior high schools and three (3) commercial bakers have been trained in composite bread making with HQCF in the Volta and Greater Accra Regions. Backstopping activities are on-going for the trained stakeholders (processors and bakers). The introduction of HQCF, has recorded a boost in the relationship between stakeholders in the cassava value-chain. There has also been a significant reduction in the cost of bread and plywood production by stakeholders. If fully adopted and implemented by law, the nation's economy will experience a significant reduction in wheat importation.

8.5 Total utilization of pineapple in the food industries

The objectives of the project were specifically to de-juice pineapple pulp into syrup, flour and chunks and to conduct market research on pineapple syrup and flour (sensory / full financial evaluation). To obtain the syrup, the juice obtained from the pineapple pulp was made to boil at temperatures between 93-100°C for 10-12 hours and vapour was evaporated with a ventilator. The pulp was washed, pressed and spread to dry in order to obtain pineapple chunks which were milled and sifted to obtain the pineapple flour. Market survey revealed that, majority of people preferred cake made from the pineapple flour to be packaged in a transparent plastic foil and to be sold in super markets. At the end of the project, it was concluded that pineapple syrup and flour has a potential in the food industries.

8.6 Development and optimization of choco-peanut spread

The objective is to develop and optimize a prototype peanut-based spread with cocoa ready for industrial adoption. The factors to be considered are product attributes (high spreadability, good consistency, as well as peanut and chocolate flavour) and position attributes (high satiety value and high nutrition)

The method to be used is a constrained simplex centroid mixture design to optimize the sensory acceptability of the chocolate-peanut spread. The detailed plan of work has been finalized, an MOU signed and transfer of funds documented.

8.7 Comparative and morphological studies on 13 strains of *Pleurotus* species

Species of the genus *Pleurotus* are important industrially. They occupy third place in worldwide production of edible mushrooms. *Pleurotus* species produce large amounts of protein on substrates consisting primarily of lignocellulose. They also produce a diversity of extracellular digestive enzymes which play an important role in lignocellulose degradation. As part of its research activities, the Mushroom Unit evaluates the strains and species of mushrooms it receives from different countries in order to ascertain its growth characteristics and yield and to release the best to mushroom farmers. The Unit received 23 strains of six *Pleurotus* species from China and USA which included *P. ostreatus* P7 (TL), P12 (SL), P25 (Pearl), P5 (Azul), P6 (012A), P47 (HK), P25 (A8), P15 (B soy 3), P31 (JB), P8 (Rl), P15 (B soy s), P8 (Rh). The objectives of this study were to compare the mycelial growth rates, yield, biological efficiency and morphology of 13 strains of P. ostreatus cultivated on two nutrient media (PDA and MEA) under the same conditions (29°C and 80% humidity) and on composted wawa sawdust.
At the end of the project, it was observed that, strains P47(HK) and P31(JB) showed a favourable growth rate and thickness on composted sawdust.

8.8 Investigations into alleged problems associated with the production of salted-dried fermented fish (*Koobi and Momone*) using iodized salt

Traditional processing methods employed in Ghana to preserve fish include salting, fermentation, smoking and sun drying. Salting and fermentation are widespread in the coastal regions of Ghana in addition to some catches from rivers in the various regions.

However, the lack of standardization in the processes has caused the presence of many and varied salted and fermented fish products on the market.

Some aspects of fish preservation need attention and improvement to produce shelf stable end products. These include the use of acceptable preservatives, proper equipment and practice of hygienic standards during handling and production. The project aims at conducting a survey of major production areas in Ghana to evaluate process of salted-dried fermented fish using structured questionnaire; collecting samples of salted and fermented fish for physical, chemical, microbiological, sensory and textural analysis and undertaking comparative fermentation studies on salted and fermented fish using iodized/ uniodized rock salt and iodized/ uniodized smooth salt.
The study is expected to establish the effect of iodated salt on fish fermentation as well as to train processors on standardized and hygienic methods of fish salting and fermentation and finally, to make economic gains in marketing and exporting good fish products.

8.9 Improving snail meat processing methods in Ghana

Improved processing and preservation methods for the giant African snail *(Achatina achatina)* over traditional methods were investigated. This project was financed by FAO. Traditional methods involve the use of poor quality snail meat raw material (including sometimes dead snail meat), improper washing or slime removal, intensive heat and smoke treatment and poor handling and storage, resulting to overall poor quality snail meat end-product. Results of work indicated higher protein content and improved microbiological quality. The overall product quality, stability and acceptability were also higher for the improved product than traditionally processed products. It has been concluded that, the improved method leaves snails with higher protein content than the traditional process.

8.10 AFTER (African Food Tradition Revisited by Research)

This project aimed to revisit traditional African products, knowledge and know-how in the light of new technologies for the benefit of consumers, producers and processors in Africa and Europe. By applying improved science and technology to African traditional food products, it seeks to turn research into quantifiable and innovative technologies and products that are commercially viable in various markets. The products of concern were: fermented fish (*lanhouin, kong*) , Salted beef (*kitoza*) , Fermented cereal-based products (*akpan, kenkey, gowé, kishk*) and Vegetal extract for functional food (*Adansonia digitata, Hibiscus sabdariffa, Ziziphus mauritiana*) .

The expected beneficiaries are micro, small and medium scale enterprises (MSMEs) and the implementing communities. The project hopes to improve traditional African products in the light of combined and/or new technologies for mutual benefits for the consumers, companies and the producers in Africa and Europe. In addition, it seeks to improve processes that enhance the control of the safety, sensory and nutritional quality of kenkey and new forms of kenkey adapted to urban African consumers in accordance with European market and consumer expectations

for the identified market segments. Further, it will determine the factors that influence market access for kenkey in Ghana and European countries.
Activities carried are project start up meeting held in Benin, a write up of Standard Operational Procedures (SOPs) for sampling and all analytical procedures, chemical and microbiological analysis and sensory evaluation, literature review on kenkey and other project products and development of questionnaire for survey in Central and Eastern regions of Ghana.

8.11 Value-added processing of underutilised savannah tree seeds for improved food security and income generation in West Africa

The project involved the study of the processing of seeds from three semi-domesticated trees commonly found in Burkina Faso, southern Mali and northern Ghana, namely, African locust bean (*Parkia biglobosa*), baobab (*Adansonia digitata*) and kapok (*Ceiba pentandra*).

The specific objectives were to survey the availability of seeds from the selected trees and to optimise the technologies for dehulling of the seeds for processing of fermented food products, identify and characterise the dominant micro flora in the fermented seed products and select appropriate strains for the development of multifunctional starter cultures. Other objectives were to study the microbial interactions and their importance for product quality and safety and analyse the human health and nutritional status of the selected fermented seed products using cell models of the gastro-intestinal tract (GIT).

This project was undertaken to improve food security and to create opportunities for income generation, especially for women producers, through value-added processing of seeds derived from semi-domesticated tree species that commonly grow in the savannah ecological region of West Africa.

Activities undertaken so far include removal of undesired odour from fermented tree seeds products, establishment of pilot scale production of *kantong* at UDS, Navrongo Campus and for a women's co-operative group in Tamale, fabrication of hammer mill (at FRI) and acquisition of other equipment for pilot plant which has been established. In addition the project has achieved the processes for reduction of the pungent aroma of *dawadawa, kantong* and *maari*.

8.12 Root and Tuber Improvement and Marketing Programme (RTIMP)

This project was undertaken to upgrade rural micro and small enterprises (MSEs) involved in root and tuber processing through enabling their access to improved cassava processing equipment and also through training and backstopping on business management and marketing skills. CSIR-FRI constructed two Good Practice Centres (GPCs) to be used as demonstration centres. These involved the redesign and expansion of the processing hall, covering of ventilation gaps in walls with expanded metal and mesh, construction of a roasting hall/shed, large improved stoves with large stainless steel roasting pans, a new washing trough, fermentation trough and a large concrete solar tent dryer. In addition, the project installed a new water pump, stainless steel self-feeding cassava grater, a large robust screw press and lined two old graters with stainless steel.

8.13 Tackling Malnutrition in Northern Ghana-Cereal Flour Fortification

The World Food Programme (WFP) and its partner agencies have long been recognized for their ability to deliver food to deprive and resource –poor people all over the world. Relatively little is known about the efforts WFP puts to ensure food

supplied provides vitamins and minerals and not just calories. The technology of cereal flour fortification with micronutrient (vitamin/mineral) premix was transferred in twelve (12) communities in the Upper East, Upper West and the Northern regions of Ghana. This was organized as part of WFP/UNICEF joint project on Tackling Malnutrition in Northern Ghana using fortification of their staple foods (cereal flour) with six vitamins and two minerals as a means of meeting their nutritional needs. The communities that benefited from the technology included Gorogo, Zorko Goo, Tangasia, Chuchuliga Namosa in the Upper-East Region, Woribogu-Kukuo, Yilonayili, Gortani, Yankazia, Nansoni in the Northern Region and Lam-Uollo, Ketuo and Dahile-Kpanagaan in the Upper-West Region.

A hand-operated mixer designed and fabricated at the CSIR-Food Research Institute was employed for the mixing process. The training sessions were also facilitated by the use of a poster which showed step-by-step procedures both in graphic and words. A group discussion approach was adopted to help participants feel a sense of ownership of the programme and to also appreciate the intervention.

Some of the major achievements of the project were the transfer of fortification of cereal flour technology to field officers of WFP and the fact that several communities in Upper East and Upper West are beneficiaries of the fortification programme.

8.14 Improving Post-Harvest Quality and Packaging of Rice, Sorghum/Millet and Cassava Products to Enhance Marketability in West Africa

The poor post-harvest practices used in rice production system, such as floor-drying, parboiling, milling and bagging pose significant problems in quality. This has rendered the rice sector low in marketability and profit-making to producers and processors. Three (3) projects were achieved. These included organizing:

a. a natural sensitization workshop b. writing booklets on cassava and rice processing for processors and
c. organizing training programmes on rice and cassava processing for processors.

The output of women cassava processing groups is reduced by 40% during the dry season as a result of drudgery vis-a-vis high labour cost in harvesting cassava roots. On the contrary, excessive glut and harvest losses occur at the peak of harvesting time. Traditional pealing and grating methods of cassava into main products such as gari, flour and dough are grossly inefficient with low turnover, and sometimes injurious to health.

APPENDIX I

Senior Members and Senior Staff List

Directorate

1.	Dr. P- N. T. Johnson	-	Acting Director
2.	Robert. M. Yawson	-	Senior Scientific Secretary
3.	Stephen Nketia	-	Scientific Secretary
4.	Faustina Mante (Mrs.)	-	Prin. Admin Assistant
5.	Eric K. Ofori	-	Prin. Admin. Assistant
6.	Mariam Yakubu (Ms.)	-	Technologist

Administration Division

1.	J. Aggrey -Yawson (Ms.)	-	Ag. Head Admin/Asst. Admin Officer
2.	John F. Asigbey	-	Chief Admin. Asst.
3.	Emmanuel A. Larbi	-	Chief Works Supt.
4.	Jacob Kuwornu	-	Prin. Works Supt.
5.	Isaac Hammah	-	Senior Works Supt
6.	Christiana Ketsie (Ms.)	-	Senior Admin Asst.
7.	Victoria A. Asunka (Mrs.)	-	Senior Admin. Assistant
8.	Beullah Adadevoh-Sallah (Mrs.)	-	Senior Admin. Assistant

Accounts Division

1.	N. Adoboe-Mensah	-	Head/Accounts Division
2.	C. Aikins Tutu	-	Chief. Accounting Asst.
3	John M. Nakotey	-	Chief Stores Supt.
4.	Kenneth K. Aidoo	-	Chief Accounting Asst.
5.	Judith Dogbegah (Ms.)	-	Chief Accounting Asst.
6.	Christian Amegah	-	Prin. Accounting Asst.
7.	Joseph K. Larbi	-	Accounting Asst.
8.	Mabel Aryee (Ms.)	-	Accounting Asst.
9.	James Cromwell	-	Stores Supt.

Commercialization & Information Division

1.	Dr. Kwame A. Vowotor	-	Ag. Head/CID (Senior Research Scientist)
2.	Dr. P. Adu-Amankwa (Mrs.)	-	Senior Research Scientist
3.	Kwabena A. Bugyei	-	Asst. Scientific Info. Officer
4.	Raphael Kavi	-	Jnr Asst Librarian
5.	Augustine Andoh	-	Chief Tech. Officer
6.	Benedict Awotwi	-	Chief Tech. Officer

7.	Philip.O. Baidoo	-	Prin. Accounting Asst.
8.	Joana B. Dzikunu (Ms.)	-	Snr. Admin. Assistant
9.	Jeremiah Lartey- Brown	-	Senior Technical Officer
10.	Mary Assimah (Ms.)	-	Admin. Assist.

Food Processing & Engineering Division

1.	Dr. Nanam T. Dziedzoave	-	Ag. Head/FPED (Prin. Research Scientist)
2.	Dr. John T. Manful	-	Senior Research Scientist
3.	Daniel. Blay	-	Senior Research Scientist
4.	Ebenezer C. Tettey	-	Research Scientist
5.	Dr. Lawrence D. Abbey	-	Research Scientist
6.	Cletus K. Gyato	-	Research Scientist
7.	Benjamin A. Mensah	-	Research Scientist
8.	Joseph Gayin	-	Research Scientist
9.	Dr. C. Tortoe	-	Senior Research Scientist
10.	Gregory A. Komlaga	-	Research Scientist
11.	C. Oduro-Yeboah (Mrs.)	-	Research Scientist
12.	Elvis A. Baidoo	-	Research Scientist
13.	Moro Adams	-	Research Scientist
14.	Daniel A. Anang	-	Research Scientist
15.	Seidu A. Sampare	-	Chief Tech. Officer
16.	John A. Asafu-Adjei	-	Chief. Works Supt
17.	Rhodes Y. Anthonio	-	Prin. Works Supt.
18.	Robert O. Lamptey	-	Prin. Works Supt.
19.	Isaac Apollonius Nyarko	-	Senior Technologist
20.	Emmanuel A. Saka	-	Technologist
21.	Edna Mireku	-	Technologist
22.	Patrick Mintah	-	Prin. Tech. Officer
23.	Peter Dalabor	-	Prin. Works Supt.
24.	Joseph Akoto	-	Senior Works Supt.
25.	Emmanuel Alorsey	-	Asst. Technologist
26.	Godwin Armah	-	Senior Tech. Officer
27.	Solomon Dowuona	-	Senior Tech. Officer
28.	Thomas Najah	-	Senior Tech. Officer
29.	John R. Addo	-	Senior Tech. Off.
30.	Samuel Asiedu	-	Technical Officer
31.	Makafui Torgbui	-	Technical Officer
32.	Agartha Amuzu	-	Technical Officer
33.	Helene A. Van-Ess	-	Technical Officer
34.	Desmond Mensah	-	Technical Officer
36.	Emmanuel Tettey Agbloe	-	Works Supt.

7.	Philip.O. Baidoo	-	Prin. Accounting Asst.
8.	Joana B. Dzikunu (Ms.)	-	Snr. Admin. Assistant
9.	Jeremiah Lartey- Brown	-	Senior Technical Officer
10.	Mary Assimah (Ms.)	-	Admin. Assist.

Food Processing & Engineering Division

1.	Dr. Nanam T. Dziedzoave	-	Ag. Head/FPED (Prin. Research Scientist)
2.	Dr. John T. Manful	-	Senior Research Scientist
3.	Daniel. Blay	-	Senior Research Scientist
4.	Ebenezer C. Tettey	-	Research Scientist
5.	Dr. Lawrence D. Abbey	-	Research Scientist
6.	Cletus K. Gyato	-	Research Scientist
7.	Benjamin A. Mensah	-	Research Scientist
8.	Joseph Gayin	-	Research Scientist
9.	Dr. C. Tortoe	-	Senior Research Scientist
10.	Gregory A. Komlaga	-	Research Scientist
11.	C. Oduro-Yeboah (Mrs.)	-	Research Scientist
12.	Elvis A. Baidoo	-	Research Scientist
13.	Moro Adams	-	Research Scientist
14.	Daniel A. Anang	-	Research Scientist
15.	Seidu A. Sampare	-	Chief Tech. Officer
16.	John A. Asafu-Adjei	-	Chief. Works Supt
17.	Rhodes Y. Anthonio	-	Prin. Works Supt.
18.	Robert O. Lamptey	-	Prin. Works Supt.
19.	Isaac Apollonius Nyarko	-	Senior Technologist
20.	Emmanuel A. Saka	-	Technologist
21.	Edna Mireku	-	Technologist
22.	Patrick Mintah	-	Prin. Tech. Officer
23.	Peter Dalabor	-	Prin. Works Supt.
24.	Joseph Akoto	-	Senior Works Supt.
25.	Emmanuel Alorsey	-	Asst. Technologist
26.	Godwin Armah	-	Senior Tech. Officer
27.	Solomon Dowuona	-	Senior Tech. Officer
28.	Thomas Najah	-	Senior Tech. Officer
29.	John R. Addo	-	Senior Tech. Off.
30.	Samuel Asiedu	-	Technical Officer
31.	Makafui Torgbui	-	Technical Officer
32.	Agartha Amuzu	-	Technical Officer
33.	Helene A. Van-Ess	-	Technical Officer
34.	Desmond Mensah	-	Technical Officer
36.	Emmanuel Tettey Agbloe	-	Works Supt.

Food Microbiology Division

1.	Dr. W.A. Amoa –Awua	-	Head /FMD (Chief Research Scientist)
2.	Dr. M. Ottah-Atikpo (Mrs.)	-	Senior Research Scientis
3	Dr. M. Obodai (Mrs.)	-	Senior Research Scientist
4	Dr. M. Owusu (Ms.)	-	Research Scientist
5.	Peter Adoquaye Addo	-	Research Scientist
6.	Bernice D. Kalton-Senaye (Mrs.)	-	Research Scientist
7.	Matilda Dzomeku (Mrs.)	-	Research Scientist
8.	Ivy Yawson (Mrs.)	-	Research Scientist
9.	Amy Atter (Mrs.)	-	Asst. Res. Scientist
10.	Deborah L. Narh (Ms.)	-	Asst. Res. Scientist
11.	Nina Bernice Ackah (Mrs.)	-	Asst. Scientific Officer
12.	Evans Agbemefle	-	Asst. Scientific Officer
13.	David K. Asiedu	-	Prin. Technologist
14.	David K. Baisel	-	Senior Technologist
15.	Richard Takli	-	Asst. Technologist
16.	Michael Amoo-Gyasi	-	Senior Technologist
17.	Theophillus Annan	-	Technologist
18.	May A. Boham (Ms.)	-	Senior Tech. Officer
19.	Angela Adams	-	Technologist

Food Chemistry Division

1.	Dr. (Mrs.) K. Kpodo	-	Head/FCD (Prin. Research Scientist)
2.	George A. Anyebuno	-	Research Scientist
3.	Charles Diako	-	Research Scientist
4.	Hayford Ofori	-	Research Scientist
5.	Foster Y. Mensah	-	Asst. Research Scientist
6.	William K. Amevor	-	Prin. Technologist
7.	David N. A. Ankrah	-	Senior Technologist
8.	Nelson Y. Amey	-	Senior Technologist
9.	Mercy Fianu (Ms.)	-	Senior Technical Officer
10.	Kofi K. Essel	-	Asst. Technologist
11.	Vida Awidi (Ms.)	-	Senior Technical Officer
12.	Belinda Quaye (Mrs)	-	Technical Officer
13.	Emefa Gblende (Ms.)	-	Technical Officer
14.	Dorothy Narh (Mrs.)	-	Technical Officer
15.	Ebenezer Tawiah	-	Technical Officer
16.	Frank Dogbey	-	Technical Officer
17.	Derrick Ashley	-	Technical Officer

Food Nutrition & Socio-Economics Division

1.	Wilhemina Quaye (Mrs.)	-	Head/FNSED (Senior Research Scientist)
2.	Mary Glover Amengor (Mrs.)	-	Senior Research Scientist
3.	Lynda Hagan (Mrs.)	-	Research Scientist
4.	Evelyn S. Buckman (Mrs.)	-	Assistant Research Scientist
5.	Eric Owusu Sarpong	-	Research Scientist
6.	Ruth Adisetu Pobee (Mrs.)	-	Research Scientist
7.	Iris A. Tamakloe (Mrs.)	-	Chief Tech. Officer
8.	Alice Padi (Mrs.)	-	Senior Technical Officer
9.	Constance Boateng (Ms.)	-	Senior Technical Officer

APPENDIX II

CSIR-FRI Staff Promotions

(A) Senior Members Promotions

No	Name	Grade Promoted To	Effective Date
1.	Dr. P-N.T. Johnson	Chief Research Scientist	1/1/09
2.	Dr. Mrs. Kafui Kpodo	Prin. Research Scientist	1/7/08
3.	Dr. N.T. Dziedzoave	Prin. Research Scientist	1/1/10
4.	Dr. Mrs. M. Ottah- Atikpo	Senior Research Scientist	1/7/08
5.	Dr. Mrs. M. Obodai	Senior Research Scientist	1/7/08
6.	Dr. Charles Tortoe	Senior Research Scientist	1/7/08
7.	Mrs. W. Quaye	Senior Research Scientist	1/7/08
8.	Mrs. M. Glover-Amengor	Senior Research Scientist	1/7/08
9.	Mr. N. Adoboe-Mensah	Senior Accountant	1/1/09

(B) Senior Staff Promotions

No	Name	Grade Promoted To	Effective Date
1.	Michael Amoo-Gyasi	Snr. Technologist	1/1/10
2.	Philip Baidoo	Prin. Acct. Asst.	1/1/09
3.	Peter Delabor	Prin. Works Supt	1/1/10
4.	Greta Akpokli	Snr. Admin. Asst.	1/1/10
5.	Joseph Larbi	Snr. Acct. Asst.	1/1/10
6.	Thomas Najah	Snr. Tech. Officer	1/1/10
7.	May Boham-Dako	Snr. Tech. Officer	1/1/10
8.	Vida Awidi	Snr. Tech. Officer	1/1/10
9.	Solomon Nii Dowuona	Snr. Tech. Officer	1/1/10

(c) Junior Staff Promotions

No	Name	Grade Promoted To	Effective Date
1.	Mabel Aryee	Accounting Asst.	1/1/10
2.	Emmanuel Agbloe	Works Supt	1/1/10
3.	Francis Yin	Snr. Sec. Asst.	1/1/10
4.	Sylvanus Akanue	Snr. Sec. Asst.	1/1/10
5.	John Abalansah	Snr. Sec. Asst.	1/1/10
6.	Afara Avuto	Sec. Asst. Gd. 1	1/1/10
7.	Daniel Mustapha	Sec. Asst. Gd. 1	1/1/10
8.	Ebenezer Asare	Sec. Asst. Gd. 1	1/1/10
9.	Samuel Amaning	Sec. Asst. Gd. 1	1/1/10
10.	Paul Kpotor Tetteh	Sec. Asst. Gd. 1	1/1/10

APPENDIX III

CSIR-FRI Staff Who Completed Training

No	Name	Courses Studied	Institution
1.	Ms. Margaret Owusu	PhD	University of Denmark
2.	Mr. Appolonius Nyarko	BSc. Lab. Tech	University of Cape coast
3.	Ms. Mercy Fianu	BSc. Lab. Tech	University of Cape Coast

CSIR-FRI Staff under Training

No	Name	Course of study	Institution
1.	Robert M. Yawson	PhD. Sci. Tech	Univ. of Minnesota
2.	Mr. Kofi Kwegyir Essel	BSc. Applied Sci.	Univ. for Dev. Studies
3.	Ms. Joana Dzikunu	BBA Admin	IPS
4.	Mr. Emmanuel Alorsey	BSc. Food Sci. & Tech	KNUST
5.	Mr. Kwabena Bugyei	MBA Info. Systems	KNUST
6.	May Boham-Darko	BSc. Lab. Tech	University of Cape Coast
7.	Ms. Helene Ama Van-Ess	BSc. Lab. Tech	University of Cape Coast
8.	Justina Thompson	BSc. Marketing	IPS
9.	Angela Addy	BSc. Accounting	IPS
10.	Solomon Dowuona	BSc. Lab. Tech	UCC
11.	Agartha Amuzu	BSc. Agric.	University of Ghana
12.	Patrick Mintah	BSc. Tech.	Ho Polytechnique
13.	Evelyn Buckman	MSc. Food Sci.	KNUST
14.	Bernice Kalton Senaye	PhD Energy/Env. Sys.	Purdue University
15.	Amy Atter	MSc. Food Micro	KNUST

APPENDIX IV

Conferences, Courses, Workshops And Seminars Attended By CSIR-FRI Staff

Date of Conference/ Seminar	Type of Conference/Seminar	Organizers	Venue	Participants
18-19/01/10	Kick off meeting, 'Value-added processing of underutilised savanna tree seeds for improved food security and income generation in West Africa' (Seed Foods)	DANIDA	Bamako, Mali	Dr. W.K. Amoa-Awua
9/02/10	Project overview and planning of Research component of Rice Sector Support Project	Directorate of Crops Services, MoFA	Tamale	Mr. J. Gayin
15-17/02/10	The role of technology in enhancing competitiveness of local enterprises. The Second Continental Conference of Pan-African Competitiveness forum	CSIR-STEPRI	Elimina	Mrs. Wilhemina Quaye, Mr. Steven Nketia
16 -25/02 /10	72nd Meeting of the Joint FAO/WHO Expert Committee for Food Additives (JECFA) dedicated to the evaluation of certain contaminants in foods	FAO/WHO	Rome, Italy	Dr. Kpodo
12-13/03/10	Workshop on promoting corporate governance in the public sector	State Enterprise Commission	Volta Hotel, Akosombo	Dr. P-N.T Johnson
17/03/10	Stakeholders Meeting on National Food Safety Policy	FDB	Alisa Hotel	Dr. L.D Abbey

29-30/03/10	Greater Accra Regional Planning Session-Research Extension Farmer Linkage Committee	CSIR, MoFA	MoFA Resource Centre, Accra	Mr. J. Gayin
06 –08/04/10	Pan African Meeting for Experts to discuss Codex issues in the Codex Committee on Contaminants in Foods (CCCF) of interest to Africa	AU/BAR	(AU/IBAR) Office Nairobi, Kenya	Dr. K. Kpodo
13-16/04/10	9th Wartburg Symposium on Flavour Chemistry and Biology	Wartburg Stiftung Eisenach	Eisenach, Germany	Dr. Margaret Owusu
20-22/04/10A	Workshop On Rice Research Planning In Ghana	Africa Rice Center, CSIR	CSIR Conference Room, Head Office	Mr. J. Gayin
22-23/04/10	AWARD Monitoring and Evaluation workshop	AWARD	Novotel Hotel, Accra	Evelyn Buckman
26–30/04/10	4th Session of the Codex Committee on Contaminants in Foods (CCCF)	FAO/WHO	Turkey	Dr. K. Kpodo
02-06/05/10	National Workshop on WEB 2.0 learning opportunities	CSIR-INSTI/CTA	INSTI	Mr. R. Kavi
05/05/10	Procurement seminar	CSIR	CSIR -FRI	Accts. Staff/project leaders
26–27/05/10	Workshop on Good Laboratory Practices	CDM training solutions professional	African Royal Beach Hotel	Mr. George Anyebuno
02/06/10	Priority Setting meeting for the implementation of the Libreville Declaration on Health and Environment in Africa	Ministry of Health	Alisa Hotel, Accra	Mrs. Mary Glover-Amengor

13-26/06/10	Climate Change and its Impacts Workshop	Brown International Advanced	Providence RI, USA	Mrs. Wilhemina Quaye
06/07/10	Sweet potato Support Platform (SSP) for West Africa	CSIR-CRI	CSIR-CRI	Mr. Elvis Baidoo
13-14/7/10	Conference and workshop on Mycotoxins	National Codex Committee	Oak Plaza Hotel	Dr. Kafui Kpodo, Mr George Anyebuno, Mr. Foster Mensah
20-24/07/10	Training of trainers workshop on rice and cassava processing	USAID, CORAF/WECARD, Songhaï Centre,	Songhaï Centre, Porto-Novo, Benin	Mr. J. Gayin
27/07/10	AGOA Policy Dialogue	AGOA	GIMPA	Mrs. Mary Glover-Amengor
02/08/ 10	Seminar on pesticide residues in local and imported fruits and vegetables in Ghana	Physikalisch Technishe Bundesanstalt	Ghana Standards Board	Mr Charles Diako, Mr. Foster Mensah
08-09/08/10	Energia and Gender Annual General Meeting	Energia	Forest Hotel, Dodowa	Mrs. Mary Glover-Amengor
17/08/10	Stakeholders dissemination seminar on the ASTI Survey report	CSIR-STEPRI	CSIR -STEPRI	Mrs. W. Quaye
24/08/10 - 04/09/10	Food Microbiology	-	Copenhagen, Denmark	Dr. W.K. Amoa-Awua
26-27/08/10 15-16/09/10	Workshop on Single Spine Migration for the CSIR	CSIR	Main confab Room	Mr. C.T Aikins
22-23/09/10	SABIMA stewardship awareness creation workshop	CSIR-STEPRI	CSIR -STEPRI	Dr. M. Atikpo & Dr. M. Obodai
22/09/10	National Conference on the honey sub-sector in Ghana	SNV Netherlands Dev. Organisation	Miklin Hotel	Mr. C. Gyato

27/09/10	Project Sensitization Seminar	STEPRI	Auditorium	Dr. Abbey
01 –15/10/10	AWARD Mentoring Orientation Workshop	CGIAR-AWARD	Mombasa, Kenya	Dr. Mary Obodai
04-05/10/10	Executive Professional development Workshop	CSIR	Main Confab room	Dr. Johnson, Dr. Kpodo, Dr. Dziedzoave and Ms. Aggrey-Yawson
11-16/10/10	Kick off meeting, 'African Food Tradition Revisited by Research', EU project	University of Abomey	Cotonou, Benin	Dr. W.K. Amoa-Awua
14-15/10/10	Strategic Planning Workshop On MOAP Project	GTZ, MoFA	Korkdam Hotel, Accra	Mr. J. Gayin
18/10/10	Sensitisation workshop on the use of SMART Toolkit for evaluating information projects, products and services.	CSIR-INSTI	CSIR-INSTI	Dr. K. Vowotor, Mr. R. Kavi
08 -11/11/10	3rd International Rice Congress (IRC 2010)	International Rice Research Institute (IRRI) & ASIA CONGRESS Events Management Co. Ltd (ACE)	Vietnam National Convention Centre, Hanoi	Mr. J. Gayin
12-13/11/10	First West African Mycological Workshop	Ludwig-Maximilians-Universitat Munchen	Ouagadougou, Burkina Faso	Dr. Mary Obodai, Matilda Domerku
17-19/11/10	Training on rice mill management for selected processing group	NERICA Rice dissemination Project	Ejura	Dr. Mary Obodai, Ms. Deborah Narh

22-26/11/2010	Profiling of Projects / Needs-Resource Gap Mapping and Update of National Rice Development Strategy (NRDS)	Coalition for African Rice Development, (CARD), Directorate of Crops Services, MoFA	Jefkings Hotel, Adentan, Accra	Mr. J. Gayin
30/11/10	Workshop on Intellectual Property and Patents information	Registrar-Generals Dept, MoJAG	NMIMR	Dr. C. Tortoe
01-02/12/10	ARIC Workshop	CSIR	STEPRI confab room	Mr. Aikins, Ms. Aggrey-Yawson

APPENDIX V Scientific Reports and Publications

Edited Research Report

(1) **Amoa-Awuah, W.K., Kpodo, K., Vowotor, K. A., Ottah- Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno,G., Oduro-Yeboah,C., Baidoo,E. and Sampare, A. (2010).** Report on Training Needs Assessment for Eleven Farmer Based Organizations in the West Mamprusi District of the Northern Region of Ghana. Report submitted to the Regional Implementation Consultant (IFDC) under the MiDA Agriculture Project.

(2) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Stage One Training of 10 FBO's in West Mamprusi District: First Bi-weekly Report. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp.66.

(3) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Stage One Training of 10 FBO's in West Mamprusi District: Second Bi-weekly Report. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp.55.

(4) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Stage One Training of 10 FBO's in West Mamprusi District: Third Bi-weekly Report. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp.49.

(5) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E. Sampare, A. (2010).** Report on training and training related activities for designated FBO's in West Mamprusi District for Late Phase 2 Stage 1, 7th December 2009 to 20th January 2010. pp.71.

(6) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** FBO Training Needs Assessment for Beneficially FBO's in the Northern Intervention Zone in the West Mamprusi Districts pp.75.

(7) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Stage two training of 10 FBO's in West Mamprusi Districts, Biweekly Report. Pp 66.

(8) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Report on training and training related activities report for designated FBO's in the West Mamprusi District of the Northern Region for Early Phase 2 Stage 2, 22nd February to 10th March 2010. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp. 65.

(9) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, Ali (2010).** Stage One Training of 11 FBO's in West Mamprusi District: Second Bi-weekly Report. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp.55.

(10) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E. Sampare, A. (2010).** Stage One Training of 11 FBO's in West Mamprusi District: Third Bi-weekly Report. MiDA Agriculture

Project /CSIR-FRI, Accra, Ghana. pp.49.

(11) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** Report on training and training related activities for designated FBO's in West Mamprusi District for 11FBOs, 9th August 2009 to 17th Sept 2010. pp.71.

(12) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E., Sampare, A. (2010).** FBO Training Needs Assessment for Beneficially FBO's in the Northern Intervention Zone in the West Mamprusi Districts pp.

(13) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E. Sampare, A. (2010).** Stage two training of 11 FBO's in West Mamprusi Districts, Biweekly Report.

(14) **Amo-Awua, W. K., Kpodo, K., Vowotor, K. A., Ottah-Atikpo, M., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Oduro-Yeboah, C., Baido, E. Sampare, A. (2010).** Training and training related activities report for designated FBO's in West Mamprusi District of the Northern Region. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp. 65.

(15) **Amo-Awua, W. K., Vowotor, K. A., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Sampare, A. (2010).** Stage Two Training of 15 FBO's in West Mamprusi and savelugu-Nanton District: Bi-weekly Report. MiDA Agriculture Project /CSIR-FRI, Accra, Ghana. pp.103.

(16) **Amoa-Awua, W. K., Vowotor, K. A., Gyato, C., Gayin, J., Tortoe, C., Anyebuno, G., Sampare, A. (2010).** Report on training and training related activities for designated FBO,s in West Mamprusi and Savelugu Nanton Districts for Late phase 1 Stage 2 (T2S2). 10th December 2009-23rd December 2009. pp.94.

(17) **Gayin, J., Sampare, S.A., Oduro, H., Anaman, E., Johnson, P-N.T. and Fusheini, Z. (2010).** Report on Workshops to Introduce Fortification of Cereal Flours with Micronutrients in Twelve Communities in the Three Northern Regions of Ghana. CSIR-FRI/WFP Scale Up of Community-Based Milling and Fortification in Northern Ghana Project.

(18) **Johnson, P-N. T., Oduro-Yeboah C., and Dowuona, S. (2010).** The CSIR—Final Technical Report FRI//GTZ//MOAPP Dried Fruits Shelf—Life Studies. P.30.

(19) **Obodai, M. , Narh,D.L. , Baka, D. and Dzomeku, M. (2010).** Effect of substrate formulation of rice straw (Oryza sativa) and sawdust (Triplochiton scleroxylon) on the cultivation of Pleurotus ostreatus (Jacq. ex. Fr.) Kummer.

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APPENDIX VI

IGF Report for the year ending 31st December, 2010

	DIVISIONS/ UNITS	PERIODS (QUARTERS)	1ST	2ND	3RD	4TH	TOTAL
A	MICROBIOLOGY	INCOME	55,144.10	33,753.70	61,429.10	47,554.70	197,881.60
		CHEMICAL COST	55,144.10	33,753.70	61,429.10	47,554.70	197,881.60
		OTHER EXPENSES	(20,143.72)	(8,645.40)	(20,140.31)	(2,388.57)	(51,318.00)
		DEP. FIXED ASSETS	(2,755.50)	(889.60)	(987.30)	(1,848.00)	(6,480.40)
		GROSS MARGIN	-	(3,375.37)	(6,142.91)	(4,755.47)	(14,273.75)
	MUSHROOM	INCOME	3,310.75	4,020.60	4,919.40	4,771.00	17,021.75
		DEP. FIXED ASSETS	-	(402.06)	(491.94)	(477.10)	(1,371.10)
		CHEM/OTHER. COST	(2,556.12)	(1,853.00)	(3,426.65)	(1,454.80)	(9,290.57)
		GROSS MARGIN	**754.63**	**1,765.54**	**1,000.81**	**2,839.10**	**6,360.08**
B	CHEMISTRY	INCOME	14,327.90	11,337.55	15,613.10	16,634.00	57,912.55
		CHEMICAL COST	(5,572.89)	(6,083.82)	-	(8,498.03)	(20,154.74)
		OTHER EXP	-	(1,189.10)	(852.25)	(569.68)	(2,611.03)
		DEP. FIXED ASSETS	-	(1,133.76)	(1,561.31)	(1,663.40)	(4,358.47)
		GROSS MARGIN	**8,755.01**	**2,930.88**	**13,199.54**	**5,902.89**	**30,788.32**
	MYCOTOXIN	INCOME	3,870.00	4,981.00	9,210.00	12,642.50	30,703.50
		CHEMICAL COST	-	-	(3,998.80)	-	(3,998.80)
		DEP. FIXED ASSETS	-	(498.10)	(921.00)	(1,264.25)	(2,683.35)

		OTHER EXPENSES	(2,701.12)	-	(1,985.83)	(382.00)	(5,068.95)
		GROSS MARGIN	**1,168.88**	**4,482.90**	**2,304.37**	**10,996.25**	**18,952.40**
C	**ENGINEERING**	INCOME	1,200.00	4,800.00	23,498.00	12,180.00	41,678.00
		DEP. FIXED ASSETS	-	(480.00)	(2,349.80)	(1,218.00)	(4,047.80)
		OPERATIONAL COST	(1,817.00)	(3,700.00)	(23,621.00)	(13,933.00)	(43,071.00)
		GROSS MARGIN	**(617.00)**	**620.00**	**(2,472.80)**	**(2,971.00)**	**(5,440.80)**
	PROCESSING	INCOME	4,268.50	5,438.00	1,632.00	5,705.80	17,044.30
		COST MATERIALS	(2,295.20)	-	(2,861.50)	(645.00)	(5,801.70)
		DEP. FIXED ASSETS	-	(543.80)	(163.20)	(570.58)	(1,277.58)
		GROSS MARGIN	**1,973.30**	**4,894.20**	**(1,392.70)**	**4,490.22**	**9,965.02**
	ROOT & TUBER PROD. & DEV. UNIT	INCOME	7,337.00	779.00	1,081.50	4,166.50	13,364.00
		DEP. FIXED ASSETS	-	(77.90)	(108.15)	(416.65)	(602.70)
		COST OF MATERIAL	(5,910.00)	(2,778.60)	(1,200.00)	(1,710.00)	(11,598.60)
		GROSS MARGIN	**1,427.00**	**(2,077.50)**	**(226.65)**	**2,039.85**	**1,162.70**
D	**LIBRARY**	INCOME	251.00	578.10	404.75	385.70	1,619.55
		DEP. FIXED ASSETS	-	(57.81)	(40.48)	(38.57)	(136.86)
		Expenses	-	-	-	-	-
		GROSS MARGIN	**251.00**	**520.29**	**364.28**	**347.13**	**1,482.70**

	UNITS						
	FNSED	INCOME	249.00	-	-	-	249.00
		DEP. FIXED ASSETS	-	-	-	-	-
		Expenses	=	=	=	=	=
		GROSS MARGIN	**249.00**	-	-	-	249.00
	MIDA	INCOME	-	-	10,000.00	-	10,000.00
	HIRING OF VEHICLES	INCOME	-	-	265.19	-	265.19
		DEP. FIXED ASSETS	=	=	(1,026.52)	-	(1,026.52)
			-	-	**9,238.67**	-	**9,238.67**
	TRAINING	INCOME	5,040.00	-	-	2,550.00	7,590.00
		Expenses	(3,840.00)	-	-	(255.00)	(4,095.00)
		GROSS MARGIN	**1,200.00**	-	-	**2,295.00**	**3,495.00**
	GENERAL EXPENSES	STATIONERY	(1,130.00)	(2,141.24)	(2,316.74)	(2,864.00)	(8,451.98)
		VEHICLE RUN & REPAIRS	(2,501.00)	(841.94)	(1,409.81)	(510.00)	(5,262.75)
		STAFF TRAINING	(6,920.00)	-	(11,410.70)	(7,159.43)	(25,490.13)
		ACCREDITATION EXP	(3,965.76)	(1,005.92)	-	(915.10)	(5,886.78)
		REPAIR GEN/OFFICE EQUIP	(4,445.70)	(500.00)	(1,747.24)	(940.00)	(7,632.94)
		MEETING EXPENSES	(647.00)	(1,364.00)	(3,193.76)	(2,934.00)	(8,138.76)
		GENERATOR RUNNING	(1,601.00)	(1,800.00)	(600.00)	(800.00)	(4,801.00)
		SANITATION/OFFICE GEN EXP	(4,149.51)	-	-	(86.00)	(4,235.51)
		TOTAL EXPENSES	**(25,359.97)**	**(7,653.10)**	**(20,678.25)**	**(16,208.53)**	**(69,899.85)**

DIVISIONAL PERFORMANCE FOR 2010.

MICROBIOLOGY DIVISION					
DIVISIONS	**GROSS MARGIN FOR THE FIRST QUARTER OF 2010**	**GROSS MARGIN FOR THE SECOND QUARTER OF 2010**	**GROSS MARGIN FOR THE THIRD QUARTER OF 2010**	**GROSS MARGIN FOR THE FOURTH QUARTER OF 2010**	**GROSS MARGIN FOR THE YEAR 2010**
MICROBIOLOGY	32,244.88	20,843.33	34,158.58	38,562.66	125,809.45
MUSHROOM	754.63	1,765.54	1,000.81	2,839.10	6,360.08
TOTAL	**32,999.51**	**22,608.87**	**35,159.39**	**41,401.76**	**132,169.53**

CHEMISTRY DIVISION					
DIVISIONS	**GROSS MARGIN FOR THE FIRST QUARTER OF 2010**	**GROSS MARGIN FOR THE SECOND QUARTER OF 2010**	**GROSS MARGIN FOR THE THIRD QUARTER OF 2010**	**GROSS MARGIN FOR THE FOURTH QUARTER OF 2010**	**GROSS MARGIN FOR THE YEAR 2010**
CHEMISTRY	8,755.01	2,930.88	13,199.54	5,902.89	30,788.32
TOXICOLOGY	1,168.88	4,482.90	2,304.37	10,996.25	18,952.40
TOTAL	**9,923.89**	**7,413.78**	**15,503.91**	**16,899.14**	**49,740.72**

FOOD PROCESSING &ENGINEERING DIVISION					
DIVISIONS	**GROSS MARGIN FOR THE FIRST QUARTER OF 2010**	**GROSS MARGIN FOR THE SECOND QUARTER OF 2010**	**GROSS MARGIN FOR THE THIRD QUARTER OF 2010**	**GROSS MARGIN FOR THE FOURTH QUARTER OF 2010**	**GROSS MARGIN FOR THE YEAR 2010**
ENGINEERING	(617.00)	620.00	(2,472.80)	(2,971.00)	(5,440.80)
PROCESSING	1,973.30	4,894.20	(1,392.70)	4,490.22	9,965.02
RTPDU	1,427.00	(2,077.50)	(226.65)	2,039.85	1,162.70
TOTAL	**2,783.30**	**3,436.70**	**(4,092.15)**	**3,559.07**	**5,686.92**

FOOD NUTRITION & SOCIO-ECONOMIC (FNSED) DIVISION					
DIVISIONS	**GROSS MARGIN FOR THE FIRST QUARTER OF 2010**	**GROSS MARGIN FOR THE SECOND QUARTER OF 2010**	**GROSS MARGIN FOR THE THIRD QUARTER OF 2010**	**GROSS MARGIN FOR THE FOURTH QUARTER OF 2010**	**GROSS MARGIN FOR THE YEAR 2010**
FNSED	**249.00**	-	-	**0.00**	**249.00**

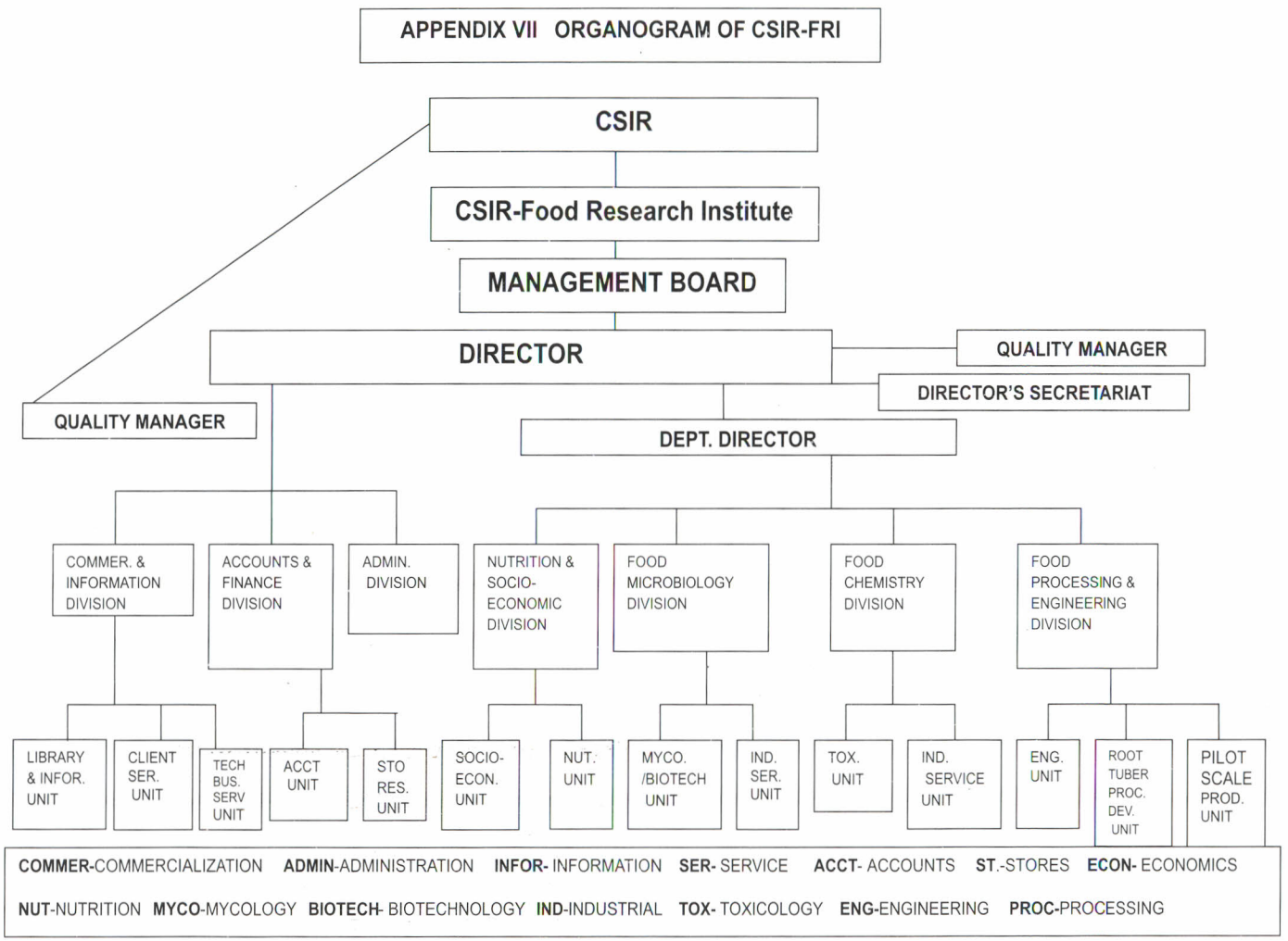
MISCELLANEOUS INCOME					
	GROSS MARGIN FOR THE FIRST QUARTER OF 2010	**GROSS MARGIN FOR THE SECOND QUARTER OF 2010**	**GROSS MARGIN FOR THE THIRD QUARTER OF 2010**	**GROSS MARGIN FOR THE FOURTH QUARTER OF 2010**	**GROSS MARGIN FOR THE YEAR 2010**
LIBRARY	251.00	520.29	364.28	347.13	1,482.70
TRAINING	1,200.00	-	-	2,295.00	3,495.00
MIDA/HIRING OF VEHICLES	-	-	9,238.67	-	9,238.67
TOTAL	**1,451.00**	**520.29**	**9,602.95**	**2,642.13**	**14,216.37**
TOTAL GROSS MARGIN	**47,406.70**	**33,979.64**	**56,174.10**	**64,502.10**	**202,062.53**
LESS					
OTHER EXPENSES	(25,359.97)	(7,653.10)	(20,678.25)	(16,208.53)	(69,899.85)
NET INCOME	**22,046.73**	**26,326.54**	**35,495.85**	**48,293.57**	**132,162.68**
LESS					
REMITTANCE TO HEAD OFFICE	3,307.05	3,948.98	5,015.71	7,243.99	19,515.73
CADASTRAL PLAN	-	3,000.00	-	-	3,000.00

OTHER TRAINING COST	-	7,052.00	-	-	7,052.00
HONORARIUM	-	8,660.70	5,280.00	5,280.00	19,220.70
YEAR END INCENTIVE	-	-	-	18,360.00	18,360.00
BAL C/D	**18,739.68**	**3,664.86**	**25,200.14**	**22,689.58**	**70,294.25**
BAL B/FWD	**85,902.11**	**104,641.79**	**108,306.65**	**133,506.78**	**85,902.11**
RETAINED	**104,641.79**	**108,306.65**	**133,506.78**	**156,196.36**	**156,196.36**

SUMMARY

	2010	**2009**	**% change**
TOTAL INCOME	396,408.84	374,275.93	**6%**
EXPENSES	(264,246.16)	(346,176.43)	**-24%**
NET INCOME	**132,162.68**	**28,099.50**	**370%**

ORGANOGRAM


APPENDIX VII ORGANOGRAM OF CSIR-FRI
CSIR
CSIR-Food Research Institute
MANAGEMENT BOARD
DIRECTOR
QUALITY MANAGER
DIRECTOR'S SECRETARIAT
QUALITY MANAGER
DEPT. DIRECTOR
COMMER. & INFORMATION DIVISION
ACCOUNTS & FINANCE DIVISION
ADMIN. DIVISION
NUTRITION & SOCIO-ECONOMIC DIVISION
FOOD MICROBIOLOGY DIVISION
FOOD CHEMISTRY DIVISION
FOOD PROCESSING & ENGINEERING DIVISION
LIBRARY & INFOR. UNIT
CLIENT SER. UNIT
TECH BUS. SERV UNIT
ACCT UNIT
STO RES. UNIT
SOCIO-ECON. UNIT
NUT. UNIT
MYCO. /BIOTECH UNIT
IND. SER. UNIT
TOX. UNIT
IND. SERVICE UNIT
ENG. UNIT
ROOT TUBER PROC. DEV. UNIT
PILOT SCALE PROD. UNIT
COMMER-COMMERCIALIZATION ADMIN-ADMINISTRATION INFOR- INFORMATION SER- SERVICE ACCT- ACCOUNTS ST.-STORES ECON- ECONOMICS
NUT-NUTRITION MYCO-MYCOLOGY BIOTECH- BIOTECHNOLOGY IND-INDUSTRIAL TOX- TOXICOLOGY ENG-ENGINEERING PROC-PROCESSING

Design & Printing: CSIR-INSTI, 030 2780708/9