# Food Research Institute

## 2013 Annual Report


COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
CSIR
• GHANA •

Council for Scientific and Industrial Research

**FOOD RESEARCH INSTITUTE (CSIR-FRI)**

# ANNUAL REPORT 2013

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# TABLE OF CONTENTS

# LIST OF APPENDICES

# 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 for Scientific and Industrial Research |
| CSU | - | Clients Services 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 |
| FDA | - | Food and Drugs Authority |
| 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 Centers |

| | | |
|---|---|---|
| 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 |
| SARI | - | Savana Agricultural Research Institute |
| 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 |
| WRI | - | Water Research Institute |
| WAAPP | - | West African Agricultural Productivity Programme |

# CSIR-FRI MANAGEMENT BOARD MEMBERS

| | | | | |
|---|---|---|---|---|
| 1. Dr. Osei Boeh-Ocansey | - | Director-General, PEF | - | Chairman |
| 2. Dr. Nanam Tay Dziedzoave | - | Director, CSIR-FRI | - | Member |
| 3. Mr. Herbert A. Obiri | - | Ag. Director, CSIR-IIR | - | " |
| 4. Dr. (Mrs.) R. E. M. 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 THE CSIR-FRI INTERNAL MANAGEMENT COMMITTEE

| | | | | | |
|---|---|---|---|---|---|
| 1. | Dr. Nanam Tay Dziedzoave | - | Director | - | Chairman |
| 2. | Dr. (Mrs.) K. A Kpodo | - | Deputy-Director /Head/FCD | - | Member |
| 3. | Dr. (Mrs.) Margaret Ottah Atikpo | - | Head/FMD | - | " |
| 4. | Dr. Lawrence Abbey | - | Quality Manager | - | " |
| 5. | Dr. (Mrs.) Mary Obodai | - | Head/Mushroom Unit | - | " |
| 6. | Dr. Charles Tortoe | - | Head/FPED | - | " |
| 7. | Mr. Cletus Gyato | - | Head/Eng. Unit | - | " |
| 8. | Mrs. Mary Glover-Amengor | - | Head/Nutrition Unit | - | " |
| 9. | Mr. Gregory Komlaga | - | Ag. Head/PSPU /President, RSA | - | " |
| 10. | Mr. Elvis Baidoo | - | Ag. Head/RTPDU | - | " |
| 11. | Ms. Janet Aggrey-Yawson | - | Ag. Head/Admin | - | " |
| 12. | Mr. Coffie Aikins Tutu | - | Ag. Head/Accounts | - | " |
| 13. | Dr. Margaret Owusu | - | Head/ISU-FCD | - | " |
| 14. | Mr. George Anyebuno | - | Ag. Head/FCD | - | " |
| 15. | Mr. Richard Takli | - | Chairman, Staff Welfare | - | " |
| 16. | Mr. Theophilus Annan | - | Chairman, SSA | - | " |
| 17. | Mr. Michael Amoo-Gyasi | - | Chairman, TUC | - | " |
| 18. | Mr. Stephen Nketia | - | Scientific Secretary | - | " |
| 19. | Mr. Eric Ofori | - | Prin. Admin. Asst. | - | Recorder |

# EXECUTIVE SUMMARY

The Council for Scientific and Industrial Research, Ghana has reiterated that all its thirteen Institutes must aggressively pursue the generation of their Internally Generated Fund (IGF), so that they could wean themselves off Government subvention. The CSIR-Food Research Institute (CSIR-FRI) in pursuit of this quest generates technologies that are aimed at meeting the demands of the private sector and socio-economic development of the country. Its vision is to be the leading research Institute in the area of food processing technology. It is tasked to provide technical and analytical services, contract research, collaborative research and consultancy services to governmental agencies, micro-medium and multinational agro-food processing industries, and international development agencies. The Institute maintained its accreditation status to ISO 17025 test methods under the South African National Accreditation System (SANAS). It has purposefully positioned itself to primarily conduct market-oriented applied research and provide technical services and affordable products to be available and profitable to the private sector and other stakeholders as its main objective. The targeted goal of the Institute for the past year is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within the micro, small, medium and large-scale agro-food industries; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

The management of the Institute per the objectives has strategically reset its programmes in line with the local commodities of the country as Root and Tuber products; Fruit and Vegetable products; Fish, Meat, Poultry and Dairy products; Grains and Legumes products. CSIR-FRI continued with its development of cassava, plantain, cocoyam, yam, *kokonte*, cowpea, soybean, fermented flours, among others to ensure that local staple food is safe. The Institute also continued providing services which include design and fabrication of food processing equipment, analytical services, training programmes such as product development (nutrition, sensory analysis, recipe development and shelf-life studies), mushroom cultivation and spawn production, microbiological and chemical safety and quality control of foods; consultation and out-sourcing services, such as the establishment of Hazard Analysis Critical Control Points (HACCP) system for food industries, post-harvest management, etc.

Fifteen (15) scientific articles were published in nine (9) refereed journals as output of scientific research. Some of the research activities carried out include Survey on Consumption of Vegetables and Fruits in a Coastal District in Ghana; Performance and Acceptability of Legume-Fortified Yam Flours; Heavy Metal Analysis of Fruit juice and soft drinks bought from Retail Markets in Accra, Ghana; Effects of pre-treatments and storage condition on physicochemical properties of taro (*Colocasia esculenta)* flour; Relationship of sensory and instrumental aroma measurements of dark chocolate as influenced by fermentation method, roasting and couching conditions; Baseline data of cassava and yam processed products by SME's, large and household processors in Ghana; Health implications of late night eating.

Major collaborators of the different projects carried out at the Institute included the United Nations-Food and Agricultural Organization (UN-FAO), the Ministry of Food and Agriculture (MoFA), Natural Resources Institute (NRI) of UK, Kwame Nkrumah University of Science and Technology, University of Ghana, Legon and agriculture and industry related CSIR Institutes.

As part of income generation effort, the Institute generated a net total income of GH¢410,118.00 which represented 5 % of its total income for the year.

# 1.0 ADMINISTRATION DIVISION

**Introduction**

The Administration Division provides administrative support for the Research and Technological programs of the Institute. It is also responsible for identifying professional and managerial training needs and opportunities for staff; assessing, maintaining and improving all Institute's infrastructures; maintaining and repairing Institute's vehicles and monitoring their use. The Division consists of the Registry Section, Human Resources Section, Transport Section, Estate Section and Security and Front Desk Section.

**Staff Strength**

The staff strength of the Institute stood at 167. The breakdown is as follows:

- Senior Members 41
- Senior Staff 64
- Junior Staff 62

**Divisional/Unit Headship**

Mrs. Mary Glover-Amengor, a Senior Research Scientist and Head of the Nutrition Unit was appointed Head of the Food Nutrition and Socio-Economic Division. This took effect from 10th September, 2013.

**Appointment**

Dr. Frederick Wayo-Teye was temporarily appointed as Research Scientist but was later confirmed as Senior Research Scientist. He assumed duty on 1st February, 2013.

**Secondment**

Ms. Marmatta Yakubu, a Principal Administrative Assistant with the CSIR-Savannah Agricultural Research Institute (SARI) was seconded to the Institute for a two-year period. This took effect from 2nd October, 2013.

**Promotions/Upgrading**

Five (5) Senior Staff and four (4) Junior Staff were promoted during the reporting period. Also four (4) staff consisting of three (3) Research Scientists and One (1) Senior Staff were upgraded to various designations after successfully completing their course of studies. This is shown in *Table 1.1 of Appendix II*

## Human Resource Development/Training

The Institute continued to grant training opportunities to staff to enable them acquire skills and expertise needed to enhance performance. The list of staff on study leave and staff who have resumed duty from study leave within the year under review is as shown in *Table 1.2 in Appendix II.*

## Retirements

Five (5) long-serving staff of the institute either retired compulsorily or voluntarily. See *Table 1.5* for details.

## Transfer

Dr. (Mrs.) Wilhemina Quaye, Head of Food Nutrition and Socio-Economics Division was transferred to CSIR-Science & Technology Policy Research Institute. This took effect from 1st September, 2013.

## Resignations

Three (3) Senior Members, One (1) Senior Staff and One (1) Junior Staff resigned from the Institute for personal reasons. See *Table 1.6* for details.

## Vacation of Post

Mr. Emmanuel Alorsey, a Technologist with the Food Processing & Engineering Division was dismissed from the Institute on 20th November, 2013 for vacating his post.

## Obituary

Dr. Kwame Akorli Vowotor, a Senior Research Scientist and Head of Commercialization and Information Division passed on to eternity after a short illness. The sad event occurred on 5th November, 2013. Funeral and burial arrangements have been scheduled for 4th January, 2014.

## Internships & National Service

During the year under review, the Institute accepted students from the Universities, Polytechnics and other Institutions to undertake their internship programs at the various Divisions of the Institute. The Institute also hosted ten (10) National Service Personnel during the year.

**Institute Visitors**

The Institute hosted few visitors among whom were the Advisory Board of the Institute of Applied Science and Technology, University of Ghana on 12th September, 2013; Nihon University Scientist on 9th March, 2013 and the consultant working on the CSIR Business Plan on 4th – 5th July, 2014.

# 2.0 ACCOUNTS DIVISION

## Introduction

### Main responsibilities of the Accounts Division

- To ensure the effective and efficient management of institute's revenue expenditure, assets, liabilities and other resources in accordance with the Financial Administration ACT 2003.
- To ensure that procurement for the institute is done in accordance with the Public Procurement ACT 2003
- To ensure that the institute comply with the provisions under the Internal Revenue ACT 2001

### Major Activities

In order to fulfill the above responsibilities, the following major activities are carried out in the Division.

1. Preparation of Annual Budget for the Institute.
2. Cash receipts and banking transactions
3. Payroll processing and the preparation of related reports
4. Procurement and store supplies for all the Divisions of the Institute.
5. Recording and keeping of financial transactions of the Institute.
6. Keeping of Assets Register of the Institute
7. Provision of annual financial statements.
8. Provision of monthly, quarterly, semi-annual and annual reports to the government agencies and the ministries.
9. Overseeing both internal and external auditing of Institute's books, reviewing and analyzingreports and giving recommendations when appropriate.

The following activities of the Division were accomplished within the period under review:

1. The completion of the 2012 final Accounts was done within the first quarter of the year, audited and signed by the end of the second quarter of the year.
2. All statutory reports to the ministries, CSIR and other state agencies were prepared.
3. Entries of the 2013 transactions were prepared to October 2013.

4. Management Reports were prepared quarterly to aid management in its decision making.
5. The Division assisted in the migration of the Institute's payroll onto Government of Ghana payroll with Controller and Accountant General's department in March.

Within the period under review the Division assisted with the migration of the Institute's pay structure onto the Single Spine Pay Structure in March.

| Item | Subvention | Actual Expenses | Variance |
|---|---|---|---|
| | GH¢ | GH¢ | GH¢ |
| Personal Emoluments | 8,257,061 | 6,963,04 | 1,294,015 |
| Use of goods | - | 61,044,760 | (1,044,760) |
| IGF | 410,118 | 280,684 | 129,434 |
| **Total** | **8,667,179** | **8,288,490** | **378,689** |

*Table 2.1: 2013 Financial review*

The total income for the period amounted to Eight Million, Six Hundred and Sixty-Seven Thousand, One Hundred and Seventy-Nine Ghana cedis. (GH¢8,667,179.00) of which 95% represents income from government sources.

# 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 enhance the income generation capacity and ensure effective information management to guide management decisions, continual availability of enough competitive business in all the core commercial business areas of the Institute, i.e. analytical services, consultancy and training services and sale of research by-products; increase our regular reliable customer base by two hundred percent (200%); attract business and improve business competitiveness to increase our excess income over expenditure by a factor of four (4) and also ensure that every idle facility/staff with commercial potential is put to beneficial use.

The Division has three (3) sections namely, the Client Services Section (CSS); Technological Business Service Section (TBSS) and Information Management Section (IMS).

## Client Services Section (CSS)

The Client Services Section is the interface between the Institute and its clients for services in Chemistry, Microbiology, Toxicology and Processing. For the period under review, a total of 2,397 samples were received from 383 clients who patronized the analytical services of the Institute. Compared to samples received in 2012, the total samples received in 2013 decreased by 717 samples. The cause of this loss during the period was due to three (3) major clients withdrawing their services from FRI as consequences of the suspension of analysis by the microbiology test laboratory by SANAS. These are Pioneer Food Cannery, Aviation Handling Services and Niche Cocoa Industry.

Table 3.1: Samples and Clients

| LABORATORY | NO. OF CLIENTS 2012 | NO. OF CLIENTS 2013 | NO. OF SAMPLES 2012 | NO. OF SAMPLES 2013 |
|---|---|---|---|---|
| FMD-Industrial Services Unit | 126 | 124 | 2140 | 1269 |
| FCD-Industrial Services Unit | 158 | 180 | 549 | 569 |
| FCD-Mycotoxin Unit | 45 | 43 | 243 | 187 |
| FPED–PSPU Laboratory 1 | 28 | 36 | 182 | 372 |
| **TOTAL** | **357** | **383** | **3114** | **2397** |

**Technological Business Service Section (TBSS)**

Technological Business Service Section (TBSS) is in charge of sales of research by-products, consultancy, training and technical services.

***Consultancy and Training Services***

Areas that consultation and training services were undertaken included Contract Research, Collaborative Research, Information enquires, Sensory Evaluation, Equipment Fabrication & Design, Engineering Services, Product Development and Up-scaling, Technology Transfer, and Incubation Services as shown in *Table 3*.

The areas of Product Development and Up-scaling had seven (7) requests but none was executed. While One Hundred & Nine (109) Technology Transfer requests were made, only Seventy-two (72) were executed. The main problem was the cost of developing products and cost of technology transfer where entrepreneurs could not afford. The way forward is for the Institute to liaise with Fund and financial Institutions, both private and Ministries to help transfer and disseminate the technologies developed. Within the year, One Hundred & Fifty-One (151) requests were received out of which One Hundred & Two (102) were executed. This was 67.5% of total requests received.

A total of Sixty Thousand, Nine Hundred and Twenty cedis, Forty Eight Ghana Pesewas (GH¢60,920.48) was realized from the requests executed in the year under review as compared to Forty Thousand and Sixty-Five Ghana cedis (GH¢40,065.00) executed in 2012.

Table 3.2: Services for 2011-2013

| DETAILS | REQUESTS RECEIVED | | | REQUESTS EXECUTED | | | GROSS INCOME GENERATED (GH¢) | | |
|---|---|---|---|---|---|---|---|---|---|
| **SERVICES** | **2011** | **2012** | **2013** | **2011** | **2012** | **2013** | **2011** | **2012** | **2013** |
| Consultation: Information enquires | 11 | 24 | 24 | 11 | 24 | 24 | 383.00 | 205.00 | 175.00 |
| Sensory Evaluation | 0 | 0 | 1 | 0 | 0 | 0 | 0.00 | 0.00 | 20.00 |
| Contract Research | 0 | 0 | 3 | 0 | 0 | 3 | 0.00 | 0.00 | 3,270.49 |
| Collaborative Research | 0 | 0 | 2 | 0 | 0 | 0 | 0.00 | 0.00 | 10.00 |
| Product Development and Up-scaling | 0 | 0 | 1 | 0 | 0 | 1 | 0.00 | 0.00 | 1,426.00 |
| Equipment Fabrication & Design | 0 | 0 | 1 | 0 | 0 | 0 | 0.00 | 0.00 | 20.00 |
| Product Development and Training | 0 | 4 | 7 | 0 | 2 | 0 | 0.00 | 850.00 | 120.00 |
| Technology Transfer | 83 | 23 | 109 | 30 | 7 | 72 | 11,749.20 | 2,810.00 | 50,109.99 |
| Incubation Services | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 5,769.00 |
| **Totals** | **94** | **52** | **151** | **41** | **34** | **102** | **12,132.20** | **4,065.00** | **60,920.48** |

Table 3.3: Cost Centers for 2011-2013

| DETAILS | REQUESTS RECEIVED | | | REQUESTS EXECUTED | | | INCOME GENERATED (GH¢) | | |
|---|---|---|---|---|---|---|---|---|---|
| ***COST CENTERS*** | ***2011*** | ***2012*** | ***2013*** | ***2011*** | ***2012*** | ***2013*** | ***2011*** | ***2012*** | ***2013*** |
| Multiple Requests | 0 | 0 | 1 | 0 | 0 | 0 | 0.00 | 0.00 | 11,430.00 |
| CID - TBSU Services Section | 2 | 12 | 3 | 1 | 12 | 3 | 10.00 | 150.00 | 40.00 |
| FMD - Mushroom Unit | 8 | 11 | 73 | 8 | 6 | 71 | 1,657.00 | 1,410.00 | 33,540.00 |
| FMD - Industrial Services Unit | 2 | 1 | 0 | 0 | 1 | 1 | 106.40 | 200.00 | 0.00 |
| FCD - Toxicology Unit | 1 | 0 | 0 | 1 | 0 | 0 | 5.00 | 0.00 | 0.00 |
| FCD - Industrial Services Unit | 5 | 0 | 0 | 5 | 0 | 0 | 418.20 | 0.00 | 0.00 |
| FPED - Engineering Unit | 4 | 3 | 6 | 2 | 3 | 5 | 25.00 | 40.00 | 5,829.00 |
| FPED - Pilot Scale Production Unit | 55 | 21 | 47 | 20 | 11 | 16 | 7,531.60 | 2,250.00 | 8,178.60 |
| FPED - Roots and Tubers Production Demonstration Unit | 10 | 1 | 6 | 1 | 0 | 2 | 1,758.50 | 0.00 | 40.00 |
| FNSED - Nutrition Unit | 7 | 3 | 15 | 3 | 1 | 4 | 620.50 | 15.00 | 1,862.88 |
| FNSED - Socio-Economic Unit | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| Totals | 94 | 52 | 151 | 41 | 34 | 102 | 12,132.20 | 4,065.00 | 60,920.48 |

### *Sales of Research By-Products*

Sale of Research by-products mainly dwelt on personal sales strategy with a few selected markets at Legon, GAEC, sister Institutes, Military Stores and some Ministries. Table 4 indicates that a total of 5.7 tonnes of products were produced out of which 4.87 tonnes were sold. The products were produced with pilot scale equipment that needed to be expanded to undertake commercial production. The market needs to be expanded to reach shops and other regional capitals through promotions.

Table 3.4: Sale of Research By-Products

| No | Research by-Products | Quantity Produced | Quantity produced (kg) | Quantity of Stock Sold (kg) | Quantity of stock unsold (kg) | GROSS Amount (GHS) Realized |
|---|---|---|---|---|---|---|
| 1 | Spawns | 9454 bottles | - | 9,403 bottles | 51 bottles | **21,862.00** |
| 2 | Groundnut paste | 1858 containers | 929 | 1542 containers | 158 kg | **8,586.00** |
| *3* | *Kokonte* | 1650 kg | 1650 | 1487kg | - | **6,602.30** |
| 4 | Compost bags | 5,276 bags | - | 5,276 bags | - | **3,542.90** |
| 5 | Plantain *fufu* | 838 boxes | 587 | 662 boxes | 175.7 kg | **3,072.00** |
| *6* | *Banku* mix | 1017 boxes | 1017 | 768 boxes | - | **3,009.00** |
| 7 | Yam *fufu* | 864 boxes | 605 | 684 boxes | 126 kg | **2,647.50** |
| 8 | *Weaner* maize | 953 boxes | 476 | 745 boxes | 104 kg | **2,459.50** |
| 9 | Cocoyam *fufu* | 479 boxes | 239 | 371 boxes | 54 kg | **1,899.00** |
| *10* | *Weaner* rice | 589 boxes | 295 | 481 boxes | 54 kg | **1,667.25** |
| *11* | Fermented maize | 494 sachets | 494 | 371 sachets | 123 kg | **1,370.00** |
| 12 | Maize grits | 756 sachets | 378 | 499 sachets | 128 kg | **1,226.25** |
| 13 | *Gari* | 335 sachets | 335 | 250 kg | - | **775.25** |
| *14* | *Agbelima* | 165 sachets | 165 | 165 kg | - | **559.75** |
| | **Total** | | **5798 kg** | **4875.3 kg** | **922.7 kg** | **59,278.70** |

***Technical Services***

The number of technical services provided increased considerably which indicated increase in demand for our technical services.to the budding food processing industries that do not have all the required equipment for processing. Hausa koko drying was the topmost technical services rendered. In total about 21 tonnes of food products were serviced.

Table 3.5: Technical Services Provided

| No. | Type of service | Frequency of visit | Quantity of product (Kg) |
|---|---|---|---|
| 1 | Roasting of groundnuts | 6 | 1,200 |
| 2 | Roasting of soybean | 1 | 100 |
| 3 | Drying of Hausa koko | 20 | 13,484 |
| 4 | Milling of samples | 11 | 1,867 |
| 5 | Drying of cassava dough | 3 | 1,403 |
| 6 | Drying of cassava chips | 4 | 194 |
| 7 | Drying corn dough | 2 | 950 |
| 8 | Drying of maize starch | 1 | 100 |
| 9 | Set of services (drying, milling) | 6 | 1,455 |
| 10 | Drying of other samples | 9 | 858 |
| 11 | Drying Moringa leaves | 3 | 14 |
| | **TOTAL** | **66** | **21,625** |

## Information Management Section (IMS)

*Library Services*

The Food Research Institute library is one of the most important libraries that provide and disseminates information in the field of food science and technology, nutrition, food microbiology, mycotoxin including aflatoxins, agricultural economics and food engineering in the country. The library has a total book stock of over four thousand books (4,000) and over 200 back issues of food science and technology journals. The library also has over one thousand four hundred (1,400) soft copies of books in the area of food science and technology and other related subject areas that can be accessed on the FRI-SERVER.

The library has access to numerous electronic databases and journals such as AGORA, OARE, SCIENCEDIRECT, HINARI, EMERALD, TEEAL, etc. Also the library

has an in-house database known as AGRIS database that contain about 800 records,

The clientele of the library has extended beyond the Institute's Research Scientists and Technical Staff to include students from the various Polytechnics and Universities in Ghana. The library is also patronized by lecturers, farmers, industrialists, journalist, Civil Servants and Public Servants, Consultants and many others.

A total of one hundred (100) persons used the library during the period under review. On the whole, the clientele acknowledge that the information provided was useful, relevant and met their various information needs.

The library continued to enjoy the availability of Internet connectivity making it possible for the Institute's Research Scientists and Technical Staff to browse the internet and access their electronic mails, full text articles and other relevant information for their work.

***a. Information Request***

Information sought for during the period under review included publications on fermentation of African traditional foods, fish and fish processing, post-harvest losses of fish, nutritional enhancement of food, food fortification, gelatinization of starch, heavy metals in food, waxing treatments of root and tuber crops, nutritional value of cowpea and *Solanum torvum*, coconut processing, food product development, mushroom cultivation, fruits processing, determination of fructose in honey, ginger processing, pepper processing, aquaculture, browning reaction on cacao, food microorganisms, shelf-life studies on pepper, lactic acid fermentation on maize, fish texture analysis, sour sap and nmeda drink, physicochemical and functional properties of wheat flour were provided for the library users.

***b. Referrals***

The library referred twenty (20) clientele to CSIR-INSTI during the period under review.

***c. Usefulness of information provided***

During the period under review the users noted that the information provided was useful but remarked that there was the need to replenish the stock of the library

with more up-to-date publication and improve access to e-resources available in the library. Users who visited the library personally to source for information had various information materials provided for their perusal. These included soft and hard copies of books and full text journal articles that were acquired from the various electronic databases like AGORA, SCIENCEDIRECT, CTA/SDI Service and also others made use of the TEEAL Collection and Ghagri database.

**Public Relations Activities**

In the area of publicity of services, the Research Scientists and Technical Staff were verbally informed of certain information resources available at the library. The library also sent e-mails to Research Scientists to inform them of journal articles and publications available. The organization and participation in exhibitions and trade fairs and secretarial functions were undertaken, e.g. six (6) exhibitions were mounted by the Institute including the one at the National Farmers day. Four (4) seminars were organized.

# 4.0 FOOD PROCESSING AND ENGINEERING DIVISION

## 1.0 Introduction

There are three operational units under the Food Processing and Engineering Division (FPED) of the Food Research Institute. These are the Engineering Unit (EU), Pilot Scale Production Unit (PSPU) and Root and Tuber Products Development Unit (RTPDU). The Division had 36 staff members comprising of 9 senior members, 17 senior staff and 10 junior staff. The Divisional Head is Dr. Charles Tortoe and he is assisted by three Unit Heads namely Dr. Fredrick Teye (Head of Engineering Unit); Mr. Gregory Komlaga (Head of Root & Tuber Products Development Unit) and Mr. Elvis Baidoo (Head of Pilot Scale Production Unit).

The Division maintained its five Performance Improvement Teams led by other Senior Members which was created to support management of the Division for efficiency. The teams are: Research and Development Management Team, Quality Management Team, Information Management Team, Market Development Team and Equipment Installation and Maintenance Management Team. This report presents activities undertaken by the Division during the year of 2013; the challenges faced and proposed measures to address these challenges.

## 2.0 Major Activities

The major activities undertaken in the Division during the period under review were:

- Research and Development activities
- The production and sale of research by-products
- Technical and analytical Services
- Consultancy and
- Training

## 2.1 Research and Development Activities

Senior Members and Senior Staff were involved in nine (9) projects within the Division. Various project activities undertaken during the year were as follows:

**Cassava: Adding Value for Africa [C:AVA] Project – FRI Technical Services**

- Monitoring visits to end-users of HQCF was conducted in the Volta and Greater Accra regions.

**WAAPP 2A (West Africa Agricultural Productivity Programme)**

- Cassava processor groups were formed in the Volta, Eastern, Ashanti and Brong Ahafo regions.
- Bakery and pastry groups were formed for technology transfer of root and tuber/cereals and legume composite flour and products in the Eastern, Ashanti, and Brong Ahafo regions.
- Construction of an agribusiness center for the production of glucose syrup and hospital ethanol is almost completed at RTPDU, Pokuase.

**WFP-Community Based Cereal Milling and Fortification Programme**

- Technology transfer to more than 10 communities in the Northern region of Ghana on rice parboiling was completed during the year.

**Africa Rice Project:**

- Conducted baseline surveys in all the three northern regions of Ghana and the northern part of the Volta region.
- Conducted a needs assessment for rice farmers and processors in order to establish benchmarks for monitoring purposes.

**KAFACI Tomato Project:** Developing and Transforming Vegetable Technologies in Ghana: The Case of Tomato. (CRI, FRI, PGRRI)

- The project conducted baseline studies on tomato production and processing in Ghana during the year.

**Rice Sector Support Project (RSSP)**

- Training was organized for rice farmers and processors in four Districts in the Upper East region.
- Training of rice farmers/processors in districts of the Upper East region was completed in the year.
- Development of a manual on improving quality of parboiled rice in Ghana was completed.

**Cassava G-market Project:**

- New product development with HQCF and studies into the functional properties of cassava flour was conducted during the year.

**Gratitude Project**

- Value chain analysis on cassava and yam in Ghana was completed during the period.
- Key yam varieties were identified in the Brong Ahafo and Ashanti regions and yam curing strategies completed during the year.
- The use of cassava and yam waste in mushroom cultivation was conducted during the year.

**Udeswa Project**

- Questionnaire to conduct scoping studies and gather baseline data on existing drying systems, capacity training gaps and needs in Ghana were conducted in the year under review.

Staffs were involved in other projects domiciled in other Divisions like the AFTER Project. Client requested training; and consultancy was conducted on fruit juices, *fufu* flours, fermented maize meal, groundnut paste etc.

## 2.2 Production and Sale of Research By-Products

### *2.2.1 Production and Sales*

Research by-product production quantities over the period were as presented in *Tables 1 -5*.

Table4.1: Production and Sale of Research By-Products in the PSPU

| No. | Type of Product | Quantity Produced (Kg) | Total Amount (GH¢) |
|---|---|---|---|
| 1 | Groundnut | 850.5 | 9,296.00 |
| 2 | Fermented Maize Meal | 357.0 | 1,428.00 |
| 3 | Yam *fufu* | 288.6 | 4,524.00 |
| 4 | Cocoyam *fufu* | 496.3 | 4,254.00 |
| 5 | Plantain *fufu* | 682.0 | 2,810.00 |
| 6 | *Banku* Mix | 394.5 | 2,295.00 |
| | **TOTAL** | **3,596.7** | **27,487.00** |

Table 4.2: Production and Sale of Research ByProducts at the RTPDU

| No. | Type of Product | No. of Times | Quantity Produced (Kg) | Total Amount (GH¢) |
|---|---|---|---|---|
| 1 | Gari | 2 | 270.0 | 120.00 |
| 2 | *Kokonte* | 6 | 1092.0 | 3246.00 |
| 3 | Drying *Hausa Koko* | 2 | 240.0 | 120.00 |
| 4 | HQCF | 5 | 200.0 | 680.00 |
| 5 | Starch | 3 | 240.0 | 240.00 |
| | **TOTAL** | **18** | **2042.0** | **4406.00** |

Table 4.3: By-Products in the EU

| No. | Type of Product | No. of Times | Quantity Produced (Kg) | Total Amount (GH¢) |
|---|---|---|---|---|
| 1 | Equipment design | 2 | 2.0 | 0.00 |
| 2 | Fabrication of equipment | 5 | 5.0 | 2,100.00 |
| 3 | Installation | 5 | 6.0 | 750.00 |
| 4 | Repair and maintenance | 29 | 29.0 | 7,971.50 |
| | **TOTAL** | **41** | **42.0** | **10,821.50** |

### *2.2.2 Services to clients*

The services provided at the PSPU were roasting of groundnut and soybean and drying of Hausa Koko, etc. (Table 4).

Table 4.4: Services to clients at PSPU

| No. | Type of service | Number of times | Quantity of product (Kg) | Total Amount (GH¢) |
|---|---|---|---|---|
| 1 | Roasting of groundnuts | 6 | 1,200 | 420.00 |
| 2 | Roasting of soybean | 1 | 100 | 60.00 |
| 3 | Drying of Hausa koko | 20 | 13,484 | 8012.00 |
| 4 | Milling of samples | 11 | 1,867 | 469.00 |
| 5 | Drying of cassava dough | 3 | 1,403 | 820.00 |
| 6 | Drying of cassava chips | 4 | 194 | 504.00 |

| | | | | |
|---|---|---|---|---|
| 7 | Drying corn dough | 2 | 950 | 590.00 |
| 8 | Drying of maize starch | 1 | 100 | 200.00 |
| 9 | Set of services (drying, milling) | 6 | 1,455 | 1930.00 |
| 10 | Drying of other samples | 9 | 858 | 1008.00 |
| 11 | Drying Moringa leaves | 3 | 14 | 120.00 |
| 12 | Processing Protocol Products | | | 1852.00 |
| | **TOTAL** | **66** | **21,625.0** | **15,985.00** |

### *2.2.3 Analytical services*

Three Hundred and Seventy two (372) samples were analyzed within the period as presented in *Table 5*.

Table 4.5: Analytical services to clients

| No. | Type of Analysis | No. of samples | Type of products | Total Amount(GH¢) |
|---|---|---|---|---|
| 1 | Water activity | 39 | flours | 390.00 |
| 2 | Pasting Characteristics | 65 | flours | 975.00 |
| 3 | Water absorption | 39 | flours | 390.00 |
| 4 | Colour | 35 | flours | 350.00 |
| 5 | pH | 16 | Flours | 160.00 |
| 6 | Dispensability | 26 | Variable | 260.00 |
| 7 | Bulk density | 44 | Flour/starch | 440.00 |
| 8 | Oil Absorption | 27 | Flour | 270.00 |
| 9 | Moisture content | 20 | Variable | 200.00 |
| 10 | Emulsion capacity | 37 | Flour/starch | 370.00 |
| 11 | Foaming capacity | 16 | Flour | 160.00 |
| | **Total** | **372** | | **4,045.00** |

## 3.0 Public Private Partnership (PPP)

Technical support for the following companies under PPP was conducted during the year:

- Natures Best Company Limited
- Home Foods Ghana Limited
- Inland Brewery Limited

## 4.0 Divisional Meetings

In order to facilitate a bottom-up approach for effective management in the Division the following meetings were held during the year.

- Five (5) Management Team Meetings were held on 5th January, 8th April, 5th June, 9th July and 21st November, 2013.
- Three (3) Divisional General Meetings were held on 15th February, 3rd May, and 3rd December, 2013.

## 5.0 Challenges

Challenges within the Division during the year under review were as follows:

- Difficulty in getting cassava for processing at RTPDU.
- Minimal production during the period of renovation at PSPU.
- Engineering Unit lacks tools for fabrication; and equipment for welding.
- Engineering Unit lacks young engineers to undertake electrical works.
- Marketing of the Divisions' research by-products continues to be limiting factor in scaling-up production.

## 6.0 Way Forward

- Renovation works at PSPU is completed. Acquisition of certification from GSA and FDA for the Division's research by-products and commercial production is 70% completed.
- The renovation works at PSPU and the yet-to-start renovation works at RTPDU are envisaged to increase research by-products and commercial production of the Division in 2014.

Five farmers in Bawjiase in the Central Region have been contracted to supply fresh cassava to RTPDU.

# 5.0 FOOD CHEMISTRY DIVISION

**Introduction**

The Food Chemistry Division primarily gives support to the commercialization activities of the Institute by offering analytical services to Industry, local and International students, as well as training for students. In addition, the Division conducts applied research into chemical contaminants (mycotoxins and heavy metals) in foods and feeds; as well as food flavour (aroma) analyses. Additionally, the Division offers consultancy services and advice to clients. The Division has two Units, namely the Food Toxicology Unit and the Industrial Services Unit.

**Staff Strength and Movements**

The Division currently has 14 members of staff consisting of:

1. Principal Research Scientist - 1
2. Research Scientists - 4
3. Principal Technologist - 1
4. Senior Technologists - 2
5. Technologist - 1
6. Senior Technical Officers - 4
7. Technical Officers - 2

The following staff movements occurred during the period:

a. Ms. Emefa Gblende completed her Bachelor in Laboratory Technology course at the Accra Polytechnic.
b. Mr. Charles Diako continued his studies in the USA towards the award of a doctorate.

***Analytical Services***

During the year, the Division offered analytical services to several companies, establishments and individuals. A total of 569 samples were received by the Industrial Services Unit for analyses. This number represents a 3.64% increase over the 549 samples received in 2012.

The samples analyzed included Alkalized cocoa cake, Alkalized cocoa powder, Sausages, Bella ginger drink, Khenaja Yoghurt and Bissap, Maize grits, Corn Soya blend, Rice, Margarine, Garden egg accessions, Palm kernel cake, Noni fruit and juice, Mirinda orange, Mirinda pineapple, Pepsi, 7 UP, Nkulenu palm drink, Soya bean cake, crude Soya bean oil, Dried Mushroom, Mushroom khebab, Royale

natural cocoa powder, Janico orange,Pure Heaven sparkling red grape juice, Yam flour, Smart tea, iodated salt, Coca Cola, Sesame seeds, Alfa Mayonnaise, Alfa Tomato ketchup, Parle biscuits, Juvita strawberry, Juvita cocktail, Raw maize, Cowbell strawberry milk, Ga kenkey, Shea butter, Palm oil, Groundnut, Groundnut paste, Tom brown, Cassava, Green beans, Pepper sauce, Poultry feed, Tiger nut, Adams' brandy, Tomato paste, Tomato juice, High quality cassava flour, Cashew nut, Becky Queen Natural honey, dried mango, milled rice, salt, Sweet potato flour, Cocoyam flour, Pistachio nuts, black tea, fruity ice ginger juice, Semolina, preserved dried pineapple, wheat bran, Lucozade energy drink, Aromatic Schnapps, Plantain fufu powder, Lemon tea, China green tea, Stella Sunflower oil, among others.

The hundred and eighty clients included Intertek Ghana Ltd., Ghana Standards Authority, Premium Foods Ltd., Leander Dede Kubie, Cocoa Processing Ltd, Samartex Timber & Plywood Co. Ltd., Equator Foods Ghana Ltd, Cassava G-Market Project, CSIR-FRI & MIRI, New Age Feed, AfricaRice Project, Evergreen Super-market Ltd., Gratitude Project, Ideal Providence Farms, Rice Sector Support Project, Aisha Senya, WAAPP 2 Project, Bomarts Farms Ltd, Promasidor Ghana Ltd, Acquah Isaac, Olam Wheat Mill, Allied Cocoa Products Ltd, Food Research Institute, The Potters Touch Ventures, Lam Agency Ltd., Isaac Vandapuye, Savannah Agric Research Institute, Reindorf Armah Ashitey, Agrana Gh. Ltd., HPW Fresh and Dry Ltd, Bobo Foods & Beverages Ltd., Nii Kortey Kortei, Southern Star Bottling Co.,Tabam Ent., Dry Foods Processing Ltd., Danblo Enterprise, Apue Ent., Evic Ent., Strongmen Ltd., Super Star Food & Pasteries Ltd., King Solomon Natural Health Center, Irani Brothers & Others Ltd., Agricare Ltd., Mapouka Co. Ltd., among others. Analysis of the 569 samples generated a gross income of Eighty-one Thousand, Three Hundred and Fifty Ghana cedis, Forty-six pesewas(GHC81,350.46) as against a gross income of sixty-nine thousand, eight hundred and seventy-four Ghana cedis seventy-seven pesewas(GH¢69,874.77) for 2012. This represents an increase of 16.42% over the 2012 gross income.

During the year, the Toxicology Unit received a total of 188 samples for aflatoxin and histamine analyses as against 243 samples for the year 2012. This represents a decrease of 22.6% over the previous year.

The samples analyzed consisted of peanut and peanut products, maize and maize products, rice, raw cocoa beans, Mushroom khebab, roasted cashew nuts, Pistachio nuts, Hazelnuts, Cassava products, Nestle cerelac cereals, Snappy peanut snack, Melon seeds, De-oiled Shea meal, Suya powder, yam fufu flour, cocoyam fufu flour,

wheat bran, Sword fish, Herrings,salted Tilapia, Anchovies, smoked salmon, smoked Mackerel, among others.

The clients included: Intertek Ghana Ltd., Ghana Standards Authority, CSIR-Food Research Institute, Cassava G-Market Project, Plot Enterprise Ghana Ltd, C & S Foods Ghana Ltd, Cosmo Seafoods, Foodtech Ltd., Ghana China Foods, Shantel De Babs Ent., Eunice Pessy, Joankorf Trading Enterprise, Kestevebel Ventures, Movenpick Ambassador Hotel, Peace Adokatse, Celestine Adjei, Ghatty Foods, Agricare Ltd., among others.

Total charges for the 188 samples amounted to twenty-five thousand, one hundred and fifty-seven Ghana cedis (GHC25,157) as against thirty-two thousand, eight hundred and forty-eight Ghana cedis (GH¢32,848). This figure represents a decrease of 23.4% over the 2012 gross income.
The gross total for the two Units of the Chemistry Division was therefore One Hundred and Six Thousand, Five Hundred and Seven Ghana cedis and Forty-six pesewas (GH¢106,507.46). This amount represents an increase of GH¢3,784.69 (3.68%) over the gross income for 2012 (Table 1).

Table 51: Summary of gross income generated in 2012 by Chemistry Division

| Quarter | Industrial Services Unit | | Toxicology Unit | |
|---|---|---|---|---|
| | No of Samples analysed | Gross Income GH¢ | No of Samples analysed | Gross Income |
| 1st | 205 | 24165 | 39 | 5,619 |
| 2nd | 146 | 19422.5 | 43 | 5,080 |
| 3rd | 131 | 23687 | 62 | 9,545 |
| 4th | 114 | 14075.96 | 44 | 4913 |
| **TOTAL** | **569** | **81,350.46** | **188** | **25,157.00** |

***Industrial Attachment and Practical Training***

During the year the following students benefited from Industrial Attachment/Practical training in the Division:

- Betty Makafui Obeku (KNUST) from 24th June 2013 - 5th August 2013
- Anthony Kwablah (UCC) from 3rd June 2013 – 31st July 2013
- Benedicta Boateng (KNUST) from 3rd June 2013 – 31st July 2013

- Vanessa Pettey-Agamatey (KNUST) from 5th June to 31st July 2013
- Maame Esi Swatson (UCC) from 5th June to 31st July 2013
- Benjamin Ebo Adu (UCC) from 3rd June to 31st July 2013
- Marian Attoh (UCC) from 17th June to 31st July 2013

***National Service Personnel***

Two (2) National Service Personnel namely, Benjamin Amos Nunoo and Francis Yinka Aminu were assigned to the Division in September 2013.

***Accreditation of Chemistry Laboratories***

*Internal Audits*

In compliance with the Food Research Institute (FRI) Accreditation Quality Manual, two internal audits were conducted during the year. These audits were carried out on the 21st of February and the 18th of September 2013.

*External Audit (SANAS Audit)*

A surveillance audit was conducted by SANAS from 2nd – 3rd April 2013 for the purpose of evaluating the Quality System for the Chemistry scope to guarantee continued accreditation. The audit was very successful.

*Proficiency Tests*

According to the CSIR-Food Research Institute Quality Manual, the analytical methods in use have to be subjected to proficiency testing once every year. The Division placed the orders for the test materials. The Toxicology Laboratory as well as the Industrial Services laboratory conducted the test and obtained acceptable z-scores for the parameters tested.

***Training***

Staff of the Division were involved in the Internship Programme for 3rd Year students from the Food Science and Technology Department of KNUST from 18th January to 23rd February 2013. Staff of the Division trained the students on Chemical analysis of foods and demonstrated the use of specific analytical equipment in the laboratories.

Representatives from small holder farmer groups drawn from Techiman, Sekyere Dumase, and surrounding areas were trained on manual sorting of maize grains to reduce aflatoxin levels under the SEND-Ghana project (Deepening linkages between Research, Advocacy, and the Media on aflatoxins in maize)

*Figure 5.1: Mr. Vincent Kyei-Baffour assisting participants in the sorting exercise*

*Figure 5.2: Participants sorting maize grains with the aid of a chart*

George Anyebuno and Hayford Ofori were also involved in the training of iced kenkey producers/sellers at Madina.

**Meetings, Conferences and Workshops**

Some of the staff of the Division participated in various workshops and conferences as indicated in *Appendix IV.*

# 6.0 FOOD MICROBIOLOGY DIVISION

**Introduction**

The Food Microbiology Division (FMD) has the main task of undertaking research and development activities in food safety and quality assurance for the food industries in Ghana. The Division is made up of two Units, namely the Industrial Services Unit (ISU) and the Mushroom Unit (MU).

The Industrial Services Unit (M-INDUS) carries out services for clients through analyses of samples submitted or sampled directly by staff. The Unit also advises clients, inspects food production premises of clients and food products. Seven methods of analysis carried out are accredited methods by South African National Accreditation System (SANAS). ISU is also involved in training entrepreneurs and students from tertiary institutions such as Polytechnics and Universities.

The Mushroom Unit (M-MUSH) carries out research activities in indigenous and exotic edible and medicinal mushrooms. It disseminates results to stakeholders through training programmes, technical reports and scientific papers. The M-MUSH also maintains a National Mycelium Bank which contains samples of mushrooms researched into. The Unit is also engaged in production and sale of mushroom spawns and compost bags to local farmers and researchers in some countries in sub-Saharan Africa like Cote d'Ivoire, Benin and Togo.

**Major Activities and Outputs**

**Activities and output of Industrial Services Unit (M-INDUS)**

The main activities carried out are:

- Technical and analytical services to clients for income generation.
- Quality control of analytical methods under the ISO 17025 accreditation.
- Visit to laboratories of food industries to advice on quality control procedures.
- Advice to clients
- Training of students from tertiary institutions in Ghana.
- Research activities.

The ISU continued with routine technical and analytical services carried out for clients who submit samples to the laboratory through the CID. A total of 1,269

samples were analyzed (Fig 6.1). The total number of individual analysis carried out in 2013 was 3195 (Fig 6.2). Clients that patronized the services of the Division during 2013 included Cadbury Ghana Ltd., Pioneer Food Cannery, Airways Catering Ltd., Burger Food Industries, Cocoa Processing co. LTD, Euro Food Gh. Ltd, West Africa Mills Ltd., Ghana Inspection Ltd, Promasidor Ghana Ltd., among others.

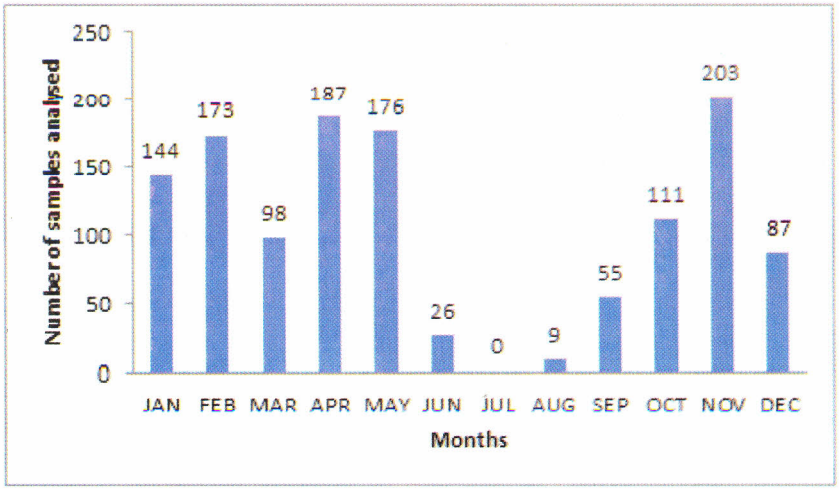


*Figure 6.1: Number of samples analyzed for clients in 2013*

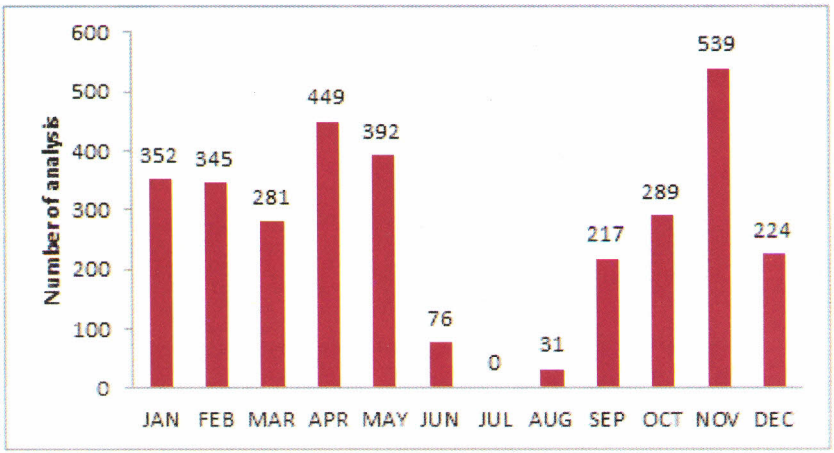


*Figure.6.2: Number of individual analysis carried out for clients in 2013*

**Laboratory quality management system: ISO 17025 Accreditation.**

The quality of analytical services carried out for clients was assured by maintenance of the ISO 17025 for which the Food Microbiology Division has accreditation for seven (7) analytical methods namely:

- Enumeration of Yeasts and Moulds. ISO 7954,1987 (E)
- Detection of Salmonella. NMKL No. 71, 1999, 5th Ed.
- Coliform bacteria detection in foods. NMKL No.44, 2004, 6th Ed.
- Determination of aerobic microorganisms. NMKL No.86, 1999.
- Detection of thermo-tolerant coliform bacteria in foods after pre-incubation
- Enumeration of coagulase positive *Staphylococcus aureus* in foods. NMKL No.66.2003
- Enterobacteriaceae determination in foods and feeds. NMKL No.144. 3rd Edn. 2005

**Activities and Output of Mushroom Unit (M-MUSH)**

The main activities carried out in the mushroom unit are commercial production and sale of mushroom spawns, compost bags and occasionally some fresh mushrooms to clients.

Research activities in the indigenous and exotic edible and medicinal mushrooms (Figure 6.3) are also carried out by the Unit. The number of bottled spawns and compost bags produced and sold monthly in 2013 and 2012 to mushroom growers are as shown in Figs 6.4 and 6.5 respectively. There was a 10% increase in production of spawns over the two year period. There was however no increase in bag production over the two years.

*Figure.6.3:*
*Fruit bodies of MES 03147 strains cultivated on sawdust*

## Regular and Vacation Training Programmes

Students from tertiary institutions are trained in laboratory procedures and quality management. Intensive and refresher training programmes are also carried out in mushroom cultivation for clients. Third year KNUST students of the Department of Food Science undertook internship programme in the Division. Under CSIR-FRI: MUGREAG SDF: COTVET training, 40 mushroom growers were trained in spawn multiplication techniques (Figure 6.6), refresher courses in mushroom cultivation and Good agronomic practices within the year.

Figure 6.6: Resource person demonstrating spawn multiplication technology to participants

## Research projects carried out

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

- Microbiology, aroma/flavour on shelf life of cocoa beans
- Microbial Quality and Shelf life of butternut squash flour and juice
- Evaluation of the microbial quality of water from dispensers in FRI – CSIR
- Microbial and chemical processes associated with burukutu, a Ghanaian fermented alcoholic beverage

- Nutritional evaluation of burukutu, a Ghanaian fermented alcoholic beverage
- Morphological Characteristics of Mycelia Growth of Two Strains of the Indigenous Medicinal Mushroom, *Lentinus squarrosulus* Mont. (Singer), on Solid Media
- Domestication of an indigenous Ghanaian edible mushroom-*Pleurotus sajor-caju*: variations in the proximate, and mineral contents of the wild and cultivated species
- A comparative study on the indigenous knowledge of macro fungi in the Eastern and Volta regions of Ghana
- Mushroom diversity and their uses in Ghana: Case study in the Volta and Eastern regions
- Heavy metal and proximate composition associated with the composting of cassava (*Manihot esculenta*) peels used in the cultivation of mushrooms in Ghana
- Utilization of cassava waste as substrate for mushroom production
- Optimization of the growth conditions of eight new strains of oyster mushrooms (*Pleurotus* species)
- Survival of four enteric pathogens occurring during steeping of dehulled maize for the preparation of white kenkey
- Varietal characterization of two rice species on the biological efficiency and nutrient content of two strains of oyster mushrooms.
- Utilization of radiation to sterilize compost bags and preserve mushrooms (*Pleurotus ostreatus*) cultivated on sawdust.
- Edible and medicinal mushrooms as functional foods in Ghana.

# 7.0 FOOD NUTRITION AND SOCIO-ECONOMICS DIVISION

**Introduction**

The Food Nutrition and Socio-economics Division (FNSD) has two sections, Nutrition and Socio-economics sections. The mandate of FNSD is to conduct nutrition and food utilization studies as well as conduct feasibility studies into the economic viability and socio-economic impact of on-going projects in Food Research Institute. Generally, key activities carried out during the period under review included Product Development, Recipe Formulation, Sensory Evaluation and Analysis, Training, Surveys and Nutrient analysis. Research Scientists and Technical Staff in FNSD also collaborated with other Divisions in key projects. Major activities include training on improved technologies and utilisation of Cassava under C : AVA, WAAPP and Socio-economics studies under AfricaRice and Rice Sector Support Projects. Other performance related activities are efforts made on proposal writing, technical reports and publications as well as presentations at conferences.

## 1. MAJOR ACTIVITIES

### A. Sustainable Intensification of Key Farming Systems in the Sudano-Sahelian Zone of West Africa (Africa Rising) under the Sub-Project: Improving Farm-Household Nutrition–Ghana.

- Participation in project planning and implementation meetings
- Farm household nutrition survey conducted in some selected communities in the three northern regions (Northern Region, Upper East and Upper West).
- Report written and submitted

### B. CIDA-Funded Africarice Project

- Revision of economic baseline sampling protocols under the policy task force for the AfricaRice surveys. These surveys comprised of:
  a. sample generation for producer surveys
  b. sample generation for processor surveys
  c. sample generation for marketer surveys
  d. sample generation for consumer surveys

- Implementation of baseline survey protocols and field data collection at the Afife hub. The sample is composed of:
  a. 4 communities (40 farmers) for Participatory Varietal Selection (PVS) protocol
  b. 4 communities (40) for Yield Gap protocol
  c. 5 communities (50) for Seed Training and
  d. 3 communities (30) for Mechanization
  e. 4 communities (40 farmers) for the Control protocol

- Conducted baseline survey which aims to understand the profile of communities and situation of potential beneficiaries, such as producers and post-harvest actors, prior to the design of the project activities.
- Development and quality evaluation of complementary foods from low grade broken rice fractions fortified with local ingredients rich in protein, iron and vitamin A.
- Development, Quality Evaluation and Consumer Acceptability Studies of Weaning Foods Developed from Orange-fleshed sweet potatoes, soybeans, cowpea and broken rice fraction for infant nutrition.

**C. Gratitude Project**

- Involved in Work Package 1 activities as outlined and in all these activities technical reports have been submitted
- Selection of target areas and evaluation of the existing value chains for cassava and yam as well as the assessment of the current levels of post-harvest losses and their causes at specific selected locations in Ghana.
- Identification of various options for reducing losses.
- Assessment of household decision making process with respect to reducing post-harvest losses and value addition to cassava & yam

**D. Agricultural Innovation Mkt Place; A Comparative Study on the Indigenous Knowledge of Macrofungi in the Eastern and Volta Regions ff Ghana**

**E. Sensory Evaluation and Product Development**

*Sensory Evaluation conducted in support of on-going projects (FRI)*

- Sensory evaluation was carried on different formulations of

complementary food using broken rice fraction and local ingredient rich in protein, iron and vitamin A (***AFRICARICE PROJECT***).

- Sensory evaluation was also carried on composite rice and wheat noddles developed from the product development laboratory (**AFRICARICE PROJECT**).
- Consumer acceptability on composite rice and wheat noddles was carried out at FRI environs and GBC (**AFRICARICE PROJECT**).
- The Division carried out sensory evaluations on formulated products from flours of cereals, roots and tubers (**WAAPP PROJECT**).

*Sensory evaluation in support of Students' Projects*

- Sensory evaluation of boiled bread fruit and bread fruit chips (students from Accra Polytechnic)

## 2. TRAINING OF CLIENTS

***Training of Small Scale Entrepreneurs***

- Staff of the Division trained Mrs. Charlotte Naa Djamah Briandt from Goshenland Enterprise on the concept underlying processing of weaning foods in May 2013. A HACCP system on the processing of weaning foods was developed for her.
- Staff also trained Miss Francisca Yeboah from Kharis Food Company Limited on soy milk processing in December 2013.

### Conferences/Workshops

Some of the staff in the Division participated in series of Workshops and Conferences as indicated in *Appendix IV*.

### Staff Training

- Mrs. Ruth Pobee undertook three months Mentorship Training on Data Analysis of Diet and Bioavailability of iron in foods. Penn State University, U.S.A. under the Borlaug Fellowship Programme Funded by USDA. From 11th March to 31st May 2013.

### Commercialization Activities

Commercialization activities in FNSED involve Sale of Research By-products, training of clients and Sensory Evaluation. During the period under review, incomes were generated from sale of weanimix, sensory evaluation, training of clients and research activities.

Description of Income Generation Activities

| Item | Quantity | Amount (GH¢) |
|---|---|---|
| Training | 2 | 1,722.88 |
| Sensory Evaluation | 4 | 220.00 |
| FRI Weaner (Maize) | 1,041 | 3,657.50 |
| FRI Weaner (Rice) | 665 | 2,327.50 |
| 10% Institutional Support From Research Fund | | 6,840 |
| **TOTAL** | | **14,767.88** |

**Student Internship**

- Third year Food Science and Technology Students from KNUST were attached to the Division for three (3) days. They were lectured on the concepts underlying product development and sensory evaluation. They were taken through hands-on practicals in the preparation of composite maize, soybean and peanut meal (weanimix) and 'dzowe'.
- Students of the Allied Health from Korle-Bu, University of Ghana, were attached to the Division for three (3) days. They were lectured on the concepts underlying product development and sensory evaluation.

**National Service**

Three National Service Personnel made up of two (2) ladies and one (1) gentleman were attached to the Division.

# 8.0 PROGRAMMES AND PROJECTS

## 8.1 ACCREDITATION, FOOD SAFETY AND QUALITY ASSURANCE PROGRAMME

### Introduction

This annual report summarizes all quality related activities of the CSIR Food Research Institute for the period January to December, 2013. A Quality Management System conformable to ISO/IEC 17025 was established in 2007 and has been operational to date. The Institute is accredited by the South African National Accreditation System (SANAS) for four (4) Chemistry analyses and currently seven (7) Microbiology methods. The Institute has continued to maintain the standards so as to ensure that the Chemistry and Microbiology laboratories produce technically valid analytical results that can be internationally accepted.

### Outcome of SANAS Visit

Representatives from SANAS visited the Institute from the 2nd – 3rd April, 2013 to conduct a reassessment of the accredited laboratories. At the end of the audit, the Assessor team recommended continued accreditation for Chemistry and re-instatement of accreditation for the Microbiology Laboratory subject to successful clearing of non-conformances within 25 working days.

In conclusion, the Assessor team indicated that Management System is implemented and maintained. The laboratory must ensure that all practices relating to processes implemented are documented to avoid misinterpretation and misunderstanding. Personnel demonstrated competence in the management system and technical activities.

Mr. Frank Kwesi Dogbey and Ms. Vida Akuyo Awidi were recommended for approval as technical signatories for the General Chemistry scope and Mrs. Amy Atter for Microbiology subject to clearance of non-conformances within the stipulated time. The following were also maintained as technical signatories:- Mr. David Baisel, Mr. Michael Amoo-Gyasi, Mr. Evans Agbemafle and Mr. Theophilus Annan.

### Activities

***Internal Audits***

Two internal audits were conducted in the year. Chemistry, Mycotoxin and

Microbiology; the Client Services Unit of the CID and the FRI Stores were audited in February to verify whether the operations comply with the requirements of the FRI Quality Management System and the International Standard ISO/IEC 17025 and if defined methods, procedures and instructions as stated in the documents were properly carried out. A second audit was conducted in September. The two audits were conducted in January and the other in October. The audits were conducted by Dr. Charles Tortoe and Mr. Elvis Baidoo of the Processing and Engineering Division, Dr. Oswald Ansa Asare, Mrs. Regina Banu of CSIR-Water Research Institute and Dr. Lawrence Abbey (Quality Manager).

***Findings of Internal Audit Held in February, 2013***

*Microbiology Laboratory*

Ten (10) non-conformances (NCs) were found in the March audit of the Microbiology laboratory.

*Chemistry Laboratory*

The Chemistry laboratory recorded one (1) non-conformance.

*Mycotoxin Laboratory*

The Mycotoxin laboratory recorded no (0) non-conformance.

*Stores*

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

*Commercialization and Information Division*

Three (3) minor non-conformances were identified at the CID.

***Findings of Internal Audit Held in September, 2013***

*Chemistry Laboratory*

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

*Mycotoxin Laboratory*

The Mycotoxin laboratory recorded two (2) non-conformances.

*Stores*

No non-conformance was identified at the Stores.

*Commercialization and Information Division*

Three (3) minor 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. The meetings were held on 28th May, 2013 and 19th November, 2013 respectively. The agenda of the meetings were on: 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.

The major issues arising from Management Review for the year 2013 were:

- the Reassessment and Re-instatement visit by SANAS
- Quotation for the design of the hot room for the Furnace for Chemistry Laboratory
- Employment of two additional staff for the Microbiology Laboratory.
- Purchasing of new printer for Customer Services Division to facilitate quick delivery of reports to clients and the return of the CID assigned vehicle (GV 788) back for repairs.

**Supplier Evaluation**

In the year under review, an assessment team from the Food Research Institute visited and inspected the premises of three suppliers of equipment and consumables from the 4th to 5th November, 2013. Following are the names of suppliers who have been selected:- Process and Plant Sales (Gh) Ltd; Labmed Co. Ltd. and Mayfremp Enterprise.

**Participation in proficiency tests/inter laboratory comparisons**

**Proficiency Tests**

By the Quality Manual, the methods in use have to be subjected to proficiency testing at least once every two years. Chemistry and Microbiology proficiency tests are obtained from FAPAS and FEPAS respectively.

**TRAQUE Project**

The accredited laboratories were expecting the TRAQUE project, an EU funded project aimed at refurbishing and equipping laboratories with new equipment. The bid for the project was not won by suppliers and had to be reopened.

**Notification of surveillance**

The Quality Manager received a notification of surveillance assessment for 2014/2015 from SANAS. The proposed date for assessment is scheduled for 11th July, 2014. The scope for the proposed audit was to cover the management system and technical activities against the requirement of our Quality Manual, ISO/IEC 17025:2005 and additional SANAS requirements.

**Accomplishments**

- Continued accreditation for the Chemistry Laboratories
- Re-instatement of accreditation for microbiology laboratory and accreditation for the following methods, determination of yeasts and moulds, *Enterobacteriaceae*, *Staphylococcus*, e-*coli*, Coliforms, Aerobic Microorganisms, *Salmonella*.

**Recommendation for Continuous Improvement**

Training in other laboratories, preferably overseas and refresher courses for staff to enable them become abreast with current trends in laboratory quality management and accreditation.

## 8.2 PROJECTS

### A. GAINS FROM LOSSES OF ROOT AND TUBER CROPS (GRATTITUDE)

**Start date:** January, 2012

**Estimated duration:** 2 years, 8 months

**Sponsors:** European Union

**Budget:** € 350,850.00

**Location:** Greater Accra, Brong Ahafo and Volta Regions and possibly Northern and Ashanti Regions

**Principal Investigator:** Dr. Nanam Dziedzoave

**Participating Scientists:** Dr. Charles Tortoe, Dr. Mary Obodai, Mrs. Wilhemina Quaye, Mr. Gregory Komlaga, Mr. Benjamin Addi Okae

**Participating Technologists**: Mrs. Marian Tandoh Wordey, Mr. Richard Takli, Mr. Solomon Dowuona, Mr. Eric Ofori and Mr. Derrick Sallah,

**Collaborating Institutions:** Caltech Ventures, St. Baasa Ltd, Social Development and Improvement Agency (SODIA)

**Objectives:** To improve the postharvest management of cassava and yams leading to reduced physical losses, reduced economic losses through value-added processing and valorization of waste products.

**Methodology:** Laboratory Research, Field trials and Industrial trials.

**Activities/Progress made since previous report:**

1. Cassava/Yam Value Chain Analysis has been completed.
2. Market Study on the range of potential Cassava (and Yam) waste solutions in Ghana has also been completed.
3. Work on market study is almost completed and draft report written.
4. Work on cassava and yam value chains is about 80% complete.

5. Key yam varieties and level of losses have been identified.
6. Assessment of on-farm yam storage structure is completed.
7. Development of High Quality Yam Flour (HQYF) is in progress.
8. Development methods for growing mushrooms from the waste of cassava and yam peels are in progress.
9. Communication channels have been developed to disseminate information to stakeholders.
10. Project publicity has been prearranged based on bi-weekly press releases and briefs.
11. A website has been constructed and relevant information has been uploaded.
12. A brochure/handout/ newsletter have been designed to document information on the technologies.
13. GRATITUDE Newsletter has been printed for distribution.
14. Market study was carried out and is almost complete.
    - Reports on Cassava Value Chain, Yam Value Chain and Market Study for the range of potential Cassava and Yam waste product solutions in Ghana were completed and submitted for review.
    - Additional information was collected on the market study for the range of potential Cassava and Yam waste product solutions.
15. Post-harvest characteristics of eighteen (18) farmers' key yam varieties were documented during the period.
16. An improved yam storage barn was constructed at Primukyeae. Using an RCBD technique of three (3) replicates (20 tubers each) of five farmers' key yam varieties (*pona, lariborkor, dente, muchumodo, serwah*) were stored for dormancy studies for a period of 90 days.
17. Development of High Quality Yam Flour (HQYF).
18. A survey was conducted in 14 suburbs of Accra to assess consumers' preference for yam varieties.
19. Development of methods for growing mushrooms from the waste of cassava\yam peels.A baseline assessment on processing systems of project partners as Caltech Venture Limited, St. Baasa Ghana Limited and Social Development and Improvement Agency (SODIA) was submitted to partners. Other processors assessed included Casacossa and household processors.
20. Five major communication channels were selected to ensure that all targeted groups or stakeholders have an equal share of the information on the project.

21. An initial press release dubbed "Post-harvest losses in roots and tuber production to be reversed" was publicized on 22nd June 2012 by Ghana News Agency (GNA). As an on-going activity, information is sent on monthly basis to Ghana News Agency (GNA) where both print and electronic media source for information to be distributed to their media houses for national publication.
22. A website has been fully constructed and having specialized interaction.

## B. IMPROVING LIVELIHOOD OF SMALL HOLDER CASSAVA FARMERS THROUGH BETTER ACCESS TO GROWTH MARKETS (CASSAVAG-MARKETS)

**Start date:** 1st June 2012

**Estimated Duration:** 4year, 6months

**Sponsors:** European Commission (EC)

**Budget:** EC= £287,883.00; FRI= £31,987.00 Total= £319,870.00

**Location:** Greater Accra, Volta and Brong-Ahafo Regions

**Principal Investigator:** Dr. Nanam Tay Dziedzoave

**Participating Scientists:** Marian Tandoh-Wordey, Elvis Baidoo and Mr. Paa Toah Akonor, Mr. Benjamin Addi Okae

**Collaborating Institutions:** Natural Resources Institute, (UK); University of Agriculture (Abeokuta, Nigeria); University of Malawi, Tuber Crops Research Institute, (India) Tanzanian Food & Nutrition (TFNC), Africa Innovations Institute (AfII), Uganda

**Objective(s):** To provide knowledge and technologies to allow the development of value chains linking small-holder farmers to growth markets for HQCF in the context of climate change & variability.

**Methodology:** Transfer of composite flour baking technology through training workshops with the use of posters, brochures; Bank facility facilitation and search for new markets.

**Activities/Progress made since previous report:**

1. Existing different bin and flash dryers have been technically assessed and reported.
2. A review of previous experiences and work done on cassava cyanogens and interventions carried out on internationally acceptable safe limits has been done.
3. Reviewed previous experiences in the development of new products from HQCF
4. Processing and quality parameters/standards have also been reviewed and included in the report.
5. Options of available value chain development using CAVA value chains as basis have been identified.
6. Communications channels have been identified to enable dissemination of project information to stakeholders easier.
7. Project publicity channels have been pre-arranged for initial press releases and briefs.
8. Project specialized website development is under construction

## C. IMPROVING FOOD SECURITY BY REDUCING POST HARVEST LOSSES IN THE FISHERIES SECTOR (SECUREFISH)

**Start date:** 1st January, 2012

**Estimated duration:** 3 years

**Sponsors:** European Commission

**Budget:** € 227,800.00

**Location:** CSIR-Food Research Institute

**Principal Investigator:** Dr. Lawrence Abbey

**Participating Scientists:** Dr. Wisdom Amoa-Amua, Dr. Margaret Ottah Atikpo, Dr. Charles Tortoe, Dr. Frederick Teye.

**Participating Technologists:** Mr. Seidu Ali Sampare, Mr. Apollonius Isaac Nyarko,

and Mr. Emmanuel A. Saka.

**Collaborating Institutions:** University of Surrey.

**Objective(s):** To enhance food security by addressing post-harvest losses comprehensively in the fisheries sector in selected low and medium-income countries.

**Methodology:** Training of fishermen/women, processors and consumers; Use of flyers and posters.

**Activities/Progress made since previous report:**
Trials on the single screw extruder (work package 2)

- Extrusion runs were performed on the single screw extruder (Fabricated at Food Research instituted) equipped with screws designed to impart high shear.
- A circular die with a 5-mm diameter annular exit was used. Barrel screw speed were held constant across all extrusions.
- Rice flour with moisture content of 30% was used and the feed rate and temperature set points were optimized for each combination of rice flour and salt.

## D. RICE SECTOR SUPPORT PROJECT (RSSP)

**Start date:** August, 2011

**Estimated duration:** 2 years

**Sponsors:** Agence Francaise de Developpment (AFD), MoFA/DCS

**Budget:** € 120,000.00

**Location:** Northern, Upper East, Upper West and Volta Regions

**Principal Investigator:** Mr. Elvis Alfred Baidoo

**Participating Scientists:** Wilhemina Quaye, Elvis Baidoo, Charles Diako, George

Anyebuno, Seidu Ali Sampare.

**Collaborating Institutions:** CSIR-SARI, CSIR-CRI, MoFA, GRATIS, GRIB, GRAMEEN, CRAN

**Objective(s):** To strengthen stakeholders of the rice value chain.

**Methodology:** Materials used include parboilers and rice. Methods used are survey, demonstrations and training sessions.

**Activities/Progress made since previous report:**

1. Writing of report on training conducted in the Upper West Region
2. Submission of returns with appropriate documentations attached and request for funds transfer
3. Mid-term evaluation by external consultants and review of mid-term evaluation Report
4. Preparation for fieldwork (Training of rice farmers, processors and millers in Northern, Upper East and Volta Regions) in the next quarter in progress.
5. Training of rice value chain actors (A total of 78 rice farmers and 98 processors) was conducted in selected rice production and marketing communities in Northern Region of Ghana in November and December 2012.

**E. Cassava Adding Value for Africa (C: AVA) Project-FRI**

**Start date:** June, 2008

**Estimated duration:** 5 years

**Sponsors:** Bill and Melinda Gates Foundation

**Budget:** USD 119.527.10

**Location:** Accra, Volta Region and Brong Ahafo Region

**Principal Investigator:** Dr. Nanam Dziedzoave
**Participating Scientists:** Mr. Gregory Komlaga, Mrs. Mary Glover-Amengor, Mr.

Cletus Gyato

**Participating Technologist:** Mr. Peter Delabor, Mrs. Beullah Sallah.

**Collaborating Institutions:** NGOs, University of Greenwich- UK, CSIR-Crop Research Institute, Ministry of Food and Agriculture.

**Objective(s):** To significantly boost the income of small-scale farmers by linking them to new markets

**Methodology:** Trainings and demonstrations

**Activities/Progress made since previous report:**

1. Monitoring visits to end users (bakers and matrons in SHS) in Greater Accra and Brong Ahafo Region.
2. Training of end users in the Volta region.
3. There was the training of six (6) kitchen staff of Ghana Prisons Service and twenty four (24) commercial bakers on composite bread baking and pastry making with HQCF and wheat flour in Ho.
4. Monitoring visits were made to end users of HQCF in the Greater Accra, Volta and Brong Ahafo regions.
5. Monitoring visits were made to end users of HQCF in the Greater Accra, Volta and Brong Ahafo regions of Ghana.
6. Monitoring and evaluation visits were made to end users of High Quality Cassava Flour (HQCF) in the Greater Accra, Volta and Brong Ahafo regions of Ghana.

### F. Cassava: Adding Value for Africa (C:AVA) Project

**Summary:** 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. From the initial stages of the contract, the project was targeted to end in March 2011; however, it has been given a two (2) year low cost extension, thus it is estimated to end in the year 2013. The new directive still focuses on improving cassava value chains but is narrowed down to processing, market development and credit management excluding

production activities. This reduces stakeholders from ten (10) to eight (8) with the exclusion of Ministry of Food and Agriculture (MoFA), Brong Ahafo and Volta Regions.

**Estimated duration:** 2 years

**Sponsors:** Bill and Melinda Gates Foundation

**Budget:** USD 504,967.00

**Location:** Greater Accra, Brong Ahafo and Volta Regions

**Principal Investigator:** Dr. Nanam Tay Dziedzoave
**Participating Scientist**: Mr. Gregory Komlaga, Mr. Victor Antwi

**Participating Technologist:** Mrs. Beullah Sallah

**Collaborating Institutions:**

- Associates for Sustainable Rural Development (Ho)
- Progressive Youth in Community Development (Hohoe)
- Christ Apostolic Agency for Rural Development (Atebubu)
- Social Development and Improvement Agency (Bechem)
- Association of Africa women in Development (Sunyani)
- CSIR-Forestry Research Institute of Ghana (Kumasi)

**Background information and justification:** Through an initiative led by the University of Greenwich's Natural Resources Institute, UK, in close partnership with the Food Research Institute, Ghana, the Bill and Melinda Gates Foundation is funding a 3-year project on cassava-" Cassava: Adding Value for Africa"- in Ghana. Four other African countries-Nigeria, Uganda, Tanzania and Malawi-are also beneficiaries of this initiative. This project was set up to develop the cassava value chain and to maximize achievements in the cassava sub-sector.

**Objective(s):** The project aims to significantly boost the incomes of small-scale African farmers by linking them to new markets.

**Expected beneficiaries:** Cassava farmers, processors and end users

**Expected outcome:** C: AVA-Ghana will develop value chains for High Quality Cassava Flour (HQCF) in Ghana, to improve the livelihoods and incomes of at least 20,000 smallholder households as direct beneficiaries including women and disadvantaged groups, it will promote the use of High Quality Cassava Flour (HQCF) as a versatile raw material for which diverse markets have been identified in pilot studies. The project will focus on three potent intervention points:

- Ensuring a consistent supply of raw materials;
- Developing viable intermediaries acting as secondary processors or bulking agents in value chains and
- Driving market demand and building market share (for example, bakery industry, and components of traditional foods or plywood/paperboard applications).

Farmers and farmer/processors will be supported in production and primary processing activities through partnership with NGOs, identifiable service providers or other extension services. Business development and other specialists will support intermediaries to meet the requirements of end users. End users will be supported technically in adopting HQCF.

**Activities/Progress made since previous report:** 396 community members of project targeted community based processing groups produced and sold processed traditional cassava products.

1. 237 processors sold processed cassava to bin dryer operators in Ghana.
2. 995 farmers sold fresh roots for HQCF production by Bin Dryer operators.
3. 5,137 farmers sold fresh cassava roots for production of local products.
4. Employment was generated for 1619 paid employees at processing sites; and 6,245 paid workers on-farms.
5. 1,382 tons of HQCF produced were sold into viable markets.
6. Three (3) business focus group meetings were held for one hundred and thirteen (113) stakeholders at Ho and Hohoe in the Volta Region.
7. There was a technical training for thirty (30) end users of HQCF in Ho through the collaborative effort of ASRUD and CAVA-FRI.
8. Monitoring visits were made to implementation partners during the period under review.
9. One stakeholders meeting was held in September 2012 at CSIR-FRI to discuss progress of work.
10. There was a technical training workshop organized at Ho by the Ghana

country office in partnership with Natural Resources Institute (NRI) on quality management.

11. There was a field visit to Ghana by Dr. Hollics, NRI, UK.
    a. Monitoring visits were made to project partners in the Volta and Brong Ahafo regions during the period under review.
    b. A member of the Monitoring and Evaluation Team in UK, Fedra Vanhuyse, paid two weeks (8th – 12th October, 2012) working visit to C:AVA-Ghana country office. She was taken round project partners in the Volta and Brong Ahafo Regions for evaluation of project activities.
    c. Semi-annual report for the project (April-September, 2012) was prepared and submitted to the UK Project Management office by the Ghana country office within the period under review.

## G. CIDA-funded/AfricaRice Project on Rice post-harvest handling, marketing and the development of new rice-based products

**Summary:** The ultimate outcome of this project is to increase food security and sustainable livelihoods among rice value chain actors in Africa. To achieve this, the project will introduce improved harvest and post-harvest rice processing practices and technologies to upgrade the quality and marketability of locally produced rice in order to meet urban consumers' preferences. The project will also promote the development and adoption of new rice-based products. Moreover, to foster an enabling environment for regional rice production and trade, the project will provide technical advisory and policy guidance support to the regional economic communities in sub-Saharan Africa.
The activities of this project will be carried out in Cameroon, The Gambia, Ghana, Mali, Nigeria, Senegal, Sierra Leone and Uganda. The nature of project activities in each country will depend on the specific country needs and circumstances.

**Start Date:** August, 2011

**Estimated duration:** 5 years

**Sponsors:** Canadian International Development Agency (CIDA)

**Location:** Afife, Atebubu, Navorongo

**Principal Investigator:** Mr. Elvis Alfred Baidoo

**Participating Scientists:** Mrs. Ruth Pobee, Ms. Hannah Oduro

**Participating Technologist(s):** Mr. Ali Sampare, Mr. Isaac Apollonius Nyarko, F. Mboom

**Collaborating Institutions:** McGill University, NARS, CSIR-SARI, CSIR-CRI, Ghana Rice Inter-professional body, Sinappy Aba (Micro-finance), Selassie Farms (Secondary Processor), TechnoServe, Departments of Nutrition & Food Science and Crop Science (University of Ghana), MoFA, MoTI- NBSSI, Single Mothers Rice Processors (Primary Processor), GRATIS Foundation (Processing equipment), Institute of Packaging Ghana, Consumer Association of Ghana

**Background information and justification:** In response to global food crises, CIDA has developed a Food Security strategy which focuses on Food aid and nutrition, Sustainable agricultural development and Research and development. The aim of this project is in alignment with CIDA's "Food security" priority theme for Africa and its contribution to research and development. The measures taken through research and development will give farmers in partner countries better access to the new technologies and specialized expertise they need for their farming operations, to keep pace with the growing demand for food.

Rice has become an important staple for both rural and urban dwellers and is gradually taking over from traditional crops such as root and cereal crops. Ghana therefore spent $218 million as at 2009 for the importation of rice. Despite the efforts made in local rice production the cost of production is high and uncompetitive in the domestic market due to relatively cheaper imported rice. The high local demand for foreign rice is crowding-out local farmers and processors from their own domestic market resulting in job loss, poor quality livelihood and increased food insecurity among rice farmers and other value-chain actors. There is therefore the urgent need for intervention in the rice industry to ensure proper post-harvest handling and marketing.

**Objectives:** To introduce improved harvest and post-harvest rice processing practices and technologies to upgrade the quality and marketability of locally produced rice to meet Sub-Saharan African consumers' preferences.

**Expected beneficiaries:** Small-holder rice producers, women rice parboilers, local artisans, local rice traders, scientists and agricultural extension staff

**Expected outcome:**

- Increase access to improved harvest and post-harvest rice processing practices and equipment for farmers, millers, parboilers and marketers in "good-practice concentration areas" of targeted countries.
- To increase applied knowledge of rice producers, processors and consumers in new rice-based products developed from slower-digesting varieties, broken rice fractions and rice by-products.
- Rice value-chain actors in target countries would have enhanced applied knowledge of improved harvest and post-harvest rice processing practices and the making and use of new value-added rice-based products and by-products.
- Improve evidence-based rice policy formulation and adoption by policy-makers in targeted pilot countries.
- Increase coordination and harmonization of regional rice policy in the Regional Economic Communities.
- Scientists and agricultural extension agents in selected pilot countries would have increased applied knowledge on rice harvesting, processing, marketing and policy analysis.

**Activities/Progress made since previous report:** Successful pretesting of questionnaire on consumer preference:

1. Started characterization of local rice varieties for noodle production
2. Commenced field work on the determination of rice harvest and post-harvest losses
3. Determination of harvesting and threshing losses by two BSc. students of the College of Agriculture and Consumer Sciences of the University of Ghana (UG) has been completed and dissertations presented. Their work was on the "*Assessment of post-harvest losses of rice cultivated under rain fed and irrigated conditions*".
4. One M.Phil student from the Department of Nutrition and Food Science of the University of Ghana working on the "*Characterization of local rice varieties for noodle production*" has also completed and presented her work.
5. Another M.Phil student, also of the same department of UG is working on, "*Assessing the qualitative and quantitative losses in the rice value chain in*

*Ghana- A case study of Rice cultivated at Afife in the Volta Region*". He has completed his data collection and about to finalize the thesis for submission in July.

6. A PhD student of the Department of Botany of UG has started his work on "Utilization *of by-products of two rice varieties, Oryza sativa and Oryza glaberrima for the production of edible mushrooms*".
7. At the inception of the project, three rice growing zones (Afife, Atebubu and Navorongo) were selected. These sites originally referred to as Good Practice Concentration Areas are to be called Rice Development Hubs. Activities are yet to begin in these hubs.
8. In February, the coordinating agency, AfricaRice, Benin, decided to institute synergies in all other rice development projects (projects on agronomy, breeding, post-harvest handling and marketing being handled by the different CSIR Institutes) so as to ensure that there are no duplications and that all the research activities are carried out in tandem and along the rice value chain. They therefore requested that all the operating zones of the various projects should be put under "Rice Development Hubs". A new agreement was signed between AfricaRice and CSIR.
9. A meeting of rice stakeholders was held in Kumasi in April 2012 and three new sites (Navorongo, Kumasi and Afife) were selected.

## H. African Food Tradition Revisited by Research (AFTER) Project

**Summary:** The African Food Tradition Revisited by Research (AFTER) Project aims 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 European science and technology to African traditional food products, AFTER seeks to turn research into quantifiable and innovative technologies and products that are commercially viable in both European and African markets. The 10 selected products representing 3 families of foods (fermented cereal-based, fermented salted fish and meat, & vegetable and fruit based functional foods) fit into a matrix of technologies and processes shared between Europe and Africa that will be jointly developed within the framework of AFTER.

Creating new markets and trade opportunities for improved traditional foods and novel products in Europe and Africa will increase economic returns for all

stakeholders involved in the production chain, down to the community level. Due consideration will be accorded to regulatory, ethical and IPR issues while also protecting the intellectual rights of Africans.

In Ghana, the dehulled *kenkey* will be characterized according to existing knowledge on technologies and processes. The improved product, produced through reengineering and new processing technologies, will be tested for consumer acceptance, safety and nutritional quality. The market and entry requirements for new *kenkey* will be assessed. Involving EU and African companies in production trials for the improved product will translate the results into ready-to-use information for food companies.

**Start Date: June, 2010**

**Estimated duration:** 4 year

**Total Budget**: €132,800; EU Contribution: €98,000
CSIR FRI Contribution: €34,800 (in assets and personnel)

**Sponsors:** European Union- Seventh Framework Theme

**Location:** Greater Accra, Central and Eastern Regions

**Principal Investigator:** Dr. Wisdom Kofi Amoa-Awua

**Participating Scientists:** Dr. Mary Obodai, Mrs. Charlotte Oduro-Yeboah, Mr. George Anyebuno, Mr. Charles Diako, Mr. Hayford Ofori, Dr. Charles Tortoe, Dr. Margaret Owusu

**Participating Technologist:** Mr. Theophilus Annan

**Collaborating Institutions:** Ministry of Food and Agriculture-Women in Agricultural Development, University of Ghana, Legon

**Background information and justification:** *Kenkey*'s importance in modern-day life is underlined by the wide spectrum of fermented foods marketed both in developing and industrialized countries, not only for the benefit of preservation and safety, but also for their highly appreciated sensory attributes. The process of

*kenkey*-making is lengthy and laborious; therefore it is more often purchased from a commercial *kenkey* producer rather than cooked at home. The producers who are mainly women with little or no formal education– carry out commercial production as a family-acquired art. In a survey conducted in Accra, Allotey (1996) found that at most production sites the amount of maize processed weekly ranged from 0.05 to 1.2 metric tons with an average of 0.3 tons of maize processed into 0.5 tons of *kenkey*. There are however, a few large production sites with weekly capacities of several tons (up to 5 tons) of maize. The production of *kenkey* is based on traditional technologies that have been handed down in generations.

Commercial production and street vending of *kenkey* is the source of livelihood for many traditional food processors and food vendors in Ghana and these activities make a sizeable contribution to the rural and urban economy in Ghana. *Kenkey,* as a street food is convenient, cheap, and affordable for the poor and provides informal and self-employment opportunities as well as supplementary income for households. The vending of *kenkey* contributes positively to the food security of all the actors in the value chain including maize farmers, input suppliers, *kenkey* processors and vendors. The market for *kenkey* was originally limited to Ghana but recently it has a niche market in the Diaspora including some West Africa countries. There is however a possibility for further extension to the international markets.

This study is part of an European Union collaborative project between CSIR-Food Research Institute, four European countries and seven African countries. It will directly contribute to improving the competitiveness of traditional products and facilitate the implementation and uptake by food companies. Beyond these direct results, the lessons learnt and the methodologies for the assessment of traditional products and processes will be shared with other countries worldwide in order to disseminate the results among the research community involved in food research in developing countries.

**Objective(s):**

- To reach comprehensive scientific knowledge of the existing know-how on technologies, processes and products.
- To propose improved traditional processes by reengineering of the unit operations with the aim of improving the safety and nutritional quality while keeping or improving the organoleptic characteristics of traditional

products.

- To reach objective criteria of acceptability of the traditional products by the consumers and to ensure that the products can effectively access the EU markets in view of regulatory and ethical issues while protecting the intellectual rights of the people in Africa.
- To present the results into ready-to-use information for food companies including SMEs via guidelines on quality management, food law and regulation and consumer protection and to transfer the results to the stakeholders from Africa and from the EU.

**Expected beneficiaries:** Consumers, producers and processors in Africa and beyond Food companies including SMEs

**Materials and Methods:** ***Survey methodology***

A semi-structured questionnaire was administered to producers, sellers and consumers of *kenkey*. The questionnaire aimed at gathering information about the production, vending and consumption of kenkey in Ghana in order to identify the major problems and bottlenecks related to kenkey so as to investigate some of them and propose adequate solutions.

The total sample size of the respondents to be interviewed for the whole geographical region was calculated using $Ni = 4X\, p_i(1-p_i)/d^2\, N_i$ is the total number of respondents to be surveyed for the study (Chadare *et al*, 2008).

$p_i = n_p/N_t$ $P_i = n_p/N_t$; the proportion $n_p$ of the product producer, seller and consumer among the Nt randomly interviewed persons and d is the expected error margin fixed at 0.05 (Dagnelli, 1998). Based on the calculation above, the total number of consumers to be interviewed was three hundred and fifty four (354), producers was two hundred and thirty two(232) and sellers was two hundred and nine (209).

**Expected outcome:** To improve traditional African products in the light of combined and/or new technologies for mutual benefits for the consumers, the companies and the producers of Africa and Europe.

**Activities/Progress made since previous report:** Final submission of the Regulatory Report.

1. Completed sensory evaluation of Kenkey and other fermented maize products

2. Consumer testing of products is on-going
3. Mrs. Charlotte Oduro-Yeboah (PhD) and Mr. Theophilus Annan (Msc) continued their research work in their respective areas
   i. Write-up on analysis of results of the sensory tests and consumer acceptance of kenkey and other fermented maize products carried out in the first quarter was completed.
   ii. There was a trip to Anum and Bawjiase for sample collection for microbial analysis to test the safety of the products: Analysis carried out included enumeration of Coliforms, *Escherichia coli*, *Clostridium*, yeast and moulds etc.
   iii. M.Phil student (Mr. Theophilus Annan) continued his work in the development of starter cultures for production of dehulled kenkey: Microbial analysis –Lactic acid bacteria and yeasts identification and selection of starter cultures based on their technological properties.
   iv. Ph.D student (Mrs. Charlotte Oduro-Yeboah) continued her work in the reengineering of dehulled kenkey which included the following activities:
      - Physicochemical (moisture, pH, titratable acidity, particle size, pasting properties and colour) properties of laboratory and traditional white kenkey (*nsiho*) and its intermediates.
      - Textural measurement of laboratory white kenkey and traditional white kenkey types.
      - Sampling white kenkey samples and their intermediates from Anum, South Senchi and Bawjiasie for physical and chemical analysis. (Five samples each from each location).
      - Trials on yoghurt preparation using dehulled maize dough were conducted.
      - Preparation of "wasawasa" (couscous) using yam with the idea of using maize dough later.
4. M.Phil student (Mr. Theophilus Annan) has completed his work and is preparing for his project defense (Viva).
5. Dr. Wisdom Amoa-Awua attended the EFFoST Annual Meeting from 20th – 23rd November, 2013 in Montpellier, France where he presented a poster titled 'Value-addition to Kenkey, an indigenous African fermented food, targeting the international market'.
6. From 24th October to 22nd December, 2013, Mrs. Charlotte Oduro-Yeboah travelled to Montpellier where she carried out a series of experiments:
   - Scanning Electron Micrograph (SEM) on maize grain samples and

dehulled samples among others
- Textural measurement of laboratory white kenkey and traditional white kenkey types
- Differential Scanning Calorimetry (DSC) carried out on fermented dehulled dough (12 hours), pre-cooked dough (*aflata*), white kenkey types from Anum Kenkey, Atimpoku Kenkey and sweet Kenkey), Ga and Fanti kenkey
- High Performance Liquid Chromatograpy (HPLC) determinations for sugar and organic acids

## I. Development and optimization of choco-peanut spread and development of high quality stabilized peanut butter.

**Summary:** In recent years, nuts have received considerable attention as one of the foods that have beneficial effects for cardiovascular health. As a measure to curb post-harvest losses of peanuts, its development into spread and butters have gained much recognition. Thus, the research to improve this product development.

**Estimated duration:** Two (2) years

**Sponsors:** Global Peanut Product Processing and Marketing team (UGA-GP3MT) - University of Georgia.

**Budget:** USD 3,000.00

**Location:** CSIR-FRI

**Principal Investigator:** Mr. Charles Diako

**Participating Scientist:** Mrs. Evelyn Buckman

**Participating Technologist:** Mr. Emmanuel Saka

**Collaborating Institution:** University of Georgia

**Background information and justification:** The University of Georgia UGA-GP3MT is funded by the Peanut Collaborative Research Support Program (Peanut-

CRSP) of the United States Agency for International Development with the University of Georgia at Griffin being the implementing body. CSIR-FRI operates as the Managing Partner of a series of projects being implemented in Ghana under this programme. The program aims at bringing scientists and industry together for collaborative development and transfer of technology through an early engagement approach. The development and optimization of the Choco-peanut spread was implemented with an industry partner who wants to adopt the technology and commercialize the product.

**Objective(s):** To develop and optimize a prototype peanut-based spread with cocoa ready for industrial adoption

**Expected beneficiaries:** Small, medium and large scale industries; food processes.

**Materials and Methods:** Peanuts, sugar, stabilizer, cocoa powder, roaster, oven, refrigerator, colloid mill, blender, plaster jars, sacks and liners, gloves, hair nets and nose masks. The methods used were mixture designs and optimization methodologies.

**Estimated outcome:**

- To develop and optimize a prototype peanut-based spread with cocoa ready for industrial adoption.
- To develop a stabilized peanut butter for small companies.

**Activities/Progress made since previous report:**

1. 60 consumers of peanut spread evaluated the 9 products
2. The sensory evaluation of the prototypes was done on a 9-point hedonic scale with 1 being 'dislike extremely' and 9 being 'like extremely'. Contour plots showed the following scoring:
    - ***Sweetness***: Consumers scored an acceptance of 7 and above for sweetness for formulations with high levels of peanuts and sugar.
    - ***Peanut flavor***: Acceptance scoring for this attribute was high (7 and above) for formulations with high peanut.
    - ***Chocolate flavor:*** More sugar and peanuts masked the bitter taste of the natural cocoa powder used and gave an acceptable chocolate taste which was scored from 6.5 and above for those formulations with high levels of sugar and peanuts.
    - ***Spreadability***: This was affected by high levels of natural cocoa

powder. Consumers therefore gave high scores (8-9) to formulations with high amounts of peanuts and sugar which made the product highly spreadable.

- ***Smoothness:*** Product smoothness was scored from between 8 and 9 for samples with more peanuts and sugar in the formulation
- ***Overall acceptability***: Overall consumer acceptance was scored between 8 and 9 for formulations with high peanuts, sugar and low natural cocoa powder.

3. Different locations were used for the sensory evaluation
4. An ABSTRACT of this work has been accepted for the IFT conference in Las Vegas, USA in June 2012.
5. The project focused on the verification of the product developed to help in the selection of a formulation that consumers like most which will have greater chance of commercial success.
6. Four products were developed from four formulations and subjected to sensory evaluation.
7. Mr. Gregory A. Komlaga was appointed the project leader of the Peanut CRSP project to coordinate the project activities at FRI effective July 1, 2012.
8. There was a Choco Peanut Spread product Launch in collaboration with CBA Foods (industrial partner), during the Grand Sales Fair 2012 at the Accra International Trade Fair Centre. The launch was published in the Daily Graphic and Ghanaian Times newspapers.
9. The project leader was invited by the UGA-GP3MP team to Georgia, USA in September 2012 for an orientation on project activities (planning of future activities, financial/technical reporting) and participation in the Georgia Peanut Tour 2012.

**Major findings:**

1. CSIR-FRI in partnership with CBA foods (an industrial partner) developed and launched a non-detectable aflatoxin peanut product **"Peanut Choco Spread"** at Trade Fair Centre during the 2012 Grand sales trade fair. The launch was very successful and demand for the new product has since been increasing.
2. CSIR-Food Research Institute trained twenty key entrepreneurs in the groundnut processing enterprise in Ghana on how to eliminate aflatoxin during groundnut processing. This was a major innovation in the peanut processing industry.

**Expected Beneficiaries/Potential Impact:** The project has benefited some food processors in the peanut industry especially the CBA foods in the elimination of aflatoxin in peanut products, this will go a long way to prevent its harmful effect on consumers

**Media Popularization:** Diako, C., CSIR develops peanut spread with no aflatoxins. *The Ghanaian Times,* Thursday, August 2, 2012.

## J. Tackling Malnutrition in Northern Ghana-Cereal Flour Fortification

**Summary:** The World Food Programme (WFP) and its partner agencies have long been recognized for their ability to deliver food to deprived and resource –poor people all over the world. Relatively little is known about the efforts it puts in place to check that the food they supply provides vitamins and minerals and not just calories. As a result of that, the technology of cereal flour fortification with micronutrient (vitamin/mineral) premix was transferred in twelve 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. 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. A Group discussion approach was adopted to help participants feel a sense of ownership of the programme and to also appreciate the intervention.

**Estimated duration:** ~2 years

**Sponsors:** CIDA/WFP

**Location:**

- Upper-East Region (Gorogo, Zorko Goo, Tangasia, Chuchuliga Namosa)
- Northern Region (Woribogu-Kukuo, Yilonayili, Gortani, Yankazia, Nansoni)
- Upper-West Region (Lam-Uollo, Ketuo and Dahile-Kpanagaan)

**Principal Investigator:** Mr. Joseph Gayin

**Participating Scientists:** Dr. P-N.T. Johnson, Ms. Hanna Oduro

**Participating Technologist:** Mr. Seidu Ali Sampare

**Collaboration Institution:** World Food Programme (WFP)

**Background information and justification:** Under nourishment accounts for a third of all deaths in children under the age of five in developing countries annually (WFP, 2011). Micronutrient malnutrition also known as "hidden hunger" due to lack of intake, absorption and utilization of food accounts for 7.3% of the global burden of diseases (Fe, I, Zn, Vit. A). Malnutrition is both a cause and manifestation of poverty. Northern Ghana has the highest percentage of Ghana's poor (WFP/UNICEF report, 2009). In order to aid in poverty reduction, the concept of a deliberate addition of one or more micronutrients to particular foods (usually staples) so as to increase the intake of these micronutrient(s) was borne. This was in order to correct or prevent a demonstrated deficiency and provide a health benefit.

**Objectives:**

- To improve the nutritional status of women and children by promoting flour fortification with micronutrients
- To provide an alternate source of income for women groups through milling and fortification

**Expected outcome:** Improve the nutritional status of malnourished pro-poor farming communities in the selected communities in the northern regions.

**Activities/Progress made since previous report:**

- Fabrication of 27 mixers (in progress)
- Preparation of Premix using whole grain maize
- Trainings have been conducted in communities
- Reports have been submitted to WFP
- Commenced the fabrication of five (5) hand mixers

# APPENDIX I

## Senior Members and Senior Staff List

### Directorate

| | | | |
|---|---|---|---|
| 1. | Dr. NanamTay Dziedzoave | - | Prin. Res. Scientist/Director |
| 2. | Dr. Lawrence Abbey | - | Quality Manager |
| 3. | Mr. Stephen Nketia | - | Scientific Secretary |
| 4. | Mr. Benjamin Addi Okae | - | Scientific Secretary (M&E) |
| 5. | Ms. Faustina Somuah | - | Prin. Admin Assistant |
| 6. | Ms. Mariam Yakubu | - | Technologist |

### Administration Division

| | | | |
|---|---|---|---|
| 1. | Ms. Janet Aggrey-Yawson | - | Admin. Officer |
| 2. | Mr. Eric K. Ofori | - | Prin. Admin. Asst. |
| 3. | Mr. Patrick OfosuMintah | - | Chief Tech. Officer |
| 4. | Mr. Isaac Hammah | - | Prin. Works Supt |
| 5. | Mrs. Victoria A. Asunka | - | Snr. Admin. Asst. |
| 6. | Mrs. Beullah Sallah | - | Prin. Admin. Asst. |
| 7. | Ms.Anita Adusah | - | Snr. Admin. Asst. |
| 8. | Mr. Moses Ollennu | - | Snr. Asst. Transport Officer |
| 9. | Mr. Samuel Osarfo | - | Asst. Transport Officer |

### Accounts Division

| | | | |
|---|---|---|---|
| 1. | Mr. Coffie Tutu Aikins | - | Accountant/Head. Finance |
| 2. | Mr. John M. Nakotey | - | Chief Stores Supt. |
| 3. | Ms. Judith Dogbegah | - | Chief Accounting Asst. |
| 4. | Mr. Christian Amegah | - | Chief Accounting Asst. |
| 5. | Mr. Derrick Victor Sallah | - | Prin. Accounting Asst. |
| 6. | Mr. Joseph K. Larbi | - | Snr. Accounting Asst.. |
| 7. | Mr. James Cromwell | - | Snr. Stores Supt. |
| 8. | Ms. Mabel Aryee | - | Accounting Asst |
| 9. | Ms. Wolase Efodzi | - | Stores Supt. |

**Commercialization & Information Division**

| | | | |
|---|---|---|---|
| 1. | Dr. Kwame A. Vowotor | - | Snr. Res. Scientist/Ag. Head. CID |
| 2. | Mr. Kwabena A. Bugyei | - | Scientific Info. Officer |
| 3. | Mr. Raphael Kavi | - | Librarian |
| 4. | Mr. Augustine Andoh | - | Chief Tech. Officer |
| 5. | Mr. Benedict Awotwi | - | Chief Tech. Officer |
| 6. | Mr. Philip.O. Baidoo | - | Prin. Accounting Asst. |
| 7. | Ms. Joana B. Dzikunu | - | Snr. Admin. Assistant |
| 8. | Mr. Jeremiah Lartey- Brown | - | Prin. Technical Officer |
| 9. | Ms. Mary Assimah | - | Snr. Admin. Assist. |
| 10. | Ms. Syndy M. Williams | - | Marketing Assistant |
| 11. | Ms. Judith Larweh | - | Technical Officer |
| 12. | Mr. Rufai Braimah | - | Technical Officer |

**Food Processing & Engineering Division**

| | | | |
|---|---|---|---|
| 1. | Dr. Charles Tortoe | - | Snr. Res. Scientist/Head. FPED |
| 2. | Dr. Lawrence D. Abbey | - | Snr. Research Scientist |
| 3. | Dr. Frederick WayoTeye | - | Snr. Research Scientist |
| 4. | Mr. Cletus K. Gyato | - | Research Scientist |
| 5. | Mr. Benjamin A. Mensah | - | Research Scientist |
| 6. | Mr. Ebenezer C. Tettey | - | Research Scientist |
| 7. | Mr. Joseph Gayin | - | Research Scientist |
| 8. | Mr. Gregory A. Komlaga | - | Research Scientist |
| 9. | Mrs. C. Oduro-Yeboah | - | Research Scientist |
| 10. | Mr. Peter Adoquaye Addo | - | Research Scientist |
| 11. | Mr. Elvis A. Baidoo | - | Research Scientist |
| 12. | Mr. Paa Toah Akonor | - | Research Scientist |
| 13. | Mr. Jonathan Ampah | - | Research Scientist |
| 14. | Mr. Seidu A. Sampare | - | Chief Tech. Officer |
| 15. | Mr. Rhodes Y. Anthonio | - | Prin. Works Supt. |
| 16. | Mr. Apollonius Isaac Nyarko | - | Senior Technologist |

| | | | |
|---|---|---|---|
| 17. | Mr. Emmanuel Adokwei Saka | - | Technologist |
| 18. | Ms. Edna Mireku | - | Technologist |
| 19. | Mr. Solomon Dowuona | - | Technologist |
| 20. | Mrs. Helene A. Annan | - | Technologist |
| 21. | Mr. Peter Dalabor | - | Prin. Works Supt. |
| 22. | Mr. Joseph Akoto | - | Prin. Works Supt. |
| 23. | Mr. Desmond Mensah | - | Prin. Tech. Officer |
| 24. | Mr. Godwin Armah | - | Snr. Tech. Officer |
| 25. | Mr. Thomas Najah | - | Snr. Tech. Officer |
| 26. | Ms. MakafuiTorgbui | - | Technical Officer |
| 27. | Mrs. Agartha Amuzu | - | Technical Officer |
| 28. | Ms. Jemima Ofori | - | Technical Officer |
| 29. | Mr. Ofori Brempong | - | Technical Officer |
| 30. | Mr. Emmanuel Tettey Agbloe | - | Works Supt. |

**Food Microbiology Division**

| | | | |
|---|---|---|---|
| 1. | Dr. (Mrs.) Margaret Ottah Atikpo | - | Snr. Res. Scientist/Head. FMD |
| 2. | Dr. (Mrs.) Mary Obodai | - | Snr. Res. Scientist/Head M.U |
| 3. | Mrs. Bernice D. Kalton-Senaye | - | Research Scientist |
| 4. | Ms. Matilda Dzomeku | - | Research Scientist |
| 5. | Mrs. Ivy Yawson | - | Research Scientist |
| 6. | Mrs. Anthonia Andoh | - | Research Scientist |
| 7. | Mrs. Amy Atter | - | Research Scientist |
| 8. | Ms. Deborah L. Narh | - | Research Scientist |
| 9. | Mrs. Nina Bernice Ackah | - | Research Scientist |
| 10. | Mr. Evans Agbemefle | - | Asst. Research Scientist |
| 12. | Mr. David K. Baisel | - | Snr. Technologist |
| 13. | Mr. Michael Amoo-Gyasi | - | Snr. Technologist |
| 14. | Mr. Richard Takli | - | Technologist |
| 15. | Mr. Theophilus Annan | - | Technologist |
| 16. | Mr. Alexander Henry K. Appiah | - | Technologist |

| | | | |
|---|---|---|---|
| 18. | Ms. May A. Boham-Dako | - | Technologist |

**Food Chemistry Division**

| | | | |
|---|---|---|---|
| 1. | Dr. (Mrs.) Kafui A. Kpodo | - | Prin. Res. Scientist/Head. FCD |
| 2. | Mr. George A. Anyebuno | - | Research Scientist |
| 3. | Mr. Charles Diako | - | Research Scientist |
| 4. | Dr. Margaret Owusu | - | Research Scientist |
| 5. | Mr. Hayford Ofori | - | Research Scientist |
| 7. | Mr. David N. A. Ankrah | - | Prin. Technologist |
| 8. | Mr. Nelson Y. Amey | - | Prin. Technologist |
| 9. | Mr. Kofi Kwegyir Essel | - | Snr. Technologist |
| 10. | Mr. Vincent Kyei-Baffour | - | Technologist |
| 11. | Ms. Vida Awidi | - | Snr. Tech. Officer |
| 12. | Mrs. Belinda Quaye | - | Snr. Tech. Officer |
| 13. | Mr. Derrick Ashley | - | Snr.Tech. Officer |
| 14. | Mrs. Dorothy Narh | - | Snr. Tech. Officer |
| 15. | Ms. Emefa Gblende | - | Technical Officer |
| 16. | Mr. Ebenezer Tawiah | - | Technical Officer |
| 17. | Mr. Frank Dogbey | - | Technical Officer |

**Food Nutrition & Socio-Economics Division**

| | | | |
|---|---|---|---|
| 1. | Mrs. Mary Glover-Amengor | - | Snr. Res. Scientist/Head FNSD |
| 2. | Mrs. Lynda Hagan | - | Research Scientist |
| 3. | Mrs. Ruth Adisetu Pobee | - | Research Scientist |
| 5. | Ms. Hannah Oduro | - | Research Scientist |
| 6. | Mrs. Evelyn S. Buckman | - | Research Scientist |
| 7. | Mr. Frank Peget Mboom | - | Technologist |
| 8. | Mrs. Alice Padi | - | Snr. Tech. Officer |
| 9. | Ms. Constance Boateng ) | - | Snr. Tech. Officer |
| 10. | Ms. Mary Abena Okai | - | Snr. Tech. Officer |

# APPENDIX II

## Table 1.1: CSIR-FRI Staff Promotions 2013

| Name | Designation | Promoted To |
|---|---|---|
| Mr. Theophilus Annan | Technologist | Senior Technologist |
| Mr. Christian Amegah | Principal Accounting Asst. | Chief Accounting Assistant |
| Ms. Vida Awidi | Senior Technical Officer | Principal Technical Officer |
| Mr. Thomas Najah | Senior Technical Officer | Principal Technical Officer |
| Mr. Emmanuel T. Agblo | Works.Supt. | Senior Works Supt. |
| Mr. Samuel Agyei | Tradesman Gd. 2 | Junior Foreman |
| Mr. Samuel Amaning | Security Asst. Gd. 1 | Senior Security Assistant |
| Mr. Paul Kpotor Tetteh | Security Asst. Gd. 1 | Senior Security Assistant |
| Mr. Daniel Mustapha | Security Asst. Gd. 1 | Senior Security Assistant |

## Table 1.2: CSIR-FRI Staff under Training

| NAME | PROGRAMME OF STUDY | INSTITUTION |
|---|---|---|
| Mrs. Bernice Karlton - Senaye | PhD, Energy & Environ Systems | North Corolina State Univ. USA |
| Mrs. Charlotte Oduro-Yeboah | PhD,Food Science | University of Ghana |
| Mr. Joseph Gayin | PhD, Food Science | University of Guelph, Canada |
| Mr. Charles Diako | PhD Food Science | Washington State University, USA |
| Janet Aggrey-Yawson | MBA Human Resource Management | Kwame Nkrumah University of Science & Technology (KNUST) |
| Evans Agbemefle | MSC Food Science & Tech. | Chonbok National University, South Korea |
| Mr Apollonius I. Nyarko | MPhil, Food Science | University of Ghana |
| Mr. Emmanuel A. Saka | MPhil, Food Science | University of Ghana |
| Ms. Marian Yakubu | MSc. Sustainable Food Manufacturing Management | Catholic University of Lille, France |
| Mr. Seidu Ali Sampare | MSc. Mechanical Engineering | Kwame Nkrumah University of Science & Technology (KNUST) |

## Table 1.3: Staff who resumed from study leave

| NAME OF STAFF | PROGRAM OF STUDY | INSTITUTION |
|---|---|---|
| Ms. Deborah L. Narh | MSc, Biotechnology | Wageningen University |
| Mrs. Nina Bernice Ackah | MSc,Food Quality Management | Wageningen University |
| Mrs. Evelyn Serwah Buckman | MSc,Food Science | KNUST |
| Mrs Angela Addy | BSc, Accounting | University of Professional Studies |
| Mrs. Agartha Amuzu | BSc, Agric. Engineering | University of Ghana |
| Ms. Constance Boateng | Bachelor of Technology, Hospitality Management | Ho Polytechnic |
| Ms. Emefa Gblende | B-Tech, Science Laboratory | Accra Polytechnic |

## Table 1.5: Retirement 2013

| No. | NAME | DESIGNATION | TYPE OF RETIREMENT | YEARS OF SERVICE |
|---|---|---|---|---|
| 1. | Dr. Mrs. KafuiKpodo | Prin. Research Scientist/Deputy Director/Head FCD | Compulsory | 32 years |
| 2. | Mr. Cletus Gyato | Research Scientist | Compulsory | 23 years |
| 3. | Mr. Benjamin A. Mensah | Research Scientist | Compulsory | 28 years |
| 4. | Mr. Benedict Awotwi | Chief Technical Officer | " | 36 years |
| 5. | Mr. David Ankrah | Principal Technologist | " | 22 years |

## Table 1.6: Resignations 2013

| S/N | NAME | DESIGNATION | EFFECTIVE DATE |
|---|---|---|---|
| 1 | Mr. Robert M. Yawson | Senior Scientific Secretary | 1st Sept. 2013 |
| 2 | Mr. Eric Sarpong Owusu | Research Scientist | 8th June, 2013 |
| 3 | Ms. Angela Guma Adam | Technologist | 9th Dec. 2013 |
| 4. | Mr. Stephen Atta-Sonno | Library Assistant | 13th June, 2013 |

# APPENDIX III

## Conferences, Courses, Workshops and Seminars Attended By CSIR-FRI Staff

| Date of the Conference/Seminar | Type of Conference/Seminar | Organizers | Venue | Participants |
|---|---|---|---|---|
| 8th – 11th January, 2013 | AFRICARICE project dissemination workshop, | AFRICARICE Project | Accra, Ghana | Mrs. Lynda Hagan |
| 18th – 21st February, 2013 | World Soybean Research Conference | American Soybean Association | Durban, South Africa | Mrs. Mary Glover Amengor<br>Mrs. Lynda Hagan |
| 11th – 13th March, 2013 | Training in mycelium production | Lab for Biotechnology for Mycelium bvba | Nevel, Belgium | Dr. Mary Obodai |
| 5th – 7th March, 2013 | 8th North Atlantic Seafood Forum | | Bergen, Norway | Dr. Margaret Ottah Atikpo |
| 5th March, 2013 | Workshop on diffusion of innovation in low income countries project | CSIR-STEPRI | CSIR-STEPRI | Mr. Benjamin Addi Okae |
| 11th – 14th March, 2013 | Biotechnology training workshop | CSIR-OPRI | CSIR-CRI | Mr. Evans Agbemefle |
| 19th March 2013 | Laboratory Water conference | | La Palm Beach Hotel | Mr. George Anyebuno |
| 20th – 24th March, 2014 | African Women in Agricultural Research and Development (AWARD) Mentoring Orientation Workshop, | AWARD | Speke Resort, Kampala-Uganda | Dr. Margaret Owusu |
| 21st – 22nd March, 201 | Workshop on laboratory quality assurance and quality control | CSIR-STEPRI | CSIR-STEPRI | Mr. Gregory Komlaga<br>Mr. Elvis Baidoo<br>Mr. Hayford Ofori<br>Mrs. Anthonia Andoh |
| 22nd – 26th April, 2013 | Mid-Term Review Meeting of the GRATITUDE Project | NRI | Bankok, Thailand | Dr. Nanam Dziedzoave |
| 20th – 24th April, 2014 | Workshop on Experimental Biology 2013, | UCSA | Boston Convention & Exhibition Center, UCSA | Mrs. Ruth Pobee |
| 10th – 14th June, 2013 | 4th FP7 European Project Securefish | Institute for Marine Resources and Ecosystem | Department of Aquaculture, Netherlands | Dr. Lawrence Abbey |
| 5th – 7th June, 2013 | Study trip to Addis Ababa, Ethiopia | PTB | Ethiopia | George Anyebuno |
| 12th – 14th June, 2013 | Laboratory Management Workshop: Laboratory quality assurance and quality control | CSIR-WAAPP Ghana | CSIR-WRI | Ms. Edna Mireku<br>Mr. Solomon Dowuona<br>Mr. Frank Dogbey |

| | | | | |
|---|---|---|---|---|
| | | | | Mr. Vincent Kyei Baffour<br>Mr. Richard Takli |
| 26th June-2nd July, 2013 | African Women in Agricultural Research and Development (AWARD) Proposal Writing Skills Course, | AWARD | Speke Resort, Kampala-Uganda | Dr. Margaret Owusu |
| 1st – 4th July, 2013 | Training workshop on development and management of Institutional repositories suing agridrupal and AgrioceanDspace Tools | CSIR-INSTI | INSTI | Mr. Raphael Kavi<br>Mr. Kwabena Asiedu Bugyei<br>Ms. Marian Yakubu |
| 10th of July 2013 | Workshop on rules and procedures for receiving laboratory equipment | M-Plaza Hotel, Roman Ridge, Accra | Traque Project | Mr. George Anyebuno |
| 8th – 12th July, 2013 | Workshop on laboratory equipment maintenance | Ghana Standards Authority | GSA Training room, Accra | Mr. Hayford Ofori<br>Mr. Jonathan Ampah |
| 27th – 29th August, 2013 | Workshop on 'Measurement Uncertainty in Microbiology Measurement, Internal Quality control and Instrument Qualification' | PTB | Ghana Standards Authority | Mr. Vincent Kyei Baffour |
| 12th – 14th August, 2013 | Post-harvest experts meeting on strengthening the engagement of knowledge Institute in ARD Policy processes | Technical Centre for Agriculture (CTA) | CTA Headquarters, Netherlands | Dr. Kwame Vowotor |
| 11th November, 2013 | Africa Rising Project Planning Meeting | Africa Rising Project | Tamale | Mrs. Mary Glover Amengor |
| 14th – 18th October, 2013 | Workshop On Proposal Writing, Scientific Writing, Project Management and Intellectual Property | WAAPP | CSIR-STEPRI | Mr. Hayford Ofori |
| 30th Sept. – 5th Oct. 2013 | 12th Symposium of the International Society for Tropical Root Crops – Africa Branch (ISTRC-AB) | IITA, CSIR | Alisa Hotel, Accra | Dr. Nanam Dziedzoave<br>Dr. Mrs. Margaret Ottah Atikpo<br>Dr. Charles Tortoe<br>Mr. Gregory Komlaga<br>Dr. Frederick Wayo Teye |
| 30th Sept. – 5th Oct. 2013 | 12th Symposium of the International Society for Tropical Root Crops – Africa Branch (ISTRC-AB) | IITA, CSIR | Alisa Hotel, Accra | Mr. Stephen Nketia<br>Mr. Paa Toah Akonor<br>Mr. Benjamin Addi Okae<br>Mrs. Evelyn Buckman |
| 1st – 2nd October, 2013 | AWARD Progress Monitoring Meeting | AWARD | Mensvic Hotel, Accra | Dr. Margaret Owusu |
| 15th Oct. – 15th Nov, 2013 | Training on Re-engineering du kenkey blanc, produit traditionnel de mais fermente du Ghana | CIRAD's Laboratory, | Montpellier, France | Mrs. Charlotte Oduro-Yeboah |
| 2nd – 6th November, 2013 | workshop on Neglected and Under-utilized | | Abomey-Calavi, Benin | Mrs. Evelyn Buckman |

| | | | | |
|---|---|---|---|---|
| | Species | | | |
| 12th – 15th October, 2013 | VII International Symposium on Mushrooms in Brazil and VI national symposium on Edible Mushrooms | | Manaus-Amazonas, Brazil | Dr. Mary Obodai and Mr. Richard Takli |
| 2nd – 6th December, 2013 | Workshop on 'Laboratory Management within the Food Safety System' | EDES | Ghana Standards Authority | Mr. Vincent Kyei Baffour |
| 8th – 14th Dec. 2013 | Sixth Science Conclave 2013 | Institute of Information Technology | Allahabad, India | Mr. HayfordOfori and Deborah Louisa Mensah |

## APPENDIX IV

### Publications (Refereed Scientific Reports and papers)

**Journal Paper**

1. **CSIR-FRI/JP/G-AM/2013/001**
   **Glover-Amengor M., Vowotor K.A (2013).** Survey on Consumption of Vegetables and Fruits in a Coastal District in Ghana.Journal of Natural Sciences Research Vol.3, No.8, 2013.

2. **CSIR-FRI/JP/G-AM/2013/002**
   **Glover-Amengor M.,** Quansah J., **Peget F.M., (2013)** Performance and Acceptability of Legume-Fortified Yam Flours.Journal of Food Science and Quality Management, Vol.17, 2013.

3. **CSIR-FRI/JP/OH/2013/003**
   **Hayford Ofori, Margaret Owusu, George Anyebuno (2013).** Heavy Metal Analysis of Fruit juice and Soft drinks Bought from Retail Market in Accra, Ghana. Journal of Scientific Research and Report, 2 (1), 424-428.

4. **CSIR-FRI/JP/BEA/2013/004**
   **Baidoo E.A. and Akonor P.T (2013).** Effects of pre-treatments and storage condition on physicochemical properties of taro (*Colocasia esculenta)* flour. Article submitted to Journal of Food Preservation. (June 2013)

5. **CSIR-FRI/OM/KGA/2013/005**
   **Owusu, M.**, Petersen, M. A., Heimdal, H. (2013). Relationship of sensory and instrumental aroma measurements of dark chocolate as influenced by fermentation method, roasting and conching conditions. Journal of Food Science and Technology Sept-Oct 50(5) 909-917. DOI 10.1007/s13197-011-0420-2.

6. **CSIR-FRI/JP/OH/2013/006**
   **Ofori, H., Owusu, M., Anyebuno, G. (2013).** Heavy metal analysis of fruit juice and soft drinks bought from retail market in Accra, Ghana. Journal of Scientific Research and Reports 2(1), JSRR.2013.029

| | | | | |
|---|---|---|---|---|
| | Species | | | |
| 12th – 15th October, 2013 | VII International Symposium on Mushrooms in Brazil and VI national symposium on Edible Mushrooms | | Manaus-Amazonas, Brazil | Dr. Mary Obodai and Mr. Richard Takli |
| 2nd – 6th December, 2013 | Workshop on 'Laboratory Management within the Food Safety System' | EDES | Ghana Standards Authority | Mr. Vincent Kyei Baffour |
| 8th – 14th Dec. 2013 | Sixth Science Conclave 2013 | Institute of Information Technology | Allahabad, India | Mr. HayfordOfori and Deborah Louisa Mensah |

## APPENDIX IV

### Publications (Refereed Scientific Reports and papers)

**Journal Paper**

1. **CSIR-FRI/JP/G-AM/2013/001**
   **Glover-Amengor M., Vowotor K.A (2013).** Survey on Consumption of Vegetables and Fruits in a Coastal District in Ghana.Journal of Natural Sciences Research Vol.3, No.8, 2013.

2. **CSIR-FRI/JP/G-AM/2013/002**
   **Glover-Amengor M.,** Quansah J., **Peget F.M., (2013)** Performance and Acceptability of Legume-Fortified Yam Flours.Journal of Food Science and Quality Management, Vol.17, 2013.

3. **CSIR-FRI/JP/OH/2013/003**
   **Hayford Ofori, Margaret Owusu, George Anyebuno (2013).** Heavy Metal Analysis of Fruit juice and Soft drinks Bought from Retail Market in Accra, Ghana. Journal of Scientific Research and Report, 2 (1), 424-428.

4. **CSIR-FRI/JP/BEA/2013/004**
   **Baidoo E.A. and Akonor P.T (2013).** Effects of pre-treatments and storage condition on physicochemical properties of taro (*Colocasia esculenta)* flour. Article submitted to Journal of Food Preservation. (June 2013)

5. **CSIR-FRI/OM/KGA/2013/005**
   **Owusu, M.**, Petersen, M. A., Heimdal, H. (2013). Relationship of sensory and instrumental aroma measurements of dark chocolate as influenced by fermentation method, roasting and conching conditions. Journal of Food Science and Technology Sept-Oct 50(5) 909-917. DOI 10.1007/s13197-011-0420-2.

6. **CSIR-FRI/JP/OH/2013/006**
   **Ofori, H., Owusu, M., Anyebuno, G. (2013).** Heavy metal analysis of fruit juice and soft drinks bought from retail market in Accra, Ghana. Journal of Scientific Research and Reports 2(1), JSRR.2013.029

7. **CSIR-FRI/JP/TC/2013/007**
   **Tortoe, C., Dowuona, S., Dziedzoave, N. T. (2013).** Development of CCP's and method for monitoring. CSIR-FRI, Accra, Ghana. pp. 45.

8. **CSIR-FRI/JP/TC/2013/008**
   **Tortoe, C., Quaye, W., Dowuona, S., Dziedzoave, N. T. (2013)**. Baseline data of cassava and yam processed products by SME's, large and households processors in Ghana. CSIR-FRI, Accra, Ghana. pp. 34.

9. **CSIR-FRI/JP/PRA/2013/009**
   **Pobee R. A. (2013),** Health Implications of Late Night Eating. DE today, *No.1. pp6.*

**Consultancy report**

1. **CSIR-FRI/CR/TC/2013/001**
   **Tortoe, C., Nketia, S., Owusu, M., Akonor P. T. (2013).** CSIR-Food Research Institute-Mitsubishi Research Institute Inc., Yam consultancy. Development of new value-added products of yams and cassava, and data collection and analysis for commercial viability. Final Consultancy Report.

**Technical report**

1. **CSIR-FRI/TT/OM/2013/001**
   **Obodai, M., Narh Mensah, D. L., Dzomeku, M., Takli, R. K., Prempeh, J., Nketia, S. (2013)** CSIR-FRI:MUGREAG:SDF (COVET) Spawn multiplication training course, CSIR-FRI, Ghana

2. **CSIR-FRI/TT/OM/2013/002**
   **Obodai, M., Narh, D., Dzomeku, M., Takli, R. &Prempeh, J (2013)** Report on trainer of trainers workshop held at Apesiwa Conference Room, CSIR-FRI, Ghana

3. **CSIR-FRI/TT/OM/2013/003**
   **Obodai, M., Komlaga, G., Dzomeku, M., Narh, D., Takli, R., Dzeidzoave, N (2013)** Development of methods for growing mushrooms from the waste from cassava peel: Gains from Losses of Root and Tuber Crops (GRATITUDE) Deliverable Report; D4.1

4. **CSIR-FRI/TT/TC/2013/004**

**Tortoe, C., Nketia, S., Glover-Amengor, M., Owusu, M., Hagan L., Akonor, P. T., Dowona, S and Padi, A., (2013)** Development of New Value-Added Products from Yam (*Dioscorea rotundata*), Consumer Data Collection and Analysis for Commercial Viability. A poster presented at the MiRI Yam Diversification Consultancy Workshop, 7th February, 2013. CSIR-STEPRI Conference Room, Accra.

**Papers under Review**

Hagan L. L, Sargent S. A, Berry A, Huber DJ, Plahar WA, Johnson PN T (2013). Effects of 1-methylcyclopropene (1-MCP) pretreatments and storage conditions on the ripening characteristics of mature-green plantain (var. Falsehorn) and sensory characteristics of ampesi, a traditional boiled product. LWT Food Science and Technology (in press).

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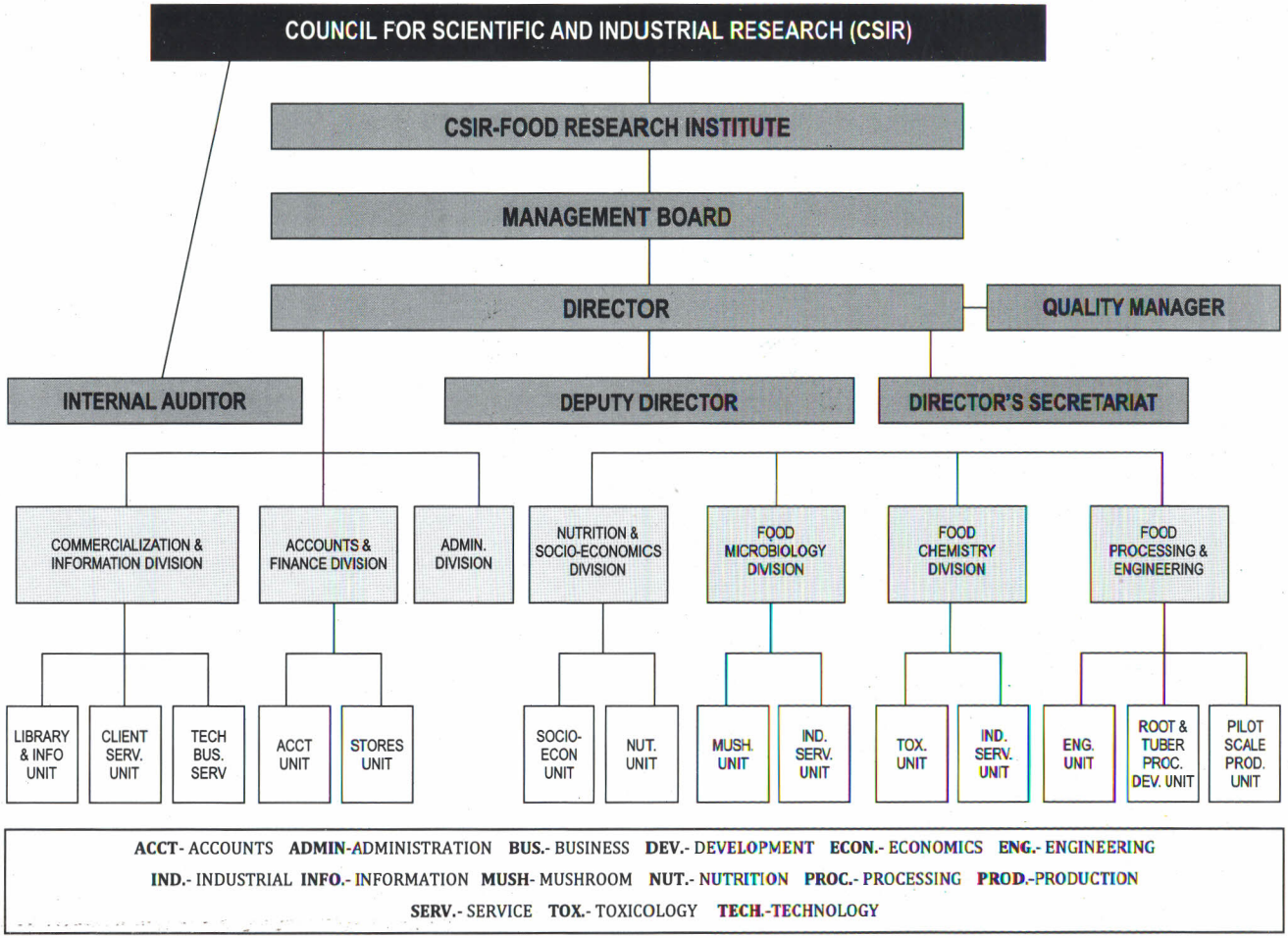


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