2017 ANNUAL REPORT

CSIR-FRI

CSIR-FOOD RESEARCH INSTITUTE

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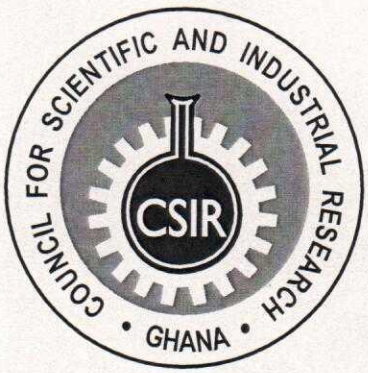

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CONTENT

FORWARD

CSIR-Food Research Institute (CSIR-FRI), one of the 13 institutes of the CSIR, is mandated to conduct applied market oriented research into problems of food processing and preservation, food safety, storage, marketing, distribution and utilisation, as well as national food and nutrition security in support of the food industry. It strengthens its impact on socio-economic development of the nation by generating technologies that meet the demands of the private sector and other stakeholders. CSIR-FRI also provides technical and analytical services, contract research and consultancy services to micro-medium and multinational agro-food processing industries and international development agencies. Over the years CSIR-FRI has been working towards delivery of excellent research outputs through innovative and technological exploits for uptake by entrepreneurs and the private sector.

This report is a presentation of research outputs classified under two broad research thematic areas: Food Security and Science and People. It is also a representation of activities and achievements for the year 2017.

On behalf of the CSIR-FRI management and staff, we wish to thank all those who in diverse ways made us attain all the successes of the year.

Thank you

EXECUTIVE SUMMARY

CSIR-Food Research Institute conducts Research and Development activities with market oriented and profitable out-puts beneficial to various actors in the country's food value chains. It had staff strength of one hundred and forty-six (146) comprising of eighty-five (85) males and sixty-one (61) females within the period under review.

Project activities were carried out under the thematic areas Food Security and Poverty Reduction; and Science and People. In contributing to the agenda of ensuring that all people, at all times have physical, social and economic access to sufficient, safe and nutritious food, the Institute identified farmers, processors and small-medium scale enterprises in different locations of the country with specific needs depending on the food commodities. Identified target groups were trained on various technologies including plantain processing technology, better fish feed storage and handling practices, agronomic practices, use of composite flours, mushroom cultivation technology, compost bag production etc. Value chain assessments were conducted and improvements made on various crops, such as plantain value chain in Ghana; market linkages were fostered and established between farmers, processors and small-medium scale enterprises; discussions with various groups such as farmer and/or processor groups were held to foster technology transfers and mushroom cultivation facilities were constructed and established. To impact the local food industry and encourage medium to large scale production of fermented millet product, *fura,* studies were conducted into re-engineering of *fura* by obtaining, characterizing and isolating microbial starter cultures. Studies were also carried out on storage of varieties of pineapples for export.

Commercial activities generated GHS 1,446,279.00, with a bulk of income generated from analytical and technical services. Funds received within the year from various donors amounted to GHS 1,909,839.57.

INTRODUCTION

Mandate

The CSIR-Food Research Institute (FRI) is **mandated to conduct applied market oriented research** into problems of food processing and preservation, food safety, storage, marketing, distribution and utilisation, and national food and nutritional security in support of the food industry and also to advise government on its food policy.

Vision

The Food Research Institute's vision is to be recognised nationally and internationally as an S&T institution that is playing a key role in the transformation of the food processing industry to be internationally competitive with particular reference to product safety, quality and presentation.

Mission

The Institute's mission focuses on providing scientific and technological support to the growth of the food and agricultural sectors of the national economy in line with corporate prioritisation and national objectives. Primarily, the CSIR-FRI's mission is to conduct market-oriented applied research and provide technical services and products profitably to the private sector and other stakeholders. To do this the food Research Institute will conduct business in a conducive and transparent working environment with a cadre of highly qualified and motivated staff for timely delivery of quality services and products to clients.

Overall Goal

The overall goal of the Institute is to assist in poverty alleviation through creation of opportunities for generating and increasing incomes within the micro, small, medium and large-scale food industry; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

Products and Services

1. Internationally certified **Analytical Services** (Microbiological, Physical, Toxicological & Chemical Analyses)
2. **Technical Services** (Collaborative research and Consultancies, Wet and Dry milling, Blending & Packaging)
3. **Mushroom production** (Sales and Training in edible & medicinal mushroom production)

4. **Fabrication of Food Processing Equipment** (Fabricating strong & reliable food processing equipment and industrial dryers)
5. **Food Processing** (Processing of high quality natural food products and Contract productions)
6. **Extension Services** (Technology transfer, Business incubation, Hiring of conference facilities etc.)

CSIR Research Thematic Areas

The Research Thematic areas of the CSIR under which CSIR-FRI's activities fall are:
Thematic Area 1 (TA 1) -Food Security and Poverty Reduction and
Thematic Area 7 (TA 7) - Science and People.

FOOD SECURITY AND POVERTY REDUCTION

Food is a basic human right. This right, may not be met due to poverty and unavailability of crops in certain parts of the world. Most countries, especially in Africa, have over the years placed focus and put systems in place to ensure that, all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food. CSIR-FRI's strategies to contribute to food security and poverty reduction are executed through research projects on various commodities. These strategies include, storage, processing and improving shelf life of food crops. Activities under this thematic area are outlined under the following projects:

Project 1:

Developing Biomass-based Value Chain Of Plantain And Reduce Post-harvest Losses Of Plantain Through The Development Of Value Added Products For Small Scale Farmers And Processors In Two Regions In Ghana

Plantains and bananas (*Musa* sp.) are valuable starchy staples in Ghana. They provide not only a rich source of dietary energy but also contribute to a good quality diet and rural income. Processing of plantains into flour is limited, as most plantain foods are eaten as boiled, fried or roasted. Although plantain is an important crop, there are huge post-harvest losses, which must be evaluated to improve its production and processing. The main goal of this project was to develop a biomass value chain of plantain and reduce post-harvest losses of plantain through transfer of processing technologies of instant plantain *fufu* flour; plantain composite flour for bread, cookies, cakes; plantain flour for traditional foods such as *tatale*, *bofrot*, *togbee*; and plantain chips as value added products to small-medium scale processors and also create linkages between farmers and processors. The two key production and consumption areas selected for the project activities were Brong Ahafo (Kukuom, Sunyani) and Western (Juabeso and Takoradi) regions.

Key Activities and Achievements

Biomass-based value chain assessment of plantains in Ghana

A survey was conducted to identify the actors and their roles along the plantain value chain, to understand the plantain value chain activities and to identify value addition opportunities that will help reduce post-harvest losses of plantains.

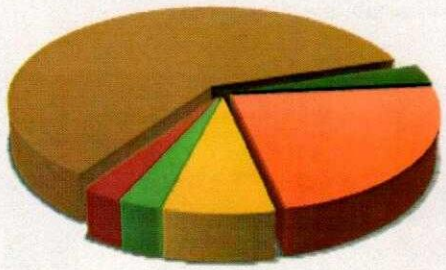
Information obtained set the benchmark to develop plantain biomass-based value chain to reduce post-harvest losses of plantains through the development and transfer of value added products. Biomass-based value chain assessments, levels of post-harvest losses and market potentials for plantain were assessed as baseline studies for production, marketing and consumption locations. Respondents included producers, processors, traders/sellers, caterers and consumers.

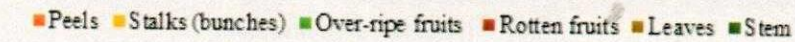
Group discussion sessions

Value chain survey session

A total of 309 plantain value chain actors were covered in the Brong Ahafo and Western Regions. Findings covered the biomass-based value chain assessments, gender roles, levels of post-harvest losses and identification of market potentials along the entire plantain value chain. The study estimated post-harvest losses of up to 20% at production level, 15% at the market levels and less than 5% at the consumption level. The study found that 83% of the plantains were traded mostly in unprocessed forms. By-products identified at the production level included leaves, stems/trunk, bunches and few peels with low utilization levels.

Percentages of wastes from plantain





Some leveraging measures made included intervention in linking actors in the value chain to prospective buyers as well as taking advantage of improved varieties and possibility of staggering planting to get plantain all year round. It also involved research to improve existing coping measures to control losses, expanding plantain products, promotion of existing and new processed products and development of new products from by-products along the plantain value chain.

Identification of farmers, processors, women processors, small-medium scale processors for plantains

Training needs of identified farmers, processor groups and small-medium scale processors for capacity building on developed plantain value added products was assessed through engagement with trainees.

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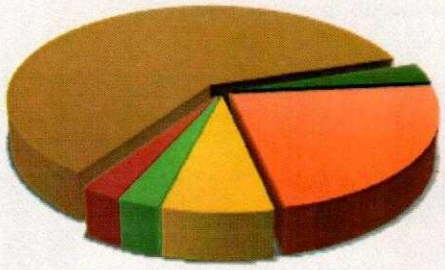

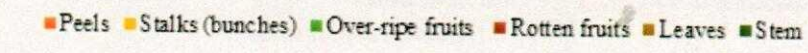

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Some needs identified included lack of credit facilities for plantain farming, lack of inputs (agrochemicals), gradual reduction in soil fertility, lack of storage facilities, lack of value added products and lack of community processing facility among others.

Processing technologies on plantain value added products disseminated to identified processors

Training of processor groups and small-medium scale processors on plantain processing technologies was carried out at the project locations.

One hundred and seventeen (117) participants were taken through periods of lectures, demonstrations, trainees' hands-on practicals and discussions. Regional officers of the Ministry of Food and Agriculture-Women in Agricultural Development were involved in all trainings to ensure sustainability.

Hands-on demonstration

Marketing linkages and hand-holding for farmers, processors and small-medium scale processors

Marketing is an important component of every product. In order to ensure the marketing of the value added products that were transferred to trainees, marketing linkages were conducted for farmers, processors and small-medium scale processors. This was done to link farmers, processors and small-medium scale processors to markets within their catchment areas.

The marketing linkage and hand-holding trainings were disseminated through lectures, demonstrations, market linkages and discussions.

It was attended by a total of 90 participants whose line of businesses included plantain processing, catering and restaurant services, bakery and pastry making. Trainees learnt product profile portfolio for the first time and could calculate their own cost benefit to analyse the product portfolio. Trainees agreed to register their business in order to enjoy tax exemptions.

Training on market linkages

Project 2:

Aflatoxin In Fish Feed: It's Implication On Growth And Nutritive Value Of Farmed Fish (Oreochromis niloticus) In Ghana

Fish feed and food supply chain have been plagued by various hazards including mycotoxigenic fungi which affects production, safety and trade of agricultural products as well as causing both acute and chronic diseases in humans. Typical fish feed is composed of agricultural by-products including soy, maize, wheat and rice brans and manure. Fish meals are liable to both microbiological and chemical (aflatoxin) contamination due to environmental factors relating to storage. These hazards associated with the food chain pose a risk to human health and have negative economic impact pertaining to farmed fish product destruction and market loses.

Mycotoxins, specifically Aflatoxin B1, have been reported to be a key contaminant in fish feed mainly emanating from its raw material base *inter alia*. The four major aflatoxins (AFB1, AFB2, AFG1 and AFG2) are direct contaminants of grains and animal feed. Though many works on aflatoxins have been carried out in Ghana, most have focused on food crops with a few centered on processed marine captured fishes. There is also limited information on the incidence and effects of aflatoxin contaminated feed on the growth and health of farmed fishes in Ghana. Therefore, this study was aimed at investigating and generating information on the levels of potential aflatoxins in farmed fish (Nile Tilapia) and it's feed; its impact on Nile Tilapia growth. The project is focused on five (5) fish farming communities in the Eastern Region (Senchi, Akwamufie and Akosombo) and Greater Accra Region (Achavanya and Ada).

Key Activities and Achievements

A socio-economic study revealed that, monthly expenses on fish farming ranged from GHS100.00 to GHS16,000.00 with a mean value of GHS1,843.00. Feed expenses on monthly basis spanned from GHS70.00 to GHS6,000.00 with an average value of GHS3,040.00.

However, the variation in expenses whether overall or on feed could be attributed to the number of cages and the stocking density.

Feed storage

Most of the feed used within the study areas were in the form of pellets; minority of the feed are plant based. Feeding of farmed fish is done manually; this could be due to the unpopular use of automated feeding apparatus coupled with its high purchasing price. About (88%) of the respondents buy feed (commercial feed) in bulk. Thirty-nine percentage (39%) of farmers store feed on pallets, 2% store them on the floor and 6% store them in cool ventilated rooms.

Farmers identified changes in overstored fish to include, caking of feed, discoloration, mustiness and moisture. Due to the expensive price and sometimes shortage in fish feed, farmers do apply overstored fish feed to the farmed fishes, despite the observed changes in structure and colour. As a result, majority (96%) of farmers practice feeding policy of first-in-first out. Methods used to avoid fish feed contamination include, clean environment, well ventilated feed store rooms, use of pallets/tarpaulin, avoiding contact with pest and other rodents, and drying feed in the open.

Examination of fish farms

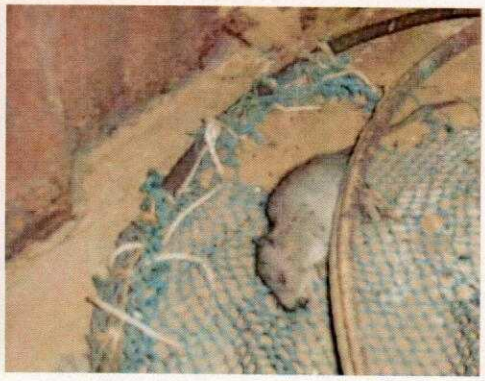
Selected fish farms were examined on how feed is stored and handled; aeration and sanitation of store rooms. It was observations that, stored feed were not handled, maintained and stored appropriately thereby compromising their safety. Below are some pictures that show improper feed handling and storage in some fish farms.

Unhygienic bowls used in feeding fish

Poor feed handling practices

Packing feed on the floor instead of packing on pallets or stands

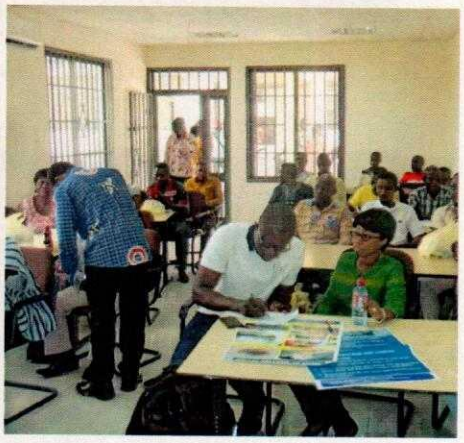
Congested feed store rooms



Some of these poor feed handling and storage practices suggested that fish farmers need more training on appropriate practices that would ensure safe fish feed in good condition.

Training of fish farmers

A workshop dubbed 'Fish Feed Storage and Handling Practices' was held at CSIR-Water Research Institute, Akosombo, to train fish farmers from selected areas and representatives of fish farmers across the country.



Training some fish farmers

Presentation by facilators

Project 3:

Cassava: Adding Value For Africa Phase II (c:ava II)

The Cassava: Adding value for Africa Phase II (C:AVA II) Project, Ghana, is a Bill and Melinda Gates Foundation funded project which started in April 2014 and is scheduled to end in March 2019. The primary objective of the project is to increase the incomes of at least 200,000 cassava value chain actors, especially smallholder farmers and processors in Nigeria, Ghana, Tanzania, Uganda and Malawi, by at least USD177 million in 5 years. The performance by project countries is basically measured by how much fresh cassava roots are mobilised for processing into cassava products in project catchment areas by stakeholders. The project catchment areas in Ghana are Volta, Brong Ahafo, Central, Ashanti, Northern and Eastern regions. This project is managed internationally by the Federal University of Agriculture, Abeokuta, Nigeria (FUNAAB) with technical support from the Natural Resources Institute (NRI) of the University of Greenwich, UK.

Key Activities and Achievements

This project has contributed to increasing the incomes of smallholder farmers and community processors in various ways. Some of these include:. intensive awareness creation of cassava value chains through investment forums, business fora, TV and radio programmes; linkages to new markets such as improved traditional products for export markets; facilitation of large scale cassava farmers (project partners) to actively mentor more smallholder farmers in adopting high yielding planting materials and good agronomic practices and increased

engagement with Ghana Industrial Cassava Stakeholders' Platform to promote cassava as an industrial crop in Ghana.

C:AVA has provided continuous support to High Quality Cassava Chips (HQCC) processors (e.g. Akinlola) and exporters of improved Gari (e.g. Ernimich Company Ltd, Amya Agro Processing, MIVA Life Ltd) by strengthening quality management practices. The project facilitated good business relations between processors and end users, thereby, establishing market linkages for improvement of the cassava value chain. Sun drying of cassava products was expanded to a hundred and forty-two (142) project locations, nine (9) small and medium enterprises and one hundred and ninety-one community groups. Bin drying of cassava products was transferred to sixteen (16) bin dryers located at various processing centres in project targeted areas. There was the identification and facilitation of Warren Farms in the Eastern Region, on commercial cassava cultivation and processing. The project also established cassava demonstration farm at Good Food Farms in the Central Region; training of a network of farmers was carried out around Good Food Farms to enhance cassava yields.

Training farmer groups on agronomic practices by regional coordinator

On-farm cassava yield assessment by in Brong Ahafo Region by project team members

Interaction with a women's farmer group (Atebubu, Brong Ahafo) to access the impact of project activities by the monitoring and evaluation team

Out-grower management growing of beneficiaries (Staff of Tropical Starch Ltd) in the Central Region

Extension visit to project demonstration farm in Central Region

Meeting cassava processors in Manfi-Kumasi, Volta Region

Training of processors on how to secure funding at CSIR-FRI

Market linkage exercise for an SME (Coastal Growth Ltd) in the Central Region

Training gari processors on cassava dough pressing at Oxy Industries, Sege, Volta Region

Inspection of a new bin dryer at Aurthur Grains and Tubers Ltd. (SME) in the Central Region

Project 4:

Sawdust For Mushroom Cultivation In Ayum Forest Area, Brong-ahafo Region [australian Direct Aid Mushroom Project (aus-damp)]

The Ayum Forest located in the Brong-Ahafo Region is a production forest where the timber industry thrives, accounting for the large production of sawdust which is of a socio-economic importance in the production of mushrooms in terms of nutrition, health and income generation.

The objective of the project is set up the mushroom cultivation industry in Ayum area through training in mushroom cultivation; using sawdust and provision of two complete mushroom cultivation facilities. The project is also aimed at capacity building of women and girls in mushroom cultivation using sawdust for enhancing food security, improving nutritional status, alleviating poverty and minimizing environmental pollution caused by improper disposal of sawdust in the area

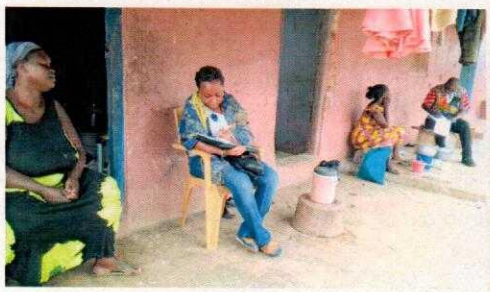
Key Activities and Achievements

Feasibility study and pre-training monitoring and evaluation

Feasibility study was carried out to select actual locations for construction of mushroom cultivation facilities. It was also done to inform and familiarise the relevant community leaders about the project, scout for materials to be purchased, engage artisans for construction and commence selection of beneficiaries.

Project team in a meeting with opinion leaders at Badiako

Viewing of proposed site for construction of mushroom cultivation at Ayumso



Adminstration of re-training questionaire by Mr. Takli and Mrs. Mensah

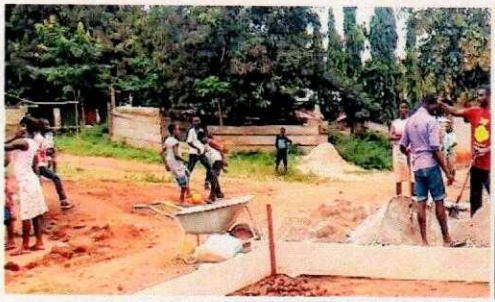
Timber production site located in close proximity to project site at Ayumso showing sawdust being burnt

Construction of mushrooms cultivation facilities, installation of rain water harvesting facilities and commencement of composting of sawdust

One complete set of mushroom cultivation facility was constructed at Ayumso and Bediako. The facility comprised of a composting platform, bagging shed with a store, inoculation and incubation rooms, cropping house and a urinal. Rain water harvesting facilities were also installed at project sites; these were rain gutters fitted on the roofs of the incubation rooms and cropping houses. A water storage tank was connected to the rain gutters for water harvesting.

Site grading at Badiako

Structured roofed and selected beneficiaries working on compost preparation at Badiako



Commenced construction at Badiako

Gutter construction at Badiako

Beneficiary selection and registration at Badiako

Some completed structures at Badiako showing internal arrangements of cropping house and rain gutter on roof.

Badiako Queen mother involved in team formation

Internal arrangement being made in incubation room

Bagging shed and store constructed at Ayumso

Polytank installed and connected to rain gutters

Cropping house Ayumso showing internal arrangements

Compost preparation and on composition platform

Production of training and branding materials

Training and branding materials were designed, these included a training handbook, an extension leaflet and an interactive training pull-up.

Training on compost bag production

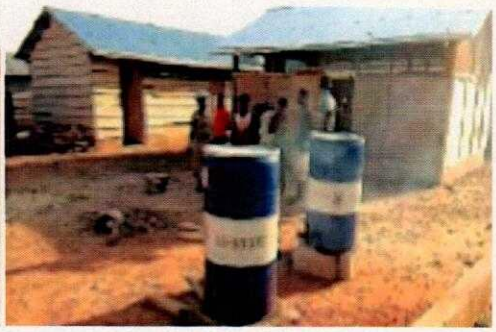
Compost bag production and sterilization materials were provided to the two project sites. Each community was provided with 1500 pieces of polypropylene bags, half bale of cotton waste, 5 bags of rice bran, 10 packs of quick lime, 10 pieces of PVC pipes, 5 sachets of rubber bunds, 50 bottles of mushroom spawns, 2 complete oil drums, 2 wooden racks, 2 hack saws and saw blades.

Trainees were given practical training on mushroom compost bag production (bagging, sterilisation, inoculation and incubation). Although women and girls were the intended target group for the project, some men took part.

Compost bag sterilisation methods delivery at the project at Ayumso

Sterilisation process being explained to beneficiaries during training at Bediako

Sterilization rack prepared for use in Ayumso



Sterilisation unit installed and compost bags being sterilised during practical trainnig

Trainees actively participating in practical bag compost production

Produced compost bags arranged on shelve in incubation room

SCIENCE AND PEOPLE

The impact of research on society, socio-economic development and national development is a strong focus of the CSIR. Contributions of CSIR-FRI are through technology transfer programs, capacity building exercises, etc. Technologies developed are aimed at industry, households and livelihood.

Project 1:

Preserving Africa Food Microorganism For Green Growth (Greengrowth)

Introduction

The West African microbial heritage has recently resulted in the discovery of unique traits relevant for the food and biotechnological sectors. Spontaneously fermented foods (i.e. food produced by the activity of microorganisms) hold a key position in the West African diet. Indigenous fermented food forms a high percentage of meals produced from cereals. Studies have shown that, cereals account for as much as 77 % of total caloric consumption in African countries and contribute substantially to dietary protein intake in a number of these countries. Scientifically spontaneous fermentation provides a good opportunity as a green technology for processing as the activity of the microorganisms lowers energy, water and time consumption during processing and converts otherwise inedible raw materials to food. Fermented foods are additionally environmentally friendly as they are produced from local crops and can be stored unrefrigerated. Further they are nutritious, generally free from food borne pathogens and ensure the livelihood of many families. In order to preserve these traditional local foods it is necessary to move from uncontrolled fermentations to controlled fermentations and to upgrade all parts of the food value chain through technology transfer and implementation of business models. The project has partly addressed issues as value addition in the food chain, microbial functionality, transforming otherwise inedible waste products into healthy nutritious food, by using reduced time, energy and drudgery in the production process which are the consumer preferences. Multifunctional starter cultures development is in progress to up-grade the food sector in a more sustainable and greener direction. Convenience food based on traditional foods and procedures for sustainable packaging and quality assurance has partially been achieved. Business models have been developed at the SME level.

Key activities and achievements

Value chain analyses and contextual framing was conducted for *fura* production from millet in Ghana. Bio-banks have been established in three African countries selected for this project. A project member, (post-doctoral fellow) is implementing methodologies for preserving microbiological starter cultures and managing a -80 freezer (training from Belgium and Germany). Microbial biota of *fura* has been successfully banked. Microbial starter cultures have been obtained from isolation of microorganism (Lactic acid bacteria (LAB) and yeast) from prepared *fura* samples, steeped water and fermented dough. After isolation, cultures were purified; some of the organisms were sent to the UK for characterization and identification.

The fermentation steps are still under study to reduce time of fermentation by enhancing the biota and processing parameters to reduce energy input and drudgery. Micro, small and medium scale entrepreneurs and partners were trained on new business opportunities for production and commercialization of fermented food.

For sustainability, the project team contacted and visited SMEs (SALASI Foods Enterprise, Yomi Food Ghana limited and Healthy Life Company limited) to discuss taking up of the technology that is being developed upon completion of the project. A workshop on sensitization of stakeholders on project objectives and progress was conducted following this initiative.

Fura samples were prepared and preservation methods applied for storage. Shelf life studies was carried out with samples stored in plastic and glass bottles (plain and dark); monitoring was done by analysing for microbial and chemical parameters. Treatments included use of preservatives and heat as well as storage under ambient and refrigerated conditions.

Fura samples in storage

CONSULTANCIES AND TRAININGS

The Institute undertook many consultancy and training services. The profiles of these consultancies and training services have been categorized into; food product development or improvement, training and engineering services. Food products developed over the period under review include beverages, snacks, breakfast cereals, soups and sauces. Products developed were largely crop-based and developed to suit client's requests.

Many of the requests for training were in the area of beverage processing and preservation, these included fruit juices, bissap and other local beverages. Requests were generally startup companies who needed to acquire knowledge and good processing skills required to churn out good quality and safe food products. The Institute also carried out many works on shelf life stability of food products. All practicals and hands-on training programs took place within designated laboratories in Institute.

Some consultancy works included:

- Production of green pepper sauce
- Sensory evaluation of smoked tilapia
- Sensory Evaluation of Bio-sugarloaf pineapple
- Corn-base products - Product improvement and sensory evaluation of porridge, *kenkey* and *banku*
- Training of Head porters on the utilization of composite flours in bakery and pastries production
- Development of instant cocoa beverage mix
- Training on Bissap processing
- Training on Fruit juice processing
- Training on the preservation of *burukutu* and *pito*

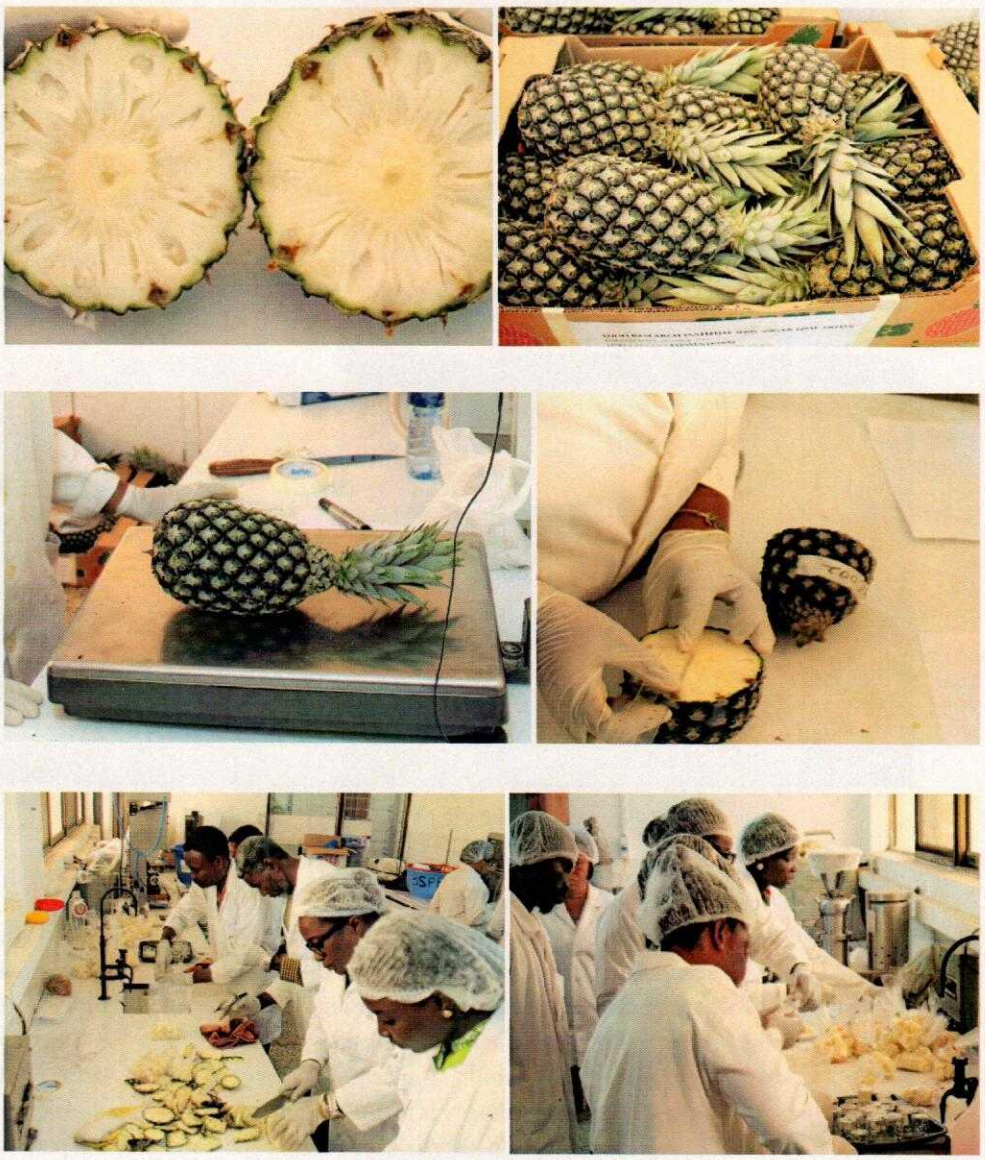
Possibility of sea-freighting bio-sugarloaf pineapples

Pineapple (*Ananas comosus*) is a tropical plant with edible fruit of the *Bromiliaceae* family, having several different cultivars or types. The sugar-loaf pineapple is smaller in size than other varieties, stay green even when ripe and feature a brighter pearl white fruit, with a soft edible core.

There is a big demand for organically produced sugar-loaf pineapples in Europe. Studies have indicated that organically grown sugar-loaf is stronger and has a longer shelf life that could be suitable for the export market. The main objective of this research was to assess the possibility of sea- freighting organic sugar-loaf pineapples by comparing the shelf-stability of conventional and organic pineapples.

Generally, organic pineapples had large fruits compared to conventional pineapples. Conventional pineapples had a short shelf-stability compared with organic pineapples. The acidity of the organic sugar-loaf pineapples was higher than the conventional pineapples, comparing pH values. Vitamin C content for baseline organic sugar-loaf pineapples varied from 25.22 to 33.02 mg/100 ml and that for conventional pineapples 19.69-23.66 mg/100 ml. Generally, conventional sugar-loaf stored at 8°C attained a higher translucency (50-75%). Although Vitamin C was generally lower after storage (compared to the baseline), organic sugar-loaf stored at 1°C and 8°C had higher Vitamin C compared to the conventional pineapples. Lower acidities were also observed in both types of sugar-loaf pineapples after storage.

Organic sugar-loaf pineapples stored at 1°C and 8°C largely had 25-50% translucency after storage. Only 16% and 8% of the organic fruits recorded 50-75% translucency for after storing at 1°C and 8°C correspondingly. Conversely, majority (52.3%) of conventional sugar-loaf pineapples at 1°C recorded 50-75% translucency. These results suggest that the organic sugar-loaf pineapples will have a longer shelf-life under refrigerated conditions. Using proper handling and packaging methods with right conditions (1°C and 8°C), it is possible to export sea-freight organic pineapples to Europe; as it can thrive at both temperatures without spoilage.



Preparation of pineapple sample for storage

Storage of conventional and organic samples under different temperatures

Checking of brix levels of different smaples

Development of promotional and extensions materials

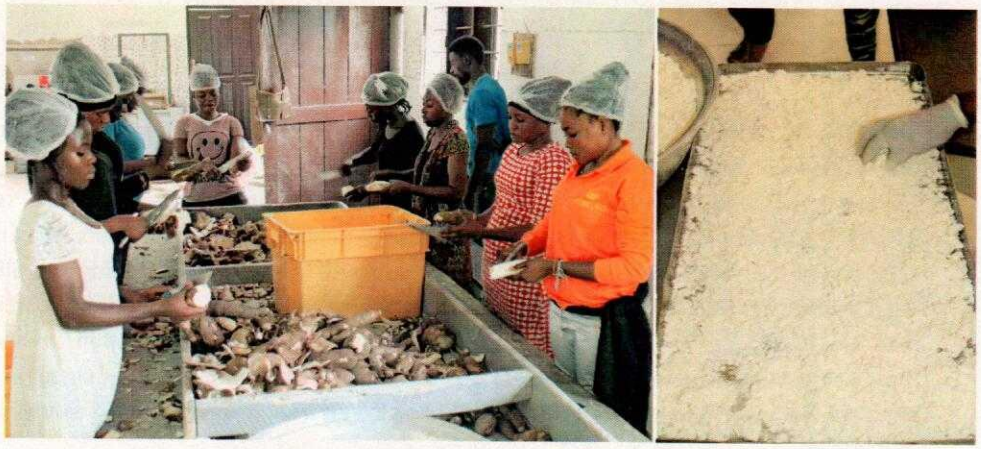
CSIR-FRI is one of the institutes involved in the Modernizing of Agriculture in Ghana (MAG) Project. Constraints identified for the implementation of this work included, high perishability of orange fleshed sweet potatoes and cassava for Brong Ahafo, Eastern, Central, Volta and Western Regions; high perishability of mango and water-melon for Upper East, Upper West and Brong Ahafo Regions and unavailability of mushroom spawns for Bron Ahafo, Volta and Eastern Regions. The goal of this consultancy is to produce technical bulletins and collaborate with MoFA to produce relevant extension materials for training and dissemination purposes, to address the constraints identified at the Research Extension Farmer Linkage Committees' regional meetings. This consultancy is aimed at benefiting farmers, processors and extension officers.

Six (6) promotional and extension manuals have been developed to address the identified constraints at the RELCs meetings organized at the ten regions.

- Manual for Drying Of Mango Fruit.
- Manual for Mango Juice Production.
- Manual for Production and Value Addition to Cassava Flour.
- Manual for Production and Value Addition to Sweet potato Flour.
- Manual for Watermelon Juice Production.
- A Guide to Spawn Multiplication Technology.

Training of 'head porters' on production and utilization of Root and Tuber flours, cereal mix and soybean powder.

As part of the livelihood enhancement activities of Purim African Youth Development Program (PAYDP), a training was held for twenty (20) head porters (*kayayee*) from Accra and Kumasi. The aim of the training was to endow head porters with the skill in processing and utilizing HQCF, cocoyam and sweet potato flour for bakery applications and production of cereal mix and soybean flour. Trainees were taught the details of each unit operation involved in processing winimix from local cereals and flours from root crops such as cassava, green plantain, cocoyam and sweet potato. They were also given an expose on food safety in food processing.



Hands-on training on production of root and tubers flours

Group branded products: plantain flour, Soyabean flour, Cocoyam flour, Cereal mix

Product development sessions

PRODUCT DEVELOPMENT

Some products developed within the year under review include;

- Canned soups: 'Light' soup (tomato soup), Palm soup, Groundnut soup and 'Kontomire' soup.
- Bread and 'koose' made from *Solenostemon rotundifolius* (frafra potatoes).
- Rice pops.
- Rice pop bars.

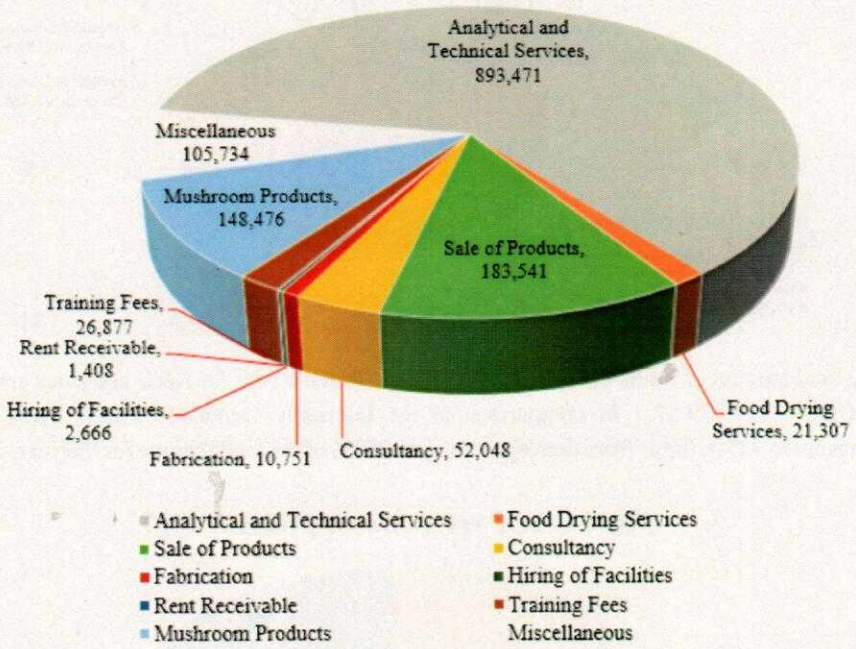
Cocoyam leave (colocasia) paste - 'Kontomire' paste

Turkey burry (Solanum torvum) paste - ('kwehunsusuawa' paste)

COMMERCIALIZATION OVERVIEW

The commercial wing (Commercialization Division) coordinates all commercial activities of the Institute in order to enhance income generation. Commercial activities directly contribute to the socio-economic development of the country by services rendered through areas of poverty alleviation, post-harvest management and food security.

Income Generated from Commercial activities

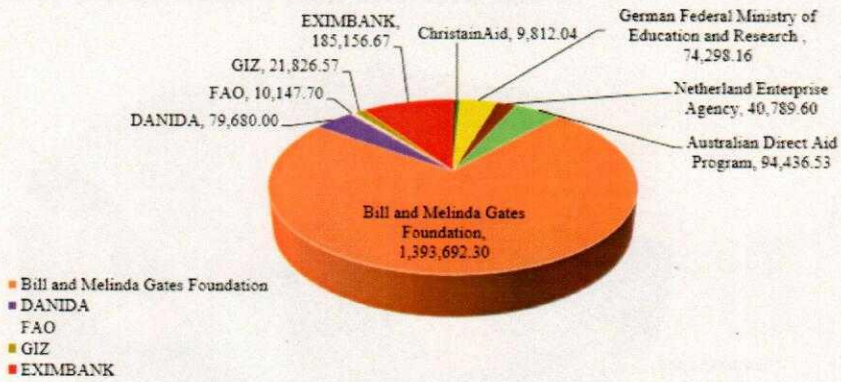


Commercial activities generated a total amount of GHS 1,446,279.00. With analytical and technical services bringing in 62% and sale of products and sale of mushroom products generating 13% and 10% respectively.

FINANCIAL SUMMARY

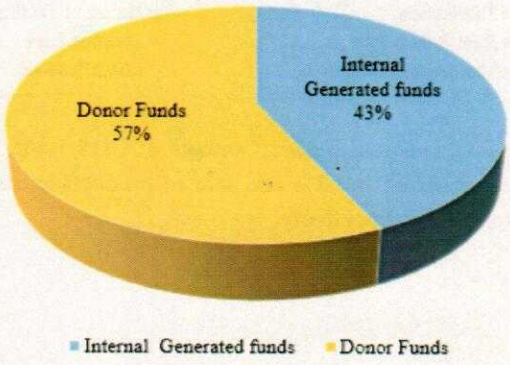
Majority of the Research and Development activities carried out by CSIR-FRI are run with the aid of donor funds. Donors within the year included Bill and Melinda Gates Foundation, DANIDA, FAO, GIZ, EXIMBANK, ChristainAid, Australian Direct Aid, Netherland Enterprise Agency and the German Federal Ministry of Education and Research.

Income Generated from Projects (GHS)



The total amount of funds the Institute received within the year for R&D activities amounted to GHS 1,909,839.57. In comparison to the Internally Generated Funds, IGF, (which represented 43%), funds from donors represented 57% of the total income for the year.

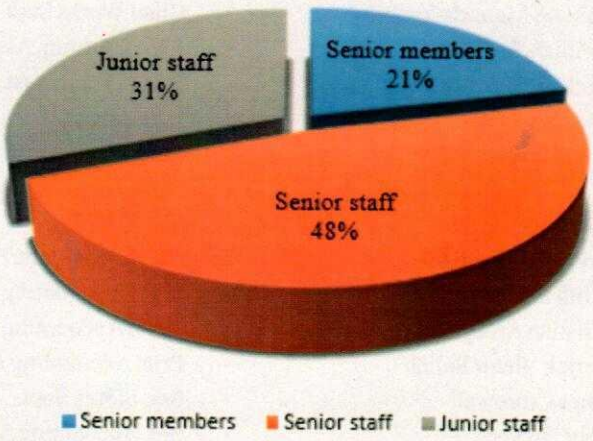
Ratio of IGF verses Donor Funds of 2017



ADMINISTRATIVE ACCOUNT

CSIR-FRI is divided into the commercial wing (Commercialization Division) the Research wing (Research Divisions) and the CSIR College of Science and Technology (CSIR-FRI Campus). The Research Division is divided into the Food Microbiology and Mushroom Research Division, the Food Chemistry and Nutrition Research Division and the Food Technology Research Division. The CSIR College of Science and Technology: CSIR-FRI Campus runs a postgraduate programme leading to the award of MPhil in Food Science and Technology. Currently, it has a student population of twelve. The goals, objectives and mandate of CSIR-FRI are achieved through the diligent work output of its human resource and administrative efforts. The staff strength was one hundred and forty-six (146), eighty-five (85) male and sixty-one (61) female. Senior staff represent the highest percentage of staff, forty-eight percent (48%); while senior members represent twenty-one (21%) of staff.

Staff distribution



OUR STAFF

Senior Members and Senior Staff List

Directorate

1.	Prof. Mrs. Mary Obodai	-	Chief. Res. Scientist (Director)
2.	Dr. Charles Tortoe	-	Prin. Res. Scientist (Deputy Director)
3.	Mrs. Anthonia Andoh –Odoom	-	Quality Manager
4.	Mr. Ebenezer Tawiah	-	Deputy Quality Manager
5.	Ms. Faustina Somuah	-	Chief Admin. Assistant
6.	Ms. Mariam Yakubu	-	Technologist/Scientific Secretary

Administration Division

1.	Ms. Janet Aggrey-Yawson	-	Admin. Officer/HOD
2.	Mr. Eric K. Ofori	-	Chief. Admin. Asst.
3.	Mr. Patrick Ofosu Mintah	-	Chief Tech. Officer
4.	Mr. Edmund Mensah-Yemoh	-	Chief Works Supt.
5.	Mrs. Beullah Sallah	-	Chief. Admin. Asst.
6.	Mrs. Victoria A. Asunka	-	Prin. Admin. Asst.
7.	Ms. Anita Adusah	-	Prin. Admin. Asst.
8.	Ms. Esther Lamptey	-	Admin. Assistant

Finance Division

1.	Mr. David-Hayford Ahiabor	-	Snr. Accountant/HOD Finance
2.	Ms. Judith Dogbegah	-	Chief Accounting Asst.
3.	Mr. Christian Amegah	-	Chief Accounting Asst.
4.	Mr. Derrick Victor Sallah	-	Prin. Accounting Asst.
5.	Mr. James Cromwell	-	Snr. Stores Supt.
6.	Ms. Mabel Aryee	-	Snr. Accounting Asst
7.	Ms. Wolase Efodzi	-	Snr. Stores Supt.
8.	Mrs. Angela Addy	-	Snr. Stores Supt.
9.	Ms. Regina Tsotsoo	-	Snr. Accounting Assistant
10.	Ms. Joana B. Dzikunu	-	Prin. Admin. Assistant
11.	Ms. Judith Larweh	-	Snr. Tech. Officer

Commercialization Division

1.	Mr. Stephen Nketia	-	Scientific Secretary/HOD
2.	Mr. Michael Amoo-Gyasi	-	Prin. Technologist
3.	Mr. Nelson Y. Amey	-	Prin. Technologist
4.	Mr. Richard Takli	-	Snr. Technologist
5.	Mrs. Helene Annan	-	Snr. Technologist
6.	Mr. Solomon Dowuona	-	Snr. Technologist
7.	Mr. Alexander Henry K. Appiah	-	Snr. Technologist
8.	Ms. May A. Boham-Dako	-	Snr. Technologist
9.	Mr. Emmanuel Adokwei Saka	-	Technologist
10.	Mr. Philip.O. Baidoo	-	Prin. Accounting Asst.
11.	Mr. Jeremiah Lartey- Brown	-	Chief Technical Officer
12.	Mrs. Agartha Amuzu	-	Prin. Tech. Officer
13.	Mr. Thomas Najah	-	Prin. Tech. Officer
14.	Mr. Peter Dalabor	-	Prin. Works Supt.
15.	Ms. Makafui Torgbui	-	Technical Officer
16.	Mrs. Alice Padi	-	Snr. Tech. Officer
17.	Mr. Godwin Armah	-	Snr. Tech. Officer
18.	Mr. Emmanuel Tettey Agblo	-	Snr. Works Supt
19.	Mrs. Belinda Quaye	-	Prin. Tech. Officer
20.	Mr. Ebenezer Tawiah	-	Snr. Tech. Officer
21.	Ms. Emefa Gblende	-	Snr. Tech. Officer
22.	Mrs. Dorothy Narh	-	Prin. Tech. Officer
23.	Mr. Ofori Brempong	-	Snr. Tech. Officer
24.	Ms. Syndy M. Williams	-	Snr. Tech. Officer
25.	Ms. Ruth Fosu	-	Prin. Technical Officer
26.	Ms. Mary Assimah	-	Prin. Admin. Assist.
27.	Ms. Getty Afuukar	-	Prin. Admin. Assist

Food Technology Research Division

1.	Mrs. Charlotte Oduro-Yeboah	-	Snr. Research Scientist/HOD
2.	Mr. Gregory A. Komlaga	-	Snr. Research Scientist
3.	Mr. Peter Adoquaye Addo	-	Research Scientist
4.	Mr. Elvis A. Baidoo	-	Snr. Research Scientist
5.	Mr. Raphael Kavi	-	Librarian
6.	Mr. Kwabena A. Bugyei	-	Scientific Info. Officer

7.	Mr. Paa Toah Akonor	-	Snr. Research Scientist
8.	Mr. Jonathan Ampah	-	Research Scientist
9.	Mr. Joseph Akoto	-	Prin. Works Supt.
10.	Mr. Seidu A. Sampare	-	Chief Tech. Officer
11.	Mr. Desmond Mensah	-	Chief. Tech. Officer
12.	Mrs. Edna Essel	-	Sen. Technologist
13.	Ms. Jemima Ofori	-	Sen. Tech. Officer
14.	Mr. Rufai Braimah	-	Technical Officer

Food Microbiology Mushroom Research Division

1.	Dr. Margaret Owusu	-	Snr. Research Scientist/HOD
2.	Ms. Matilda Dzomeku	-	Snr. Research Scientist
3.	Mrs. Anthonia A. Odoom	-	Research Scientist
4.	Mrs. Amy Atter	-	Research Scientist
5.	Mrs. Deborah L. N. Mensah	-	Research Scientist
6.	Mrs. Nina Bernice Ackah	-	Research Scientist
7.	Mr. Evans Agbemafle	-	Research Scientist
8.	Mr. Theophilus Annan	-	Research Scientist

Food Chemistry Nutrition Research Division

1.	Mr. George A. Anyebuno	-	Research Scientist/HOD
2.	Mr. Hayford Ofori	-	Research Scientist
3.	Mrs. Hannah Oduro-Obeng	-	Research Scientist
4.	Mr. Kofi Kwegyir Essel	-	Prin. Technologist
5.	Mr. Frank Peget Mboom	-	Snr. Technologist
6.	Mr. Vincent Kyei-Baffour	-	Snr. Technologist
7.	Ms. Constance Boateng	-	Prin. Tech. Officer
8.	Ms. Vida Awidi	-	Prin. Tech. Officer

PUBLICATIONS

Refereed Journal Papers

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