COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
(CSIR)

FOOD RESEARCH INSTITUTE
(FRI)

1995 ANNUAL REPORT

Compiled and Produced by the
Scientific Information Division
Food Research Institute
P. O. Box M.20
Accra.

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FOOD RESEARCH INSTITUTE

1.0 EXECUTIVE SUMMARY

The Food Research Institute (FRI), one of the 18 affiliate institutes of the Council for Scientific and Industrial Research (CSIR), is mandated to conduct applied research into problems of food processing and preservation, storage, marketing, distribution and utilization, in support of the food industry and also to advise government on its food policy.

During 1995, research work continued on most of the commodity groups: Root and Tuber Crops, Grain Legumes, Cereals, Horticultural crops, and Fish. Work was conducted on edible and medicinal mushrooms, rice and sorghum for malting and brewing purposes. Work on Fermentation also progressed.

Research resulted in selection two strains of American Oyster *mushroom Pleurotus ostreatus* (OT-3 and OT-6) for cultivation, during all seasons in Ghana. A study showed that irradiation was more effective than the conventional steam sterilization of compost bags for indoor mushroom cultivation, and also gave higher fruit body yields for two mushroom strains.

Ten cultivars of locally produced rice were screened for their agronomic characteristics and evaluated for their proximate and food quality attributes.

A national survey on peanut production in Ghana was completed during the year.

406 food and pharmaceutical products were analysed for microbiological safety whilst chemical analyses were carried on 195 samples.

Income generating activities included microbiological and chemical analyses, food economics and utilization services, processing, library, engineering, mushroom training, cassava processing and a commercial unit.

The institute organized eight training workshops and seminars for various groups; the Brewing and Soft Drinks Industries, in mango and cashes processing for women farmers, in Quality Assurrance Systems, Fish processing and Mushroom Cultivation. Participants came from Ghana and other African countries. The Institute also hosted the first international meeting of the Aflatoxin working group in Accra.

2.0 GENERAL MATTERS

2.1. Establishment

The staff strength of the Institute as at December 1995 stood at 175.

1994/1995 FRI STAFF PROFILE

	CATEGORY	1994	1995
1.	Research Grade Staff	36	34
2.	Senior Staff	39	38
3.	Junior Staff	58	58
4.	Monthly Rated	41	45
	TOTAL	172	175

2.2. Appointments

Six new staff were appointed during the year.

NEW APPOINTMENTS

	NAME	DESIGNATION	EFFECTIVE DATE
1.	Mr. K.E. Agyiri Sackey	Snr. Accts. Clerk	13/02/95
2.	Mr. Emmanuel Alorsey	Tech. Asst. Gd. I	13/02/95
3.	Miss Stella Jemima Nartey	Tech. Asst. Gd. I	1/02/95
4.	Miss Faustina Somuah	Stenographer Gd. I	28/02/95
5.	Mr. Isaac Appolonius Nyarko	Technical Assistant Gd.II	10/07/95
6.	Mr. Nash Appiah	Driver Grade I	1/11/95

2.3 PROMOTIONS

13 staff promotions were announced in the course of the year, with effect from 1st October, 1994.

NAME	PROMOTED FROM	PROMOTED TO
1. B.A.K. Sarbah	Prin. Adm. Asst.	Chief Admin. Asst.
2. Seidu Ali	Snr. Tech. Officer	Prin. Tech. Officer
3. A. Andoh	Snr. Tech. Officer	Prin. Tech. Officer
4. E.A. Larbi	" Works Supt	Prin. Works Supt
5. J. Asafu-Adjaye	"	"
6. J.M. Nakotey	Snr. Stores Supt	Prin. Stores Supt
7. Samuel Tagoe	Technical Officer	Snr. Tech. Officer
8. Ernest Abloh	Snr. Tech. Asst.	Tech Officer
9. Nelson K. Amey	Tech. Asst. Gd.I	Snr. Tech. Asst.
10. Constance Boateng	"	"
11 Peter Dalabor	Artisan	Jnr. Foreman
12. V.C. Tackie	Driver Gd.I	Driver Inspector
13. M.A. Ollenu	"	"

2.4 RESIGNATIONS

Two members of staff resigned their posts during the year. They are Mr. J.A. Boadi, Technical Asst. Grade I of the Analysis Division and Mr. K.E.A. Sackey, Senior Accounts Clerk.

2.5. RETIREMENT

Mr. C.J. Buckman, Prinicpal Assistant Transport Officer retired from the service of the Council on 30th September 1995, at the age of 60.

2.6. STUDY LEAVE

Mr. W. K. Amoa-Awua returned home after completing his course of studies towards a Ph.D in Microbiology at the Royal Veterinary & Agric. University in Denmark. Messrs. Akleih and Takyi Yeboah also reported for work after completing the Senior Technical Supervision course at the Weija Technical Institute in Accra. Over ten members of staff were still studying under various training programmes. Please see Appendix IV for details.

2.7. Completion of Construction Works at the Pilot Plant Workshops

Construction work was progressing steadily on the Pilot Plant Workshop for which Government hadreleased some money, under Item 7 of the 1994 budget, for completion. It was expected to be completed soon.

2.8 Rehabilitation of Bungalows

Major repair works and painting was carried out on all the Institute bungalows during the year.

2.9. Meetings

The Finance and Administrative Committee and the Research Committee of the Management Borad met in July and August 1995 respectively.

The Management Board met on Tuesday, 19th Dec. 1995 to discuss the implementation of the Business Development Plan, the Recurrent and Development Budgets for 1996 to 1998 and other matters relating to the development of the Institute.

The Director met with the Research and Technical staff of the Institute in the second quarter of the year, to discuss the preparation of annual budget estimates.

Another meeting was held between the Director and research staff to discuss the annual staff performance appraisal form and how to complete it.

A staff durbar was held to discuss matters affecting the operations of the staff canteen, particularly in relation to its finances.

2.9. **Conferences/Workshops/Seminars**

FRI staff participated in over ten conferences, seminars and workshops. Please see Appendix III for details.

2.10. **Vehicles**

FRI received 4WD Nissan Patrol Registration from NARP.

2.11. **National Service Personnel**

Eleven National Service Personnel were posted to the Institute. Their service period ended in August 1995.

2.12. **Industrial Attachment**

Three persons, from the Accra Polytechnic, were attached to the Accounts Division to do their vacation training during the year. They have since gone back to the Polytechnic to continue their studies.

2.13. **Deaths**

Two members of staff died during the year. There were Messrs. Alfred Adu Bonaparte, Watchman Supervisor and Ernest Kofi Allotey, Driver Grade I in May and June respectively.

The death also occurred, in Accra, of Mr. J.E. Musey, retired Principal Administrative Officer, on Tuesday, 12th December, 1995 at the Korle Bu Teaching Hospital at the age of 63. He was the immediate past Head of the Administrative Division.

2.14 Accounts

In 1995, total income for the year amounted to about 470 million cedis and total expenditure amounted to 460 million cedis. Please see Appendix VIII for details.

The major problem which confronted this Division was the lack of transport for effective performance of our duties. The Purchasing procedure was so cumbersome that there should always be a vehicle available to beat the price hikes in the system. Other duties such as shuttling between office and the Ministries, Bank transactions by the Cashier and the payment of salaries to various banks also require transport.

2.15 Commercial Unit

The Unit continued to generate income. The items that went to direct production are as follows:

- Maize - 52mini bags (2625kg)
- Groundnuts - 41maxi bags(3560kg)
- Cassava flour -
- Yam - 100 tubers (270kg)
- Plantain - 600kg
- Packaging materials
- Cowpea 6.6 mini bags of dehulled Cowpea
- Cocoyam - 10 MINI BAG (564kg) no purchase this year.
- Two commercial LPG cylinders Aluminium
- Aluminium mesh,
- 12 jute sacks and
- packaging materials - polythene and labels

Processing and Sales

The unit processed and sold the following:

Groundnut Paste	-	5574	sachets
Fermented Maize Meal	-	95,677.00	"
Cowpea flour	-	613	"
Yam fufu	-	344	"
Cocoyam	-	579	"
Plantain	-	661	"

Total cost incurred for production (direct cost) of these items was ¢6,500.287. Expected revenue from sales was ¢12,954,980.

Problems

There is urgent need to get a new dehuller. The second major problem is transport.

Technical Reports & Publications

About 20 Technical Reports and Publications were completed during the year. Some of these were published in refereed international journals. Please see Appendix VII for details.

3.0 DIVISIONAL REPORTS

3.1 SCIENTIFIC INFORMATION DIVISION

3.1.1 INTRODUCTION

The Scientific Information Division is responsible for the Institute's information processing and handling by way of documentation and public relations services both within the Institute and between the Institute and external organizations.

STAFF POSITION

In 1995, the Division had a permanent staff of seven, and one National Service personnel. Of these staff, the Head of Division, Dr. W.A. Plahar was on internal secondment from the Analysis Division, and the Chief Technical Officer (Public relations), Mr. Kafui Ameh, was on external secondment to the Ministry of Environment, Science and Technology. The national serviceman, Mr. Alex Acheampong completed his service and left the Division in September.

LIBRARY AND DOCUMENTATION SERVICES

Stock

14 books were added to the stock within the year. 12 were received from donors such as CTA, FAO and the CSIR whilst the remaining two were purchased locally.

Only two issues of one of the three journals, ordered under the NARP, have been received. The other journals from CABI and the locally subscribed ones were however received within the period.

Library Users

Apart from the Institute Staff, 88 outsiders used the Library within the period. Over fifty per cent were students from the Universities and colleges of Ghana. The rest were researchers, food scientists, consultants, chemical engineers, agricultural economists, industrialists, and farmers.

Loan System

Some overdue books have been retrieved with great effort on the part of the library staff. There are still more overdue books to be returned.

PUBLIC RELATIONS SECTION

A total of 19 institute seminars, including three quarterly review seminars and an annual review seminar, were organized (Please see Appendix VI for full details). Reports of the 1994 annual review seminar, and the 1995 quarterly review seminars have been compiled. The production of these reports have been seriously constrained by lack of ready access to a computer.

Mr. Augustine Andoh, Principal Technical Officer, Public Relations, continued to serve as the secretary to the FRI Standing Exhibitions Committee and was responsible for the successful participation of the Institute in all the exhibitions, fairs, and public relations activities this year. Some of these included the Africa Industrialisation Day, Africa Scientific Renaissance Day, Belly Full '95, National and Regional Farmers' Days.

3.2 PROCESSING DIVISION

The processing division conducted research work on rice, plantains and pineapples .

Work plans for the NARP-approved projects on Maize, Rice, Sorghum and Millet research, for 1996-98, were drawn up for implementation early next year. This is expected to form the basis of research in this area for the next three years.

The work would include the nutritional and food quality evaluation of varieties developed by agronomists in other CSIR sister Institutes which are ready for on-farm or on-station trials. The development of new cereal based food products would also be pursued.

3.3 ANALYSIS DIVISION

INTRODUCTION

The division is made up of chemistry and microbiology sections. It has a staff strength of 31 made up of 12 research grade officers and 19 technicians. Two of the research staff are currently on study leave.

ANALYTICAL SERVICES

1. **Microbiological Analysis**

406 food and pharmaceutical products were submitted for analyses during the year under review. The samples were assessed for microbiological quality and safety.

1.1 The food items included cocoa products, fish, meat, maize, cowpeas, water etc. Pharmaceutical products included Milk of Mangesia.

1.2 The samples came from clients such, Food Aid Agencies, Pharmaceutical companies, food industries, animal feed industries, inspection agencies, private entrepreneurs and individuals.

2. **Chemical Analysis**

195 samples were submitted for analyses during the year. The samples were analysed for nutrient content and other quality parameters.

2.1 Samples included processed and raw foods such as fruits and vegetables, cereals, grain legumes, fats and oils, feed ingredients and concentrates, etc.

2.2 The clients were from breweries, food industries, animal feed industries, inspection agencies and some private entrepreneurs.

3. **Mycotoxin analysis**

Six samples were analyzed for mycotoxin content during the year for two clients.

3.4 FOOD ECONOMICS AND UTILIZATION DIVISION

Sensory Evaluation Studies were conducted on nine cultivars of locally produced rice, Solar-dried beef strips, fermented cassava meal "Agbelima", fermented fish stored by improved and traditional methods and Iodated salt

The Division rendered catering services for the CSIR Visitation Committee, Microbiology Training Programme on Quality Assurance for Industries, Management Board and Salt Producers on Iodation Training . The Division also participate in the following exhibitions: World Food Day, 11th National Farmers' Day. IITA Cowpea Conference, and Accra International Food Industry Fair (Belly Full '95).

3.5 ENGINEERING DIVISION

The division's electrical, refrigeration and mechanical sections continued to render support services to the research programmes of the various divisions and projects of the Institute.

The Electrical Section undertook general rehabilitation of electrical lighting systems in FRI Bungalows, the repairs of lathe machine, spray gun and lighting systems inside and outside the FRI Engineering workshop, repairs and maintenance of hot air cabinet dryer, of power points, blender and sealing machine at the Pilot Plant and in the Test Kitchen,

The Section also undertook repairs of the autoclave, water bath, incubator, pH meter and electric heater, and faulty electrical wiring at the FRI Microbiology Laboratory

The electrical section was actively involved in the resigning of the electrical supply system at the five new laboratories/offices for the processing division, the engineering workshop and the chemistry laboratories, all at Okponglo.

All necessary arrangements for electricity to be supplied to the Fish Resources Centre at Okponglo have also been completed by this section. An electrical power consumption meter was installed at the pilot plant transformer room to serve the entire complex.

Five ceiling fans were installed in the stores, Accounts office, reception, office C3 and chemistry laboratory C4.

Refrigeration Section

Refrigeration Section under took scheduled routine maintenance of all airconditioners and refrigerators in the Institute and at the Pilot Plant Okponglo.

The mechanical section completed the construction of disintegrator, designed by Mr. D. Blay, for Root and Tuber Crops Project. The disintegrator is expected to break the materials for drying into smaller and equal size to achieve uniform drying and product consistency. An interim report on the design and construction of the disintegrator has been submitted to the Institute. The report indicates that the disintegrator has a disintegrating surface of 0.05m^2 and a plunger frequency on the disintegrating surface of 25 strokes perminute. Test run to establish operating parameters and performance characteristics is scheduled for next year. The section also constructed a dehuller, designed by Mr. C.

Gyato for the Dawadawa Project and 90% completed the construction of a steam cooker from the aluminum-base cooking vessel popularly known as "dadesen". Three solar dryers were also constructed - one at Kinkansen for Cocoa Research Institute, one at Okponglo for the Meat Project and one at Broz Tito Avenue Campus for the Dawadawa Project.

Repair works undertaken on the Groundnut dehuller for the commercial unit., Chimney of hot bed dryer at Okponglo for Iodated Salt Project and , Chimney of hot air fuel wood dryer at CPDU, Pokuase.

The first phase of the general rehabilitation of the machines and equipment at the Cassava Processing Demonstration Unit at Pokuase started in December, 1995. The disc grater and the drum grater have been dismantled and sent to the engineering workshop. The main shaft of the drum grater has been polished and pressure plate constructed. These parts are yet to be reassembled. The components of the disc grater needing rehabilitation are yet to be worked on.

4.0 RESEARCH ACTIVITES

4.1 CEREAL PROCESSING AND PRESERVATION

4.1.1 Quality Evaluation of some locally grown rice cultivars.

Work focused on the Quality Evaluation of some locally grown rice cultivars. This work is a collaborative one between the FRI and the Irrigation Development Centre at Ashaiman. Rice Cultivars which were screened for their agronomic characteristics were evaluated at the Institute for their proximate and food quality attributes.

Initially ten cultivars of rice were screened. Varieties B-189, TOX-3108, GK 88, IR-66 and IR-72 showed good agronomic traits in the field. Their yields were also generally high and field resistance to pest and diseases were fairly adequate.

However, B-189, IR-66 and ITA-304 also had a high level of chalky and discolored grains.

In the over-all sensory acceptance of the cultivars, TOX-3108, B-189 ITA-304 and IR-64 had very high acceptability ratings.

The local Akpafu variety had good milling characteristics, that is, low level brokens. However, it had the least acceptability rating on sensory evaluation.

The suitability of each variety for the various local dishes was also reported on. Whilst B-189 was judged to be good for all local dishes, Akpafu was found to be best for "Waakye".

A sample of a local variety, "mandee", has also been received from the Savanna Agricultural Research Institute and the Nasia Rice Co. Ltd. for food quality evaluation. Results of these would be reported on in the next quarter.

4.1.2 Utilization of Locally Produced Sorghum in Malt and Beer Processing

The project agronomist received ten new Sorghum varieties from FAO in Rome and these were distributed to the Savanna Agricultural Research Institute (SARI) and the Manga

Agricultural Research Institute for on-station multiplication trails during the rainy season in May. Depending on the results of these trials, on-farm multiplication trials would be undertaken during the next cropping season.

ANALYTICAL ACTIVITIES

Installation of laboratory steeping and germination vessels and a kiln, built by the FRI Engineering division, has been completed and steeping, germination and drying trials will be carried out on these appliances when this year's agronomic trials have been received.

NEW DEVELOPMENTS

A firm order has been placed for the delivery of a Pilot malting Plant, through a Belgian firm, MEURA, to be delivered hopefully by June 1996.

4.2 GRAIN & LEGUME PROCESSING & UTILISATION

A. Joint AAU/UNU/EC African Regional Food and Nutrition Project on the Development of High Protein-Energy Foods Based on Local Legumes.

The external funding component for this project ended this year. A final report has been submitted to the Association of African Universities in Accra. The research team also submitted a paper entitled "Development and quality evaluation of a soy-fortified Ghanaian weaning food" for publication in the Food and Nutrition Journal which has been accepted.

B. NARP Soybean Research Project (Project # FRI/H12/92/G92/---)

Research activities concentrated on product development in addition to the characterization of new cultivars from the Crops Research Institute (CRI). Current projects include "Development of village level techniques for soy fortified products" and "Characterization of milk extracts from different cultivars of soybean".

C. **Cowpea Research Project (Project # FRI/H13/93/G93/-**

Work on the physical, chemical and functional characteristics of nine cultivars of cowpeas received from CRI has been completed and a report written.

D. **IDRC/IITA/FRI Soybean Utilization Project**

Activities

Surveys were undertaken at three project sites in Ghana: Manchie-Korleman, Asutsuare and Accra, to determine the status of soybean production, utilization and marketing in these areas. The Rapid Rural Appraisal technique was used in the exercise, backed with quantitative data from conventional survey. A training and demonstration farm was set up for farmers at Manchie-Korleman, and a soybean production and utilization campaign was intensified at Asutsuare. Farmers at Manchie-Korleman, a farming village in the Greater Accra Region, have now taken up the cultivation and utilization of soybeans. Farmers in the other project site, Asutsuare, have also increased their soybean cultivation from a total of five acres to 50 acres this year.

Characterization of five cultivars of soybean, in terms of their anti-nutritional, physical, chemical and functional properties, has assisted breeders and agronomists in the selection of suitable varieties to promote for cultivation in Ghana.

Activities under the cowpea project facilitated the elimination of unsuitable high tannin varieties in the *weanimix* promotional campaign, thus helping to enhance the nutritional status of the average Ghanaian.

E. PEANUT COLLABORATIVE RESEARCH SUPPORT PROGRAMME (PEANUT CRSP) PROJECTS

Major Goal:

To address the constraints which limit the maximum utilization of peanuts for human consumption in Semi-Arid-Tropic (SAT) Africa.

Sponsors/Funding Agency:

United States Agency for International Development (USAID)

E.1 PROJECT 1: An interdisciplinary Approach to Optimum Food Utility in Semi-Arid-Tropical Africa

Objectives

(i) To determine, through field surveys, the peanut production system in Ghana and the existing traditional techniques for peanut butter production in the country.

(ii) To modify/standardize identified unit operations in the production of peanut butter to attain product uniformity and reduce drudgery.

(iii) To evaluate the quality of traditional peanut products in Ghana.

Collaborating Institutions:

Food Research Institute, Ghana
Department of Food Science and Animal Industries
Alabama A&M University, USA.

Food Research Institute Team members:

Mrs. K. Kpodo (Principal Investigator)
Dr. W. Plahar (Co Principal-Investigator)

Mrs. M. Hodare-Okae

Mrs. N. Annan

Mr. C. Gyato

E.1.1. SURVEY/RESEARCH STUDIES

E.1.1.1 Field survey on peanut product in Ghana

The National Survey on Peanut production and processing in Ghana, which started in November 1994, was completed during the year. The study covered the major peanut growing areas of Ghana. These were ten districts in the Ashanti, Brong-Ahafo, Northern, Upper-East and Upper West regions. A total of fifty peanut farmers were interviewed. Analysis of data has been completed and a report, entitled "Peanut production in Ghana" (A survey Report), has been prepared.

E.1.1.2. Studies on existing traditional processing procedures for peanut butter

A nationwide survey was conducted during the year to study the existing traditional methods for the preparation of peanut butter. The major unit operations identified were roasting, dehulling, winnowing, milling and packing. Analysis of data on this survey is in progress.

E.1.1.3. Quality evaluation of traditional peanut butter samples

Analysis of peanut butter samples collected during the survey is in progress. Samples are being evaluated microbiological, chemical and for aflatoxins. Samples from the Eastern, Central and Western regions have so far been analysed. Main micro-organisms isolated included *Bacillus spp., Candida sp., Aspergillus niger, A. ochraceus, A candidus, A flavus and A. parasiticus. Aspergillus spp.* were the most prevalent and account for 80% of the total mould population of the samples.

No pathogenic bacterial organism were isolated. Eighteen out of 20 samples contained aflatoxins at levels ranging from 47 ppb. to 2,024 ppb. Moisture contents varied from 0.7% to 3.0% whilst protein and fat contents were characteristically high ranging from 27% to 36% and 40% to 53% respectively.

B. OTHER ACTIVITIES

Mrs. Kafui Kpodo (the Principal Investigator) was in Alabama A&M University from the 8th to 11th April 1995 to discuss progress on the project and plans for the future.

E.2 PROJECT 2: Mycotoxin Management in Peanut by Prevention of Contamination and Monitoring

Objectives

(i) To evaluate the occurrence of mycotoxigenic fungal species and related mycotoxin on peanuts.

(ii) To identify, characterize and utilize plant metabolites which inhibit or induce the production of aflatoxins and other mycotoxin.

Collaborating Institutes:

(a) Food Research Institute, Ghana.
(b) Crop Science Dept., University of Science and Tech., Ghana.
(c) Plant Pathology and Microbiology Dept., Texas A&M Univ., USA

A. Research Work

Stored peanut kernels from 21 locations throughout the country were analysed for the mycotoxin: aflatoxins B_1, B_2 G_1 G_2, citrinin and ochratoxin A.

Aflatoxins were detected in all kernels designated as damaged i.e visually mouldy and shrivelled kernels. Aflatoxin levels higher than the WHO/FAO maximum permissible level of 30 ppb were found in 71% of the damaged peanut samples analysed. Levels as high as 22ppm were recorded. Handpicking of sound kernels however resulted in very low levels of aflatoxins.

Ochratoxin A was detected in damaged kernels from five out of the 21 locations. Levels ranged from 5.6 - 136 ppb. No citrinin was detected.

A. flavus was detected on 39% of the damaged peanut kernels and on 12% of the undamaged kernels. The most prevalent mould species isolated were *A. flavus, A. nisger, A. ochraceus, Penicillium spp., Mucor and F. monisliforme.*

4.3 EXTENSION OF IMPROVED FISH PROCESSING TECHNOLOGY

A. GHANA / NETHERLANDS. ARTISANAL FISH PROCESSING AND APPLIED RESEARCH PROJECT

EXECUTING AGENCIES:

Food Research Institute, CSIR, with the support of Department of Fisheries, Minlstry. of Agriculture, Department of Nutrition and Food Science, University of Ghana, Legon, National Council of Women and Development, Department of Agricultural Extension, University of Ghana, Legon, and Women in Agricultural Development, Ministry of Agriculture, with support from the Food and Agriculture Organisation of the United Nations, Regional Office for Africa, Accra.

The immediate objectives are to carry out a training programme to instruct key extension personnel from Africa in the technical background of fish preservation as well as the social and economic factors influencing the extension of improved technology and to carry out applied research programme to adapt and develop appropriate methods and equipment at intermediate technology level for African artisanal fisheries.

Activities

The project sponsored seven applied research projects which have been completed. The final reports are in preparation. The topics of the research projects are as follows:-

1. Socio-economic Baseline Studies on Pilot Fishing Villages.
2. Assessment of needs and constraints with regard to marketing and distribution of fish in selected markets in Ghana.
3. Entomological and mycological studies on traditional processed fish.
4. Studies of fish consumption patterns in Ghana and the effect of handling at household level.
5. Pilot-scale production and consumer acceptability of anchovy fish powder in weaning foods.
6. Studies on traditional and improved methods of storage of fermented fish (momone).
7. Post-harvest management and spoilage of tropical shrimps (Penaeus merguiensis).

The 8th six-week residential regional training Course took place from Monday 24th July to Friday 1st September 1995. 19 out of 21 invited participants, from Ghana (11), the Gambia (1), Uganda (2), Eritrea (2), Zambia (2) and Kenya (1) took part in the training. A total of 150 extension workers from the African region have been trained by the project from 1988 to 1995.

A one-day workshop was organised for lecturers and facilitators on the 8th training before the start of the course in order to get them together for study and discussions on the course time table and be informed on other developments on the project as a whole.

A Regional follow-up workshop, for 17 past course participants and course facilitators, was held at Sogakope, from 20th to 24 November 1995. The workshop evaluated the usefulness of the courses that have been held since 1988 at the field level, discussed the the sustainability of the project and need for research at field level in the different countries.

A follow-up programme, involving routine visits, group strengthening and extension of research results continued in the 12 project pilot fishing communities in the Greater Accra region. A maiden issue of the project's Newsletter known as PROFISH was published.

B. PROCESSING OF AND RELATED BIOCHEMICAL STUDIES ON THE UNDERUTILISED MARINE FISH/CRUSTACEA SPECIES IN AFRICA AND ASIA (EU PROJECT NUMBER ERB 3504PL 932408)

This is one of three new projects on fish. This work is being carried out in collaboration with the University of Surrey, UK and ATO-DLO, the Netherlands. The study forms part of a major programme, which is jointly being sponsored by the European Union (EU) and the Government of Ghana.

Work to be undertaken include:

(a) Biochemical studies for identification of species;

(b) development of new products;

(c) assessment of the quality of fish protein isolates and products

(d) shelf-life studies.

Preliminary work was carried towards the characterisation of the species.

Within the period, the following analyses were undertaken towards the characterisation of the selected species namely; Atlantic Horse Mackerel and Boops boops, Proximate analysis and Microbiological Assessment.

C. RESEARCH AND PRODUCT DEVELOPMENT OF ANCHOVIES (FAO/FRI)

The project is a collaborative work between the Food Research and the Fishery Industries Division of FAO.

Activities being carried out under the project include; physical and chemical analysis to determine the effect of season variation on the quality of fresh anchovies; establishment

of processing parameters for products development; sensory analysis and consumer acceptability test.

During the year, new products were prepared from the anchovies. These included the following: Anchovy balls, golden fried anchovies, breaded anchovies (coujon of anchovies), anchovy burger, coated fried anchovies, fried anchovies and anchovies boiled in seawater and dried. The storage life of fresh anchovies in ice is being assessed.

The following would also be prepared: salted ripened anchovy fillets, marinated anchovies and fermented anchovy paste and sauce.

D. ASSESSMENT OF THE OPPORTUNITIES OF INCREASING THE MARKETING OF FRESHWATER FISH FROM YEJI UNDP/ (FAO/GHA/93/004 (IDAF, YEJI)/FRI)

The project is being carried out under a Contractual Service Agreement between UNDP/FAO(IDAF YEJI) and FRI with funds provided by the FAO.

Through the activities carried under the project, potential markets in Accra and Kumasi for freshwater fish from Yeji have been identified. It was observed that tilapia would feature as the most preferred species for these markets. Fishermen have expressed interest in the processed fish trade and were willing to cooperate in the venture.

Preliminary cost-benefit analysis shows that marketing of fresh tilapia from Yeji in Accra and Kumasi, could be economically feasible and attractive when quantities of 60 kg or more are handled.

It is expected that distribution trials of fresh tilapia to the identified markets would begin early next year.

4.4 STUDIES ON IMPROVED TRADITIONAL MEAT PRESERVATION METHODS

A. THE USE OF SOLAR DRYERS IN DRYING OF MEAT

A tent-type solar dryer also proved efficient in drying snail meat over a 3-day drying cycle to stable moisture contents in the range of 8 to 12% . In another experiment, the tunnel solar dryer, augmented by photo-voltaic-driven fans, proved more efficient than the cabinet solar dryer in the drying of meat strips

4.5 QUALITY CONTROL OF NON-TRADITIONAL HORTICULTURAL CROPS

A. EDIBLE AND MEDICINAL MUSHROOMS

Objectives

The objectives of the National Mushroom Development Project (Research Unit are to:

- collect and develop edible and medicinal mushroom species for commercial cultivation;
- define appropriate procedures and conditions for the fruiting of mushrooms on agricultural and forestal by-products;
- devise efficient methods for processing, preservation and packaging of mushrooms.

Research Activities

The following research projects were completed within the current year:

1. **Yield performance of different *Pleurotus* (oyster mushroom) strains on sawdust compost (1993-95)**

   The yields of different strains of Pleurotus were compared for the periods June-August (wet season) and November - January from 1993 to 1995. The high yielding

varieties of *Pleurotus ostreatus* (American oyster) OT-3 and OT-6 were selected for all seasons.

2. **Effect of composting of mixed redwood sawdust on fruitbody yield of two *Pleurotus eous* varieties**

This study was carried out to establish the optimum period of composting required if mixed with redwood sawdust, in the cultivation of commercial varieties of *Pleurotus eous*, EM-1 and ET-8. Maximum production of fresh mushrooms was obtained when the sawdust was fermented for l60 days instead of 28 days for wawa sawdust. A shorter period of 3-5 days was required for the first flush of mushroom on 60 day composted sawdust then on 90 day composted sawdust (9-10 days).

3. **Physical characteristics of *Pleurotus* species of the National Mycelium Bank, Food Research Institute**

This is a compilation of some physical and physiological characteristics of 24 *Pleurotus* (oyster) cultivars of the National Mycelium Bank collected over the years. The characteristics, which should guide growers in their selection of species for cultivation, include the spawn-run period, fruitbody initiation, fruitbody , weight, size, number and colour.

4. **Preliminary studies in the use of gamma irradiation in the treatment of sawdust compost for the cultivation of mushrooms species.**

This study was undertaken jointly with the Ghana Atomic Energy Commission. The irradiation of sawdust compost in bags, with gamma rays at different levels as a method of sterilization, was tested. Irradiation at a rate of 20 KGy was most effective giving higher fruitbody yields than the conventional steam sterilization for two mushroom strains.

Extension Activities

The Unit organized two two-day training workshops for interested people. This attracted a total of 220 participants from all regions. Three-week intensive course

were also organized for the commercial growers. A net amount of ¢1,493,225 was realised from these training activities.

Organized groups reached within the year included three Women's Development Associations from Boi, Doblo Gonno and Onyansana; men and women's fellowships of the Presbyterian Methodist Church (Teshie Camp), Immanuel Presbyterian Church (Madina) and St. Paul's Methodist Church (Tema); and retiring workers of Ghana Ports and Harbours Authority.

Constraints and Problems

The progress of work of the National Mushroom Development Project was hindered by inadequate laboratory and office space and equipment, frequent contamination and spoilage of mushroom cultures due to location of spawn laboratory, disruption of research work by daily enquiries from the general public as well as and under-staffing and inadequate training of technical staff.

Research Team

Leslie Sawyerr	-	Res. Officer
Mary Obodai(Mrs)	-	"
Richard Takli	-	Tech. Asst.

Other

Samuel Mawudeku	-	National Serviceman
Godson Agbeley	-	Manual Worker

Outlook for 1996

The Unit intends to set up a quality control Unit to ensure top quality mushroom to the international market. Our spawn production facilities will also be expanded to meet the growing demand.

In the year under review, work continued on plantains and pineapples while active vegetable research will take off in January, 1996.

B. PINEAPPLES

With pineapples, the following trials at Oboadakoar and Pokuase were harvested in November and December.

- effect of k source
- fertilizer ration N:K
- Inductance trial
- Fertilizer schedule
- population density
- Plant material size

Analysis is currently on going on the fruit weight, yield maturity etc. The data derived will be analysed statistically. The adoption of rate of the use of black plastic mulch is encouraging in the dry areas of Senya-Breku.

C. PLANTAIN

Harvesting has been done on the trial of effect of fertilizer N:K ratios on different varieties of plantain ie local and improved varieties - FHIA 01, 02; at Akrochie and Abesim in the Brong Ahafo region. The rate of ripening has been ascertained for different maturity levels.Stored samples would be analysed for proximate analysis in January, 1996.

4.6 FERMENTATION

4.6.1 CAPABILITY BUILDING FOR RESEARCH IN TRADITIONAL FERMENTED FOOD PROCESSING IN GHANA

1. **Background Information**

The project on Capability Building for Research in Traditional Fermented Food Processing in Ghana is a collaborative project between the Alfred Jorgensen Laboratory (AJL) of Denmark and the Food Research Institute of Ghana.

2. **Objectives**

- Strengthening of national capability in R & D for production of fermented foods through the establishment of a long term collaborative relationship between Food Research Institute (FRI) and Alfred Jorgensen Laboratory Ltd. (AJL), Denmark.

- Establishing scientifically based and controlled handling and processing techniques for traditional fermented foods.

- Building up capability for establishing a Quality System for the production of fermented foods in Ghana.

- Developing methods for the production of foods with improved quality and microbiological stability.

- Establishing the base for a national fermentation laboratory at FRI.

3. **Starting Date: July 1991**
4. **Completion Date: December 1996**
5. **Sponsor and Estimated Cost: DANIDA DKK 9.72 millions**

6. **Results Achieved:**

4.6.1.1 RESEARCH WORK

Various studies were conducted on Lactic acid bacteria (LAB) during various processing stages of maize and cassava dough. An investigation of the occurence of mycotoxins in maize dough fermentation was also undertaken. Results of these studies were accepted for publication in the International Journal of Food Microbiology.

A. **The antimicrobial activity of lactic acid bacteria from fermented maize (Kenkey) and their interactions during fermentation** / Olsen, A., **Halm, M.** and Jakobsen, M.

Results indicated that each processing stage has its own microenvironment with strong antimicrobial activity. About half of the *Lact. plantarum* and practically all of the *Lact fermentum/reuteri* investigated were shown to inhibit other Gram-positive and Gram-negative bacteria, explaining the elimination of these organisms during the initial processing stages.

Further, widespread microbial interactions amounting to 85% to 18% of all combinations tested were demonstrated amongst lactic acid bacteria within the various processing stages, i.e. raw material, steeping, 0 h and 48 h of fermentation, explaining the microbial succession taking place amongst lactic acid bacteria during fermentation.

The antimicrobial effect was explained by the combined effect of acids, compounds sensitive to proteolytic enzymes and other compounds with antimicrobial activity with the acid production being the most important factor. The pattern of antimicrobial characteristics an important factor that should be taken into consideration in the selection of starter cultures for maize fermentation.

B. **The inhibitory potential of latic acid bacteria and yeasts again *Aspergillus spp* and *Penicillium spp.* occuring in fermented maize dough and the effect of organic acids on sporulation and germination**
/ Olsen, A., **Halm, M**. and Jakobsen, M.

The study concluded that lactic acid bacteria and yeasts found in fermented dough are likely to play a major role in the disappearance of moulds during the initial steps of fermentation.

Attempts have also been made to produce starters from substrates that can be cheap and easily available in Ghana. Various forms of maize were chosen as substrates for production of two starters of lactic acid bacteria. Results obtained indicated that whole milled maize, steeped maize and maize grits can be used as substrates for cultivation of the main fermenting organism in maize fermentation.

C. **Lactic Acid Fermentation of Cassava Dough into Agbelima**
/ Amoa-Awua, W.K.A., Appoh, F. and Jakobsen, M.

Cassava dough inoculum was added to grated cassava in order to achieve a modification of texture during fermentation into the fermented cassava meal, agbelima. The microflora of two different types of inocula and subsequently inoculated cassava mash at 0, 24, and 48 h of fermentation were examined in order to determine the mechanism responsible for the breakdown of cassava tissue. Bacillus spp. occurred in high numbers, 10^7-10^8 cfu g^{-1}, in both types of inocula and persisted throughout the cassava dough fermentation. *Bacillus spp.* found were ***B. subtilis, B. mycoides, B. pumilus, B. cereus, B. amyloliquefaciens*** and ***B. licheniformis*** with ***B. subtilis*** acounting for more than half of the *Bacillus* isolates. All *Bacillus* isolates produced a wide spectrum of enzymes and showed similar enzymatic activities but only *B. pumilus*, *B. licheniformis*, *B. amyloliquefaciens* produced linamarase. Some isolates produced the tissue degrading enzymes polygalacturonase and pectin esterase and nearly all isolates hydrolysed starch. All isolates showed cellulase activity and were able to disintegrate cassava tissue. When cassava pieces were incubated in amylase, cellulase, pectin esterase and polygalacturonase solutions, only pieces in cellulase solution were dissolved, indicating that the breakdown of cassava dough texture

during fermentation with the inocula examined is brought about by *Bacillus* spp. through cellulase activity.

D. Lactic Acid Fermentation of Cassava Dough into Agbelima.

Wisdom Kofi Amoa-Awua and Mogens Jakobsen

The souring of cassava dough during fermentation into the fermented cassava meal, agbelima, was investigated. Four different types of traditional inocula were used to ferment the dough and increases in titrable acidity expressed as lactic acid from 0.31-0.38 to 0.78-0.91% (w/w) confirmed the fermentation to be a process of acidification. The microflora of all inocula and fermenting dough contained high counts of lactic acid bacteria, 10^8 to 10^9 cfu/g in all inocula and 10^7-10^8, 10^8-10^9 and 10^9 cfu/g at 0, 24 and 48 hrs in all fermentations. *Lactobacillus plantarum* was the dominant species of lactic acid bacteria during all types of fermentation accounting for 51% of 171 representative isolates taken from various stages of fermentation. Other major lactic acid bacteria found were *Lactobacillus brevis*, 16%, *Leuconostoc mesenteroides*, 15%, and some cocci including *Streptococcus spp.* whose numbers decreased with fermentation time. The lactic acid bacteria were responsible for the souring of agbelima through the production of lactic acid. All *L. plantarum, L. brevis* and *Leu. mesenteroides* isolates examined demonstrated linamarase as well as other enzymatic activities but did not possess tissue degrading enzymes like cellulase, pectin esterase and polygalacturonase. The aroma profile of agbelima did not vary with the type of inoculum used and in all samples the build up of aroma compounds were dominated by a non identified low molecular weight alcohol, 1-propanol, isoamylalcohol, ethylacetate, 3-methyl-1-butanol and acetoin. Substantial reductions occurred in the levels of cyanogenic compounds present in cassava during fermentation into agbelima and detoxification was enhanced by the use of inoculum.

E. MYCOTOXIN STUDIES

The occurrence of mycotoxins in maize dough fermentation.
/ Kpodo, K., Sorensen, A. and Jakobsen, M.

The occurrence of mycotoxins in fermented maize dough and Ga Kenkey (an end product of maize dough fermentation from some major processing sites and markets in Accra was investigated. Experiments were then conducted to study the effects of spontaneous fermentation and cooking into Ga Kenkey on aflatoxin and citrinin levels at two processing sites and under laboratory conditions.

Occurrence of aflatoxins and citrinin was widespread with generally high concentrations levels as high as 289 ug Kg^{-1} for aflatoxins and 594 ug for citrinin were recorded. Low amounts of ochratoxin A were detected and no zearalenone nor α-zearalenol was found. High performance liquid chromatography (HPLC) analysis indicated that aflatoxins and citrinin persist throughout the traditional steeping and fermentation process. Cooking fermented maize dough for three hours resulted in total "destraction" of citrinin and 80% reduction in aflatoxins B_1 and G_1 levels. A reduction of 35% was recorded for aflatoxins B_2 and G_2.

OTHER ACTIVITIES

There was an exchange of staff involving one scientist, two PhD students and two technicians, from Ghana and two scientists and two consultants from Denmark.

The project undertook maintenance of the FRI laboratories and upgrading of the Kenkey production site at Osu Ajumako to Pilot Plant status.

4.6.2 CAPABILITY BUILDING FOR RESEARCH AND DEVELOPMENT IN QUALITY ASSURANCE AND FERMENTATION TECHNOLOGY FOR TRADITIONAL AFRICAN FERMENTED FOODS

Background Information:

A new collaborative project between six African and three European research institutions began during the year . The collaborating institutions are the Food Research Institute, Ghana; Federal Institute of Industrial Research, Oshodi, (FIIRO) Nigeria; and Laboratoire de Biochimie De Technologie Alimentaire, Burkina Faso in West Africa as well as Tanzania Industrial Research and Development Organization, Kenya Industrial Research and Development Institute, Scientific and Industrial Research and Development Centre (SIDRC), Zimbabwe, in East and Southern Africa.

The European partners are the Royal Veterinary and Agricultural University of Copenhagen (RVAUC), Denmark; the World Association of Industrial and Technological Research Organizations (WAITRO) and the Institute of Hygiene and Toxicology, Germany.
The World Association of Industrial and Technological Research Organizations (WAITRO) is co-ordinating the project.

The purpose of the project is to establish a core group of relevant African Research Institutes where capability can be built to undertake research into the improvement of traditional fermentation methods and to introduce quality systems into the African food industry. Core activities will include introduction to quality systems, eg. Hazard Analysis and Critical Control Point (HACCP) and Good Manufacturing Practice (GMP); selection, tailoring and maintenance of starter cultures, and layout of processing areas and design of equipment to improve hygiene and food safety.

The project hopes to arrive at a set of guidelines for monitoring, evaluating, and controlling the fermentation process for the basic staple food types of the selected countries and codes of good hygiene for local processors.

The project will provide training in the practice of networking and collaborative research using relevant experiences from Europe through links with European institutions.

It is planned to disseminate the results of the research to other developing countries through a WAITRO network on Food Technology.

3. Objectives:

A: Long term objectives:

i. Capability building in selected African institutions through promoting co-operative research and networking between African institutions and links to European counterparts in fermentation technology and related disciplines.

ii. Improving traditional methods of fermented food processing in order to reduce raw material wastage and spoilage and to improve the safety and quality of fermented African foods.

iii. Introducing the concept of quality systems to the traditional African food industry with the view towards long-term industrialization and commercial scale production of fermented foods of desired quality.

B: Specific objectives:

i. Adapting and introducing the concept of hazard analysis critical control point (HACCP) and good manufacturing practice (GMP) to current research work in the African fermentation industry.

ii. Facilitating local production , selection and tailoring of starter cultures in order to ensure product safety and quality of traditional fermented foods.

iii. Improving the layout of processing areas and design of equipment to meet the technological and hygienic requirements of the emerging small-scale food industry.

iv. Establishing a nucleus for an African network for research in fermentation technology through the participating African institutions as well as a client base in local industry.

4. **Starting Date:** January 1995

5. **Completion Date:** December 1997

6. **Sponsor and Estimated Cost:**

Commission of the European Communities STD 3 Programme. A total of **47,800 ECU** is allocated to the Food research Institute.

7. **Detailed description of research work:**

The work envisaged is in two programme areas made up of :

i) a scientific collaboration component which will form the core of activities for developing specific technologies and

ii) a networking component which will enhance the sharing of resources, expertise and research results among the participating institutions as well as providing linkages to the local food industries.

PROGRAMME AREA 1: SCIENTIFIC COLLABORATION

This programme include three specific activities : 1) Quality Systems, 2) Selection, tailoring and maintenance of starter cultures, and 3) Layout of processing areas and design of equipment

PROGRAMME AREA II: INSTITUTIONAL NETWORKING AND TECHNOLOGY TRANSFER

The network activities will take the form of training workshops and information exchange. The leading scientists from the participating institutions from Africa and Europe will comprise the core of the network which will operate under the aegis of WAITRO. Activities also cover co-operation with industry.

Progress so far made

Three workshops were hosted by the Food Research Institute. The first was in March 1995 for all the participating Institutions followed by the West African Regional meeting from 29th May to 2nd June.

The first workshop discussed modern Quality Systems and the basic principles of Hazard Analysis Critical Control Points (HACCP) system and examined their applicability in the context of the African fermented food industry. Each participating country conducted risk analysis for their selected fermented product, identified the critical points of the production process, established control parameters and specifications for the critical control points and means for verifications of the control parameters.

Under this project the FRI has selected "Kenkey" as the fermented product to be worked on. During the year, a Quality System based on HACCP composed of Quality Manual (Level 1), Procedures (Level 2), and Instructions (Level 3) was prepared for Kenkey.

At the second workshop for the West African participants, detailed discussions of drafts for the Quality Systems of the selected products were held with the resource person, Mr. Arne Nielson, from Alfred Jorgensen Laboratory Ltd. Denmark. The first

draft for the complete system for each country was finalized by the end of the workshop.

A third workshop was held from 3rd to 7th July 1995, with the project team members resource persons, and helped the East and South African participants to finish work on their Quality Systems for their selected fermented products.

The Quality System for Kenkey was implemented at Osu Ajumako production site where the Institute is also conducting studies on maize fermentation under the DANIDA funded project on Fermented foods.

Project Team

Mary Halm (Project Leader)
Wisdom Amoa-Awua (Food Technologist)
Alice Hayford (Biotechnologist)
Nanam Dziedzoave (Food Technologist) Quality Systems
John Manful (Food Technologist) Quality Systems

5.0 APPENDICES

APPENDIX I

F.R.I. MANAGEMENT BOARD MEMBERS - 1995

1.	Dr. A.A. Owusu	-	Chairman & Member of Council
2.	Mrs. A. Andah	-	Director, FRI
3.	Prof. S. Sefa-Dedeh	-	Univ. of Ghana,
4.	Dr. E.K. Marfo	-	Director, Ghana Standards Board -
5.	Dr. J. Wonkyi-Appiah	-	Director, Oil Palm Res. .
6.	Dr. J. Dei-Tutu	-	Prin. Res. Off., FRI
7.	Miss Mary Halm	-	Snr. Res. Off., FRI
8.	Mr. A.K. Gaisie	-	Min. of Fin. & Eco. Planning
9.	Mr. J.K. Asare	-	Ghana Inst. of Engineers
10.	Dr. B. Grant-Monney	-	Agric. Dev. Bank
11.	Mrs. Felicity Acquah	-	EMPRETEC,
12.	Mr. Timothy Osei	-	Chartered Accountant
13.	Mrs. Victoria Appiah	-	Ghana Atomic Energy Comm.
14.	Miss Rosetta Tetebo	-	WIAD, Min. of Fd. & Agric
15.	Mr. Tony Antwi Mensah	-	President, ATHENA Foods
16.	Mr. H.F. Appiah	-	Rep. the Director-General
17.	Mr. J.F. Asigbey	-	Snr. Staff Assoc., FRI
18.	Mr. Solomon Anthonio	-	TUC, FRI

APPENDIX II FRI SENIOR STAFF LIST (1995)

A. Andah (Mrs) - Director
B.Sc. (Gen)
B.Sc. (Special- Food Science)
M. Phil. (Leeds University)
Post Grad. Dip. Rural Fd. Tech.
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W.A. Plahar (Dr.) - Prin. Res. Officer
B.Sc (Gen) (Deputy Director)
B.Sc (Hons) (Univ. of Ghana)
M.Sc Fd. Sci. (Univ. of Ghana)
Ph.D (Washington State Univ.)

ANALYSIS DIVISION

M. Halm (Ms) - Senior Res. Officer
B.Sc (Gen.) (U. O. G.) (Hd. of Div.)
B.Sc (Hons) Botany (U. O. G.)
M.Sc Botany (Univ. of Ghana)
Post Grad. Dip. Rural Fd. Tech (Netherlands)

K.K. Eyeson - Chief Res. Officer
B.Sc Bio. Sci.(Lond.) (On contract)
Dip. Nut. (Lond.)
Post Grad. Dip. Fd. Quality Control
(Nat. Coll. of Fd. Tech.) (Lond.)
MRSH; AIRST.

E.K. Ankrah - Prin. Res. Officer
B.Sc. (Gen.) (U.O.G.)
M.Sc Fd. Quality Control (Reading)

K. Kpodo (Mrs) - Research Officer
B.Sc (Gen) (Univ. of Ghana)
B.Sc (Hons) (Univ. of Ghana)
M. Phil. (West Indies)

P.N.T. Johnson B.Sc (Hons) Biochemistry UST, Ghana) M.Sc. Agric. Eng. Tech.(Silsoe Coll.) Cranfield Inst. of Tech., U.K.	-	Research Officer
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A.E. Hayford (Ms) B.Sc (Hons) Biological Sci. (UST, Ghana) M.Sc (Biotech.) Monach Univ. Australia	-	Research Officer
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D.N.A. Ankrah - Technical Officer
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City & Guilds Cert. (Final)
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(Parts I, II, III)
Adv. Electrical Tech. - City &
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Dip. Sales Mgt. and Marketing

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LCC Cert. Stage II
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RSA Stage III; LCC Stage III

ADMINISTRATION DIVISION

E. Atta-Sonno B.A. Hons. (Cape Coast) Specialist Teachers Cert. in English	-	Snr. Admin. Off. (Head of Division)
J.F. Asigbey GCE 'A' Levels Cert. in Marketing Cert. Stenography; Cert. Personnel Management; Cert. Management Practice Cert. in Human Resource M'gt. (Univ. of Ghana)	-	Chief Admin. Asst.
C.J. Buckman Dip. Auto Eng. Dip. in Tech. Supervision (F) Dip. In Tech. Supervision	-	Prin. Asst. Transp. Off.
B.A. Sarbah MSLC; Cert. Inst. of Commerce(Lond); Dip. Takoradi Secretarial Inst. GCE 'O' Level Cert. in Practice of Supervision in Human Relations & Comm. Cert/in {Personnel M'gt)	-	Chief Admin. Asst.
E.A. Larbi Cert. General Cource in Const. Const. Tech. Cert. Parts I & II	-	Prin. Works Supt.

APPENDIX III

FOOD RESEARCH INSTITUTE
1995 CONFERENCES WORKSHOPS AND SEMINARS

	CONFERENCE/WORKSHOP/ SEMINAR ATTENDED	PARTICIPANT/S	DESIGNATION	VENUE	DATE/ DURATION	ORGANISERS
1.	International Seminar on Human Resource Needs for Change in R & D Institutions	Mrs Abigail Andah	Director	New Delhi , India	15-18 February 1995	WAITRO
2.	2nd Pineapple Symposium	Dr. Pearl Adu Amankwa	Research Officer	Fort de France, Martinique	17 Feb. - 4 March 1995	CIRAD
3	Attachment to CIRAD Laboratories	Dr. Pearl Adu Amankwa	Research Officer	Montpellier, France	4-12 March 1995	CIRAD
4.	Impacts & Scientific Advance through Collaborative Research on Peanut	Mrs. K. Kpodo	Research Officer	Washington D.C., USA	March 1995	Peanut/CRSP Project
	Procedures for analysis of Fumonisms and Aflatoxin precursors using HPLC	Mrs. K. Kpodo	Research Officer	Texas A & M University, USA	1-8 April 1995	Peanut/CRSP Project
5.	Progress & Plans of Peanut/CRSP Project	Mrs. K. Kpodo	Research Officer	Alabama A & M University, USA	8 -11 April 1995	Peanut/CRSP Project
6.	10th Int. Conf. on Global Impacts of Applied Microbiology	Ms. M. Halm	Hd of Analysis, FRI/Snr. Res. Off.	Helsingor, Denmark	6-27 August 95	
7	Meeting of Participating Institutions on EU - funded project on Processing and related Biochemical Studies on Marine species in asia and Africa	Mrs Abigail Andah	Director	University of Surrey, United Kingdom (UK)	4-11 Apil 1995	School of Biol. Sci. University of Surrey, Guildford
		Mr. L.D. Abbey	Research Officer	"	"	"
8.	Workshop on Professional Development	Mrs Abigail Andah	Director	Sogakope	1-3 May 1995	Women in Science and Technology
		Ms. M. Streetor	Chief. Libray Asst.	Accra, Ghana	May 1995	NARP
9.	Processing and Drying of Fruits and Vegetables	Mrs Pearl Adu Amankwa	Senior Research Officer	Accra, Ghana	11 July 1995	Federation of Associations of Ghanaian Exporters (FAGE)
10.	Export of Yams and other Root Crops to USA	Mrs Pearl Adu Amankwa	Senior Research Officer	Accra, Ghana	19 July 1995	FAGE

APPENDIX IV

FRI STAFF TRAINING - 1995

	NAME OF STAFF	DESIGNATION	COURSE	INSTITUTION OF STUDY	DURATION
1.	W.K. Amoa-Awua	Snr. Res. Off.	Ph.D	Royal Vet. & Agrc. Univ. Copenhagen, Denmark	1992 -95
2.	A.E. Hayford (Ms)	Rese. Officer	PhD	Royal Vet. & Agrc. Univ. Copenhagen, Denmark	1995-97
3.	P.N.T. Johnson	Res. Officer	Ph.D	Univ. of Reading, U.K.	1992-95
4.	K.A. Vowotor	"	Ph.D	Univ. of Ghana/IITA (Coutonou)	1993-96
5.	N.T.Dziedzoave	"	M.Sc.	Univ. of Science & Tech. (UST), Kumasi	1993-95
6.	V. Antwi	Asst. Res. Officer	M. Phil	UST, Kumasi	1993-95
7.	M.E.K. Amenu	Snr.	H.N.D.-Accounting	Accra. Poly.	1993-96
8.	B. Awotwi	Snr. Tech. Off.	H.N.D-Marketing	"	1993-96
9.	C. T. Aikins	Accounting Assistant	C.I.M.A. Stage 4	Inst. of Prof. Studies (IPS)	1993-95
10.	Mr. Raphael Kavi	Library Asst.	Diploma of Library and Archival Studies	University of Ghana, Department of Library and Archival Studies	1994-
11.	Mr. Sebastian Garbrah	Library Asst.	Dip., Public Relations	Ghana Inst. of Journalism	1994-96
12.	Mr. W.K. Amevor	Snr. Tech. Off.	Univ. of Ghana, Legon	HND Lab. Tech.	1992-96
13	Mr. P.M.Toku	Snr. Tech. Off.	Univ. of Ghana, Legon	"	"
14.	Mr. J.Y. Anlobe	Prin. Tech. Off.	Univ. of Ghana, Legon	"	"
15.	Mr. R. M. Mawuli	Foreman	Tema Technical Institute	Mech. Eng. Advanced	1994-96

APPENDIX V

TRAINING	PARTICIPANTS	VENUE	DATE/DURATION
Training Course for the Brewery and Soft Drink Industries	Astek, D&C Industries, Accra Brewery Ltd., ABC Brewery	`FRI	7-10 February 1995
Processing of Mangoes into Slices, Bars & making of Cashew Figs and Bars	10 Women from Oyarifa Womens Development Association	FRI	
Workshop on Modern Quality systems and the Hazard Analysis Critical Control Point (HACCP)	All participating institutions of the EU project from Burkina Faso, Ghana, Kenya, Nigeria, Zimbabwe	Science and Technology Policy Research Institute (STEPRI), Accra	
Workshop on Modern Quality systems and the Hazard Analysis Critical Control Point (HACCP	All participating institutions of the EU project from West Africa - Burkina Faso, Ghana, Nigeria	FRI	
First Meeting of Aflatoxin Working Group on Peanuts	Nigerai, Senegal, Burkina Faso,Ghana ICRISAT (Niamey), Peanut CRSP (USA),CIRAD, Univ, Coll, London	SSNIT Guest House	31 May - 2 June 1995
Workshop on Modern Quality systems and the Hazard Analysis Critical Control Point (HACCP	All participating institutions of the EU project from East and Sounthern Africa Ghana, Kenya, Zimbabwe	FRI	
8th Regional training Course in Artisanal fish Processing	Ghana (11), Gambia (1), Uganda (2), Eritrea (2), Zambia (2) and Kenya (1)	University of Ghana, Legon	24 July - 1 Sept.1995
Mushroom Training	220 farmers	FRI	

APPENDIX VI

FOOD RESEARCH INSTITUTE 1995 SEMINARS

	DATE	TOPIC	SPEAKER
1.	Wed. March 24	Seminar on Prep. of Budgets for Recurrent & Capital Exp.	Dir./Dep. Director
2.	Wed. April 5,	First Quarter Review Seminar	Hds./Ldrs.
3.	Wed. April 19,	Quality Evaluation of locally produced Rice	J.T. Manful
4.	Wed. April 26,	The inhibitory Potential of lactic acid bacteria & yeasts against moulds occurring in Fer. Maize Dough	M. Halm
5.	Wed. May 3,	Rapid Rural Appraisal	Dr.Plahar/L.Allotey
6.	Wed. May 10	Importance of National Food Composition Data	K.K. Eyeson
7.	Wed. May 31	In-plant Trg. prog. in the field of fruits and veg. processing at the Mamarta Res. Cen., Gebze, Turkey	D.M. Attiogbe
8.	Wed. June 7,	2ND Quarter Review Sem.	Hds./Lds.
9.	Wed. June 14,	Sensory Evaluation of Foods	A. Osei- Yaw
10.	Wed. June 21,	Cul. of Edible Mushrooms	L. Sawyerr
11.	Wed. June 28	Village level prod. & Util. of Anchovy fish powder from Weaning foods in Ghana	N.T. Annan
12	Wed. July 12	Prefeasibility study rep. for the est. of a medium-scale fufu flour prod. plant	D. Blay
13.	Wed. July 19	Studies on the Trad. storage of Smoked Anchovies in Ghana	Dr. W.A. Plahar
14.	Wed. Oct. 4	Third Quarter Review Seminar	Hds./ Lds.
15.	Wed. Nov. 8	The Role of the chem. lab. in the prod. of high qual. food composition data	N.T. Annan
16.	Wed. Nov. 15	Fish Quality and Processing	L.D. Abbey
17.	Wed. Nov. 29	Post-harvest management & spoilage of tropical shrimps (*Penaeus merguiensis*)	M. Hodari-Okae
18.	Wed. Dec. 6	Techniques for heat sterilization of mushroom compost bags	M. Obodai
19.	Fri. Dec. 22	Annual Review Seminar	Hds./Ldrs.

APPENDIX VII

TECHNICAL REPORTS AND PUBLICATIONS - 1995

1. Amoa-Awua, W.K.A., Appoh, F. and Jakobsen, M. (1995)
   Lactic Acid Fermentation of Cassava Dough into Agbelima Accepted for publication in **International Journal of Food Microbiology**

2. Amoa-Awua W.K.A. and Jakobsen, M. (1994)
   The role of Bacillus Species in the fermentation of cassava. **Journal of Applied Bacteriology** 79 (1995) 250-256

3. Andah, Abigail (1995)
   Report on the Study Tour of Selected Industrial Research Institutions in India, 14-31st May 1995.

4. Andah, Abigail (1995)
   Report on the TWAS Fifth General Conference, organised by the Third World Academy of Sciences, Abuja, Nigeria 17th-22nd Sept. 1995.

5. Andah, Abigail (1995)
   Management Development for Women - A Ghanaian Perspective. Presented at the 1st International Seminar on Management Development for Women in Africa, 25th-28th October, 1995, Abuja, Nigeria.

6. Annan, N.T. and Plahar, W.A. (1995).
   Development and Quality Evaluation of a Soy-fortified Ghanaian Weaning Food. Food & Nutrition Bulletin. In Press.

7. Blay, D (1995)
   Design and contruction of a disintegrator (An Interim Report)

8. Hayford, A.E (1995)
   Trial production of starter cultures for maize dough fermentation using maize as the substrate (progress report)

9. **Kpodo, K.** (1995)
   The Status of Aflatoxin Research into Peanut in Ghana.

10. **Kpodo, K.** et. al. (1995)
    High incidence of *Aspergillus flavus* and aflatoxins in stored groundnuts in Ghana and the effect of some plant extracts on growth of *A. Parasiticus speare* on aflatoxin sysnthesis. (Presented at Research workshop and Symposium on "Impacts & Scientific Advance through Collaborative Research on Peanut", Washington, D.C, USA, March 1995.)

11. **Kpodo, K.**, Sorensen A. and Jakobsen, M. (1995)
The occurrence of mycotoxins in maize dough fermentation. Accepted for publication in journal of **Food Chemistry**

12. **Kpodo, K.** & Gyato C.K.(1995)
Peanut Production in Ghana: A Survey Report

13. Nti, C.A. and **Plahar, W.A.** (1995).
Chemical and Biological Characteristics of a Ghanaian Weaning Food, supplemented with Cowpeas. Plant Foods for Human Nutrition. In Press.

14. Olsen, A., **Halm, M.** and Jakobsen, M. (1995)
The antimicrobial activity of lactic acid bacteria from fermented maize (kenkey) and their interactions during fermentation. **Journal of Applied Bacteriology** 79 (1995) 506-512

15. Olsen, A., **Halm, M.** and Jakobsen, M. (1995)
The inhibitory potential of lactic acid bacteria and yeasts against *Aspergillus spp.* and *Penicillium spp.* occurring in fermented maize dough and the effect of organic acids on sporulation and germination.

16. Plahar, W.A., Hossain, M.A., Annan, N.T. and Asafo-Adjei, B. (1995)
Physical, Chemical and Functional Characteristics of nine cultivars of Cowpea (***Vigna Unguiculata***). Submitted to Plant Foods for Human Nutrition.

17. Plahar, W.A., Nti, C.A., Allotey, L. and Ocloo, G.K. (1995)
Soybean Production, Processing and Utilization in Iyanfoworoge, Osun State, Nigeria. A RRA Case Studies Report submitted to IITA under the IDRC/IITA Soybean Utilization Project, Phase III. International Institute for Tropical Agriculture, Ibadan, Nigeria.

18. Plahar, W.A., Nti, C.A., Allotey, L. and Ocloo, G.K. 1995.
Soybean production, processing, marketing and utilization in Ghana: Case studies at Manchie/Korleman, Asutsuare and Accra. A Project Report submitted to IITA under the IDRC/IITA Soybean Utilization Project, Phase III. International Institute for Tropical Agriculture, Ibadan, Nigeria.

APPENDIX VIII

FINANCIAL STATEMENT
JANUARY 1, 1995 - DECEMEBER 31, 1995

	ITEM	ANNUAL ESTIMATES (¢)	APPROVED BUDGET (¢)	AMOUNT RELEASED BY GOVT. (¢)	ACTUAL EXPENDITURE (¢)	INCOMES (¢)
1.	PERSONAL EMOLUMENTS	336,796,926	303,762,000	392,800,630	385,124,744	
2.	ITEMS 2 -5	290,928,840	52,105,600	49,551,500	76,658,676	
	TOTAL	627,751,766	355,867,600	442,351,130	461,783,420	
3.	Recurrent Grant from Ghana Govt.					429,202,159
4.	Research & Technical Services					17,012,873
5.	Other Incomes					25,429,483
	TOTAL					471,644,515