

BIOTECHNOLOGY AND GENETIC ENGINEERING ADVANCED LABORATORY

2.0 RESEARCH THRUST AND OBJECTIVES

The Biotechnology Advanced Laboratory (BAL) is a component of the National Advanced Laboratories (NAL) of the Complex. The laboratory is set up with the mandate to conduct proactive research and development activities directed at meeting the national needs, and to serve as a functional centre for biotechnology incubation, with the following core objectives:



New Biotechnology Laboratory Complex under construction

- i. To promote scientific activities that will lead to developing and applying safe uses of biotechnology.
- ii. To assist in strengthening the nation's scientific and technological capabilities.
- iii. To stimulate and promote activities at all levels of our national polity in the field of biotechnology and genetic engineering.
- iv. To develop and promote application of biotechnology and genetic engineering for solving problems of national development.
- v. To provide a forum for exchange of information, expertise and know-how among scientists in this field.
- vi. To attain the status of a centre of excellence for research and training in West and Central Africa.

2.1 ONGOING RESEARCH ACTIVITIES

2.1.1 AGRICULTURAL BIOTECHNOLOGY

- a) **Micropropagation projects:** To meet the growing demand for disease-free planting materials for afforestation and crop production projects in Nigeria, BAL has developed *in-vitro* protocols for mass propagation of plantain, banana, pineapple, and cassava. Domestication of micropropagation protocols for sugarcane and olive tree is also ongoing. The capacity of BAL to transfer hardened micropropagated plants from the laboratory to farmers is being developed and strengthened. Efforts are on-going to scale up the production of *in vitro* plants of plantain,

banana, cassava and pineapple to end users such as farmers and entrepreneurs.

- b) **Genetic Transformation:** In line with our national mandate to domesticate the technologies for genetic transformation of crops, BAL has succeeded in obtaining relevant plasmid constructs and *Agrobacterium* strains for establishing the protocols for *Agrobacterium*-mediated gene transfer to plants. Equipments have been acquired for electroporation-mediated and also for biolistic gene transfer. Currently, protocols are being tested in the laboratory for genetic transformation of cowpea, some of which methods have been integrated into our genetic transformation training workshops. The major objectives of the genetic transformation project are to develop novel cassava varieties with glutenin-rich cassava flour (for bread making) and waxy-cassava starch, control post-harvest deterioration of cassava tubers, and develop insect-resistant transgenic cowpea varieties. BAL collaborates with the National Root Crops Research Institute (NRCRI), Umudike, and the International Institute of Tropical Agriculture (IITA), Ibadan to achieve the objectives of this project.
- c) **Application of molecular markers:** BAL has initiated a collaborative project on the application of molecular markers to characterize indigenous accessions of fluted pumpkin (*Telfaria* spp) and acha (*Digitaria* spp.). In this direction, the acquisition of other relevant state-of-the-art facilities for molecular-marker assisted abiotic-stress related gene discovery research is underway. It is expected that molecular markers will be exploited for the precise evaluation and sustainable utilization of Nigerian diverse plant resources for enhanced food security and poverty alleviation.



Researchers and Technologists working in the Biotechnology Advanced Laboratory

2.1.2 INDUSTRIAL BIOTECHNOLOGY

(i) The Biotechnology Advanced Laboratory is involved in:

Production of antibiotics and industrial enzymes from indigenous microbes and other sources such as plant and animal wastes. Some of these include antibiotics against typhoid spp, candida spp. and industrial enzymes like glucosidase, pectinases and cellulases.

Collection and isolation of different strains of yeasts, fungi and bacteria from different ecological zones of the country for the subsequent establishment of a microbial gene bank. It is expected that yeast strains of good baking potential will be used for Baker's yeast production, and enzyme production potential of identified fungi and bacteria species assessed.

Production of single cell protein for the fortification of foods and feeds.

Use of local waste materials and tubers as substrates for the growth of yeast as replacement for molasses.

(ii) Sequel to the new government interest in cassava production, there is the need for diversification of cassava utilisation and value addition to prevent glut and sustain the initiative. The laboratory has therefore designed projects on the production of glucose, ethanol and vitamin C from cassava starch and peels in collaboration with XeChem.

2.1.3 BIOMATERIALS RESEARCH AND DEVELOPMENT

The Laboratory is currently involved in the development of biomaterials for agro and biomedical industries. Ongoing efforts include the development of:

starch-based biodegradable films useful for food preservation (Hydroxypropylated starches);

biodegradable films moldable into plant nursery bags;

agricultural mulch films; and

waste disposal bags.

Research work aimed at ameliorating the menace caused by non-durable plastics used for food packaging applications is in progress. Cassava starch is being processed into thermoplastic form, making it possible to develop products such as single use food packs, cutleries, cups and food packaging films (edible films).

2.2 FUTURE PRIORITY PROJECTS

2.2.1 AGRICULTURAL BIOTECHNOLOGY

Genetic modification of selected crops (*Musa spp.*, *Vigna spp.*; etc) for resistance to major abiotic (drought; soil aluminium toxicity; etc) and biotic (nematodes, striga, gal midge, etc) stress factors on farms in Nigeria.

Utilization and development of appropriate molecular markers to mine for genes of agronomic importance from Nigeria's rich plant resources.

Biochemistry and molecular biology of starch formation and deterioration in cassava with the view to enhance the

amylopectin/amylose ratio and identify the genes responsible for rapid deterioration in cassava after harvest.

Joint application of plant tissue culture and mutation breeding to develop herbicide-tolerant varieties of acha (*Digitaria spp*), and rice (*Oryza sativa*), to facilitate export-oriented large-scale production.

Establishment of Temporary Immersion Bioreactor (TIB) technology for low-cost large-scale commercial propagation of in-vitro planting materials, especially for sugarcane, pineapple, cassava and gum arabic (*Acacia spp.*), the markets of which are growing rapidly in the country.

Establishment of Micropropagation Technology Park (MTP) to serve as pilot scale micropropagation center for demand-driven all-year-round commercial propagation of quality planting materials for growers in Nigeria.

2.2.2 INDUSTRIAL BIOTECHNOLOGY

Establishment of pilot plants for the production of yeast, glucose, vitamin C and ethanol.

Application of bioengineering techniques on selected strains of microorganisms to increase and improve their industrial uses; e.g. yeast strains of high potentials (including growth requirements) will be transformed by recombinant DNA methods to enhance carbohydrate metabolism. Plasmid constructs containing β -1, 4 and β -1,6 glucoamylase genes will be used in the transformation.

Biochemical and genomic analysis of targeted microorganisms, like local yeast strains.

2.2.3 BIOMATERIAL DEVELOPMENT

Exploiting the utilization of nanotechnology in the reinforcement of commodity plastics using locally available nano-clay sources such as "black cotton soil".

2.3 PROFILE OF THE DIRECTOR



Prof. Godwin Haruna Ogbadu, Professor of Biochemistry and the current and pioneer Director of the Biotechnology Advanced Laboratory, has extensive teaching and research experience in Biochemistry. His areas of expertise include production of secondary metabolites and fungal toxins, irradiation and food chemistry. He has published extensively in reputable scientific and technical journals. He is a member of the Scientific Advisory Board of the Organization for the Prohibition of Chemical Weapons based in The Hague

in The Netherlands, and a member of the Governing Council of Kogi State University, Ayingba. He is also a member of several other national and international boards and professional bodies including membership of the New York Academy of Sciences and the Alexander von Humboldt Club of Nigeria.

1. Short Term courses e.g. Industrial training for undergraduates and specialised training for scientists and technologists. The Lab in collaboration with IITA and USAID organised a two-week training on transformation for scientists from universities and research institutes in April 2005. The lab has developed in collaboration with IITA-Ibadan, a comprehensive Training Manual on "Plant Regeneration and Genetic Transformation.
2. Long Term Training: This is for postgraduate (M.Sc; Ph.D) students who carryout their bench.work with a biotech staff as a co-supervisor.
3. Visiting Scientists on sabbatical.