ENHANCING THE DEVELOPMENT OF INDIGENOUS FRUIT TREES IN AKWA IBOM STATE, NIGERIA THROUGH BIOTECHNOLOGY APPLICATIONS

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Abstract
Akwa Ibom State is richly endowed with so many indigenous forest fruit trees. These edible fruits are nutritionally rich in vitamins, minerals, protein, carbohydrate and fat and oil. Forest fruits are often good sources of macro-nutrients such as calcium and iron, which many rural poor require for good health. They provide food, income, employment and also have a great potential for local and commercial development. The major problems associated with forest fruit trees in the state include seed dormancy, low germination rate, lack of mature fruit bearing trees recalcitrant seed uncollected germplasm. These militate against the realization of potentials of the fruit trees in the state. This paper discusses biotechnology techniques such as meristem culturing, invitro conservation, embryo culturing, anther culturing, root culturing, leaves culturing and micropropagation that can solve some of the problems associated with forest fruit trees development in the state in particular and the country in general.

Keywords: *Biotechnology, Indigenous fruit trees, sustainable management, invitro conservation, micropropagation.*

Introduction

Among the valuable non-timber forest resources of rainforests are edible and medicinal fruits, seeds leafy vegetables, nuts and bark. In contrast to wood exploitation, exploitation of non-timber products causes negligible destruction of forest ecosystem. The Non Timber Forest Products (NTFPs) are particularly important part of multiple use strategies, because they increase the range of income generation options of forest-dependent villagers while avoiding some of the ecological costs of timber cutting (Ford Foundation, 1998; Lorbach *et al*, 2000; Ella and Domingo, 2014; Udo, 201).2The tropical rainforest is cornucopia of food items from time immemorial (Udo *et al;* 2009; OlaJide and Etigale, 2017). The lowland rainforest is a home of plant species that produce edible materials in the form of fruits, seeds and nuts (Table 1). It has been observed that the edible fruits from forest plants are mostly available at the seasons of the year when food crops are not yet mature (Ikojo *et al*, 2005). This enhanced rural house hold food security. The edible fruits constitute important and cheap sources of vitamins, minerals, protein, carbohydrate,

Table 1: Some indigenous plant species producing edible forest fruits in Akwa Ibom State.

PLANT	SPECIES	USES
Gambeya	*albidum*	Edible fruit, cultural and religious purposes
Pentadethra	*Macrophylla*	Edible sees, oils, medicinal, cultural and And religious purposes.
Dacryod	*esedulis*	Edible fruits
Coula	*edulisedulis*	Edible seeds
Irvingia	*gabonensis*	Edible fruits, seeds and oil
Treculia	*Africana*	Medicinal, poridge and thickener
Tetracapidium	*conophorum*	Medicinal, oil and edible seeds
Lnadophia	*owerriensis*	Edible and medicinal
Dennettia	*tripetala*	Eating, medicinal and cultural use
Parkia	*biglobosa*	Food condiment, medicinal and pod for catching
9Afzelia	*africana*	Edible, soup thickener and medicinal
Canarium	*schweinfurhii*	Edible fruits, nuts far rattles, bark and root for medicine
Chrysophllum	*albidum*	Edible fruits
Cola	*argentia*	Edible fruits; fodder leaves

Cola	*milieni*	Edible fruits; medicinal
Afromumom	*meleguela*	Edible and medicinal
Afromumom	*strolaleus*	Edible fruits
Garcinia	*kola*	Edible fruits, seeds and medicinal
Monodora	*myristicia*	Edible spice in soup and stew, medicinal
Dialium	*guineense*	Edible fruits
Cola	*acuminate*	Edible, cultural and medicinal purposes
Blihia	*sapida*	Edible fruits
Maesobotrya	*barteri*	Edible fruits

Sources: Udo et al (2009); Olajide and Etigale (2017).

One very essential need of man is food. Unfortunately, about 925 million people in the world, that is one-sixth of the world's population, are food insecure (FAO, 2011). Wild foods obtained from forests are often good sources of micronutrients such as vitamins, calcium and iron, which many rural poor require for good health (Centre for International Forestry Research, CIFOR, 2013). Edible fruits, nuts and seeds from the forests provide forest dependent people with fat and oils necessary for the absorption of vitamins A, D, E and K (FAO, 2011). They are good sources of essential minerals such as calcium, iron and magnesium (FAO, 2011).

There are numerous wild fruits that provide regular supplement to the diet, and in many cases represent a primary source of food. Some of these wild fruits have not been utilized by man and have not significantly to industries. Forest fruits can be processed and used as ash, crude fibre, lipids and numerous photochemical for industrial and domestic uses. There are abundance of forest fruits that have a great potential for local and commercial development. Many indigenous edible fruits are nutritionally rich. They act as supplement to local foods and help provide food security. Ogunika (2001) stated that wild fruits are used by the local people as a source of food daily basis.

Some plants and their parts particularly fruits, seeds and leaves are consumed and seasonal basis as food and food supplements in rural communities. This food and food supplements have contributed immensely to the rural household diets and are obtained from plants. Varieties of plant species are eaten as snacks by most people in communities. They save as a quick remedy for hunger to rural husbands. Numerous plant species are also used to flavor foods and beverages. Natural flavors, species, condiments and aromatics are mainly products of secondary metabolite of various plants. These products are very useful in foods pharmaceutical and many other industries.

The major problems associated with forest fruits trees in Akwa Ibom State are difficulty in seed productions, seed dormancy, loss of viability, low germination rate, lack of mature fruit bearing trees and recalcitrant seeds. All these problems are as a result of lack of silvicultural requirement. There are difficulties in regenerating forest and establishing of new plantations by State government and member of the public due to lack of knowledge about the silvicultural requirement of plant species. Most of the indigenous edible fruit trees have not been selected for desirable fruits and no serious genetic or biotechnological research has been done on them.

A greater number of forest fruit trees are not easily available in the State as gathering of such fruits are done with great drudgery and difficulty from the very few stands that are in the wild. Fruit trees that are affected are as follows. *Treculia africana*, *Dialium guineensis*, *Irvingia gabonensis*, *Pentaclethra macrophylla* and *Denettia tripetala*. Thus, there is need for genetic and biotechnological research on these forest fruit trees in order to fully exploit the benefits of these special forest products that have contributed immensely to the livelihood of the rural communities.

Biotechnology is defined as any technique that uses living organisms or substances from those organism, to make or modify a product, to improve plants or animals or to develop microorganism for specific uses (Persley, 1992). According to the United Nations (UN) Convention on Biological Diversity Art, biotechnology is the use of living systems and organism to develop or make improved useful products. It has also been described as a tool box for solving problems leveraging on science knowledge. In Nigeria, Research Institutes and Universities with biotechnology laboratories and facilities usually carry out research works on food crops. No or little researches have been done an indigenous forest fruit trees. Thus, there is need to research on fruit trees through biotechnology applications.

Constraints to Forest Fruits Production

Forest fruit trees suffer neglect from research and development process, many of these trees have not had their germplasm collected and conserved for future production. There are no field gene-banks in the State to conserve

genetic diversity of these plants, thus, the fear of disappearing of fruit trees because of pressure by humans. Seed dormancy, recalcitrant seeds and lack of mature fruit bearing trees are major production constraints of fruit trees. Germination capacity of most of these fruit trees declines due to problems of seed coat and hard endosperm. Other major problems facing fruit trees are the inability to survive under adverse environmental conditions with respect to current environmental and climate change. The problems of pests and diseases of forest plants have caused reduction in quality and market value of these plants.

Roles of Biotechnology Indigenous Forest Fruit Tree Development

Forest fruits play major role in the diets and economic emancipation of rural communities. They have great potential for local and commercial development. Many of these fruits are nutritionally rich, they act as supplement to local foods and help in providing food security. Wild fruits are consumed by the local people on daily basis. Although human activities such as deforestation forest degradation, bush burning and unsustainable harvesting of these forest fruits impacts negatively on the survival and abundance of these valuable forest species. Also, the problem of pests and diseases, seed dormancy, loss of viability, low germination rate, lack of mature fruits bearing trees, germplasm conservation and sustainable production strategies have limited the efforts towards exploiting the nutritional and production potentials of these valuable forest resources.

Forest fruit trees require urgent biotechnological applications, these applications will make available improved novel species and genetic conservation of species that are disappearing or going extinct thereby assisting in sustainable management of forest fruits.

***Pentaclethra macrophylla* (Oil Bean Tree)**

Pentaclethra macrophylla which is one of the useful plants of Southeastern part of Nigeria belongs to the family *Mimosoidae*. In Akwa Ibom State, the seeds of oil bean tree are slightly fermented and cut into small shreds to make a very nutritious snack called "Ukana" the fermented cotelydom is also used as ingredient in soup preparation. It could also be used as sauce for eating yam, cocoyam and plantain. This fruit tree is becoming rare and collection for consumption is done with difficulty.

The major problems of *Pentaclethra macrophylla* production is that of lack of mature fruit bearing trees, seed coat and hard endosperm and low germination rate. Therefore, the tree needs urgent biotechnological application. Germplasm of oil bean tree can be conserved using various biotechnological means of preservation e.g. the use of liquid nitrogen (cryopreservation). This will help in conservation of the tree against extinction.

7The application of meristerm culture can helps in rapid propagation and multiplication of tissue as *Pentaclethra*, thereby overcoming the constraints of difficulty in propagation of the tree. Culture of embryo excised from the tree seeds can facilitate the germination of the plant and problems associated with seed coat and hard endosperm can be eliminated through zygote embryo culture (Okezie, 1984).

***Treculia Africana* (African Bread Fruit)**

This is an evergreen tropical fruit tree belonging to the family of Moraceae. Its distribution extends from latitude 130N of Angola and down to Saotome Island, and within the approximate latitude range of 150N to 200S (Keay, 1989; WAC, 2005). In Nigeria, this fruit tree is commonly found in states sush as Oyo, Ogun, Anambra, Cross River, Delta and Imo (Keavy, 1989). The tree is also found in Akwa Ibom State and it is specially called "*Adiang*" by the Ibibios tribe of the South South Nigeria.

Treculia Africana is a source of food to many Akwa Ibomite, it is variously cooked as sole porridge or mixed with other stuff such as Sorghum (Onweluzo and Nnamuchi, 2009). Bread fruits are cooked with ingredient such as pepper, salt, fish, onions and oil and sold for commercial purposes. African bread fruit is going extinct in Akwa Ibom State it is mainly gathered in the wild as farmers do not cultivate it in their farms. Lack of mature fruits bearing trees, seed dormancy and low germination rate are hindrance to production of this tree. Biotechnology can provide solutions to these hindrances. In vitro conservation is a solution against genetic erosions of the tree. Seed dormancy and low germination rate of this specie could be easily tackled through tissue culture techniques. These techniques include: Culture of embryo which can facilitate the germination of bread fruit. Others are seed culture, root culture and meristem culture.

***Dennettia tripetala* (Pepper Fruit)**

This shrub produces edible fruit when the conventional stable foods are scarce. The fruits, green at first then turning red, ripen in April and have a peppery spicy taste. The young leaves are chewed on account of their pungent spicy taste. The fruit is a good source of vitamins and have cultural and economic benefits. The seeds and leaves of this tree are utilized for medicinal purposes. The fruit is edible and slightly pepper and is used among Eket people in Akwa Ibom State of Nigeria to prevent vomiting in early pregnancy among women while

men chew it with palm wine (Nsien, *et al*., 2013).

The major production – limiting factors of pepper fruits are insect pest attack, seed dormancy and propagation difficulty. Micro propagation is a reliable solution to this problem. In vitro propagation protocol for the fruit tree should be established. The problem of seed dormancy can be solved by embryo rescue technique. Biotechnology technique such as biological control, recombinant DNA technology, use of vectors and other genetic engineering methods can be used to address the problem of insect pests and diseases in *Dennettia tripetala*. The development of monoclonal and polyclonal antibodies (Miller and William, 1990) gave practical application into identification and detection of pathogens and pests in plants. This area of biotechnology has been a useful tool in screening plants that have been infected.

***Afzelia africana* (African Mahogany)**
This species is mostly recognized for its economic value. All the parts of the plant are used for one or two purposes. When the bark of the plant is ground and mixed with honey it is used in treating cough (Agbiye and Igbado, 2003). Extraction from the seed of the plant has seen to be a good source of oil for both industrial and domestic uses. Due to high demand for this tree species in both local and international markets, the species has suffered high degree of exploitation and is fast becoming very scarce. This has necessitated efforts towards its domestication consequently leading to its conservation.

There are three major production factors that limit the production of African mahogany. These include; lack of mature fruits bearing trees, propagation difficulty and germplasm conservation. Biotechnological means of preservation such as the use of liquid nitrogen (Cryopreservastion) can be used to conserve *Afzelia africana* against extinction. Meristem culture and micro propagation are solutions for propagation difficulty in *Afzelia africana* species.

***Irvingia gabonensis* (Bush Mango)**
Irvingia gabonensis is a tropical forest fruit tree. The fruit has sweet edible fibrous pulp which is rich in vitamin C. the most important part of this forest fruit to the people of AkwaIbom is its nutritious seeds. Seeds of *Irvingia gabonensis* are primarily used for soup making in many parts of the State. The seeds are used as soup thickener for the popular "*Ogbono* soup". The harvest and sale of cotyledons of bush mango is a major source of income for rural communities of the State.

This important forest fruit tree requires urgent application of biotechnology. This is because there are many problems that limit the efforts towards exploiting the nutritional and production potentials of these multi-purpose trees. These problems include germplasm conservation, lack of mature fruit bearing trees, low germination rate and sustainable production strategies. The application of biotechnology has a role to play in combating constrains limiting the production and availability of *Irvingia gaonensis.*

Irvingia gaonensis can be mass propagated through tissue culture technique and its germplasm stored through various means of preservation example, the use of liquid nitrogen (Cryopreservation). Culture of embryo excised from seeds helps in culture can be used in the production of haploid plants. This is of great genetic value for plant improvement and genetic conservation (Ng, 1988).10

***Gambeya albidum* (African star apple)**
Gambeya albidum also known as African star apple, are widely eaten in Akwa Ibom State. The fruits are consumed because of its sweetness and nutritive value, it serves as cheap source of protein, minerals, oil and vitamin C, thus increased fruit production would significantly improve the available food supplies and the nutritional status of the people (Nwadinigwe, 1982). According to Anazonwa (1981), the fruit pulp has been used as an experimental basis for excellent jams, jellies with good appearance and flavor. *Gambeya albidum* contribute financially to household income in the State. Marketing of star apple has the prospect of providing a considerable income generating opportunity for rural people (Onyekwelu and Stimm, 2011).

Mass propagation of *Gabeya albidum* ensures abundance supply of the tree through various mass propagation techniques. Tissue culture, which include leaf culture, root culture, seed culture, meristem amongst others could be used to tackle the problem of difficulties in propagation. New plants can be obtained through somatic embryogenesis from pedicels, stem, leaves, roots and others explants and this can solve the problem of recalcitrant seeds. This technique can make possible the production of artificial seeds in star apple. In vitro propagation of star apple should be encouraged to provide disease-free starting material for genetic improvements and cultivar breeding. Germplasm conservation is a solution against genetic extinction of the plant.

Conclusion
In Akwa Ibom State, little or no attention is given to the use of biotechnological techniques on the indigenous forest fruit trees. As Nigerian government is demonstrating political will for increasing biotechnology capacity

and application through the National Biotechnology policy and programme on certain crops, the government of AkwaIbom State should follow suit and extend it to forest fruit trees. Biotechnology will help in solving the problems of germplasm conservation and sustainable production strategies.

Its application will make available improved novel species and genetic conservation of species that are disappearing or going extinct thereby assisting in sustainable production and management of forest fruit trees in the State.

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