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Eco-Conservation of Important African Herbs Tree for Culinary and Medicinal Purpose

Abinotami Williams Ebuete[1], Eluan Ebuete[2] and Okpoebi Kenneth Berezi[3]

[1]Department of Geography and Environmental Management, Niger Delta University, Nigeria. [2]Department of Animal and Environmental Biology, University of Port Harcourt, Nigeria. [3]Department of Marine Environment and Pollution Control, Nigeria Maritime University, Okerenkoko, Nigeria.

Corresponding author: ebuetewilliams@gmail.com

Abstract

Herbs as spice and herbs has long time traditional history of use with stout roles in cultural folk medicine, cultural heritage, in appreciation of food and strong association to healthy living. The longings for herbs and spices is one of the greatest achievements in human progress which has played fundamental role in changing course of history, geography and in promoting international relations. Herbs hold a center pace in traditional (folk) medicine particularly in Africa. Africa is blessed with these natural resources and they have served various purposes such as stringent, acidifiers, alkalinizes, tonics, diaphoretics, diuretics, laxatives etc. Regrettably, these herbs are in danger of extinction occasion by anthropogenic activities such as urbanization, increasing population, and demand for fast profit, unholy agricultural practice and decaying human conscienceless through uncontrollable deforestation. This review directly looked at the medicinal and culinary important of Negro pepper/Grains of Selim (Xylopia aethiopica) and Prekese/Uyayak (Tetrapleura Tetraptera) tree; while condemning non-selective logging as the lead caused of deforestation; it also provides an approach to the conservation of these tree herbs in Africa to compliment in achieving good health and wellbeing; cut down Ozone layer depletion through climate change monitoring and conservation/protection of life on land which is capsulated in the United Nation (UN) Sustainable Development Goal 3, 13 and 15 respectively; a global policies target for the year 2030. This brief overview therefore recommended for traditional approach to herbs tree conservation.

Keywords: Culinary and Medicinal Herbs, Plants phytochemical compositions, Threat to plant tree life, Plant tree, Conservation.

Introduction

The earth planet is a unique ecosystem that is made of three (3) spheres such as the lithosphere/terrestrial (solid part), Hydrosphere/Aquatic (water), Atmosphere (envelope of gases) and the Biosphere (living entity). The peculiarity of the earth terrestrial ecosystem is in her self-regulatory association of flora and fauna with her abiotic environment, characterized by definite plants formations, through which their growth, forms and distributions; plants reflecting the earth's physical systems.

Life-form designations in terrestrial ecosystem according to Christopherson (2001) is built upon the superficial properties of individual plants and the conglomeration in forms and structures of vegetation, characterized with trees (large woody main truck, perennial plants usually 3m or 10ft in height); Lianas (usually woody climbers and vines); Shrubs (Succulent woody plants with stem branching from the ground); Herbs (Succulent woody plants without stems like grasses and non-woody vascular plants); Bryophytes (Non-flowering, spore bearing plants like the mosses and

liverworts); Epiphytes (plants growing on other plants above the ground, using other plants as based support for her survivals); and Thallophytes (plants without true leaves, stems and roots like fungi, algae, bacteria and lichens).

These plants are instituted with enormous important in food safety, preservation and basic sources of natural products; though obviously different in structure and biological properties (Akindahunsi & Salawu, 2005; Singh, Kumar, Jyoti & Kumar, 2021). The use of medicinal plants had hitherto been placed on the treatment rather than prevention of diseases and over 90% of traditional medicine recipes/remedies contain medicinal plants. Global trade in herbs and spices is over USD100 Billion per annum (Bellamy and Pfister, 1992; Christopherson, 20001).

Plants role in food safety and preservations have been studied *invivo* and *invitro* to revealed plants phytochemical compositions whose results and recommendations are quite expedient in today's pharmacological advancement, revealing the traditional potency/strength of various continents and countries particularly in Africa. There is no gainsaying that plants were first used in traditional systems of medicine and is serving a pivotal role in today's modern medicine. The report of World Health Organizations (WHO) opined that about 25% of today's medicines are plant derived (Saslis Lagoudakis *et. al.,* 2012) which make it more effective without side effects. Today, the prevention of cancer and cardiovascular diseases according to Pereira and Milner (2014) is gaining global pace through the assimilation of medicinal herbs, vegetables, fresh fruits rich in flavonoid, spices and tea rich in natural antioxidants (www.projecttopics.org; Virgili *et.al.,* 2001; Kaefer & Milner, 2008). Extracts from most plants according to Lee, Noh, Lim & Kim (2021) is traditionally known for regulating and managing blood glucose through phosphoinositide 3-kinase (P13K) protein Kinase B (Akt) pathway and with the anti-inflammatory and antioxidant properties of plant extracts which suppresses C-Jun amino terminal kinase (JNK) and the nuclear factor kappa B (NF-κB) pathways, which induce insulin resistance. The efficacy of plant products is traceable but not limited to the antioxidants properties but with several components with a discrete mechanism in actions like enzymes and protein with other lower molecular weight like flavonoids (Birt, Hendrich & Wang, 2001, Yin, 2021). This molecular component poses a performing function as styptics, tonics, diaphoretics, emetics, diuretics, alkalinizers, acidifiers and other several medical purposes (Tapsell *et.al.,* 2006; Valko *et.al.*, 2007; Saliu *et. al.,* 2021).

The chronicle of plants used is as old as man existence and is traceably revealing both material and no-material cultural heritage in food appreciation and divers healthy links to human health (Gottardi, Bukvicki, Prasad & Tyagi, 2016). Herbs may be spices (parts of plants such as buds, stigma, rhizomes, resin, fruits, bark, leaves, flowers, seeds or roots that are rich in essential oils, colors, preservatives and aromatic principles) as well as herbs (leafy parts of plants that is either sweet or savory in flavor) with a functional role in pest controlling, medicinal, sacred or culinary purposes. Starting from the food preparation, herbs and spices can affect both food spoilage and taste (pdfs.semanticscholar.org; Carlsen, *et. al.* 2010). Strenuously, the used of spice and herbs for culinary, embalming, incense, ointments, perfumes, poison antidotes, cosmetics and medicinal purposes has span through over a millennium and is advancing speedily per second due to widening exposure of human to disease causing agents negatively caused by human actions (Weiss, 2002).

Spice and herbs are vivacious to food preparation due to their unique flavor, gusto aroma, food and beverage coloring. They also aid in the protections against acute and chronic diseases because of their diverse range of health properties via their bioactive constituents, such as sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes and vitamins, especially flavonoids and polyphenols (Edeoga, Okwu & Mbaebie, 2005; John-Dewole, Agunbiade, Alao & Arojojoye, 2012).

Spices are also known for stimulating the secretion of saliva, promoting digestion, preventing cold and influenza and reducing nausea and vomiting (Gottardi, Bukvicki, Prasad & Tyagi, 2016).

There are linking reasonable evidences in lowering the risk of cancerous death, Ischemic heart and respiratory system disease to constant and regular consumption of spicy foods (Kaefer & Milner, 2008; Pereira & Tavano, 2014; Jiang, 2019). In traditional (folk) medicines, herbs and spices has demonstrated curative effect on most commonly diseases like hypertension, diabetes mellitus, cough, atherosclerosis, rheumatoid arthritis, stomach ailment, reperfusion injury, neurodegenerative diseases such as Alzheimer's and Parkinson diseases; ant aging rejuvenator, tooth ache reliever and general immune boosters (Valko *et. al.,* 2007; Opara & Chohan, 2014).

In most cases, the associated bitterness innards in herbs and spices is hypothesized in depressing glucose levels while the whisky is emetics to colic, intestinal worm infections and stomach pains when taking before meal in the morning (Chang, 2003). There is a notion that, newborn babies fed with food made of natural spices grows faster and healthier as most chemical compositions in the spices aid in springing up growth hormones and building immunity (Jiang, 2019) and due to the preservative contents of these plants, spices are used for mummification necrosis (Gottardi, Bukvicki, Prasad & Tyagi, 2016). The multiple complimentary used of medicinal plants in traditional medicine has awakened researchers and health practitioners' curiosity on the effectiveness background, numinous efficacy and safety threshold. In Nigeria alone, it will interest you to know that about 56-70% of her total population particularly in the semi and rural settlement frequently access traditional medicinal practitioners in various forms and method for array of ailment due to accessibility, availability and cost (Sofowora, 2001). In addition to delivering antioxidant and other properties, herbs and spices can be used in recipes to partially or wholly replace less desirable ingredients such as salt, sugar and added saturated fat in food.

Aside, the pharmacological and traditional uses of these plants, they also have the ability to provide an essential of life for all living things on Earth planet particularly in the production of Oxygen and Carbon sink. Interestingly, a single mature tree produces approximately 260pounds (322grams daily) of Oxygen yearly (Luis, 2019); thereby supplying the required yearly 740kg oxygen needed by a man for an existence.

The unique soil type in Africa naturally supports the growth of these herbs and spices in their forms and numbers without special considerations to topographic and climatic differences. It is commonly found throughout the high forest zone - Savanna (Guinea and Sudan) region, within the Southern, Western and Eastern regions of the continents in their forms as climbers, slim shrubs, trees and perennial creeper (Sofowora, 1993). Nigeria as a case study, it has been estimated that over 40% of the naturally grown plants served for food while about 30% of the known plants served as spices and medicinal plants (Nwobegu, 2002).

Nature's biodiversity is like a full medicine cabinet that need to be preserved as the unprecedentedly loss of these plants will close the undiscovered potentials food and medicinal resources of nature waiting to be found and discovered. It is now a major problem that these spice and medicinal plants are treated with contempt as knowledge on the medicinal and health importance of these herbs is limited; going through the act of indiscriminate deforestation by battling the edge rough of endemicity. Accordingly, an estimated 40%-50% (50% in Africa, 40% in Asia and 40% in Central and South America) of the Earth's original forest area is loss to extinction due to human activities in the last century and remained a great treat to ecosystem restoration. These important tree herbs and spices is fast fading off the face of the earth as modern society is expanding its pervasive

developmental course with no regards to conservation surrounded with a monumental debilitation with the fear of pushing earth herbs and spices to extinction by 2050; which essentially call for this study.

Certainly, the preservation for sustainable use of plants is traceable to the commodity values attached and this work is designed to highpoint Physicochemicals; phytochemicals and antioxidant constituents in local trees and herbs, examined the nutritional value and therapeutic values; derived their true benefits and the mechanisms of action that underpin their purported efficacy; undress, address and redress the remote cause and challenges confronting tree plants in Nigeria and provided conservative approach that guarantees sustainability with special reference to Negro pepper/Grains of Selimi (*Xylopia aethiopica*) and Prekese/Uyayak (*Tetrapleura Tetraptera*) tree . This is because several metabolic diseases and age-related degenerative disorders is closely associated with oxidative processes in the body and the increasing use of these herbs tree and spices as a source of antioxidants to combat oxidation call for their preservation.

Literature Review

Emperor Charlemagne (AD 742-814) stated that "herbs are friends of physicians and the praise of cooks"; suggesting the dual role of herbs and spices for flavoring and for health benefits as it is still recognized. The historical use of herbs and spices for health benefits began 6million years ago (Rosengarten, 1969) and early documentation suggested that hunters and gatherers accidentally discovered the enhancement of meat taste through the wrapping of meat in leaves; so did certain nuts, seeds, berries and bark were used to mask unpleasant tastes and odors in foods and to keep it fresh (Duke, 2002).

Biblically (17th Century BC), spices were prized for wide variety of uses including religious offerings, burial rituals, medicines, trade and seasoning as may find in the book of Exodus, 2Chronicles, Songs of Solomon, Mathew and Mark. A summary of ancient Egyptians medical practices date back in 1500 BC (*De Ebers Papyrus*) where the used of Caraway, Coriander, Fennel, garlic, onions etc were used to promote health. Remarkably, the medical writings of Charaka (1st Century) and Sushruta (2nd Century) also make references to the uses of spices and herbs. Charaka in particular uses white mustard and other aromatic plants to ward off malignant spirits.

Interestingly, the earliest medical publication called the *Pen Ts'ao Ching (meaning classic herbal*- 2700 BC) recorded over hundred medicinal plant used; also the 3rd Millennium Sumerian Clay Tablets also recorded various used of odoriferous plants for medical purposes; the scroll of Cuneiform (668-633) also recorded long list of aromatic plants and their uses (Tapsell *et. al.*, 2006). Spices and herbs indigenous to India such as Cardamon and Turmeric were cultivated as early 8th century BC in the Babylonian gardens. Great philosophers like Hippocrates (460-377 BC) also wrote about the used of spices and herbs; the father of Botany-Theophrastus (372-287 BC) also summarizes the knowledge used of over 600 spices and herbs; Physician Pedanius Dioscorides (AD 40-90) who authored the most useful (over 1500 years of used) Botany and Medical book ever in the East and West entitle *De Materia Medica* detailed more uses of spice and plants for health purposes. The use of herbs and spices remained a regional affair until between 4500-1900BCE when an international trade in spices and herbs began mainly with the Ethiopians (Tapsell *et.al.*, 2006). The used of spices and herbs remained crude not until around 9th Century that the Arab Physicians used spices and herbs to formulate syrups and flavoring extracts; laying the foundation for contemporary uses of herbs and spices (Duke, 2002).

Method

This paper summarizes on selected published and unpublished research works. The search for literature in this article is done on popular Google Scholar, PubMed Central and Medline using keywords like "The important of African herbs and spices; The medical and curative uses of herbs and spices; The physiochemical compositions of African herbs and spices". Article's search was conducted and screened between September -to- December, 2021. Clinical reports, cohort studies, review cases and editorial series were critically screened so that only articles that met the aim of this review were selected and considered. All-inclusive literature reports, cohorts' study, *invivo* and *invitro* reports with respect to Negro pepper/Grains of Selimi (*Xylopia aethiopica*) and Prekese/Uyayak *(Tetrapleura Tetraptera)* where jealously considered.

Culinary Herbs and Spices

Culinary herbs could be annual, biennial or perennial plant whose tender roots, green plants, ripe/unripe seeds/fruits possess a uniquely aromatic fragrance and aroma that is appreciable to food preparation and preservations (Opara & Chohan, 2014). It is noted that the uniquely aromatic fragrance in these plants is traceable to the self-concentrated volatile oil or other chemical substances unusual to their species (www.projecttopics.org). The herbs with pleasing scent are known as sweet herbs because of their longtime traditional used in cuisine and unique characteristic flavor in soup, stews, dressing sauces and salads to engrossed the term culinary herbs whereas others with unpleasant scents are rather used as preservatives and repellants (Chang, 2003). Local spices on the other hand are any of the edible vegetable products with a sweet fragrant or aromatic but pungent to taste.

Today, the used of culinary herbs and local spices in many countries is quite revealing, industrious and extensive with local and cultural history; for instance, in Nigeria, the herbs, seed and spices reflect the country's rich and extensive culinary history as well as its vast natural resources (Sofowora, 1993). As with most African countries, Nigeria's food culture bears the mark of pre-colonial, colonial and trade with other parts of Africa and Europe. These are also reflected in the varied palette of flavors that show up in recipes from the West African Nations (www.projecttopics.org). Culinary herbs and spices make invigorating tea and drinks as purgatives, detoxifying, aroused libido and boost hunger in human. According to Pereira and Tavano (2014) the potential natural antioxidant additives in most herbs served as messaging liquid; used as communication liquors and oils for bites; management of distensions, wrenches, pang and contusion; as cataplasm/poultices to withdraw foreign bodies and impurities; as aphrodisiacs that makes a man virile; gravidity in woman also as contraceptives for woman as it induces abortion at earlier gestations (Edeoga *et.al.*, 2005).

The efficacy of these plants depends more on the processing, storage and the application techniques. For instance, Borut Poljsak *et. al.* (2021) has demonstrated on the modification of natural antioxidants through different food processing methods/techniques and storage methods. According to them, heating/thermal, drying, ultraviolent, pulsed electric field treatment, lightening and irradiation drastically affect the antioxidant mobility of most herbs. Eyenga Manga, Brostaux, Ngondi and Sindic (2020) also added that, the bioactive molecules and polyphenolic properties in *Tetrapleura tetraptera* and *Aframomum citratum* fruits where the active ingredients that makes them efficient and effective in managing different ailments however, when heated or exposed to certain temperature range undergoes denaturation. On the coronary, Chohan, Forster-Wilkins and Opara

(2008) submitted that soup making, stewing and simmering significantly captivate antioxidant capacity whereas stir frying and grilling constantly reduces/decrease antioxidant capacity. Based on the foregoing both conventional and non-conventional agents and herbal therapy of Negro pepper/Grains of Selimi (*Xylopia aethiopica*) and Prekese/Uyayak *(Tetrapleura Tetraptera*) is discussed based on Morphology and Somatic; Physicochemical and phytochemical Compositions; Applications and Uses; taking into consideration the principle of Ayurveda, Allopathic, chiropractic, homeopathy and traditionalism into practice.

TETRAPLEURA TETRAPTERA (Prekese/Uyayak/Oshosho/Asihisihi)

Morphology and Somatic

*Tetrapleura tetraptera (*T.T) is a native and common plant in West Africa. The importance of the plants is labeled with native names, such as Prekese in Twin Ghana; Chêboué in Côte d'Ivoire; Uhio in Igbo, Aridan in Yoruba, Dawo in Hausa and Asighisighi in Ogbia in Nigeria respectively. T.T is a vigorous single stemmed flowering perennial tree of about 30m or taller (Margret, 1988; Aladesanmi, 2006). It is a deciduous tree from the *Fabaceae* family, of the *Mimosoideae/Caesalpinioideae* sub-family in the Order of *Fabales* and Genus of *Tetrapleura*. It is grown and mostly found in the lowland forest area of the tropical rainforest in Africa (N'zebo *et al.,* 2020).

Tetrapleura tetraptera is a glabrous yound branchlets tree with a smooth/rough bark that is grey/brown in completion. The branchlets burs flowers paired in the terminal axils (Shvidenko, 2008). T.T is a flowering plant and its flower is always yellow/pink and racemes white that matured into dark brown fruits of four-winged pods (12-25 x 3.5-6.5cm) (Fig.1). The fruit is consisting of small fleshy pulp of brownish-black seeds that is appealing to the eye (Aladesanmi, 2006; Yin *et. al*., 2019). The fruits possess a unique fragrant, characteristically pungent aromatic odor that is responsible for repelling insects and fish poisoning, spicy (topically exotic) and redolence in food preparation while its bark is used for medicinal purposes (Manga *et.al.,* 2020).

Physicochemical and Phytochemical Compositions

The important of *Tetrapleura tetraptera* (T.T) particularly in folk medicine has attracted researchers' interest over the years, and has revealed important compositions of the plant. The compositions of numerous bioactive phytochemicals in T.T had established outstanding radical scavenging activities and antioxidant potency (Igwe & Akabuike, 2016; Saliu *et.al.* 2021). For instance, the study by Uyoh, Ita and Nwofia (2013) on the chemical composition of *T. Tetraptera* revealed that the plant is composed of 2.886-4.81% ash; 2.79-4.81% fiber; 11.79-21.71% fat; 5.48-7.84% protein and 51.17-66.29% carbohydrates. Igwe and Akabuike (2016) also affirmed that T. *Tetraptera* seeds contained 0.34% phenols, 0.91% flavonoids, 0.52% alkaloids, 0.23% tannins, 0.51% saponins, 5.23% ascorbic acid, 0.11% riboflavins, 1.25% niacin, 3.40% β-carotenoid and 0.06% thiamine while the trace element content (mg/kg) based on dry weight in the pulp, seeds and whole fruit remained Fe (162.00 ± 7.14, 115.00 ± 12.00, and 154.00 ± 25.20, respectively), Zn (31.60 ± 4.77, 43.40 ± 5.29, and 41.50 ± 8.97, respectively), Cu (16.10 ± 4.98, 11.90 ± 8.40, and 17.20 ± 14.50, respectively), Mn (55.30 ± 2.41, 156.00 ± 10.20, and 122.00 ± 5.29, respectively), Co (38.10 ± 6.40, 21.10 ± 7.15, and 44.00 ± 14.90, respectively) and Se (1.49 ± 0.17, 2.43 ± 0.28, and 2.97 ± 0.27 μg/g, respectively) (doaj.org; Oteng *et.al.,*2020). Other phytochemicals contemporaries in the fruits of T. *tetraptera* includes terpenoids, steroids, glycosides, plummeting glucose levels and anthraquinones (Famobuwa *et.al.,* 2016); others include naringenin, ferulic acid, oridonin and scopolamine as active elements that is very germane in the therapy of neurodegenerative diseases (Odukoya, Odukoya & Ndinteh, 2021).

Further studies revealed other two active oleanane-type of saponins antioxidants like tetrapteroside A and B, in the stem bark of T.T plants (Not´e, 2009); while the leaves and stems also contain stigmasterol, stigma-5, 22-diene-3-O-*β*-D-glucopyranoside, 3-O-*β*-D-glucopyranosyl-2'-acetamido-2'-deoxy]-oleanolic acid, pheophytin and tetracosanol (Olajide, Fatokun & Okwute, 2020). Another oxygenated compound found in T.T includes spathulenol (0.20 %), δ-eudesmol (0.80 %), α-cadinol (2.49 %) and hydrocarbons including α-copaene (0.25 %), β-elemene (0.21 %), γ-cadinene (0.19 %) (N'zebo *et.al.,* 2020). More so, the Methanol extracts from the fruits of T. *Tetraptera* led to the isolation of a saponin glycoside with an oleanolic acid aglycone, a monodesmosidic diglycoside of the rare sapogenin 27-hydroxyolean-12 (13)-en-28-oic acid; echinocystic acid-3-0-sodium sulfate from the stembark, umbelliferone and ferulic acid from the leaves and branches respectively (Aladesanmi, 2006; N'zebo, *et.al.,* 2020; Aikins *et. al.* 2021).

Application and Uses

The antimicrobial properties from T.T is also used in making traditional black soap for bathing and skin maintenance (Adebayo, Gbadamosi & Adewunmi, 2000); whilst the shiny dark dry purple glabrous brown fruit from T.T plant with its unique pleasant aroma is useful as spice for pepper soup making to combat cold weather (Abii & Amarachi, 2007). According to Akintola, Bodede and Ogunbamjo (2015), T*. Tetraptera* possess the ability for secondary metabolites, nutrients supply and medicinal constituents and its fruits causes substantial reductions on the indices of hematology in male rabbits as contrary to female rats (Onuka, Okechukwu, Maxine & Bond, 2017) which by implication is not advisable for used at early pregnancy.

The curative potency of T.T is proven to be effective in arrays of human ailments (Ebana *et.al.* 2016; Larbie, *et. al.,* 2020) without selective used of the plant parts. The whole parts of T.T plant have demonstrated usefulness and effectiveness in human health curative medicine, though the phytochemical compositions vary discretely among plants parts. Oteng *et.al.* (2020) additionally exposed that, nutrient concentration, vitamin and other trace elements concentrations significantly very among fruits part (seeds, pulp and whole fruits) of T. *Tetrapleura*. Interestingly and quite revealing that the variation in elements like among fruits parts (Pulp, Seeds and whole fruits) follow in this respective other Co>Zn>Fe>Cu>Se>Mn. Also, the differences in the discrete parts of the fruits revealed that the whole fruit possess higher concentrations in vitamin and trace metals.

Ojewole (2005) disclosed it that the aqueous fruits extracts from T.T plants contained analgesic and anticonvulsant properties; anti-inflammatory and hypoglycemic (Obiri & Osafo 2013). It also inhibits bovine serum albumin and 5-LOX denaturation (Manga *et.al.,* 2020). The anti-spirochetal properties from T.T bark and fruit is capable of terminating pathogenic agents causing syphilis, relapsing fever and yaws (Adegbenu, Aboagye, Amenya & Tuah, 2020). Traditionally, Africans used T.T to manage and cure infertility in women within the age bearing group, treat hemorrhoids, malaria, uterine fibroid, cough, diabetes, syphilis and dysentery in various preparatory forms as the case may demand while the anti-oxidizing properties in the plant is used for preventinm ng and destroying cancerous tumors (Okigbo, Mbajiuka & Njoku, 2006). Currently, cancer research is taking lead in improving on the already existing therapies through the exploration and the use of natural plants products with no side effects (numbness, hair loss, chronic excruciating pains in body parts, vital organ damage, tumor reoccurrence and chemo resistance). T.T is among the few selected plants identify to clear off the negative remarks on the 18.1million new cases of cancers and 9.6million global cancerous death annually (Bray, *et. al.,* 2018); Alkins *et. al.,* (2021) has reported that T.T extract can be used for breast

cancer treatment because the extract fractions of T.T. contained waning activity of less than 100µg/mL against Jurkat cells which is more vulnerable than MCF-7 cells.

The seed of T.T when chewed or taken as decoction treats epilepsy, anemia and numbness (Boampong, *et. al.,* 2013). The seed is used traditionally to enhance postpartum placental expulsion by newly put to birth mothers (Yin *et.al.,* 2019), treat analgesic (Woode, *et. al.* 2012), act as antidiabetic (Mohammed, Koorbanally & Islam, 2016; Manga, Brostaux, Ngondi & Sindic, 2020); cure cardiovascular diseases (Odukoya, Mmutlana & Ndinteh, 2021); served as Antimalaria (Lekana-Douki *et. al.,* 2011; Boampong *et. al.,* 2013); antimicrobial effects (Fleischer *et.al.,* 2008).

The documented biological and pharmacological potencies of T.T. according to Aladesanmi (2006) is bounded around molluscicidal, hypotensive, anti-convulsant, cardio-vascular, neuromuscular, trypanocidal, schistosomiasis management, hirudinicidal, anti-ulcerative, ecotoxicity, anti-inflammatory, hypoglycemic, anti-microbial, emulsifying property, birth control, food value and the control of intestinal parasites (www.scienec.gov). In 2015, Kuate *et. al.* also submitted that T.T plant possess unique properties like antilipidemic, anti-obesity, anti-insulin resistance, anti-inflammatory and anti-hypotensive against HET; thus, its potential could be developed further to manage Met's like Obesity, T2DM and hypertensions.

In Cameroon; Nwakiban *et. al.* (2020) submitted that the extracts from T.T abridged on the expression of some NF-κB-dependent pro-inflammatory mediators strictly involved in the gastric inflammatory process, such as IL-8, IL-6, and enzymes like PTGS2 (COX-2), without distressing on the PTGS1 (COX-1) and further concluded that T.T extracts decreased pro-inflammatory markers by inhibiting the NF-κB in the gastric cells, justifying in part, the traditional use of the spices. The efficacy of T.T is believed to play remedial and curative influence on Covid-19 pandemic following recommendation made by Oladele *et. al.* (2020); Singh, Kumar, Jyoti and Kumar (2021) and Sengupta *et. al.* (2021) also reported that the mechanisms action of SARS-CoV-2 can be managed successfully through therapy combinations of medicinal herbs in consideration to individual pharmacological strengths.

Furthermore, the Aqueous extract from T.T is said to enhanced steroidogenesis, spermatogenesis and maintained testicular integrity in rats (Adelakun, Ogunlade, Olawuyi & Ojewale, 2021); hence, with the antioxidant properties and free radicals scavenging ability of the plant parts; it can be used to improved testicular toxicity in human. In summary, the flavonoid and antioxidant as well as pro-fertility properties of T.T antioxidant activity and pro-fertility potential of T.T extracts also served a potent adjuvant in the treatment and management in male infertility (Adelakun, Ogunlade, Olawuyi & Ojewale, 2021). To put an end to the common viral schistosomiasis parasitic disease (bilharziasis/Snail fever) transmission through fresh water snails that is very peculiar in the Niger Delta region of Nigeria; Afolabi, Babatunde and Simon-Oke (2017) has demonstrated the use of *Tetrapleura tetraptera* among other plants parts (fruits, barks and leaves) like *Bridelia Ferruginea* and *Azadirachta Indica* to improve the veritable means of controlling schistosomiasis and other trematode infections.

Another disease of medicinal concerned is Liver diseases. The antioxidant properties and hepatoprotective activity of the polyphenolic extract from the fruits of *Tetrapleura tetraptera* have demonstrated effectiveness on the treatment of liver injuries (Saague *et. al.,* 2019). On a new development, the alcohol distillation company is taking advantage of African herbs like T. Te*trapleura* to boost peculiarity and win public like for their products. T. *Tetrapleura* is an active ingredient among other herbs in the popular alcohol dry gin named **Action Bitter.**

Fig 1. TETRAPLEURA TETRAPTERA (Prekese/Uyayak/Oshosho

XYLOPIA AETHIOPICA (Negro pepper/ Grains of Selim)

Morphology and Somatic

Xylopia aethiopica is an aromatic tall slim tree measuring 15-30m tall and 60-70cm in diameter (www.worldagroforestry.org). It has a straight stem and crowned with many branches that sometime buttressed at a circumference of about 70-120°. The plant is naturally common to the lowland area of the tropical rainforest and the moist fringe forest of Africa, particularly in countries like Nigeria Burkina-Faso, Benin, Cameroon, Gambia, Ghana, Guinea, Sierra-Leone, Sudan, Central Africa Republic, Ivory Coast, Tanzania, Kenya, Togo, The Democratic Republic of Congo, Mozambique, Liberia, Zambia, Ethiopia, Gabon, Uganda, Sao Tome and Principe (Okagu, *et. al.*, 2018). *Xylopia aethiopica* is in the Family of Annonaceae (Custard apple family), Order of Magnoliales and Genus of Xylopia (Burkill, 1985; Harris *et. al.*, 2011).

Etymologically, Xylopia is derived from a Greek word called **Pikron Xylon (iXov Irt'poy)** meaning "bitter wood" while "aethiopica" denoting to the Ethiopian origin of the tree. Xylopia at mature stages buttresses over a meter high with a grey-brown bark, smooth or finely vertically slightly fissured and fibrous, flaking easily, topped by a plume of branches and twigs out horizontally (www.projectopics.org). It is a flowering plant and each flower produces one fruit, but each fruit can have up to 20 individual carpels of about 7-24 forming dense cluster. The fruits looked rather like small twisted beans-pods, cylindrical and dark brown of about 4-6mm thick and 1.5-6cm. Each pod is contained with 5-8 kidney pod shaped seeds grain of 5mm length with a yellow papery aril whose contour of the seeds is visible from outside (Figure 2) (www.worldagroforestry.org). The best of it is that the aromatic part is in the seed and not in the hull.

The usefulness of the plant is accorded with local names in various languages such as the Akan-Asante of Ghana (hwenteaa), Ewe of Ghana (Etso); Arabic (Fulful as-Sudan, Hab al-Zelim), Dutch(Granen Van Selim) Edo (Unien), English (Grains of Selim, Kani Pepper, Ethiopian Pepper, Moor Pepper, Negro Pepper, Senegal Pepper, Guinea Pepper and African Pepper); Efik/Ibibio (Atta); Hausa (Kimba, Chimba); Estonian (Etioopia Ksüloopia); French (Piment noir de Guinée, Kili, Graines

de Selim, Poivre de Sénégal), Korean (Kusillipia); German (Senegalpfeffer, Selimskörner, Kanipfeffer, Mohrenpfeffer and Negerpfeffer); Greek (Αφρικάνικο (Afrikaniko Piperi); Lithuanian (Juodieji pipirai); Portuguese (Pimenta-da-África, Pimenta-do-congo); Russian (Кмба перец); Polish (Pieprz murzyński); Hungarian (Arabbors, Borsfa); Igbo (Uda, Oda); Nupe (Tsunfyányá) (Okagu *et. al.,* 2014); while in Ogbia, Niger Delta, Nigeria it is called Alalar.

X. aethiopica is a flowering plant that bears flowers twice a year in West Africa between March-July and October-December; fruiting starts in December-March and June-September (Opara & Chohan, 2014). The Wet and dried fruits of X. aethiopica (Grains of Selim) is used as spicy and for traditional medicinal purposes (www.projecttopics.org). Aside the flavoring importance of *X. aethiopica*, it served as a closer alternatives/substitute to pepper, hard wood for hurt constructions (post, roofing ridges) and local boat construction (Masts, Oars, Paddles and spars) while in countries like Togo and Gabon, *X. aethiopica* wood is used traditionally to make Bows and Crossbow for Warriors and Hunters (Burkill, 1985).

Physicochemical and Phytochemical Compositions

X. *aethiopica* contained a variety of complex chemical compounds which are of significant important for traditional folk medicine and therapeutical used (Edeoga, Okwu & Mbaebie, 2005). The plant contains flavonoids, alkaloids, cineol, limonoids, Ditterpenic, Limonene, Folic Acid, polysaccharides, phenolics phytosterols, tannins, saponins, glycosides, carbohydrates, β-phellandrene, spathulenol, bisabolene, nimbidin compounds, anti-spirochetal, anti-oxidizing properties pinocarveol, 3,3-dimethyl-1-vinylcyclohexene, 4,4-dimethyl-2-vinylcyclohexene and myrtenol as well as Vitamins such as A, B1, B2, C and E (globalfoodbook.com; Ezekwesili, Nwodo, Eneh & Ogbunugafor, 2010; Yin, 2021). These compounds are responsible for reducing blood cholesterol, boosting oxidant activity, reduces risk of cancer, management of heart problems, acting as antiallergic, anti-cancer, anti-inflammatory and anti-viral activities (Obajuluwa & Durowaiye, 2012). On the other hand, Okagu *et. al.* (2018) disclosed the predominant amino acids present in *Xylopia aethiopica* fruits which include proline, alanine, norleucine, isoleucine, glycine, threonine, cysteine, methionine and tryptophan, while the most abundant fatty acids include arachidonic acid, dihomoϒ-linolenic acid, palmitic acid, caproic acid, linoleic acid, palmitoleic acid, stearic acid and myristic acid.

X. *aethiopica* parts and products such as the fresh and dry bark, fruits, leaf, stem bark and root bark has demonstrated multiple notches of activities counter to both Gram-Positive bacteria (*Staphylococcus Aureus and Bacillus Subtilis*) and Gram-negative bacteria (*Pseudomonas aeruginosa* and yeast-like fungus *Candida Albicans*) (Puvanendran *et. al.*, 2008). However, the overall picture of a complex essential oil composition is based on a constant monoterpene profile having pinenes as a major constituent in fruits which is a main storage compartment for the essential oils, with levels of up to 7% while the leaves contained 30 times less on average of the essential oil than the fruits and 100 times less the bark (Kama. *et.al.*, 2014). The dry leaves are sometimes grand into powder form and taken as snuff for treating headaches and bronchiole pneumonia (Burkill, 1995).

It will interest you to know that among the various West African *X. aethiopica* been studied; the Nigerian sampled outshine other West African country samples regarding quality, antioxidant effects, flavonoid contents, total phenolic etc (Yin *et. al.,* 2019); a potent reason why the plant products is used for mouth washing, treatment of toothaches, tooth decorations; it is administered orally to expel intestinal worms with other related parasitic animals responsible for dysentery (Yapi *et. al.* 2014). These minor disparities were also found in the root bark and stem bark oil from the

Ivoirian *X. aethiopica* been difference considerably from the Ghanaian plant part extracts with contents like 8-diene and transmentha-1-7 (Karioti, 2004; Yapi *et. al.,* 2014).

Application and Uses

Evidence by Abolaji, Adebayo and Odesanmi (2007) confirmed that the mixture of *X. aethiopica* with other roots like the root of *Uvaria Chamae Annona Senegalensis, Gardenia Tennifolia* and *Strychos Inogia* is used in managing coughs, fever, flu and cold, while a mixed used with *piper guineense,* utazi leaves and pepper induces labor, boost the clearing of blood clots in the womb after delivery, healing and recovery process of wounds and for blood replenishment after delivery (globalfoodbook.com; John-Dewole, Agunbiade, Alao & Arojojoye, 2012). In same vein, the dried Negro pepper is used to cure female abdominal pains, increase menstrual blood flow and the treatment of Amenorrhea (abnormal absence of menstruation) (Fetse, Kofie and Adosraku, 2016). Nursing Mother in Africa, traditionally consumed Negro Pepper to boost breast milk production and increase appetite after putting to birth (Victor, 2019); this is because Negro pepper is capable of stimulating lactogenesis (milk production after giving birth), inhibit pregnancy after birth, suppressed cycle for ovulation (ThankGod, Anacletus & Wopara, 2015). The fruits from Negro Pepper is a close substitute/alternative to pepper for cooking while its anti-spirochetal properties of the plant is a defensive management and treatment for primary, secondary and tertiary stages of syphilis (Boampong, *et.al.,* 2013; Fetse, Kofie & Adosraku, 2016).

Interestingly, most Gastrointestinal problems like dysentery, stomach ache and gastric Ulcer is better managed using Negro Pepper fruits while the bark when soak in alcohol is used for the management and treatment of other respiratory system diseases like bacterial pneumonia, bronchitis, asthma, rheumatism, arthritic, biliousness, dysentery antipyretic and anti-inflammatory (Okigbo, Mbajiuka & Njoku, 2006; Obiri & Osafo, 2013). It also served medically as Carminative, management of cough, post-partum tonic and lactation aid, whereas in Cote D'ivoire, the fruit is used as analgesic for chest pain and expulsion of parasitic worms (anti-helminthic) like tapeworm, liver fluke, ascarid and leech (Esuoso & Odetokun, 2005).

The rummage-sale of herbal therapy is gaining strength in the promotion of heartiness and improving diabatic patients (Kibiti & Afolayan, 2015). The essential fruits oil from *X. aethiopica* has showed activity against four microorganisms and cytotoxic to carcinoma cell (Hep-2 cell line) at 5mg/ml concentration (Asekun & Adeniyi, 2004); and in West African traditional medicine, the decoction from the fruit of *Xylopia aethiopica* is generally utilized for the management of diabetes mellitus (DM) in a joint used or single used following prescribed process. X. *aethiopica* acetone fraction (XAAF) treatment has exhibited excellent anti-diabetic effects in a T2D model of rats because of the antioxidant potentials (Mohammed, Koorbanally & Islam, 2016); it was further professed that the potent antioxidant properties of X. *aethiopica* is used to ameliorate oxidative stress that is associated with metabolic complications like TDS (Mohammed & Islam, 2017).

In most cases, the dried fruits are used for increasing menstrual blood flow and induced abortion which also serves as local contraceptives for control spacing of children when solution is taken after sexual intercourse (Karioti *et. al.,* 2004). The crumple seed of Negro Pepper is very affective in the treatment of skin boil, skin flare-up if topically or directly apply on the skin (Okigbo, Mbajiuka & Njoku, 2006; Ilusanya, Odunbaku, Adesetan & Amosun, 2012). The seed can be crinkled and topically placed on human forehead for managing neuralgia and headache (Fets, Kofie & Adosraku, 2016). The fruits, roots and the bark contained anti-malaria properties; a peculiar curative and prophylactic

acid properties on plasmodium berghei-induced malaria as well as antipyretic properties which is an ideal antimalaria drug candidate that also served as insecticides to combat insect invasion and treatment of malaria (Adewoyin, Odaibo & Adewunmi, 2006). Nguemtchouin *et. al.* (2010) has also demonstrated an insecticidal formulation that is founded in the essential oil of X. *aethiopica* when mixed with kaolinite clay mostly used for the protection of maize. The formulation between X. *aethiopica* essential oil and kaolinite clay is very insecticidal for the protection of maize seeds and it has revealed that the formulation based has a mortality rates ranging between 22% at 2.5% (w/w) to 100% at 10% (w/w) with a lethal concentration of 50% mortality rate (LC50) at 4.35% (w/w). Lajide in 1995 further reported that the crude extract of x. *aethiopica* exhibiting strong anti-feedant activities on subterranean termite (*Reticulitermes speratus*).

Xylopia aethiopica posse analgesic and Sedative effects that is used traditionally for treating central nervous system disorders like epilepsy. The essential oil from the plant product displayed antidepressant potential on 5-HT neurotransmission that is mostly possible with glutamatergic effects on the glycine B Co-binding site and nitric oxide synthase inhibition (Biney *et.al.*, 2016). It was further demonstrated, that the anti-depressant effects of essential oil from X. *aethiopica* posse management mechanisms on unpredictable chronic stress disease like depression by mitigating against oxidative stress and reducing serum Corticosterone (CORT) and brain monoamine oxidase-A (MAO-A) levels (Ekeanyanwu, Nkwocha & Ekeanyanwu, 2021). Remarkably, normal cell metabolism that causes damage to biological macromolecules capable for causing sever health threats to human at high concentrations is possibly managed using essential oil from X. aethiopica. Further study by Moukette, Pieme, Nya Biapa and Ngogang (2015) disclosed that *X.* aethiopica contained complex antioxidants, potentially protective against ion-mediated oxidative damage.

Ogbonna, Nozaki and Yajima in 2013 demonstrated the importance of X. *aethiopica* extract in fruits juice preservation. Their finding revealed that X. *aethiopica* fruit contained selective antimicrobial activities against Gram negative/positive pathogenic and lactic acid bacteria, fungi and other pathogenic microorganisms responsible for causing food born infections, food poisoning and spoilage, such as, Escherichia coli NRIC 1023, Bacillus subtilis IAM1069, Staphylococcus aureus FDA 209p, Bacillus cereus IFO 13494, Leuconostoc mesenteroides-M, Salmonella typhimurium IFO12529, Lactobacillus plantarum IAM 1041, Pediococcus acidilactici-M, Lactobacillus casei TISTR390, Saccharomyces cerevisiae OC-2, Hansenula anomala IFO 0140 (p), Pichia memb IFO 0128, Penicillium funiclosum NBRC 6345 and Candida species (www.ajol.info). It was concluded that Orange juice can be preserved at room temperature using 100ppm solution of X. *aethiopica* at 4cfu/mL for 28days. It is said to maintained similar effectiveness in a related fresh juice.

Further studies on meat preservatives using natural sources has been successful in extending the shelf life of meat by inhibiting survival of spoilage microorganisms due to high levels of amino acids, causing microorganisms metabolism, producing ammonia, organic acids, ketones and sulphur compounds. Bagwai, Magashi and Burkar (2019) has demonstrated the usefulness of X. *aethiopica* in meat preservation; stating that the Ethyl acetate fraction from X. *aethiopica* when applied on fresh meat help decrease pH, reduce microbial load and preserve fresh meat at ambient temperature for up to 96 hrs. (4days). This summarized that; fraction of X. *aethiopica* fruits represent probable foundation of natural preservatives in meat food and drinks as an alternative to synthetic chemical preservatives.

At present, the search for natural feed additives in replacement for growth promoting antibiotics is gaining more research attention; African Negro pepper (X. aethiopica) is observed to have those potentials to be among the league of these feed additives. In 2018, Ndelekwute and Enyenihi

conducted an experimental study to determine the proximate composition of Negro pepper, its antibacterial effect and its dietary effect on growth performance of broilers using 150 Ross and 308 chicks; and was submitted that 2.5g/kg Negro pepper added to broiler diets promotes optimum productivity. This is because the phytogenics or phytobiotics in X. *aethiopica* when incorporated into diets of farm animals; it not only improves productivity and performance but also guarantee products quality (Isikwenu & Udomah, 2015). Similarly, recent experience gathered about X. *aethiopica* use in human nutrition is been applied in monogastric animals due to its anti-oxidant and antimicrobial activities and yielded positive results (Omodamiro, Ohaeri & Nweke, 2012). The challenges of coastal erosion and other related environmental problems in most African countries utilized X. *aethiopica* for environmental restoration and conservative purposes. For instance, to ensure its sustainability, commercial use and maintained production/constants supply of essential oils of X. *aethiopica* for food and medicine; a program of afforestation for the poor coastal savannas in the region of Pointe-Noire has demonstrated extremely encouraging results in Coastal Forest protection in Congo-Brazzaville using X. *aethiopica* (Karma, 2014). On a new development, recent observation shows that a Negro pepper fruit extracts have demonstrated effective corrosion inhibitors for mild steel (Giwa, Adetunji & Wewers, 2020).

Fig. 2. Negro Pepper (Xylopia Aethiopica)

Drivers and Effects of Uncontrolled Deforestation in the Niger Delta

Forest is a natural self-regulating system with antique contributions that has influenced social patterns, economic and environmental development, supportive to livelihoods, aide economic change construction and encouraging sustainable growth (Hwang, 2017). The uses of African plants as discussed above is not limited to culinary, medicinal and food but also timber, firewood, shade and cultural applications. The latter is dominating the system as poverty, decaying human consciousness, fast means of wealth creation, urbanization, weak institutions and poor implementation of policies occupied a centre point of the human society particularly in Africa. The end point of these factors has exposed these valuable plants imperiled. The use of Non-Timber Forest Products for the sustenance of forest community dwellers and their livelihoods is an age long African inheritance, with its used, extractions, collections and local/regional trading is still ongoing

typically in rural and semi-rural communities. In countries like Benin and Nigeria; these plants are vulnerably exposed and threatened to extinction due to anthropogenic pressures and uncontrolled extractions for multiple uses. Studies has showed that medicinal use of these plants accounted for more than 60%; firewood, construction wood and food used accounted for 18% while magico-religious uses accounted for 22% (Ganglo *et. al.;* 2017; Silou, Bassiloua & Kama-Niamayoua, 2021). Sadly, these trees are regarded as hard wood upon the fading out of hard woods like Mahogany and Iroko by lumbers and woodworker; having fine grained, hard and durably fit for building, roofing and crafting; Negro Pepper and Prekese trees are substituted for woodwork needs. Also, the fire from this wood is classified into class A Fire; possessing rapid oxidation level, volatile and very flammable with a roaring inferno, generating heats fit for cooking with limited smokes and smoldering; craving the need demand for local firewood by locals due to increasing cost of cooking gas in the country. Surprisingly, more than half of the world peoples depend on firewood for heating and cooking; currently the probable demand for wood in Nigeria for the year 2020 was 180 million metric tons contrary to the 100 million metric tons, sustainably supply level annually (Mongabay, 2021). This has prompted 14% loose on the primary forest at a changing speed rate from 3.12% to 31.2% per annum (Vizzuality, 2021). My greatest fear is that, if the proposed "Operation Feed Yourself Program" per UN-Backed Food System Dialogue is launch in Africa to fight/tackled malnutrition's, these plants stand the chance of going into extinctions if proper policy monitoring is not put in place in the right perspectives to address the dare issue.

Conclusions

Today, out of the known 4,600 plant species endowed in the country, 707 species is endemic including culinary and medicinal plants of this study (National Forest Policy, 2006). Undoubtedly, the 3.12% annually deforestation rate in the country has translated to an average degradation of about 350,000ha - 400,00ha of her natural forest yearly which is contrary to the proposed government policies in maintaining 20-25% of the country land area as forest reserved, parks, gardens and ranches for the well-being of the nation, regional and global environment. Regrettably, the protection of these unique natural biodiversity remained unrealistic under the current rate of deforestation (permanent or enduring conversion of the forest cover into other land uses like farming, animal husbandry, pasture, water reservoirs, infrastructure building and urban development) in the remaining natural forest and the forested wetlands. An act that has influenced directly (Population growth, density and spatial distribution) or indirectly (social, economic, Institutional, political and cultural) drivers; responsible for about one-fifth (1/5) total greenhouse gas emissions and other environmental impacts like habitat fragmentation; biodiversity loss; water cycles disruption; soil erosion and desertification.

Unpredictably, Man remained a direct recipient (precipice) of his actions that has caused imperial discomfort to his existences particularly the current generations. Inquest for revising man's ill actions on the environment, man has jointly fitted into several environmental policies and programs for promoting safer earth. In Nigeria, some of the unyielding environmental driven policies includes, The National Forest Policies; The National Drought and Desertification Policy; The National Drought Plan; The National Environment Policy; The Climate Change Policy and Response Plan; The Reducing Emissions from Forest Deforestation and Degradations (REDD+); The National Forestry Trust Fund etc; each with underpin challenges such as Illegal felling and poaching, ineffective coordination and supervision, misinformation from policy makers, inharmonious roles by forestry stakeholders, absent of private forest plantation and undefined forest program (Faleyimu & Agbeja,

2012). Recently, President Buhari has promised to plant over 25 million trees before the year 2025; the fifth summit of the Pan African Agency of the Great Green Wall also resolved to restore African (Nigeria inclusive) degraded land and to hold back the encroachment of the Sahara Desert by growing 8,000km of trees to stretch out the whole Sahel region may end up as mere press statement without practical actions. Africans should arise to the protection, preservation, discovering and genetically utilization of her abundant plants resources to immensely contribute to the food tables and medicine cabinet and amass on the abundant wealth thereof.

Currently, the country needs essential practical and avant-garde policies, anticipating social, economic and environmental changes that promote forest sector development through practicable policy formulation, institutions, implementation and enforcement of Community Forest Guide program. The proposed Community Forest Guide (surveillance) if instituted will liaise with rural communities, other forest stake holders, law enforcement agencies in enforcing forestry policies in the country.

Imperatively, Forest is the original habitat of man and every forest is linked to people and the people understand better of these resources and ways to manage it if giving the necessary supports. For ages, some Communities with Dense Forest in the Abureni (Kolo and Idema Town) in Ogbia Local Government Area, Bayelsa State, protected her Forest Trees, particularly the Culinary and Medicinal Plants through the enforcement of outstanding local laws. These laws are implemented with a fee per storm head; for instance, any Wild Mango tree cut attract a fine fee of One Hundred Thousand Naira (100,000) only while Palm trees; Negro pepper/Grains of Selimi; Prekese/Uyayak etc. attracts a fine fee of Fifty Thousand Naira (50,000) only. Conservationist appreciates the settings in these localities in protecting forest resources and in the realization of Good Health and Wellbeing; Responsible Consumption and Production; Climate Action and Life on Earth (UN Goal 3; 12; 13 and 15 respectively) of the sustainable Development Goal by 2030.

Recommendation

This paper therefore recommended:

- The formulation and enforcement of Community Forest Guard Policy and Programs in saving Man's Forest.
- Encourage and sponsor new groundbreaking research to discover other pharmacological/medicinal use of these plants
- Promote, support and monitor indigenous mass production and used of plant-based medicines.
- Integrate traditional medicines into the national health care systems.
- Protection of intellectual property rights and traditional medical knowledge

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