THE ROLE OF PHYTOBIOTECHNOLOGY IN PUBLIC HEALTH

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Content

Summary

An evaluation on the role Phytobiotechnology could play in disease prevention, treatment and effect sustainable health is presented. This report is based on work by the author over an eight year period [2000 to 2008] built on traditional knowledge and medicinal plants used in traditional medicines surveyed from amongst tribes in Cameroon, Nigeria and Benin republics. These formed the basis for experimentation, validation, development and application of appropriate biotechnologies for cheap, low-tech disease control strategies with an equally high efficiency and ecological acceptability. The findings generally show that most African tribes as well as globally have a rich heritage of indigenous knowledge and medicinal plants that can be utilized through product formulation using simple and cheap biotechnologies to attend to human and livestock diseases rather than the over dependence on synthetic drugs with its

uncomfortable side effects Herbiotics formulated from screened plant extracts whose antimicrobial activities have been ascertained can be used directly to control infectious diseases such as Salmonellosis, Amoebiasis, tuberculosis, cryptosporidiosis, Malaria, Toxoplasmosis, Hepatitis, Leishmaniasis, Dracucunliasis, HIV and AIDS etc, replace pesticides/insecticides for vector control, tick sprays for ectoparasites of man such as lice e.g., Sarcoptic mange, Pediculosis humanus var capitis etc., as well as on animals, phytocosmetics for skin problems in human and livestock and in the end reduce the dependence on synthetic biocides and drugs. Plants such as Allium sativum (garlic), Vernonia amygdalina (bitter leaf), Moringa oleifera (Horse radish plant), Lantana camara, Occimum gratissimum (basil), Aspilia africana (Iodine plant), Carica papaya (pawpaw), Aloe barbadensis, Khaya senegalensis, Artemisia annua, Distemonantus benthamianus, Standia kamerunansi, Viscum album, Arctium lappa, Cucurbita pepo (pumpkin) and macrofungi such as Ganoderma lucidum, pleurotus tuberregium, Termitomyces titanicus amongst several others were identified as important candidate plants and macrofungi that could bring about hygiene and sanitation when used directly and can provide important leads in the production of natural antiseptics, antibiotics, fungicides and insecticides for the control of diseases. Some of these plants have been formulated with starch from maize and paraffin to control cercaria, Cyclops, and larvae of Annopheles and culex mosquitoes respectively. Extracts from Moringa oleifera and termitomyces have been used as nutriceuticals to boost immunity in HIV and AIDS patients. Moringa oleifera seed extracts amongst others have been used in sand filter systems to purify domestic water while other plants have the potential to control treated waste water for irrigation. Medicinal plants and phytodrugs useful in attending to cardiovascular diseases, hypertension, diabetes etc have been cited. The conclusion is made that Phytobiotechnology has a crucial role in bringing about sustainable health as it is comparatively cheaper and effective. There is therefore the need to further develop and promote it.

1. Introduction: The Concept of Medicinal Plants and Phytobiotechnology

Seventy to eighty percent of the people in Africa live in rural areas and practice subsistence farming. They are generally poor and lack basic amenities and infrastructure. They play host to many diseases: Malaria, Typhoid, Skin diseases etc, and due to the high cost of drugs and inaccessibility to urban areas to purchase these drugs (when money is available), they resort to the use of indigenous plants and traditional medicine. The exploitation of this indigenous knowledge, especially medicinal plant resource base, and its enhancement for easy usage by our rural population is a viable tool in reducing the problems raging in our rural communities.

The African environment is probably the least explored in terms of available resources. One needs to take a course to the plant world to discover untapped resources. Medicinal plants, vast indigenous knowledge and herbal medicine is readily available in our diverse vegetation, cheap and above all carries the potentials of introducing new templates into modern medicine. Medicinal plants have a long history of use in most communities throughout the world. As a matter of fact 80% of Africans depend on homeopathic medicine. In Africa, people still consult traditional healers even when being attended to in conventional orthodox clinics. The history of medicinal plants is widely documented in various pharmacopoeias; Planta medica, Napralert, etc, around

the world. Unfortunately, little effort has been made in transforming this vast knowledge using simple low cost technologies. Apparently, a great number of rich unclassified indigenous knowledge on the therapeutic ability of medicinal plants abounds in Africa that has not been documented for possible modification and application by academia to address the pressing problems of indigenous people on the African continent. Historically, medicinal plants have provided a source of inspiration for novel drug compounds, e.g., Quinine the oldest antimalaria drug was inspired from a south American plant,Cinchonna tree bark, Vincristine and Vinblastine, the famous and widely used antileukaemia alkaloid drug was derived from Rose perinwinkle (Vinca rosea), Ergot Fungus (Clavicep purpurea), Artemisia annua and a host of others are medicinal plants widely known to have inspired synthetic drugs used in modern medicines today.The use of plants in Medicine predates orthodox medical practice. For instance, the ayuverdic practice of India is a medical system more than 3000 years old. Similar traditional medical systems of China had been documented in China 2730 years ago by Shen Nuny. Plant derived medicines have made large contributions to human health. It can be recalled that as far back as 1660, Napoleon Bonaparte used ipecacuanha, -Kurchi- bark to treat amoebic dysentery and other complications of amoebiasis. Many of such examples of indigenous knowledge and practices abound throughout the world and remain largely underutilized through appropriate technology. There are increased use of herbal products globally, for instance, between 1990 and 1997, the use of herbal based products reached 38%. The World Health Organization (WHO) has estimated that up to 80% of the world's population relies on plants for their primary health care while in Nigeria, WHO surveys in 1985 estimated that up to 75% of the population patronizes traditional medicine.

For technology to be effectively transferred, penetrate and impact the wider society, especially in the third world, the technologies must be simplified with a sound foundation on indigenous knowledge reminiscent of the region or locality. For most of the times, this has not been the global trend. Enhancing and applying indigenous medicinal plants and formulations without attempting to manipulate these plants through genetic engineering to control insects and pests of medical importance, attend to diseases of humans, preserve food are components of Phytobiotechnology that will not only cut down health cost but will demonstrate the power and benefit of drawing inspiration from the well springs of nature.

Phytobiotechnology is a marriage of two words, Phyto derived from a Greek vernacular Phyton meaning Herb or vegetable, then biotechnology which is the application of science or knowledge to life systems to derive useful products. Unfortunately, a lot of focus on the definition of biotechnology has been skewed toward the use of microorganisms and molecular biology. Phytobiotechnology is the application of Science or Knowledge to the Plant Kingdom (this includes higher and lower plants like mushrooms, algae, lichens, that can be seen with the unaided eye) to derive products for the benefit of humanity. Phytobiotechnology includes plants and plant based technology for nutrition and control of diseases (nutritherapy) and Phytotherapy, means treatment of diseases by the use of medicinal plants and or medicinal plant extracts. The plant or part thereof can be made in one or more of the following forms: decoction, concoction, infusion, galenical, tincture or a tisane or taken with food or as an enema or in the form of ointment for topical application.

The present form in which traditional medicine on the African continent is practiced cannot really be termed as phytobiotechnology. Phytobiotechnology would require that an existing traditional knowledge on the uses of a medicinal plant is validated using scientific protocols and then formulated into a product using basic pharmaceutical knowledge in its natural form and some form of Standardization (basic analysis of phytochemical constituents),quality control employed. Phytobiotechnology is an ecological approach to drug development from mother earth without artificial interference. The knowledge on medicinal plants and natural product research is widespread globally with an increasing interest but the fundamental phytobiotechnology approach is lacking. The overall purpose of this report is to present the level of work carried out in developing appropriate biotechnologies (phytobiotechnology) from African indigenous plants/knowledge in attending to human diseases, sanitation problems, livestock, pests and ectoparasites of humans and animals. The ultimate goal is to come up with a health system in Africa and the world at large that originates from the available and cultured vegetation. "*The world will never starve for want of wonders but for want of wander*"-G.K.CHESTERTON

The expected outcomes:

- To reduce artificial interference and cut down on the use of synthetic drugs and biocides.
- To optimize the use of available resources in fighting diseases and poverty.
- To promote indigenous solutions in disease-control and environmental pollution.
- To enhance the available knowledge on the efficacy of natural products as drugs and pesticides.
- To reduce cost of health management in our communities' especially occupational diseases due to agriculture, and hence make drugs available to a wider group of people.
- To provoke interest in the medicinal potentialities of various vegetation.
- To provide data on the status of ethno medicinal plants and their scope of applications in various regions of the world.
- To promote skills in the formulation and application of natural products in meeting some of our health needs and finally, to strengthen research on natural products and phytobiotechnology and boost our confidence.
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"*The only disability in life is a bad attitude*"-SCOTT HAMILTON

2. A Recap of Infectiology and Contemporary Challenges in the Control of Infectious Diseases

Infectious diseases constitute the nerve wire of global health today. In particular 80 - 90% of all diseases in Africa are infectious. The transmission dynamics falls within one or more of the following areas; foods, fluids, flies, fields, faeces, fingers, sexual and or congenital. It is estimated that WHO spends more than ¼ of its budget on the control and treatment of infectious diseases. Despite ample studies on the incidence, prevalence, epidemiology, pathogenesis, pathology, pathogenicity and virulence, immunology, transmission, prophylaxis and chemotherapy, the global picture of infectious disease has not improved. The study of microorganisms, *forms* the bedrock of infectious diseases.

Most microorganisms are free-living and perform useful activities that benefit animal and plant life. Without micro-organisms, dead organic matter would not be broken down and converted into the carbon, nitrogen and sulfur compounds which animals and plants require for their existence. Apparently, the majority of microorganisms is rather useful for humankind and could even be used to control harmful ones (antibiosis). Groups of microorganisms causing diseases of medical importance include viruses, mycoplasma, rickettsia, bacteria, protozoa and fungi. Microorganisms that cause diseases are called *pathogens*. The ability of pathogens to cause disease is *virulence*. The degree of pathogenicity of a micro-organism depends on its degree of invasiveness or its ability to produce toxins. The invasion of the body by a pathogenic organism is called *infection*, although not all infections, however, lead to a disease. The immune system of an infected person may be able to prevent the multiplication and spread of a pathogen and resist the effect of toxins in the tissues. It may even be possible for a person to overcome the infection and become a healthy carrier of the pathogen but able to infect the next person. It is in this light that Hippocrates (father of medicine) once asserted that "what cannot be cured by the forces within the body can certainly not be cured by the forces outside"

Before a pathogen can cause disease, it must be able to enter the body by a route which will enable it to reach a site where it can establish itself and multiply e.g. parasites of the genus *leishamania* get to the tissues. Factors like temperature, oxygen tension, hydrogen ion concentration, availability of nutrient etc. influence the sites in the body selected by micro-organisms. The routes taken depend on whether the organism is ingested (e.g. *Entamaeba histolytica*), penetrates the skin (e.g. Schistosoma spp), contaminates the skin (e.g. Trypanosoma cruzi) or is inhaled with air and reaches the lungs as is the case with pneumonia. Some pathogens require vectors for part of their development as well as for transmission. For example, **Plasmodium** parasites require mosquitoes, *Trypanosomes* require tsetse flies etc, other vectors that are involved in the transmission of pathogens include ticks, mites, fleas, lice etc. These vectors transmit diseases to man through bite when the organisms are ingested into the blood. The name vector is given to any living or non living agent that can carry a disease from one host to another e.g. water, food, dust, vomit, an insect, tick, flea, mite or lice, rats or rodents. The state of the health of a host is important before a pathogen can cause disease in man. For some organisms entry of a large number of organisms may be necessary before a healthy persons' defense mechanisms are overcome, whereas only a few organisms may be required to produce a disease in a person with poor health or one who is malnourished especially children. Particularly virulent organisms like *Shigella dysenteriae* can cause disease in very small numbers. Boosting the immune system and nutrition plays a key role in the control of infectious disease. Examples of pathogenic bacteria (the study of bacteria being bacteriology), and some of the diseases they cause include:-*Clostridium tetani* – causing tetanus, *Brucella* spp – causing brucellosis, *Vibro cholerea* - causing cholera, *Neisseria meningitides* causing meningitis – while, Mycobacterium tuberculosis causing tuberculosis, Treponema pallidum – causing syphilis etc. Viruses of medical importance (the study of which is *Virology*) includes the measles virus, yellow fever virus, lassa fever virus etc. Protozoa (the study of which is Protozoology) of medical importance includes the malaria parasite i.e. *Plasmodium* species, *Entamoeba histolytica* causing amoebic dysentery, *Trypanosama* species causing *Trypanosomiasis*, *Leismania* species causing leishmaniasis, *Toxoplasma gondii* causing

Toxoplasmosis etc. Diseases caused by fungi are referred to as *Mycosis*. Fungal diseases are generally opportunistic infections or allergies, by eating food contaminated by fungal toxins (Mycotoxins). Fungi in recent years do not rank with protozoa, bacteria or virus as causes of human suffering but they are now taking prominence as emerging diseases of the 21st century due to their role in HIV and AIDS as well as cancers. They seldom kill and unlike malaria, yellow fever or cholera, they do not cause wide-spread or dangerous epidemics. Examples of fungal infections include candidiasis caused by *Candida albicans*, *ringworm* infection (dermatophytosis) caused by *Microsporum* species and Cryptococosis caused by Cryptococcus neoformans. Another less common group in routine practice is Rikkettsia and mycoplasma.. Rickettsia spp (though similar to bacteria in many ways) cause diseases such as typhus with aetiolgy being R. *typhi* and *R.prowazeki*, that causing scrub typhus is *R. tsutsugamushi* and the spotted fever group include R. rickettsi, R. conosi etc. Mycoplasma of medical importance include *Mycoplasma pneumoniae* causing pulmonary diseases including upper respiratory diseases sore throat, inflammation of the ear etc. *M. hominis* causes pelvic inflammatory diseases in women may also be associated with spontaneous abortions and postpartum fever. Proper and prompt diagnosis of infectious diseases is the key to its control. Some diseases are referred to as communicable diseases; they are transmitted directly from one organism to another e.g. sexually transmitted disease like gonorrhea. A *communicable disease* is often referred to as infections or when transmitted from one person to another is referred to as *contagious*. Some major communicable bacterial diseases in tropical countries include leprosy, cholera, typhoid, tuberculosis, gonorrhea, syphilis, meningitis, whooping cough, measles, bacillary dysentery etc. The study of a particular disease, why it occurs, how it is spread among a group of people and what can be done to prevent it and improve the health of the community is known as epidemiology. An e*ndemic disease* refers to the constant presence of a disease or agent of a disease in a community or region while *sporadic disease* is one which breaks out only occasionally. An *epidemic* usually means an acute outbreak of a disease, but when referred to communicable diseases, it is defined as "the occurrence in a community or region of a group of illnesses of similar nature, clearly in excess of normal expectancy and derived from a common and propagated source". Many endemic diseases can rapidly become epidemic if environment or host influences changes in a way which favor transmission. A disease is referred to as *pandemic* if it spreads to several countries and affects a large number of people e.g. influenza and cholera, and now HIV and AIDs. Human carriers are important in the spread of diseases. A carrier is a person, who is infected by a pathogen, but experience from it, such a person can excrete the pathogen he or she is carrying over a long period of time and be a source of infection to others without knowing it. There are several routes of transmitting infectious diseases some of which include: by inhaling aerosols (air-borne droplets) containing pathogens secreted by an infected person coughing, spitting, sneezing, nose blowing or laughing as in the case of respiratory diseases like tuberculosis, whooping cough, measles, pneumonia etc. by ingesting pathogens in water or food contaminated with urine or faeces from person disease carriers e.g. gastrointestinal diseases, typhoid, dysentery etc. by direct transfer of pathogens from one person to another as in venereal diseases, by transfer of pathogens from the skin of one person to another as in ringworm infection, by pathogens from, contaminated soil or dust entering the skin e.g. tetanus infection, by pathogens entering wounds, burns or cuts by way of contaminated hands or unsterile instruments e.g. infections of the skin or tissues such as boils and abscesses, by

pathogens entering the blood and tissues through bites of arthropod vector e.g. malaria and bubonic plaque, by transfer of pathogens in blood from mother to fetus as in the case of syphilis and toxoplasmosis pathogen can also be transferred from mother to infant during childbirth e.g. gonorrhea. Pathogens can also be transferred in the blood or through blood products e.g. in hepatitis and AIDS infections, just to cite a few. Factors that affect the transmission and spread of infectious diseases include, inadequate preventive and control measures e.g. lack of primary health care in the rural areas to detect and treat patients with communicable diseases, Socio-economic factors e.g. poverty, poorly constructed houses, overcrowding, malnutrition etc. Inadequate and contaminated water supplies, inadequate sewage disposal system, unhygienic practices, little or no health education, climatic factors including an increase in vectors during the rainy season or an increase in dust-borne particles, and damage to nasal mucosa in the dry season. Local customs especially with regards to food preparation, home delivery of babies, post natal care and feedings of infants. Poor communications in rural areas make it difficult for patients on long term drug therapy such as that of tuberculosis to attend treatment center.

2.1 Challenges involved in Controlling Infectious Diseases

Infectious diseases in tropical Africa are prevalent because of the combined effect of suitable ecological and climatic factors on the micro-organisms and their vectors, human behavioral practices, customs, traditions and the socio-economic conditions that prevail. Infectious diseases have contributed immensely to undermining the health status of the people and jeopardizing the economic development of nations especially in Tropical Africa.

There is more to controlling infectious diseases in tropical Africa than insecticide, drug resistance studies, and knowledge of life cycles and transmission dynamics which still requires a lot of studies. There are still undocumented means of transmission and control of diseases away from the traditional life cycles. Human factors play an eminent role for the persistence of infectious diseases and can be viewed in the following perspectives: Lack of organized or basic health infrastructure, lack of manpower both in quality and quantity, lack of adequate financial provision (where international) agencies like WHO, FAO or World Bank assistance, the moment they withdraw, the problems worsen, lack of drive by the government to control such diseases, failure of authorities to appreciate the advantages to be derived from control, political disturbances and instability like revolutions, war, civil disturbance etc., and/or rejection of some of the measures by the people. Very often wrong emphasis is placed by some authorities on causes of mortality instead of morbidity thereby ignoring conditions which produce prolonged illness and suffering of people and reduce their productive power to enjoy life to the full, increased in occupational diseases due to agriculture in developing countries that has not been researched adequately. The documented conventional mechanisms of controlling infectious diseases are numerous, a few cited are: Socio-economic realities inhibit the provision of pipe borne water, public latrines and good sanitary conditions in most of Africa. Provision of piped water alone will reduce 80% of all infectious diseases of man while installation of efficient sewage disposal and treatment systems will check diseases like amoebisasis, dysentery, hookworm infection etc. Diseases like malaria and filariasis, which is transmitted by mosquitoes, can be controlled or reduced drastically

by developing good drainage system to eliminate mosquito-breeding sites and introducing strategies for reducing man/vector contact. Diseases like Schistosomiasis and Onchocerciasis can also be controlled by taking adequate precautions during the planning stage when appropriate safety measures can be build in.

Some infectious diseases are also *zoonotic* (i.e. are transmissible between man and animals). Thus interaction with domestic animals and controlling their movement becomes essential. Many domestic and wild animals also serve as *Reservoir hosts* (are healthy carries of infection). Thus close interaction with animals should be avoided.

Personal preventive measures /health education is also good prospects for controlling infectious diseases. The following measures need to be taken: Protective personal hygiene especially among children and food vendors. Avoiding eating raw or undercooked meat, fish, green vegetables or fruits contaminated with cysts or eggs. Such a practice will reduce diseases like Taeniasis, Echinococosis, Spanogonosis etc. Human faces should not be used as fertilizers and shoes should be worn. This will reduce infection with intestinal nematode. Wearing protective clothing is also important in areas where vectors of diseases like trypanosomiasis transmitted by tsetse flies are abundant in order to prevent bites leading to diseases.

In the case of snail borne infections like schistosomiasis, contact with bodies of water should be avoided. Bad habits like spitting and coughing indiscriminately can also help in spreading some diseases like pneumonia and tuberculosis. A good knowledge of the way certain diseases are transmitted is useful in avoiding infections. Chemical control of vectors-This is the use of chemicals (i.e. insecticides, mulluscides, etc) against vectors of diseases. These have been successfully applied in the past, but are now branded as agents of pollution. Problems associated with chemical control include: Vectors easily develop resistance. The prohibitive cost of chemicals, their application, monitoring etc. detecting and treating human infections using many drugs have got toxic side effects, apart from being expensive with possibility of patient going to be exposed to re-infection all over again if the vectors promoting transmission have not been removed. For most diseases caused by micro-organisms, no chemo prophylactic methods have been developed. There is also the problem of drug resistance, as well as prohibitive cost of developing new drug particularly when they have to pass through stringent safety tests for toxicity etc. use of vaccines – Vaccines have been developed for a few infectious diseases, and where available, they have to be repeated almost annually. The cost of production of the vaccines is also high. Genetic control- This offered bright prospects in the laboratory. But has great problems on the field e.g. use of the male sterile technique.

For third world countries, the prospect for controlling infectious diseases remains gloomy. Sources of funding and proper planning of infrastructures like good water and sewage disposal mechanisms, development of organized primary health care system will be very important especially if rooted in indigenous knowledge. There is need for every village to have a trained village based health worker who can carry out health education and have some first aid training to assist at village levels. The cooperation and support of community leaders will also be very important. The modern day scientist would need to liaise with rural people to study their historic modes of life in the past and how

indigenous people cope with diseases; these are promising platforms to build research and development reminiscent of each ecological niche. The solutions and impact surprisingly may not be deep rooted in high tech. There is a need to review the processes involved in the control of infectious diseases as afore highlighted. Despite all the available high tech-measures, the prevalence of infectious diseases are rather galloping especially in rural Africa and it is envisaged that the status quo would likely not change so soon. The need to co-opt indigenous knowledge systems, study them, apply simple low cost technologies that will be accessible and easy to use by our people stands unequivocal, thus the rationale for developing phytobiotechnologies. This could change the health for our people in a more sustainable way.

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Bibliography

Abubakar; M., M.B. Ngele; D.J.U. Kalla; A.K. Yongabi and Dauda (2003) Proximate Analysis of Crop Residues Biologically Treated or Ensiled. Proceedings of the 28 Annual Conference of the Nigerian Society for Animal Production, Vol. 28, PP155-157. [Article explains on improved nutrition technology for animals]

Barone, F.E and Tansey, M.R (1977) Isolation, Purification, Identification, Synthesis and Kinetics of activity of the anticandidal components of Allium sativum and a hypothesis for its mode of action. *Mycologial* 69,793-825. [Articles explains effects of garlic on candida albicans]

Berdy,J (1974) Recent Developments of antibiotic Antibiotic Research and Classification of antibiotics according to Chemical structure.Adv.APPL.Microb.18,309-406 [Article explains the raw materials for the synthesis of antibiotics from actinomycetes and fungi]

Chemistry in Britain (1995) Xeno-oestrogen pollution: The Male fertility culprit, vol.3, No 7 [Articles explains how chlorine and the halogens interfere with hormones and lead to decreased sperms in men]

Chemistry in Britain (1998) *Sex Offenders*, Vol.34.No.10, pp25 [article on how pollution affects sex hormones]

Chindo,I.Y., K. A. Yongabi. M. O. Agho, Z. B. Timothy and D.N. Anong (2002) Extracts of Ageratum conyziodes: Pesticidal Activity and Phytochemical studies. *Journal of chemical Society of Nigeria*, Vol.27, No. 2, PP 110-113 [Article is on the search of pesticides from medicinal plants]

Deroop,R(1954) *Drugs and the Mind*, St. Martins Press, New York. [Article is critical on synthetic organic chemists as limited compared to nature]

Dongs;I.S., K.A. Yongabi; M.O. Agho; E.B. Agbo; M.B. Wufem and D.N. Anong (2003) Break Down of Agricultural Residues using Mycelia of Pleurotus ostreatus. *Journal of the League of Researchers of Nigeria (JOLORN)* Vol.4, No.2, pp47-54 [article on mushroom cultivation for improved nutrition in Nigeria]

Elsenberg, D.M, Davis, R.B., Ethmer, S.C (1990)Trends in Alternative Medicines Use in United States.*Jama*:280:156a-1575 [article noted the increasing use of alternative medicine in the United states]

Fransworth,N.Rand Kaas,C.J(1981) An Approach Utilizing Information from Traditional Medicine to Identify Tumour inhibiting plants: *Journal of Ethnopharmacology* 31:85-100 [article cited the number of drug leads developed from medicinal plants]

Gugani, H.C (1982) Mycoses as a Public health problem in Nigeria, A key note address delivered at the 6th Conference of mycological society of Nigeria. [Article about fungal infections in Nigeria]

Isa, I.J; Chindo, I Y; Wufem, B.M; Yongabi, K.A; Abayeh, O.J. and Agho, M.O (2000) The impact of Agro-chemicals on eight selected local government areas of Bauchi State, Nigeria. A technical report submitted to UNDP, Nigeria, Bauchi Office, June 2000 by the FEPA/ZERI Center, ATBU. Web page on line http://www.zeri.org/fepazeridocs/agrochemicals.pdf [Article on agrochemical pollution in Nigeria]

Isa,I.J;Chindo, I.Y; Wufem, B.M; Yongabi, K.A; Abayeh,O.Jand Agho, M.O (2000) Classification and management strategies of Effluents discharge by agro-small and medium scale enterprises. A technical Report submitted to UNDP, Nigeria, Bauchi Office, June 2000 by the FEPA/ZERI Centre, ATBU, Bauchi. Web page on line http://www.zeri.org/fepazeri/docs/effluents.pdf [Article on the effect of waste on the environment]

Jacky, E.L Foo; Kenneth Yongabi and Mamadou Gueye (2005)Proceedings of papers and discussions on the Use and Impacts of Biotechnology and Bioengineering in Africa-internet conference on biotechnology and bioengineering in Africa.-www.iobbnet.org ICCB-Africa includes Symposia.; E-symposium on Biological Nitrogen Fixation—E Symposium on Economic Aspects on the Use of Biotechnologies and Bioengineering in Urban Agriculture by African households(sponsor by RUAF) and E Symposium on Phytoremediation and Water Purification. [Article on the promotion of appropriate Integrated biosystem biotechnologies in Africa]

Lewis, R.A (1981)Scientific Terminology in ethnopharmacology, *Journal of ethnopharmacology*,4:121 [Article explains terms in ethnopharmacy]

Moore, G.S and Atkins R.D (1977) The fungicidal and fungistatic effects of an aqueous garlic extracts on medically important yeasts and fungi. Mycologia 69, 341-348. [Article explains the antifungal activity of garlic]

Munyanziza,E and K.A.Yongabi (2007) Moringa Peregrina (Forssk.) Fiori. In:Van der Vossen,H.A.M and Mkamilo,G.S (Editors). Plant Resources of Tropical Africa 14.Vegetable Oils. PROTA Foundation, Wageningen, Netherlands/Backhuys publishers, Leiden, Netherlands /CTA, Wageningen, Netherlands.PP119 to121. [Article explains the culinary and medicinal uses of oil extract of moringa peregrina]

Okemo, P.O., W.E. Mwatha, S.C. Chhabre and W Fabry (2001) The kill kinetics of Azadirachta Indica A. Juss (meliaceae) Extracts on Staphyloccocus aureus, Escherichia Coli, Pseudomonas aeruginosa and Candida acbicans. *AJST*, Vol.2. No.2. [Article explains the rate of inhibition of neem seed oil on Staphylococcus aureus.]

Omoseyindemi,B.X(2003) Plants as Natural Medicine.Paper presented at the Annual Conference of Botanical Society of Nigeria(BOSON) University of Lagos. [Article presents a collection of plants used by Tradipractitioners in Nigeria]

Rama, A.V Rao (1995) Sustained Development through Technology: An Indian Experience with drug industry. Proceedings of the general meeting of the third World Academy of Science,Abuja,Nigeria,17 to 22,1995.IN:Science Technology and Africa Development by Awele Maduemezia, ISBN 978-2162-05-1,Dare Printex Press Tokunbo Ojo,Orogun State. [Article explains the nomenclature of drugs and their synthetic routes]

Richard,J.P.Cannells(1998)Methods in Biotechnology TM. Natural Products Isolation Edn. Humana Press, Totowa, New Jersey. [Articles comments of techniques in biotechnology]

Robert,W(1990)Biotechnology and the 3rd World, Miracle or Menace. Panos Institute, Italy, pp36-37. [Article presents an overview of the content of Biotechnology and Contemporary challenges]

Shuaibu, O. A. Usman and K. A. Yongabi (2005) Phytoaccumulation of Selected heavy metals in Nymphaea lotus (waterlilly) from polluted stream in Bauchi and a proposed integrated system use. Proceedings of an internet conference on Phytoremediation and water purification, International Organisation of Biotechnology and Bio engineering http://www.iobbnet.org/iccb-africa/phyto. [Article

explains how plants can pick up heavy metals from poluuted habitats]

Singh,Y.N(1986)Traditional Medicine in Fiji, Some Herbal Folk Cures Used by Fiji Indians. *Journal of Ethnopharmacology*; Vol 15.No.1 pp57-58 [Article explains traditional practices of natives from Fiji]

Sofowora, E.A (1980) Guidance For Research Promotion and Development in Traditional medicine. *Nigerian Journal of Pharmacy*, No 3.pp117-118 [Article explains strategy for effective development of traditional medicine in Nigeria]

Trudeau, K. (2004) Natural Cures They Don't Want You to Know About, www.naturalcures.com [Article is on Natural medicine in the USA]

WHO (1991) Traditional Medicine and Modern Health Care: Progress Report by The Director General, Document A 44(10); March 22, WHO, Geneva. [Article explains on the importance of traditional medicine]

Yongabi, K. A. (2005) Development of a Pilot backyard farm at Kuru Jos, Plateau State CARUDEP, IBS project. Proceedings of an Internet conference on Phytoremediation and water purification, International Organisation of Biotechnology and Bio engineering http://www.iobbnet.org/iccb-africa/bbua. [Article is on Integrated biomass systems in Nigeria]

Yongabi, K. A. (2005) Evaluation of an integrated low cost/Bio coagulant – sand filter drums for household water and waste water purification. Proceedings of an Internet conference on Phytoremediation and water purification, International Organisation of Biotechnology and Bio engineering http://www.iobbnet.org/iccb-africa/phyto.(article explains how to construct a plant cum sandfilter to purify water]

Yongabi, K. A., Agho, M.O. Adamu, H.M. Adebitan, S. A. Angeh, J.E. and Jalo I. I. (2002) Antibacterial Effects of the Extracts of Carica papaya, Urtica dioica, and Aloe barbadensis on Some Bacterial Isolates from Lycopersicon esculentum mill (tomato) Journal of Chemical Society of Nigeria Vol. 27. No. 2 PP 180-182. [Article explains the possible use of Aloe vera extracts on Phytopathogens]..

Yongabi, K.A. (2003) A technical Report Report on a capacity building training of rural women in some selected Communities of Bauchi State on Soap (Washing) Production. A technical Report submitted to Development Exchange Center (DEC), Bauchi office, March 17, 2003, FEPA/ZERI CENTRE, ATBU BAUCHI. [article on linking sanitation to income generation inNigeria]

Yongabi, K.A. (2004) Medicinal plant biotechnology:It's Role and Link in Integrated (The Role Of Medicinal plants in Environmental biotechnology and integrated biosystems Biosystems.) Proceedings of an International E –Seminar organized by the International Organization for Biotechnology and Bioengineering (IOBB), Web Page:www.biotech.kth.se/iobb/activities.(www.iobbnet.org,www.iobbnet.mpb.doc,March 8-22,2005. [Article on the Role of medicinal plants in environmental biotechnology]

Yongabi, K.A. (2004) Studies on the use of Medicinal plants and Macro fungi (Lower Plants) in water and Wastewater purification. Proceedings of an International E-conference organized by the International Organization for Biotechnology and Bioengineering (IOBB), Sweden, June14-25.Web Pages online: www.biotech.kth.se/iobb/news/Kenneth/photos.html, www.biotech.kth.se/iobb/activities,http://segate.sunet.se/archives/et-oden.html, www.biotech.kth.se/iobb/news/kenneth04.doc, advertised on news on the lead: http://www.lead.virtualcenter.org/en/events_list.asp?type=1, At Waterwire: www.waterwire.net/events/events.cfm, and in Netherlands:www.irc.nl/content/view/full/10180, Republished in Tree for Life Journal, March 10,2006, http://mail.treesforlife.org:8083/moringa/staticpages/kenneth04.pdf [Article is on the use of phytocoagulants in wastewater treatment]

Yongabi, K.A. (2004)Assessment of The Efficacy of Extracts of Disthemonantus bentamianus baillair,and Cucurbita pepo L on Microorganisms isolated from infected Human Semen Unpublished Msc thesis,Abubakar Tafawa Balewa University,Bauchi,Nigeria. [Article is on Medicinal plants in reproductive health in Nigeria]

Yongabi, K.A. (2007) Potential use of Mushrooms and spent substrate in Decontamination of Oil Contaminated Soil.(Uso Potentcial de Hongos en descontamination de substratus) Proceedings of the First World Conferences on the Conservation and Sustainable Use of Wild Fungi, organized by the Regional

Government of Andalucia,Cordoba,Spain,December10 to 16,pp62 to63.[Article is on use of mushroom spent substrate to decontaminate oil contaminated soil in Nigeria]

Yongabi, K.A. (2007)Ethnomycological Survey of Wild Mushrooms in the Guinea Savanna Belt f Nigeria,Poster Presentation at the First World Conferences on the Conservation and Sustainable Use of Wild Fungi Organized by the Regional Government of Andalucia,December 10 to 16,pp296 to 297.[article is on ethnomycology of guinea savanna of Nigeria]

Yongabi, K.A. (2007)Ethnomycology of Grassland fields and Tropical Rainforest of Cameroon, Poster Presentation at the First World Conferences on Conservation and Sustainable Use of wild fungi,organized by the Regional Government of Andalucia,Spain,December 10 to 16,pp 298 to 299.[Article is on Ethnomycology of Cameroon]

Yongabi, K.A. (2007)Inventory of African Indigenous Knowledge in water treatment and Sanitation in Cameroon and Nigeria:A Preliminary study on the disinfection of fresh human Excrement with Medicinal plant extracts,Kerosene and Saw dust,Accepted for Presentation at the International Conference on Sustainable Sanitation/Eco cities and Villages,Dongsheng,Erdos,Inner Mongolia,China,August 26 to 29 [Article on Indigenous Knowledge and sanitation in Cameroon]

Yongabi, K.A. 2004) Hygienic Assessment of Nigerian currency (Naira) Notes. Proceedings of the 30th WEDC International Conference at Vientianne, PDR of LAO, South China, and 25-29 October. Preprint page 94: www.lboro.ac.uk/wedc [Article explains the health implication of Nigerian currency]

Yongabi, K.A. and I.S.Dongs (2004) Cost Benefit Analysis and Marketing of Simple Polyethylene Biogas plants for villages in Bauchi, Nigeria. *Wited Multidisciplinary Journal for Teachers (WIMJOT)* Vol.1, No.1, PP 43-45.[Article is on marketing of renewable energy and ecosanitation in Nigeria]

Yongabi, K.A., M.O. Agho, I.Y. Chindo and M.W. Buba (2000). Evaluating the Medicinal Potentials of indigenous plants in controlling Microbial contamination of poultry feed. *Journal of Phytomedicine and Therapeutics* Vol. 5, No 2, PP 98-102 [Article shows the application of medicinal plants in ethnoveterinary practice in Nigeria]

Yongabi, K.A., P. L. Harris, A. S. Sambo, and M. O. Agho (2003) Managing Cow Dung with A Cheap, Low Tech Plastic Digester. Proceedings of the 29 WEDC International Conference on Water and Environmental Sanitation co-organised by Water Engineering Development Centre-of Loughborough University, UK, in conjunction with the Ministry of water resources, Abuja holding at Abuja on September 22-26.PP486-489.Proceedings at wedc web page (2004) online: http://wedc.lboro.ac.uk/conferences/pdfs/29/yongabi1.pdf PP74-77. [Article is on faeces decontamination using plastic digesters in Nigeria]

Yongabi, K.A; Yusuf, I.Z; Dongs, I.S.andAnong, D.S. (2004) Prevalence of Filariasis and Some Traditional methods of attending to the disease in Wum, North West of Cameroon. Nigerian Journal of Microbiology, Vol.18, No.1-2 ISSN0794-1293, PP207-211. [Article is on filariasis in Cameroon]

Yongabi,K.A (2008) Antifungal Effect of Four Nigerian Medicinal Plant Extracts on Field Brassica oleracea L(Cabbage) Rot Fungi.Journal of Mycology and Phytopathology of Nepal(MAPSON) maiden edition comes out in June 2008. [Article is on Medicinal plants in the control of cabbage rot in Nigeria]

Yongabi,K.A(2007)Disinfection of pit toilets with Medicinal plant Extracts and kerosene [Unpublished works Explainingthe use of medicinal plants in toilet and latrine disinfection].

Yongabi,K.A(2008)management of opportunistic skin diseases of HIV /AIDS patients with plants and mushroom based cosmetics [unpublished article explaining prevalent skin diseases in HIV patients in cameroon]

Yongabi,K.A(2008)Management of opportunistic Skin diseases of HIV/AIDS with Plant and Mushroom based Cosmetics [Unpublished works explaining skin cancers and microbial infection of the skin and phytodrugs for effective management]

Yongabi,K.A., U.H. Dukku, M.O. Agho and I.Y. Chindo (2000). Studies on the Antifungal properties of Urtica dioica; Urticaceae (Stinging Nettle). *Journal of Phytomedicine and Therapeutics* vol. 5, No. 1, page 39-43. [Article is on Screening and production of herbal cosmetics from Stinging Nettle in Cameroon and Nigeria]

Yongabi,K.A.,Mbacham,W.,Kaba,C and Cham, C (2008) Prevalent Yeast Isolates from HIV seropositive

patients in Cameroon and Sensitivity to Methanol Extracts of Eight Medicinal plants, unpublished research work. [Article explains yeast infections amongst HIV patients in Cameroon]

Yongabi,K.A; Ijah,U.J.J and Ejilah,R.I 2006)Potentials of Pleurotus ostreatus and Urea as Biocatalysts in the biodegradation of lubricanting oil contaminated Soil. Proceedings of an Internet seminar organized by the working group on Bioremediation web page;http//www.iobbnet.org/drupal/forum 123 [Article is on bioremediation of contaminated soil in Nigeria]

Yongabi; K., D.Martinez-carrera and M.Agho (2004) Ethno mycological studies on wild mushrooms in Cameroon, CentralAfrica.Micologia Aplicada International, 16(2) pp34-36 (presented in Oaxaca, Mexico, August 26,2003) Abstract online: http://micaplint.fws1.com [Article on Ethnomushroom and medical uses in Cameroon]

Yongabi; K.A., M.O.Agho; A.L.Abdullahi and O.J.Abayeh (2005) An Integrated Bio-systems for Agricultural Wastes Management in Bauchi-Nigeria through Mushroom cultivation. *Journal of League of Researchers in Nigeria (JOLORN)* Vol.5, No.2, pp76to 81. [Article is on agricultural waste management in Nigeria using bioconversion]

Yusuf, I.Z; Oyawoye, O.M; Yongabi, K.A.and Pemu, A.T. (2004) Bacteriological Quality Assessment of Salad Vegetables sold in Bauchi Metropolis. Nigerian Journal of Microbiology, Vol.18, No1-2, ISSN0794-1293, PP316-320. [Article is on the quality of food sold on the streets of Nigerian cities]

Biographical Sketch

Kenneth Anchang, Yongabi borned a Cameroonian on July 2nd 1972 did his undergraduate and post graduate studies in clinical Microbiology at Abubakar Tafawa Balewa University (ATBU) Bauchi,Nigeria, from 1995 to 2003, where he looked at semen infection and development of Phytopharmaceuticals for male infertility problems. In 2000, he joined the same university,as a lecturer and researcher attached to the ZERO Emission Research facility of the university.He taught a range of courses including, biotechnology and business management, pharmaceutical and medical microbiology, microbial physiology and Research methods. Took a fellowship program as a Crawford fellow at Adelaide University, South Australia in anaerobic digestion, integrated biosystems and mushroom cultivation in 2002.He undertook UNESCO courses on higher education pedagogy in 2005. He has 30 journals/referred publications within local and international journals, 2 technical and 20 conference papers as well as articles, newspapers /bulletins, and has co supervised a few undergraduate thesis and review for a couple of local journals. Currently a professional member of the American Naturopathic medical Association, and the International organization for Biotechnology and Bioengineering and served as country representative in 2005.He is a medical consultant at a community clinic that looks at diseases of elderly people in Cameroon, and founder and coordinator of Phytobiotechnology Research Foundation(PRF) and clinics with focus on low tech diagnosis and phyto therapy.Married with two kids.
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