MEDICINAL PLANT BIOTECHNOLOGY: IT'S ROLE AND LINK IN INTEGRATED BIOSYSTEMS: PART I

Kenneth A Yongabi
FMEnv/ZERI research Centre, Abubakar Tafawa Balewa University, Bauchi
Pmb0248,Bauchi, 740004, Nigeria
Email:yongabika@yahoo.com

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Abstract
In this study, an evaluation on the role medicinal plants could play as an entity in integrated biosystems is presented. This report which was carried out through review of past research works by the author, other sources, and traditional knowledge surveyed from tribes in Cameroon, Nigeria and Benin republic shows that medicinal plants utilization through products formulation can be employed to attend to human, livestock and plant diseases in an integrated biosystems. Herbiotics formulated in the form of pesticides /tick sprays for plant pests and animals respectively, creams for skin problems in human and livestock could reduce the dependence on synthetic biocides and reduce the cost of running an IBS.Plants such as Allium sativum (garlic), Vernonia amygdalina (bitter leaf), Moringa oleifera (Horse raddish plant), Lantana camara, Occimum gratissimum (basil) Aspilia africana (Iodine plant), Carica papaya (pawpaw), Cucurbita pepo (pumpkin) amongst others were identified as important candidate plants that could bring about hygiene and sanitation. Kitchen sinks and garbage dumps treated with formulations from these plants led to a reduction of 99.7-100% of the bacterial load. Moringa oleifera seed extracts amongst others reduced hydraulic retention time in anaerobic digestion, purified and recovered waste water while other plants have the potentials to control nematodes, preserve food and control mushroom disease, treat waste water for irrigation while controlling algae and bacteria that may possibly clog pipes and emitters as well. The conclusion is made that since medicinal plants can serve the major IBS subsystems, there is therefore the need to cultivate them in a prototype herbarium in an IBS.

KEYWORDS: Medicinal plants, Biotechnology, Disease control, Sanitation, Anaerobic digestion, Algae control, Role, Link, Integrated Biosystems.

"*There are plenty of natural resources in the world and all living beings can know peace and plenty if creative intelligence is used in the management of the resources"*

Roy Eugene Daris

1.0 Introduction

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. 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 through out the world. As a matter of fact 80%of our people depend on homeopathic medicine. In Africa, people still consult traditional healers even when being attended to in orthodox clinics. Needless attempting to narrate the history of medicinal plants, which is

widely documented in various pharmacopoeias, planta medica, around the world. 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 indigenous knowledge and practices abound through out the world and remain largely underutilized.

"*Good art is not what it looks like but what it does to us*"-ROY AZDAK.

William James, a great philosopher, once said that God has balanced up creation so well that nature is man's laboratory to exploit, and that in it exist the cures of all ailments. When God created the universe, its goodness was the best compliment. Thus all things go in pairs, by opposite and he has made nothing defective; they consolidate the excellence of the other. Nature in itself could be considered as an Integrated Biosystems (IBS). Bio-integrated systems have different components that function symbiotically with each other.

Traditional integrated bio-systems (IBS) often use labour intensive bio-systems or technologies in low input organic farming that can provide a variety of products at a micro-level (Foo 2000).

Today, our world is not only marked by aggregate affluence but also by economic uncertainties, poverty, hunger and violent conflicts with greater burden in Africa and Asia. Poverty and environmental degradation go hand in hand, for it is the poor that suffer the consequences of desertification and live the misery of unsanitary conditions.

The solutions to these problems lie in the optimization of the available earth's resources rather than expecting the earth to create more. The task of meeting our daily needs in the future is even more challenging as It has been estimated by the Nobel laureate, Norman Borlaugh, that to meet projected food demands by the year 2025, average cereal yield must increase by 80% over the 1990 average (Ramusser et al, 1998)

Foo (2000) in his report wondered if integrated bio-systems could serve as a tool to lessen this burden and opined that large scale farming and intensification on small farms seem inevitable in the future if the estimated 50% of the world's population who will live in the urban areas by 2025 are to be fed. Needless elaborating on the fairly known concept of integrated biosystems (http://www.ias. unu.edi/proceedings/icibs/ibs/ibsnet), but there is a need to further enhance/simplify the technologies inherent in an integrated biosystems for a wider adoption and penetration. Foo (2000) acknowledged the limitations of the IBS technologies to composting in vermiculture, anaerobic digestion, and noted the need for not only the incorporation of more technologies such as insect larvae technology, ensilaging and microbial protein enrichment of plant material or agro-industrial wastes technologies, but emphasized the need for simplification of such technologies.

As a matter of fact for IBS to penetrate the wider society and impact tremendously, especially in the third world, the technologies must be simplified with a sound foundation on indigenous knowledge reminiscent to region or locality.

This is the type of IBS committed to effectively reducing poverty and generating local industries. An IBS that still uses synthetic fungicides, and insecticides to control insects / pests forinstance, is not fully independent. Enhancing and incorporating indigenous knowledge on how to control insects/pests, preserve crops/food after harvest into the mainstream activities of IBS will not only reduce the cost of running an IBS farm but will showcase the power and benefit of drawing inspiration from the well springs of nature.

It will be most beneficial if the system fully depends on itself. Therefore, inclusion of ethno medicinal plants will not only conserves the earth's natural resources but also could be carefully utilized for disease control in humans, livestock and plants. The overall purpose of this study is to review/evaluate indigenous plants/knowledge

in attending to human diseases, sanitation problems, livestock and plant diseases as well as fight the pests of plants and ectoparasites of animals and propose the inclusion of a medicinal plant herbarium/herbal product formulation unit as a component of an in an integrated-bio-system. The ultimate goal is to come up with a health system in an IBS 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 of linking medicinal plants in integrated biosystems will be:

- To reduce artificial interference and cut down on the use of synthetic drugs.
- To optimize the use of available resources.
- To promote indigenous solutions in disease-control and environmental management.
- To enhance the available knowledge on the efficacy of natural products as drugs and pesticides.
- To nurture and prevent waste.
- To reduce cost of health management in farms and hence; make the 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.

"*The only disability in life is a bad attitude*"-SCOTT HAMILTON

1.1 Livestock diseases and ethno therapy.

Livestock in the IBS needs to be looked upon with care for efficient products at low cost. Gastroenteritis continues to threaten the poultry industry and other livestock in Africa, causing huge economic loss. Salmonellosis in chickens caused by *salmonella galinarum* causes fowl typhoid while *Escherichia coli* causes poisoning by producing colicine, and the strain incriminated is often entero-invasive *E. Coli* (EIVEC). Bacterial and fungal diseases are very important in livestock and are normally transmitted through water, soil and especially feed. Antibiotics have been usually incorporated in feeds to contain this situation, but the disadvantages are far too devastating; Firstly, the high cost of these drugs means less profits, besides, limited veterinary services militates against successful production. Furthermore, the emergence of bacteria resistant strains to the commonly used antibiotics poses a health risk to livestock in the near future (New Scientist, July 1996). Similarly, vancomycin resistant enterococci have been observed in poultry (New Scientist, 1996). The frequent inclusion of antibiotics in animal feeds does not only lead to resistant strains but also limits the efficacy of antibiotics also used in the treatment of some human diseases.

Aspergillosis caused by *Aspergillus flavus* and *Aspergillus fumigatus* has led to loss of huge flock of turkey and chickens in Nigeria especially the exotic breeds. (Personal communication with Animal Scientists). These fungi had been contracted through, amongst others, contaminated feed. The presence of microorganisms particularly fungi does not only deplete the nutritional content of the feed but the production of aflatoxins. Consumption of meat infected with aflatoxin can cause cancer. It is known that *Aspergillus flavus strains* produces aflatoxin B, a carcinogen.

Clarke and Ottinger (1987) reported that chickens fed with aflatoxin-infected feed reduced circulating levels of testosterone, thus reducing their fertility through suppression of sperm production.

Enthnomedicinal plants can be used to control these diseases and can enhance production. Yongabi et al (2000) evaluated some medicinal plants in controlling the microbial content of feed with tremendous success. Garlic (*Allium Satium*), pawpaw (*Carica papaya) and ginger (Zingiber officinale)* when incorporated in animal diet suppressed microbial growth after storage. These

plants are suggested to be grown in the integrated bio-system with an overall advantage of preventing and curing livestock diseases. The table below shows the commonly encountered poultry diseases, treatment and estimated costs as well as loses.

Table 1a:Poultry (bacterial and Fungal diseases transmitted through water, soil and air)

Disease (Symptoms)	**Causes**	**Drug treatment**	**Cost**	**Side effects if any**	**Loss of agriculture**	**Reference**
Gastro-enteritis Salmonellosis (fowl typhoid)	Salmonelia galinarum	Keproceryl a combination of streptomycin sulphate neomycin and tetracycline	Ranges ₦400 – ₦600	Resistance due to prolong usage, over/under dose	Losses are huge and really unquantifiable	Personal communication animal health Officers
Poisoning	Escherichia coil	Keproceryl and acyryl	--	--	--	--
Aspergillosis rattling of the throat and flu coming out heavy weight loss	Aspergillus flavus Aspergillus fumigatus	No specific treatment for it, a part from changing the mouldy feed.	--	--	Has led to huge flock losses comes as an epidemic	--
Ruminants	Same as above except Aspergillosis	No specific treatment for it, a part from changing the mouldy feed.	--	--	--	--
Plants	Fusarium rot on cabbages	Fungicides formulated with mercury and copper	--	1. Most of these fungicides really are toxic to mammals and can lead to cancer in long run 2. Toxic to non-targeted organisms thus a disbalance to our ecosystems	Food shortage really unquantifiable especially in the villages	

Table1b: ***Prevalent Poultry Diseases in Nigeria and Treatment Profile.***

Disease	Treatment	Vaccination
New castle	Lasota	Lasota
Gumboro	Oxytetracycline[*1]	Gumboro vaccine
Fowl Cholera	Neo-terramacin[*1]	Fowl cholera vaccine
Chronic respiratory disease	Tetracycline[*1] Erythromycin[*1]	
Coccidiosis	Amprolium	Coccidiostat
Bronchitis	Streptomycin[*1]	
Fowl pox		Fowl pox vaccine
Roundworms	Piperazine	
Fowl typhoid	Terramycine Soluble powder	Fowl Typhoid vaccine

[*1] antibiotics also used in the treatment of human diseases, and this is responsible for the rapid development of resistant strains of bacteria.

[*] These antibiotics/vaccines are expensive and few people especially in the rural areas hardly farm exotic breeds.

Source: Collected from Animal health officers in the field.

The diseases in table 1 can be treated from our vegetation, the problem of resistance; costs could be minimized if we turn to nature. Table 2 presents a list of some plants in the treatment and management of some poultry diseases

Table 2: Some selected plants in the treatment and management of some poultry diseases in Bauchi

Disease	***Plant / Mode of application***
Fowl typhoid	Allium sativum (Garlic) in feed /in drinkers
	Cassia occidentalis (leaves)
	Moringa oleifera (seed extracts)
	Terminalia catappa (leaf extract)
Coccidiosis	Solanum incanum (in feed and drinks
	(Garden egg)
	Capsicum frutescens (pepper)
	Allium sativum (Garlic) bulb
Round worms	Khaya senegalensis (seed oils)
	Dry wood mahagony
	Cucurbita pepo (pumpkin seed oils)
	Carica papaya (seed extracts)
Fowl cholera, Diarrhea	Allium sativum (garlic), leaves decoctions of solanum incanum
	(sweet potato) twigs of Guava plant
New castle	Allium sativum (Garlic) Moringa oleifera seed extracts
Aspergillosis/Bronchitis	Aloe bar badensis bark extracts.

Employing medicinal plants in the treatment of diseases of livestock has been a long-term practice in most cultures in Africa. These practices need not only be well documented but enhanced and incorporated in an integrated biosystems farms. In the past, the olden people noticed that sick animals walked past many herbs and ate only particularly herbs. The case of sick dogs selectively eating bahama grass that makes them vomit has been mimicked/used by

some herbalists in Cameroon as an emetic herb. Take the case of domestic fowls (local breeds) comparatively looking stronger and less prone to diseases unlike the exotic breed. This may not just be because of the climate but probably because the indigenous breed strays around and feed on wild herbs/vermin that possibly prevents them from diseases. The early man might have used this knowledge in the Stone Age to survive. In a related report, Harris (2002) likened the ingenious shaping of stones and other materials by the early man for hunting and cultivation of crops to the genesis of Agricultural Engineering. Tending to our roots(how our early parents cope with life in their days) and enhancing such knowledge especially within the loops of an integrated biosystems could mark the beginning of another of another technological era.

If such knowledge were promoted in an IBS, the output would be tremendous. A lot medicinal plants have been screened and compounds identified (Balasenthil et al, 1999, Adrian et al, 1999; Kim et al, 1999; Kudi et al, 1999; Bisignano et al, 2000; Comley, 1990' Ahmed and Grainge, 1986; Mahmoud, 1994; Adetumbi et al 1986) but relatively few have been actually put to use.

The cost of synthesizing new leads from plants takes for long is expensive and this has limited use. The need to improve local formulations may make more plants drugs (crude) available for and impact more, while waiting for the drug development. The Asians countries are to be congratulated for actually promoting generic drugs

The use of Allium satium (Garlic) extracts has been used in the treatment of diarohoea in Cow and Goats (personal communication) seed extracts of Khaya Senegalensis (dry wood Mahogany) has been used by the Fulani's in the Northern Nigeria to deworm their cattle. Similarly plants like Piper guinensis Annona Senegalensis extracts have been formulated into Soap solution to control ticks and lice (ectoparasites) in cattle. (Yongabi, unpublished). There are many undocumented practices in animal health across the globe that needs to be explored.

Medicinal plants in Artificial insemination,

In order to meet protein demand and improve on animal productivity, animal scientists have had to resort to artificial insemination. This practice though very resourceful has not been very successful in Nigeria. Apart from the expensive equipment needed, semen extension/preservation has not been very successful. Antibiotics have often been incorporate in diluents to extend the shelf live of semen (spermatozoa) without the knowledge of semen microbial flora.

Above all, antibiotics are expensive and increase overhead cost of production. Yongabi et al (1999) reported the use of oil extracts of Cucurbita pepo and seed extracts of khaya senegalensis as very effective in increasing the shelf life of semen pending artificial insemination.

"*Vision without action is a daydream, action without vision is a nightmare*"-UNKNOWN

The role medicinal plants in environmental sanitation.

Poor environmental sanitation remains a major setback to sustainable development in most third world countries. In general, more than 80% of the world populace live in poor sanitary conditions, yet there are increased concerns over this issue.

There have been global concerns on environmental sanitation (www.Webc.lboro.uk, Ecosan, http://www.gtz.de/ecosan /docs/Nlz eng, pdf and IBS network, http://www.ias.Unu.Edu/proceedings.icibs/ibs/ibsnet) and many non-governmental as well as community-based organizations have proliferated and actions intensified across Africa. In Nigeria, the Federal Ministry of Environment, the states Environmental protection Agencies and NGOs such as the Development Exchange center (DEC), water Aid and UNICEFhave launched Programmes in the aspect in a bid to enlighten the public. Water, municipal solid waste/ management, Agricultural waste management and erosions have been focal points. While the NGOs have focused on simple and basic sanitation strategies at grass roots, other international groups have focused on innovative technologies such as recycling techniques, anaerobic digestion and composting etc. The anticipated impact of these so far has been rewarding, but a lot still needs to be done considering that infectious disease prevalence is still increasing with continuous collapse of health facilities as experienced in Nigeria. But questions remains if these technologies and strategies in place alone would solve the problem? Ecosan technologies though simple may still be slightly expensive to adopt for most of our people who are not educated, poor and live from hand to mouth. Further more, the semi urban settlements are slums, hardly planned with a high garbage burden. This means that pathogen burden in the environment is equally very high; channels/ wastewater ways are clogged with garbage, polyethylene e.t.c.

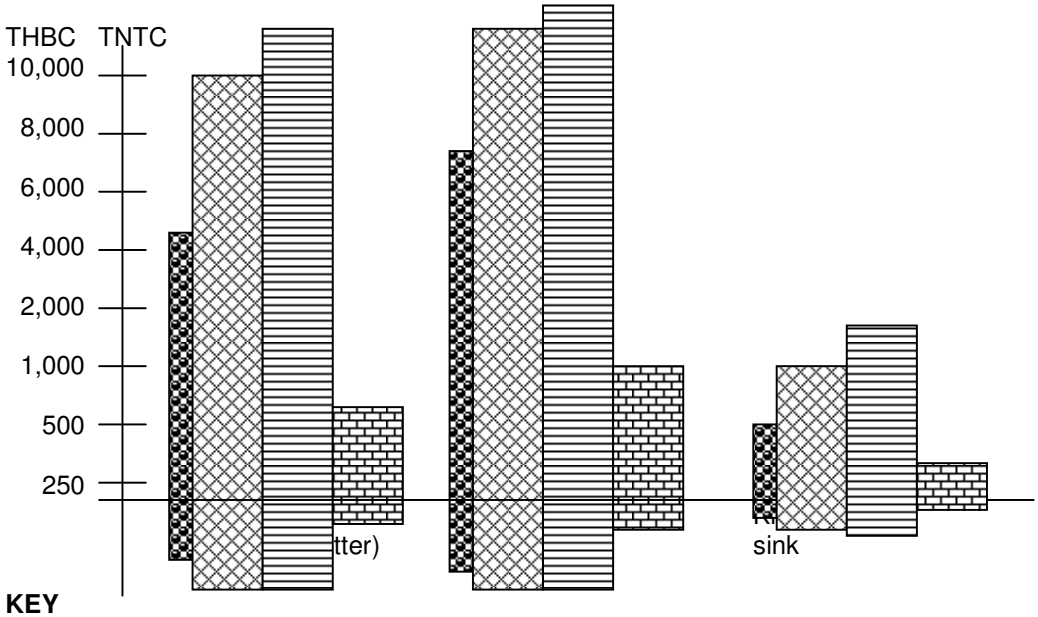
However, effort must be continuously made to discover simpler technologies especially rooted in indigenous knowledge on old time practices. Enhancing and building science around such old practices might penetrate faster, less expensive at almost no cost and thus complement Ecosan type of technology, who, Unicef, unep strategies.

The idea of screening plant in this research for sanitation stemmed from the practice that people in some village in western Cameroon preserve corpses by cutting some specific leaves and use it to wrap the corpses, thus preventing it from quick decay. Equally, the use of "macepo" (occimum gratissimum) extracts in same villages in Cameroon for embalmment, preservative of meat and

cleaning of kitchen surfaces. The use of “maganin saura” extracts in stagnant water to kill larvae of mosquitoes by some tribes (‘sayawas’) in Bauchi Nigeria.

This empirical knowledge has been explored in our study and eco- friendly sanitation products produced from such plants. First, these plants were catalogued, through personal communication with indigenous people and then others based on some ecological indications were randomly screened.

Surfaces, sinks and water channels were cultured for their microbial load, then a water extract of these plants carried out and use to swab the surfaces of tables, flushed the water channels and stagnant water around homes. Following this, a post treatment culture of swabs from sites revealed of 97-99%reduction of total aerobic mesophilic bacterial counts.



KEY

Bacteria count after water treatment.

Total bacterial before treatment

Total bacterial count after treatment with occimum gratissimum extract.

Total bacterial count of site left without treatment for the study period.

TNTC——→Too numerous 70 count.
THBC----------Total Heterotrophic Bacteria Count

Fig.I Shows treatment cleaning of water channel, garbage dump and kitchen sink with water extracts of *occimum gratissium* (macepo (Yongabi, 2004).

(Photo 8)

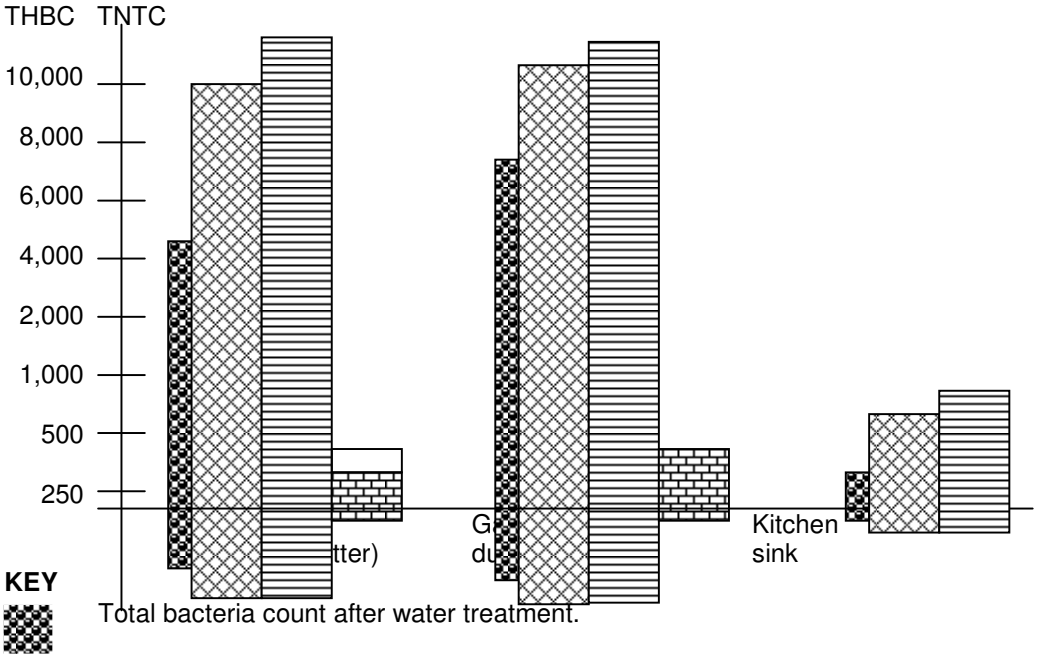


Fig. 2 Treatment of cleaning of water channels, garbage dump and kitchen sink with extract of Allium sativum (garlic).

Source: (Yongabi, 2004)

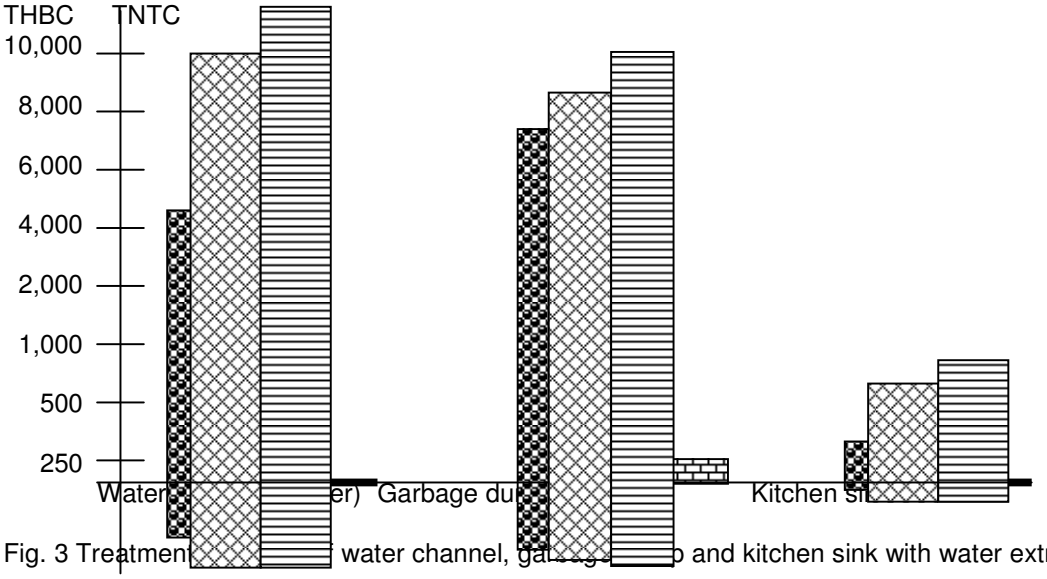


Fig. 3 Treatment [illegible] water channel, [illegible] and kitchen sink with water extract of Moringa oleifera.

KEY

Total bacteria count after water treatment.

Total bacterial count before treatment

Total bacterial count after treatment with *Allium sativum* (garlic) extract.

Total bacterial count of site left without treatment for the period.

Zero bacterial count.

TNTC Too numerous to count (Yongabi, 2004)

THBC-------Total Heterotrophic Bacterial Count.

The results in Fig1, 2,3shows how clearly plant extracts can be used to reduce bacteria burden on the environment. Allium sativum, Moringa oleifera and Occimum gratissimum could be used as phytohygienic plants at home cleaning gutters/channels where wastewater exists (Further details of this study may be slated in a future report). Moreso, biotech. Products were developed from these plants using kaolin and starch carriers (Yongabi, 2000) Antiseptic soaps, powders and solutions were equally formulated using suitable carriers as well and the assay tests repeated to note the effect on bacterial load. In most cases, a 99.7%-100% was often recorded. (Yongabi, 2000) (Photo13)

These eco-products can now be used to disinfect kitchen table surfaces, sinks, water channel ways (gutters) as well as poultry and animal pens.

Most plant screening exercises have not considered this option, rather the ultimate goal of developing synthetic pharmaceuticals that often takes time and very expensive as well as with a number of uncertainties. The real question here is how many pharmaceutical companies or an agrochemical company that synthesizes drugs or chemicals derived from plants do exist in Sub Saharan Africa or the third world in general? With the more than four hundred thousand medicinal plants that exist in Africa, how much have the rural man benefited so far? How many synthesized drugs of plant origin are cheaply available for the poorest of poor? Yet, thesis/dissertations linger in piles on the shelves of the various universities with many professors and academic doctorates on Natural products that have not helped the situation the least. The thrust of this research is that, in as much as screening medicinal plants with view to synthesizing the templates/leads, the indigenous people could develop temporary formulations for local use especially now, if they must run an integrated farm. The training on this is simple and is largely a do it yourself phenomenon.

The use of these products in some homes in Bauchi is yielding success and fascination as well. An extensive trial of this technology is in use at the Songhai integrated farm, Porto-novo in the republic of Benin (www.songhai.org) following training I delivered in December 2003.

A photograph of some of these products is displayed at the photo gallery of the of the IOBB (www.biotech.kth.se/iobb/news/kenneth/photos.html) photos 11 and 13.

The residue from the extracts were kept in a compost pit and in just five days, degradation was apparent with predominant species like Trichoderma viride, Aspergillus niger,Rhizopus nigricans,Nigrospora,Neurospora sitopholia and yeast(Rhodoturella sp).Similarly, the residue when mixed in to an anaerobic digester with other substrates ,the hydraulic retention time reduced.The benefits of the use of plants in sanitation,disease treatment are tremendous.With such a downstream/lowtech,the likelihood of rapid dissemination of this practice and the cultivation of these plants in an integrated biosystem farm can have several advantages;food preservation,control of gastrointestinal infections in both human and livestock ,treatment of waste water, and catalyst for anaerobic digestion process.

Are there any doubts of the tremendous roles of medicinal plants in integrated biosystems?

ROLE OF MEDICINAL PLANTS IN ANAEROBIC DIGESTION

One may still wonder if medicinal plants could play a role in anaerobic digestion or have a link in integrated biosystems? As indicated earlier, medicinal plant extracts may serve as biocatalysts or biostimulants in the anaerobic process.Apart from composting the residues as explained above, the extracts of Moringa oleifera seeds used in making cow dung slurry can reduce the take off time for digestion process, thus reducing the hydraulic retention time.Water with a high content of

phytochemicals/phytonutrients can be drained into an anaerobic digester,the nutrients will be utilized by hydrolytic bacteria,and the water recovered with the use of biocoagulants, In an earlier study in Belgium,it was reported that Moringa oleifera seed extracts stimulated the hydrolytic bacteria in an upflow bioreactor.(Photo 13,19and20)

The bacteria from this were reported as predominantly Enterobacter and klebsiella aerogenes. This is an area worthy of further study.An interesting connection exist again as same plants could be used to recover water from an anaerobic digester for future use. Moringa oleifera, sclerotium of pleurotus tubberegium, Jatropha curcas and Hibiscus sabdarrifa calyx have been reported to possess coagulative and disinfective properties (Yongabi, 2004: wwwbiotech.kth.se/iobb/k). Due to the multivariate uses of these plants, they could be cultivated in a herbarium in an integrated biosystems.

MEDICINAL PLANTS USE IN MUSHROOM CULTIVATION

The use of essential oils of Occimum gratissimum, rhind of Citrus species,extracts of Lantana camara,Occimum sanctum L and Azadirachta indica can be used to control Mushroom pathogenic fungi.The extracts can easily be used as preservatives of mushroom harvests as well. In our study (Yongabi, 2003) we observed that extracts from these plants inhibited conidial germination, radial mycelia growth of a number of plant pathogenic fungi such as Aspergillus, Botrytis, and Fusarium SP isolated from Tomatoes and other crops. These fungal isolates have been incriminated in mushroom disease as well. This might be new concept that should be encouraged, so that IBS truly becomes natural and independent as much as possible. (Photo8, 11 and15)

MEDICINAL PLANTS IN NEMATODE CONTROL

Soil nematodes attack a wide variety of crops and reduce productivity. Many local farmers may not be aware of this but the damage caused by soil nematodes is of great significance to crop yield. Nematodes like *Rotlenchus reniformis* that is reniform nematodes attack a wide range of crops, tomatoes, wheat, carrot, potato, lettuce okra, garden egg, sweet and cowpea.

They cause systemic infection resulting in wilting, necrosis and stunted growth. They mostly attack roots of crops thereby providing openings for secondary bacteria and fungi infection. Prominent symptoms of nematode infection are yellowing of leaves, wilting and stunted growth.

Actually farming techniques such as crop rotation, inter-cropping and nematode resistant crops reduce the nematode population, but this is not sustainable because not all farmers can carry out

crop rotation due to land limitation and above all few crops resist nematode infection. Fertilizer has been noted to have no effect but organic manure has been noted to have some benefit in suppressing nematode population. Akhtar, (1995) in India, reported a decrease in plant parasitic nematode population and increase soil fertility when blood, fish and meat wastes were incorporated into the soil.

Similarly, Prasad and Singh, (1997) in India reported increase in crop productivity and increased soil fertility in alley farming system of white popinac (*leucaena latisiliqua)* with field crop of sorghum bicolor and sorghum and pigeonpea, while alley cropping on an ultisol in sub-saharan Benin showed a 50% significant yield of maize-potato, maize-back gram and maize-pigeon pea, changes in crop physiology, conservation of soil by cajanus cajan (pigeon pea) and increase in organic matter and subsequent utilization by other crops was observed (*Leithner et al, 1996). Leihner et al, (1996)* also reported that alley farming with low competitive trees might improve food crop yield.

Soil nematodes cause a lot of havocs to field crops and this has resulted to low yield in some cases. Medicinal plants can be cultivated in an IBS that could be used to control soil nematodes. The use of Garlic, ginger,clove and pepper extracts have been mixed with soil that have been infected with nematodes and nematicidal activity observed.Similarly,the works of Onifade and equnjobi(1995) reported that the fruit extracts of Meloidogyne javanica exhibited nematicidal activity comparable to a standard nematicide furdom.

1.2 Management of plant pathogenic diseases and pests with medicinal plants.

Plant pathogenic diseases such as bacterial wilts lead to poor yield and loss of money. Bacterial diseases caused by *Erwinea spp. Pseudomonas spp* attack stem and fruits, leading to poor harvest.

Table A: Fungal isolates from some crops at the School of Agriculture Research Farm at the Abubakar Tafawa Balewa University.

Crop (infected field crop	Culture Media Microscopic feature	Isolate
Groundnut blight (late blight)	White colony in 7 days. Pure white cottony in 21 days aseptate hyphae	*Cercospora personata*
Rice blast (dark spots on grain)	Gregish brown or ash colonies in 4 – 7 days. Hyphodia, hyphae aseptate, boroing conidia	*Pyricularia oryzae*
Mango (field rot)	White colonies in 5 days	*Alternaria spp*

- Treatment is usually with fungicides composed of mostly copper and some other heavy metals.

(Source: generated by K. A. Yongabi, 2003).

Equally, fungal diseases such as *Fusarium spp. Aspergillus spp, sclerotium and Alternaria spp etc* do not only kill plant and reduce crop yield but contaminate animal feed when used in feeding livestock. Some common available medicinal plants namely *Azadirachta indica, lantana camara and Recinus communis. L* has been used to control plant pathogenic diseases. (Kumar, 1979). The inhibitory effects of some plant extracts on the conidial germination of *curvalaria pallescens* have been reported by Mumar, (1979). Similarly, Durbey and Dwivedi, (1991) reported the fungitoxic properties of some plant extracts against vegetative growth and sclerotial viability of *Macrophomina phaseolina.*

Insect pests cause a lot of harm to crops. They carry disease-causing microorganisms on their wings such as bacteria and fungi and deposit them on the crops and more so destroy leaves and feed on the fruits. Sometimes, their caterpillar larvae feed aggressively on leaves leaving nothing for humans, thus, leading to low yield. Sometimes soil ants destroy roots and secrete substances that frustrate plant growth.

Synthetic insecticides have been used and are still being used. This has a lot of setbacks. Firstly, they pollute the environment interfering with non-target organisms, and some could be carcinogenic to man in the long run. Besides, the high costs of these insecticides to local farmers militate against increased food production.

These insecticides are not only ecologically biased as there are harmful to non target organisms which should have otherwise acted as predators of other pests in the environment or as pollinators, but some are soluble in oils, fats and waxes of plants and animals and when consumed by man may have devastating health effects.

In fact, it has been reported that some plants accumulate insecticides and *organochlorine* and man in turn generates levels of these in serum and such a case interfering with human fertility has been reported as *xenoestrogen* (Chemistry in Britain July, 1995) thus reducing fertility.

Emerging resistance to agrochemicals couple with their havocs has been baffling so much that there is a turn around to genetically modified products. This is no escape as genetically modified products are increasingly under scrutiny of safety. There exist serious allegations that they are potential carcinogens (BBC, 18th June, 1999). It is clear that natural products from plants may have the solution to this. Therefore, such plants in the IBS can greatly enhance productivity in an environmentally acceptable manner.

Details of some more potential Ethnomedicinal plants proposed for IBS.

1. **Capsuim annum** (red pepper) Icapsium frustescen. It is very common plant used in most villages as a condiment. Very widely available and has been used in ethnopharmacological preparations. It can be used as an anti weevil and preservation of grains. It is suggested for the integrated bio-system so that it can be harvested and sold as well as used in livestock feed against coccidiosis and other diseases and can be used in anti fleas lotions.

2. ***Jotropha curcas (phsic nut)***

   This is a drought-resistant multipurpose plant that can be used both for arresting soil erosion and for the production of valuable oil from its seeds (35% oil content) the oil from this plant has an anti-fungal property and can be used in feed formulation to control microbial content of feed.

   Equally, the plant (leaves) can be used to treat boils venearal diseases) when taken with a pastry.

3. Allum sativum (Garlic)

   This is a multipurpose herb. It has been used in many ethnopharmacological preparations and has been proven to be a broad spectrum antimicrobial as indicated by the published literature.

   Possibility of incorporating garlic in animal feed to control its microbial content has been studied with success by Yongabi et al (2000), Garlic can control aflatoxin producing organisms in feed and both bacteria producing exotoxin and endotoxins. Anti-fungal effects of Allium sativum extract against Aspergillus species involved in otomycocis has been reported to show an in vitro growth inhibition effect against a large number of yeast including candida spp fungi such as coccidiodes immitis (Appleton and Tanser, (1975), Baroner and Tansey, (1977), Adelumbi et al (1986) Ghannoum, (1988) and known to have a protective effect against in vivo fungal infections as reported by Prasad And Sharma, (1993) Aitkin, (1977) and Adetumbi et al (1986) reported that Garlic has insecticidal, Antiparasitic and antitumor besides antimicrobial activity Richter, (1993) noted vehemently that Garlic if interplant with other crops, repels insect/ pests on those crops . Such claims could be further verified and explored in an IBS .. The chemical composition has been partially defined by Block, (1985) and its active component thought to be a di-ally-thiosulfinate (allicin), a sulphur containing compound.

Cavillito et al, (1944) reported that Garlic has antiprotozoal, antibacterial and antifungal and the bioactive ingredient attributed to allicin, methyllyl thiosulfinate and allyl-methyl thisoulfinate. This has been supported by Fenwick and Hanly, (1985) ,Hughes and Lawson, (1991).

Volatile compound in Garlic repels insects and can be used to repel soil nematodes; this is so necessary in an integrated biosystems.

Garlic has been used in field trials to curb plant diseases. These compounds in garlic are lethal to soil nematodes and can be used to control plant parasitic nematodes. Garlic is a vermifuge and does not destroy intestinal flora.

4. Carica papaya (paw-paw)

An economic crop. An edible fruit tree. Paw-paw bark extracts have been found to control aflatoxin-producing organisms (Yongabi et al, 2000). The fruit and leaves contain the enzyme papain; papain aids in digestions, meat tenderizer and can be used in breweries to precipitate proteins. The seeds of the fruit can be used in animal feed as an antihelminthics. The seeds contain an alkaloid carprine known to destroy Ascaris spp, Enterobius vermicularis and Trichiuris spp. It is possible that extract of this seed could control gastro-enteritis in livestock present in an integrated-biosystems and thus enhance productivity at low cost.

5. Vennonia amydallna (bitterleaf)

It is taken as a vegetable soup in most villages in Africa and used as hops for beer in Ethiopia. It is used as a prophylatic against worms in babies. The leaves have been added to horse feed as a vermifuge (Dalziel, 1937). Fresh bitterleaf together with Guava and Mango in lotion can be used to treat wounds in cattle and pigs.

6. Solanium incanum (gayan gauta) and solanium melangltis (Garden egg)

This is an eggplant, used as a vegetable plant. It can be used to control gastroenteritis due to bacteria. It has been used in ethnoveterinary practices for a long time. (Personal communication with practitioners).

7. Aloe barbadenis (Aloevera)

It is very useful plant and can resist drought. It is used as an anti-poison. Oils from the bark of Aloevera rhizome are effective in controlling Aspergillus contaminated feed. Yongabi et al (2000), Aloe Vera is known to control dermatophyte infections in man and animals as well.

8. Annona senegalensis (wild apple)

It is available and can be utilized as vermifuge, antilice for livestock. The plant has an alkaloid called anonnaine and can be tested for other livestock infections such as babesiosis.

9. Oil grass.

These plants need to be identified. These are very good plants with obnoxious scents and are used to repel floor lice in poultry pen .

10. Momordica charantia(L)

African cucumber. This is a plant and can be used for wines and fruit juice. The seeds have been used in an IBS as antihelminthics, particularly as a taenifuge and for roundworms in both man and animals.

11. Cucurbita pepo styrlaca (pumpkin)

The fruit is edible and is rich in iron, calcium and vitamins. The seed oils are rice in vitamin E. (Tocopherol) and can be used to enhance fertility. Seed oils have an anti-inflammatory activity particularly hypertrophy of the prostrate. It is a good source of vegetable oil for cooking as well as for cosmetics.

12. Cajanus cajan (pigeonpea)

This plant when intercropped with other crops leads to high crop yield; improvement in soil fertility and when used in biodigester yields high biogas. This crop when planted in an alley farming system suppresses plant parasitic nematodes.

Other plants like ginger (Zingiber officinale) and Hibiscus sabdiriffa (rosette) are potential vermifuges and these multipurpose plants should be exploited.

Methodology and criteria for future plant selection for IBS.

Plants should be selected based on their indigenous uses and proven efficacy tests and ecological indicators, then nurseries made.

Formulations.

Plant extracts will be mixed with oil base or suitable carrier and sprayed on the crops. While the moisture normally used for compounding feed will be plant extracts and will be used for feed formulation before storage. Similarly oily extracts and the plant powders will be formulated directly into the feeds. Quality control tests should always accompany initial formulation trials.

Studies on other ethno medicinal plants with multipurpose uses should be continuously carried out so as to include and link them in IBS.

The gem cannot be polished without friction nor man perfected without trials---CHINESE PROVERB

Conclusion

According to Doelle,"Sustainaibility can be obtained together with health and living standards, if appropriate technologies are applied according to climatic region and local society "IBS technologies promises a brighter future for the world especially developing countries, but the technologies have to be built on indigenous knowledge, and skills made simpler so as to empower the commoner. The systematic in put of science to indigenous knowledge is what we need in order to add value to medicinal plants, in as much as we have to wait long to synthesize these products-which still comes out expensive for the commoner. A closer look at the local resources and planning technologies and development around that is pivotal to the survival of IBS in Africa and of course solving Africa's problems. The world's scientists/engineers need to carve out new maps/routes if they want their researches to solve the pressing problems of today.

The most damaging phrase in the language is: it's always been done that way---REAL ADMIRAL GRACE HOOPER

Unfortunately the world of academia is suffering from rather lofty intellectual epilepsy with published researches and scholarly papers that are meaningless to addressing human needs, yet much money sunk in to such researches and whereas a fraction of such colossal sums on simple but meaningful researches built on indigenous knowledge could actually change the lot of our people..

If we knew what it was we were doing, it would not be called research, could it? —ALBERT EINSTEIN---

Acknowledgements.

"*A healthy altitude is contagious but don't wait to catch it from others. Be a carrier" UNKNOWN*

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Picture 1

Field cabbage (Brassica oleracea) rot fungi,multiple infections by Fusarium sp, Botrytis cinerea and Aspergillus nigercausing dry rot disease (Yongabi et al, 2003) Cabbage disease have been effectively treated with biofungicides a formulated from mango seed extracts (Magnifera indica), lantana camera occcimum gratissimum. At two spraying regime plus seed treated.

Photo 2

Pathogenicity test of 4 fungal isolates (moulds) on freshly stored Tomatoes (Lycopersicon lycopersicon Karst) Rhizopus stolonifer, most pathogenic of the test fungal isolates in this region (Yongabi et al, 2003)

Photo 3

Pure cultures of some fungal isolates:From Left to Right: Rhizopus stolonifer,Aspergillus fumigatus,Aspergillus niger, Penicillium notatum ,isolated from post harvest fruit loss
These fungi have also been isolated from decaying sweet potato. Biofungicide dips formulated from Garlic (Allium sativum, Citrus aurantofolia and Lantana camara have effectively increased the shelf life of stored potato thus reducing post harvest losses.
(Yongabi K.A. 2003)

Photo 4

Cercospora personata (on the slant in the bottle) isolated from ground nut rot disease.
A multipurpose biopesticide and biofungicides formulated with suitable carrier base from the mentioned plants. To control insects /field pests and rot disease of field crops. These also repel mosquitoes and flies at home when sprayed.(developed at the ZERI research centre, ATB university, Bauchi)

Photo 5

It was observed that the common Goat weed, Ageratum conyzoides leaves were hardly perforated in the field whereas other crops growing in the same vicinity were heavily perforated. A hypothesis was formed that this could be a good pesticide/pest repellant. Herbiotics formulated from the extracts have been used to preserved cowpea from the weevils, Callosobruchus macalatus.

Photo 6

Tobacco plant(Nicotiana tobaccum): Herbiotics formulated fro this plant have been used to repel pest.
Extracts in a honey syrup has been used in the treatment of filariaisis(Yongabi et al ,2004)

Photo 7

Iodine grass(Aspilia africana)
Ointment prepared from this plant with treats sores in animals and humans. Extracts treat foot disease of cattle when dips are prepared.

Photo 8

Occimum gratissium commonly called spice plant or macepo by the Yorubas in Nigeria. Extracts of this plant have used as food preservatives to increase shelf life of meat, reduce post harvest losses of potato e.t.c and prevents weevils on grains.

Antiseptic solutions and powders have been prepared and used to clean surfaces in the kitchen ,Cistern toilets, flush gutters around home to reduce pathogen burden.

Photo 9

Exhibition of fermented table wine from fruits(pawpaw, grapes)with orange rhind extracts, extract from cloves etc without significantly interfering with the organoleptic properties.

Photo 10

Unidentified plant(locally called Maganin saura in Hausa) produces a strong aromatic cent that repels insects. It has been used to preserve grains and extracts from the plant repels mosquitoes at home. It has been

sprayed on stagnant water to kill mosquitoes larva (source: Yongabi K.A 2002)

Soaps have been prepared from leaf extracts for human skin disease as well. Used as a preservative in food, antiseptic solution prepared from this has been used to clean kitchen sink etc (Phytohygiene)

Photo11

A.indica (Neem) seeds. Bark contain antimicrobial activity, while seeds extracts contain insecticidal activity(mosquito repellant candles have been produced from neem oils)

Photo 12

Extracts of bitter herbs (Vernonnia amygdalina) has been used to manage diabetes, prevent malaria. Formulation from this plants such as Soaps have been prepared from leaves and bark extracts for human skin disease as well.Very goog candidate plant for hygiene and sanitation.

Has been used to control brown blotch of cowpea. Extracts from the leaf prevents clogging of algae and bacteria in irrigation pipes. The practice of flushing algae clogging pipes often employ Copper sulphate and sodium hypochloride which of course are not environment friendly (Unpublished works of Yongabi, K.A. 2004).

Photo13

Apart from water purification, Moringa oliefera seed extracts have the ability to control algae clogging irrigation pipes and emitters. Its ability to inhibit iron bacteria and can effectively control corrosion of pipes (Yongabi K.A. 2004).

Photo14

Wild garden egg (solanum incanum) dried fruit extract used to treat gastrointestinal infections in livestock.

Photo15

Lantana camara.

Important plant in sanitation: leaf extracts have been sprayed on dirty gutters to reduce pathogen burden in the environment. Leaf extracts repels mosquitoes in stagnant waters. Antiseptic solutions have been prepared for keeping kitchen sinks/ table surfaces free from pathogenic microorganisms.

Photo16

Field of cowpea infected with Collototrichium SP before treatment with biofungicides.

Photo17

The same field after treatment with biofungicide formulated with medicinal plants on the spot.

Photo18

The use of a local knapsack spraying set to apply the biofungicide/pesticide by a plant pathology student.

Photo19

Gynandropsis pentalophylla (in hausa: Gasaya)

Produces white flowers that attract bees. Used in the tratment of Otitis media, boils and management of hypertension.(Yongabi and Babatunde,2004)

A weed that can be cut fresh and mixed with dung to promote anaerobic digestion for the production of highly rich/mineralized slurry.

Photo 20

Plastic digester mounted at the ZERI research centre. Cow dung made in plant seed extracts(Moringa seeds) boosts digestion process.

Photo 21

Tomato leaves, used as a pest repellant.

Photo 22

Photomicrograph of plasmodium falciparum frequently encountered (photo:yongabi)

Malaria also constitutes an occupational disease due to agriculture. Antimalarial plants that have multipurpose uses like Accacia nilotica, Artemisia sp Psidium guajava and other regional plants could form part of IBS herbarium.

Photo 23

Beaded rods typical of Mycobacterium SP (Yongabi)

Human and Bovine TB are very common in Nigeria. TB also constitutes an occupational disease due to agriculture. Plants with a history of use in TB management such as Piper guinensis, Garcinia cola, and Artemisia SP e.t.c could form part of an African IBS herbarium.