Link Natural

DIGEST

Volume.15, Issue 1 , 2019

LINK NATURAL PRODUCTS (PVT) LTD

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Link Natural DIGEST

Volume 15, Issue 1, 2019 ISSN : 1391-8869

IN THE PAGES THAT FOLLOW.....

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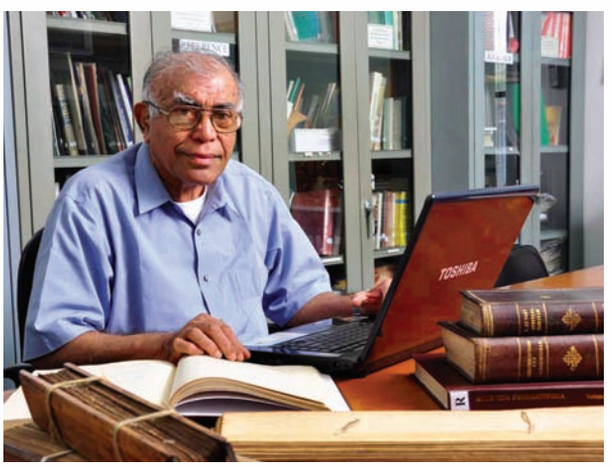
EDITORIAL



We are living this day amidst the threat of what appears to be a worldwide phenomenon of destructive terror. When one examines the reasons that may have given rise to this phenomenon there are many. Globalization has made it clear that there is a staggering difference between the daily lifestyles of the rich nations as compared with the poorer ones. The resultant envy is the cause and the threat that the world now faces. This difference is also the driving force for the massive migrations that are occurring, and which has resulted in millions suffering in refugee camps worldwide. International agencies are desperately hard pressed to cope with the new phenomenon of the homeless populations in refugee camps. They are hard-pressed to provide the needed humanitarian services of food and water, shelter and sanitation at the most basic levels. The richer nations spend away on weaponry and competitive gains in trade which display meaningless disregard for the human side of the suffering endured by so many. The richer nations may well be advised to spend their funds in attempting to share advantages they enjoy with the ones in dire situations like those spending their lives in refugee homes today, particularly the millions of children.

R O B Wijesekera

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SANDALWOOD: KING OF THE FRAGRANCE EMPIRE

By R.O.B.Wijesekera

Introduction

The Sandalwood Tree has given to the world its oldest and perhaps its best-known fragrance. It is now recognized as the fragrance of classical eminence sought after and treasured by Pharaohs and dignitaries of like eminence and treasured the world over throughout the long ages of time. The documented use of Sandalwood goes back more than four centuries through ancient Arabian empires through Greece and Rome, and through the ***Mohendro Daro*** period of Indian History.

Sandalwood is obtained from the wood of the trees that belong to the genus Santalum. The Sandalwood tree has long been known for its characteristically hard wood from the core of the tree which is dark yellow in colour and which has an outer rim lighter in colour and distinct from its core.

Ancient people knew of the fragrant smelling oil that emanated from the sandalwood and knew of the method of steam distillation which was used to express the fragrant volatile oil from the hardwood of the tree. Sandalwood had been valued since ancient times for its unique fragrance, as a choice wood for carving, for health-related uses, and its employment in religious rituals.

The documented use of Sandalwood goes back to over four to five millennia, to Arabian times through the empires of Egypt, Greece and Rome, and in Egyptian times paleontologists have discovered its use in embalming.

The Sandalwood tree is believed to be indigenous to the region of South and South-east Asia. It is a relatively small evergreen tree which grows to full maturity in 25-30 years. Modern scientists reckon this is when the essential oil content of the heartwood reaches its maximum. At first the sapwood is light coloured and odourless and as the tree matures the heartwood develops in colour intensity to a brownish yellow when it becomes strongly scented. This is the stage at which the trees are ready for harvesting of the sandalwood. The sandalwood tree is not felled but instead uprooted in the rainy season, when the soil is loose, as the root bulk is richest in the precious fragrant essential oil. The Sandalwood tree delivers a variety of products other than the fragrant wood and the essential oil. By-products such as the sandalwood scented water, a by-product of the distillation process is also

valued as a medicinal bath water since ancient times. So too is the residue left after the steam distillation of the wood to produce the sandalwood oil. This residue mostly in the form of sawdust after exhaustion with steam forms the basis of the Indian *"joss sticks"* or *Agarbathi.* The spare wood left from cuttings, and branches and reckoned as unsuitable for extraction of oil, finds use for carvings, and generally artistic models for ornaments. Most people touring the regions where sandalwood abounds reach for these as curios. But in all of these the majestic fragrance of sandalwood leaves behind with everyone its dominant and lingering impression.

Botany Habitat & Distribution

A Sandalwood tree

A cross section of the tree trunk

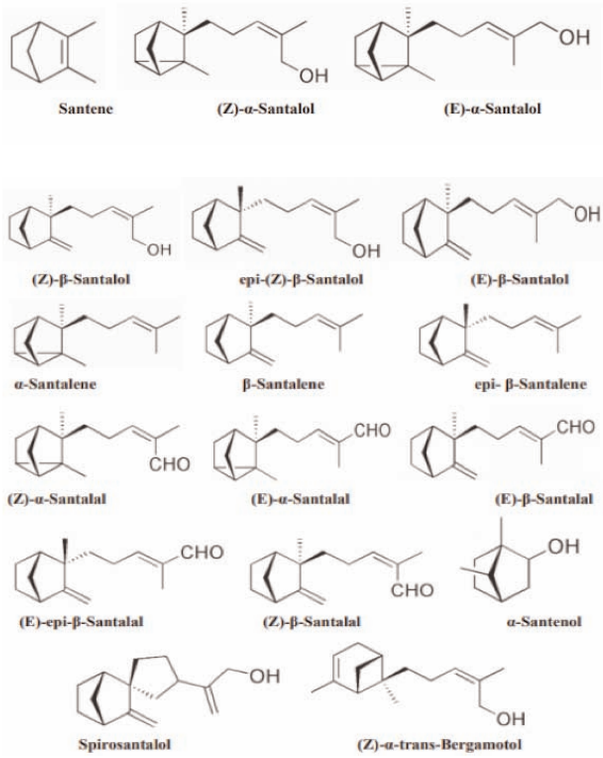
The Sandalwood tree botanically identified as *Santalum album* is indigenous to the tropical belt that covers the Indian sub-continent, and eastern and northern Australasia. The main distribution is in the tropical regions of the Indonesian islands of Timor and Sumba and areas of Tamil Nadu, Andra Pradesh and Karnataka. Sandalwood grown in Australia comes from the species identified as *Santalum spicatum.* There is also a West Indian and the African variety of the species of *Santalum.*

In a wide survey of the distribution of the sandalwood trees in Asia, Subasinghe (2013), reports that there are over 18 species belonging to the genus *Santalum*, and which are hemi-parasitic to the Sandalwood tree. The global distribution of the sandal family lies between the tropical belts mentioned above. The best quality of sandalwood originally came from Mysore, India. The Mysore variety is now an endangered species following the rape of the natural forest trees by terrorist groups. Sandalwood oil is the most treasured commodity that comes from the Sandalwood tree, and the oil cells are located primarily in the heartwood which forms as a central column within the tree trunk.

Chemical composition and Main Constituents

Detailed chemical studies have been conducted on the composition of the essential oil from Sandalwood, known since ancient times as one of the costliest, as this is an important constituent in the fragrance industry. The fragrant oil is the major constituent that is responsible for the economic value of the wood. There are variations in the compositional pattern between oils from different sources and locations but the major constituents that repeat themselves are a group of compounds whose structures are featured below:

(from Rakesh et al. World Journal of Pharmaceuticals (2015)



The specific odour of sandalwood is attributed to two major constituents, *alpha* and *beta* Santalol, which belong to the chemical class of compounds known as sesquiterpenoids. They are terpenoid alcohols also known as Santalols- A series of closely related chemical compounds contribute to the overall fragrance. Stalwart Indian chemists such as. S.C. Bhatacharya and co-workers have elucidated the chemical structures of the major constituents of the sandalwood oil over the years and the constituents are well documented.

The detailed composition of sandalwood oil has been extensively researched thereafter by modern chemists using the latest techniques of GC-MS and small differences in varieties due to location or species variation is detectable. Searches on the composition of natural sandalwood oils from varied sources is a hot ongoing research theme of all the fragrance companies as are the newest synthetic structures that have similar odour profiles.

(Vide `Rakessh Kumar, N.Anjum & Y.C.Tripathi, 2015, World J. Pharmaceutical Res. vol 4. Issue 10 pgs. 1842-1876).

Extraction Methodologies

Sandalwood oil has been extracted over the centuries by the traditional methods of distillation with water or steam, and then subjecting the distillate to cooling and settling so that the condensed oil can be physically separated from the aqueous phase, (aerosol phase)

Steam distillation is most usually the method used

The procedure in a typical process involves the following steps:

- The sandalwood both sapwood and heartwood are finely comminuted mechanically.
- The wood is then pre- soaked in water for several hours- sometimes more than 20-30 hours.
- Then steam is passed through the bed of woody material, - now well moistened, and impregnated with water, and the steam loaded vapour condensed by cooling. Generally superheated steam is used.
- The floating oil layer is separated from the aqueous phase after a period of settling.

Despite the fact that the distillation time for sandalwood oil is far longer than for most other essential oils, commercial producers for the most part seem to be content with the yields and the

quality of the oil obtained via this method. The quality of the oil varies, according to the care with which the methods are applied. The method of steam distillation as a means of extracting sandalwood oil has lasted a long time. It is the method most usually employed by producers of sandalwood oil. However more recently, the sensitive modern fragrance applications have prompted the use of newer methods that are swifter and less time consuming. Further, the methods of using steam involved high temperatures and can cause the oil to undergo modification of the odour profile due to decomposition of the sensitive odour components.

To accommodate this, at first solvent extraction was the obvious alternative option. However, this gave rise to the problem of solvents extracting extraneous substances, as well as leaving residues causing odour modifications. This technique universally popular in the extraction of the fragrances like those from flowers for example roses, jasmines etc., is not popular with sandalwood oil producers. The solvent residues seem to cause undesirable modifications to the odour.

In modern days, the method of extraction with supercritical carbon dioxide has taken over the commercial production of sandalwood oil for use in sophisticated fragrance formulations. This method became quite popular because of the quality of the product which had little interfering impurities to vitiate its purity. The extraction process is efficient, and the product is suitable for direct use for example in aromatherapy. The method involves pumping pressurized carbon dioxide into chambers filled with powdered sandalwood heartwood. When carbon dioxide is in the pressurized liquid mode it possesses solvent properties of a high order and is able to extract the oil globules from the heartwood almost completely. The extraction process is completed in far less time and within temperatures between 95-100 deg. F. (Eden Botanicals: http://wwwedenedenbotanicals.com/co2--extracts-supercritical-extraction-esseential-oils.html, 2014). The efficiency of extraction is almost the same as with the steam distillation. However it requires far less time, and temperatures are milder. The most recent method is the one now known as the Phytonics process. It is a process devised and patented by Phytonics Ltd., of Manchested, U.K. It is also known as the Florasol Extraction Process and the oils so extracted are referred to as Florasols. The method is used chiefly to extract phyto-pharmaceutical products like fragrances to be used directly in products without the necessity of any chemical or physical modification. The process uses a unique solvent originally designed as a refrigerant named as R134, hydrofluorocarbon of b.p. -25 deg C. It is neither inflammable nor toxic and is an ideal solvent for essential oil extraction as it could be distilled off leaving no residue or odour. The Phytonic process is gentle and environmentally friendly and is very much a candidate for the industrial future.

Product Yields and quality Variations

The yields of essential oil vary from location to location, depending on several factors such as the age of the tree, if it is diseased or healthy and on the parts of the tree from which the wood was taken. For instance, the maximum content of essential oil resides in the heartwood reaching towards the roots and the sapwood contains less. Sometimes the heartwood is rich in the essential oil to the extent even of excess of 10% and the sundry wood consisting of mixtures of sapwood and heartwood could be lower than 1-2% in the essential oil.

In India where the Sandalwood is grown it has been reported that the heartwood itself of trees with 100 cm girth have yielded as much as 85-100 kg of heartwood. On an average, mature trees which are the ones recommended for harvesting, yield up to 0.9% of the distilled essential oil. Oil from the younger trees are known to contain lesser amounts of oil and the oil itself in immature trees contain a lower quantity of Santalols. (now the yardstick of quality assessment).

Besides the fragrance industry, Sandalwood has long been valued as a pliable wood for carvings mostly of objects with a religious theme. It is also recorded that the wood for this purpose is gathered mostly from branches of younger trees harvested on account of diseases such as spike disease.

Uses in Perfumery

Sandalwood oil has been a major constituent of items of perfumery even since very ancient times. The characteristic Indian perfumes known as Attars, believed to have originated during the Egyptian period are based on the Oil of Sandalwood. They are produced by the very special technique, known as the *Deg-Bhapka* method vide Fig(1).- where the vapours (2) of aromatic flowers such as jasmine, rose, kewda, etc are distilled from the distilling vessel (3) via a bamboo condenser (4) into a base of sandalwood oil contained in the distillate receiving vessel (5)

(Vide LNP Digest Vol 2.Issue 2, 2017)

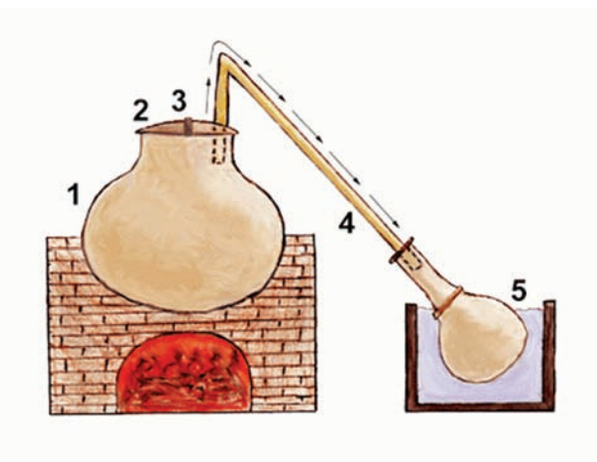


Diagram of the Deg-bhapka process

Sandalwood oil extracted by a variety of methods, forms a major component of perfumery formulations in many parts of the world and this position is maintained even in the modern perfumery industry. Every modern perfumery preparation invariably contains sandalwood oil, or its components included as constituents. Its specific odour profile is respected by perfumers as an essential component of modern perfumery. Accordingly, it is used in the formulation of all types of perfumery compositions. Modern formulations of perfumes invariably use sandalwood oil constituents, and so the sandalwood remains as a major item in the armoury of perfumers.

Health Benefits

The health benefits that are attributed to the power of the Sandalwood and its fragrance over the millennia can be categorized as: - Mythical, Apocryphal, Ethno medical and Psychological. Religious beliefs seem to have been dominant in the earliest times and prevails even this day clothed in pseudo-scientific jargon. Several evidence-based health benefits have been reported even in modern literature, but these are largely yet to be clinically evaluated.

Perfumers attribute to it what they term as a "sweet and woody" fragrance and it forms certainly one of the most valuable ingredients in all of the formulated perfumes.

Besides, modern views have entered the scenario and the sandalwood, its perfume and mystery has acquired an additional dimension. It is problematical to identify the ethnomedical from the evidence-based reality.

Evidence based health benefits have been described in publications of a scientific nature in the following fashion.

- Ethnopharmacology; Sandalwood employed for therapeutic effects is believed to act as a relaxant and able to combat fear, depression, nervous exhaustion, and is used in the traditional systems of medicine such as Ayurveda, Siddha and in the Unani, it is used as an anti-septic and an agent to treat ulcers.
- According to Traditional Chinese Medicine Sandalwood is used to treat chest pains originating in the lungs or heart, and the oil is used to treat angina pains.

- Pharmacological studies have indicated the hepatoprotective value of Sandalwood root extracts.
- The health benefits of sandalwood were said to have been known to the ancient Greek physicians and recorded by Dioscorides in his therapeutic Review.
- In the modern context sandalwood is a component of the major perfumes and is also a component of the fragrances that are being tailored as mood changers to enrich the environment of workplaces.
- The reported pharmacological activities of sandalwood oil can be summarized as follows:
    * Hepato-protectivity
    * Memory enhancement
    * Anti-bacterial function
    * Anti-ulcer effects
    * Anti-viral and anti-fungal activity
    * Anti-inflammatory effect
    * Anti-tumor activity and a host of health beneficial potential effects are documented, and these are based on scientific experimental evidence.

Yet these reported effects are still to be clinically evaluated.

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COCA COLA'S BOTANICAL BEVERAGES

Moxie is a small regional soda brand, but is one of the oldest surviving bottled soda brands in the United States and it predates Coca cola and Pepsi. It has an unusual flavor which is described as bittersweet owing to the presence of gentian (*Gentiana* spp) root extract. It is known mainly in New England. The Coca cola company (TCCC) has now bought over Moxie, thus continuing its trend of expanding its portfolio of beverage brands containing plant derived ingredients. One of its other products is Aquarius vive which was launched in Spain and contains baobab. The baobab tree however, is native to Sub Saharan Africa, and is noted for its rich calcium and Vitamin C content of the fruit. This was in 2016 and in 2018 the company introduced yet another product, a Coca cola sweetened with the purified extract of the leaves of Stevia, the South American herb which is used as a sweetener in other products. This product was first launched in New Zealand, and the product is alleged to be devoid of the bitterness that can be caused by steviol glycosides, the sweet tasting constituent of Stevia.

HerbalGram Number 120, Oct-Dec 2018

FOOD PACKING FROM NATURAL SOURCES

By Dilmani Warnasuriya

Plastics and its ill effects on the environment have been the topic of several seminars, discussions and articles, with the ban on plastics occupying pride of place. It has evinced arguments for both for and against the ban. The concern of the general public is that while realizing that ill-disciplined use of plastics has a definite deleterious effect on theenvironment, alternatives for usage should have been provided before the ban was put into effect. Nevertheless, it is indisputable that plastics are injurious to the environment and future generations will have to pay the price for it, if uncontrolled use of plastics is continued. What then is the solution?

In terms of polythene products, the ban on polythene currently covers, the *"Manufacture, sale, offer for sale or free of charge, exhibition and the use of polythene or any product of polythene that is 20 microns or below in thickness (GN 2034/33). In addition to that, it also bans the manufacture, sale, exhibition and the use of polythene food wrappers commonly known as lunch sheets (GN 2034/34)"*. In fact, the Gazette notification 2034/34 is inclusive of both high-and low-density polyethylene alongside polypropylene which was used as raw material in the production of the said food wrappers in the past.

Island wide awareness campaigns should be held to educate the public on the deleterious effects of plastic pollution, and the state should also place the act of pollution as a punishable offence. This will be some deterrent. In addition to this, our scientific community should carry out intensive research on using the natural resources of our country to develop alternative packaging materials, particularly for food packaging purposes, which would not require long term durability, and which could be trashed immediately after use. Even now for foods which are consumed soon after purchase, such as lunch packets, bakery products and confectionary products some alternatives such as newsprint, leaves and reeds are already in use, but more refinements are necessary. For foods which require longer shelf life, more sophisticated packaging to protect them against air, light, moisture, and bacteria should be developed.

There are several biodegradable and recyclable packaging materials used as alternatives available. These include:

- Leaves (from plant species)
- Paper and cardboard - paper and cardboard is reusable, recyclable and biodegradable.
- Corn starch – packages made from corn starch are biodegradable and are ideally suitable for items which have a short term use, such as takeaway food.
- Bubble wrap – this is made from recycled polythene and is completely biodegradable
- Biodegradable plastic - this is now commonly used in plastic bags. This type of plastic starts to decompose when it is exposed to daylight and is a good alternative to traditional plastics.

Leaves used in packaging

Being a tropical country, Sri Lanka has access to an abundant supply of plant resources to be used for several purposes. Compared to the flora of Western countries there is an enormous difference in the size of the leaves, those found in tropical countries being much larger. This being so, many Asian countries in particular use various kinds of leaves for food packaging, for foods requiring

short term storage. Thus modification of these leaves could surely offer some solace to the food packager? Starting an industry to convert leaves into suitable packaging material would also be beneficial for employment generation. It is also interesting that these large tropical leaves used to serve as umbrellas in many rural areas, even in Sri Lanka. Perhaps a delve into folk lore and related historical literature and also conversations with persons of the older generation, will provoke our research community and entrepreneurs to enter into more innovative activity with regard to our natural resources.

Presently, leaves which are commonly used for packaging for short term needs are banana and lotus leaves, bamboo, rice straw, coconut and palm leaves, heliconias, ginger, macarangas, and many others with banana leaves being predominantly used.

Each country may have its own indigenous plants which are used for food packaging. In some parts of China for instance *Phrynium pubinerve* Blume (Marantaceae) and *Thysanolaena latifolia* (Poaceae) are used. Researchers in China have found that the essential oils of these plants showed notable anti-microbial and anti-oxidant activity which could help in the preservation of food, in addition to its packaging use. In Chinese restaurants, Lotus, (*Nelumbo nucifera*) leaves are used to serve special rice dishes. The lotus leaves impart a characteristic flavour to the rice.

In some parts of Malaysia, plants of the Marantaceae are commonly used. In Sabah, some rice dishes are packaged in Macaranga leaves and in another area, leaves from teak trees (*Tectona grandis*) are used. In the making of the famed Malaysian dish, *bakchang*, glutinous rice along with other fillings are neatly wrapped with bamboo leaves into different shapes, and then boiled to cook and compress the rice. However, before use the leaves must be boiled to clean and remove fine bristles on the leaf surface.

Leaves of the family Marantaceae

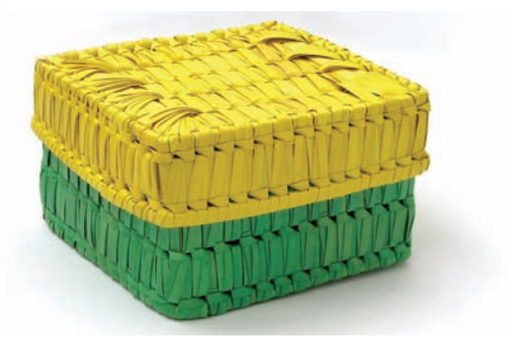
Rice wrapped in Macaranga leaf

Bakchang

(Casey, Ng,Utar Agriculture Science Journal Vol. 1 No. 4. October 2015)

But what must be borne in mind is that not all large leaves are suitable for wrapping food, but the species that are being used have been tested and proven by long usage. No toxins, dyes or other irritants have been identified in these leaves. All the leaves thus used are flexible, allowing folding into shapes, and have strong water proofing quality. In some cases, leaves are pre-softened by steaming, boiling or grilling. In most of the leaves used, an added attraction is that the specific flavour of the leaf is also imparted to the food packaged in it.

Research is currently in progress to study the essential oils and components of the leaves to assess the special attributes attached to these compounds which could add to their desirability for packaging. As mentioned, some of these leaves have been shown to have beneficial anti-oxidant and anti-microbial compounds which could add to the preservation of the foods being stored.



Palm leaf boxes

Palm leaf plates

In Sri Lanka , banana leaves are the most popular commodity used for short term food packaging. Lampries and other traditional foods are wrapped in banana leaves to impart its flavour to the food in addition to its convenience, and other beneficial effects. While this type of packaging is good for immediate use, modifications of this could provide packaging for longer shelf life as well. It is amazing what a little ingenuity could do to this basic packaging material.

Unconventional materials such as hay, mushrooms, agricultural waste and coconut fibers, can also be made into natural packaging materials, and as these are derived from earth, make it easier for it to return to it as well. Many of these innovative packaging materials can be recycled, composted, biodegraded or sometimes even reused to serve a different purpose after their intended use. These attributes are used to develop innovative and less damaging packaging materials for today.

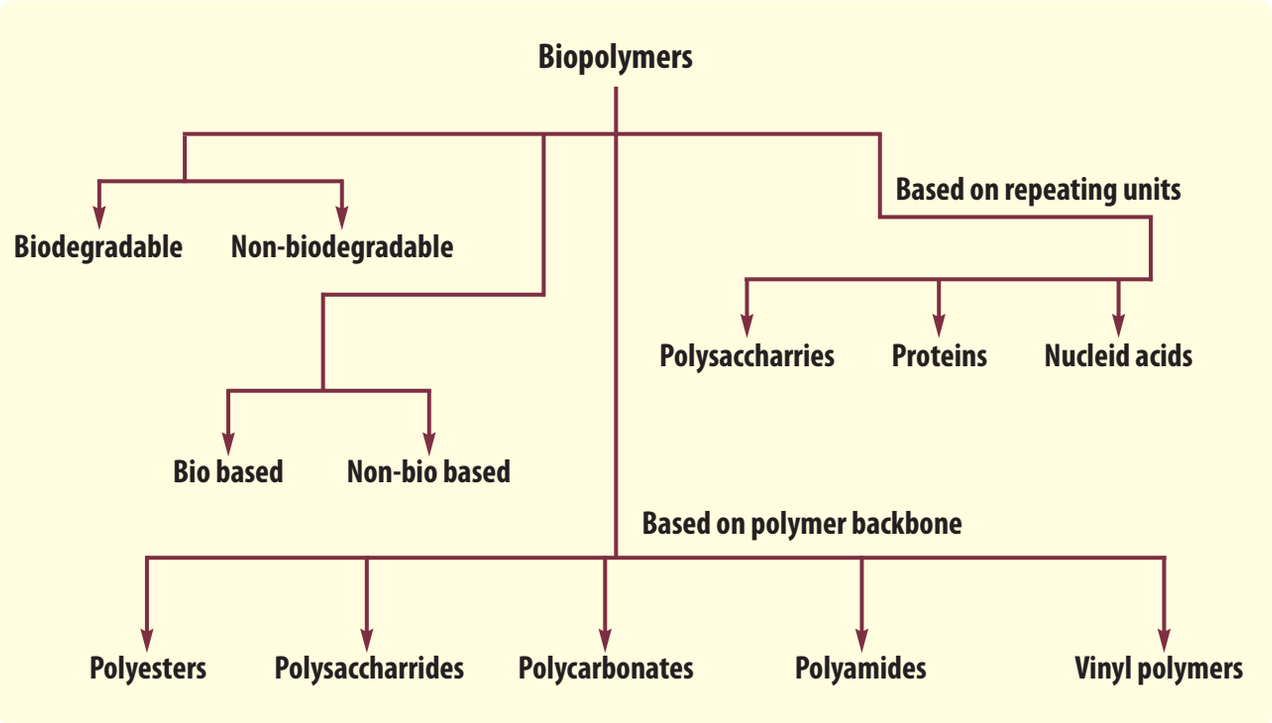
Food Packaging Research

Food packaging research is based on developing formulations which could provide new packaging materials with improved mechanical, barrier, anti-oxidant, and anti-microbial properties, but which could also be degraded, composted or recycled. In recent years this focus has somewhat being diverted to developing materials with these same properties but using biomaterials or naturally occurring materials. This is to address environmental concerns, where the disposal of plastic packaging is an ever-growing problem.

In this scenario, a fast-developing area in the quest for new materials is biopolymer formulations. These formulations could provide and have provided new food packaging materials.

Biopolymers and Bioplastics

There is much confusion and misconceptions with regard to the nomenclature of Biopolymers, bioplastics, biodegradable plastics, bio-based polymers and other terms. To elucidate a little on this, broadly, **Biopolymers** are polymers produced naturally by living organisms; in other words, they are monomeric units which are covalently bonded to form larger structures or polymers.



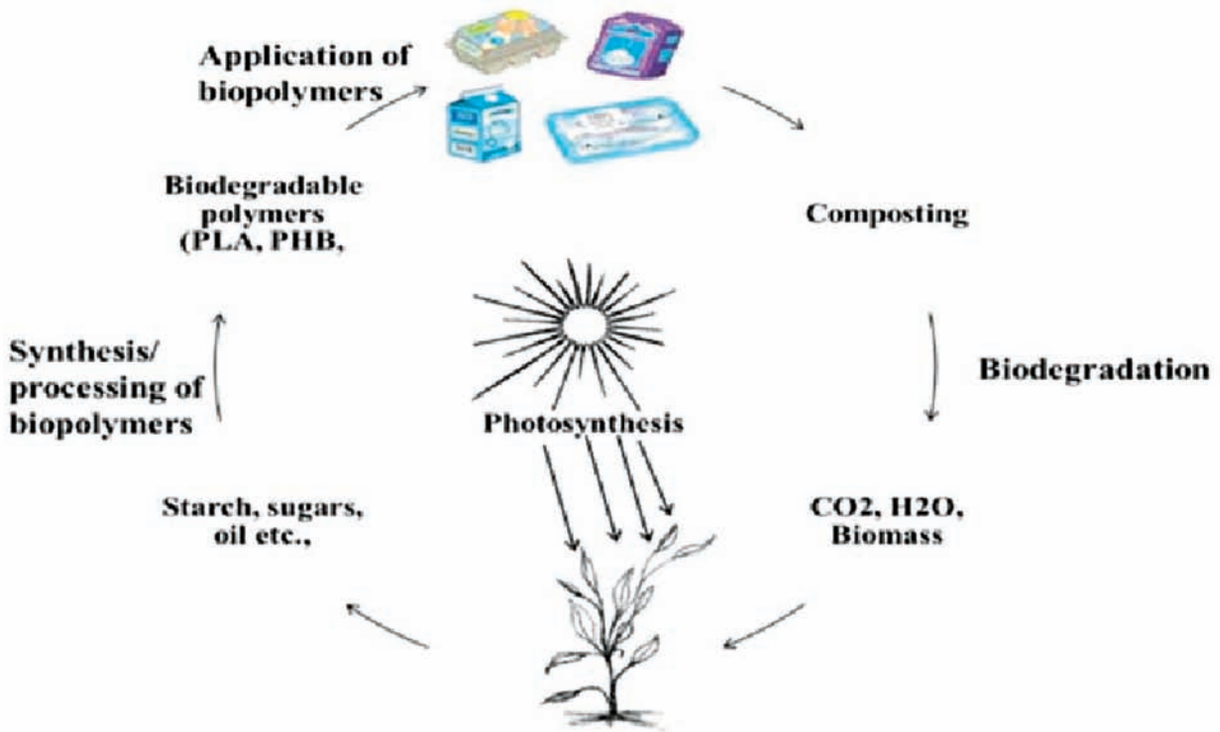
https://www.intechopen.com/books/recent-advances-in-biopolymers/biopolymers-application-in-nanoscience-and-nanotechnology

Common biopolymers include starch, proteins and peptides, DNA, and RNA. Their significant properties are that they are often biodegradable, eco-friendly and nontoxic to produce, being obtained from natural sources. They have been in existence for billions of years longer than synthetic polymers like plastics. More details of biopolymers will be given later on in the article.

Bioplastics, according to the Society of the Plastics Industry (SPI) are defined as a plastic that is often biodegradable, has bio-based content such as biopolymers, or both. Biodegradable bioplastics products are typically intended for short term applications such as single-use packaging, food waste collection bags, or food service ware (e.g. utensils, cups, plates), and which are expected to be composted after use.

Biodegradable Plastics are plastics that undergoes biodegradation through the action of naturally-occurring micro-organisms such as bacteria, fungi, and algae, into natural substances such as water, carbon dioxide, and/or methane (CH4), biomass, and inorganic compounds. However, to make good the claim, it is necessary that the environment and time frame during which biodegradation is expected to occur must be specified. Industry Standards have also been laid down for this type of plastic, the accepted industry standard specifications being : ASTM D6400, ASTM D6868, ASTM D7081 or EN 13432.

Bio based plastics are made from renewable resources instead of fossil fuels. A bio-based plastic can be partly or entirely bio based. This nomenclature has gained so much attention and become such a significant factor that the United States Department of Agriculture's (USDA) Bio-Preferred Program recently promoted the use of bio-based products and laid down a quantifiable amount to warrant the term Bio based. It should also be noted that just because a plastic product is bio-based it does not always mean the product is biodegradable or compostable. Again, the difference between biodegradable and compostable must be clarified, although they are often used interchangeably. Composting is one environment



Life cycle assessment of biopolymers

International Journal of Chemical Studies 2018; 6(2): 2411-2418

where biodegradation occurs. Compostable plastics are those that biodegrade in industrial composting operations at the rate of other compostable materials. The standard for compostability (ASTM 6400) is based on complete biodegradation within 180 days under active composting conditions. Also, most compostable plastics are not suitable for home composting, as the temperature may not be high enough. Bioplastics that are compostable can be used for collecting food and other organic wastes and directed for composting.

A compostable plastic is biodegradable in a composting environment, yielding water, carbon dioxide, biomass, and inorganic compounds. Biodegradable also does not necessarily mean a material is compostable or recyclable. Bioplastics can be bio-based and/or compostable. There are also other bioplastics which are completely biodegradable/ compostable but are made with fossil materials such as petroleum-based materials. This means that whether a material can biodegrade or be accepted at a compost facility does not depend on its origin (renewable or fossil). It depends on its chemical structure, if it can be a food source for bacteria, fungi, and algae in a set environment and timeframe.

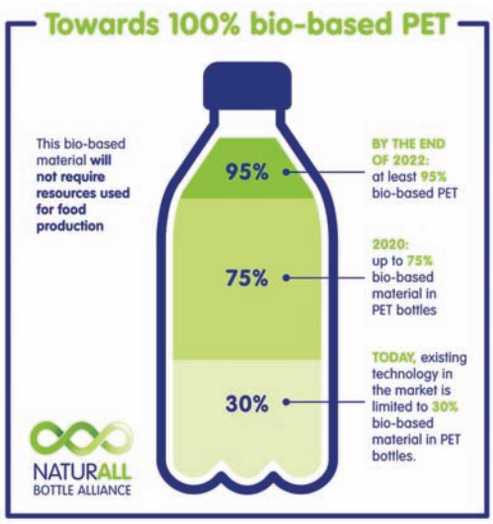
Int. Res. J. of Science & Engineering, 2016; Vol. 4 (1): 17-26

It is also interesting to note that several bio-based plastics are chemically identical to petroleum-based materials. A case in point is that PET (polyethylene terephthalate) can be made with renewable resources and recycled in the same area where PET plastics are collected for

recycling. However, although suitable for recycling, bio-based plastics (like bio-based PET) are not suitable for composting. To make the right choice to recycle, compost, or dispose of these products at their end-of-life, consumers need to know the differences, and be able to identify these products from traditional plastics. In Sri Lanka, some progress has been made to segregate wastes according to these requirements. However, it remains to be seen whether the subsequent actions such as composting or recycling or biodegrading will be carried out according to accepted standards.

More on Biopolymers

Biopolymers are long chain organic compounds made up of long chain molecule subunits. They can be produced by alternative means such as through biological systems (i.e. micro-organisms, plants and animals), or chemically synthesized from biological starting materials (e.g. sugars, starch, natural fats or oils, etc.) and act as an alternative to petroleum-based polymers (traditional plastics).

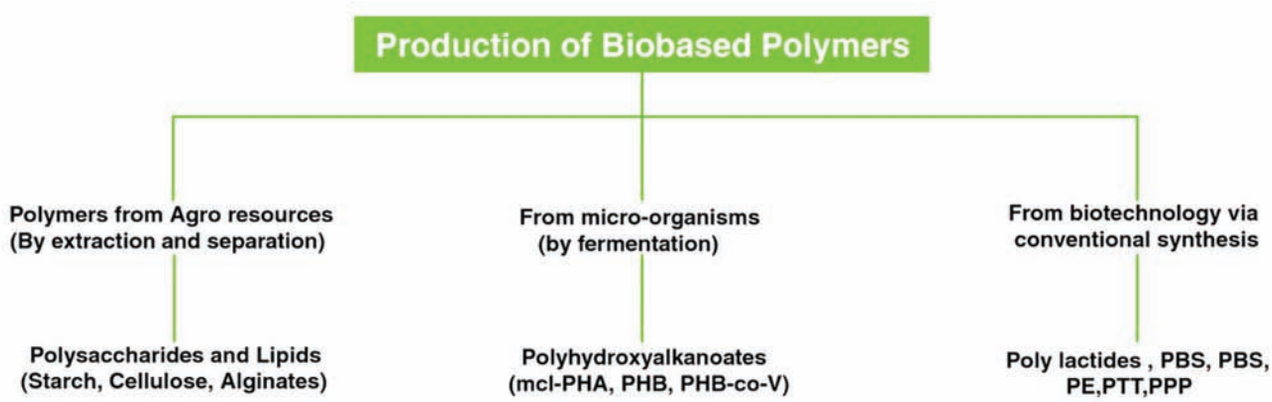


Bio-based polymers may be divided into three main categories based on their origin and production:

Category 1 :
Polymers directly extracted / removed from biomass.
Category 2 :
Polymers produced by classical chemical synthesis using renewable bio-based monomers.
Category 3 :
Polymers produced by microorganisms or genetically modified bacteria.

The three categories are presented in schematic form as given below.

To reiterate, plastics in the environment is a major cause of pollution and destruction of the natural ecosystems. So, the approach to produce plastic, which is an essential polymer used in our day to day life, using microbes (product of microorganisms) is a novel and welcome approach. It will reduce the environmental pollution as well as the use of petroleum to make plastic bags thus conserving the fossil resources of the country. So, it can be said in one word that bioplastic is eco-friendly.



However, the negative aspect of this is that the production of bioplastics is costly and not within the budget of present-day plastic product manufacturers. In its manufacture, it is necessary to include several additives in order to simulate the consistency and versatility of plastics, and also make it possible to use the equipment presently used. Thus, more research is needed to look into this aspect and make it possible to manufacture products which can be used by the consumer and also not be a drain on their budgets.

In this connection, one of the ongoing development projects is the production of PSM or Plastarch Material. This is a combination of starch and other biodegradable material and is a thermoplastic resin. The starch is modified through a process which imparts it with heat resistant properties, and this makes it one of the few bioplastics which can withstand high temperatures. It is also stable under atmospheric conditions but biodegradable under microbial rich environments. One advantage of PSM is that being similar to other plastics such polypropylene, it can run on many existing thermoforming and injection molding lines and does not need additional processing equipment. This will indeed be a boon to plastic manufacturers as additional equipment will not be necessary. PSM is currently used for a wide variety of applications in the plastic market including food packaging, bags and other items. Its advantage is that since it is derived from renewable sources, it can be disposed of through incineration and the residue can be used as a fertilizer. However, again, the prohibitive factor preventing its widespread use is the cost involved in processing.

In addition to providing biodegradable packaging materials considering the environmental concerns, researchers are also concerned with the improving food quality and maintaining safety of the foods packaged. New approaches should target these two aspects as well, while adhering to international standards available. The latest approach in research is the development of new active packaging strategies and modified atmospheric packaging . Research on multilayer packaging is also prolific, and here biomaterials including plant fibres play an active role. An alternative to composite materials in formulations for food packaging is the use of multilayer systems based on biodegradable layers in combination with natural extracts.

With the resurging interest by environmentalists and also the government in streamlining garbage collection and disposal, it is hoped that our scientist will also put their best foot forward and develop alternative solutions to address the issue of plastic pollution, which will be within the budget of industrialists, consumers and administrators. Our rich natural resources could well provide the basis for this.

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THE OTHER SIDE OF THE COIN

While we, who are advocates of herbs, esences and oils, laud their benefits for the improvement of health, the other school of thought labels all essential oils as being potentially harmful particularly to babies and pets. Four out of every five toxic exposures to oils occur in children. Oils like camphor, clove, lavender, eucalyptus, thyme, tea tree, and wintergreen oils can cause hallucinations, seizures, chemical burns, breathing problems, liver failure and brain swelling. Not only are these oils potentially harmful, and don't actually treat anything, but the demand for rare, indigenous plants is causing habitat destruction. For example, only around 200 critically endangered Arabian leopards remain in the wild and their habitat is being threatened by frankincense hunters serving the essential oils industry.

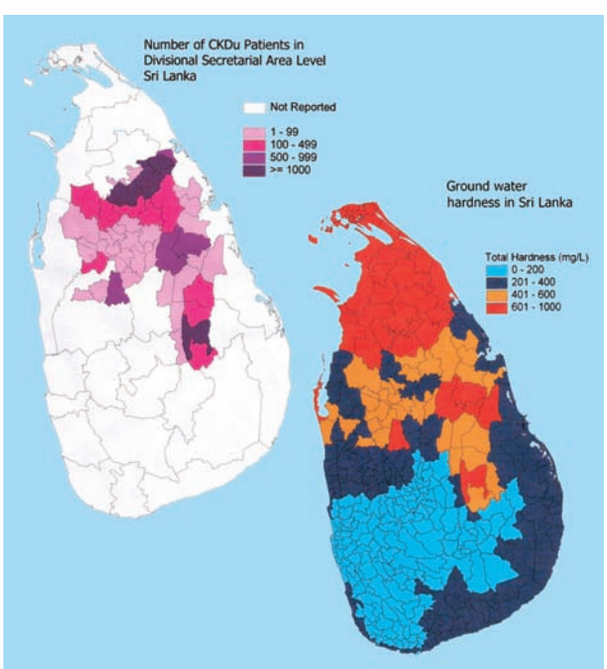
https://medium.com/the-method/top-10-alternative-medicine-stories-of-2016-1cb7b2886599

PLANT-DERIVED NEPHROPROTECTIVE AGENTS: THE ANSWER TO KIDNEY DISEASES?

By R.O.B.Wijesekera

Background

The increase in the incidence of Kidney related diseases has in recent years reached alarming proportions. Combatting this trend is costly in terms of treatment and time consuming; and the results are not nearly as successful as health workers desire. The health authorities of the world including the World Health Organization (WHO/OMS) are understandably concerned. The concern is on all sides of the divide between the richer nations and the poor. In Sri Lanka and particularly in the Agricultural communities the prevalence of what is medically described as Chronic Kidney Disease (CKD) has been noted to be on the increase and this in alarming proportions, giving cause for much concern. The precise causes are not exactly known, though the role of ground water and contents have been researched. No preventive measures have been identified on a decisive basis and the regional role and plethora of causes are still to be clearly identified.

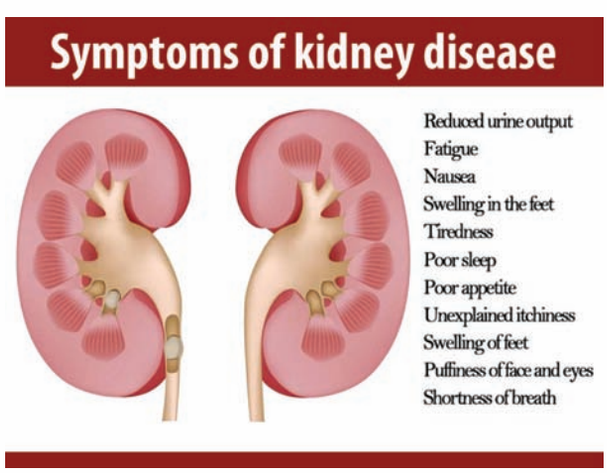


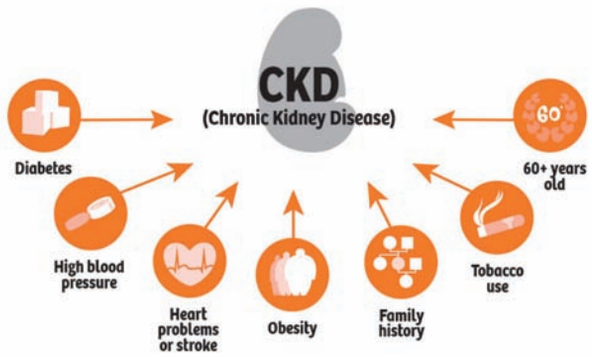
Sri Lankan Situation

The situation in Sri Lanka is grave and has been recently described by the Director of the Presidential Kidney Disease Prevention Task Force (P- KDPTF) as follows: "Terminal Renal failure" *the disease commonly called Kidney disease is, identified as a condition that decreases the functionality of the kidney gradually for quite some years, and finally turns as the kidney disease. The chances of reviving the functionality of the kidneys once terminal kidney disease sets in is very remote.*

Once the symptoms set in most of the kidney has become dysfunctional. The disease is found in almost 10% of the global population. Impact of this disease is common among Asian and African populations, and the situation has made a big impact in Sri Lanka in recent times. Symptoms of the kidney disease are some of the following according to the Head of the Special Presidential Task Force.

Fatigue, severe anaemia, swelling of the body and legs, Itching of the body, loss of appetite, vomiting, respiratory difficulties, numbness of the feet.





The serum creatinine test is done to monitor the functionality of the kidneys. It is reckoned that in a typical healthy individual the kidneys filter about 90-120 mL/min/1.73 m^2 times. If the performance is below that the individual could be termed a kidney patient and needs attention and If the rate is below 10 then dialysis becomes necessary.

There are many reasons for kidney disease. Many of those who suffer from kidney disease also have diabetes, blood pressure, inflammatory diseases, or chronic kidney infections, bladder stones or infections in the urinary tract, so the causes can be many and the treatment may be complex.

Research is vital to find out more about this disease and the reasons for its spread in Sri Lanka. That a concerted goal-oriented research effort is lacking is evident. This is a scientific problem which involves many disciplines, and must be approached in a multidisciplinary manner.

Cases have been reported to Health authoroties from 13 districts in Sri Lanka including:

Anuradhapura
Badulla
Pollonnaruwa
Kurunegala
Vavuniya
Ampara
Mullattivu
Mannar
Trincomalee
Puttalam
Hambantota
Monaragala

The Presidential Task force seems to have taken steps to attend to the epidemiological issues as well as to assemble the hospital needs of the afflicted population but sadly has not taken the steps to mount an island wide research program with the support inevitably needed from the international scientific community. International support to address the scientific issues is a must as Sri Lanka is weak in scientific expertise. There are many issues that will call for scientific and technological inputs and the possible solutions will inevitably require international expertise and funding. This is the crucial need of the hour.

Sri Lanka is a country which has been dominated since ancient times by a belief in Ayurveda and rural folk in particular can only afford Ayurveda treatment in many instances so the belief in plant derived remedies remains well entrenched. It is in this domain that one could seek answers to the therapeutic problems given the advantages that modern scientific advances can now bring into the equation.

Role of Herbals – a global initiative

In a review article published in Pharmacophore 2014, Vol 5. Sunderajan et al describe the phytochemical entities isolated from plants reputed to have proprties that would posess nephroprotective activity. Several of these plants have been used in this fashion within the ancient medical systems such as Ayurveda, Sidda, and the Traditional Chinese Medical system. (TCM)

In fact recent reviews have revealed that even former greats like Pliny the Elder and Dioscorides had identified Plants that had Nephroprotective properties. The work of Dioscorides is reckoned to be the commencement of the subject now known as Renal

Pharmacology. These plants and the phytochemicals they contain would be supreme candidates for research in identifying new nephroprotective drugs. A goal orientd research initiative would be a valid means of approach in the long term to combat what is now established as a global scourge as far as health is concerned. There has already been some research on these lines but it is contended that an international agency should sponsor a powerful global initiative in this direction, an initiative in which Sri Lanka must be an active participant in view of the problems we face.

Medicinal Plants used in Ayurvedic therapy

Sugested Preliminary LIST of Plant Species

Based on the research that is available the following plant species would appear to be priority candidates for a global research programme which could bear the title a Global Search for Nephroprotective Agents for Therapeutic Use.

1. *Aerva lanata* (Amaranthaceae)
2. *Artimesia annua* (Asteraceae)
3. *Andrographis paniculata* (Acanthaceae)
4. *Cassia auriculata* (Fabaceace)
5. *Curcuma longa* (Zingiberaceae)
6. *Nigella sativa* (Ranunculaceae)
7. *Solanum xanthocarpum* (Solanaceae)
8. *Ceratonia siliqua* (Fabaceae)
9. *Pedallium murex* (Pedaliaceae)
10. *Hygrophila schulli* (Acanthaceae)
11. *Zingiber officinalis* (Zingiberaceae)
12. *Camellia sinensis* (Theaceae) {epigallocatechin extract}

The above is an indicative list of plants used for kidney related ailments that may provide interesting possibilities. They have been researched but a purpose oriented research project with the intention of finding drugs for kidney diseases is necessary.

Suggested Methodology for a Research Approach- "Plants for Nephroprotective therapy"

It may be suggested that regional expert groups be set up initially for drawing up appropriate methodologies for the research, and countries be called upon to name appropriate institutions to conduct the research as a national priority. Certainly, as far as a country like Sri Lanka is concerned it is an issue of the highest concern and

given the global situation it would be the same for several countries. Plant extracts should be tested on animal models and/or selected methods of clinical assessment on humans, - all plant species being at present orally administered in traditional treatment methodologies. This is possible.

It would be useful if traditional practitioners are involved in research as well and the subject of toxic manifestations also be addressed. Some of the methods developed by the WHO in the bygone decades for their Special Programme for research on Tropical Medicine (TDR) and Fertility Regulation (HRP) may serve as examples for collaborative international research.

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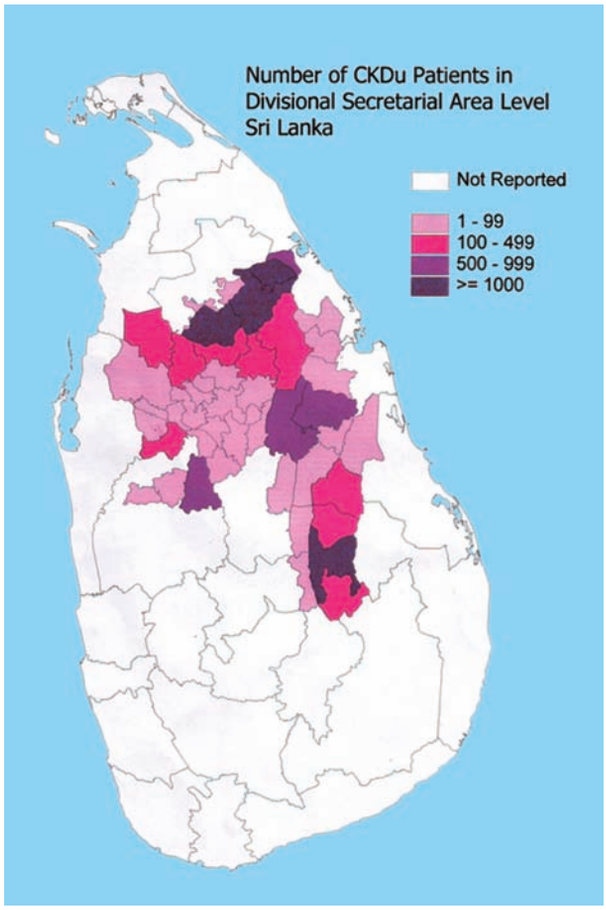
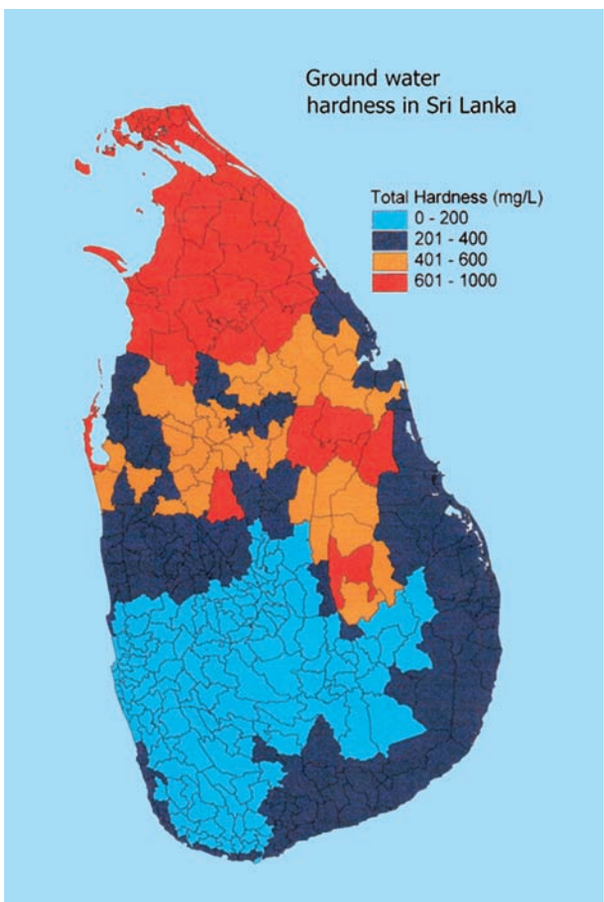
I think science has enjoyed an extraordinary success because it has such a limited and narrow realm in which to focus its efforts. Namely, the physical universe.

~Ken Jenkins





BIOASSAYS & FIELD TRIALS OF NEEM FORMULATIONS

By Y.M.H.B Yapabandara, L.S.R. Arambewela*, V. Ratnabarathi*, A.T.LN. Athauda*, Dr. C. Kudagamage** & K.A.N.P Bandara***

Introduction

The use of synthetic agrochemicals and pest management agents has resulted in many adverse consequences including severe environmental pollution and health hazards[1]. Therefore, attention has been focused on the use of biological methods and natural products in pest management. Neem has been identified as one of the most effective plants that can be used for this purpose.

Neem has been used in the fields of medicine and agriculture since ancient time. However, this plant gained greater importance in the recent past with the discovery of its remarkable insecticidal potential[2].

Unlike in other agrochemicals, insects do not form resistant mutants for neem[3]. With this remarkable property and with the increasing demand for bio-products under 'Back to Nature' concept and other broad-spectrum biological activities, neem has become one of the most valuable plants of the era. Other than its wide range of activities against insects it has many other activities such as anti-fungal, anti-bacterial, anti-viral and nematocidal which are quite useful in bio-based agriculture. In addition to its pest management and applications in plant pathology, it has soil enriching effects in agriculture and applications in post-harvest management of agricultural products[4].

Neem products can affect more than 200 insect species[2], some mites, nematodes, fungi, bacteria and few viruses including plant viruses[5]. Hundreds of chemicals have been isolated from neem which are responsible for above activities. More effective ones are Azadirachtin, Salanin, Meliantriol, Nimbin and Nimbidin. Azadirachtin

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** *Dr. C. Kudagamage & K.A.N.P Bandara, Horticulture Crop Research and Development Institute, Gannoruwa.*

is the most effective and covers a range of insects[6]. It acts as a growth regulator and feeding deterrent. Salanin is a good anti-feedant. It is even more effective than DEET (N, N-diethyl-m-toluamide) which is found in hundreds of commercial insect repellents[2].

Anti-insect properties of Neem are based on

- Anti-feedant activity
- Insect growth regulatory effect
- Effect on reproduction

Anti-feedant activity

Neem retards or disrupts insect feeding by rendering the treated materials unattractive or unpalatable for insects and is known as an anti-feedant. Anti-feedant effect of Azadirachtin acts on insects in two ways.

1. Primarily anti-feedant activity is represented by the regulation of food intake, resulting from contact between the antifeedant and the sensory organs of the mouthparts of the insect.
2. The secondary processes involve gut motility disorders.

Insect Growth Regulatory Effect

Azadirachtin is structurally similar to insect hormones called "ecdysones," which control the process of metamorphosis as the insects pass from larva to pupa and to adult.

It affects the corpus cardiacum, an organ, which controls the secretion of hormones. Azadirachtin acts as an "ecdysone blocker." It blocks the insect's hormones production and their release. The affected insects do not molt, hence their life cycles are disrupted.

Effect on Reproduction

Neem components disrupt mating and sexual communication, induce sterility, inhibit fecundity, inhibit ovarian development and have anti-oviposition properties

Objectives of the present study

Many formulated neem based agrochemical products now in the markets are patented leaving no access to their formulations. Therefore, objective of this project is to develop marketable neem based pesticides with sustained biological activities and longer shelf life while addressing the other problems experienced by other investigators.

Experimental Procedure

Formulation of Biopesticide

Different methods for extraction of neem seeds were tried and most economical methods were adopted. Using different concentrations of extracts, neem formulations were prepared.

Neem oil was obtained by pressing. The remaining cake was extracted with solvents and evaporated at low temperatures to prevent degradation of active compounds.

Four Neem formulations were prepared using neem oil, neem extract, stabilizing and emulsifying agent.

Evaluation of the products

The neem formulations were evaluated against Cabbage DiamondBack Moth, *Plutella xylostella* in the laboratory and against the cabbage leaf eating caterpillar complex in the field.

(a) Laboratory Evaluation

Leaf Dipping Bioassay

Culturing of DiamondBack Moth (DBM) *Plutella xylostella*

The culture of DBM was maintained on potted cabbage (variety: exotic) plants in aluminum framed rearing cages (1 m X 0.5 m X 0.5 m). The potted cabbage plants (two-weeks-old) were kept in an oviposition cage for 24 hrs for oviposition.

A cotton wool dipped in an aqueous solution of 5% honeybee was plunged inside the oviposition cages as food source for adults. The oviposited plants were transferred to the rearing cages and when second in star larvae emerged (after 7-8 days after oviposition), they were used for bioassay experiments.

Preparation of test solution

A series of concentrations of each product were prepared by diluting the formulations with distilled water A greenhouse grown cabbage leaf with same maturity was cut into 2.6 cm diameter discs using a cork borer and these discs were dipped in the solution for 1 minute. The dipped leaf discs were held vertically to allow to drain off the excess solution. After 2 hrs of drying in the room, the discs were used for bioassay with DBM larvae. Cabbage leaf discs were kept in petri dishes lined with wet filter paper and five 2nd instar larvae were introduced. A piece of moistened cotton wool was placed inside each petri dish to delay drying up of leaf discs. The experiment was in Completely Randomized Design (CRD) with four replications

The leaf area (mm2) consumed by the larvae and the number of larvae that were moribund or dead after 24, 48 and 72 hrs were recorded. After 72 h, the larvae were provided with fresh cabbage leaf discs when necessary. Percentage pupation, Percentage adult emergence, developmental abnormalities were also recorded. In this method, the active compounds enter the larval body through contact, inhalation, and also taken in with food.

Results

The results of the bioassay showed two formulations A & E were highly active for DBM. To find out the optimum concentrations another bioassay was conducted using different concentrations. This data showed 5.4 ml/l as the most effective concentration to achieve the highest mortality of DiamondBack Moth larvae.

Four neem formulations, NSWE - Water extract of neem seeds,

Neemsal (commercial product) Control – solvents used in the formulations

Treatment	Azadir-actin ppm of the solution	Larval feeding area mm2	% Larval mortality		% Adult emerg-ence
			24 HAI	48 HAI	
Sample A	34	145	25	60	10
Sample B	N/D	153	10	35	30
Sample C	23	205	30	50	25
Sample E	38	105	30	75	8
NSWE	N/D	130	35	70	25
Neemazal	10	220	20	40	30
Control		450	10	12	55

Samples A-E - Four neem formulations, NSWE- Water extract of neem seeds,

Plant house Bioassay

This was conducted to compare the activity of the selected formulated products, against DBM larvae under the planthouse conditions. ITI neem formulations A & E, water extract of neem seeds, neemsal and controls were tested. Potted cabbage seedlings (variety-exotic; 45 days old) were separately sprayed with 10.0ml of each solution using a rotating table and a glass atomizer. To each sprayed plant was introduced ten, 2nd instar larvae of DBM about 2 hours after spraying. The sprayed plants were individually covered with cylindrical transparent plastic bottles (diameter 13 cm, height 23 cm). The top of the bottles and 25 cm^2 from the wall were removed and they were covered with organdy material for providing ventilation. Leaf damage was visually estimated 24, 48 and 72 HAI. Percentage pupation, percentage adult emergence and developmental abnormalities if any were also recorded.

Effect of formulated products on the second instar larvae of *P. xylostella* under planthouse condition

Treatment	Azadir-actin ppm of the solution	Larval feeding area mm2			% Adult emerg-ence
		24 HAI	48 HAI	72 HAI	
ITI A	54	140	196	220	30
ITI E	81	105	145	186	26
NSWE	N/D	156	210	300	36
Neemazal	10	278	305	345	38
Control	-	350	430	550	90

Results

The plants sprayed with two neem formulations A & E showed significantly lower damage

(b) Field Evaluation

Field Trial

The promising neem formulations A & E were evaluated against cabbage leaf eating caterpillar complex on cabbage field at the Horticultural Crop Research and Development Institute (HORDI), Gannoruwa, during 2001/2002 Maha cropping season.

The experiment was in randomized complete block design (RCBD) with three replicates.

The experiment was conducted under rain fed conditions and sprinkler irrigation was done when necessary.

The field received average of 45.5 mm rainfall during the experimental period, and the average temperature range and RH were 20.1-29.1 C°, 68.8% - 80.7% respectively.

Nursery Preparation

The seedlings were reared in nursery bed (1 m x 10 m). The top layer of the nursery bed was filled with cow dung: top soil (1:1) mixture sterilized by burning straw and sawdust.

After burning, the bed was covered with transparent polythene for one week for further sterilization. Fungicide (Captan) was also mixed. Seeds were sown in rows having 5 cm spacing.

Land Preparation

Four-wheel tractor was used for land preparation. Roundup® (Glyphosate) was applied as a weedicide before land preparation. Cow dung (60 Kg) was added to each plot, along with recommended fertilizer application. Two weeks old cabbage seedlings were transplanted in 40 X 50 cm spacing, three days after fertilizer application.

Field application of neem formulations

The plants were exposed for natural pest infestation. The treatments started 13 days after transplanting and initial pest count was taken on 10 randomly selected plants in each plot, before treatments. Treatments were applied using a knapsack sprayer and repeated at 10-day intervals Four days after each application pest counts and leaf area damages (%) were recorded in labelled plants.

Yield Parameters under Treatments				
Treatment	Average caterpillar count (Just before Harvest)	Average Yield (tons/ha)		% Yield loss
		Total yield	Mkt yield	
ITI A	3	104.7	82.1	26.1
ITI E	0.6	115.3	85	26.1
Atabron	2.3	117.6	83.2	29.6
Neemazal	4.3	97.1	69.3	28.5
NSWE	1	101.1	72.7	24
Control	22	80.9	41.2	37.3

Results

There was no significant difference in the caterpillar count among different treatments before spraying. All treatments showed significantly lower number of caterpillars when compared to the control.

ITI-E, NSWE, Atabron®, ITI-A and Neemazal® significantly reduced the caterpillar population, when compared with the untreated control.

Lowest damage to yields due to caterpillar attack was observed in, IT1-A, ITI-E .and Atabron treated plots.

ITI – E treated plot gave the highest market yield

Conclusions

Results of the laboratory evaluations involving Leaf Dipping and Plant House bioassays showed that products A & E are most effective for DBM larvae

The results of the field experiments showed higher cabbage yield from plots sprayed with product E.

Cabbages from ITI sample E treated plot

Affected cabbage

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Every day you use dozens of products that have strong chemicals in them, but remember, the only difference between poison and medicine is dosage.

-Aubrey McClendon

HRH PRINCESS CHULABHORN MAHIDOL, PRESIDENT OF THE CHULABHORN RESEARCH INSTITUTE

By R.O.B. Wjiesekera

Professor Dr. HRH Princess Chulabhorn Mahidol, President of CRI

Princess Chulabhorn is indeed a unique personality. Born into the Royal family of Thailand as its youngest member of the generation, she jettisoned the privileges of Royalty to pursue a career in scientific research.

She completed her graduate studies in science, and post-graduate studies as well, and at the Mahidol University Department of Chemistry she finally achieved her goal of becoming a scientific researcher specializing in Natural product Chemistry. Eventually she was to become a Professor at the Mahidol University. Her main interest was in the medicinal properties of Thai medicinal plants and their biological activity. She steadfastly pursued her interest and when she finally became a fully-fledged researcher at Mahidol University in 1985, she was more than convinced that scientific development was the key to the social and economic development of Thailand.

This led her to the supreme measure of founding a Research Institute which was an independent one dedicated to conduct research into Thai medicinal plants. This was the beginning of the Chulabhorn Research Institute whose founder President was Her Royal Highness herself. As a Professor of Chemistry at the Mahidol University since 1985 she devoted her attention to natural Products and their bioactivity.

She was associated with several international scientists in her work as for instance she spent a period researching with Professor Norman R. Farnsworth's Group at the University of Illinois, Chicago.

Many international research leaders were to collaborate with her in activities related to Natural Products at the Chulabhorn Research Institute which soon became an internationally ecognized center in Thailand. She has also been the recipient of honorary degrees from several Universities. She was awarded the coveted UNESCO Einstein Medal, for her work in promoting scientific collaboration between countries in Asia and the Pacific region. She has been recognized as a scientific worker by many agencies both international and regional such as the WHO, UNESCO, the Royal Society of Chemistry, and the Japan Society for the Promotion of Science.

She is also a member of the National Research Council of Thailand. In 2006 she was awarded the coveted **Nagoya Medal,** for her services to science and the scientific community.

TEA TREE OIL AND ITS ADULTERATION

Tea tree (*Melaeuca alternifolia M linariifolia*) is a native to Australia and its oil constitutes a popular ingredient in many medicinal preparations. Tea tree oil is used as a topical treatment for dermatological or skin problems, and also to heal wounds and cuts, burns warts, urinary tract infections, bites, lice oral disease, sore throats and acne, thus proving to be a great immune tonic. It is said to ease the symptoms of the common cold and used as an inhalant and in chest rub formulations. It has won the reputation of being a great medicinal oil, assisting with different types of infection, this being attributed to the oil having anti-bacterial, anti-fungal and other beneficial health effects.

Australia supplies around 80% of the global demand for Tea tree oil and is said to be an expensive commodity. Due to this, unscrupulous traders use lower cost adulterants in their commercial products. These adulterants include monoterpene rich materials obtained from the industrial waste stream after the purification of several essential oils from plants such as camphor, eucalyptus, pine or even pure chemical compounds produced through fermentation, chemical synthesis or other plant material.

Several methods are used to determine the identify the adulterants used, and these include organoleptic or sensory evaluations, physic-chemical tests and chemical methods. All these methods have been studied and evaluated and a Laboratory Guidance Document (LGD) had been released. This document even gives the chemical composition of Tea tree oil and also known adulterants and will be very useful for quality control laboratories and traders.

HerbalGram No.120 , Oct-Dec 2018

Melaleuca alternifolia

A COLLABORATIVE VENTURE IN THE INTERNATIONAL MARKET

By Achini Dharmasiriwardena

The Personal Care product category, being the youngest of the total product portfolio of Link Natural Products Pvt Ltd was able to craft a new landscape to the current business model. This was done with the development capabilities of the Research & Development unit, along with the Business Development team of the Personal Care category, by venturing into a international private labelling project with the renowned Indian beauty and wellness giant, Marico Ltd.

The Personal Care category of Link is currently catering to the hospitality industry in Sri Lanka by introducing herbal based products to hotels as room amenities. The Link range of herbal cosmetic products are now available in renowned hotels, spas and business ventures in local as well as in some international markets.

Currently, unique signature developments have been carried out with these products in leading hotels and spas and operate in more than 100 star graded hotels within the country.

This contract manufacturing and private labellingproject plays a major role in the Personal Care category, having the benefit of its

GMP certified dedicated state-of-the-art cosmetic manufacturing facility located in- house.

This international venture was inspired by the company policy of utilizing natural resources and scientific know-how for the development of products. For example, this development places organic coconut in a predominant role in crafting the range of skin and hair care products under the brand name of COCO SOUL for Marico India to cater to the cosmetic patrons at large.

Marico Limited is one of India's leading consumer products companies operating in the beauty and wellness area. Marico has nurtured multiple brands in the categories of hair care, skin care, edible oils, health foods, male grooming, and fabric care. Marico's business markets in India includes household brands such as Parachute, Parachute Advanced, Saffola, Hair & Care, Nihar, Nihar Naturals, Livon, Set Wet, Mediker and Revive among others, that enhance the quality of life of the Indian cosmetic market. The International business offers unique brands such as Parachute, HairCode, Fiancée, Caivil, Hercules, Black Chic, Isoplus, Code 10, Ingwe, X-Men and Thuan Phat that are localized to fulfil the lifestyle needs of international consumers. The annual turnover of the company is INR 63 billion as at FY 2017 – 2018 across all the portfolio according to their FY17/18 Annual Report.

Unique Coco Soul Development & Brand Story

A business discussion of a tripartite venture with Link as the product development arm, Hotel Emporium USA as the packaging development arm and with the brand owner MARICO India. With almost six months of brainstorming sessions, the Research & Development unit of Link Natural products with the Personal Care team was able to develop and introduce eleven unique products under the Coco Soul brand delivering the brand essence as virgin Coconut oil infused with the time-tested Ayurveda herbal ingredients.

The unique product range comprise of head to toe treatments such as Hair and Scalp Cleanser, Revitalizing Shower Gel, Hair and Scalp Conditioner, Nourishing Body Lotion, Revitalizing Face Wash, Handmade Glycerin Soap, Foot Cream, Hand & Nail Cream, Lip Balm, Face Scrub and Nourishing Body Butter.

While following the developments in the international cosmetic market the company was able to deliver this range of products to comply with the latest cosmetic trends and the emerging consumer insights. All eleven products were developed enabling the brands to claim the products as being free of Parabens, sulfate mineral oil, petrolatum, Silicones, DEA, Phthalates, Formaldehyde, propylene glycol and no animal testing. With this development the Personal Care unit was able to prove the strength and the capability of their in- house research & development unit by being able to comply with cosmetic regulations of twenty different target countries.

It is planned to make available the products at leading stores and online sales platforms in their main target markets of India, USA, Canada, Australia, New Zealand, Russia, Ukraine, United Kingdom, Germany, Malaysia, Singapore, Peru, Argentina, Netherlands, Sri Lanka, Nepal, Bangladesh, Spain, Italy and France.

The first commercial shipment with seven 40 ft containers was delivered to our client on time in November 2018 making this our first international large-scale cosmetic production in the newly built cosmetic manufacturing facility. This first shipment of "COCO SOUL" developed and manufactured by Link Natural was dispatched to India, Russia, USA, Australia and New Zealand and was followed by the Coco Soul Brand launches in India in January 2019, Russia & USA in March 2019. The cosmetic and R & D arms of the company are indeed proud of this achievement and hope to continue in this vein in the future as well.

AVAILABILITY OF LINK PRODUCTS

Editor's Note : A frequently asked question by Link afficionados, is "where can you buy the various products from". So for their benefit and for those who would like to sample the many superior products of Link Natural, we give below the products and their location of their availability.

	Super Market													Grocery	Phamacy	Osusal
	Sathosa	Cargills	Keels	Arpico	Laugfs	PDK	Health guard	Family super	Air Force	City Exchange	CIC	SPAR	Odel			
Link Samahan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Link Enriched Paspanguwa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Natural Sudantha	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Kesha Hair Oil	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Hair Care Cool	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Akalapalitha	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Swastha Thriphala		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
Link Swastha Amurtha	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
Link Five Herbs		✓	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓
Link Gotukola Tea			✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓
Link Osupen		✓	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓
Link Muscleguaed		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link SP Balm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Essentials - Siddhartha Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Pinda Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Mahanarayana Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Kendaperalumhara Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Kolaseleshma Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Sarvavisadee Oil		✓		✓			✓					✓			✓	✓
Link Essentials - Composite Pack		✓	✓	✓		✓		✓				✓			✓	✓
Link Dekatone		✓					✓					✓				✓
Link Viritone		✓					✓					✓				✓
Herbal Pharmaceutical														✓		✓

A SPECIAL LECTURE, ON "FROM PLANTS TO PHARMACY SHELF: DISCOVERY AND DEVELOPMENT OF THERAPEUTICS FOR PROSTATE CANCER", BY PROF. LESLIE GUNATILAKA

A Special Lecture, on "From Plants to Pharmacy Shelf: Discovery and development of Therapeutics for prostate cancer", was given by Prof. Leslie Gunatilaka, on 7th March 2019 at 10.30 a.m. at the Link Auditorium. Prof. Gunatilaka is a renowned researcher in the field of Natural Products, and holds the post of Director of Natural Products Centre, School of Natural Resources & the Environment College of Agriculture & Life Sciences, University of Arizona Other academics in the field were also invited for the lecture, and an active discussion ensued.

If we do not change our negative habits toward climate change, we can count on worldwide disruptions in food production, resulting in mass migration, refugee crises and increased conflict over scarce natural resources like water and farm land. This is a recipe for major security problems

- *Michael Franti*

LINK NATURAL PRODUCTS (PVT) LTD, ADJUDGED RUNNER-UP AT BEST CORPORATE CITIZEN AWARDS 2019

By Gimhani Pemarathne and Isuru Gayashan

'Best Corporate Citizen Sustainability Award 2018' is an annual event organized by the Ceylon Chamber of Commerce, to recognize sustainable champions of the local corporate sphere. Link Natural Products (Pvt) Ltd won the ***'Best Corporate Citizen Sustainability Award 2018'*** first runner up award in Category B - ***Less than Rs. 15 billion Annual turnovers.***

The awards ceremony was held on 26th November at the Cinnamon Grand Hotel, Colombo amidst a gathering of about 350 distinguished corporate executives. Speaker of the Parliament of Sri Lanka, Hon. Karu Jayasuriya attended as the Chief Guest on the occasion.

The annual BCCS Award, is aimed at recognizing the importance of Corporate Sustainability in Sri Lanka and encourages businesses to adopt best practices in line with achieving the UN Sustainable Development Goals (SDGs). It focuses on all stakeholders of the company ranging from employees, customers, community, shareholders, the Government and the environment. Companies that compete in the annual Best Corporate Citizen Sustainability (BCCS) Award, believe that it serves a greater purpose beyond the accolade itself, acting as a measure of their year-on-year progress, as well a performance evaluation alongside peers in their respective industries. Submissions are evaluated by a highly respected panel of local experts, academics and thought leaders, as well as representatives from IFC (International Finance Corporation), the World Bank, USAID (United States Agency for International Development), The Colombo Plan Secretariat, UNDP (United Nations Development Programme), and ILO (International Labour Organisation).

Link Natural - 1st Runner-up at Best Corporate Citizen Sustainability Awards 2018

Link Natural Manager of Regulatory Affairs Chamari Wickramathilake and Manager of ER/CSR Priyantha Collonnage accepting the award

LINK CONTRIBUTES TO THE ECOLOGICAL CONSERVATION IN THE ADAMS PEAK AREA

By Dilmani Warnasuriya

For six long years, Link Natural has been running a programme for the benefit of pilgrims at Adams peak, providing freshly brewed Samahan and therapeutic foot massages, using Link's herbal SP balm. This proved to be immensely popular and appreciated by all those undertaking the ascent.

Having been at the scene for days on end during several years, Link officials were able to witness the devastation caused to the mountain precincts and the waters which, falling over the mountain, enriches the tributaries of the Mahaveli ganga and Kalu gaga, through plastic pollution. According to official statistics, around 800 metric tons of plastic ,polythene and solid wastes accumulates in the area annually. This will greatly affect the ecology of this historical area, including its fauna and flora.

Rather than remaining passive witnesses to this impending catastrophe, Link natural took the initiative to launch another campaign under the slogan Asiri Surakimu Samanola having obtained the collaboration of fifteen active stakeholders from government and local government institutes and also private organizations and volunteers. The programme consisted of clean up activities, carried out by over 4000 persons, including pilgrims. The company also conducted several awareness programmes using novel communication tools and platforms. educating the people on the desecration of this sacred environment.

The officials and volunteers of this campaign undertook a reconnaissance expedition with the assistance of the Sri Lanka Police Nallathanniys, to assess the damage caused to the environment, and this was a shocking eye opener to all. It was revealed that a plastic waste layer was entrenched in the Maskeliya tank upstream and several dumps of plastics and polythene were seen deep in the forests of Adams Peak. One of these dumps had even caused a landslide in 2016.

The company established six large collection centres equipped with enormous cages for dumping of the waste plastics, and even provided over 1,500 bags for volunteers to collect waste during their descent. Several shramadana campaigns were also organized for the purpose of cleaning up the surrounding environment.

Link Natural wishes to express their deep appreciation to all the stakeholders and volunteers who so readily supported this programme , and without whose contribution, the programme would have not have achieved its goal.

The company plans to sustain this campaign on a long term basis and ensure that the environment be maintained as befitting such a religious and historical area in the country.

LINK PROVIDES SOLACE FOR NEW YEAR COMMUTERS

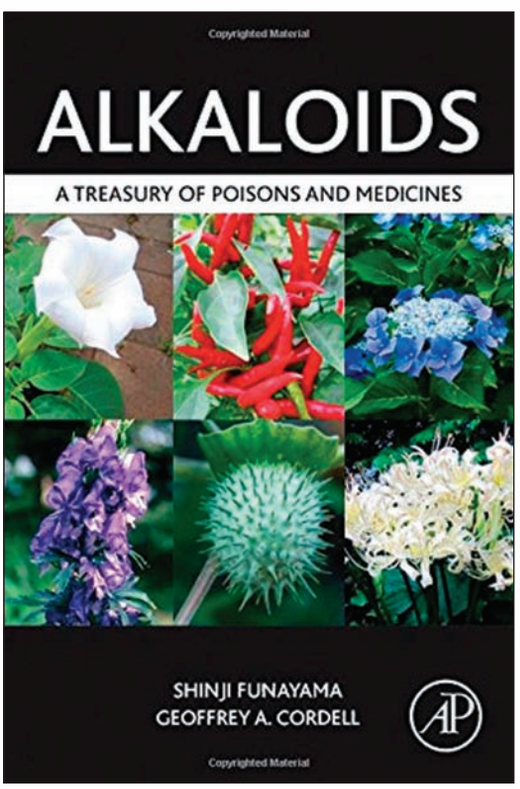
Link Natural Products is a company which is constantly in touch with the people's needs in everyday life. This year, the company launched a programme targeting thousands of commuters travelling from Colombo to their homes during the New Year season. Through this campaign titled, "Samahan Avurudu Sangrahaya", the company provided freshly prepared cups of Samahan herbal drinks at the central bus station in Pettah. The aim of this programme was to provide relief from common cold and catarrh related symptoms to these commuters.

The campaign took place daily from 9.00 a.m. to 7.00 p.m. from April 5 -12. Two vehicles were stationed at the bus stand, with one vehicle incorporating a large LED screen displaying messages relating to the New year season, while the other vehicle provide freshly prepared cups of Samahan to the travelling public who were outside the bus stand. In addition, a large trolley together with a boiler dispensed Samahan drink to those queuing up inside the building. It is noteworthy that the preparation was carried out under stringent hygienic conditions.

Mr. Priyantha Collonnege, Head of CSR in the company expressing his views on the campaign said that the bus journeys to far corners of the country were never easy with the warm and humid conditions prevailing in crowded buses. Their susceptibility to various illnesses was thus high and a cup of Samahan can help them to strengthen their immunity against infections relating to a common cold. This is intended to provide the core message that Samahan provides early protection from 15 symptoms of common cold and catarrh. To add zip to the programme, 10 commuters were able to win gift packs containing valuable provisions suitable for travelling. New Year almanacs (Lith) were also distributed to the commuters.

As commented by Shanaka Fernando, Marketing Manager of Link Natural Products, "We want all Sri Lankans to enjoy a happy and healthy New Year".

ALKALOIDS,1ST EDITION
A TREASURY OF POISONS AND MEDICINES



Hardcover : *294 pages*
Publisher : *Academic Press; 1 edition (November 7, 2014)*
Language : *English*
ISBN-10 : *9780124173026*
ISBN-13 : *978-0124173026*
ASIN : *0124173020*

Alkaloids are a large group of structurally complex natural products displaying a wide range of biological activities. The purpose of Alkaloids: A Treasury of Poisons and Medicines is to classify, for the first time, the alkaloids isolated from the natural sources until now. The book classifies all of the alkaloids by their biosynthetic origins. Of interest to the organic chemistry and medicinal chemistry communities involved in drug discovery and development, this book describes many alkaloids isolated from the medicinal plants, including those used in Japanese Kampo medicine.

- Classifies and lists alkaloids from natural sources
- Occurrence and biosynthetic pathways of alkaloids
- Indicates key uses and bioactivity of alkaloids

Source:
https://www.amazon.com/Alkaloids-Treasury-Medicines-Shinji-Funayama/dp/0124173020

Whenever science makes a discovery, the devil grabs it while the angels are debating the best way to use it.

~Alan Valentine

DIGEST MAIL BOX

Letter 1

Dear Team,

I would like to have a copy of Link digest magazine for institutional reference.

Thank you

Dr Chamal D Thenuwara (B.A.M.S-Uni of Colombo)
Researcher/Physician,
Institute of Ayurveda-Mount Lavinia

Letter 2

I received The Link Natural Digest (Vol. 14, Issues I and 2, 2018) today. I congratulate the Link Team for a splendid effort. This is an outstanding production and possibly, a unique instrument promoting a National effort. I am not aware of any similar publication from any other local enterprise. It is a quality effort in subtly promoting a local industry. Brings to mind, the Canadian example which captures a market by the Saying "We eat what we can and can what we can't" A Thai In-flight magazine shows an enticing selection of their fruit's with the caption, "We have it, come and get it !" I have yet to see a similar example for advertising local strengths (subliminal), Tourism and Fresh Produce, at the same time, I wonder whether University libraries, bodies like the NSF, Tourist Board and such like, who should be excited enough to garner a research force to encourage the young to explore some of the leads that The Link Digest provides.

My personal thanks to Link, who have polished my little offering. Keep going ahead with your exceptional service.

Sincerely & Best,
Dr U.P.
(Dr Upali Pethiyagoda)

Response

Thank you so much Dr Pethiyagoda for your most encouraging and appreciative words. It is indeed a pleasure to serve readers like you.

Letter 3

Thank you for your generous donation of the publication received to the Sabaragamuwa University of Sri Lanka. People like you make it possible for us to continue to share the knowledge and information resources for reference purposes for the users at the Sabaragamuwa University of Sri Lanka.

Librarian, Sabaragamuwa University of Sri Lanka

Letter 4

LINK NATURAL DIGEST MAGAZINE

This is to confirm receipt of Volume 14, Issue 1 & 2, 2018 of Link Natural Digest.

I have found the " Digest quite easy to Digest " !.

I would like to suggest a Directory of terms etc which have been used in the Link Natural Digest from inception.

I would also like to suggest if it is not already published the names of various edible leaves which could be used in curry form like Karapincha, Gotu Kola, & Mukunuwenna etc.

The quality of your Digest is excellent and I would also like to mention that you keep it up .

With best regards,

Yours sincerely,
Iqbal Jafferjee.

Response

Dear Mr Jafferjee,

Thank you for your nice comments.

As for the Directory of Terms you have suggested, we have published an index to issues from Vol.1-10. This is available in Vol. 10 , No 2.

We will be publishing another index after Vol. 15.

Regarding a list of edible leaves, we have published details of the leaves used for herbal porridges in Vol. 13. No.1 and spices used in curries in Vol. 6 Nol.1

Thank you for your valuable suggestions. Please continue to advise us on what you would like to read in future issues as well.

ERRATA

Link Digest Vol 14, Issue 1&2, page No 05,

Quinine, isolated from the cinchona bark forms one of the classic tales of medical history which has a romantic side as well as the profound impact in the battle against malaria.(Vide Link Natural Digest Vol.12,No 1). In the country then known as Laxa. In the 17th century, Jesuit priests came across a tree the native doctors or caciques had identified as the Fever Tree. It was renowned for its efficacious cures of fevers. In 1652, the bark had been set to Rome by Juan de Vaga a doctor, who claimed the extract of the bark had cured the wife of the viceroy. Thus, the compound strychnine came to be isolated and used as such for the cure of Malaria.

In this paragraph **strychnine** should be corrected as **Quinine**.

There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact. ~

Mark Twain, Life on the Mississippi, 1883

Science is the great antidote to the poison of enthusiasm and superstition.

~Adam Smith,
The Wealth of Nations, 1776

NOTE TO POTENTIAL CONTRIBUTORS

Link Natural Digest

The DIGEST is a popular publication, albeit a scientific one, dedicated to medicinal plants, herbal healthcare and personal care products, essential oils, aromatherapy, herbal therapy and Ayurveda, and related healthcare systems. It is published bi-annually.

The DIGEST welcomes contributions in English in the category of reviews, brief communications, ethno reports in brief, phytomedical and phytochemical communications, book reviews, and reports on safety and efficacy of phytomedicines.

Potential authors may consult the Editor-in-Chief prior to dispatch of communications, reports and reviews.

Authors may submit manuscripts byemail to :

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By post to:

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Kapugoda

Please forward to the editor one original hard copy and a soft copy in the form of a PC compatible diskette (Microsoft Word).

All manuscripts must include the following :

Title (in brief), author(s), address(es) of affiliated institutions. The authors' names must include initials and/or forenames as required in publication. All papers and submissions are subject to peer review, but the editors reserve the right to regulate the content. No proofs can be sent prior to publication. The decision of the Editor-in-Chief will be final in all matters.

The Digest Mail Bag Welcomes Reader's Views & Ideas.

NOTE