LINK NATURAL DIGEST

Volume.13, Issue 2, 2017

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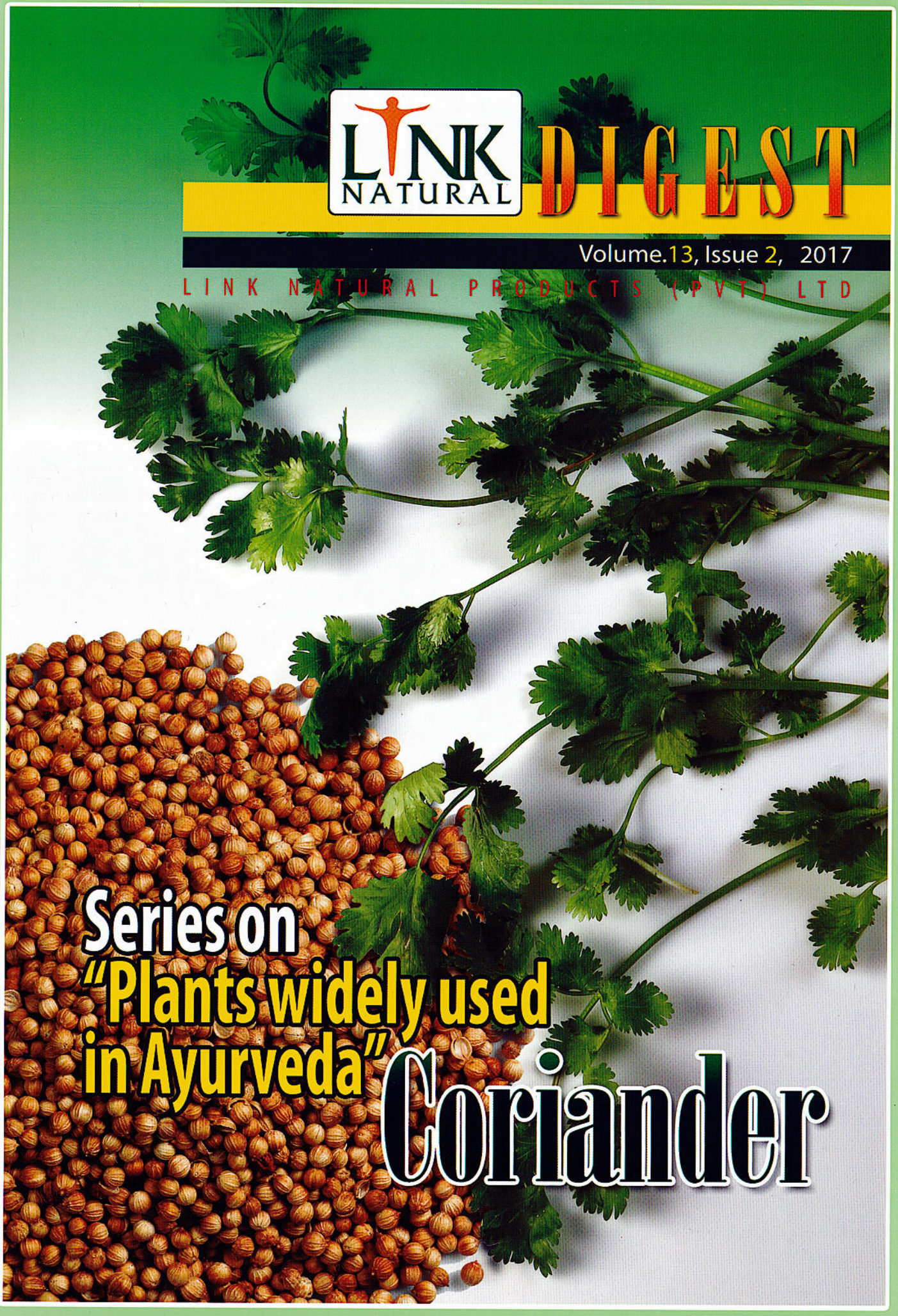

Series on "Plants widely used in Ayurveda"

Coriander

LINK NATURAL DIGEST

Volume 13, Issue 2, 2017 ISSN : 1391-8869

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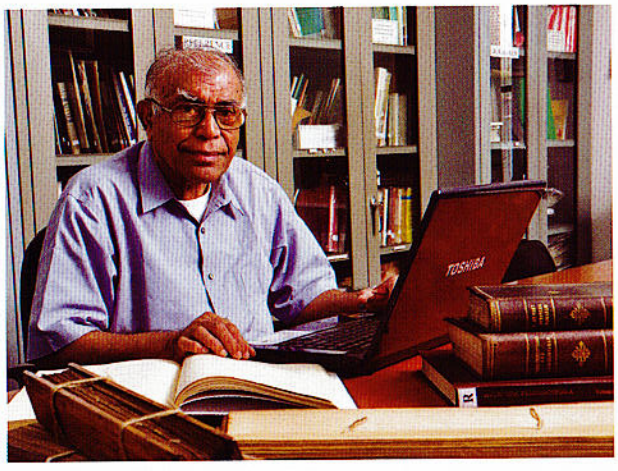
IN THE PAGES THAT FOLLOW.....

EDITORIAL

GLOBAL DEMAND FOR NATURAL FRAGRANCES ON THE RISE?



A recent concern for the WORLD HEALTH ORGANISATION is the increase in the mortality rates both maternal and infant, during the years 2016 onwards, when it had been assumed that the modern scenario was a secure state of affairs in terms of childbirth. WHO reports that increased infections may be the cause. In the case of primitive peoples - now an almost vanishing breed – there are no enhanced concerns as those who are now studying the behaviour patterns and life styles of these remaining groups observe. There is much to be learned from the practices and lifestyles of primitive tribes particularly their food habits during pregnancy and their childbirth techniques and medical treatment including herbal therapies Thus concerted efforts to study and preserve these for the future becomes a prime need.

R O B Wijesekera

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SPICE OLEORESINS

By R.O.B. Wijesekera

Introduction

Spices have been employed since antiquity to bring about taste variations and piquancy to bland human foods such as meats and fish. The attraction of spices to human consumers of food gave rise to the famous international explorations in search of spices now historically identified as the spice trade. The overland spice trade route on camels commenced with early Arab merchants. This was followed by the maritime voyages of Vasco da Gama and Christophe Columbus, which now belong to the epic tales of the search for spices and these maritime exploits resulted in the dramatic discoveries of continents, countries, as well as the exploits of colonization that are associated with them.

Spice trading route

Spice trading vessel

Spices are grown in various regions of the world and one large scale method of preserving their value is that of storing them as spice oleoresins.

Oleoresins are the concentrated form of the spice which represents fully its flavour as well as its odour characteristics. Oleoresins are used in the food and beverages industry in order to enhance the flavour of their products. The main advantages in the use of oleoresins instead of the crude spice itself lies in that oleoresins make quality assessment and control of product consistency easier. For these reasons the use of oleoresins are preferred in the industry.

Technology for oleoresin production

Oleoresins are obtained by extracting the raw spice with an organic solvent. The solvent could be one such as alcohol or acetone which has the property of being readily removed by distillation under reduced pressure, thus minimizing any tendency for the flavour giving components to decompose with heat causing off-flavours, but best of all is the modern technique of using supercritical fluids as the extracting medium. The technology is relatively simple and the solvent extraction can be carried out using a laboratory scale Soxhlet-type apparatus or the method used can be a variant of simple peculation where the solvent, generally an non-aqueous one, is passed several times through a bed of the powdered raw material in an apparatus similar to a separating funnel, and the total percolated distilled under reduced pressure.

Advantages and Disadvantages of Traditional Ground Spices

Advantages	Disadvantages
Slow flavour release in high temperature processing	Variable flavour strength and profile and ready adulteration with less valuable materials
Easy to handle and weight accurately	Unhygienic – Often contaminated by filth (microorganisms)
No labelling declaration problems	Presence of lipase enzymes
Presence of natural antioxidants in many herbs	Flavour distribution poor and flavour loss and degradation on storage
	Dusty and unpleasant to handle in bulk
	Discoloration due to tannins
	Dried herbs usually have unacceptable hay-like aroma
	Undesirable appearance characteristics in products

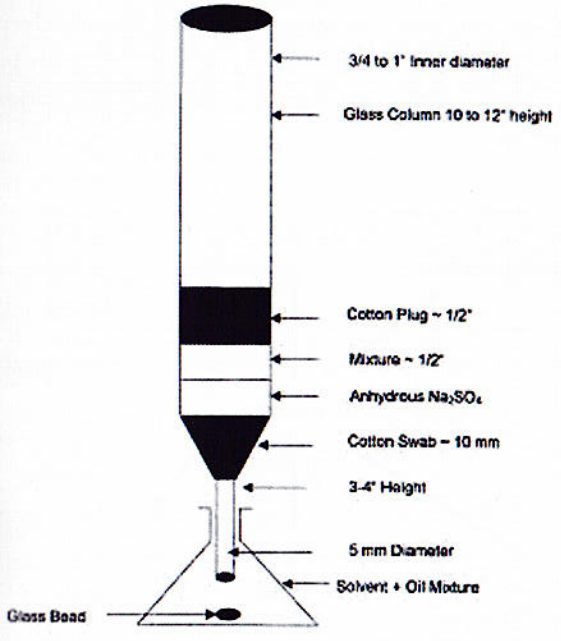
The use of oleoresins in industry has several advantages over the traditional use of the raw spice itself and is the preferred option. In the processing of oleoresins the main methods are the use of organic solvents for extraction and the use of supercritical solvents. The main features of the methodologies employed are the following:

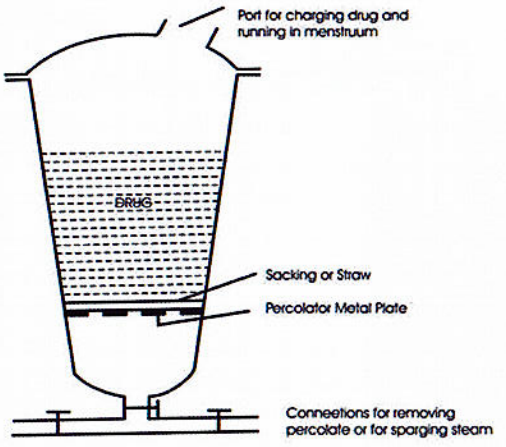
SOLVENT EXTRACTION.

The use of solvents are featured in two ways. There is the method of cold percolation and the method of continuous hot solvent extraction by variations of the classical Soxhlet technique.

Common organic solvents like alcohol, acetone, hexane, ethylene chloride and methanol are commonly used.

The methodology of COLD PERCOLATION generally involves the initial soaking of the plant material with the extracting solvent for a period and then making the solvent drip down the column of plant material several times. The collected solution is then distilled under reduced pressure to give the oleoresin. The equipment employed could be the usual glass laboratory types or on a larger scale the industrial "Quickfit & Quartz" type standard joint heavy glass equipment. However the efficiency of extraction, with solvents is low in comparison with the technique of SFE





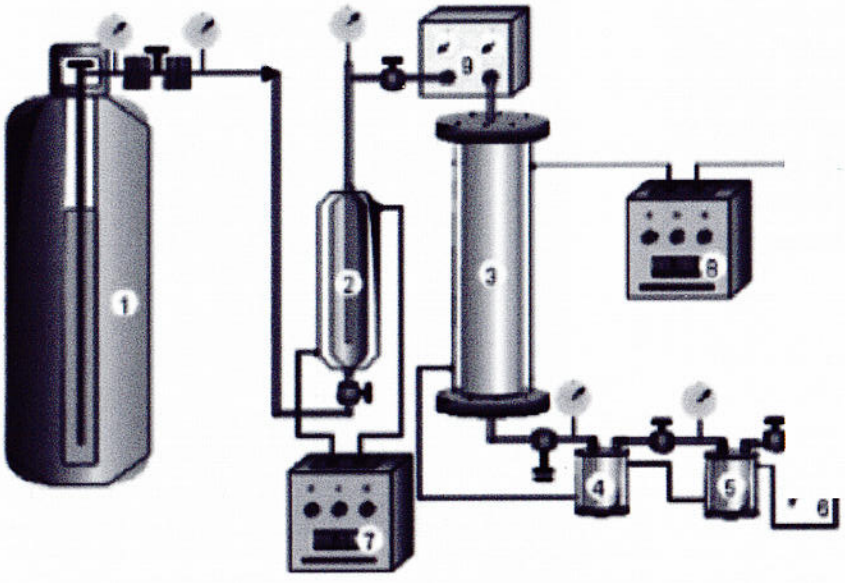
Commercial scale (about 1 ton capacity) percolator

SUPERCRITICAL FLUID EXTRACTION (SCFE)

Here generally liquid carbon dioxide at high pressure is used as the solvent. When the Carbon di Oxide is removed the oleoresin is recovered. However the equipment used is specialized and expensive but once it is acquired it can with convenience be used. The extraction is clean and efficient and is fast becoming the preferred method. Basically it is a two step process where generally carbon di oxide is used above its critical temperature and pressure for extraction. In this process there remains no residual solvent

Market trends

It is conservatively estimated that the global market for oleoresins is over a million dollars annually. However the estimated global requirements in oleoresins, now that they are the popularly used industrial products, exceeds fifteen thousand tons a year. This includes primarily the oleoresins of spices such as pepper, capsicum, cardamom, turmeric, ginger, and perhaps does not include the vanilla market from African regions. China with India, and Portugal, are the market leaders in the global oleoresin industry with participation from other south Asian countries such as Vietnam, Thailand, Sri Lanka, South Africa, Brazil and Latin America. The increase in demand for oleoresins comes in the wake of the burgeoning global demand for fast foods and flavoured preparations of traditional foods and the modern food industry



1. CO_2 cylinder
2. Surge tank
3. Extractor
4. Separators
5. Separators
6. Collector and gas measuring device
7. Thermostatic baths
8. Thermostatic baths
9. Isocratic pump

Figure 1 : Sketch of apparatur for Super Critical Fluid Extraction (SFU)

finds advantages in the standardized oleoresins available in the global market. Oleoresins have the following advantages over traditional whole spices:

- Consistency in flavour quality
- Unaffected by bacterial contamination
- Comparatively long shelf life
- Facile storage and handling
- Complete release of flavour during product processing
- Convenience in transportation
- Facile blending ability when composing secondary products

Spice oleoresins in the global markets have to comply with stringent international standards particularly in regard to solvent residues etc. and thus have to be processed under strict scientific surveillance

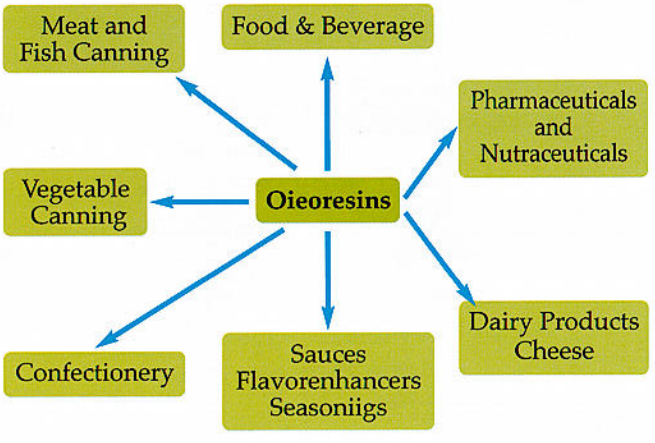
Many modern industries depend on the use of quality oleoresins. Also the use of oleoresins have now entered the domain of domestic cooking as well, enhancing the variety and appeal of the housewife's home products. The sauces and dressings to home-made salads and the variety of flavours to soups and stews have been enhanced by the availability of quality oleoresins for the housewife, and enabling the home production of appealing menus with relative convenience to the cook.

Conditions for Production of Quality Oleoresins.

The production of quality oleoresins for the global export market depends on several factors such as the following:

- Well organized agro technology for production of raw material.
- Good post-harvest practices
- Efficient processing conditions guided by scientifically derived protocols
- Good packaging

Global markets are understandably demanding and any aspirant to enter the modern industry must be ready to meet the demands. Oleoresins find application in several industries such as:



The wide range of uses are because of their inevitable standards in quality and reproducible character and any producer must conform to these standards all along the production line from good Agricultural practices through processing to packaging.

A shift in Nomenclature

While in reference to spice, the product generated by extraction of vegetable raw material with organic solvents or with supercritical fluids is referred to as OLEORESINS, a distinctly different nomenclature is employed for these products in the older and more traditional industry- the Fragrance Industry. The total extract, after removal of the solvent, is referred to as the "concrete", in the case of aromatic plants, where mainly flowers are used as is the case in the fragrance industry; this would correspond to the Oleoresin in the corresponding case of spices. Thus the concrete would include the essential oils, the fixed oils, resins and pigments as well. When the concrete is extracted with alcohol the alcoholic solution is referred to as a "tincture" and when the solvent is removed the product is then known as the "absolute".

In the old times petals of flowers were placed on layers of lard – a process known as enfleurage-and the extract of fragrance in the lard was referred to as a "Pomade", This nomenclature still prevails within the fragrance industry. The essential oil component of flowers in the Fragrance Industry is separated by the traditional steam distillation technique as in the case of lavender, and Ylang ylang oils or by extraction with low boiling solvents as in the case of rose oils and jasmines.

In Summary

Spice Oleoresins are now a significant item of necessary ingredients in several major industries. The rapid market development of the fast foods industry has given extra impetus to the increased importance of the use of spice oleoresins instead of raw spices in the processing industry. The advantages of spice oleoresins in industrial use have been summarized above. Its convenience of storage and the relatively small volume in shelf space, and its facile availability add another dimension to its utility. There are little if any negative factors in the industrial use of oleoresins in place of raw spices in the processing industries. One can therefore envisage a burgeoning increase in their usage in the coming years particularly since the use of SFE technology is now popular. Developing nations such as India and China are already geared up to this need and there is a place for smaller nations too in regard to the specialty spices they can contribute. Converting the raw spice into quality ensured oleoresin would indeed serve to prevent wastage of the raw material from spoilage if stored in the fresh condition, and this is a factor which is indeed of consequence.

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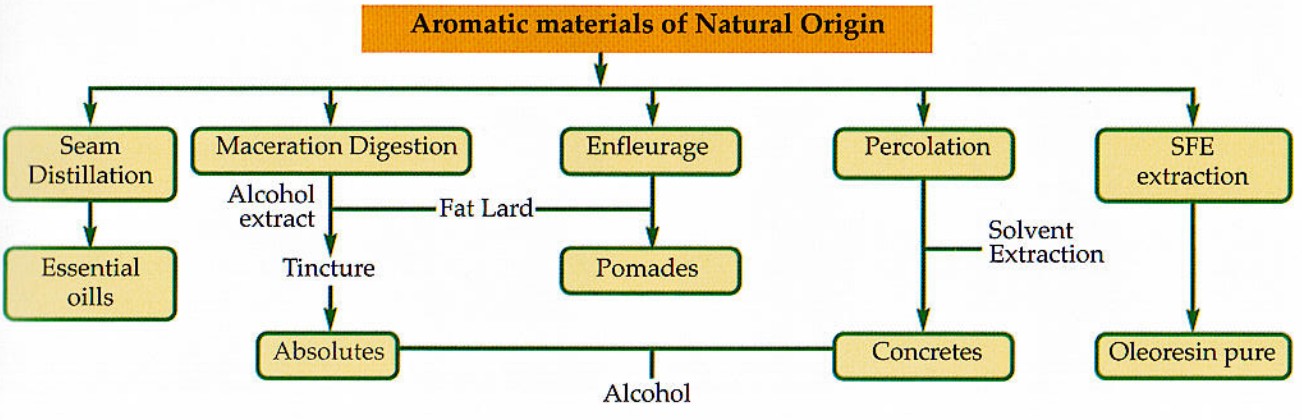


MARIGOLDS – A TREASURE FROM THE AZTECS

By R O B Wijesekera

Preamble

The attractive and brightly decorative Marigold flowers are well known to horticulturists, but not so well known are their medicinal and other features. The characteristic odour of the marigold flowers and the leaves of the marigold plant is also well known as an insect repellent and has been so used by forest dwelling tribes in the regions where the marigold plant is found growing in the wild. The variety known as wild marigold is botanically identified as : *Tagetes minuta*, and it has become a popular home garden plant in almost every continent. As a result, many variations of the species have now come to be almost ubiquitous.

The first recorded instance of the use of the marigold flower dates back to 1552 and the De la Cruz Badiano Aztec. It has been recorded that the Aztecs had many uses for the flower and its leaves, and that sometime during the 1550's the Spanish brought the seeds over to Spain, where they were to cultivate them first for horticulture.

The Aztec's regarded it as a sacred flower and had attributed many magical curative properties to it. So it can well be deemed a Treasure from the Aztecs. There are several different flowers that are now referred to as "Marigolds" but they belong to distinct genera: *Bidens tripartiita, Caltha palustris, and Calendula officinalis*, and the genus Tagetes. These are hardy annual flowers whose colours range from various shades of yellow, orange and even red or mahogany. These Marigolds were indigenous to the south-west of America and South America but are now spread elsewhere in America by early colonists and have in modern times become ubiquitous. One story goes that it was the Spaniards who carried seeds of the Tagetes species to Spain and thence it spread to all of Europe. Another story relates that Portuguese explorers took the seeds from Brazil to India where they propagated the species, and so its therapeutic effects led it to be incorporated into Ayurveda therapy and even local rituals. In India today it is produced in large scale for use in local festivals.

The Burpee Story

The story of Burpee is now an integral component of the history of "Marigolds", as far as the American venue of the flower is concerned. Northwards of Santa Ynez Mountains in California in the Flora dale farms one sees the vast display of various coloured Marigold blooms, belonging to the Burpee Company. The story goes that the company favoured the Tagetes Marigold in developing new hybrids, and sponsored a contest for the development of the first white marigold. As a consequence today white marigold species are abundantly available from this company itself. David Burpee of the Company, was to sponsor the Marigold as a candidate as the National Flower of the US. So perhaps as a result, innumerable variations in the type of hybrids that are now commercially available worldwide have evolved.

The Ubiquitous Marigold

Now that the Marigold flower has been introduced to India as well as elsewhere such as Europe, many hybrids of the several species are widely distributed. In India Marigolds have become the symbolic flower used in religious ceremonies, at weddings and festive occasions. Temples are draped with Marigolds strung into garlands, and the demand is so great that the production of Marigolds in India has become a large commercial industry. The main types produced for the markets in India are:

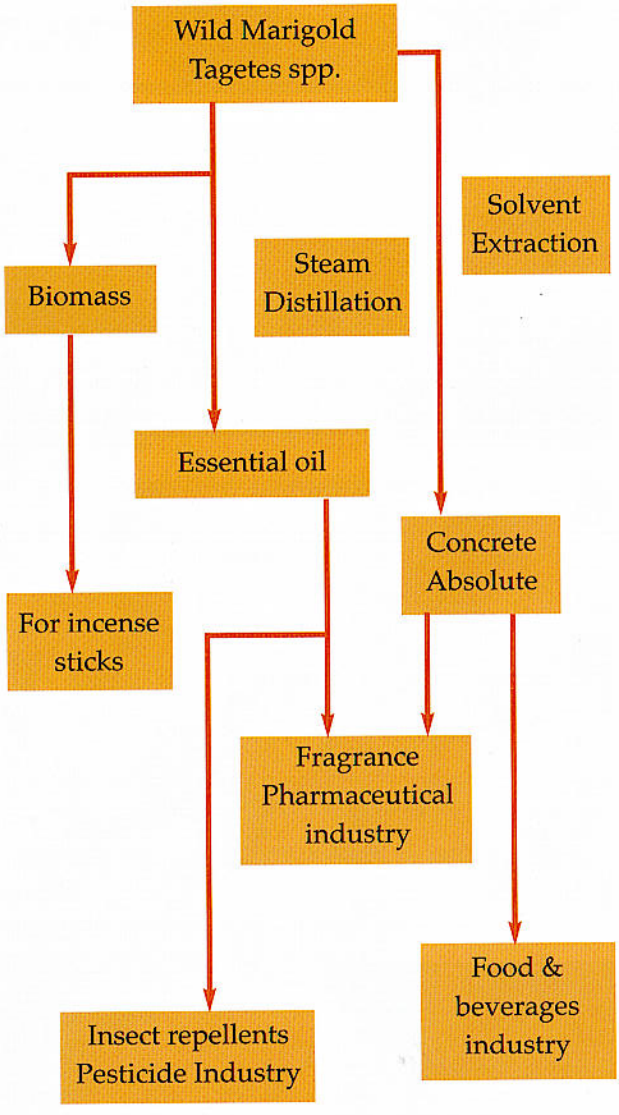
- *Tagetes erecta* (African Marigold)
- *Tagetes patula* (French Marigold)
- *Tagetes tenufollia* (Striped Marigold)

There are now over fifty species of marigolds within the species Tagetes the most commonly found in the markets being *T.erecta* and *T.patula*, as well as hybrids of these two.

Tagetes Essential oil

The essential oil from the flowers leaves and stems of the plant species *Tagetes minuta*, is an established commercial product produced on a commercial scale in India and South Africa, and utilized worldwide within the fragrance and pharmaceutical industries. The ethno medical use as an insect repellent plant is amply justified in the scientific evidence available for the biological effects of the essential oil itself. The essential oil is produced by the standard technique of steam distillation with the aspect of "cohobation" – that is the recycling of the water being continuously provided for.

There are today many industrial uses of the oil itself and the cultivation of the tagetes species on a wide commercial scale finds ample justification from economic stand points. First there is the horticultural appeal, and then the social and cultural aspect particularly in the festival customs in the Hindu areas. Then the



fragrance industry and the pharmaceutical industry has its call for products based on the properties both medicinal and fragrance value of the essential oil. The insect-repellent property of the plant is still to be fully employed on a global scale and the plant species belonging to the Tagetes species has an established global future.

In Europe and the Americas, the Tagetes is frequently confused with the Calendula species on account of the striking similarity of the blossoms but is this merely a cosmetic confusion because they are both referred to as "Marigolds. Scientific evidence on the biological effects of the species will perhaps decide the issue in the future, The Fragrance industry may be perhaps the major user of the Tagetes essential oil in the future and its Perfumery profile has been defined as follows:

- **Perfumery Note** - Top to middle
- **Odour** - Wild & Fresh with bitter undertones,; when freshly distilled fruity herbaceous and citrus like.
- **Strength of initial aroma.** - Medium
- **Dry out.** - bitter and Herby
- **Blending.** - Blends well with the following:

  Oils of - Clary sage, Lavender, Ylang ylang, sandalwood, Geranium, Tea tree oil, Citrus oils, lemon & Orange oils and Frankincense oil

Chemical constituents of the essential oil

Detailed analyses of the essential oil have been made by flavour chemists and several such are available. The main components of the flavour are the terpenoid compounds Limonene, Ocimene, and the compounds dihydrotagetonone, and Tagetone.

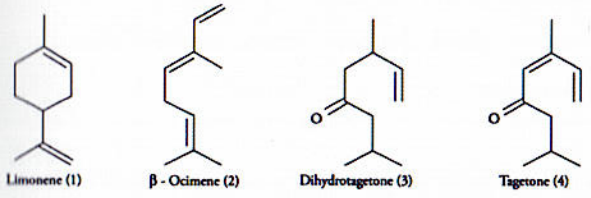


Figure 1. Chemical structures of the compounds identified in the *T. minuta* essential oil.

Table 1. The primary chemical composition of *Tagetes minuta* essential oil.

Compound	Retention time (min)	Area (%)
Limonene (1)	9.52	6.96
β-Ocimene (2)	9.62	5.11
Dihydrotagetone (3)	9.89	54.21
Tagetone (4)	11.60	6.73

Min – minutes. % percentage.

The composition varies from one sample to another depending on the source. (Lawrence, B.M. 2005)

In Summary

As a result of the horticultural interest in the Tagetes species of plants in particular and the other species called Marigolds, there has been unprecedented hybridization and such an enormous range of flowers have resulted. The Burpee Co in the US developed an odourless variety too but the appeal of this variety was unpopular because enthusiasts preferred a Marigold with an authentic odour. *Tagetes minuta*, in addition to its many uses is also employed in the on site preparation to deter nematodes and also for its antiviral properties for plant diseases, stemming from its essential oil. The oil also finds use in the pharmaceutical and nutraceutical preparations as wound healing agents, anti-inflammatory agents and as insect repelling preparations.

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Plants to counteract Obesity

Obesity is a fast increasing condition seen in both male and female subjects today. Although much deprecated by the sufferers, the reduction of weight poses a severe problem, substantiating the common saying 'the spirit is willing but the flesh is weak.' Plants offer a simple way of weight reduction as an alternative to strenuous exercise and stringent diets and sufferers will find it most useful to read about these plants.

American J. Translational Research, 9 (5) ,pp.2050-2064, 2017

SERIES ON "PLANTS MOST USED IN AYURVEDA"
1. CORIANDER

By Dilmani Warnasuriya and Nadeesha Gunasekera

Coriander in the Home

Coriander or Kottamalli is an integral part of the Sri Lankan home medicinal arsenal. There is hardly a household, traditional or modern, that does not take recourse to a steaming hot decoction of Kottamali laced with dry ginger at the first indication of a cold, cough or fever. A testimony to its widespread renown in Sri Lanka, is the catchy song Kottamalli in a baila style, composed by a famous Sri Lankan singer. Of course it must also be said that Samahan is now fast making its debut as a quick replacement for kottamalli. The knowledge that coriander is an effective remedy for such common ailments has been handed down by our forefathers, and as such it would behove us to learn more about this plant to reaffirm the sagacity of our ancestors. However, it is interesting to note that although coriander has been reported to possess a wide range of traditional medicinal uses, no authentic report is available in its effectiveness in reactive airway diseases for which it is mainly used, traditionally.

What is Coriander?

It is often pondered whether Coriander is a spice or a herb. Actually, it is both a spice and a herb, and is one of the oldest on record. It is even mentioned in the bible and the seeds have been found in ruins dating back to 5000BC. Coriander also seems to have been cultivated in Greece since at least the second millennium BC. The word coriander is derived from the Greek word koris, meaning a stinky bug. This is obviously referring to the strong aroma emanating from the plant leaves when bruised. Some of the records reveal that it refers to a species cultivated for the manufacture of perfumes, and later records show that it apparently was used in two forms: as a spice for its seeds and as a herb for the flavour of its leaves. These facts appear to be confirmed by archaeological evidence.

Coriander or known botanically as *Coriandrum sativum*, belongs to the family Apiaceae, the stepwise classification being as follows.

Kingdom : Plantae – Plants
Subkingdom : Tracheobionta – Vascular plants
Superdivision : Spermatophyta – Seed plants
Division : Magnoliophyta – Flowering plants
Class : Magnoliopsida – Dicotyledons
Subclass : Rosidae
Order : Apiales
Family : Apiaceae – Carrot family
Genus : *Coriandrum* L. – coriander P
Species : *Coriandrum sativum* L. – coriander P

Coriander is also known by a variety of names, depending on its locality, these being, Chinese Parsley, Cilantro, Dizzycorn, and Japanese Parsley. Coriander is also referred to as "kusthumbari" or "dhanayaka" in the Sanskrit literature; in Hindi it is called Dhania, while Dhane in Bengali. When the leaves are used in their fresh form, it is commonly referred to as cilantro. In fact, In the US, the leaves and stalks of the plant are referred to as Cilantro but in the UK the term cilantro does not even exist. The dried seeds are what we usually refer to as coriander. It is a native plant of the eastern Mediterranean, in Palestine, Syria , and Greece, from where it may have spread to Europe, Asia Minor, Mexico Argentina and even to some extent in England and the United States. Records indicate that Coriander was taken to British North America in 1670, and was one of the first spices cultivated by early settlers. Closer to home, cultivations are also seen in Sri Lanka and India.

What the plant looks like

C. sativum L. (family Umbelliferae/ Apiaceae) is an erect annual herb with a pronounced taproot, and slender branching stems up to 20–70 cm in height. There are two varieties of *C. sativum: vulgare* and *microcarpum;* the former has larger fruits ranging from 3–5 mm in diameter and with Essential Oils (EO) yields of 0.1%–0.35% (v/w) while the latter has smaller fruits with EO yields of 0.8%–1.8% (v/w). The leaves are lanceolate, dark green, glabrous on both surfaces and are variable in shape and lobed. The upper leaves are wispy and finely divided, and the lower ones broad, undivided and trilobate. The flowers are borne in small umbels, white or light pink, asymmetrical, with the petals pointing away from the centre. The coriander seed is ovate or globular, has a dry schizocarp with two mericarps, and multiple longitudinal ridges on the surface. The fruits are achenes, crowned with a minute calyx.

How do you cultivate the plant?

Coriander plants grow from the seeds which can be planted directly in the soil, and is a

popular garden or even pot plant. It is a short season annual herbaceous plant with a 3-4 month growing season, occasionally surviving into a second year. It prefers warm dry conditions. For seed, it is sown in the spring, needing little maintenance. Harvest is in about ninety days as soon as seeds are ripe and before they drop. An indication of ripeness is that the aroma emanating from the seeds turns pleasant. For the leaf, the seeds are sown during the summer.

As mentioned there are two main varieties of the plant and the choice of which type to grow depends on the end use and growing conditions. The small seeded plants have high oil content and extracts, and are better suited for cold climates. The larger seeded variety is used for grinding and is grown in warmer climates. Planting is through sowing the seeds with the seed rates being between 15 to 25 kg/ha. It is preferable to harvest the seeds when the fruits are fully ripened, as otherwise the oil quality and consequently the spice taste will be adversely affected.

The coriander plant is resilient and can grow under dry conditions and heavy soils using residual moisture, although immediately after sowing, water is needed.

Production and Processing of Seeds

The fruits ripen at different times in the plant, and thus high losses maybe seen, as fully ripe seeds often shatter and fall to the ground while other fruits are still immature. To minimise these losses, the plant should be cut and windrowed when half to two thirds of the fruits are ripe and left for a few days for ripening to be completed. Threshing is then carried out. Yields could vary between 500 to 1500 kg/ha.

Coriander as food

All parts of *C. sativum* plant are edible although the most frequently used are the fresh leaves and dried seeds. Its green foliage, containing proteins, vitamins and minerals (like Calcium, Phosphorus, and Iron), fibres and carbohydrates, is used as vegetable, and in salads. Both the leaves and seeds contain EO, rich in varying components, which provides typical flavour, when added to the food products. It also acts as a preservative .

Coriander seeds in our diet

In the food industry, coriander is approved for food use by the US Food and Drug Administration, the Flavor and Extract Manufacturers Association and the Council of

Europe, and the plant can be used as a spice, medicine and a raw material in food, beverage and pharmaceutical industries.

The coriander used for medicinal purposes and as a food ingredient is the dried fruit of *Coriandrum sativum*. Ground coriander and the oil or oleoresin extracts are even used in liquors such as gin, vermouth and liqueurs and also in sauces, seasonings and meat products. It is also sometimes used as a source of the aroma chemical linalool.

The most common use of Coriander seed is in curry powder where it is the principle component, and in India and many other countries, it is rough ground to give a crunchy texture. The seeds can be also used in stews and soups. They blend well with smoked meats, sausages, and game and even used in puddings and sweetmeats. Coriander is an ingredient of garam masala, pickling spices and is used in cakes, breads and other baked foods as well. It is also a characteristic of Arab cookery, being common with lamb, kid and meat stuffing and often combined with other ingredients such garlic, sesame, cumin. It enhances fish dishes and, with other spices, may form a delicious coating for spiced fish or chicken, rubbed into the scored flesh and grilled. It may even be added to cream or cottage cheese.

Coriander Leaves in our Diet

Having a characteristically pleasant and strong taste, the fresh leaves are used for garnishing and widely used as a flavouring in many Middle Eastern dishes. In Sri Lanka, it is an indispensable addition to biriani and other dishes. It is a common additive in Spanish, Middle Eastern, Indian, Oriental and South American cookery, the preparations being unique to each region or country. They are sprinkled like parsley on cooked dishes, minced or puréed in sauces, chutneys, soups and curries. Both seeds and leaves can be used in salads. In Thailand the root of the coriander plant is used to flavour meats and curries, it's dark green colour imparting a more attractive appeal for culinary use.

Health Benefits of Coriander leaves and Seeds

A myriad health benefits are attributed to coriander leaves and seeds although most of them are yet to be scientifically proven.

Having Antibiotic Properities

The leaves and seeds are said to have antibiotic properties which are effective in overcoming several digestion problems such as gastric inflammation, diarrhoea, flatulence, and this has some scientific justification, as the leaves contain the antibiotic substance Dodecenal which is effective against some pathogenic bacteria and also Cineole, Borneol, Limonene, Alpha-pinene and beta-phelandrene which have known antibacterial properties.

Easing Digestive Discomfort

Coriander seeds act as an effective digestive aid, and this is due to it's antispasmodic effect which helps in relaxing contracted digestive muscles that cause the discomfort of IBS and other problematic gut disorders. This claim has even been substantiated through exhaustive animal studies. According to these studies, it is due through stimulation of the liver to secrete more bile enriched in bile acids, and stimulation of enzyme activities that participate in digestion, both of pancreatic and intestinal origin. The increased bile secretion and activities of digestive enzymes, leads to an accelerated overall digestive process, which significantly reduces the duration of passage of food through the gastrointestinal tract. An added boon is the high metabolically inert insoluble dietary fibre present in the seeds which helps increase bulk of the food by absorbing water throughout the digestive system and easing constipation conditions.

As a home remedy, a drink made out of boiling the roasted and ground coriander fruits in water , cooled and mixed with honey or sugar taken early in the morning is supposed to be effective in hyperdipsa and vitiated conditions of pitta.

Decreasing Blood Pressure and Balancing cholesterol levels

The diuretic effect displayed by coriander seeds has been shown to reduce high blood pressure, consequently decreasing the risk of blood clots and strokes. It is also said to decrease levels of bad cholesterol and increase healthy cholesterol and thereby is effective in balancing LDL and HDL levels. This has been demonstrated in animal studies, and in one such study, a significant decrease in bad cholesterol or LDL and an increase in healthy cholesterol or HDL was shown among subjects who were administered coriander seeds. Overall, results of studies confirmed the hypolipidemic potential of coriander and the efficacy was comparable to the commercially available herbal drug namely 'Liponil'. The seeds also contain high dietary fibre content and these fibres bind to bile salts (produced from cholesterol) and decrease their re-absorption in the colon, thus helping to lower serum LDL cholesterol levels. Together with flavonoid anti-oxidants, fibre composition of coriander helps protect colon mucosa from cancers.

Fighting Food Poisoning

Several studies suggest that coriander is among several herbs that have strong antimicrobial effects against food-borne pathogens. Like the leaves, Coriander seeds actually contains antibacterial compounds including dodecenal, that may specifically fight against Salmonella, which is a major cause of food-borne illnesses. Adding this spice into the diet, can actually be a guard against uncomfortable or even fatal food poisoning. Dodecenal, is a natural compound that's actually twice as powerful as an antibiotic than the leading treatment for salmonella-based illness.

Combating Urinary Tract Infections

Coriander seeds are helpful in relieving symptoms of a urinary tract infection or UTI. Again,, animal studies have been conducted, and it has proven that the crude aqueous extract of coriander seeds increased diuresis, excretion of electrolytes and glomerular filtration rate, depending on the dose administered. A simple remedy is to soak 1.5 teaspoons of dried coriander seeds overnight in two cups of water, and then straining and imbibing it, even after adding to a morning smoothie.

Supporting Healthy Menstrual Function

Coriander seeds are said to actually help in supporting healthy menstrual function by its effect in promoting proper endocrine gland function and the hormones that regulate menstrual cycles. It can also help in reducing the bloating, cramping and pain during the cycle. This is an antidote commonly used in Ayurvedic medicine.

Preventing Neurological Inflammation & Disease

Neurodegenerative diseases including Alzheimer's, Parkinson's, multiple sclerosis, brain tumours and meningitis are associated with chronic inflammation. Studies have found that diets high in turmeric, pepper, clove, ginger, garlic, cinnamon and coriander helped in targeting inflammatory pathways and preventing neurodegenerative diseases. The causative factor in this is that Coriander contains linoleic acid which has analgesic properties which help to reduce inflammation. Researchers have postulated that that lifestyle factors of individuals with diets rich in these nutrients showed lower incidences of neurological degeneration.

Preservation of Foods

Rancidity, unpleasant tastes and odours in food is due to the lipid peroxidation causing oxidative stress. Changes in colour and loss of nutritional value could also result by this. The synthetic antioxidants viz., butylated hydroxyl anisole (BHA) and BHT have been in use in foods but the safety of such synthetic antioxidants has been doubted due to their toxicity, liver damage and carcinogenicity. Coriander provides a good

alternative having excellent antioxidant activity and it is stable at high temperatures. Research studies have demonstrated that the *C. sativum* essential oils inhibited the rate of primary and secondary oxidation product formation in cake, salami and several other food products - their effects being almost equal to synthetic BHA. It is thus most effective in increasing the shelf life of the products and consequently in food preservation. Foods seasoned with essential oils thus have a significant effect in preventing spoilage presumably due to the essential oils of coriander having antibacterial, antifungal and anti-oxidative activities..

Displaying Antioxidant Activity

The antioxidant activity said to be possessed by coriander leaves again has some scientific merit with the presence of caffeic and chlorogenic acids which are said to hamper free radicals causing oxidation. It also expected to reduce the risk of skin cancer which is caused by the free radicals resulting from the sun's rays. It is even recommended that a tea spoon of coriander powder that is extracted from coriander leaves into a daily meal can prove to be beneficial in reducing the risk of skin cancer.

Exhibiting Anti inflammatory effects

Coriander leaves are also said to reduce inflammation of the skin, and is powerful in healing eczema, mouth ulcers and other skin ailments. A paste of coriander and turmeric juice are even used to treat pimples and blackheads thus cleansing the skin.

The presence of iron in the leaves is expected to be beneficial for anemia patients, while also easing respiratory problems, extreme fatigue and abnormal heart beat.

Mitigating Body odour

Consuming coriander leaves is a good solution for people who have problem with their body odour, as the leaves act as a detoxification agent and is capable of getting rid of bacteria causing body odour.

Lowering blood Sugar

These wonder leaves are reported to stimulate the endocrine gland, increasing insulin secretion from the pancreas which finally increase the insulin in our blood. This process results in the absorption of sugar in the blood and is thus a boon to those afflicted with diabetes. As reported in the case of coriander leaves, Coriander seeds, with its essential oils, also have an effect on lowering blood sugar and this could be a natural way of treating diabetes. The essential oils have dual blood glucose-lowering effects in diabetes, by enhancing insulin secretion from the pancreas and exhibiting insulin-like activity at the cellular level. Some even apply two to three drops of coriander essential oil with a carrier oil on the soles of feet daily and going further, this same mixture is applied to the pancreas area at night with a warm compress.

Reviewing this, it is apparent that coriander is a good home remedy for many common ailments.

Selection and storage

Coriander seeds as well as its oil can be readily available in the markets the year around. Good-quality coriander seeds should release a pleasant, slightly peppery flavour when squeezed between index and thumb fingers. In the market it is always advisable to purchase whole seeds instead of coriander powder since, often it could be adulterated.

At home, seeds should be stored in cool, dry, dark places, in airtight containers. This way, they keep well for many months and can be milled using a hand-mill whenever required. Ground or powdered coriander should be stored inside airtight containers and placed in the refrigerator. The spice should be used as early as possible since it loses its flavour rather quickly due to evaporation of essential oils.

The leaves, with its root intact should be wrapped loosely in a piece of newspaper in order to retain its moisture. It can be stored in a plastic

bag in the refrigerator to preserve it for a longer time. A slice of lemon imparts a better taste.

How to make coriander leaves water

Step 1: Take a bunch of coriander leaves and clean it gently.

Step 2: Cut it into small pieces and put it in a pot.

Step 3: Pour clean water and boil it for ten minutes and let it cool down.

Step 4: Filter and pour the water in a clean bottle.

Chemistry of Coriander

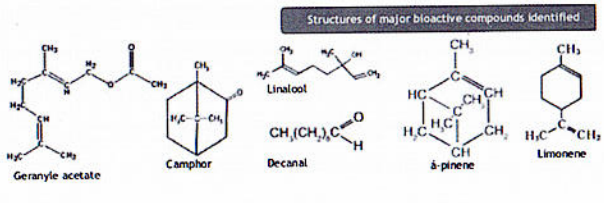
Coriander is one of the most useful essential oil bearing spice as well as medicinal plants, essential oils being present in its leaves, stem, flowers and fruits/seeds. The yield of *C. sativum* essential oils and its chemical composition however is not constant as it undergoes changes during the maturing process and this affects the aroma of the plant. Immature fruits and leaves have an unpleasant odour called a "stink bug smell" which is due to trans-tridecen contained in the oil and the Greek name stems from this factor.

The characteristic aromatic flavour of coriander seeds comes from their essential volatile oils and fatty acids. The EO can be extracted from various parts of plants including the leaves, flowers, stem, seeds, roots and bark; however, the composition of the EO can vary among different parts of the same plant, such as, EO obtained from the *C. sativum* seed has different composition from the EO of *C. sativum* flower as well as cilantro (immature leaves). The *C. sativum* oil from fully ripe and dried seeds is a colourless or pale yellow liquid with a characteristic odour and mild, sweet, warm and aromatic flavour, and linalool is its major constituent.

Some important fatty acids in the dried seeds

Petroselinic acid, (major acid)
Linoleic acid (omega 6)
Oleic acid
Palmitic acid

In addition, the seeds contain essential oils such as linalool , which is the principle component, a-pinene geraniol, camphene, terpine etc. Together these active principles are responsible for digestive, carminative, and anti-flatulent properties of the seeds. Thus, the plant is a potential source of lipids and essential oils isolated from the seeds and the aerial parts.



Variation of Essential Oil composition of coriander across different countries (Bangladesh, Brazil, Fiji, India, Kenya and Korea)

Compounds found in Coriander Essential oils	Essential oil of Coriander Seeds	Essential oil of Coriander leaves
Linalool	60%-80%	13.9%
γ-terpinene	1%-14%	
α-pinene	0.2%-8.5%	1.9%
β-Pinene	0.05%- 1.8%	
p-Cymene	0.4%-2.0%	
Camphor	0.12%-6.0%	
Decanal	4.7%	1.39%-14.3%
Geranyl acetate	0.5%-17.8%	
Camphene	1.7%	
Limonene	0.02%-1.28%12	
Geraniol	0.6%-2.6%	
D-Limonene	1.36%	
Linalyl acetate	0%0-2.7%	
Terpen-4-ol	3%	
α-terpineol	0.5%	
r-cymene	3.5%	
Myrcene	0.2%-2.0%	
E)-2-decenal	0.1%0.6%	32.23%
(E)-2-dodecenal		0.% -9.93%
α-Cedrene	0%-3.8%	
α-Farnasene	0%-1.22%	
Citronellal	0%-1.96%	
Neryl acetate	0%-14.2	
Decanal	0.1%-1.0%	
1-Decanol		0%-19.6%
2-Dodecanal		0%-9.93%
Dodecanal		1.25%-5.8%
Tridecanal		0%-3.0%
1-Decanol		5.7%-19.6%
(E)-2-tetradecenal		6.56%
2-decen-1-ol		0%-26%
(E)-2-undecenal		0%-1.87%
Capric acid		0%-12.7%
(E)-2-tridecenal		0%-3.0%
(E)-11-tetradecenoic acid	0%-13.37%	
2-Decenoic Acid		0%-30.8%

It is seen that a range of aldehyde compounds are present in the leaves, and these are largely responsible for the aroma of coriander leaves. The largest proportion of these are those with 6-10 carbon atoms, particularly decyl (10) and nonyl (9) aldehydes. These aldehydes or similar are also present in soaps and lotions , and some discerning users even detect a soapy taste in the leaves presumably due to these aldehydes. However, perception of this facet of coriander's taste isn't purely chemical, but studies have

shown that genetic factors may be involved, which accounts for the eschewing of coriander leaves by several people. Akin to that encountered in the Durian fruit, some consumers love the fruit, leaves while others abhor it.

However it should be borne in mind that the components could vary depending on the locality, environmental conditions , weather, maturity of the plant and other factors.

As in other spices, coriander is also rich in dietary fibre, 100 g seeds providing around 41.9 g of fibre. Its seeds are an excellent source of minerals like iron, copper, calcium, potassium, manganese, zinc and magnesium, all of which have a significant effect on the healthy functioning of the body. Copper is required for the production of red blood cells. Iron is essential for cell metabolism and red blood cell formation. Zinc is a co-factor in many enzymes that regulate growth and development, sperm generation, digestion and nucleic acid synthesis. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is utilized by the body as a co-factor for the powerful anti-oxidant enzyme, superoxide dismutase.

The seeds are also a rich source of Vitamin C, which is an anti oxidant vitamin, generally lacking in other dry spice seeds. This could be the reason of its effectiveness against colds and respiratory tract infections, although documentary proof is absent. Many vital Vitamin B_complex vitamins such as thiamin, riboflavin, and niacin are present in the seeds in significant quantities.

Safety and Toxicity profile

From studies carried out on the toxicity of coriander it has been shown that there is very low toxicity on human cells, and tests for mutagenicity also proved negative. According to the European Food Safety Authority, Coriander seed oil is proposed to be supplied as a food supplement at a maximum level of 600 mg per day. This dosage is recommended for healthy adults and not for children and pregnant and lactating women. Also, since Coriander leaves (cilantros) contain a high level of potassium, kidney failure patients with hyperkalemia, should avoid eating coriander or limit the intake of it.

There is also a strong need to evaluate and control the microbial quality of spices including the presence of microbial toxic metabolites.

In a Nutshell

In conclusion, one could justify the sobriquet of " herb of happiness" frequently used in relation to coriander. It is indeed a miraculous herb, having multifunctional uses and protective and preventive action against various chronic diseases, with its antioxidant, antifungal and antibacterial activities. This justifies its use in pharmaceutical products and the essential oils and other volatile materials in the plant makes it a suitable component in perfumes and fragrances. In addition, its nutrient composition of fats proteins vitamins, minerals makes it a useful food as well.

One can only marvel at the perspicacity and wisdom shown by our forefathers in exploiting the resources of nature for the maintenance of bodily health.

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Growth in the Essential Oil market.

Market research carried out shows a substantial growth in the global essential oil market. A 5.92% growth is predicted from 2017 -2023. The driving force behind this is fragrances, flavours and personal care industry. This is partly due to the increasing awareness of the health benefits from essential oils and improving economic conditions. Aromatherapy is now taking the world by storm in both developed and developing countries, with health spas mushrooming across the world offering various health benefits. Sri Lanka is no exception and retailers, pharmacies and even grocery stores are now stocking their shelves to meet the demand of consumers for essential oils and aromatherapy products and herbal cosmetics.

Perfumer& Flavorist, Vol. 43,(2) Feb.2018

No one should approach the temple of science with the soul of a money changer.

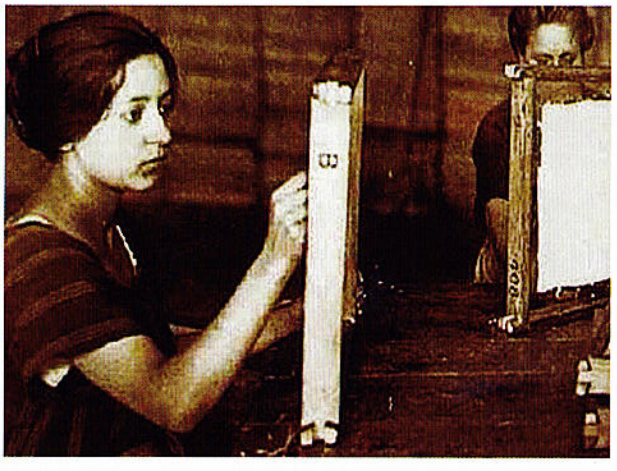
~Thomas Browne

ESSENTIAL OILS - METHODS OF EXTRACTION REVISITED

By R.O.B. Wijesekera

Preamble

The aromatic properties of plants have attracted mankind ever since the beginning of time. It is recorded that even Neanderthal man had been attracted to the fragrant smells in the plant kingdom and had used this property in several ways. In medieval times mankind was able to locate the agents deemed responsible for odour characteristics in plants, and thence the need to find methods for isolating the odour characteristics arose. It was known that the responsible chemical substances were volatile and that is why they were able to readily be detected by odour. It was simple to identify flowers as the main parts of plants that bore odors characteristics and so flowers were the first to attract the attention of mankind in the search for the odour giving elements. Flowers such as roses, Lavender and Jasmine were examined with a view to isolating their odour principles, and so in the beginning there arose the methodology now characterized as enfleurage.



Process of Enfluerage

Enfleurage

This was one of the oldest methods of extraction of the volatile principles within flowers and although it is identified in medieval Europe there is evidence that the method or similar techniques may have been employed even in earlier times. The volatile oils were called "essential oils" not with any connotation of "need" but signifying their odour as being the "essence" that characterized the flower's odour.

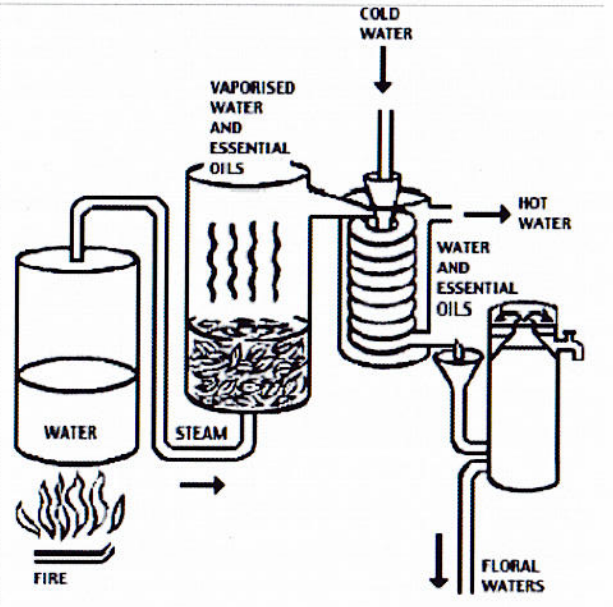
Enfleurage although extensively used in medieval times and known to the best of fragrance producers is nevertheless rarely used at the present day. In this technique flower petals are placed on plates of glass on which a thin layer of a fatty substance has been pre-spread. This thin layer of fat was known as the "chassis" or the "Matrix". The principle was that the essential or volatile oil diffused from the flowers into the fatty layer. The fat extract, called the "Pomade", was then collected and extracted with alcohol when the volatile component then separates from the fatty material. Evaporation of the alcohol leaves behind what was termed "the Absolute" It can be imagined that this was indeed time consuming but for a very long time it was the only way to extract the delicate aromas of flowers such as jasmine.

Mechanical Expression of Oils.

This is also a medieval technique but with limited application mostly to oils from the citrus species such as oranges, limes, lemons, mandarins and grape fruit. Mostly they are applied to express the oils,(by mechanical means,) from within the rind of these fruits, and the technique is also known as cold pressing or mechanical pressing. It remains the preferred method for citrus oils and modern mechanical presses have now been devised to enable rapid and clean cold extraction. Since heat is not used the heat-labile components are intact and market value is enhanced with cold-pressed oils particularly with the oils from the citrus species. These expressed oils are sometimes not classified as essential oils but they are more often referred to as "expressed" oils, and these are definitely used as therapeutic oils, as well as in the flavoring business. In the processing of these expressed oils it is important to consider the fact that citrus fruits are subject to the use of pesticide sprays in the growing stages and these can reach high concentrations in the expressed oils.

The technique of Steam Distillation.

Steam distillation is a very special technique that has also been associated with the extraction of fragrance materials of plants since the early historical times. It had been used in ancient times by the Egyptians, the Greeks, the Romans, and even the civilizations of the Indus valley. The principle involves the rupturing of the fragrance containing membranes within the plant material by steam and rendering the fragrances essential oils volatile and extractable. With steam the individual components of the essential oils which in their totality are responsible tor the overall odor, form constant-boiling mixtures with the aqueous phase that boil well below the boiling point of water, and hence condense and float as globules upon the water that condenses along with the steam. There are many variations of this technique and this makes it a most versatile method of getting the essential oils from fragrant plant materials.



Sketch of the Method of : STEAM DISTILLATION.

There can be three main variables.

- Direct Steam distillation
- Water and Steam distillation
- Water distillation.(Hydro distillation)

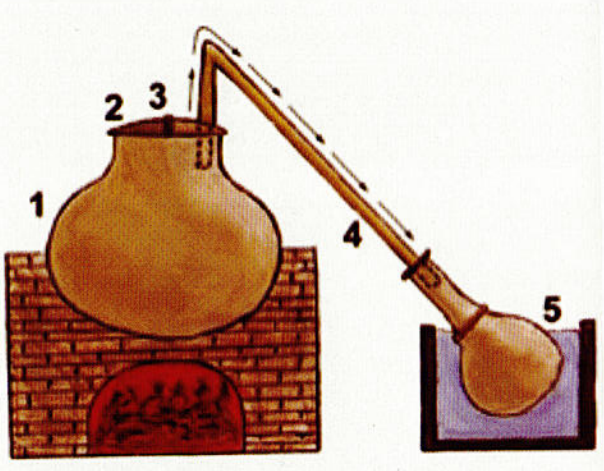
In olden times as well these techniques had been employed but sophisticated methodologies developed following the post-industrial revolution period when industrial processing of natural fragrance commodities became the vogue. Direct passage of stem through a body of plant material is the most commonly employed method. It is employed to distil lavender, citronella lemongrass, mint species, geranium, clove steam and clove buds, and a variety of such material to extract the respective essential oils. The other two variations have different exposures to water, and sometimes, as in the traditional methods of distillation of cinnamon bark and sandal wood the plant material is completely immersed in water. The water-cum-steam distillation methodology sometimes referred to as hydro distillation is equally popular It was the typical method used by nomadic tribes when distilling eucalyptus oils from forest growing trees. In the methods of steam distillation, the oil phase and the water phase separate on cooling. The water

phase is sometimes referred to as "hydrosol" or floral water. In the instance of the distillation of sandalwood the hydrosol is also an important byproduct and is used as a fragrant water for bathing, in the regions where distillations are carried out on a large scale. The essential oil distilling equipment, the distillation vessel, the condenser, and the cooling devisers should be such that they are purposefully designed as they have an impact on the yield and quality of the essential oil itself and hence the market value. Essential oils are subject to international standards and there are now very sophisticated methods of analyses available.

Standards for essential oils and methodologies for detection of adulterants are well observed in the trade, which underscores the need for good preparative methods.

There are however some traditional methods that have remained with time in their original unique form such as the nomadic methods for the distilation of Eucalyptus oil from the forest growing trees in Australia. Another more significant traditional technique is the method unique to the region of Kanauj in India, which is referred to as the Deg-Bhapka Method, and is used for the production of what are termed "Attars". Here the essential oils from flowers in a vessel (1) with furnace assembly (2,3) are distilled via a bamboo tube condenser (4) into a receiver vessel (5) which already contains distilled oil of Sandalwood. The procedure is unique and the apparatus is traditional. The attars are concentrated fragrant mixtures.

Steam Distillation.

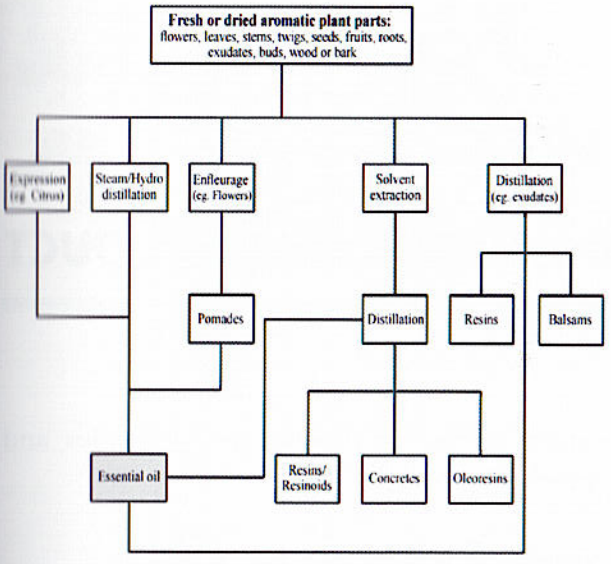


Deg-Bhapka system

Nomadic style distillstion

Attars are popularly used by women in the northern regions of India and in the Arab world. The "attars" are however not essential oils they are concentrated mixtures of essential oils.

Essential oils can be produced from plant parts either fresh or dried and they are a large variety ranging from leaves ,barks fruits flowers, berries, buds as in cloves,roots,and stems etc.. By applying the various processes one can generate the variety of products, as needed.(Chart below)



Solvent Extraction Methods

Techniques based on extraction with volatile solvents were initially developed for the perfumery industry, and now remains one of the most commonly employed technique in the extraction of essential oils from their plant sources.

Originally solvent extraction was confined to flowers such as roses and jasmines where the volatile odors within them were heat sensitive. Accordingly low boiling solvents had to be used and these were pentane, hexane etc. Even at the present time solvent extraction is used on a large scale but a new development that has emerged brings greater versatility to the technique, and extends its range of usage to the essential oils of spices as well. This is the use of supercritical fluids as the solvent. The process is now referred to as Supercritical Fluid Extraction (SCFE-CO_2.)

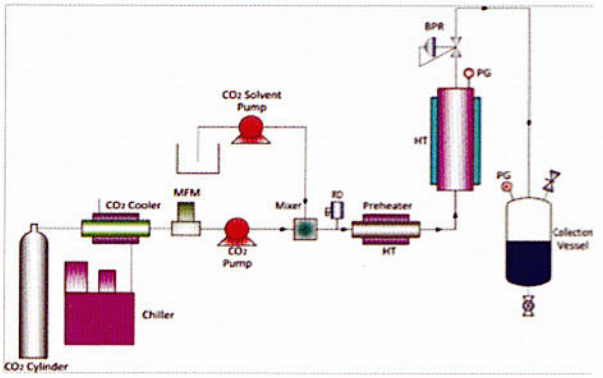


Diagram of the Process of SCFE with CO_2

This process is now preferred by large scale manufacturers as although the initial costs are formidable, the production costs are less and the product comes in a pure form, on removal of the supercritical fluid. The supercritical fluid leaves no traces of solvent unlike other solvents. In the pharmaceutical industry where therapeutic grade oils are needed this is particularly preferred.

Another development is called the Phytonic process in which specifically uses non CFC solvents. i.e. non chloro-fluorocarbons and the resultant oils are referred to as Phytols.

Of all the extraction methods easily the most widely used worldwide is still the methods of steam distillation in its variable forms.

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RESEARCH/
REVIEWS

DEVELOPMENT OF A HERBAL SNAKE REPELLENT PRODUCT

Devna De Mallawa and Lakshmi Arambewela**

Introduction

Certain plants on the earth have important properties for sustainable agriculture One of the most commonly used plants is Neem which is scientifically called *Azadirachta indica*. Neem commonly called 'Indian Lilac' or 'Margosa', belongs to the family Meliaceae, Neem is the most versatile, multifarious trees of tropics, with immense potential. It possesses more useful non-wood products (leaves, bark, flowers, fruits, seed, gum, oil and neem cake) than any other tree species. These non-wood products are known to have antiallergenic, antidermatic, antifeedent, antifungal, anti-inflammatory, antipyorrhoeic, antiscabic, cardiac, diuretic, insecticidal, larvicidal, nematicidal spermicidal and other biological activities. Due to these activities neem has enormous applications making it a green treasure. The Sanskrit name 'nimba' comes from the term 'nimbati swasthyamdadati' which means 'to give good health'. Neem tree is the most researched tree in the world and is said to be the most promising tree of the 21st century. It has great potential in the fields of pest management, environment protection and medicine. Neem is a natural source of insecticides, pesticides and agrochemicals.

Neem Components and their activities

There are many biological active compounds that can be extracted from neem including alkaloids, flavonoids, triterpenoids, phenolic compounds, carotenoids, steroids and ketones. The important compounds obtained from neem belong to the class called tetranortriterpenoid limonoids. It has ecdysones. These hormones control the metamorphosis in the life cycle of insects. The most active ingredients in neem are Azadirachtin A-G and Azadirachtin E. (Azadirachtin A has 7 isomers). Azadirachtin E is the most effective growth regulator and the quantitatively important compound in seed kernels is Azadirachtin A. Other biological active compounds are Salanin, Meliantriol, Nimbidin (Nimbin, Nimbolide, Nimbinin are tetranorterpene isolated from Nimbidin), Gedunin, Mahmoodin, Gallic acid, Catechin, trisulphides and tetrasulphides tricyclic diterpenoids. Azadirachthin act as an insect repellent and insect feeding inhibitor.

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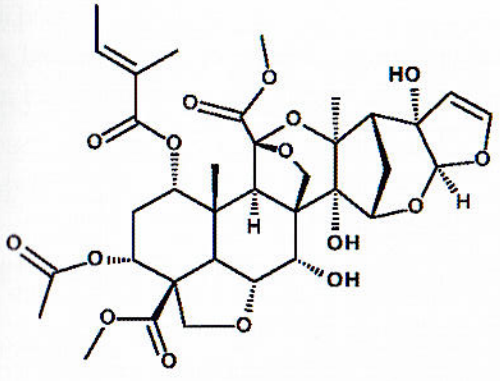
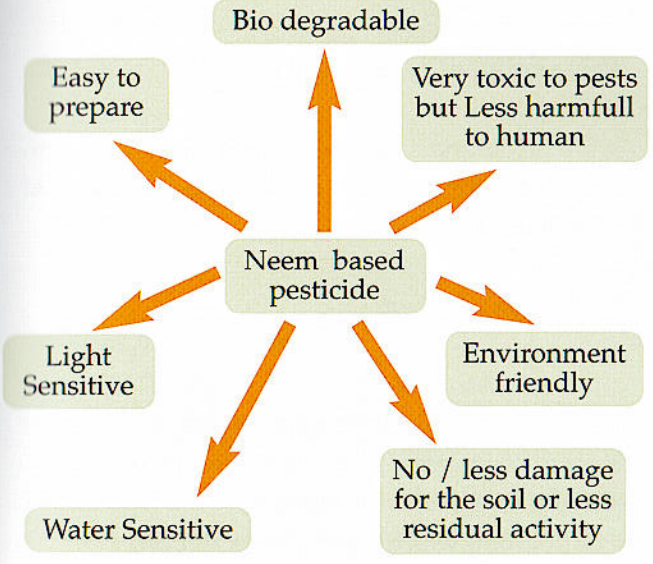
Other limonoids and sulphur containing compounds with repellent, antibacterial, contraceptive, antipyretic and antiparastic activities can be obtained from the use of neem leaves, flowers, bark, roots.

Neem Tree



Azadirachtin

Neem based pesticide (BIO PESTICIDE)



Importance of Neem as a Bio Pesticide

The use of pesticides is very important and directly affects human health and the economy in a society as well as the environment. In the absence of pesticides the standard of food will be changed and will affect the health conditions of people in a country as well as the economic conditions. Excess use of pesticides changes the conditions of the soil and sometimes it will disturb the life cycles of microorganisms and the chemicals used in pesticides can create mutations in animals as well as humans and some pests can develop resistance to particular pesticides.

The use of Bio pesticide can improve the status of environment because most of them are biodegradable, or photochemically degradable. They have less residual activity and are less harmful for the environment and humans. Neem has a large number of benefits . It does not contain DEET, not harmful to clothing and spectacle frames, no resistance can be made against Neem and biodiversity does not get changed. Neem based pesticides are non toxic and safer because they do not directly kill the pests they just disturb the stages of the life cycles of pests and repel them from plants.

Repellent activity / Oviposition Behaviour

Repellents are chemical substances which are synthesized by a natural process or by a chemical process. These chemical compounds protect the plants from the attacks of insects. To be a good repellent the active compounds should have amides, imides, alcohols and phenols. The effectiveness of a repellent as a pesticide primarily depends on the functional groups in chemical substances that are being used.

Insect repellents category :

- Physical repellents
- Synthetic repellents
- Natural origin repellents
- Ideal repellents

Characteristics of an ideal repellent

- It should be effective (repellent activity) for multiple pests
- Its activity should last long (least 8- 10 hours)
- It should have the resistance to water
- It should be greaseless and odourless

The repellent action occurs in pests due to

- Obstruction of neurons, which sense attractive chemical stimuli
- Commencement of receptors for noxious odours
- Activation of many receptors and loss of the correct attractive messengers.
- Activation of receptors, which support inappropriate behaviour.

Oviposition behaviour means repulsion of female insects by neem treated plants which prevents them from laying eggs on the plants.

Feeding deterrent

Neem can be used as an insect feeding deterrent which can prevent the of feeding on plants or discourage the feeding after their first experience(taste) on plants. Depending upon the species, effective (viable) antifeedency can vary.

Plants Used as Biopesticides

Sri Lanka has an agriculture based history and have used many naturally occurring compounds obtained from plants and plant extracts listed below

1) Lemon Eucalyptus (*Corymbia citriodora*) extracts
2) Gliricidia
3) Adathoda
4) Lantana leaf extract
5) Annona seeds extract
6) Onion bulb extract
7) Marigold leaf extract
8) Pongamia leaf extract
9) Moringa leaf and flower extract
10) Chili,garlic and onion extract
11) Neem leaves, Oscimum (Maduruthala), Calotrophis, Adathoda and Eupatorium mixed leaf extract

The use of Neem oil as a repellent: a portion of Neem oil is mixed with Coconut oil and used as a protection from anopheline species.

As a storage repellent : In early days Neem leaves were mixed with grain and used as a storage repellent. Sacks were treated with neem products to prevent the movements of flour beetles.

Insect repellent :

Ethanol, octyldodecanol, margosa extract (an extract of neem oil), bergamot oil, rosemary oil, eucalyptus oil mixed together and used as an insect repellent. Neem oil was mixed with detergents and diluted in water and used as an insect repellent.

Objective of the present study :

As the use of synthetic pesticides has adverse effects to the human health, the environment as well as the economy in a society, the development of Neem pesticide was carried out with the intention of producing a natural pesticide for use in Sri Lanka. A Neem shampoo was developed to provide safe shampoos for pets in the country.

Preparation of plant extracts

Materials used for the extractions: Neem Seeds, Neem Leaves, methanol hexane and petroleum ether

Extraction of Neem Oil:

Neem seeds were weighed. Weighed seeds were ground using a grinder and soaked in petroleum ether and hexane, with continuous stirring for 24 hours (1 day).
The solution was filtered. (Decantation)

The same seed powder was re extracted with hexane for the second time. Rotary evaporator was used to dry the filtrate. The temperature was maintained between 35°C-42°C.

Extraction of Neem Leaves :

Neem leaves were dried in the shade for 2 days and they were cut into small pieces and soaked in 98 % methanol.

The methanol extract was filtered and evaporated using a rotary evaporator. (The temperature was kept between 52°C-55°C.) 2nd extraction for the same neem leaves was done.

Extraction of Neem Seeds :

Neem seeds (700g) were soaked in 800.00 ml. of methanol for 2 days. The methanol extract (650ml) of neem seeds was filtered, and evaporated using the rotary evaporator. All these extractions were concentrated by Rotary Evaporator

Preparation of Neem pesticide

Formulation

Neem seed oil	60.00g
Neem seed extract	45.00g
Neem leaf extract	45.00g
Tween	37.50g
Butanol	67.50g
Citronella oil	45.00g
Iso propanal	150.00g

Method of preparation

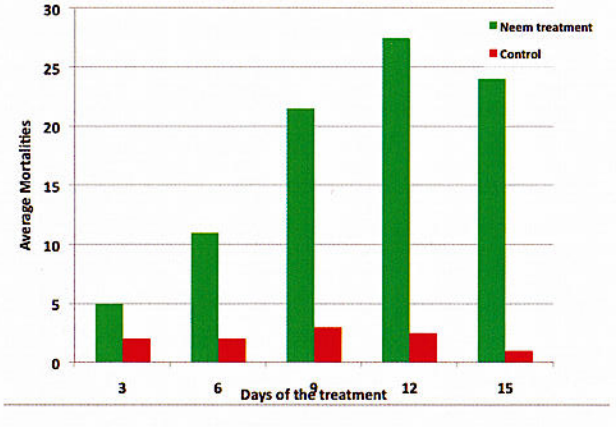
The Neem seed extract and Neem leaf extracts were mixed together and dissolved in Butanol and Iso propanol in a beaker using the electric stirrer. After the Neem extracts got dissolved the Tween and Neem oil were mixed using the stirrer . Finally Citronella oil was added and stirred for 30minutes. After the formulation the Neem pesticide was kept in a brown bottle.

Evaluation of the pesticide (as a storage pesticide)

The experiment was carried out at the research laboratory of the Department of Agriculture Biology, University of Ruhuna, Sri Lanka. Initially, the rice weevil population was collected from the infested rice from the local warehouse and mass reared on pre-cleaned (free from any insect attacked) milled rice under normal laboratory conditions (T-28 ± 2°C, RH- 65 ± 5%). One-two day old adults that emerged from the initial culture were used for the experiment. A sample of milled white rice was purchased from local market for the experiment. The solution of neem based pesticide was prepared by diluting 10 ml of pesticide in 1 liter of water. Each sample of milled white rice consisting of 500g were taken for the experiment. Each sample was treated with 5 ml of prepared solution of neem products. One sample was treated with water for control. The treated samples were shaken well by hand for 10 min to mix the pesticide with rice. Then, treated samples were air dried overnight. Each treated sample was divided into ten equal lots and placed in petri dishes. The ten replicates of each treatment were used. Ten one-two day old weevil adults were added to each replicate and topped with a polythene film. About 75 small holes were made in each covering using a No.000 entomological pin, to ensure good aeration. The petri dishes were placed in a glass cabinet under normal laboratory conditions. Natural day light was used as a light source. Mortality counts were taken at 3 days intervals and the same procedure was repeated until 15 days after treatment. The experimental design was a completed randomized design with ten replicates. All summarizing statistics were produced using Excel. Statistical comparisons were performed with SPSS 18 for Windows (SPSS Inc.).

Weevil

Results of the lab test of Neem based pesticide (as a storage pesticide)



Relationship between the Insect Mortalities and the Days of the Treatment

Development of Neem based Dog shampoo

Formulation

Sodium lauryl ether sulfate	=	100.00g
Cocodiethanol amide	=	34. 00g
Tween 20	=	14. 00g
Methyl paraban	=	0. 8g
Neem Seed Oil	=	8. 00g
Neem Leaf extract	=	10. 00g
Neem Seed extract	=	8. 00g
Citronella Oil	=	8. 00g
Isopropyl alchohol	=	20.00g

The Neem seed extract and Neem leaf extract were mixed together and dissolved in Butanol and Iso propanol in a plastic beaker using the electric stirrer. After the Neem extracts dissolved Cocodiethanol amide, Sodium lauryl ethyl sulphate , Tween and Neem Oil were added and mixed well. After everything got dissolved Methyl paraban and citronella oil were added and mixed well for 30 minutes.

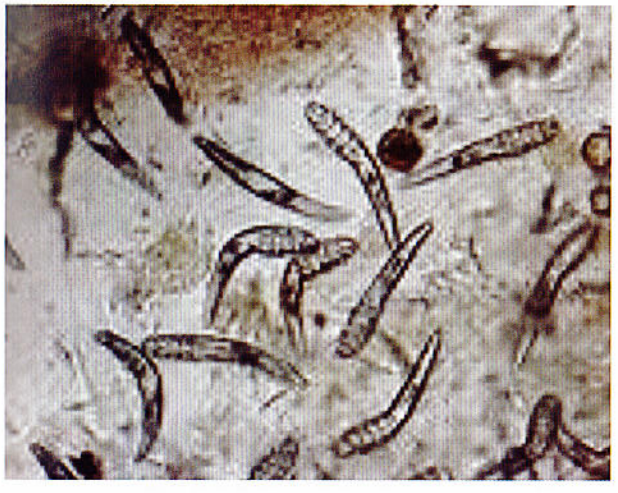
Test for the dog shampoo

The selected dog had a severe skin infection spread all over the body. The infection was due to Demodex parasite and it is known as Canine Demodicosis. The parasite has 8 legs and survived on the surface of the host (in the hair follicles or sebaceous glands of mammal). The Demodex life cycle is generally 2 to 3 weeks. A female Demodex parasite lays 15 to 20 eggs inside the hair follicle close to the sebaceous organs. The eggs hatch and in the end turn into a grown-up eight-legged parasite. The grown-up male Demodex parasite will leave the follicle looking for a mate, while the grown-up female vermin stays in the follicle. The vermin are equipped for strolling roughly 10 mm/h and have a tendency to be very dynamic

Affected areas on dogs have red color due to inflammation. They have a four stage life cycles and each stage can be determined by the microscopic test. The affected area becomes scaly with a focal patch of hair loss. The patches are commonly seen on the face, around the eyes, and the front legs. Treatments should be done immediately. If not these parasites damage the immune system of the animal.

The dog shown in the picture was treated with Neem based dog shampoo for 3 weeks (twice per week) Shampoo was dissolved in water and was applied on the skin and was kept for 20minutes. After that, the skin was washed with water.

Dog's ear before treatment



Demodex parasite

Results for dog shampoo

After the use of Neem based dog shampoo the affected areas became less red in colour and the skin become more healthy compared to before treatment

Dogs ear after treatment

Conclusion

The result of the lab test of Neem based pesticide showed that there was a significant difference between treated and untreated samples. During the experimental period, there was no significant mortality in untreated samples. Results showed that the neem preparation does not kill rice weevil immediately but they die gradually. The current experiment indicated that the neem based pesticide has a considerable potential for controlling the rice weevil of stored grains. Neem may be act on weevils in different ways other than direct poisoning, such as disrupting mating and sexual communication, eggs laying, embryonic development, post embryonic development, molting, chitin formation, repellant or any other action. Therefore, further research is needed to confirm the pesticide activity on target insects.

The results for the dog shampoo showed that shampoo has an effect on Demodex parasite because the red colour of the skin disappeared little by little. Therefore anti-parasitic activity is present in this neem based dog shampoo. There can also be other activities such as anti virus, antifungal and antibacterial. Therefore, further

research is needed to confirm the correct activity on dogs.

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Hope for Diabetics

With the growing demand for natural herbal supplement to improve the state of health, research on promising plant material has increased double fold in the scientific arena.

It is now an established fact that herbal medicines could in fact regulate the blood glucose levels in man. Giving credence to this is that the widely used diabetic drug Metformin can be traced back to the plant, Galega officinalis (goat's rue or French lilac) in medieval Europe. This plant was found to be rich in a substance guanidine, (biguanide)which is known to have blood glucose lowering activity. The rationale behind it is that consumption of refined carbohydrates poses a risk in developing type 2 diabetes and even heart disease and if a substance could retard the breakdown of the carbohydrate into simple sugars, this could go a long way in mitigating this problem. Taking recourse to herbal medicine again, researchers are now looking to exploit more of the known plants with a view of identifying such substances.

The Mulberry plant has been used in traditional Chinese medicine for several thousand years, its use being first recorded around 500AD. In the Grand Materia medica, it says that "if the juice (of the herb) is decocted and used as a tea substitute it can stop wasting and thirsting disorder". These symptoms, along with increased urination and tiredness are known to be associated with diabetes.

Research was thus carried out on the effect of mulberry extract of a standard strength on blood glucose and insulin responses in healthy volunteers using randomised, double blind, placebo controlled clinical trials. Initial results obtained were most promising, and it was shown that there was a significant drop in blood glucose levels and a rise in insulin, when compared to the placebo. The extract effectively reduced the total amount of sugar being absorbed into the bloodstream by over 20%. Moreover, no side effects which are common with many diabetic drugs were observed using this extract. Researchers were also able to identify the active component as being 1-deoxynojirimycin (DNJ), which blocks the breakdown of carbohydrates into simple sugars, preventing the absorption of sugar, lowering blood-glucose rises. More research is thus called for on the long term effects of Mulberry extracts and its use in reducing the incidence of Type 2 diabetes.

https://theconversation.com/mulberry-leaf-extract-could-reduce-the-risk-of-type-2-diabetes-73312

WLADEK S. BRUD - A POLISH ICON OF SCIENCE & INDUSTRY

By R.O.B. Wjiesekera

When one first meets Wladek Brud one gets the impression of a personality of the business world. One may not at first be conscious that he is one of the most accomplished scientific authorities in the flavor chemical field. His career began as a chemical researcher at the Warsaw Technical University, and he took his doctorate on synthetic chemistry related to terpenes, therpeol and terpenyl acetate the major volatile constituents of coriander. Since those early days his main interests and indeed his main career has been concerned with aroma chemicals, flavours & fragrances, and the theory of smell. After a career in research he joined the Pollena-Aroma Flavours & Fragrances where he rose to be Chief Executive and President.

Brud was to make a significant contribution to science in his field and was to author several publications and books and had to his credit several papers in the Fragrance field. At the peak of his career as a specialist in the Fragrance industry in Poland he was well recognized as an academic authority as well As an internationally recognised personality by this time Brud was much in demand and was included in UNIDO's specialist panel of experts. It was while he was serving as a UNIDO expert that the author first met him and came to realize the extent of his vast experience and knowledge of the fragrance industry. Our association and friendship first was instrumental in Brud serving as a special expert consultant at the Ceylon Institute of Scientific & ndustrial Research the then CISIR- the premier Research Institute in the author's own country.

Brud was to in time become a well-recognized global authority in the International fragrance industry. He was called upon to serve on international committees in Europe as well as globally. Together with his wife Iwona he introduced professional Aromatherapy into Poland and founded the Aromatherapy Association of Poland.

Presently a leading member of IFEAT, since its formation in Kyoto in 1977, a former President 1994-2000, and his credentials as a genuine international authority in the field of fragrance and essential oils is well founded. His visits to a Sri Lanka are nowadays rare but very much welcome.

PRODUCTS FROM LINK NATURAL

AVAILABILITY OF LINK PRODUCTS

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	Youmart	Odel			
Link Samahan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Link Enriched Paspanguwa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Natural Sudantha	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Kesha Hair Oil	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Hair Care Cool	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Akalapalitha	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Link Swastha Thriphala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
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															✓		✓

ORAL HEALTH AWARENESS FOR THE NATION

By Himesh Lahiru

Link Natural Products, has always aimed at being a socially responsible company, ever conscious of its obligations to society. In keeping with this, they have carried out several programmes to address the social issues of our country in the areas of education, health, Infrastructure development and environment. It proactively identifies opportunities to link their core business activities to action on related social issues.

Oral Health is a fundamental aspect of overall health and well-being. The present status of the country's oral health is not at all satisfactory, being riddled with the prevalence of oral diseases such as dental caries and gum diseases. This is in spite of positive oral health related behavior such as use of toothpaste and toothbrushes being widely in use among all age groups. One causative factor for this could be that, people do not make regular visits to the dentists, and consequently, oral health problems are not detected at the early stages.

It is thus timely to take necessary initiatives to promote the oral health of the community. Since major oral health problems are preventable, it is best to adopt the preventive care approach. This is far more economical in the long run, than sophisticated and costly dental treatment which will inevitably be needed in the failure of preventive care.

When considering the level of disease prevalence, it is evident that existing oral health infrastructure is not sufficient to meet the public demand. It is also apparent that Public service alone cannot provide a sustainable solution, and thus private sector organizations also have a role to play.

Link Natural thereby undertook to carry out an Awareness Campaign aimed at promoting preventive oral health care. Oral health awareness and education is a main area that needs attention in promoting preventive care. In this campaign, island wide coverage was targeted.

Majority of Sri Lankan do not seek professional dental services regularly, and by educating the people, their oral health related behavior can be improved and regular visits to professional dental care will enable the early detection and early treatment of oral disease. Therefore by raising the awareness positive oral health impacts can be achieved.

The awareness campaign is designed to bridge the awareness gap and induce positive behavioral changes that aid preventive oral care. Dental professionals, Medical professionals, Scientists and experts in education contributed in the preparation of the program contents, using

effective delivery methodologies. It was also evident that the level of understanding was different for different population groups, and depending on the target group, power point presentations, videos, films, banners, leaflets were used in different combinations to cater to this need .

As majority meet their dentists only after they become victims of oral diseases, our awareness campaign also arranged free dental screening programs targeting early identification of oral health problems and made referrals to the closest public dental health institutions for treatment. Screening priorities were given to the high risk population groups such as pregnant mothers, young children, and underserved rural populations, people living in geographical areas located very distantly from the existing dental health institutions and populous areas where the existing facilities are not sufficient to cater the demand.

During 2017 we were able to cover several areas in North Central, Central, and Uva provinces. Maximum penetration was targeted, as once the awareness is built among even a cluster of a population, the message will spread to their proximal community. This was achieved by reaching Divisional Secretariat and Gramaniladari divisions. Through this wide coverage, project benefits are delivered to maximum number of beneficiaries.

Emphasis is given equally to all segments of the population. Even though preventive care success is achieved more with children, parents and adults in the family have more control over the oral health related behavior of children. Therefore it is important to raise the adult's awareness as well. Children are educated through School Awareness Programs (SAP) that covers government schools, private schools, tuition classes and Sunday schools. Adults are reached through Institutional Awareness Programs (IAP) and Community Awareness Programs (CAP). These programs cover a diverse group of people attached to different demographic, geographic and socio economic classes.

During 2017 total programs conducted was 2095 and 303,853 individuals were directly made aware of the most important aspects of oral health. Total number of individuals who were given a chance for a free dental checkup for the same period was 29,941.

For this period Rs. 52.3 million has been spent by Link Natural Products (Pvt.) Ltd towards this laudable programme.

Our vision

"To build the oral health status of the nation and to give the privilege of protecting teeth for life time and thereby contribute to the improvement of the quality of life".

Awareness Programs

Dental Screening

NATIONAL GREEN AWARD 2017

Link Natural Product (Pvt.) Ltd won the bronze award at the National Green Award 2017, under the "Pharmaceutical Products and Personal Care Products Industry" category.

The National Green Award 2017 was organized by the Central Environmental Authority for recognizing outstanding performance in "Protecting and managing the quality of the environment by coordination, promotion, public participation, enforcement, appropriate technological intervention and environmental education".

The Company received this award at the "Presidential Environmental Awards – 2017" held at Bandaranaike Memorial International Conference Hall (BMICH) on 16th October 2017 under the distinguished patronage of His Excellency Maithripala Sirisena.

Isuru Gayashan receiving the award from Hon Susil Premajayantha, Minister of Science Technology and Research

CNCI ACHIEVER AWARDS 2017 FOR INDUSTRIAL EXCELLENCE – EXTRA-LARGE CATEGORY, NATIONAL LEVEL GOLD AWARD AND TOP TEN AWARD

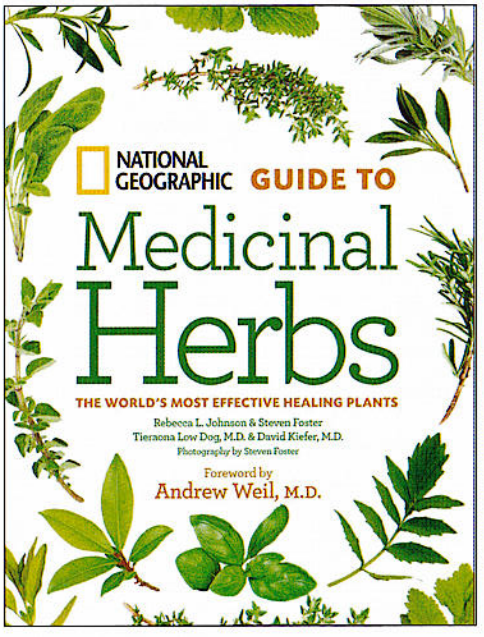
Link Natural Products became the Extra- large category National level gold award winner at the CNCI Achiever Awards 2017" organized by the Ceylon National Chamber of Industries. The Company also won the top ten award for industrial excellence. This is the second consecutive year, the company won this prestigious award for its outstanding performance in the areas of quality standards, productivity, employee benefits, labour relations and social and environmental obligations.

The Award ceremony was held on 17th August 2017 at Hotel Galadari Colombo.

Gihan Vidanagama and Chamari Wickramathilake receiving the award from Hon. Arjuna Ranatunga, Minister of Petroleum Resources Development

Tharanga Perera receiving the award from His Excellency, Maithripala Sirisena

NATIONAL GEOGRAPHIC GUIDE TO MEDICINAL HERBS



Editor : *By Tieraona Low Dog, M.D. (Author), Rebecca L. Johnson (Author), Steven Foster (Author), David Kiefer M.D.(Author), Andrew Weil M.D. (Foreword)*

ISBN : *9781426207006*

Publisher : *The National Geographic Society*

Language : *English*

There is a world of health and healing all around you in your spice rack, your backyard, and on the shelves of health food and grocery stores. This informative guide is a reference you will keep at the ready, connecting 72 of the world's most common and useful medicinal herbs with the body systems they help and heal. Eight chapters focus on body systems: 1. Mental Health & the Nervous System 2. Respiratory System 3. Heart & Circulation 4. Digestive System 5. Joints, Muscles & Skin 6. Urinary & Male Health 7. Female Health 8. Wellness & Perception

Each chapter begins with an overview of how plants can bring health to that part of the body, with stories about traditional herbal remedies from around the world and current scientific findings on herbal remedies for specific illnesses. Then each chapter highlights nine plants, combining botanical and medical information therapeutic uses, effectiveness, preparations, cautions, and advice, including a round-up of current science about the active ingredients in the plant.

Every chapter includes a photo gallery showing how one of its herbs is cultivated and processed commercially the story behind the contents of that bottle you buy in the store. Special features include "Over the Kitchen Counter" quick and easy ways to use herbs in your everyday life, and time lines for every herb, showing how today's use of herbal remedies collects wisdom from the centuries and around the world. A functional appendix includes an illustrated index to all the plants in the book, an ailment by ailment therapeutic index, a glossary, and an index.

DIGEST MAIL BOX

Letter 1

Please add my name to the list of subscribers and mail me issues of Link Natural on regular basis. Previously published issues may be sent through my e.mail address. Being interested in medicinal plants in particular and plants in general as well as being a researcher in this area, I have found Link Natural very informative and useful.

Mohammad Arfan Yousufzai, Ph.D
Professor
ICCBS, University of Karachi
Karahi

Letter 2

LINK NATURAL DIGEST
MAGAZINE VOLUME 13, ISSUE 1, 2017

I received the above magazine. The contents are very well presented and even a layman like me can understand it.

The Green Porridge of Health (Kola Kenda) as much as there is supposed to have many nutritional benefits, but when you buy this from Vendors the water they use for preparing Kola Kenda nay not be boiled properly, and this can be a health issue.

Please keep up the good work and send me your publications regularly.

With best regards,
Yours sincerely,
Iqbal Jafferjee.

Letter 3

Just now the postman gave me your latest tome, and the first article proves that adage,' great mind agree' and I can understand why you were not enthused about another article about Aspirin. Incidentally the volume of sales in 2010 was some thing in the order of 4-5 billion tabs. It will be interesting to make a list big A'a various trade names, Disprin, Anacin etc etc.

The enzymes which synthesize Prostaglandins are the Cyclo-oxygenase 1 and 2 and bid A inhibits 1. The big improvement over normal A was the enteric coating, which prevent gastric irritation. I believe even this safe aspirin causes some bleeding in the gut mucosa. Unfortunate for some heart patients who can't tolerate it.

I am still reading the rest of the digest and will send over some comments in a week or so.

Lakshman

(Dr A L Jayawardene)

Letter 4

Dear Dr Wijeskera,

I was indeed very happy to read in the Link Digest, that you have been awarded a certificate by the Royal Society of Chemistry , UK., in recognition of your long association with the Society ,- a rare honour achieved by few chemists.

I have known you since the days of CISIR as I have been associated with SAPPTA (the Spice Association) since its inception in 1984.

I am aware of the good work done by you in the field of Spices, and I hope you will continue with your contribution to the various institutions where you have been involved.

I find reading the Link Digest interesting and educational and look forward to receiving it regularly.

Regards

Gulam Chatoor.

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 by By email to :

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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 :

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