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Antimicrobial Analysis of Anti-Microbia Herbal Mixture

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Abstract **Original Research Article**

Aim: This study was conducted to assess the Antimicrobial Analysis of Anti-Microbia Herbal Mixture submitted to the Food and Drugs Administration (FDA), Ghana, for typhoid treatment. ***Method*:** Six (6) samples of the herbal Mixture were sent to the Kwame Nkrumah University of Science and Technology, KNUST, Ashanti region, Ghana to the Department of Pharmaceutics for analysis**.** ***Result*:** The herbal mixture, Anti-microbia herbal mixture exhibited inhibitory action against all the test bacterial. ***Conclusion*:** The Product is recommended for typhoid treatment and safe for use.

Key words: Antimicrobial, herbal Mixture, inhibitory action, Typhoid fever.

INTRODUCTION

According to the Wikipedia, an antimicrobial is an agent that kills microorganisms or stops their growth. Antimicrobial medicines can be grouped according to the microorganisms they act primarily against. For example, antibiotics are used against bacteria, and antifungals are used against fungi hey can also be classified according to their function. Agents that kill microbes are microbicidal, while those that merely inhibit their growth are called biostatic. The use of antimicrobial medicines to treat infection is known as antimicrobial chemotherapy, while the use of antimicrobial medicines to prevent infection is known as antimicrobial prophylaxis.

The main classes of antimicrobial agents are disinfectants (non-selective agents, such as bleach), which kill a wide range of microbes on non-living surfaces to prevent the spread of illness, antiseptics (which are applied to living tissue and help reduce infection during surgery), and antibiotics (which destroy microorganisms within the body). The term "antibiotic" originally described only those formulations derived from living microorganisms but is now also applied to synthetic agents, such as sulfonamides or fluoroquinolones. The term also used to be restricted to antibacterials (and is often used as a synonym for them by medical professionals and in medical literature), but its context has broadened to include all antimicrobials. Antibacterial agents can be further subdivided into bactericidal agents, which kill bacteria, and bacteriostatic agents, which slow down or stall bacterial growth. In response, further advancements in antimicrobial technologies have resulted in solutions that can go beyond simply inhibiting microbial growth. Instead, certain types of porous media have been developed to kill microbes on contact.

Pharmaceutical drugs have been used for centuries; however, concerns have been raised about resistance of these medications. According to the World Health Organization (WHO), Antimicrobial resistance occurs when microorganisms such as bacteria, viruses, fungi and parasites change in ways that render the medications used to cure the infections they cause ineffective. Additionally, when the microorganisms become resistant to most antimicrobials they are often referred to as “superbugs”. This is a major concern because a resistant infection may kill, can spread to others, and imposes huge costs to individuals and society. Antimicrobial resistance is the broader term for resistance in different types of microorganisms and encompasses resistance to antibacterial, antiviral, antiparasitic and antifungal drugs. Antimicrobial resistance occurs naturally but is facilitated by the inappropriate use of medicines, for example using antibiotics for viral infections such as cold or flu, or

sharing antibiotics. Low-quality medicines, wrong prescriptions and poor infection prevention and control also encourage the development and spread of drug resistance. Lack of government commitment to address these issues, poor surveillance and a diminishing arsenal of tools to diagnose, treat and prevent also hinder the control of antimicrobial drug resistance.

Due to this resistance, some researchers are exploring alternative means of drug discovery as antimicrobial. One is herbal drugs. One work by Khameneh *et al.*, [1], asserted that, phytochemicals represent a valuable source of bioactive compounds with potent antimicrobial activities. Another 2019 study by Manandhar *et al.*, [2] focused on exploring the antimicrobial properties of the plants that are commonly being used as traditional medicines. The antimicrobial potential of four different plant extracts was screened against twelve pathogenic microorganisms and two reference bacterial strains. The result indicated that most of the extracts exhibited antimicrobial properties.

The experiment confirmed the efficacy of some selected plant extracts as natural antimicrobials and suggested the possibility of employing them in drugs for the treatment of infectious diseases caused by the test organisms. Similary, a 2000 study by Nascimento et al evaluated the antimicrobial activity of plant extracts and phytochemicals with antibiotic susceptible and resistant microorganisms. In addition, the possible synergistic effects when associated with antibiotics were studied. Extracts from the following plants were utilized: *Achillea millifolium* (yarrow), *Caryophyllus aromaticus* (clove), *Melissa offficinalis* (lemon-balm), *Ocimun basilucum* (basil), *Psidium guajava* (guava), *Punica granatum* (pomegranate), *Rosmarinus officinalis* (rosemary), *Salvia officinalis* (sage), *Syzygyum joabolanum* (jambolan) and *Thymus vulgaris* (thyme). The phytochemicals benzoic acid, cinnamic acid, eugenol and farnesol were also utilized.

The highest antimicrobial potentials were observed for the extracts of *Caryophyllus aromaticus* and *Syzygyum joabolanum*, which inhibited 64.2 and 57.1% of the tested microorganisms, respectively, with higher activity against antibiotic-resistant bacteria (83.3%). Sage and yarrow extracts did not present any antimicrobial activity. Association of antibiotics and plant extracts showed synergistic antibacterial activity against antibiotic-resistant bacteria. The results obtained with *Pseudomonas aeruginosa* was particularly interesting, since it was inhibited by clove, jambolan, pomegranate and thyme extracts. This inhibition was observed with the individual extracts and when they were used in lower concentrations with ineffective antibiotics.

Another 2008 study conducted by Dorman and Deans assessed the volatile oils of black pepper [*Piper nigrum* L. (Piperaceae)], clove [*Syzygium aromaticum* (L.) Merr. & Perry (Myrtaceae)], geranium [*Pelargonium graveolens* L'Herit (Geraniaceae)], nutmeg [*Myristica fragrans* Houtt. (Myristicaceae), oregano [*Origanum vulgare* ssp. *hirtum* (Link) Letsw. (Lamiaceae)] and thyme [*Thymus vulgaris* L. (Lamiaceae)] for antibacterial activity against 25 different genera of bacteria. These included animal and plant pathogens, food poisoning and spoilage bacteria. The volatile oils exhibited considerable inhibitory effects against all the organisms under test while their major components demonstrated various degrees of growth inhibition.

A 2018 study by Mostafa et al also evaluated the antimicrobial activity of five plant extracts against *Bacillus* cereus, *Staphylococcus* aureus, *Escheri chia* coli, *Pseudomonas* aeruginosa and *Salmonella* typ hi using agar disc diffusion technique. Ethanolic extracts of *Punica granatum*, *Syzygium aromaticum*, *Zingiber officinales* and *Thymus vulgaris* were potentially effective with variable efficiency against the tested bacterial strains at concentration of 10 mg/ml while extract of *Cuminum cyminum* was only effective against *S. aureus* respectively. *P. granatum* and *S. aromaticum* ethanolic extracts were the most effective plant extracts and showed bacteriostatic and bactericidal activities against the highly susceptible strains of food borne pathogenic bacteria (*S. aureus* and *P. aeruginosa*) with MIC's ranged from 2.5 to 5.0 mg/ml and MBC of 5.0 and 10 mg/ml except *P. aeruginosa* which was less sensitive and its MBC reached to 12.5 mg/ml of *S. aromaticum* respectively. These plant extracts which proved to be potentially effective can be used as natural alternative preventives to control food poisoning diseases and preserve food stuff avoiding health hazards of chemically antimicrobial agent applications.

METHODOLOGY

DEPARTMENT OF PHARMACEUTICS

The antimicrobial activity of Anti-microbia Herbal Mixture was assessed by the Agar well diffusion technique.

RESULT

Table-1: Antimicrobial Analysis of Anti-Microbia Herbal Mixture

Test Organisms	Mean zone of Inhibition (mm)	
	Anti-microbia herbal mixture	Ciprofloxacin
Salmonella typhi	10.66^{+}_3.05	16.00^{+}_2.00

Values are mean of 3 determinations.

REMARKS

The product, Anti-microbia herbal mixture exhibited inhibitory action against all the test bacterial as in the table above.

Table 2: Microbial Test Protocol – (BP Level of Microbial Contamination)

1. Assessment of total viable count of aerobic bacteria and fungi.
2. Test for specific harmful organisms

TEST RESULTS

Level of microbial contamination

1. The total aerobic viable count of sample $3.2*10^1$ cfu/Ml
   (BP 2018 Specification -$<1*10^5$cfu/Ml)
2. Test for Escherichia coli-MAC/37^{O}C/48hrs None detected
   (BP 2018 specification-Nil/ml)
3. Test for Staphylococcus aureus-MSA/37^{O}C/48hrs None detected
   (BP 2018 specification-Nil/ml)
4. Test for salmonella spp. BSA/37^{O}C/48hrs None detected
   (BP 2018 specification-Nil/ml)
5. Test for pseudomonas aeruginosa PCA/37^{O}C/48hrs None detected
   (BP 2018 Specification-Nil/ml)
6. Test for yeast and moulds-SB/25^{O}C/5days $2.4*10^1$ cfu/ml
   (BP 2018 Specification-$<1.0*10^5$cfu/ml)

REMARKS

The bacterial load obtained for the aerobic viable count was within the acceptable limit. The fungal load was also within the acceptable limit (BP 2018). No harmful microorganisms were detected.

DISCUSSION

Plants have demonstrated several antimicrobial and therapeutic properties in research studies. Some of the common spices which have demonstrated antimicrobial activities are; cloves, garlic, onion, cinnamon, nutmeg, noni, ginger and many more according to hawaii.edu.

GINGER

Scientific Name(s): *Zingiber officinale* Roscoe; occasionally *Z. capitatum*
Common Name(s): Ginger, ginger root, black ginger, zingiberis rhizoma

Uses of Ginger

The drugs.com reported that, Ginger and its constituents have antiemetic, analgesic, cardiotonic, antithrombotic, antibacterial, antioxidant, antitussive, antihepatotoxic, anti-inflammatory, antimutagenic, stimulant, diaphoretic, diuretic, spasmolytic, immunostimulant, carminative, and cholagogue actions. Ginger is used to promote gastric secretions, increase intestinal peristalsis, lower cholesterol levels, raise blood glucose, and stimulate peripheral circulation. Traditionally used to stimulate digestion, its modern uses include prophylaxis for nausea and vomiting (associated with motion sickness, hypermesis gravidarum, and anesthesia), dyspepsia, lack of appetite, anorexia, colic, bronchitis, and rheumatic complaints. Ginger can be used as a flavoring or spice as well as a fungicide and pesticide.

Botany

A native of tropical Asia, this perennial is cultivated in tropical climates such as Australia, Brazil, China, India, Jamaica, West Africa, and parts of the US. The rhizome is used medicinally and as a culinary spice. The rhizome is harvested between 6 and 20 months; taste and pungency increase with maturity. The plant carries a green-purple flower in terminal spikes; the flowers are similar to orchids.

History

Medicinal use of ginger dates back to ancient China and India; references to its use are found in Chinese pharmacopoeias, the Sesruta scriptures of Ayurvedic medicine as well as Sanskrit writings. Once its culinary properties were discovered in the 13th century, use of this herb became widespread throughout Europe. In the Middle Ages, it held a firm place in apothecaries for travel sickness, nausea, hangovers, and flatulence.

Ginger and its constituents are stated to have antiemetic, cardiotonic, antithrombotic, antibacterial, antioxidant, antitussive, antihepatotoxic, anti-inflammatory, antimutagenic, stimulant, diaphoretic, diuretic, spasmolytic, immunostimulant, carminative, and cholagogue actions as well as to promote gastric secretions, increase intestinal peristalsis, lower cholesterol levels, raise blood glucose, and stimulate peripheral circulation. Traditionally, ginger is used as an acrid bitter to strengthen and stimulate digestion. Modern uses include prophylaxis for nausea and vomiting (associated with motion sickness, hyperemesis gravidarum and surgical anesthesia), dyspepsia, lack of appetite, anorexia, colic, bronchitis, and rheumatic complaints. The food industry uses ginger oil as a spice and ginger extract in the manufacturing of ginger ale. In China, ginger root and stem are used as pesticides against aphids and fungal spores.

Ginger is in the official pharmacopoeias of Austria, China, Egypt, Great Britain, India, Japan, the

Netherlands, and Switzerland. It is approved as a nonprescription drug in Germany and as a dietary supplement in the US.

Chemistry

It had long been believed that the pungent principles of ginger were also responsible for its pharmacologic activity, and this has been found to be accurate. The characteristic aroma of ginger is due mainly to the presence of zingiberol in the volatile oil.

The major constituents in ginger rhizomes are carbohydrates (50 to 70%), which are present as starch. The concentration of lipids is 3 to 8% and includes free fatty acids (eg, palmitic, oleic, linoleic, linolenic, capric, lauric, myristic), triglycerides, and lecithins. Oleoresin provides 4 to 7.5% of pungent substances as gingerol homologues, shogaol homologues, zingerone, and volatile oils. Volatile oils are present in 1 to 3% concentrations and consist mainly of the sesquiterpenes beta-besabolene and zingiberene; other sesquiterpenes include zingiberol and zingiberenol; numerous monoterpenes are also found. Amino acids, raw fiber, ash, protein, phytosterols, vitamins (ie, nicotinic acid and vitamin A), and minerals are among the other constituents.

Analyses of the oleoresins have resulted in the identification of a class of structurally related cardiotonic compounds called gingerols, which upon dehydration, form shogaols and degrade further to zingerone. (6)-gingerol and (6)-shogaol are the main components however, the pharmacologically active compounds (6)- and (10)-dehydrogingerdione, and (6)- and (10)-gingerdione have also been identified.

Ginger Uses/Clinical data

Human clinical trials have examined ginger's antiemetic effects related to kinetosis (motion sickness), perioperative anesthesia, and hyperemesis gravidarum. However, little is still known regarding its human pharmacology in these settings. Animal studies have described enhanced GI transport as well as anti-5-hydroxytryptamine ($5HT_3$) and possible CNS antiemetic effects.

Ginger has been reported to have weak fungicidal, strong antibacterial, and anthelmintic properties. Active constituents have been shown to inhibit reproduction of *Escherichia coli*, *Proteus* species, *Staphylococci*, *Streptococci*, and *Salmonella* but to stimulate the growth of *Lactobacilli*. In vitro anthelmintic activity has been documented for the volatile oil *of Z. purpureum* and activity has also been reported against parasites, such as *Schistosoma* and *Anisakis*.

The cytotoxic compound zerumbone and its epoxide have been isolated from the rhizomes of *Z. zerumbet*. This plant, also a member of the family Zingiberaceae, has been used traditionally in China as an antineoplastic.

According to the drugs Com, a systematic review and meta-analysis of 8 randomized clinical trials (N = 734) published before December 2014 found an overall moderate to large effect of Zingiberaceae extracts (including turmeric, ginger, and galangal) on chronic pain compared with placebo; however, substantial heterogeneity was found. Significantly lower subjective pain was reported with the intervention (P = 0.004). A strong dose-response relationship was also demonstrated. Patient groups included 3 studies in patients with osteoarthritis of the knee or hip, and 1 study each in patients with gonarthritis, irritable bowel syndrome, muscle soreness following exercise, postoperative pain, and primary dysmenorrhea. The 4 trials that used ginger monotherapy (n = 315) used doses of ginger rhizome extract or powder ranging from 510 mg/day to almost 2 g/day over a period of 3 days to 3 months. In 100 patients with knee osteoarthritis, 3 months of supplementation with ginger (500 mg twice daily) resulted in a significant reduction in the proinflammatory cytokines TNF-alpha and IL-1beta (P<0.001 each) compared to baseline and placebo. The study was a double-blind, randomized, placebo-controlled design conducted in patients 50 to 70 years of age.

It further reported that, there is limited studies suggesting ginger as effective in reducing dysmenorrhea when administered at 500 mg 3 times daily either at the onset of menses or 2 days earlier. A few studies have demonstrated ginger to be as effective as mefenamic acid or ibuprofen in women with primary dysmenorrhea. In another randomized, placebo-controlled, double-blind trial conducted in Iranian high school females (N = 150) with primary dysmenorrhea and a pain score higher than 4 on the visual analog scale, reduction in pain was significant in the ginger (250 mg 3 times daily) and zinc sulfate (220 mg 3 times daily) groups compared with placebo (P < 0.001). Interventions were taken for 4 days: the day before menstruation and for the next 3 days. Adverse effects were not significantly different among groups.

These data have been supported by results of a meta-analysis evaluating the effectiveness of ginger (750 to 2,000 mg for the first 3 to 4 days of menstruation) for treating primary dysmenorrhea in females 13 to 30 years of age. Of the 7 trials included in the analysis, 4 randomized clinical trials (N = 366) provided efficacy data for ginger versus placebo and demonstrated a significant reduction with ginger (P = 0.0003). A Cochrane systematic review and meta-analysis of dietary supplements for dysmenorrhea identified only low or very low quality studies with very small sample sizes. Very limited evidence of effectiveness was found for the treatment of primary dysmenorrhea with ginger powder 500 to 750 mg/day

compared to placebo or no treatment (4 randomized clinical trials, N = 335); however, no difference was identified between ginger 250 mg 3 times daily and zinc sulfate 220 mg 3 times daily (1 randomized clinical trial, n = 101). No adverse events from ginger supplementation were observed.

GARLIC

Scientific Name(s): *Allium sativum*
Common Name(s): Garlic, allium, stinking rose, rustic treacle, nectar of the gods, camphor of the poor, poor man's treacle

Uses of Garlic

Evidence suggests that garlic may beneficially affect cholesterol and lipids. Among its traditional uses, it has been employed for its antiseptic and antibacterial properties. Other potential areas of use include GI disorders and oncology.

Botany

A perennial bulb with a tall, erect flowering stem that grows to 2 to 3 feet. The plant produces pink to purple flowers that bloom from July to September. The bulb is odiferous.

History

The name Allium comes from the Celtic word all meaning burning or smarting. Garlic was valued as an exchange medium in ancient Egypt; its virtues were described in inscriptions on the Great Pyramid of Cheops. The folk uses of garlic have ranged from the treatment of leprosy in humans to managing clotting disorders in horses. Physicians prescribed the herb during the Middle Ages to cure deafness and the American Indians used garlic as a remedy for earaches, flatulence, and scurvy.

Chemistry

Fresh garlic is a source of numerous vitamins, minerals, and trace elements, although most are only found in minute quantities. Garlic contains the highest sulfur content of any member of the genus *Allium*. Two trace elements, germanium and selenium, are found in detectable quantities and have been postulated to play a role in the herb's antitumor effect.

Garlic contains about 0.5% of a volatile oil composed of sulfur-containing compounds (diallyldisulfide, diallyltrisulfide, methylallyltrisulfide). The bulbs contain an odorless, colorless, sulfur-containing amino acid called alliin (S-allyl-L-cysteine sulfoxide), which has no known pharmacologic activity. When the bulb is ground, the enzyme allinase is released, resulting in the conversion of alliin to 2-propenesulfenic acid, which dimerizes to form allicin. Allicin gives the pungent characteristic odor to crushed garlic and is believed to be responsible for some of the pharmacologic activity of the plant.

Uses of Garlic

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Antiseptic/Antibacterial properties

The antiseptic and antibacterial properties of garlic have been known for centuries. As recently as World War II, garlic extracts were used to disinfect wounds. During the 1800s, physicians routinely prescribed garlic inhalation for the treatment of tuberculosis.

Garlic extracts inhibit the growth of numerous strains of *Mycobacterium*, but at concentrations that may be difficult to achieve in human tissues. Preparations containing garlic extracts are used widely in Russia and Japan. Both gram-positive and gram-negative organisms are inhibited in vitro by garlic extracts. The potency of garlic is such that 1 mg is equivalent to 15 Oxford units of penicillin, making garlic about 1% as active as penicillin.

Garlic extracts have shown antifungal activity when tested in vitro and their use has been suggested in the treatment of oral and vaginal candidiasis. In an attempt to quantitate the in vivo activity of garlic extracts, one research group administered 25 mL of fresh garlic extract orally to volunteers. Serum and urine samples were tested for antifungal activity against 15 species of fungal pathogens. While serum exhibited anticandidal and anticryptococcal activity within 30 minutes after ingestion, no biological activity was found in urine. The findings suggest that while garlic extracts may exhibit some antifungal activity in vivo, they are probably of limited use in the treatment of systemic infections.

Dosing

The following doses have been suggested by the drugs.com: 2 to 5 g of fresh raw garlic; 0.4 to 1.2 g of dried garlic powder; 2 to 5 mg garlic oil; 300 to

1,000 mg of garlic extract (as solid material); 2,400 mg/day of aged garlic extract (liquid). Take with food. Clinical trials have evaluated 180 mg of allicin daily for prevention of the common cold, and at least 5.5 g of raw garlic for the prevention of prostate cancer. Doses of garlic powder used in antihypertensive trials have ranged from 300 to 2,400 mg/day for up to 24 weeks

ONION

Scientific Name(s): *Allium cepa*
Common Name(s): Onion

Uses of Onion

Onion is used as an antimicrobial, cardiovascular-supportive, hypoglycemic, antioxidant/anticancer and asthma-protective agent. However, few clinical trials are available to support the use of onion for any indication. In folk medicine, onion has been used for asthma, bronchitis, whooping cough, and similar ailments. Other uses include the treatment of stingray wounds, warts, acne, appetite loss, urinary tract disorders, and indigestion. Onion skin dye has been used as an egg and cloth coloring.

Botany

The onion plant is a perennial herb growing to about 1.2 m, with 4 to 6 hollow, cylindrical leaves. On top of the long stalk, greenish-white flowers are present in the form of solitary umbels growing up to 2.5 cm wide. The seeds of the plant are black and angular. The underground bulb, which is used medicinally, is comprised of fleshy leaf sheaths forming a thin-skinned capsule. The onion is one of the leading vegetable crops in the world.

History

The onion is believed to have been domesticated in central Asia. Onions were used as early as 5,000 years ago in Egypt, as depicted on ancient monuments; ancient Greek and Roman records also refer to the onion. During the Middle Ages, onions were consumed throughout Europe. They later were thought to guard against evil spirits and the plague, probably because of their strong odor. Onion skin dye has been used for egg and cloth coloring for many years in the Middle East and Europe. Columbus was said to have brought the onion to America. Folk healers used the onion to prevent infection. The combination of onions and garlic cooked in milk is a European folk remedy used to clear congestion. Onions also are used in homeopathic medicine.

Chemistry

Onions contain 89% water, 1.5% protein, and vitamins, including B_1, B_2, and C, along with potassium. Polysaccharides such as fructosans, saccharose, and others are also present, as are peptides, flavonoids, and essential oil. Onion contains alliin and similar sulfur compounds, including allylalliin and methyl and propyl compounds of cysteine sulfoxide. Sulfur and other compounds of *A. cepa* have been analyzed. Prostaglandins also have been identified in onion.

Antimicrobial effects

Onion has reported antibacterial, antiparasitic, and antifungal actions. Growth of oral pathogenic bacteria, including *Streptococcus mutans*, *Porphyromonas gingivalis*, and *Prevotella intermedia*, organisms associated with dental caries and periodontitis, was prevented by onion extracts. Onion juice or oil also have inhibited growth of other gram-positive bacteria and gram-negative bacteria such as *Klebsiella pneumoniae*. Antifungal actions of onion include inhibition of yeasts and a number of molds. The antibacterial, antiparasitic, and antifungal actions of onion is believed to be due to a number of sulfur containing compounds such as alliin, allylalliin, diallyl disulfide and the methyl and propyl compounds of cysteine sulfoxide.

Onions are also noted for their ability to make you cry. This effect is due to one of these propyl sulfoxides which is converted to propanethial-S-oxide which then escapes from the onion in vapor form and hydrolyzes to sulfuric acid when it reacts with moisture, causing the familiar eye irritation and lacrimation.

The health promoting reputation of onions is legendary and may be due to other compounds found in the bulb. For instance, prostaglandins, which have profound physiological effects in animals, also have been reported to exist in onion [3.

Dosing

Onion-based quercetin 100 to 500 mg per day has been used in limited clinical studies. Average daily doses of 50 g of fresh onion, or 20 g of dried onion have been suggested. Topical onion extract gels have been used in studies evaluating effects on scarring and are generally applied 3 times daily.

NUTMEG

Scientific Name(s): *Myristica fragrans*
Common Name(s): Nutmeg, mace, magic, muscdier, nux moschata, myristica oil, muskatbaum

Uses of Nutmeg

Nutmeg and mace, widely accepted as flavoring agents, are used in higher doses for their aphrodisiac and psychoactive properties.

Botany

Mace and nutmeg are 2 slightly different flavored spices, both originating from the fruit of the nutmeg tree, *Myristica fragrans*. This slow-growing evergreen grows to more than 20 m and is cultivated in India, Ceylon, Malaysia, and Granada. The fruit, which is called a drupe or a nutmeg apple, is similar in appearance to a peach or an apricot. When the mature fruit splits open, the nutmeg (stony endocarp or seed surrounded by a red, slightly fleshy network or aril) is exposed. The dried aril alone is called mace. The nut is removed and dried to produce nutmeg.

History

Nutmeg is a widely used food spice that has received attention as an alternative hallucinogen. Nutmeg and mace have been used in Indian cooking and folk medicine. The folk uses of nutmeg have included the treatment of gastric disorders and rheumatism, and it has been used as a hypnotic and an aphrodisiac. During the 6th century AD, nutmeg and mace were imported by Arab traders. By the 12th century, these spices were well known in Europe. At the turn of the 19th century, interest developed in the use of nutmeg as an abortifacient and a stimulant for menses. These properties have been largely discounted but remain a persistent cause of nutmeg intoxication in women.

Chemistry

Nutmeg seeds contain 20% to 40% of a fixed oil, commonly called nutmeg butter. This oil contains myristic acid, trymiristin, and glycerides of lauric, tridecanoic, stearic, and palmitic acids.

Nutmeg also yields 8% to 15% of an essential oil that is believed to be partially responsible for the effects associated with nutmeg intoxication. The essential oil contains myristicin, elemicin, eugenol, and safrole. The essential oils of nutmeg and mace are very similar in chemical composition and aroma, with wide color differences (brilliant orange to pale yellow). Mace oil appears to have a higher myristicin content than nutmeg oil.

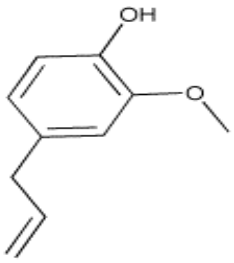
Also present in the oil are sabinene, cymene alpha-thujene, gamma-terpinene, and monoterpene alcohols in smaller amounts. Phenolic compounds found in nutmeg are reported to have antioxidant properties. Other isolated compounds include the resorcinols malabaricone B and malabaricone C, as well as lignans and neolignans.

Antimicrobial effects

The oils of mace and nutmeg and their individual components have been assessed for their antimicrobial activity in vitro. Activity has been shown against some oral microorganisms, including *S. mutans*, *Porphyromonas gingivalis*, and others. Activity against other bacteria includes some strains of *Escherichia coli*, some strains of *Salmonella typhi*, *Bacillus subtilis*, *Staphylococcus aureus*, and *Listeria monocytogenes*. Anti-viral effect has also been reported against human rotavirus.

Reports of activity against fungi is conflicting, with no activity against *Aspergillus* but activity against some dermatophytes has been found.

The spices cloves, nutmeg, cinnamon, bay leaves contain eugenol, a clear to pale yellow oily liquid with a pleasant, spicy, clove-like odor, that can be extracted from the essential oils from these plants.



C10 H12 O2

Fig-1: Eugenol

Eugenol is used in perfumeries, flavorings, essential oils and in medicine as a local antiseptic and anaesthetic. Combining zinc oxide and eugenol forms zinc oxide eugenol which can be used as a filling or cement material used in dentistry. It is classified as an intermediate restorative material and has anaesthetic and antibacterial properties. It is sometimes used in the management of dental caries as a "temporary filling".

CINNAMON

Scientific Name(s): *Cinnamomum verum, C. cassia, C. zeylanicum, C. loureirii*.

Common Name(s): Cinnamon, cinnamomon, ceylon cinnamon, Chinese cinnamon, Chinese cassia, Saigon cinnamon

http://unitproj1.library.ucla.edu/biomed/spice/images/historical_CINNAMON.jpg

USES OF CINNAMON

Cinnamon is used as a spice and an aromatic. The bark or oil has been used to combat microorganisms, diarrhea and other GI disorders, and dysmenorrhea. Research interest has focused on cinnamon's potential as an insulin-like analog, an anti-inflammatory agent, an antioxidant, and an antimicrobial substance.

Botany

Cinnamon spice is derived from the brown bark of the tree by grinding the bark into a fine powder. The plant is native to Sri Lanka, southeastern India, Indonesia, South America, and the West Indies.

Chemistry

The essential oil is primarily composed of 65% to 80% cinnamaldehyde and lesser amounts of other phenols and terpenes, including eugenol, trans-cinnamic acid, hydroxycinnamaldehyde, o-methoxycinnamaldehyde, cinnamyl alcohol and its acetate, limonene, α-terpineol, tannins, mucilage, oligomeric procyanidins, and trace amounts of coumarin. Differing material origins and extraction techniques are reported to alter the chemical composition of the extracts, and hence may impact the intended medicinal (and experimental) effects.

Antimicrobial Activity

Conflicting evidence exists for the action of cinnamon on *Helicobacter pylori*. Cinnamon extracts have been shown to exert in vitro activity against some common human pathogens and fungicidal activity against plant pathogens. In vitro inhibition of bacterial endotoxin has been demonstrated by an unidentified component in cinnamon bark. The essential oils of cinnamon were shown to halt mycelial growth and aflatoxin synthesis in *Aspergillus parasiticus* at a concentration of only 0.1%.

Dosing

Ground cinnamon is generally given at dosages of 1 to 3 g/day (range, 120 mg/day to 6 g/day) in studies of diabetes without reported adverse reactions.

CLOVE

Scientific Name(s): *Eugenia caryophyllata*

Common Name(s): Clove, caryophyllus

Uses of Clove

Clove has been used for its antiseptic and analgesic effects and has been studied for use as an anticoagulant and anti-inflammatory effects. However, research reveals little or no clinical data on the use of clove for any indication.

Botany

The clove plant grows in warm climates and is cultivated commercially in Tanzania, Sumatra, the Maluku (Molucca) Islands, and South America. The tall evergreen plant grows up to 20 m and has leathery leaves. The clove spice is the dried flower bud. Essential oils are obtained from the buds, stems, and leaves. The buds or cloves are strongly aromatic

History

Clove has a long history of culinary and medicinal use. The oil was used as an expectorant and antiemetic with inconsistent clinical results. Clove tea was used to relieve nausea. Use of the oil in dentistry as an analgesic and local antiseptic continues today. It also has been used topically as a counterirritant.

Chemistry

Clove buds yield approximately 15% to 20% of a volatile oil that is responsible for the characteristic smell and flavor. The bud also contains a tannin complex, a gum and resin, and a number of glucosides of sterols. The principal constituent of distilled clove bud oil (60% to 90%) is eugenol (4-allyl-2-methoxyphenol). The oil also contains about 10% acetyleugenol and small quantities of gallic acid, sesquiterpenes, furfural, vanillin, and methyl-n-amyl ketone. Other constituents include flavonoids, carbohydrates, lipids, oleanolic acid, rhamnetin, and vitamins.

Clove oil is applied for the symptomatic treatment of toothaches and is used for the treatment of dry socket (postextraction alveolitis).

Clove oil is reported to have antihistaminic and antispasmotic properties, most likely due to the presence of eugenyl acetate. Cloves are also said to have a positive effect on healing stomach ulcers. A 15% tincture of cloves is effective in treating topical fungal, ringworm infections. As with many other volatile oils, clove oil inhibits gram-positive and gram-negative bacteria. Clove oil also has anthelminthic properties.

Dosing: There are limited studies to support therapeutic dosing for clove oil.

NONI

http://www.nannisnoni.com/High%20Res%20Noni.jpg

Scientific Name(s): *Morinda citrifolia*

Common Name(s): Morinda, noni, hog apple, Indian mulberry, mengkoedoe, mora de la India, pain killer, ruibarbo caribe, wild pine

Uses of Noni

Morinda has been used for heart remedies, arthritis, headache, digestive and liver ailments.

Botany

The morinda plant, native to Asia, Australia and Polynesia, is a 3 to 8 m high tree or shrub. Its evergreen leaves are oblong and 10 to 45 cm in length. The plant's white flowers are tubular, with conelike heads. The fruit is yellow-white in color, oval in shape, about the size of a potato and has a bumpy surface. The ripened fruit has a characteristic cheese-like, offensive odor. Each fruit contains 4 seeds, 3 mm in length.

History

It is believed that Polynesian healers have used morinda fruits for thousands of years to help treat a variety of health problems such as diabetes, high blood pressure, arthritis and aging. Ancient healing manuscripts cite the fruit as a primary ingredient in natural healing formulations. Today, fruit preparations are sold as juice, in dried fruit-leather form and as a dry extract in capsules.

Chemistry

Morinda citrifolia fruits contain essential oils with hexoic and octoic acids, paraffin and esters of ethyl and methyl alcohols. Ripe fruit contains n-caproic acid, presumably responsible for its distinctive odor, known to attract insects such as *Drosophilia sechellia*. Fresh plants contain anthraquinones, morindone and alizarin. A new anthraquinone glycoside from morinda heartwood has recently been described. Hawaiian researcher Ralph Heinicke discovered a small plant alkaloid he termed xeronine. Damnacanthal, morindone and alizarin are present in cell suspension cultures.

Noni Uses

Morinda citrifolia has been used medicinally for heart remedies, arthritis (by wrapping the leaves around affected joints), headache (local application of leaves on forehead), GI and liver ailments.

Alcoholic extracts of *M. citrifolia* leaves displayed good anthelmintic activity in vitro against the human parasite *Ascaris lumbricoides*. Lyophilized aqueous root extracts of the plant showed central analgesic activity, among other effects, suggesting sedative properties of the plant as well.

Dosing

30 to 750 mL/day; dosing of 500 mg extract is nontoxic.

CONCLUSION

There are several plants which possesses antimicrobial activity and could therefore be employ and used as natural antimicrobial drugs. There is therefore the need to research, discover and formulate them as natural antimicrobial drugs.

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Conflict of Interest: None.

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