



REVIEW PAPER

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Medicinal & Aromatic Plants

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Abstract

Introduction. The objective of this study is to discuss the potential of plants species in *medical applications*.

Aim. The main purpose of this study is to discuss ethnobotanically selected plants used in medicine.

Materials and methods. We analysed literature and collected information, data, and examples of selected plants used in medicine.

Results. The literature shows that for several decades, the properties of medicinal plants have been investigated and reported in the biomedical and pharmaceutical literature.

Conclusions. This review includes studies on plants material. The properties of various plants physiology were discussed with the option for the use in phytotherapy.

Keywords. phytotherapy, medicinal plants, otorhinolaryngology

Introduction to plants and their properties

The use of Herbal medicines may influence many therapies by inducing interacting with other medications.¹ Despite concerns over its safety or efficacy, and cost-effectiveness, the use of Herbal medicines is common among patients undergoing otolaryngologic and head and neck surgery.¹ *Echinacea* and osteopathic manipulative treatment have been proposed as preventive measures.² In otitis-prone young children, treating colds with this form of *echinacea* does not decrease the risk of acute otitis media, and may in fact

increase risk. A regimen of up to five osteopathic manipulative treatments does not significantly decrease the risk of acute otitis media.² The aim of Schapowal *et al.* study was to assess the relative efficacy of a sage/*echinacea* spray and a chlorhexidine/lidocaine spray in the treatment of acute sore throats.³ An *echinacea* preparation is as efficacious and well tolerated as a chlorhexidine/lidocaine spray in the treatment of acute sore throats.³

Little data is available on complementary and alternative medicine use in children attending otolar-

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ngology services.⁴ Despite concerns regarding the efficacy, safety and cost effectiveness of complementary and alternative medicine, its use among the pediatric otolaryngology population is more common than many providers may realize.¹ To evaluate the effectiveness and safety of a preparation containing *echinacea*, propolis, and vitamin C in the prevention of respiratory tract infections in children during a 12-week winter period.⁴ The total number of illness days and duration of individual episodes were also significantly lower in the Chizukit group. Adverse drug reactions were rare, mild, and transient. A preventive effect of a product containing *echinacea*, propolis, and vitamin C on the incidence of respiratory tract infections was observed.⁴

Pigments of plants

One of the most common pigments is called chlorophyll, and it is responsible for the green color of plants which means that most other colors are absorbed. When thinking of plants, there is a spectrum of colors. Although plants do tend to be green in color due to the chlorophyll, plants have pink, red, white, yellow, or even highly patterned leaves and flowers. Leaves change color in autumn because chlorophyll is the first pigment to degenerate when trees overwinter.

Non-green plants do not need sunlight to create chlorophyll and can display an array of different rainbow colors. Sunlight is made up of all wavelengths such as ultraviolet (UV-A, UV-B, UV-C) and infrared.⁵ Each non-green plant can selectively absorb certain wavelengths for photosynthesis and reflect others that are deemed less useful. For example, chlorophyll absorbs mainly reds and blues, while reflecting green. Non-green plants have many other pigments that absorb green wavelengths and reflect red or yellow. In art but not in nature all colors are considered to be “trans-seasonal.” That is, they can span the season and are no longer limited to specific times of year. However, we live in a multi-hued world where nature provides the colors. The seasons such as spring bring nautical shades and pastels, while winter is about jewel tones and more cold textures. A living kaleidoscope of seasonal color begins from pistachio green; porcelain blue through mandarin orange, copper brown, and buckskin ending with ultra violet and black coffee.

For each garden, it is worthwhile to consider a few rules for combining individual colors in the plant composition. Plants in gray shades usually are inconspicuous but they are the perfect backdrop for other plants. In plants, gray or silvery-gray color is most common on leaves.

Throughout the past and current century, the techniques of natural dyeing in many ancient cultures have been discovered. Textile fragments were dyed using flowers leaves and roots. Native plants that continue to be

used for black color dyes in textile are: *Northern Catalpa*, *Sumac*, *May Apple* and *Sand Evening Primrose*. Black plants are in fact very dark shades of red, blue, purple and brown. Some examples of black plants by botanical name and common name are *Zantedeschia* (known as *Calla Lily*) and *Tacca Chantrieri* called *Cats Whiskers*. These plants start out with a green bloom and as it ages, the bloom turns purple, black, maroon, brown, or bronze.

Hairy Coneflower, *Red Mulberry*, *Mountain alder*, *Summer Grape* and *Black Locust* can be used to create blue and purple dyes. Blue plant colors range from cool to deep royal blues. *Adenophora* is a genus of flowering plants in the family *Campanulaceae*, the *Bellflowers*. Plants of this genus are native to eastern Asia, with a few species occurring in Europe. Many are endemic to either China or Siberia. The blue color has a calming effect and gives the impression of cool freshness. A list of blue plants by botanical name and common name is presented in Table 1.

Table 1. Botanical and common names of representative blue plants

| Common name | Botanical name |
|----------------------|-----------------------|
| <i>Aechmea</i> | <i>Blue rain</i> |
| <i>Agapanthus</i> | <i>African lily</i> |
| <i>Cineraria</i> | <i>Airplant</i> |
| <i>Hyacinthus</i> | <i>Hyacinth</i> |
| <i>Muscari</i> | <i>Grape hyacinth</i> |
| <i>Primula veris</i> | <i>Primrose</i> |

To produce brown dye the following plants were often used: *Rickly poppy*, *Texas Paintbrush*, *Elderberry* and *Downy Phlox*. Brown seems like an obvious color for plants, especially trees. Each year in the fall you can see all the beauty in brown plants, with shades of auburn, mahogany and chestnut (Table 2).

Table 2. Botanical and common names of representative brown plants

| Botanical name | Common name |
|---------------------|-------------------------|
| <i>Anigozanthos</i> | <i>Kangaroo</i> |
| <i>Anthurium</i> | <i>Flamingo flower</i> |
| <i>Cordyline</i> | <i>Mountain cabbage</i> |
| <i>Cymbidium</i> | <i>Cymbidium orchid</i> |
| <i>Gerbera</i> | <i>Barberton daisy</i> |

Native plants that produce green dye are *Butterfly Milkweed*, *Texas Paintbrush*, *Basket flower*, *Sagebrush*, *Stinging Nettle* and *Goldenrod*. Probably the most common color of plants in the world due to chlorophyll which imparts a green coloring. *Aloe*, which is used in countless beauty and medicinal products around the world, is the one of the most well-known green plants.

Table 3. Botanical and common names of representative green plants

| Botanical name | Common name |
|---------------------------------|--------------------------------------|
| <i>Adiantum</i> | Maidenhair |
| <i>Alocasia</i> | Elephant's ear plant |
| <i>Aloe</i> | Barbados aloe |
| <i>Anigozanthos</i> | Kangaroo paw |
| <i>Anthurium</i> | Flamingo flower |
| <i>Asparagus</i> | Ming fern |
| <i>Asplenium</i> | Birds nest fern |
| <i>Beaucarnia</i> | (<i>Nolina</i>) Elephant's foot |
| <i>Blechnum gibbum</i> | Tree fern |
| <i>Calathea makoyana</i> | Cathedral windows |
| <i>Calathea zebrine</i> | Zebra plant |
| <i>Capsicum</i> | Ornamental pepper |
| <i>Ceropegia woodii</i> | Rosary vine |
| <i>Chamaedorea</i> | Parlour palm |
| <i>Chlorophytum</i> | Spider plant |
| <i>Codiaeum</i> | Joseph's coat croton |
| <i>Cordyline</i> | Mountain cabbage |
| <i>Crassula</i> | Money tree |
| <i>cryptanthus</i> | Earth star |
| <i>Ctenanthe</i> | Never-never plant |
| <i>Cymbidium</i> | Cymbidium orchid |
| <i>Cyperus</i> | Papyrus |
| <i>Dieffenbachia</i> | Dumbcane |
| <i>Dionaea</i> | Venus fly trap |
| <i>Dracaena fragrans</i> | Corn lily |
| <i>Euphorbia trigona</i> | Tree euphorbia |
| <i>Ficus benjamina</i> | Weeping fig |
| <i>Ficus elastic</i> | Rubber plant |
| <i>Ficus lyrata</i> | Fiddle-leaf fig |
| <i>Ficus pumila</i> | Creeping fig |
| <i>Fittonia</i> | Snakeskin plant |
| <i>Heptapleurum (chefflera)</i> | (<i>Chefflera</i>), Umbrella plant |
| <i>Hedera</i> | Ivy |
| <i>Hypoestes</i> | Polkadot plant |
| <i>Monstera</i> | Swiss cheese plant |
| <i>Musa</i> | Banana |
| <i>Nephrolepis</i> | Boston fern |
| <i>Nolina recurvata</i> | Elephant's foot |
| <i>Opuntia</i> | Bunny's ear cactus |
| <i>Peperomia</i> | Green-ripple plant |
| <i>Philodendron scandens</i> | Sweetheart vine |
| <i>Philodendron selloum</i> | Lacy philodendron |
| <i>Phoenix</i> | Date palm |
| <i>Platycerium</i> | Staghorn fern |
| <i>Rhipsalis cassutha</i> | Mistletoe cactus |
| <i>Sarracenia</i> | Pitcher plant |
| <i>Schefflera</i> | Umbrella plant |
| <i>Sedum</i> | Stonecrop |
| <i>Syngonium</i> | Goosefoot plant |
| <i>Tolmiea</i> | Piggyback plant |
| <i>Tradescantia</i> | Wandering jew |

Table 4. Botanical and common names of representative orange plants

| Botanical name | Common name |
|--------------------------------|--------------------|
| <i>Anthurium</i> | Painter's palette |
| <i>Begonia</i> | Painted leaf |
| <i>Capsicum</i> | Ornamental pepper |
| <i>Clivia</i> | Kaffir Lily |
| <i>Cybidium</i> | Cymbidium orchid |
| <i>Euphorbia pulcherrima,</i> | Poinsettia |
| <i>Gerbera</i> | Barberton daisy |
| <i>Gloriosa</i> | Flame lily |
| <i>Guzmania</i> | Scarlet star |
| <i>Hibiscus</i> | China rose |
| <i>Hippeastrum</i> | Amaryllis |
| <i>Impatiens</i> | Busy Lizzie |
| <i>Ixora</i> | Flame of the woods |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Lilium</i> | Lily |
| <i>Oncidium</i> | Dancing orchid |
| <i>Primula veris</i> | Primrose |
| <i>Ranunculus</i> | Turban buttercup |
| <i>Solanum capsicastrum</i> | Winter cherry |
| <i>Vriesea splendens</i> | Flaming sword |
| <i>Zantedeschia</i> | Calla lily, arum |

Plants that grow vegetables also fall into this category such as *Asparagus* or *Onion*. Shades of green in plants are as varied as any other color and you can have tones ranging from deep jade to light mint (Table 3).

It has to be said that orange plants get some of the coolest common names out of all plant colors. Trees and plants that grow orange colored fruits and vegetables, like ornamental peppers or *Pyracantha* are a popular choice for gardeners who wish to inject a bit of sunshine into their allotments. Native plants for orange dye extraction include: *Western Comandra*, *Prairie Blue-ets*, *Bloodroot*, *Sassafras* and *Eastern Cottonwood*. Below a list of orange plants by botanical name and common name (Table 4).

One of the most delightful plant colors is pink. A presentation of white with pink color gives the impression of freshness. Brighter shades of purple also compatible in the company of white color. Those gardeners fond of contrasts can try to connect pink with gold or orange (Table 5).

Purple plants can fit into a garden with any color scheme to add a dramatic touch to any garden landscape. They come in many shades and tones, from pale lilac to a vibrant velvety rich violet. Here below a list of purple plants by botanical name and common name (Table 6).

Using *Ozark chinkapin*, *Sumac*, *Chokecherry*, *Prairie parsley*, *Slippery elm* and *Black Willow*, red dyes were obtained for textile dyeing. Red plants can vary from pale, almost pink varieties to intense rich red shades and there are a number of species that you can grow in your

Table 5. Botanical and common names of representative pink plants

| Botanical name | Common name |
|--------------------------------|------------------------------|
| <i>Aechmea</i> , | Urn plant (bromeliad family) |
| <i>Anigozanthos</i> | Kangaroo paw |
| <i>Anthurium</i> , | Flamingo flower |
| <i>Begonia</i> | Painted leaf |
| <i>Cineraria</i> | Dusty miller |
| <i>Cyclamen</i> | Sowbread |
| <i>Cymbidium</i> | Cymbidium orchid |
| <i>Euphorbia pulcherrima</i> | Poinsettia |
| <i>Fittonia</i> | Snakeskin plant |
| <i>Fuchsia</i> | Lady's eardrops |
| <i>Gerbera</i> | Barberson daisy |
| <i>Hibiscus</i> | China rose |
| <i>Hippeastrum</i> | Amaryllis |
| <i>Hyacinthus</i> | Hyacinth |
| <i>Hypoestes</i> | Polkadot plant |
| <i>Impatiens</i> | Busy Lizzie |
| <i>Jasminum</i> | Jasmine |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Lilium</i> | Lily |
| <i>Medinilla magnifica</i> | Rose grape |
| <i>Pelargonium</i> | Geranium |
| <i>Phalaenopsis</i> | Moth orchid |
| <i>Primula veris</i> | Primrose |
| <i>Primula</i> | Polyanthus |
| <i>Rhododendron simsii</i> | Azalea |
| <i>Saintpaulia</i> | African violet |
| <i>Sedum</i> | Stonecrop |
| <i>Schlumbergera</i> | Christmas cactus |
| <i>Streptocarpus</i> | Cape primrose |
| <i>Tradescantia</i> | Wandering jew |
| <i>Zantedeschia</i> | Calla lily, arum |

Table 6. Botanical and common names of representative purple plants

| Botanical name | Common name |
|--------------------------------|-------------------|
| <i>Achimenes</i> | Hot water plant |
| <i>Campanula</i> | Bell flower |
| <i>Cineraria</i> | Dusty miller |
| <i>Cymbidium</i> | Cymbidium orchid, |
| <i>Dendrobium</i> | Dendrobium orchid |
| <i>Dianthus</i> | Pink |
| <i>Exacum</i> | Persian violet |
| <i>Gerbera</i> | Barberson daisy |
| <i>Hyacinthus</i> | Hyacinth |
| <i>Impatiens</i> | Busy Lizzie |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Pelargonium</i> | Geranium |
| <i>Primula veris</i> | Primrose |
| <i>Primula</i> | Polyanthus |
| <i>Rhipsalidopsis</i> | Easter cactus |
| <i>Saintpaulia</i> | African violet |
| <i>Schlumbergera</i> | Christmas cactus |
| <i>Sinningia</i> | Gloxinia |
| <i>Streptocarpus</i> | Cape primrose |
| <i>Zantedeschia</i> | Calla lily, arum |

Table 7. Botanical and common names of representative red plants

| Botanical name | Common name |
|--------------------------------|-----------------------|
| <i>Anigozanthos</i> | Kangaroo paw |
| <i>Anthurium</i> | Flamingo flower |
| <i>Begonia</i> | Painted leaf |
| <i>Apsicum</i> | Ornamental pepper |
| <i>Codiaeum</i> , | Joseph's coat, croton |
| <i>Cryptanthus</i> | Earth star |
| <i>Cyclamen</i> | Sowbread |
| <i>Cymbidium</i> | Cymbidium orchid |
| <i>Dionaea</i> | Venus fly trap |
| <i>Euphorbia milii</i> , | Crown of thorns |
| <i>Fittonia</i> | Snakeskin plant |
| <i>Gerbera</i> | Transvaal daisy |
| <i>Gloriosa</i> | Flame lily |
| <i>Guzmania lingulata</i> | Scarlet star |
| <i>Hibiscus</i> | China rose |
| <i>Hippeastrum</i> | Amaryllis |
| <i>Hypoestes</i> | Polkadot plant |
| <i>Impatiens</i> , busy Lizzie | Busy Lizzie |
| <i>Ixora</i> | Flame of the woods |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Lilium</i> | Lily |
| <i>Neoregelia</i> | Crimson cup |
| <i>Primula veris</i> | Primrose |
| <i>Ranunculus</i> | Buttercup |
| <i>Rhipsalidopsis</i> | Easter cactus |
| <i>Rhododendron simsii</i> | Azalea |
| <i>Sarracenia</i> | Pitcher plant |
| <i>Schlumbergera</i> | Christmas cactus |
| <i>Solanum capsicastrum</i> | Winter cherry |
| <i>Vriesea splendens</i> | Flaming sword |

garden or keep as houseplants. Below we have a list of the flowers you can find blooming in red (Table 7).

White is a popular color, however, a native white dye is unknown. Only *White Iris*, *Butternut* and *Can-aigre Dock* are able to produce light grey to silver color dye. White is a winter color and white plants can look amazing when distributed through a lush green garden. We have compiled a list of the white flowers (Table 8).

Bright bold and yellow plants inject a good dose of sunshine into garden. Yellow gives a feeling of warmth and sunshine. The sky maybe reflected in a combination of yellow with blue.

It is also interesting to combine yellow blossoming flowers with plants with gray leaves. *Yarrow*, *Honey Locust*, *Golden wild-indigo*, *Tall cinquefoil*, *Pecan*, *Indian-grass* produced yellow color. Botanical and common names of representative yellow plants are presented in Table 9.

A variety of colors can be obtained from different parts of the one plant. Roots, nuts and flowers are common natural ways to get many colors from the entire spectrum.

Table 8. Botanical and common names of representative white plants

| Botanical name | Common name |
|--------------------------------|------------------------|
| <i>Agapanthus</i> | African lily |
| <i>Anthurium</i> | Painter's palette |
| <i>Begonia</i> | Painted leaf |
| <i>Campanula</i> | Bell, flower |
| <i>Chrysanthemum</i> | Frutescens marguerite |
| <i>Cyclamen</i> | Sowbread |
| <i>Cymbidium</i> | Cymbidium |
| <i>Dendrobium</i> | Dendrobium orchid |
| <i>Euphorbia milii</i> | Crown of thorns, |
| <i>Euphorbia</i> | Pulcherrima poinsettia |
| <i>Exacum</i> | Persian violet |
| <i>Gardenia</i> | Cape jasmine |
| <i>Gerbera</i> | Barberton daisy |
| <i>Guzmania</i> | Scarlet star |
| <i>Hippeastrum</i> | Amaryllis, |
| <i>Hyacinthus</i> | Hyacinth |
| <i>Hypoestes</i> | Polkadot plant |
| <i>Impatiens</i> | Busy Lizzie |
| <i>Jasminum</i> | Jasmine |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Lilium</i> | Lily |
| <i>Muscari</i> | Grape hyacinth |
| <i>Narcissus tazetta</i> | Paperwhite |
| <i>Phalaenopsis</i> | Moth orchid |
| <i>Primula veris</i> | Primrose |
| <i>Primula</i> | Polyanthus |
| <i>Ranunculus turban</i> | Buttercup uttercup |
| <i>Rhododendron</i> | Simsii azalea |
| <i>Saintpaulia</i> | African violet |
| <i>Schlumbergera</i> | Christmas cactus |
| <i>Spathiphyllum</i> | Peace lily |
| <i>Stephanotis</i> | Madagascar jasmine |
| <i>Zantedeschia</i> | Calla lily |

Table 9. Botanical and common names of representative yellow plants

| Botanical name | Common name |
|--------------------------------|------------------------|
| <i>Anigozanthos</i> | Kangaroo paw |
| <i>Anthurium</i> | Flamingo flower |
| <i>Begonia</i> | Painted leaf, |
| <i>Capsicum</i> | Ornamental pepper |
| <i>Codiaeum</i> | Joseph's coat, croton, |
| <i>Cymbidium</i> | Cymbidium orchid |
| <i>Euphorbia milii</i> | Crown of thorns |
| <i>Euphorbia pulcherrima</i> | Poinsettia |
| <i>Gerbera</i> | Barberton daisy |
| <i>hibiscus</i> | China rose |
| <i>Ixora</i> | Flame of the woods |
| <i>Kalanchoë blossfeldiana</i> | Flaming Katy |
| <i>Lilium</i> | Lily |
| <i>Narcissus,</i> | Paperwhite, |
| <i>Oncidium,</i> | Dancing orchid |
| <i>Phalaenopsis</i> | Moth orchid |
| <i>Primula veris</i> | Primrose, |
| <i>Vriesea splendens</i> | Flaming sword |
| <i>Zantedeschia</i> | Calla lily, arum |

Examples of applied phytotherapy

Ryeong and coworkers analyze the effects of *Eucalyptus* aroma therapy on relieving allergic rhinitis symptoms among university students and found that *Eucalyptus* aroma therapy is effective and enhancing the quality of life of university students.⁶ The purpose of the next study was to understand the role of pollen allergy in Taiwan. It was shown that pollen allergy is believed to be less common in East Asia, Latin America, and other tropical areas.⁷ In this study all individuals received a 30-item skin test panel that included perennial allergens (house dust mix, Dermatophagoides pteronyssinus, Dermatophagoides farinae, dog epithelium, cat hairs, cockroach mix, and Candida albicans) and pollen allergens (acacia, pine mix, *eucalyptus*, beefwood, juniper mix, willow, mulberry mix, pepper tree, cedar, Johnson grass, Bermuda grass, ragweed mix, Timothy grass, spiny pigweed, cocklebur, sage mix, sheep sorrel, dog fennel, pigweed mix, English plantain, castor bean, alfalfa, and dandelion).⁷ Most patients with allergic rhinitis in Taiwan are sensitive to perennial allergens, and pollens are a less common allergen.⁷ Immunological approach to extra-mural environmental naso-bronchial allergy was also investigated.⁸

Garlic in laryngology

The most important observation is that allicin, the main biologically active compound derived from *Garlic*, could prevent hearing loss induced by other drug such as cisplatin.⁹ There is still growing interest in alternative medicine with the use of *Garlic* to treat common illnesses like the common cold and asthma.¹

Ginkgo biloba in laryngology

Ginkgo biloba extract treatment was used to treat tinnitus. Since there is no objective method to measure the symptom, the search for an effective drug can only be made on an individual basis.¹⁰ This study aims to investigate the efficacy of trimetazidine, betahistine and *ginkgo biloba* extract in the treatment of tinnitus.¹¹ To investigate the clinical efficacy of *Ginkgo biloba* injection combined with traditional therapy in the treatment of explosive deafness.¹² Compared with traditional therapy alone, combined *Ginkgo biloba* extract injection and traditional therapy can significantly improve tinnitus symptom and overall response rate in the treatment of explosive deafness in coal miners, which suggests that the combination therapy is worthy of clinical application.¹³ Oxidative stress is involved in the development and progression of otitis media. In this study, we investigated the effect of *Ginkgo* leaf parenteral solution on blood and cochlea antioxidant and immunity index in rats.¹⁴ The patient's subjective assessment of the treatment with regard to improvement in hearing and reduction in tinnitus suggested that *Ginkgo biloba* ex-

tract was more beneficial than pentoxifylline.¹⁵ *Ginkgo biloba* does not benefit patients with tinnitus.¹⁵ It was noticed the effect of *Ginkgo biloba* on the expression of intermediate-early antigen (c-fos) in the experimentally induced anosmic mouse.¹⁶ Kumar and coworkers studied the role of *ginkgo biloba* extract in acquired sensorineural hearing loss.¹⁷ The effect of blood flow promoting drugs on cochlear blood flow, perilymphatic pO₂ and auditory function in the normal and noise-damaged hypoxic and ischemic guinea pig inner ear.¹⁸ The effect of blood flow promoting drugs, such as hydroxyethyl starch either of low or high molecular weight pentoxifylline, *Ginkgo biloba*, naftidofuryl and betahistine, and various combinations of the drugs was studied in unexposed and noise-exposed.¹⁸ The efficacy systemic injection of *Ginkgo biloba* extract, EGb761, in idiopathic sudden sensorineural hearing loss was also investigated.¹⁹ Steroids are currently the most frequently accepted agents for idiopathic sudden sensorineural hearing loss.¹⁹ The effect of Korean red *Ginseng* on Symptoms and Quality of Life in Chronic Tinnitus shows that the major mechanism of inner ear cell damage is the production of reactive oxygen species (ROS).²⁰ Korean red *Ginseng* has an anti-ROS effect; thus we hypothesized that KRG may be of use for the treatment of chronic idiopathic tinnitus.²⁰ These results suggest that Korean Red *Ginseng* may improve tinnitus symptoms and mental wellbeing in chronic tinnitus patients. Since Korean Red *Ginseng* has been proven to protect against gentamicin-induced vestibular and hearing dysfunction, the effects of KRG on age-related inner ear disorder in C57BL/6 mice were investigated.²¹ Numerous studies of Korean Red *Ginseng* attempts to improve radiation-induced oral mucositis.²² The protective effects of Korean Red *Ginseng* were caused by inhibition of the apoptotic signal transduction pathway linked to caspase-3. In conclusion, Korean Red *Ginseng* protects the oral mucosa and SMG from radiation-induced damage by inhibiting caspase-mediated apoptosis in rats.²² Radiation-induced oral mucositis is a dose-limiting toxic side effect for patients with head and neck cancer.²² *Ginseng* polysaccharide has multiple immunoprotective effects.²² The authors evaluated the protective effects of Korean red *ginseng* against gentamicin induced unilateral vestibular and hearing dysfunction and investigated its effective mechanism using in vitro cell cultures.²¹ Quantitative analysis of hair cell damage in the scanning electron microscopy was closely related with vestibular and hearing functional results. Korean red *ginseng* is reported to have anti-allergic properties, including beneficial effects on asthma and atopic dermatitis. 23. 3-Nitropropionic acid, a mitochondrial toxin, has been reported to induce an acute cochlear damage. Korean red *ginseng* is known to have protective effects from some types of hearing loss.^{21,22} *Ginseng* extract is known to have many

beneficial effects, including ischemia, stress, and aging. Cisplatin, an effective antineoplastic drug, can cause irreversible sensorineural hearing loss and serious tinnitus in humans; thus cisplatin-induced ototoxicity is a useful experimental model for ototoxicity.²⁴

Pelargonium

The antibacterial effect of the drugs with active ingredients of *Pelargonium sidoides* on different bacterial species (72 Streptococci, 48 Staphylococcus, 32 Neisseriae spp, 20 Moraxella catarrhalis, and 20 Haemophilus) isolated from the throat cultures of patients with upper airway infection was observed.²⁵ The roots of *Pelargonium sidoides* were used in the cold showed that all patients (100%) in the active treatment group judged the subjective tolerability of *Pelargonium sidoides* as good or very good.²⁶ *Pelargonium sidoides*, is a herbal remedy thought to be effective in the treatment of acute.^{27,28} Bachert *et al.* evaluate the efficacy and safety of the herbal drug preparation from the roots of *Pelargonium sidoides*. Patients with sinonasal symptoms of at least 7 days duration, and radiographically and clinically confirmed acute rhinosinusitis of presumably bacterial origin with a Sinusitis Severity Score of at least 12 out of 24 points at inclusion.²⁹ Bereznoy *et al.* seek to confirm that treatment with an extract of *Pelargonium sidoides* (EPs 7630) is superior to placebo for treatment of non-GABHS tonsillopharyngitis in children.³⁰

Rosemary

The aim of Sienkiewicz and coworkers was to characterize the ability of essential oils to support antibiotics against pathogenic bacteria in wounds. Gram-positive and Gram-negative bacteria obtained from wound infections were identified according to standard microbiological methods.³¹

Spirulina

Spirulina represents a blue-green alga that is widely produced and commercialized as a dietary supplement for modulating immune functions, as well as ameliorating a variety of diseases.³² To our knowledge, this is the first human feeding study that demonstrates the protective effects of *Spirulina* towards allergic rhinitis.³² Ten different types of herbal supplements were identified, with stinging nettle (*Urtica dioica*), black elderberry (*Sambucus nigra*), and *Spirulina* being the most common (12.6%, 6.1%, and 5.7%, resp.). This study found a high prevalence of herbal treatment usage for the relief of allergic rhinitis symptoms in Turke.³³ Compared to the control group, the tinnitus scores increased significantly, however, the salicylate-induced tinnitus could be reduced significantly by *spirulina* water extract.^{34,35}

The study demonstrates that cancer regression is also accompanied by a significant induction of tumor necrosis factor in macrophages in the tumor area, sug-

gesting a possible mechanism of tumor destruction by algae extract.^{36,37} The various agents were injected into the tumor bearing right buccal pouches twice-weekly for four weeks. Total tumor regression was found in 30% of phycotene animals, 20% of beta carotene animals and 15% of canthaxanthin animals after four weeks. Partial tumor regression was found in the remaining 70% of phycotene animals, 80% of beta carotene animals and 85% of canthaxanthin animals. None of the 13-cis-retinoic acid animals had total tumor regression, but 70% showed partial regression.³⁷

An enhancement of IgA antibody production by *Spirulina* extract was also observed in culture supernatant of lymphoid cells, especially in the spleen and mesenteric lymph node from mice treated with *Spirulina* extract for 4 weeks before antigen stimulation. These results suggest that *Spirulina* may at least neither induce nor enhance allergic reaction such as food allergy dependent on an IgE antibody, and that when ingested both concurrently with antigen and before antigen stimulation, it may significantly enhance the IgA antibody level to protect against allergic reaction.³⁸

St John's wort

The results indicate that *St John's wort* (*Hypericum perforatum*) lowers blood concentrations of cyclosporin, amitriptyline, digoxin, indinavir, warfarin, phenprocoumon and theophylline; furthermore it causes intermenstrual bleeding, delirium or mild serotonin syndrome, respectively, when used concomitantly with oral contraceptives (ethinylestradiol/desogestrel), loperamide or selective serotonin-reuptake inhibitors (sertaline, paroxetine, nefazodone).³⁸ Phytomedicine uses remedies possessing significant pharmacological activity and, consequently, potential adverse effects and drug interactions. Several herbal medicines, such as aloe vera gel, contain pharmacologically active ingredients that may aid in wound healing.³⁹⁻⁴⁰

Thyme

Chronic rhinosinusitis is a common disease which causes persisting inflammatory conditions of one or more sinuses. *Thyme honey* nasal spray seems to be a low-priced potential adjuvant remedy with excellent safety profile, to reduce inflammation and polyp formation and also fostering mucosal healing for patients suffering from chronic rhinosinusitis.⁴¹ Antimicrobial properties of plants essential oils including *Thyme* have been investigated through several observations and clinical studies which purpose them as potential tools to overcome the microbial drug resistance problem.⁴² The use of phytopharmaceuticals based on an investigated essential oil from *thyme* in the prevention and treatment of various human infections may be reasonable.^{43,44} The viable counts of *Salmonella typhimurium* on nutrient agar decreased upon the addition

of either the essential oil of *thyme* or its constituent thymol, especially under anaerobic conditions. Antagonistic effects of thymol against *Staphylococcus aureus* were also greater under anaerobic conditions. In the presence of thymol, the viable counts of *Salm. typhimurium* obtained on a minimal medium were lower than those obtained on NA. Addition of bovine serum albumin neutralized the antibacterial action of thymol. It is suggested that the effects of BSA or Desferal are due to their ability to bind phenolic compounds through their amino and hydroxylamine groups, respectively, thus preventing complexation reactions between the oil phenolic constituents and bacterial membrane proteins.⁴⁵ Among other disorders, these alternative treatments are used in bronchitis and rhinitis, including some topical applications. *Thyme* oil did not affect CBF, whereas the presence of all other essential oils resulted in an increase in CBF; the effect was higher at 0.2% than at 2%.⁴⁶ The antifungal effect of the essential oil from *Satureja montana* L., *Lavandula angustifolia* Mill., *Lavandula hybrida* Reverchon, *Syzygium aromaticum* (L.) Merrill and Perry, *Origanum vulgare* L., *Rosmarinus officinalis* L. and six chemotypes of *Thymus vulgaris* L. on *Candida albicans* growth were studied. The most efficiency was obtained with the essential oil from *Thymus vulgaris* thymol chemotype (MIC 80% = 0.016 microL/mL and Kaff = 296 microL/mL).⁴⁷ Essential oils extracted from ten Algerian plants were analyzed for their potential activity against *Candida albicans*. The highest efficiency was obtained with the essential oil from *Thymus numidicus* which showed antifungal effect 1357 fold stronger than that measured with amphotericin B.⁴⁸ Carvacrol, eugenol and thymol are major components of plants such as oregano, savory, clove and *thyme*. When applied to the tongue, these flavors elicit a warm sensation.⁴⁹ The results show aromatherapy to be a safe and effective treatment for alopecia areata.⁵⁰ *Thymus* oil and its components are becoming increasingly popular as naturally occurring antimicrobial and antioxidant agents. Histologic examination results show that the formation of new tissue in rats receiving thymus oil was more than other burned groups, and this finding supports our hypothesis.⁵¹ The antioxidant activity was evaluated as a free radical scavenging capacity. A significant rate of antifungal activity of all of the examined essential oils was also exhibited.⁵²

Conclusions

This review includes studies on plants material. The properties of various plants physiology were discussed with the option for the use in phytotherapy.

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References

- Shakeel M, Trinidade A, Ah-See KW. Complementary and alternative medicine use by otolaryngology patients: a paradigm for practitioners in all surgical specialties. *Europ Arch Otorhinolaryngol*. 2010;267(6):961-971.
- Wahl RA, Aldous MB, Worden KA, Grant KL. Echinacea purpurea and osteopathic manipulative treatment in children with recurrent otitis media: a randomized controlled trial. *BMC Complement Altern Med*. 2008;8:56.
- Schapowal A, Berger D, Klein P, Suter A. Echinacea/sage or chlorhexidine/lidocaine for treating acute sore throats: a randomized double-blind trial. *Europ J Med Res*. 2009;14(9):406-412.
- Cohen HA, Varsano I, Kahan E, Sarrell EM, Uziel Y. Effectiveness of an herbal preparation containing echinacea, propolis, and vitamin C in preventing respiratory tract infections in children: a randomized, double-blind, placebo-controlled multicenter study. *Arch Pediatr Adolesc Med*. 2004;158(3):217-221.
- MacDavid K, Aebisher, D. A Review of Sunlight Induced Cellular DNA Damage. *Am J Cancer Ther Pharmacol*. 2014;2(1):48-55.
- Ryeong SM, Kyung KE. Effects of Eucalyptus Aroma Therapy on the Allergic Rhinitis of University Students. *J Kor Biol Nurs Sci*. 2014;16(4):300-308.
- Liang KL, Su MC, Shiao JY, Wu SH, Li YH, Jiang RS. Role of pollen allergy in Taiwanese patients with allergic rhinitis. *J Formos Med Assoc*. 2010;109(12):879-885.
- Anand P, Agashe SN. Immunological approach to extramural environmental naso-bronchial allergy. *Indian J Otolaryngol*. 1984;36(2):39-44.
- Wu X, Li X, Song Y, et al. Allicin protects auditory hair cells and spiral ganglion neurons from cisplatin - Induced apoptosis. *Neuropharmacology*. 2017;116:429-440.
- Holgers KM, Axelsson A, Pringle I. Ginkgo biloba extract for the treatment of tinnitus. *Audiology*. 1994;33:85-92.
- Orhan I, Aydın S, Altın G, Yılmaz F. An efficacy comparison of betahistin, trimetazidine and ginkgo biloba extract in patients with tinnitus. *J Ear Nose Throat*. 2013;23(3):143-147.
- Tan J, Peng H. Clinical analysis of Ginkgo biloba injection combined with traditional therapy in treatment of explosive deafness. *Chinese J Ind Hyg Occup Diseases*. 2015;33(4):279-281.
- Zhao J, Su Y, Chen A, Yuan H, Liu L, Wu W. Effect of Ginkgo leaf parenteral solution on blood and cochlea antioxidant and immunity indexes in OM rats. *J Syn Chem Natural Prod Chem*. 2011; 16(12):10433-42.
- Jang CH, Cho YB, Kim JS, Cho SW, Yang HC, Jung KH, Kim JY, Choi CH, Lim Y, Park H, Kang SI. Effect of Ginkgo biloba extract on endotoxin-induced labyrinthitis. *Int J Pediatr Otorhinolaryngol*. 2011;75(7):905-909.
15. Reisser CH, Weidauer H. Ginkgo biloba extract EGb 761 or pentoxifylline for the treatment of sudden deafness: a randomized, reference-controlled, double-blind study. *Acta Oto-Laryngol*. 2001;121(5):579-584.
16. Lee NY, Chung KS, Jin JS, et al. Effect of Chicoric Acid on Mast Cell-Mediated Allergic Inflammation in Vitro and in Vivo. *J Nat Prod*. 2015;78(12):2956-2962.
17. Kumar A, Raizada RM, Chaturvedi VN. Role of ginkgo biloba extract in acquired sensorineural hearing loss. *Indian J Otolaryngol Head Neck Surg*. 2000;52(3):212-219.
18. Lamm K, Arnold W. The effect of blood flow promoting drugs on cochlear blood flow, perilymphatic pO₂ and auditory function in the normal and noise-damaged hypoxic and ischemic guinea pig inner ear. *Hearing Res*. 2000;141(1-2):199-219.
19. Koo JW, Chang MY, Yun SC, et al. The efficacy and safety of systemic injection of Ginkgo biloba extract, EGb761, in idiopathic sudden sensorineural hearing loss: a randomized placebo-controlled clinical trial. *Eur Arch Otorhinolaryngol*. 2016;273(9):2433-2441.
20. Kim TS, Lee HS, Chung JW. The Effect of Korean Red Ginseng on Symptoms and Quality of Life in Chronic Tinnitus: A Randomized, Open-Label Pilot Study. *J Audiol Otolaryngol*. 2015; 19(2):85-90.
21. Tian C, Kim YJ, Lim HJ, Kim YS, Park HY, Choung YH. Red ginseng delays age-related hearing and vestibular dysfunction in C57BL/6 mice. *Experiment Gerontol*. 2014;57:224-232.
22. Chang JW, Choi JW, Lee BH, et al. Protective effects of Korean red ginseng on radiation-induced oral mucositis in a preclinical rat model. *Nutr Cancer* 2014;66(3):400-407.
23. Jung JH, Kang IG, Kim DY, Hwang YJ, Kim ST. The effect of Korean red ginseng on allergic inflammation in a murine model of allergic rhinitis. *J Ginseng Res*. 2013;37(2):167-175.
24. Im GJ, Chang JW, Choi J, Chae SW, Ko EJ, Jung HH. Protective effect of Korean red ginseng extract on cisplatin ototoxicity in HEI-OC1 auditory cells. *Phytother Res*. 2010; 24(4):614-621.
25. Uslu H, Yoruk O, Ayyıldız A, Aktan B. Antibacterial spectrum of umckaloabo (Pelargonium Sidoides) on upper airway infection agents. *Europ J General Med*, 2009; 6(4):245-248.
26. Lizogub VG, Riley DS, Heger M. Efficacy of a pelargonium sidoides preparation in patients with the common cold: a randomized, double blind, placebo-controlled clinical trial. *J Sci Healing*. 2007;3(6):573-584.
27. Timmer A, Günther J, Rucker G, Motschall E, Antes G, Kern WV. Pelargonium sidoides extract for acute respiratory tract infections. *Cochrane Database Syst Rev*. 2008; (3):CD006323.
28. Conrad A, Jung I, Tioua D, et al. Extract of Pelargonium sidoides (EPs 7630) inhibits the interactions of group A-streptococci and host epithelia in vitro. *Int J Phytother Phytopharmacol*. 2007;14(6):52-59.
29. Bachert C, Schapowal A, Funk P, Kieser M. Treatment of acute rhinosinusitis with the preparation from Pelargo-

- nium sidoides EPs 7630: a randomized, double-blind, placebo-controlled trial. *Rhinology*. 2009;47(1):51-58.
30. Bereznoy VV, Riley DS., Wassmer G, Heger M. Efficacy of extract of Pelargonium sidoides in children with acute non-group A beta-hemolytic Streptococcus tonsillopharyngitis: A randomized, double-blind, placebo-controlled trial. *Altern Ther Health Med*. 2003;9(5):68-79.
 31. Sienkiewicz M, Łysakowska M, Denys P, Kowalczyk E. The antimicrobial activity of thyme essential oil against multidrug resistant clinical bacterial strains. *Microbial Drug Resist*. 2012;18(2):137-148.
 32. Mao TK, Van de Water J, Gershwin ME. Effects of a Spirulina-based dietary supplement on cytokine production from allergic rhinitis patients. *J Med Food*. 2005;8(1):27-30.
 33. Sayin I, Cingi C, Oghan F, Baykal B, Ulusoy S. Complementary therapies in allergic rhinitis. *Int Schol Res Network Allergy*. 2013:938751.
 34. Hwang JH, Chan YC. Expressions of ion co-transporter genes in salicylate-induced tinnitus and treatment effects of spirulina. *BioMed Central Neurol*. 2016;16:159.
 35. Hwang JH, Chen JC, Chan YC. Effects of C-phycocyanin and Spirulina on salicylate-induced tinnitus, expression of NMDA receptor and inflammatory genes. *PLoS One*. 2013; 8(3):e58215.
 36. Shklar G, Schwartz J. Tumor necrosis factor in experimental cancer regression with alphatocopherol, beta-carotene, canthaxanthin and algae extract. *Europ J Cancer Clin Oncol*. 1988;24(5):839-850.
 37. Schwartz J, Shklar G. Regression of experimental hamster cancer by beta carotene and algae extracts. *J Oral Maxillofacial Surg*. 1987;45(6):510-515.
 38. Hayashi O, Hirahashi T, Katoh T, Miyajima H, Hirano T, Okuwaki Y. *J Nutritional Sci Vitaminol*. 1998;44(6):841-851.
 39. Izzo AA, Ernst E. Interactions Between Herbal Medicines and Prescribed Drugs. *Drugs*. 2001;61(15):2163-2175.
 40. Pribitkin ED, Boger G. Herbal therapy: what every facial plastic surgeon must know. *Arch Facial Plastic Surg*. 2001;3(2):127-132.
 41. Hashemian F, Baghbanian N, Majd Z, Rouini MR, Jahan-shahi J, Hashemian F. The effect of thyme honey nasal spray on chronic rhinosinusitis: a double-blind randomized controlled clinical trial. *Eur Arch Otorhinolaryngol*. 2015;272(6):1429-1435.
 42. Tohidpour A, Sattari M, Omidbaigi R, Yadegar A, Naze-mi J. Antibacterial effect of essential oils from two medicinal plants against Methicillin-resistant Staphylococcus aureus (MRSA). *Intern J Phytother Phytopharmacol*. 2010;17(2):142-145.
 43. Sienkiewicz M, Łysakowska M, Kowalczyk E, et al. The ability of selected plant essential oils to enhance the action of recommended antibiotics against pathogenic wound bacteria. *J Intern Society Burn Injur*. 2017;43(2):310-317.
 44. Mahboubi M, Bidgoli FG. Antistaphylococcal activity of Zataria multiflora essential oil and its synergy with vancomycin. *Int J Phytother Phytopharmacol*. 2010;17(7):548-550.
 45. Juven BJ, Kanner J, Schved F, Weisslowicz H. Factors that interact with the antibacterial action of thyme essential oil and its active constituents. *J Appl Bacteriol*. 1994;76(6):626-631.
 46. Neher A, Gstöttner M, Thaurer M, Augustijns P, Reinelt M, Schobersberger W. Influence of essential and fatty oils on ciliary beat frequency of human nasal epithelial cells. *Am J Rhinol*. 2008;22(2):130-134.
 47. Giordani R, Regli P, Kaloustian J, Mikail C, Abou L, Portugal H. Antifungal effect of various essential oils against Candida albicans. Potentiation of antifungal action of amphotericin B by essential oil from Thymus vulgaris. *Phytother Res*. 2004;18(12):990-995.
 48. Giordani R, Hadeif Y, Kaloustian J. Compositions and antifungal activities of essential oils of some Algerian aromatic plants. *Fitoterapia*. 2008;79(3):199-203.
 49. Xu H, Delling M, Jun JC, Clapham, DE. Oregano, thyme and clove-derived flavors and skin sensitizers activate specific TRP channels. *Nature Neuroscience*. 2006;9(5):628-635.
 50. Hay IC, Jamieson M, Ormerod AD. Randomized trial of aromatherapy. Successful treatment for alopecia areata. *Arch Dermatol*. 1998;134(11):1349-1352.
 51. Dursun N, Liman N, Ozyazgan I, Güneş I, Saraymen R. Role of thymus oil in burn wound healing. *J Burn Care Rehab*. 2003;24(6):395-399.
 52. Bozin B, Mimica-Dukic N, Simin N, Anackov G. Characterization of the volatile composition of essential oils of some lamiaceae spices and the antimicrobial and antioxidant activities of the entire oils. *J Agric Food Chem*. 2006;54(5):1822-1828.