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Role of Medicinal and Aromatic Plants: Past, Present, and Future

Maiko Inoue, Shinichiro Hayashi and Lyle E. Craker

Abstract

Before the concept of history began, humans undoubtedly acquired life benefits by discovering medicinal and aromatic plants that were food and medicine. As our early ancestors learned to recognize and consume selected plants, civilization and personal and group health could advance. Traditional medicine would become part of every civilization with medicinal and aromatic plants widely used and applied to maintain life. Undoubtedly, the variety of available plant materials would be tasted and tested to determine whether a plant was valuable as a food or medicine. Today, a variety of available herbs and spices are used and enjoyed throughout the world and continue to promote good health. As the benefits from medicinal and aromatic plants are recognized, these plants will have a special role for humans in the future.

Keywords: healing, pharmaceuticals, herbs, spices, remarkable constituents

1. Introduction

From the beginning, human life in prehistoric time was undoubtedly difficult. To survive, our ancestors needed food for energy and medicine to maintain health. While a high-energy food, such as meat, would be available by hunting animals, medicines to treat afflictions were undoubtedly more difficult to find. Although modern science has discovered plants and plant extracts that can treat and cure diseases, locating and identifying plants that contained health-promoting constituents during prehistoric time would be problematic.

The oldest available medicinal records, written in 5000–3000 BCE by Sumerians on clay tablets, demonstrate that humans understood diseases and that the use of medicine-containing plants could help maintain and restore good health. Medicinal plants discovered on the preserved body known as Ötzi, the Iceman that was accidentally killed between 3400 and 3100 BCE in the cold, mountainous Alps, suggests that others were aware of medicinal plants. While the history of our early ancestors and medicines is incomplete, the value of medicinal plants in curing and maintaining health is fully recognized.

Plants, which are subject to destruction by foraging animals and insects, undoubtedly survived by producing repulsive, distasteful chemical constituents that repelled foraging animals. Humans could be selective in the parts of a plant they would eat, observing that consuming some plant tissues, such as fruit, leaves, or roots of some species, made people feel better. From these initial beginnings, gardens of desirable plants would be established for the food and the plant constituents that helped humans remain healthy.

Throughout time, medical care has continually progressed, moving from illnesses to vaccinations and new medicines along with improved health-care facilities that can more accurately diagnose and treat health problems. Advancements in modern medicine and medical care have enabled people to live longer and healthier lives. New medicines from plant materials and antibiotics from microflora have defeated most diseases. By using tissue and blood samples along with X-rays, and other materials, medical laboratories are able to diagnose the affliction, ensuring the physician can recommend the appropriate medicine in an appropriate amount.

Our prehistoric ancestors could only rely on their senses to test plants and plant constituents for taste and medicinal activity. From this beginning, however, medicinal and aromatic plants have brought many benefits, such as food flavoring, medicines, preservatives, decorations, beauty, and personal pleasure.

Accumulated knowledge of medicinal and aromatic plants from ancient history until today has passed from generation to generation, improving health and life. While the importance of medicinal and aromatic plants is not recognized by everyone, loss of species due to climate changes, plant diseases, or other plant attacks could eliminate several plant species along with the benefits to which we are accustomed.

Encouraging a lot of practices, the knowledge went down to later ages. On the other hand, various climates on earth have encouraged the selection of species, eventually many regional specific unique medicinal and aromatic plants exist in the whole world. Medicinal and aromatic plants and ethnobotany were used for an original medicine of each civilizations and cultures. The movement of human causes the spread of knowledge and distribution of materials.

Dramatic events of history were the discoveries of special plants and the chemical health constituents within the plants. Due to the scarcity of the plant materials, people ventured throughout the world to seek new spice plants and the habitat in which these plants grew (**Figure 1**) [1]. By the eighteenth century, spices were recognized as medicine, a preservative, and food flavoring. By the eighteenth century, important substances were discovered and invented important substances for human health (**Table 1**) [2]. Many synthesized medicines were patterned after plant extracts that provide outlines for new modern medicines.

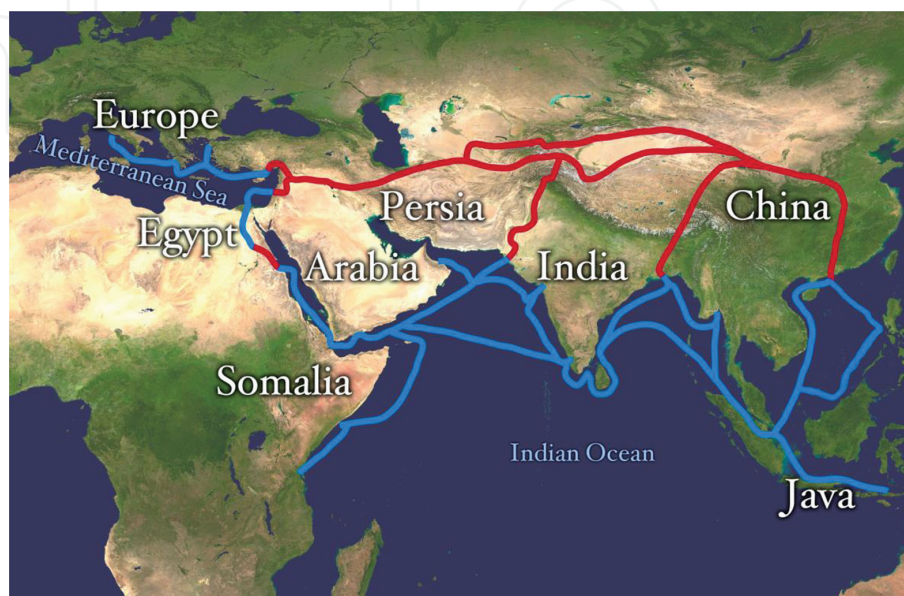


Figure 1.
Mail routes of the silk road [1].

Person	Achievements
C. W. Scheele (1742–1786)	Discovered chlorine, various organic acid, glycerol, tungsten, molybdenum
F. W. A. Sertürner (1783–1841)	Extracted morphine from opium for analgesics
P. J. Pelletier (1788–1842), J. B. Caventou (1795–1877)	Succeeded to extract quinine, specific remedy for malaria, from bark of cinchona
Friedrich Wöhler (1800–1882)	Created urea from an inorganic substance
Ludwig Knorr (1859–1921)	Created the first synthetic drug antipyrine during the try to synthesise quinine

Table 1.
The person who built organic chemistry [2].

Currently, a focus on integrated medicine provides plenty of plants and plant constituent choices for treatment of sickness. Not only in modern medicine, but also the use of plants, aromatherapy, crude drugs, and several other therapies have been adopted in the home and the hospital. Those natural drug and therapy are useful for preventive medicine too. Medicinal and aromatic plants are a good resource to develop new medicine and treat body and mind. The possibility of medicinal and aromatic plants is a hope continually for human live.

2. Past

2.1 Start of uses

Since the primitive ages, our ancestor ate plants and likely found medicines accidentally, and used for the treatments. The history related human and medicine is long, the oldest record was 5000–3000 BC in Alps from Ötzi, the Iceman used plant medicines [3]. Since then, for many centuries, human repeated trial and error and accumulate knowledge. At the same time, human likely thought to preserve the plants for a sudden health problem, such as dried plants, and started cultivations too. For example, Cannabis was cultivated in ancient Egypt [4], and opium poppy was cultivated in lower Mesopotamia and used in 3400 BC [5]. After human started to use language, they started recording medical information of plants and the records went down in later ages.

2.2 Brief history of traditional medicines

Before century, ancient civilizations were occurred around the four biggest rivers, the Nile, Tigris-Euphrates, Indus, and Yellow, which had own characteristic medicine. In China, 2800 BC to 1700 BC, Pen Ts'ao Shen Nung investigated about medicine and drug and established a foundation for traditional Chinese medicine. Later, Tao Hongjing (452–536) categorized medicinal plants to three phases: the first, second, and third. The first phase is harmless for long-term use, the second phase is mixed toxic and nontoxic one and as tonic, the third phase includes many toxic plants for curing disease and should not take for long term.

In Mesopotamia, the oldest medical text of around 2600 BC was found. The time, cypress oil, licorice, and opium were used frequently. A medicine of Egypt was started from 2900 BC, the knowledge of drugs were recorded on papyrus, especially Ebers' Papyrus which was written around 1500 BC showed 810 prescriptions, such as a collutorium, an inhalant, a suppository, a poultice, and a lotion. Greek Roma medicine

was influenced of Egyptian medicine; Hippocrates (460–377 BC) used about 60 kinds of medicinal plants for medical treatments. *De Materia Medica* written by Dioscorides (40–90) was used as the world bible of medicine until sixteenth century. Galenus (130–201), called the greatest doctor in Roman era, developed many pharmaceutical preparations called galenical preparations now, the preparations are used even in present. The oldest pharmacy came into being at Baghdad in Islamic culture. The pharmacy carried Arabic spices, medicines of Persia, India, and China, camphor, clove, and musk. Avicenna (980–1037), called Galenus of Arab, had written *Book of Healing* and *Canon of Medicine* and invented steam distillation of essential oil extraction. Currently, an estimated 70,000 plant species are used in traditional medicine [6].

2.3 Spices

Early European medicine markets made use of spices coming from Asia via routes that followed the Silk Road and via crossing at the Isthmus of Suez located between the Red Sea and the Mediterranean Sea. Limited western trade with India and China occurred as early as 1600 BCE. The conquests of Alexander the Great into Northern India by 325 BCE undoubtedly introduced other European countries to spices as flavoring and medicines.

The Indonesian archipelago of the Moluccas (or Maluku Islands), commonly referred to as the Spice Islands, were the only or best sources of such spices as cloves, nutmeg, and mace until the 1700s. Arab traders introduced spices harvested in Moluccas to Europeans around the fourth century but sought to keep their sources secret. Monopoly by Arabian caused a big antipathy because of their absurd price of spices. European needs lots of spices to get epidemic away using the medicinal property of spices; therefore, some adventures tried to find a habitat and approached from a sea route which was supported by countries. Consequently, the monopoly by Arabian was broken by the Portuguese after Vasco da Gama's voyage to India around the Cape of Good Hope in 1497. The Portuguese strengthened their stranglehold on the spice trade during the sixteenth century, and in the seventeenth century, the Dutch took over control of the Moluccas which is known the Spice War. During the period, spices were worth more than their weight in gold. Finally, a nursery tree of spice was smuggled out of Moluccas, hence the Spice War was over, and the spice was cultivated in other places of the world. The occurrence leded the reducing prices and making the commodity more available. If see the domestic dishes of each country, the diffusion of each spice could be seen as a spice route [3].

Action	Alkaloid compound
Analgesic, anesthesia	Morphine
Mydriasis	Atropine
Miosis	Pilocarpine
Blood-pressure increase	Ephedrine
Blood-pressure reduction	Reserpine
Bronchial expansion	Lobeline
Stimulus	Strychnine
Antimicrobial	Berberine
Antileukemia	Vinblastine

Table 2.
Actions of alkaloid compounds.

2.4 Remarkable discovery of compound

Generally, alkaloid from the plant has a conspicuous influence upon the central nerve of human even if taking a small quantity alkaloid, very strong action is showed (Table 2 and Figure 2) [7]. The plants which have an alkaloid have restriction of uses or on the list of poisonous plant. However, those alkaloids are used for

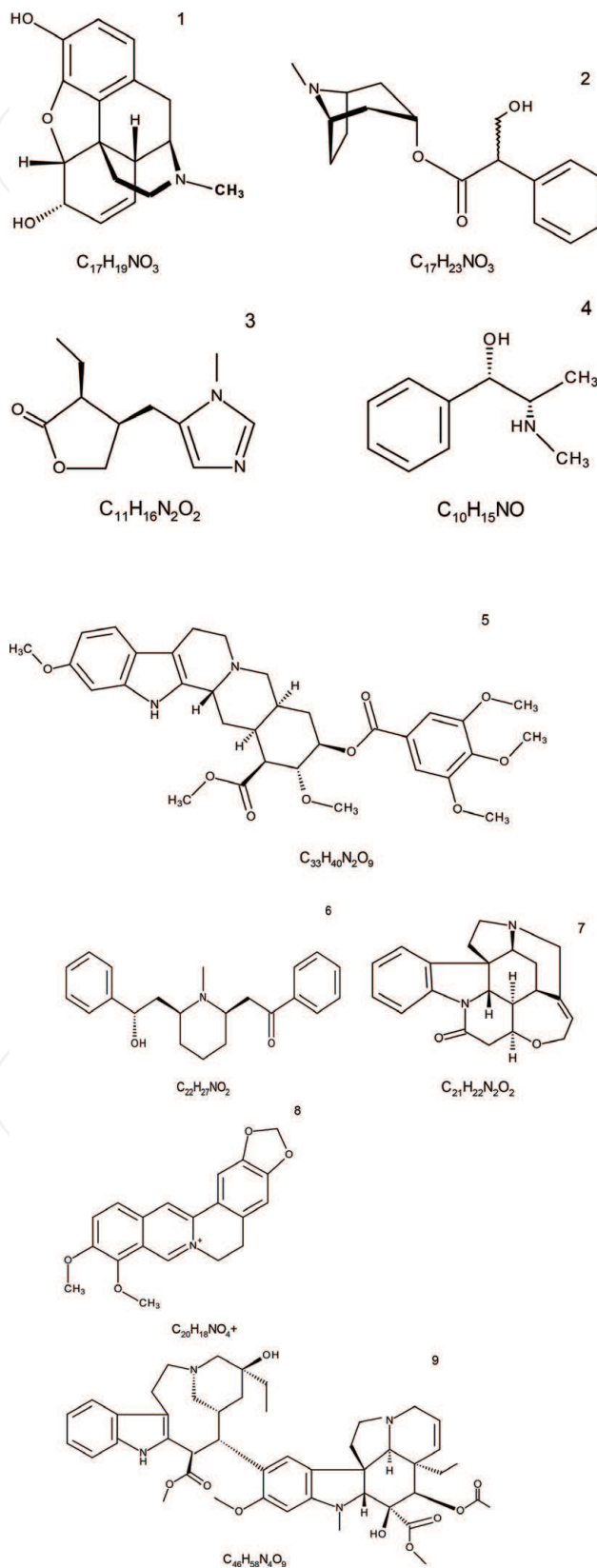


Figure 2. Diagram of alkaloid compounds of Table 2. (1) Morphine, (2) atropine, (3) pilocarpine, (4) ephedrine, (5) reserpine, (6) lobeline, (7) strychnine, (8) berberine and (9) vinblastine.

materials of medical and pharmaceutical products widely. A lot of splendid studies to discover useful alkaloid were reported [8].

Examples of narcotic analgesics are (parentheses indicated trade name):

- Codeine
- Hydrocodone (Zohydro ER)
- Oxycodone (OxyContin, Roxicodone)
- Methadone
- Hydromorphone (Dilaudid, Exalgo)
- Morphine (Avinza, Kadian, MSIR, MS Contin)
- Fentanyl (Actiq, Duragesic)

3. Present

3.1 Medicinal and aromatic plants for human life

The magical compound of medicinal and aromatic plants keeps saving human until present, such as medicine, food, healing, and recreation. One of the huge benefits from medicinal and aromatic plants was to overcome many difficult illnesses, such as contagious disease, cancer, and AIDS/HIV. The National Cancer Institute (NCI) screens plants for the possibility of new drugs and active plant chemicals for cancer and AIDS/HIV in several ongoing collaborative programs [9]. **Table 3** indicated anticancer drugs which have received FDA approval for commercial production.

Drug name	Plant resource	Feature
Taxol/paclitaxel	Pacific yew tree	Now the first drug of choice in several tumorous cancers including breast cancer
Vinblastine	Madagascar periwinkle	The first drug of choice in many forms of leukemia, and since the 1950s. it has increased the survival rate of childhood leukemias by 80%
Vincristine	Madagascar periwinkle	Another antileukemic drug
Topotecan	<i>Camptotheca acuminata</i>	Has been approved by the FDA for the treatment of ovarian and small cell lung cancer
Irinotecan	<i>Camptotheca acuminata</i>	Has been approved by the FDA for the treatment of metastatic colorectal cancer
Etoposide	<i>Podophyllum peltatum</i>	A semisynthetic derivative of a plant chemical epipodophyllotoxin
Teniposide	<i>Podophyllum peltatum</i>	Another semisynthetic derivative of a plant chemical

Table 3.

Plant-derived anticancer drugs have received FDA approval for commercial production.

3.2 Integrated medicine

Integrated medicine is a medicine to perform a satisfiable living and improve the quality of life (QOL). Integrated medicine is accepted in not only the treatment of illness but also in the treatment of the presymptomatic state, prevention of illness, or maintenance of health. Integrated medicine includes, for example, western and eastern medicine and traditional medicines. Each medicine has strong and weak point, the advantage of western medicine is quick action by operation and medicine and examination, weak point is side effect. On the other hand, the advantage of eastern medicine is that it can make a balance of whole body, regarding inveterate and chronicity disease, and for infant, aged, and pregnant woman, and weak point might be the time consumption for cure. Patient chooses the most appropriate treatment depending on the circumstances; however, the most important thinking regarding “cure” is self-healing power that could cure yourself using medicinal help, not the drug that cures yourself.

3.3 Medicinal and aromatic plants in Asia

Recently, people concern health of body and mind, prevention diseases, detox, and longevity. Consequently, integrated medicine or preventive medicine is focused and accepted in modern medicine and daily life. Some medicinal and aromatic plant origins of Asia are daily used in the world because of the popularity and variety. Daily-use medicinal plants were enumerated bellow.

3.3.1 Japanese pepper (*Zanthoxylum piperitum*)

The origin is Japan and south of the Korean Peninsula (**Figure 3(1)**). Japanese pepper inhabit from north to south in Japan, half-shade, and humid are suited. Dioecism and 1–3 m height, a tiny green fruit matures in September and turns red including one black seed, the pungent peel is used as spice and crude drug. A fresh leaf is popular as condiment and garnish. According to a historic record in China, fruits are used as medicine in the tenth century in Japan. The constituents of essential oil include citronellal, linalool, isopulegol, geranyl acetate, and α -terpineol. The medical actions are antioxidation, stomachic, digestion promotion, and improvement of blood circulation. Japanese pepper symbolized the prosperity of posterity for the fecundity.

3.3.2 Kumazasa (*Sasa veitchii*)

The origin is Japan, the Korean Peninsula, the Kuril Islands, and Kamchatka (**Figure 3(2)**). Perennial and 1–2 m height, the rhizome propagation is shown a forest floor in mountains in Japan. The edge of leaf changes white in winter. The leaves are used for rapping of cooked rice because of the antimicrobial action. An herb tea of kumazasa leaves effects a breath-freshening for the deodorization. The constituents include chlorophyll, vitamin B1, B2, and K, calcium, magnesium, potassium, and benzoic acid. The dried leaves are crude drugs which effect for stanching, diuresis, antimicrobial, anti-inflammatory, detoxification, and intestinal.

3.3.3 Dokudami (*Houttuynia cordata*)

The origin is Japan, Southeast Asia, and China (**Figure 3(3)**). A cold resistance and perennial, 20–30 cm height, rhizome propagation, dokudami inhabit

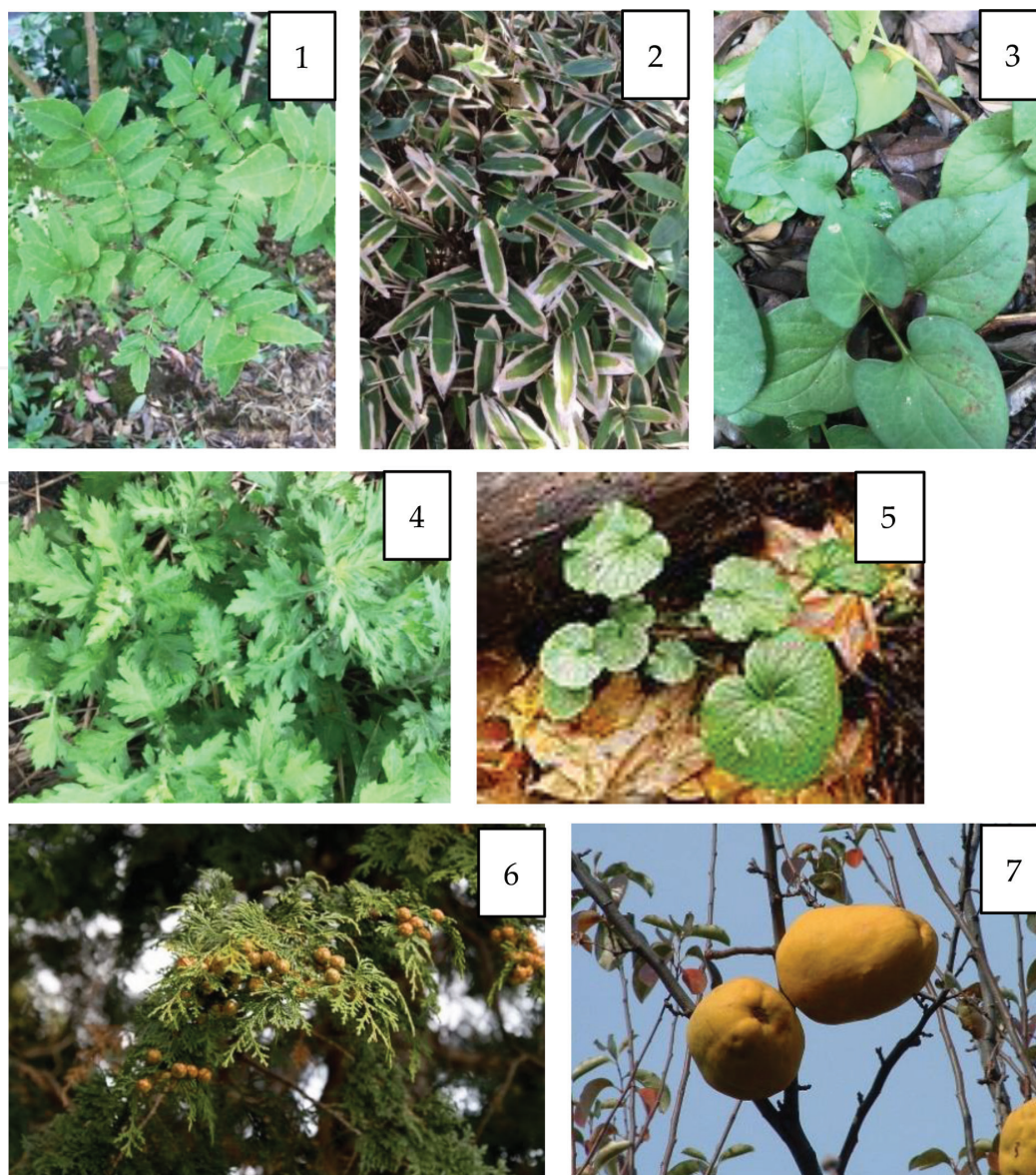


Figure 3. Medicinal and aromatic plants in Asia. (1) Japanese pepper, (2) kumazasa, (3) dokudami, (4) Japanese mugwort, (5) wasabi, (6) hinoki cypress, and (7) Chinese quince.

throughout Japan, and the whole plant is used for cosmetics and cooking. The dried leaves have no offensive odor compared with flesh. The crude drug effects for diuresis, laxative, anti-inflammatory, detoxification, and the herb tea relieves a constipation, hypertension, and strengthen capillary. However, dokudami is inappropriate for weakening sufferer. A tincture is used as body lotion for skin care, and crushed flesh leaves are used for dermatological problem, for example, to put crushed flesh leaves on a rash. The constituents of dokudami are quercetin, quercitrin, potassium, and rutin.

3.3.4 Japanese mugwort (*Artemisia indica*)

The origin is Japan, perennial, 50–100 cm height, the back side of leaf has fluff, and Japanese mugwort is used as medicine for eczema, stanching, toothache, stomachic, and diarrhea since ninth century in Japan (**Figure 3(4)**). A collected fluff is used for moxa treatment and decoction of leaves effects eczema, heat rash, lumbago, and hemorrhoids. Japanese mugwort is used for side dishes and flavor of steamed rice cake and dye in daily life. The constituents are vitamin

B1, B2, C, D, β -carotene, chlorophyll, and minerals. The essential oil includes 1,8-cineole, thujone, β -caryophyllene, borneol, and camphor. The person who has an allergy of Asteraceae should be careful.

3.3.5 Wasabi (*Eutrema japonicum*)

The origin is Japan, one of the most famous spices of Asia, remarked the antibacterial power, perennial, 40 cm height, a radical leaf has 30 cm of petiole (**Figure 3(5)**). Wasabi could be cultivated in the water or field and the growth temperature is 10–17°C. The root is used for spice. The history of use is very old, in Edo era, wasabi became popular used for sushi. As crude drug, the root is used for an appetite stimulant, an obstipant, stomachic, and an analgesic. Especially, the antibacterial power is very powerful for an enteritis vibrio, O-157, a salmonella, and *Helicobacter pylori*. The constituents are sinigrin, sulfinyl, and potassium.

3.3.6 Hinoki cypress (*Chamaecyparis obtusa*)

The origin is Japan, evergreen, monoecism, 10–30 m height, the xylem has aroma (**Figure 3(6)**). The hinoki cypress is superior timber of Japan from ancient times; Horyuji temple, which is the oldest wooden building in the world, was built using hinoki cypress, which proves the great quality. It is said there are no ticks and less mosquitos in a house made by hinoki cypress. In recent Japan, essential oil of hinoki cypress is getting popular because of the tranquilize effect and sleep-promoting derived from α -pinene, γ -cadinene, and hinokinin. The essential oil is used for cosmetics and bath salts.

3.3.7 Chinese quince (*Chaenomeles sinensis*)

The origin is China, 6–10 m height, flowering in spring and mature yellow fruit has great aroma in autumn (**Figure 3(7)**). In China, more than 2000 years ago, the fruits were used as a medicine for cough and recovering from fatigue and an aromatic. The fresh fruit is very solid and astringent; therefore, it needs to be cooked or steeped in liquor or sugar and used for cough, sore throat, tonic, diuresis, analgesic, obstipant, and calming intestinal. The constituents are malic acid, citric acid, tartaric acid, saponin, tannin, sucrose, and fructose.

4. Future

4.1 Expect role—medical Marijuana

Marijuana, *Cannabis sativa*, a plant frequently referred to as cannabis or pot, is a psychoactive, medicinal drug plant (**Figure 4(1)**). The plant tissues synthesize cannabinoid acids that under warm temperatures are converted to two major constituents: tetrahydrocannabinol, abbreviated as THC (**Figure 4(2)**), and cannabidiol, abbreviated as CBD (**Figure 4(3)**). THC is an intoxicating plant constituent that activates a brain receptor that initiates the intoxication and activates a pleasurable reward system in the brain. CBD, a nonpsychoactive constituent in marijuana, is considered to have therapeutic applications, especially for seizures.

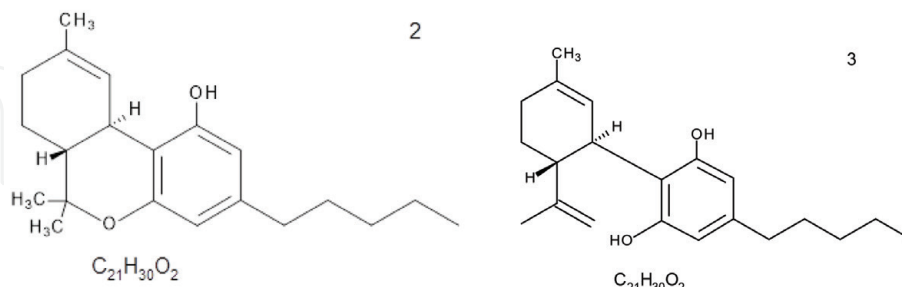


Figure 4. (1) Marijuana (*Cannabis sativa*), (2) diagram of THC, tetrahydrocannabinol, (3) diagram of CBD, cannabidiol.

4.2 Development of new drug, progress of research

Pharmaceutical industry is growing every year, especially the industry in United States added an estimated \$790 billion to the economy in 2014 [10]. Organic chemical of plant materials will give a hint to create a new drug including the level of family, plant species, and cultivars. Today, at least 120 distinct chemical substances derived from plants are considered as important drugs [9]. The structure of compound and constituent shows unique medicinal action (**Table 4**) [11] and knowledge and practices of traditional medicinal plants indicated the appropriate uses for the symptom. The information will become a signpost to develop a new drug. Traditional medicinal plants and ethnobotany have possibility to be great resources, such as artemisinin (discovered in *Artemisia annua*) and quinine (from *Cinchona*

Compound group	Typical constituent	Action
Hydrocarbon	Pinene, limonene	Stimulus, decongestant, antivirus, antitumor
Alcohol	Menthol, terpinen-4-ol, geraniol	Antimicrobial, sterilization, activation, spasmolysis
Aldehyde	Citral, citronellal	Spasmolysis, sedation, antivirus
Cyclicaldehyde	Cinnamaldehyde, vanillin	Spasmolysis
Ketone	Camphor, thujone	Mucolytic, cell regeneration, neurotoxin
Phenol	Thymol, eugenol, carvacrol	Antimicrobial, stimulus, immune function stimulus
Phenoether	Safrole, anethole, myristicin	
Oxide	Cineole, ascaridole	
Ester	Methyl salicylate, allyl isothiocyanate	Spasmolysis, sedation, antifungal

Table 4. Compound groups included in essential oils and actions of the compound groups.

officinalis) [12]. Once single compound was identified, extraction or synthesis was possible, which is almost full-drug stage. After clinical trial indicated effectiveness, the compound will be a new drug [13].

4.3 Prospects

At least, 28,187 plant species are currently recorded as being of medicinal use in the world; however, only 4478 of the species used in plant-based medicines are cited in a medicinal regulatory publication [12]. It means a huge possibility to find new drug in the future. The global market of herbal medicines is glowing year by year with the interest in natural medicine. According to estimation of the World Health Organization in 2003, the annual global market for herbal medicines is reported to be worth US\$60 billion and by 2012 the global industry in Traditional Chinese Medicine (TCM) alone was reported to be worth US\$83 billion [12].

However, human surviving and development of new drugs is as a result of existence of medicinal and aromatic plants. Sustaining the plant species and conservation of genetic resources is the most priority role of human changing with the circumstances of earth. Climate change already causes a serious state for plants throughout the world. A research group assessed late twenty-first century distributions for 1350 European plants species under seven climate change scenarios. As a result, more than half of the species could be vulnerable or threatened by 2080 [14]. As is generally known, some countermeasures against climate change need an enduring cooperative effort from national and international interdisciplinary researchers.

5. Conclusions

Medicinal and aromatic plants still have unknown and uncountable potential, though there is a long history for use since prehistoric times. To loose genetic resources leads a weighty loss in the future; therefore, the coexistence balance among plants, animal, and human should not be upset. The role of medicinal and aromatic plants is changing continuously in accord to a period and the role expands such as cure of disease to prevention of disease. The accumulated massive knowledge, information, and materials should be shared in the whole world and go down to generation to generation. The blessings of medicinal and aromatic plants are treasures that belong to all lives.

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