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HERBALISM – A REVIEW

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ABSTRACT

Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions, and to defend against attack from predators such as insects, fungi and herbivorous mammals. Many of these phytochemicals have beneficial effects on long-term health when consumed by humans, and can be used to effectively treat human diseases. At least 12,000 such compounds have been isolated so far; a number estimated to be less than 10% of the total. The present review focused on chemical compounds in plants mediate their effects on the human body through processes identical to those already well understood for the chemical compounds in conventional drugs; thus herbal medicines do not differ greatly from conventional drugs in terms of how they work. This enables herbal medicines to be as effective as conventional medicines.

Key words: Herbal medicine, herbalism, Ethnobotany, Ethnomedical.

INTRODUCTION

Herbal medicine (or "herbalism") is the study and use of medicinal properties of plants [1]. The bark of willow trees contains large amounts of salicylic acid, which is the active metabolite of aspirin. Willow bark has been used for millennia as an effective pain reliever and fever reducer [2]. The use of plants as medicines predates written human history. Ethnobotany (the study of traditional human uses of plants) is recognized as an effective way to discover future medicines. In 2001, researchers identified 122 compounds used in modern medicine which were derived from "ethnomedical" plant sources; 80% of these have had an ethnomedical use identical or related to the current use of the active elements of the plant [3]. Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including aspirin, digitalis, quinine, and opium.

The use of herbs to treat disease is almost universal among non-industrialized societies, and is often more affordable than purchasing expensive modern

pharmaceuticals. The World Health Organization (WHO) estimates that 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care. Studies in the United States and Europe have shown that their use is less common in clinical settings, but has become increasingly more in recent years as scientific evidence about the effectiveness of herbal medicine has become more widely available.

History

The use of plants as medicines predates written human history. Many of the herbs and spices used by humans to season food also yield useful medicinal compounds [3][4]. The use of herbs and spices in cuisine developed in part as a response to the threat of food-borne pathogens. Studies show that in tropical climates where pathogens are the most abundant, recipes are the most highly spiced. Further, the spices with the most potent antimicrobial activity tend to be selected [5,6]. In all cultures vegetables are spiced less than meat, presumably

because they are more resistant to spoilage. Many of the common weeds that populate human settlements, such as nettle, dandelion and chickweed, also have medicinal properties. A large amount of archaeological evidence exists which indicates that humans were using medicinal plants during the Paleolithic, approximately 60,000 years ago.

Ancient times

The essential oil of common thyme (*Thymus vulgaris*), contains 20-54% thymol. Thymol, is a powerful antiseptic and antifungal that is used in a variety of products. Before the advent of modern antibiotics, oil of thyme was used to medicate bandages. Thymol is also used to treat respiratory infections. A tea made by infusing the herb in water can be used for coughs and bronchitis. In the written record, the study of herbs dates back over 5,000 years to the Sumerians, who created clay tablets with lists of hundreds of medicinal plants (such as myrrh and opium). In 1500 B.C., the Ancient Egyptians wrote the Ebers Papyrus, which contains information on over 850 plant medicines, including garlic, juniper, cannabis, castor bean, aloe, and mandrake.

In India, Ayurveda medicine has used many herbs such as turmeric possibly as early as 1900 BC. Sanskrit writings from around 1500 B.C., such as the Rig Veda, are some of the earliest available documents detailing the medical knowledge that formed the basis of the Ayurveda system. Many other herbs and minerals used in Ayurveda were later described by ancient Indian herbalists such as Charaka and Sushruta during the 1st millennium BC. The Sushruta Samhita attributed to Sushruta in the 6th century BC describes 700 medicinal plants, 64 preparations from mineral sources, and 57 preparations based on animal sources.

The Chinese emperor Shen Nung (of the Han Dynasty) is said to have written the first Chinese herbal, the Pen Tsao. The Pen Tsao lists 365 medicinal plants and their uses - including Ephedra (the shrub that introduced the drug ephedrine to modern medicine), hemp, and chaulmoogra (one of the first effective treatments for leprosy). Succeeding generations augmented on the Shennong Bencao Jing, as in the Yaoxing Lun (Treatise on the Nature of Medicinal Herbs), a 7th century Tang Dynasty treatise on herbal medicine.

The earliest known Greek herbals were those of Diocles of Carystus, written during the 3rd century B.C, and one by Krateuas from the 1st century B.C. Only a few fragments of these works have survived intact, but from what remains scholars have noted that there is a large amount of overlap with the Egyptian herbals. Greek and Roman medicinal practices, as preserved in the writings of Hippocrates (e.g. *De herbis et curis*) and - especially - Galen (e.g. *Therapeutics*), provided the pattern for later western medicine. Sometime between 50 and 68 A.D., a Greek physician known as Pedanius Dioscorides wrote

De Materia Medica, a compendium of more than 600 plants, 35 animal products, and ninety minerals. *De Materia Medica* remained the authoritative reference of herbalism into the 17th century. Similarly important for herbalists and botanists of later centuries was Theophrastus' *Historia Plantarum*, written in the fourth century BC, which was the first systematization of the botanical world.

Middle Ages

Dandelion contains a large number of pharmacologically active compounds, and has been used for centuries as an effective laxative and diuretic, and as a treatment for bile or liver problems. Benedictine monasteries were the primary source of medical knowledge in Europe and England during the Early Middle Ages. However, most of these monastic scholars' efforts were focused on translating and copying ancient Greco-Roman and Arabic works, rather than creating substantial new information and practices [7]. Many Greek and Roman writings on medicine, as on other subjects, were preserved by hand copying of manuscripts in monasteries. The monasteries thus tended to become local centers of medical knowledge, and their herb gardens provided the raw materials for simple treatment of common disorders. At the same time, folk medicine in the home and village continued uninterrupted, supporting numerous wandering and settled herbalists. Among these were the "wise-women", who prescribed herbal remedies often along with spells and enchantments. It was not until the late Middle Ages that women who were knowledgeable in herb lore became the targets of the witch hysteria. One of the most famous women in the herbal tradition was Hildegard of Bingen. A twelfth century Benedictine nun, she wrote a medical text called *Causes and Cures*.

Medical schools known as Bimaristan began to appear from the 9th century in the medieval Islamic world among Persians and Arabs, which was generally more advanced than medieval Europe at the time. The Arabs venerated Greco-Roman culture and learning, and translated tens of thousands of texts into Arabic for further study [8]. As a trading culture, the Arab travellers had access to plant material from distant places such as China and India. Herbals, medical texts and translations of the classics of antiquity filtered in from east and west. Muslim botanists and Muslim physicians significantly expanded on the earlier knowledge of materia medica. For example, al-Dinawari described more than 637 plant drugs in the 9th century and Ibn al-Baitar described more than 1,400 different plants, foods and drugs, over 300 of which were his own original discoveries, in the 13th century. The experimental scientific method was introduced into the field of materia medica in the 13th century by the Andalusian-Arab botanist Abu al-Abbas al-Nabati, the teacher of Ibn al-Baitar. Al-Nabati

introduced empirical techniques in the testing, description and identification of numerous materia medica, and he separated unverified reports from those supported by actual tests and observations. This allowed the study of materia medica to evolve into the science of pharmacology [9].

Baghdad was an important center for Arab herbalism, as was Al-Andalus between 800 and 1400. Abulcasis (936-1013) of Cordoba authored *The Book of Simples*, an important source for later European herbals, while Ibn al-Baitar (1197–1248) of Malaga authored the *Corpus of Simples*, the most complete Arab herbal which introduced 200 new healing herbs, including tamarind, Aconitum, and nux vomica. Avicenna's *The Canon of Medicine* (1025) lists 800 tested drugs, plants and minerals. Book Two is devoted to a discussion of the healing properties of herbs, including nutmeg, senna, sandalwood, rhubarb, myrrh, cinammon, and rosewater. *The Canon of Medicine* remained a medical authority, used at many European and Arab medical schools, until the early 19th century. Other pharmacopoeia books include that written by Abu-Rayhan Biruni in the 11th century and Ibn Zuhr (Avenzoar) in the 12th century (and printed in 1491), Peter of Spain's *Commentary on Isaac*, and John of St Amand's *Commentary on the Antedotary of Nicholas*. In particular, the Canon introduced clinical trials, randomized controlled trials, and efficacy tests [10].

Early modern era

The fifteenth, sixteenth, and seventeenth centuries were the great age of herbals, many of them available for the first time in English and other languages rather than Latin or Greek. The first herbal to be published in English was the anonymous *Grete Herball* of 1526. The two best-known herbals in English were *The Herball or General History of Plants* (1597) by John Gerard and *The English Physician Enlarged* (1653) by Nicholas Culpeper. Gerard's text was basically a pirated translation of a book by the Belgian herbalist Dodoens and his illustrations came from a German botanical work. The original edition contained many errors due to faulty matching of the two parts. Culpeper's blend of traditional medicine with astrology, magic, and folklore was ridiculed by the physicians of his day yet his book - like Gerard's and other herbals - enjoyed phenomenal popularity. The Age of Exploration and the Columbian Exchange introduced new medicinal plants to Europe. *The Badianus Manuscript* was an illustrated Aztec herbal translated into Latin in the 16th century.

The second millennium, however, also saw the beginning of a slow erosion of the pre-eminent position held by plants as sources of therapeutic effects. This began with the Black Death, which the then dominant Four Element medical system proved powerless to stop. A century later, Paracelsus introduced the use of active chemical drugs (like arsenic, copper sulfate, iron,

mercury, and sulfur). These were accepted even though they had toxic effects because of the urgent need to treat Syphilis.

Modern herbal medicine

Digoxin is a purified cardiac glycoside that is extracted from the foxglove plant, *Digitalis lanata*. Digoxin is widely used in the treatment of various heart conditions, namely atrial fibrillation, atrial flutter and sometimes heart failure that cannot be controlled by other medication. Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including opium, aspirin, digitalis, and quinine. The World Health Organization (WHO) estimates that 80 percent of the population of some Asian and African countries presently use herbal medicine for some aspect of primary health care [11]. Pharmaceuticals are prohibitively expensive for most of the world's population, half of which lives on less than \$2 U.S. per day. In comparison, herbal medicines can be grown from seed or gathered from nature for little or no cost.

The use of, and search for, drugs and dietary supplements derived from plants have accelerated in recent years. Pharmacologists, microbiologists, botanists, and natural-products chemists are combing the Earth for phytochemicals and leads that could be developed for treatment of various diseases. In fact, according to the World Health Organisation, approximately 25% of modern drugs used in the United States have been derived from plants [12].

Among the 120 active compounds currently isolated from the higher plants and widely used in modern medicine today, 80 percent show a positive correlation between their modern therapeutic use and the traditional use of the plants from which they are derived.[5] More than two thirds of the world's plant species - at least 35,000 of which are estimated to have medicinal value - come from the developing countries. At least 7,000 medical compounds in the modern pharmacopoeia are derived from plants [13].

Biological background

The carotenoids in primrose produce bright red, yellow and orange shades. People consuming diets rich in carotenoids from natural foods, such as fruits and vegetables, are healthier and have lower mortality from a number of chronic illnesses. All plants produce chemical compounds as part of their normal metabolic activities. These phytochemicals are divided into (1) primary metabolites such as sugars and fats, which are found in all plants; and (2) secondary metabolites -- compounds which are found in a smaller range of plants, serving a more specific function. For example, some secondary metabolites are toxins used to deter predation and others are pheromones used to attract insects for pollination. It is these secondary metabolites and pigments that can have

therapeutic actions in humans and which can be refined to produce drugs—examples are inulin from the roots of dahlias, quinine from the cinchona, morphine and codeine from the poppy, and digoxin from the foxglove [14].

Plants synthesize a bewildering variety of phytochemicals but most are derivatives of a few biochemical motifs: Alkaloids are a class of chemical compounds containing a nitrogen ring. Alkaloids are produced by a large variety of organisms, including bacteria, fungi, plants, and animals, and are part of the group of natural products (also called secondary metabolites). Many alkaloids can be purified from crude extracts by acid-base extraction. Many alkaloids are toxic to other organisms. They often have pharmacological effects and are used as medications, as recreational drugs, or in entheogenic rituals. Examples are the local anesthetic and stimulant cocaine; the psychedelic psilocin; the stimulant caffeine; nicotine; the analgesic morphine; the antibacterial berberine; the anticancer compound vincristine; the antihypertension agent reserpine; the cholinomimetic galatamine; the spasmolysis agent atropine; the vasodilator vincamine; the anti-arrhythmia compound quinidine; the anti-asthma therapeutic ephedrine; and the antimalarial drug quinine. Although alkaloids act on a diversity of metabolic systems in humans and other animals, they almost uniformly invoke a bitter taste.

Polyphenols (also known as phenolics or polyphenols) are compounds that contain phenol rings. The anthocyanins that give grapes their purple color, the isoflavones, the phytoestrogens from soy and the tannins that give tea its astringency are phenolics. Glycosides are a molecule in which a sugar is bound to a non-carbohydrate moiety, usually a small organic molecule. Glycosides play numerous important roles in living organisms. Many plants store chemicals in the form of inactive glycosides. These can be activated by enzyme hydrolysis, which causes the sugar part to be broken off, making the chemical available for use. Many such plant glycosides are used as medications. In animals and humans, poisons are often bound to sugar molecules as part of their elimination from the body. An example is the cyanoglycosides in cherry pits that release toxins only when bitten by an herbivore.

Terpenes are a large and diverse class of organic compounds, produced by a variety of plants, particularly conifers, which are often strong smelling and thus may have had a protective function. They are the major components of resin, and of turpentine produced from resin. (The name "terpene" is derived from the word "turpentine"). Terpenes are major biosynthetic building blocks within nearly every living creature. Steroids, for example, are derivatives of the triterpene squalene. When terpenes are modified chemically, such as by oxidation or rearrangement of the carbon skeleton, the resulting compounds are generally referred to as terpenoids.

Terpenes and terpenoids are the primary constituents of the essential oils of many types of plants and flowers. Essential oils are used widely as natural flavor additives for food, as fragrances in perfumery, and in traditional and alternative medicines such as aromatherapy. Synthetic variations and derivatives of natural terpenes and terpenoids also greatly expand the variety of aromas used in perfumery and flavors used in food additives. Vitamin A is an example of a terpene. The fragrance of rose and lavender is due to monoterpenes. The carotenoids produce the reds, yellows and oranges of pumpkin, corn and tomatoes.

Clinical tests

The bark of the cinchona tree contains quinine, which today is a widely prescribed treatment for malaria, especially in countries that cannot afford to purchase the more expensive anti-malarial drugs produced by the pharmaceutical industry. Many herbs have shown positive results in-vitro, animal model or small-scale clinical tests,[15] while studies on some herbal treatments have found negative results. In 2002, the U.S. National Center for Complementary and Alternative Medicine of the National Institutes of Health began funding clinical trials into the effectiveness of herbal medicine. In a 2010 survey of 1000 plants, 356 had clinical trials published evaluating their "pharmacological activities and therapeutic applications" while 12% of the plants, although available in the Western market, had "no substantial studies" of their properties [15].

Herbalists criticize the manner in which many scientific studies make insufficient use of historical knowledge, which has been shown useful in drug discovery and development in the past and present [5]. They maintain that this traditional knowledge can guide the selection of factors such as optimal dose, species, time of harvesting and target population [16].

Prevalence of use

A survey released in May 2004 by the National Center for Complementary and Alternative Medicine focused on who used complementary and alternative medicines (CAM), what was used, and why it was used. The survey was limited to adults, aged 18 years and over during 2002, living in the United States. According to this survey, herbal therapy, or use of natural products other than vitamins and minerals, was the most commonly used CAM therapy (18.9%) when all use of prayer was excluded [17,18].

Herbal remedies are very common in Europe. In Germany, herbal medications are dispensed by apothecaries (e.g., Apotheke). Prescription drugs are sold alongside essential oils, herbal extracts, or herbal teas. Herbal remedies are seen by some as a treatment to be preferred to pure medical compounds which have been industrially produced [19].

In India, the herbal remedy is so popular that the Government of India has created a separate department - AYUSH - under the Ministry of Health & Family Welfare. The National Medicinal Plants Board was also established in 2000 by the Govt. of India in order to deal with the herbal medical system [20]. Avid public interest in herbalism in the UK has been recently confirmed by the popularity of the topic in mainstream media, such as the prime-time hit TV series BBC's *Grow Your Own Drugs*, which demonstrated how to grow and prepare herbal remedies at home.

Herbal preparations

There are many forms in which herbs can be administered, the most common of which is in the form of a liquid that is drunk by the patient—either an herbal tea or a (possibly diluted) plant extract [21]. Whole herb consumption is also practiced either fresh, in dried form or as fresh juice.

Several methods of standardization may be determining the amount of herbs used. One is the ratio of raw materials to solvent. However different specimens of even the same plant species may vary in chemical content. For this reason, thin layer chromatography is sometimes used by growers to assess the content of their products before use. Another method is standardization on a signal chemical [22]. Leaves of *Eucalyptus olida* being packed into a steam distillation unit to gather its essential oil.

Herbal teas are hot water extracts of herbs, such as chamomile or mint. Decoctions are long-term boiled extract of usually roots or bark. Macerations are old infusion of plants with high mucilage-content as sage, thyme, etc. Plants are chopped and added to cold water. They are then left to stand for 7 to 12 hours (depending on herb used). For most macerates 10 hours is used [23]. Tinctures are alcoholic extracts of herbs, which are generally stronger than teas, infusions, and decoctions [24]. Usually obtained by combining 100% pure ethanol (or a mixture of 100% ethanol with water) with the herb. A completed tincture has an ethanol percentage of at least 25% (sometimes up to 90%). Herbal wine and elixirs are alcoholic extract of herbs; usually with an ethanol percentage of 12-38%. Herbal wine is a maceration of herbs in wine, while an elixir is a maceration of herbs in spirits (e.g., vodka, grappa, etc.) Extracts include liquid extracts, dry extracts and nebulisates. Liquid extracts are liquids with a lower ethanol percentage than tinctures. They can (and are usually) made by vacuum distilling tinctures. Dry extracts are extracts of plant material which are evaporated into a dry mass. They can then be further refined to a capsule or tablet. A nebulisate is a dry extract created by freeze-drying. Vinegars are prepared at the same way as tinctures, except using a solution of acetic acid as the solvent. Syrups are extracts of herbs made with syrup or honey. Sixty five parts of sugar are mixed

with 35 parts of water and herb. The whole is then boiled and macerated for three weeks.

The exact composition of a herbal product is influenced by the method of extraction. A tea will be rich in polar components because water is a polar solvent. Oil on the other hand is a non-polar solvent and it will absorb non-polar compounds. Alcohol lies somewhere in between [21]. An herb shop in the souk of Marrakesh, Morocco. Many herbs are applied topically to the skin in a variety of forms. Essential oil extracts can be applied to the skin, usually diluted in a carrier oil (many essential oils can burn the skin or are simply too high dose used straight – diluting in olive oil or another food grade oil such as almond oil can allow these to be used safely as a topical) [25]. Salves, oils, balms, creams and lotions are other forms of topical delivery mechanisms. Most topical applications are oil extractions of herbs. Taking a food grade oil and soaking herbs in it for anywhere from weeks to months allows certain phytochemicals to be extracted into the oil. This oil can then be made into salves, creams, lotions, or simply used as oil for topical application. Any massage oils, antibacterial salves and wound healing compounds are made this way. One can also make a poultice or compress using whole herb (or the appropriate part of the plant) usually crushed or dried and re-hydrated with a small amount of water and then applied directly in a bandage, cloth or just as is. Inhalation as in aromatherapy can be used as a mood changing treatment [26] to fight a sinus infection or cough [27], or to cleanse the skin on a deeper level.

Safety

Datura stramonium is a highly effective treatment for asthma symptoms when smoked, because it contains atropine, which acts as an antispasmodic in the lungs. However, *datura* is also an extremely powerful hallucinogen and overdoses of the tropane alkaloids in it can result in hospitalization or death.

For partial list of herbs with known adverse effects, see List of herbs with known adverse effects. A number of herbs are thought to be likely to cause adverse effects. Furthermore, "adulteration, inappropriate formulation, or lack of understanding of plant and drug interactions have led to adverse reactions that are sometimes life threatening or lethal." Proper double-blind clinical trials are needed to determine the safety and efficacy of each plant before they can be recommended for medical use. Although many consumers believe that herbal medicines are safe because they are "natural", herbal medicines and synthetic drugs may interact, causing toxicity to the patient. Herbal remedies can also be dangerously contaminated, and herbal medicines without established efficacy, may unknowingly be used to replace medicines that do have corroborated efficacy [28].

Standardization of purity and dosage is not mandated in the United States, but even products made to

the same specification may differ as a result of biochemical variations within a species of plant. Plants have chemical defense mechanisms against predators that can have adverse or lethal effects on humans. Examples of highly toxic herbs include poison hemlock and nightshade. They are not marketed to the public as herbs, because the risks are well known, partly due to a long and colorful history in Europe, associated with "sorcery", "magic" and intrigue. Although not frequent, adverse reactions have been reported for herbs in widespread use. On occasion serious untoward outcomes have been linked to herb consumption. A case of major potassium depletion has been attributed to chronic licorice ingestion.,[27] and consequently professional herbalists avoid the use of licorice where they recognise that this may be a risk. Black cohosh has been implicated in a case of liver failure [28]. Few studies are available on the safety of herbs for pregnant women [29,30] and one study found that use of complementary and alternative medicines are associated with a 30% lower ongoing pregnancy and live birth rate during fertility treatment [31]. Examples of herbal treatments with likely cause-effect relationships with adverse events include aconite, which is often a legally restricted herb, ayurvedic remedies, broom, chaparral, Chinese herb mixtures, comfrey, herbs containing certain flavonoids, germander, guar gum, liquorice root, and pennyroyal [32]. Examples of herbs where a high degree of confidence of a risk long term adverse effects can be asserted include ginseng, which is unpopular among herbalists for this reason, the endangered herb goldenseal, milk thistle, senna, against which herbalists generally advise and rarely use, aloe vera juice, buckthorn bark and berry, cascara sagrada bark, saw palmetto, valerian, kava, which is banned in the European Union, St. John's wort, Khat, Betel nut, the restricted herb Ephedra, and Guarana [30].

There is also concern with respect to the numerous well-established interactions of herbs and drugs. In consultation with a physician, usage of herbal remedies should be clarified, as some herbal remedies have the potential to cause adverse drug interactions when used in combination with various prescription and over-the-counter pharmaceuticals, just as a patient should inform an herbalist of their consumption of orthodox prescription and other medication. For example, dangerously low blood pressure may result from the combination of an herbal remedy that lowers blood pressure together with prescription medicine that has the same effect. Some herbs may amplify the effects of anticoagulants [33]. Certain herbs as well as common fruit interfere with cytochrome P450, an enzyme critical to much drug metabolism [34].

Practitioners

Traditional Chinese herbalist: one who is trained or skilled in the dispensing of herbal prescriptions;

traditional Chinese herb doctor. Similarly, Traditional Ayurvedic herbalist: one who is trained or skilled in the dispensing of herbal prescriptions in the Ayurvedic tradition. One trained or skilled in the therapeutic use of medicinal plants.

Herbalists must learn many skills, including the wildcrafting or cultivation of herbs, diagnosis and treatment of conditions or dispensing herbal medication, and preparations of herbal medications. Education of herbalists varies considerably in different areas of the world. Lay herbalists and traditional indigenous medicine people generally rely upon apprenticeship and recognition from their communities in lieu of formal schooling.

In some countries formalised training and minimum education standards exist, although these are not necessarily uniform within or between countries. For example, in Australia the currently self-regulated status of the profession (as of April 2008) results in different associations setting different educational standards, and subsequently recognising an educational institution or course of training. The National Herbalists Association of Australia is generally recognised as having the most rigorous professional standard within Australia [35]. In the United Kingdom, the training of medical herbalists is done by state funded Universities. For example, Bachelor of Science degrees in herbal medicine are offered at Universities such as University of East London, Middlesex University, University of Central Lancashire, University of Westminster, University of Lincoln and Napier University in Edinburgh at the present.

Government regulations

In the EU, herbal medicines are now regulated under the European Directive on Traditional Herbal Medicinal Products. In the United States, most herbal remedies are regulated as dietary supplements by the Food and Drug Administration. Manufacturers of products falling into this category are not required to prove the safety or efficacy of their product, though the FDA may withdraw a product from sale should it prove harmful [36].

The National Nutritional Foods Association, the industry's largest trade association, has run a program since 2002, examining the products and factory conditions of member companies, giving them the right to display the GMP (Good Manufacturing Practices) seal of approval on their products. Some herbs, such as cannabis and coca, are outright banned in most countries. Since 2004, the sales of ephedra as a dietary supplement is prohibited in the United States by the Food and Drug Administration [37] and subject to Schedule III restrictions in the United Kingdom.

Traditional herbal medicine systems

Ready to drink macerated medicinal liquor with goji berry, tokay gecko, and ginseng, for sale at a

traditional medicine market in Xi'an, China. Native Americans medicinally used about 2,500 of the approximately 20,000 plant species that are native to North America. With great accuracy, the plants they chose to use for medicine were in those families of plants that modern phytochemical studies show contains the most bioactive compounds [38].

Some researchers trained in both western and traditional Chinese medicine have attempted to deconstruct ancient medical texts in the light of modern science. One idea is that the yin-yang balance, at least with regard to herbs, corresponds to the pro-oxidant and anti-oxidant balance. This interpretation is supported by several investigations of the ORAC ratings of various yin and yang herbs [39].

In India, Ayurvedic medicine has quite complex formulas with 30 or more ingredients, including a sizable number of ingredients that have undergone "alchemical processing", chosen to balance "Vata", "Pitta" or "Kapha". In Tamil Nadu, Tamils have their own medicinal system now popularly called the Siddha medicinal system. The Siddha system is entirely in the Tamil language. It contains roughly 300,000 verses covering diverse aspects of medicine such as anatomy, sex ("kokokam" is the sexual treatise of par excellence), herbal, mineral and metallic compositions to cure many diseases that are relevant even to-day. Ayurveda is in Sanskrit, but Sanskrit was not generally used as a mother tongue and hence its medicines are mostly taken from Siddha and other local traditions [37].

Herbal philosophy and spiritual practices

Alternative medical systems

Acupuncture, Anthroposophic medicine, Herbalism, Homeopathy Naturopathy, Orthopathy, Osteopathy, Chiropractic.

Traditional medicine

Chinese, Mongolian, Tibetan, Unani, Siddha, Ayurveda

NCCAM classifications

Whole medical systems, Mind-body interventions, Biologically based therapies, Manipulative therapy, Energy therapies.

As Eisenburg states in his book, *Encounters with Qi*: "The Chinese and Western medical models are like two frames of reference in which identical phenomena are studied. Neither frame of reference provides an unobstructed view of health and illness. Each is incomplete and in need of refinement." Specifically, the traditional Chinese medical model could effect change on the recognized, and expected, phenomena of detachment to patients as people and estrangement unique to the clinical and impersonal relationships between patient and physician of the Western school of medicine.

Four approaches to the use of plants as medicine include:

1. The magical/shamanic—Almost all non-modern societies recognize this kind of use. The practitioner is regarded as endowed with gifts or powers that allow him/her to use herbs in a way that is hidden from the average person, and the herbs are said to affect the spirit or soul of the person.
2. The energetic—This approach includes the major systems of TCM, Ayurveda, and Unani. Herbs are regarded as having actions in terms of their energies and affecting the energies of the body. The practitioner may have extensive training, and ideally be sensitive to energy, but need not have supernatural powers.
3. The functional dynamic—This approach was used by early physiomedical practitioners, whose doctrine forms the basis of contemporary practice in the UK. Herbs have a functional action, which is not necessarily linked to a physical compound, although often to a physiological function, but there is no explicit recourse to concepts involving energy.
4. The chemical—Modern practitioners - called Phytotherapists - attempt to explain herb actions in terms of their chemical constituents. It is generally assumed that the specific combination of secondary metabolites in the plant are responsible for the activity claimed or demonstrated, a concept called synergy.

Herbalists tend to use extracts from parts of plants, such as the roots or leaves but not isolate particular phytochemicals. Pharmaceutical medicine prefers single ingredients on the grounds that dosage can be more easily quantified. It is also possible to patent single compounds, and therefore generate income. Herbalists often reject the notion of a single active ingredient, arguing that the different phytochemicals present in many herbs will interact to enhance the therapeutic effects of the herb and dilute toxicity. Furthermore, they argue that a single ingredient may contribute to multiple effects. Herbalists deny that herbal synergism can be duplicated with synthetic chemicals. They argue that phytochemical interactions and trace components may alter the drug response in ways that cannot currently be replicated with a combination of a few putative active ingredients. Pharmaceutical researchers recognize the concept of drug synergism but note that clinical trials may be used to investigate the efficacy of a particular herbal preparation, provided the formulation of that herb is consistent.

In specific cases the claims of synergy and multifunctionality have been supported by science. The open question is how widely both can be generalized. Herbalists would argue that cases of synergy can be widely generalized, on the basis of their interpretation of evolutionary history, not necessarily shared by the pharmaceutical community. Plants are subject to similar selection pressures as humans and therefore they must develop resistance to threats such as radiation, reactive

oxygen species and microbial attack in order to survive. Optimal chemical defenses have been selected for and have thus developed over millions of years. Human diseases are multifactorial and may be treated by consuming the chemical defences that they believe to be present in herbs. Bacteria, inflammation, nutrition and ROS (reactive oxygen species) may all play a role in arterial disease. Herbalists claim a single herb may simultaneously address several of these factors. Likewise a factor such as ROS may underlie more than one condition. In short herbalists view their field as the study of a web of relationships rather than a quest for single cause and a single cure for a single condition.

In selecting herbal treatments herbalists may use forms of information that are not applicable to pharmacists. Because herbs can moonlight as vegetables, teas or spices they have a huge consumer base and large-scale epidemiological studies become feasible. Ethnobotanical studies are another source of information. For example, when indigenous peoples from geographically dispersed areas use closely related herbs for the same purpose that is taken as supporting evidence for its efficacy. Herbalists contend that historical medical records and herbals are underutilized resources [40]. They favor the use of convergent information in assessing the medical value of plants. An example would be when in-vitro activity is consistent with traditional use.

Uses of herbal medicines by non-human species

Indigenous healers often claim to have learned by observing that sick animals change their food preferences to nibble at bitter herbs they would normally reject. Field biologists have provided corroborating evidence based on observation of diverse species, such as chickens, sheep, butterflies, and chimpanzee. The habit has been shown to be a physical means of purging intestinal parasites. Lowland gorillas take 90% of their diet from the fruits of *Aframomum melegueta*, a relative of the ginger plant that is a potent antimicrobial and apparently keeps shigellosis and similar infections at bay.

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Current research focuses on the possibility that this plants also protects gorillas from fibrosing cardiomyopathy which has a devastating effect on captive animals.

Researchers from Ohio Wesleyan University found that some birds select nesting material rich in antimicrobial agents which protect their young from harmful bacteria. Sick animals tend to forage plants rich in secondary metabolites, such as tannins and alkaloids. Since these phytochemicals often have antiviral, antibacterial, antifungal and antihelminthic properties, a plausible case can be made for self-medication by animals in the wild.

Some animals have digestive systems especially adapted to cope with certain plant toxins. For example, the koala can live on the leaves and shoots of the eucalyptus, a plant that is dangerous to most animals. A plant that is harmless to a particular animal may not be safe for humans to ingest. A reasonable conjecture is that these discoveries were traditionally collected by the medicine men of indigenous tribes, who then passed on safety information and cautions [40-45].

CONCLUSION

Extinction of medicinal plant species because over 50% of prescription drugs are derived from chemicals first identified in plants, a 2008 report from the Botanic Gardens Conservation International warned that "cures for things such as cancer and HIV may become 'extinct before they are ever found'." They identified 400 medicinal plants at risk of extinction from over-collection and deforestation, threatening the discovery of future cures for disease. These included Yew trees (the bark is used for the cancer drug paclitaxel); Hoodia (from Namibia, a potential source of weight loss drugs); half of Magnolias (used as Chinese medicine for 5,000 years to fight cancer, dementia and heart disease); and Autumn crocus (for gout). Their report said that "five billion people still rely on traditional plant-based medicine as their primary form of health care."

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