

# Herbalism

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**Herbalism** (also **herbology** or **herbal medicine**) is the use of plants for medicinal purposes, and the study of botany for such use. Plants have been the basis for medical treatments through much of human history, and such traditional medicine is still widely practiced today. Modern medicine recognizes herbalism as a form of alternative medicine, as the practice of herbalism is not strictly based on evidence gathered using the scientific method. Modern medicine, does, however, make use of many plant-derived compounds as the basis for evidence-tested pharmaceutical drugs. Phytotherapy, and phytochemistry work to apply modern standards of effectiveness testing to herbs and medicines that are derived from natural sources. The scope of herbal medicine is sometimes extended to include fungal and bee products, as well as minerals, shells and certain animal parts.

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## History

Archaeological evidence indicates that the use of medicinal plants dates back to the Paleolithic age, approximately 60,000 years ago. Written evidence of herbal remedies dates back over 5,000 years, to the Sumerians, who compiled lists of plants. A number of ancient cultures wrote about plants and their medical uses in books called *herbals*. In ancient Egypt, herbs are mentioned in Egyptian medical papyri,

depicted in tomb illustrations, or on rare occasions found in medical jars containing trace amounts of herbs.<sup>[1]</sup> Among the oldest, lengthiest, and most important medical papyri of ancient Egypt, the Ebers Papyrus dates from about 1550 BC, and covers more than 700 drugs, mainly of plant origin.<sup>[2]</sup> The earliest known Greek herbals come from Theophrastus of Eresos who in the 4th c. B.C. wrote in Greek *Historia Plantarum*, from Diocles of Carystus who wrote during the 3rd century B.C, and from Krateuas who wrote in the 1st century B.C. Only a few fragments of these works have survived intact, but from what remains scholars have noted a large amount of overlap with the Egyptian herbals.<sup>[3]</sup> Seeds likely used for herbalism have been found in archaeological sites of Bronze Age China dating from the Shang Dynasty<sup>[4]</sup> (c. 1600 BC–c. 1046 BC). Over a hundred of the 224 drugs mentioned in the *Huangdi Neijing*, an early Chinese medical text, are herbs.<sup>[5]</sup> Herbs also commonly featured in the medicine of ancient India, where the principal treatment for diseases was diet.<sup>[6]</sup> *De Materia Medica*, originally written in Greek by Pedanius Dioscorides (c. 40 – 90 AD) of Anazarbus, Cilicia, a Greek physician, pharmacologist and botanist, is a particularly important example of such writings.<sup>[7]</sup> The documentation of herbs and their uses was a central part of both Western and Eastern medical scholarship through to the 1600s, and these works played an important role in the development of the science of botany.

## Modern herbal medicine

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.<sup>[8]</sup> Pharmaceuticals are prohibitively expensive for most of the world's population, half of whom lived on less than \$2 U.S. per day in 2002.<sup>[9]</sup> In comparison, herbal medicines can be grown from seed or gathered from nature for little or no cost.

Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including opium, aspirin, digitalis, and quinine. According to the World Health Organization, approximately 25% of modern drugs used in the United States have been derived from plants.<sup>[10]</sup> At least 7,000 medical compounds in the modern pharmacopoeia are derived from plants.<sup>[11]</sup> Among the 120 active compounds currently isolated from the higher plants and widely used in modern medicine today, 80% show a positive correlation between their modern therapeutic use and the traditional use of the plants from which they are derived.<sup>[12]</sup>

### Clinical tests

In 2015 the Australian Government's Department of Health published the results of a review of alternative therapies that sought to determine if any were suitable for being covered by health insurance; Herbalism was one of 17 topics evaluated for which no clear evidence of effectiveness was found.<sup>[13]</sup>

In a 2010 survey of the most common 1000 plant-derived compounds, only 156 had clinical trials published. Preclinical studies (tissue-culture and animal studies) were reported for about one-half of the plant products, while 12% of the plants, although available in the Western market, had "no substantial studies" of their properties. Strong evidence was found that 5 were toxic or allergenic, so that their use ought to be discouraged or forbidden. Nine plants had considerable evidence of therapeutic effect.<sup>[14]</sup>

According to Cancer Research UK, "there is currently no strong evidence from studies in people that herbal remedies can treat, prevent or cure cancer".<sup>[15]</sup>

The U.S. National Center for Complementary and Integrative Health of the National Institutes of Health funds clinical trials of the effectiveness of herbal medicines and provides "fact sheets" summarizing the effectiveness and side effects of many plant-derived preparations.<sup>[16]</sup>

## Prevalence of use

The use of herbal remedies is more prevalent in patients with chronic diseases such as cancer, diabetes, asthma and end-stage renal disease.<sup>[17][18][19]</sup> Multiple factors such as gender, age, ethnicity, education and social class are also shown to have association with prevalence of herbal remedies use.<sup>[20]</sup>

A survey released in May 2004 by the National Center for Complementary and Integrative Health 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.<sup>[21][22]</sup>

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 that have been industrially produced.<sup>[23]</sup>

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 Indian government in order to deal with the herbal medical system.<sup>[24]</sup>

## 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.<sup>[25]</sup> Whole herb consumption is also practiced either fresh, in dried form or as fresh juice.



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.

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.<sup>[26]</sup>

Herbal teas, or tisanes, are the resultant liquid of extracting herbs into water, though they are made in a few different ways. Infusions are hot water extracts of herbs, such as chamomile or mint, through steeping. Decoctions are the long-term boiled extracts, usually of harder substances like roots or bark. Maceration is the old infusion of plants with high mucilage-content, such as sage, thyme, etc. To make macerates, 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.<sup>[27]</sup>

Tinctures are alcoholic extracts of herbs, which are generally stronger than herbal teas.<sup>[28]</sup> Tinctures are 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%).<sup>[27]</sup> Herbal wine and elixirs are alcoholic extract of herbs, usually with an ethanol percentage of 12-38%.<sup>[27]</sup> Herbal wine is a maceration of herbs in wine, while an elixir is a maceration of herbs in spirits (e.g., vodka, grappa, etc.).<sup>[29]</sup> Extracts include liquid extracts, dry extracts, and nebulisates. Liquid extracts are liquids with a lower ethanol percentage than tinctures. They are usually made by vacuum distilling tinctures. Dry extracts are extracts of plant material that are evaporated into a dry mass. They can then be further refined to a capsule or tablet.<sup>[27]</sup> A nebulisate is a dry extract created by freeze-drying. Vinegars are prepared in 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 thirty-five parts of water and herb. The whole is then boiled and macerated for three weeks.<sup>[27]</sup>

The exact composition of an 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.<sup>[25]</sup>

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 them in olive oil or another food grade oil such as almond oil can allow these to be used safely as a topical.<sup>[30]</sup> 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 an oil for topical application. Many massage oils, antibacterial salves, and wound healing compounds are made this way.



Leaves of *Eucalyptus olida* being packed into a steam distillation unit to gather its essential oil.



A herb shop in the souk of Marrakesh, Morocco

One can also make a poultice or compress using the whole herb or the appropriate part of the plant, which is 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<sup>[31][32]</sup> to fight a sinus infection or cough<sup>[33]</sup>, or to cleanse the skin on a deeper level (steam rather than direct inhalation here)

## Safety

A number of herbs are thought to be likely to cause adverse effects.<sup>[34]</sup> 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.<sup>[35]</sup>" Proper double-blind clinical trials are needed to determine the safety and efficacy of each plant before they can be recommended for medical use.<sup>[36]</sup> 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.<sup>[37]</sup>

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.<sup>[38]</sup> 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.<sup>[39]</sup> 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.<sup>[40]</sup> Although not frequent, adverse reactions have been reported for herbs in widespread use.<sup>[41]</sup> On occasion serious untoward outcomes have been linked to herb consumption. A case of major potassium depletion has been attributed to chronic licorice ingestion,<sup>[42]</sup> and consequently professional herbalists avoid the use of licorice where they recognize that this may be a risk. Black cohosh has been implicated in a case of liver failure.<sup>[43]</sup> Few studies are



*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.

available on the safety of herbs for pregnant women,<sup>[44]</sup> 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.<sup>[45]</sup> 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.<sup>[46]</sup> 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.<sup>[35]</sup>

There is also concern with respect to the numerous well-established interactions of herbs and drugs.<sup>[35]</sup> 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 a 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.<sup>[47]</sup> Certain herbs as well as common fruit interfere with cytochrome P450, an enzyme critical to much drug metabolism.<sup>[48]</sup>

### **Labeling accuracy**

A 2013 study published in the journal BMC Medicine found that one-third of herbal supplements sampled contained no trace of the herb listed on the label. The study found products adulterated with filler including allergens such as soy, wheat, and black walnut. One bottle labeled as St. John's Wort was found to actually contain Alexandrian senna, a laxative.<sup>[49]</sup>

Researchers at the University of Adelaide found in 2014 that almost 20 per cent of herbal remedies surveyed were not registered with the Therapeutic Goods Administration, despite this being a condition for their sale. They also found that nearly 60 per cent of products surveyed had ingredients that did not match what was on the label. Out of 121 products, only 15 had ingredients that matched their TGA listing and packaging.<sup>[50]</sup>

In 2015 the New York Attorney General issued cease and desist letters to four major U.S. retailers (GNC, Target, Walgreens, and Walmart) who are accused of selling herbal supplements that were mislabeled and potentially dangerous. 24 products were tested by DNA barcoding as part of the investigation, all but five contained DNA that did not match the products' labels. The investigation was prompted by the 2013 BMC study.<sup>[51][52]</sup>

### **Practitioners of herbalism**



A herbalist is:<sup>[53][54][55]</sup>

1. A person whose life is dedicated to the economic or medicinal uses of plants.
2. One skilled in the harvesting and collection of medicinal plants (see wildcrafter).
3. 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.
4. One trained or skilled in the therapeutic use of medicinal plants.
5. One who is skilled in the preparation/manufacture of dried and/or liquid herbal products who possesses a pharmacognostic, formulary and/or clinical understanding of the products being prepared/manufactured.



A herbalist gathers the flower heads of *Arnica montana*.

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 formalized 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.<sup>[56]</sup> 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

The World Health Organization (WHO), the specialized agency of the United Nations (UN) that is concerned with international public health, published *Quality control methods for medicinal plant materials* in 1998 in order to support WHO Member States in establishing quality standards and specifications for herbal materials, within the overall context of quality assurance and control of herbal medicines.<sup>[57]</sup>

In the European Union (EU), herbal medicines are now regulated under the European Directive on Traditional Herbal Medicinal Products.

In the United States, herbal remedies are regulated dietary supplements by the Food and Drug Administration under current good manufacturing practice (cGMP) policy for dietary supplements. Manufacturers of products falling into this category are not required to prove the safety or efficacy of their product so long as they don't make 'medical' claims or imply being other than for 'dietary supplement' use, though the FDA may withdraw a product from sale should it prove harmful.<sup>[58][59]</sup>

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 though coca is legal in most of the South American countries where it is grown. The *Cannabis* plant is used as an herbal medicine, and as such is legal in some parts of the world. Since 2004, the sales of ephedra as a dietary supplement is prohibited in the United States by the Food and Drug Administration,<sup>[60]</sup> and subject to Schedule III restrictions in the United Kingdom.

## Traditional herbal medicine systems

### Africa

### Americas

Native Americans medicinally used about 2,500 of the approximately 20,000 plant species that are native to North America.<sup>[61]</sup>

### China

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.<sup>[62][63]</sup>

### India

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".<sup>[64][65]</sup>

In Ladakh, Lahul-Spiti and Tibet, the Tibetan Medical System is prevalent, also called the 'Amichi Medical System'. Over 337 species of medicinal plants have been documented by C.P. Kala. Those are used by Amchis, the practitioners of this medical system.<sup>[66][67]</sup>



Ready to drink macerated medicinal liquor with goji berry, tokay gecko, and ginseng, for sale at a traditional medicine market in Xi'an, China.



In Tamil Nadu, Tamils have their own medicinal system now popularly called Siddha medicine. The Siddha system is entirely in the Tamil language. It contains roughly 300,000 verses covering diverse aspects of medicine. This work includes herbal, mineral and metallic compositions used as medicine. 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.<sup>[68]</sup>

## Indonesia

In Indonesia, especially among the Javanese, the jamu traditional herbal medicine is an age old tradition preserved for centuries. Jamu is thought to have originated in the Mataram Kingdom era, some 1300 years ago.<sup>[69]</sup> The bas-reliefs on Borobudur depicts the image of people ground herbs with stone mortar and pestle, drink seller, physician and masseuse treating their clients.<sup>[70]</sup> All of these scenes might be interpreted as a traditional herbal medicine and health-related treatments in ancient Java. The Madhawapura inscription from Majapahit period mentioned a specific profession of herbs mixer and combiner (herbalist), called *Acaraki*.<sup>[70]</sup> The medicine book from Mataram dated from circa 1700 contains 3,000 entries of jamu herbal recipes, while Javanese classical literature *Serat Centhini* (1814) describes some jamu herbal concoction recipes.<sup>[70]</sup>



Different types of Indonesian jamu herbal medicines held in bottles.

Though highly possible influenced by Indian Ayurveda system, Indonesia is a vast archipelago with numerous indigenous plants not to be found in India, which include plants similar to Australia beyond the Wallace Line. Indonesians might experimented and figure out the medicinal uses of these native herbal plants. Jamu may vary from region to region, and often not written down, especially in remote areas of the country.<sup>[71]</sup> Although primarily herbal, materials acquired from animals, such as honey, royal jelly, milk and *ayam kampung* eggs are also often used in jamu.

## Herbal philosophy and spiritual practices

According to Eisenburg: "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.<sup>[72]</sup>

Four approaches to the use of plants as medicine include:<sup>[73]</sup>

1. The magical/shamanic—Almost all societies, with the exception of cultures influenced by Western-style industrialization, 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 Traditional Chinese Medicine, 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.<sup>[74]</sup> 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.<sup>[75]</sup> 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 potentially active ingredients.<sup>[76][77]</sup> 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.<sup>[78]</sup>

In specific cases the claims of synergy<sup>[79]</sup> and multifunctionality<sup>[80]</sup> 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.<sup>[81]</sup> Optimal chemical defenses have been selected for and have thus developed over millions of years.<sup>[82]</sup> 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.<sup>[83]</sup> Herbalists claim a single herb may simultaneously address several of these factors. Likewise a factor such as ROS may underlie more than one condition.<sup>[84]</sup> 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.<sup>[85]</sup> 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.<sup>[86]</sup> 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.

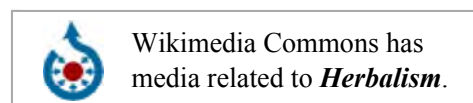
## Uses of herbal medicines by animals

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.<sup>[87]</sup> 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.<sup>[88]</sup> Current research focuses on the possibility that this plants also protects gorillas from fibrosing cardiomyopathy which has a devastating effect on captive animals.<sup>[89]</sup>

Sick animals tend to forage plants rich in secondary metabolites, such as tannins and alkaloids.<sup>[90]</sup> 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.<sup>[88]</sup>

## See also

- Adaptogen
- Ayurveda
- Chinese herbology
- Doctrine of signatures
- Ethnobotany
- Ethnomedicine
- European Directive on Traditional Herbal Medicinal Products
- Herb garden
- Herbal
- Herbal tea
- History of pharmacy
- Integrative medicine
- List of herbs with known adverse effects
- List of plants used in herbalism
- Medicinal mushrooms
- Naturopathic medicine
- Phytotherapy



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