CHAPTER THREE

HISTORICAL CONTEXT: TRADITIONAL HERBAL MEDICINE AND MODERN PHARMACEUTICALS

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The connection between modern pharmaceuticals and traditional herbal medicine has a long history and reflects the slow transition from traditional medicinal practices to modern medical research. This synthesis showcases how conventional wisdom has influenced and informed contemporary pharmacology. According to the literature, the Chinese were the first to use natural herbal formulations as medicines, and the therapeutic utilization of plants dates back to between 4000 and 5000 B.C. However, the Rig Veda, believed to have been composed between 1600 and 3500 B.C., has the oldest mention of plants as medicine in India. Herbs are used to promote general health and cure particular conditions. Around 80% of people get their primary medical care from herbal remedies. Herbs are frequently used in poultices, tinctures, and teas. By incorporating complex drug delivery systems, such as herbosomes, dendrimers, and liposomes, in modern pharmaceuticals, these technologies improve the bioavailability and efficacy of medications and pave the way for individualized treatment plans tailored to each patient's needs. As research progresses, these technologies hold great promise for improving treatment outcomes across various medical disciplines.

Keywords: Traditional, Pharmaceutical, Chinese medicine, Ayurveda, Phytosomes

Introduction

Ancient Civilizations and Herbal Medicine

Overview of ancient medical systems (Egyptian, Greek, Chinese, Ayurvedic)

Since ancient times, humans have used medicinal plants for various health purposes. In nations like India, Greece, Egypt, and China, medicinal plants have developed to become one of the oldest disciplines. Considering that they recognized and utilized the plants for energy, clothing, food, and shelter, it may be claimed that early humans were somewhat aware of the characteristics of the plants in their environment (Hamilton 2004). Humans have been using natural products—plants, animals, microbes, and marine organisms—in medicines to treat and alleviate illnesses subsequently to the beginning. Remnant testimony suggests that people have been using plants as remedies for at least 60,000 years (Shi, et al. 2010). A wide range of plants with therapeutic properties are referred to as medicinal plants. These plants are abundant in substances that can be utilized to create new drugs (Rasool Hassan 2012).

In developed countries, the use of traditional medicine for remediation is declining, whereas conventional medicine is used by 75-80% of people in developing countries (Ozioma, Ezekwesili-Ofili, and Okaka Antoinette 2019; Maroyi 2013).

Egyptian Medical System

Egyptian traditional medicine combines elements of Arabic, Islamic, and African traditions. Nonetheless, in recent decades, the use of herbal drugs for medical purposes has declined. Herbal therapy is practiced by folk healers called “Attareens”. Like Avicenna and Dawood’s ticket, they have gained experience from their Arab roots despite their lack of qualifications (Haggag 2004). In Egypt, herbal plants have become a dependable and alluring alternative medicine source. In recent years, Egypt has seen an increase in the production of medicinal plants, natural herbs, herbal drugs, and herbal drug-based treatments (Fabricant and Farnsworth 2001). Egypt is home to over two thousand types of therapeutic plants, according to the country’s flora. The soil conditions, dominant weather patterns, and other ecological factors that contribute to the growth of various medicinal plants vary across different regions. Furthermore, many botanical species have successfully adapted to Egypt’s environments (Shams et al. 2010). Throughout Egypt, herbal traders sell a wide variety of remedies made

from herbs that are still used in traditional medicine. Egypt is well-known worldwide for the fabrication of essential oils and aromatic crops, such as aniseed, lavender, peppermint essential oil, fennel seeds, and cilantro. However, the presence of pesticides, heavy metals, and residues from organic extraction solvents, along with inappropriate concentrations of pollutants, complicates the export of these products due to their current production conditions (Abd El-hamid, Makled, and Abd Elmonem 2019). Over 150 volatile and therapeutic plants are known for their exceptional quality. Key crops transmitted from Egypt include mint (Mentha spp.), basil (Ocimum spp.), and sage (Salvia spp.), Various plants are used for herbal teas, as well as those utilized for fungicides, insecticides, and aromatic purposes. German chamomile (Matricaria recutita L.) is one notable species primarily imported from Egypt. Each year, Germany receives between 500 and 600 tons of Egyptian henbane (Hyoscyamus muticus L.) (Sinha et al. 2024).

Greek Medical System

The founder of medicine, the Greek physician Hippocrates (460–377 BCE), recognized early on that natural rather than supernatural causes, like magic, could cause illness (Jones 1996). According to him, illness takes advantage of the body's 4 humors being out of balance. His investigations helped build modern medicine by acquiring knowledge of how diseases originate and how to treat them using more than 400 plant species, mostly aromatic and volatile therapeutic plants (Solomou et al. 2016; Sumner 2000).

Between the ninth and twelfth centuries, Arabic translations of the writings of Dioscorides and other Greek physicians significantly enhanced medical knowledge and practices. Although the Sumerians and ancient Greeks had long used poppies for medicinal purposes, it was the Arabs, who lived between 40 and 90 CE, who recognized the addictive properties of opium. In the eighth and ninth centuries, the physicians Avicenna and Razi made substantial contributions to advancing Iranian medicine, as outlined in their respective medical texts, the Canon of Medicine and Al-Hawi. Avicenna, one of the most renowned Persian philosophers, poets, and pharmacists, was able to classify Greek-Roman literature and develop medical practices in his work, the Canon of Medicine (Giacometti et al. 2018).

Despite having access to an advanced Western healthcare system, people in Greece, particularly on Lesvos Island, continue to rely on traditional medicine. This practice is gradually declining and is not well-documented, according to a 2.5-year study. Herbal markets—stores that offer fragrant and therapeutic plants, mostly gathered from the wild—are

still present in Greece, providing advice on using these plants for medical purposes (Koumpouros and Birbas 2013).

Chinese Medical System

One of the earliest medical systems is traditional Chinese medicine. The concepts, therapies, and approaches used in ancient Chinese medicine are distinct. This prosperous medical system is renowned globally for its evidence-based practice in the history of medicine (Patwardhan et al. 2005). Chinese people have been using ancient Chinese medicine for millenniums. Although animal and mineral components are also used, plants are the primary source of cures. Approximately 500 of the more than 12,000 tools used by traditional healers are often used (L. Li 2000). According to the Chinese theory of Yin and Yang, everything consists of indivisible and conflicting opposites. Examples of these opposing forces include black and white, elderly and young, and female and male. These complementary pairs are inherently attractive to one another. The principle of Yin and Yang was established around the third century BCE. Modern Chinese medicine remains very popular in China. Over fifty percent of the population, particularly in rural areas, tends to use traditional remedies, where they are most commonly found. Approximately five thousand traditional Chinese medicines are available, which account for about 5% of the nation's total pharmaceutical sector. The Chinese terminology for pharmacology, known as "Pen Tsao," provides a vast array of medicinal treatments for various ailments. The foundation of textual Chinese medicine is attributed to Shen Nong Ben Cao Jing, which dates back to 22–250 AD. Additionally, Cao Yuan Fang (550–630 AD) outlined the root causes and symptoms of multiple illnesses in his work "Zhu Bing Yuan Ji Lun," which has become a standard reference for learners of Chinese medicine (Kopp et al. 2003). "Ben Cao Gang Mu," a comprehensive pharmacopeia, was created by the renowned Chinese physician and scientist Li Shizhen and published in 1596. It continues to serve as an important reference and educational manual in China and other communities today, featuring 1,894 recommendations. Notably, traditional Chinese medicine passed down through generations, was not organized into a scientific framework until the 1950s (Xu and Yang 2009). Wang Tao has made significant contributions to traditional Chinese medicine (702-772). In his manuscript, Waitai Miyao, he listed almost six hundred recommendations. He used the tongue as the basis for his diagnostic theory. Depending on the disorder, the tongue's condition and color change.

The traditional medicine of Japan is kampo. After being brought to Japan from China in the 5th and 6th centuries, traditional Chinese medicine underwent significant modification and adaptation by Japanese specialists to suit their unique situation, eventually developing into Kampo. Based on a new investigation, Kampo medicines are sometimes recommended for certain Japanese specialists. While treating cancer patients, some Japanese specialists commonly use Kampo medicines in addition to radiation or chemotherapy. This shows how traditional medicine and contemporary Western medicine may thrive well simultaneously. The increasing use of Kampo in modern medicine has led to an awareness of the pressing need to research how these two medical specialties interact (Yakubo et al. 2014; A. Zhang et al. 2013).

Ayurvedic Medical System

India has a variety of ancient medical systems that have been deployed for many years. The most well-known ancient Indian medical system, Ayurveda, places an enormous value on integrated treatment, considering the fullness of the patient's physical, mental, and spiritual makeup (Vendrapati et al. 2024). In Ayurveda medicine, the five components theory is an organic theory that describes the anatomy of humans. According to the five elements idea, everything comprises fundamental components. When consumed, the elements Bhumi (earth), Jal (water), Agni (fire), Vayu (air), and Akasha (space) complement the equivalent elements in the body of an individual (Z. Zhang et al. 2014). Hindu mythology is intricately connected to the empirical study of Ayurveda. The primary body of canonical Ayurvedic literature is rooted in legendary tales about various goddesses who imparted their medical knowledge to philosophers, and subsequently to physicians. The ancient texts of the Atharva and Rig Vedas, as well as the Sushruta Samhita bear witness to India's long history of using herbs and spices as medicine. One of the earliest examples of Indian culture can be found in Sanskrit literature, which dates back to around 1500 BCE (Sumner 2000). The Sanskrit term "Ayurveda" translates to "knowledge of life." This system of medicine focuses on organic therapies and blends elements of humanistic and biological approaches. According to Ayurveda, diseases arise when there is a disturbance in the body's seven fundamental tissues, which make the foundation for health (Routh and Kazal 1999). Charaka Samhita categorizes drugs made from plants into 50 groups based on their therapeutic effects. The Sushruta Samhita emerged as another foundational text in Ayurvedic literature. While its primary focus is on surgery, the book also discusses 395 medicinal plants, 57 medications derived from

animals, and 64 minerals or elements used as drugs (Singh and Vyas 2011).

Before the advent of Nagarjuna, traditional Indian medicine mostly consisted of vegetable-based medicines. Conservative Vaidyas fiercely resisted Ras Chikitsa, also known as Rasayan, which Nagarjuna established. Mercury and iron were under Nagarjuna's control. Dhanvantari and Agnivesh refer to the ancient Lauha Shastra, a book on iron. Mercury and antimony were initially used as medicines by Nagarjuna, who rendered them intractable (agnisah).

Alchemy, chemical science, and metallurgy are closely associated with Nagarjuna. He conducted numerous experiments in metallurgy and alchemy to transform common materials into precious metals. One of the first known works in Sanskrit on alchemy and related topics is the "Rasaratnakara." In this book, Nagarjuna explains how to acquire metals like copper (cu), silver (Ag), and gold (Au). He also authored "Rasahrdaya" and "Rasandramangala."

Role of herbs in traditional medicine

Herbal remedies are primarily used to treat chronic illnesses rather than life-threatening ones and to promote wellness. Meanwhile, when contemporary medicine fails to treat a condition, such as in cases of advanced cancer or the face of emerging infectious diseases, the use of traditional treatments rises (Qato et al. 2008). Entire herbs, beverages, sugar syrup oils of essentials, creams and lotions, remedies, rubs, pills, and pellets that consist of solid ground or pulverized versions of raw material or its desiccated extract are merely a few of the various ways and forms that medicinal plants and herbs can be processed and consumed. Plant extracts vary in terms of extraction time, temperature, and abrasive. Examples include tinctures (alcohol-based extracts), cider vinegar (acetic acid extracts), tisanes (boiling water extracts), decoctions (simmered extracts), and macerates (cold injections of plants). The ingredients of an item or extract of herbs may differ greatly between producers and groups. Extensively acute and chronic medical conditions are now treated with medicinal plants. These conditions include heart disease, prostate issues, depression, inflammatory diseases, and allergies. In 2003, China incorporated traditional herbal remedies as a key element in its plan to prevent and treat severe acute respiratory syndrome (SARS). Additionally, African flowers have been used for centuries as a traditional herbal remedy to address the effects of HIV-related depletion (Tilburt 2008). Ethnobotanicals are not only used as medicinal agents, but they are also important for physiological studies and drug discovery. They can be used

as precursors for the synthesis of drugs or as analogs for substances that are known to be scientifically active (J. W. Li and Vederas 2009). Opium, derived from the seed pods of the *Papaver somniferum* plant, was used to create morphine, the first pure, chemically active substance. This discovery showed that the origin of plant-based medications can be refined and administered in precise dosages (Rousseaux and Schachter 2003).

Products derived from plants and organic sources, such as fungi and aquatic microorganisms, have significantly contributed to modern pharmaceutical formulations. Notable examples include reserpine, an antipsychotic and antihypertensive drug obtained from Rauwolfia species; digoxin, a cardiac stimulant derived from foxglove (Digitalis purpurea); salicylic acid, a precursor to aspirin sourced from willow bark (Salix species); and quinine, an antimalarial drug extracted from Cinchona bark. Moreover, medications that lower cholesterol, such as lovastatin, have been derived from mold (J. W. Li and Vederas 2009; Rishton 2008). Fig 1 shows all beneficial role of herbs.

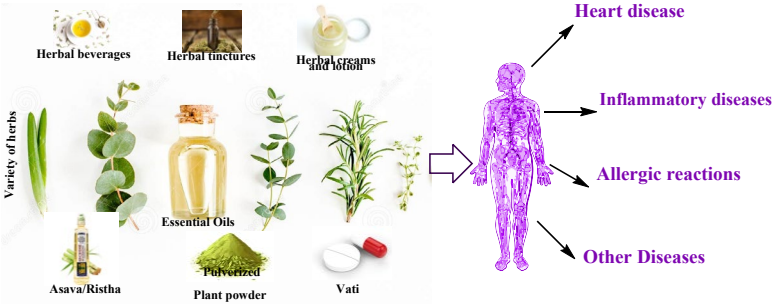

Fig. 3-1 Variety of roles of herbs as beneficial for cure

Notable herbal remedies (e.g., willow bark, foxglove)

Herbal remedies have been used in various cultures for their therapeutic benefits. Here are some popular herbal medicines along with their benefits and uses. Herbal medicine has its roots in ancient communities. Medicinal plants treat illnesses and enhance general health and well-being. Because some plants contain potent compounds, they should be treated with the same caution as prescription medications. Many pharmaceutical drugs are derived from synthetic versions of naturally occurring compounds found in plants. For example, the cardiac medication Digitalis is made from the foxglove plant (Wink 2015). Herbal therapy seeks to restore the body's

natural balance to promote self-healing. Different herbs impact the body's systems in various ways.

1. **Willow Bark (*Salix alba*)**

   The active ingredient of Willow bark is Salicin, which converts into salicylic acid in the body. Willow bark has traditionally been used to relieve pain and inflammation. It is often compared to aspirin for its effectiveness in treating osteoarthritis, migraines, and muscle pain. Additionally, it may help reduce fever.

2. **Foxglove (Digitalis purpurea)**

   The most popular active ingredient of foxglove is digoxin, primarily used as cardiac glycosides. The primary advantage is its ability to treat heart conditions such as ventricular fibrillation and cardiovascular disease. Chemicals derived from foxglove can strengthen heart contractions, help regulate heart rate, and improve heart function. However, due to its narrow therapeutic range and potential toxicity, it must be used with caution (Al-Snafi 2017).

3. **Ginseng (Panax ginseng)**

   The medicinal plant ginseng, whose roots are typically steeped to make tea or dried to make a powder, is widely used in traditional Chinese medicine to reduce inflammation and boost immunity, brain function, and energy levels. There are several varieties of ginseng, but the two most popular are the Asian and American types, Panax ginseng and Panax quinquefolius, respectively. While ginseng has been used for centuries, there is a lack of modern research supporting its efficacy; several test-tube and animal studies indicate that its special compounds, known as ginsenosides, have anticancer, antidiabetic, immuno-supporting, and neuroprotective properties; however, human research is required (Oktay and Ekinci 2019).

4. **Chamomile (Matricaria chamomilla)**

   Chamomile is a flowering plant and one of the most popular herbal treatments in the world. The blossoms are most commonly used to create tea, although the leaves can be dried and used to make tea, medicinal extracts, or topical compresses. Chamomile has been used to treat urinary tract infections, upper respiratory infections, wounds, nausea, diarrhea, constipation, and stomach aches. This

herb contains about 90 active compounds, many of which are thought to be the cause of its many health benefits (Kraft 2009).

5. St. John's wort (Hypericum perforatum)

Hypericum perforatum is a blooming plant used to make St. John's wort, an herbal remedy. Its tiny, yellow blossoms are frequently used to produce extracts, drinks, and capsules. St. John's wort may be a helpful treatment for mild-to-moderate depression because it causes fewer adverse effects than most other prescribed antidepressants. However, since the herb interacts with many medications, including birth control pills, and may trigger unexpected negative effects, it is vital to use it only under the supervision of a physician.

6. Echinacea (Echinacea purpurea)

Echinacea, another name is coneflower, a popular medicinal product and an annual plant. The North American plant is widely utilized in Native American medicine to treat ailments, including wounds, burns, discomfort in teeth, throat pain, and stomach aches. The leaves, petals, and roots of the plant can all be used; however, many believe the roots provide the most therapeutic effect. Echinacea is frequently taken as a tea or supplement, although it can be utilized physically. Despite being one of the most popular herbal remedies, there is conflicting research on echinacea's ability to prevent or treat colds.

7. Ginkgo (Ginkgo biloba)

Ginkgo biloba, commonly known as Ginkgo, is an herbal treatment derived from the maidenhair tree. This plant has been used in traditional Chinese medicine for 100 years and remains a popular herbal supplement. Ginkgo contains potent antioxidants that are believed to offer numerous health benefits. Tend to improve mental abilities and consciousness, especially in seniors. It may help to enhance the flow of blood and artery dilation (Nabizadeh et al. 2022).

8. Valerian root (Valeriana officinalis)

It is an effective replacement for medicines used for insomnia because it is believed to be soothing and harmless. Some studies confirm that valerian is beneficial, although not all have. Compared

to many pharmaceutical sleeping pills, valerian may have less severe side effects, like morning fatigue. The main active ingredient of valerian root is valerenic acid.

Medieval and Renaissance

Religious rituals, cross-cultural interactions, and the advancement of knowledge of plants were all intricately linked to herbalism during the medieval era and the Renaissance. The purposes of monasteries, the impact of Arabic medicine, and the importance of botanical gardens and herbal remedies are all examined in this overview.

Galen (Greek) Era

The Greek heritage continued to inform medical practice during the Medieval Ages. The four humors that comprised the body were plasma, mucus, black bile, and yellow bile. They were under the control of the four elements: fire, water, earth, and air. All assessments and treatments were based on Galen's modified Greek concept of the four temperaments. The concept of disposition is considered mental, social, and biological traits. An excess of blood, phlegm, yellow bile, or black bile causes a person to become sanguine, phlegmatic, choleric, or melancholy. When doctors initially visited patients, they took notice of their appearance, heard their stories, checked their urine, and felt their pulse. Galen was the most vital ancient specialist of the medieval period. He held uncontested authority over medicine during the medieval period. He discovered the four basic indications of inflammation—redness, pain, heat, and swelling—and offered fundamental contributions to our understanding of pharmacological science and viral illnesses. His knowledge of human anatomy was flawed since it was predicated on dissecting creatures, primarily pigs, sheep, goats, and apes. Herbal products, condiments, and resins were used as formulations of medicines. In 65 AD, the Greek author Dioscorides penned Materia Medica. This useful book covered the 2nd-century medical applications of over 600 plants. Despite the loss of the original Dioscorides text, numerous copies have survived. A large portion of the herbal treatment used up to 1500 was based on his writings (Buell and Anderson 2021).

The Saxon Leech Book of Bald, composed between AD 900 and 950, is the most ancient existing Anglo medicinal book. Herbal and steam baths were recommended for a variety of conditions (Willis 2007).

Monks who conducted research on medicinal plants during the medieval era by cultivating and testing the species mentioned in ancient

writings at their monasteries. Without therapeutic plants, no monastic garden could have been considered complete. The sick sought therapeutic herbs from the pharmacist, regional herbalist, or monastic. Both Dioscordes' De Materia Medica and Pliny's Naturalis Historia, composed between 77 and 79 AD and containing mythology, folktales, forests, and medicinal herbs, are generally cited in the classical era, and versions of these works became prevalent during the Renaissance.

Fragrant plants such as rosemary, lavender, and rose were used to relieve stiff joints and headaches. For painful joints, a mixture of henbane and hemlock was applied. Cilantro was utilized to lower body temperature. A combination of licorice and comforter was used to address lung issues. Various cough remedies and beverages were recommended for coughs and upper respiratory colds. Myrrh was applied to lesions due to its antimicrobial properties. Vinegar was commonly used as a cleansing agent to clean lesions ns; it was believed to eradicate the disease. Mint was used to treat burns and poisonings.

Practitioners of herbal medicine, from Dioscorides to Galen, commonly believed in the idea of "autographs." This concept suggested that plants resembling certain body parts could be utilized to treat disorders related to those organs. This belief was also evident in the use of specific herbs. For instance, the speckled leaves of lungwort, which were used to relieve tuberculosis (TB), resemble the lungs of a sick patient.

Theophrastus described over 500 plants in more than 200 essays. He developed a system for classifying plants based on their morphology, which includes their structure and form. He wrote extensively about asparagus, bananas, cinnamon, pepper, and cotton. Two of his best-known works, Enquiry into Plants and The Causes of Plants have been translated into Latin and have remained relevant time. Many refer to him as the "grandfather of botany."

The bubonic plague, known as the "Black Death," posed the greatest threat to medieval medicine. A plague outbreak occurred in Istanbul, Turkey, in 1347 and quickly spread across Europe due to trading routes. Records indicate that in some areas, up to 90% of the population perished. In the UK today, this would equate to approximately 58 million citizens. The fact that bubonic plague is a fatal and extremely contagious illness should not be overlooked. During the medieval period, the only available treatments included herbal remedies, superstitious cures, religious rituals, and various methods to rid the air of perceived poisons or miasma (Verskin 2020; Hajar 2012).

Arabic Era

Islam conquered the ancient Egyptian, Persian, Roman, and Old Eastern Emperors after emerging from the Arabian Peninsula's desert in the seventh era. While it spoke Arabic, it assimilated and blended its heritage with that of the Old East, Christianity, Judaism, Italy, and Romans. The Islamic world during the Middle Ages included Egypt, Israel, Syria, and the region around Byzantium, as well as the outer reaches of Latin America, including Portugal, the island of Sicily, and northwestern Africa (Sarton 1927; Porter 2021).

Greek and Roman doctors and philosophers laid the groundwork for Islamic medicine. Notable figures such as Galen, Hippocrates, and the Greek scholars of Alexandria, Egypt, greatly influenced Islamic physicians and thinkers. Islamic scholars utilized Arabic translations of their extensive Greek works to develop new medical knowledge. European researchers in the Renaissance and early modern periods built their medical endeavors on Islamic traditions and interpretations. For instance, Ibn Sina's (Avicenna in the West) Canon of Medicine, a five-book encyclopedia of medicine that provided a concise and well-structured overview of all medical knowledge at the time, was rendered into Latin and distributed in article and print form across Europe (Al-Ismail 2024). The Canon of Medicine was published around 35 times in the fifteenth and sixteenth centuries alone. The hakim was usually an author and philosopher who excelled in mathematics, physics, and medicine. These skilled experts embodied the unity of the sciences and were key figures in the preferment of Islamic science. They made significant discoveries and utilized their findings to further scientific progress. According to historical authors like British intellectual, mathematician, historian, and social critique Bertrand Russell (1872–1970), Islamic science was primarily significant as an intermediary of traditional wisdom to medieval Europe and, although it was commendable in many technical aspects, lacked the intellectual vigor necessary for innovation (Schwartz 2012).

Al-Razi (Muslim) Physicians 865-925 AD

Among several scientific initials credited to Al-Razi, the founder of frontier health care, are the distinctions made between measles and smallpox and the incorporation of pharmaceutical compounds within pharmacy. He was the head of medicine at hospitals in Baghdad. Al Razi said fever is a symptom, not a disease. He is known for inventing stitches made from animal intestines. Additionally, he recommended hiring

doctors who have completed advanced studies and practiced in large towns and cities rather than those working in small towns (Hajar 2013).

Mughal Era (India)

The use of betel leaf became a significant part of the royal lifestyle throughout the Mughal era. It was also provided to guests in the imperial palace and presented as a present. Manucci claims that the king frequently gave royal ladies noteworthy monetary presents because they needed to purchase footwear, scents, or betel. During adoration, betel was also offered to Hindu gods (Natnoo 2018). During the Renaissance, there was a renewed interest in scientific fields such as medicine and plants. One of John Parkinson's significant projects, Theatrum Botanicum (1640), chronicled the therapeutic uses of approximately 3800 plants. Nicholas Culpeper's 1653 work, The Complete Herbal, integrated herbal drugs and celestial principles, illustrating the fusion of conventional beliefs and advances in science (John 1640).

Modern pharmaceuticals as herbal touch

Plants, aquatic mammals, and microbes such as bacteria and fungi are the primary sources for producing innovative organic substances. In addition to these biological origins, new molecules can be synthesized through combinatorial and artificial chemistry.

There are numerous ways to distribute medicinal extracts, including microspheres, pills, capsules, formulations, niosomes, proniosomes, dendrimers, ethosomes, and transdermal drug delivery methods. The issues with herbal formulation include toxicity, instability, limited bioavailability, and moderate water solubility. Various nanoparticle networks have been used to aid with formulation, including active ingredient administration and entrapment in the nanocarrier framework. Dendrimers, solid lipid nanoparticles, liposomes, inorganic and inorganic nanoparticles, microemulsions, polymer nanoparticles, and nanoflora are some of the several types of nanoparticles.

Herbosomes

Herbosomes are newly developed formulations that improve the layer of skin and gut absorption of water-friendly polyphenols along with additional associated chemicals (Tripathi et al. 2022). The new combinations of herbosomes are made from three or more molecules; however, they ideally comprise a single molecule of either chemical-based

or natural phospholipids, such as phosphatidylcholine or phosphatidylethanolamine, and a single molecule of flavonolignans, which can be produced itself or in an organic blend in a prosthetic solvent like acetone. Silymarin has been shown to help treat liver illnesses such as hepatitis, cirrhosis, fatty liver filtration, and bile duct inflammation. Silybin protects the liver by preserving glutathione in parenchymal cells.

Liposomes

Liposomes are tiny particles composed of several bilayers of lipids, with a liquid medium in between. Their stability, long shelf life, ease of handling, controlled compatibility and degradation, and capacity to hold polar and non-polar molecules make them valuable. Liposomes can encapsulate lipophilic (fat-soluble) and hydrophilic (water-soluble) drugs.

The molecular makeup of liposomes enables the loading of lipophilic, hydrophilic, and amphiphilic materials. This flexibility allows for the pharmacokinetic and physicochemical properties of the medications they contain to be changed.

The table 1 below displays various plants and chemical constituents prepared using liposome technology.

Table 3-1 Plants and their chemical constituents incorporated as in the formulation

Plant Source	Carrier	Formulation Technique	Consequences
Silymarin	Lecitina, Cholesterol	Reverse evaporation	Increased absorption and bioavailability
Nisin-Z	Colloidosome	Colloidal	Lowered microbial growth
Quercetin	Egg phosphatidylcholine	Negative surface	Efficient
Curcumin	Responsive liposomes	Encapsulation	Stability against temperature

Dendrimers

3D, single-dispersed, hyperbranched frameworks and dendrimers have a basic core encircled by peripheral groups. A trio of architectural elements are commonly found in dendrimers: a central area, branches, and terminal units connected to the branches. Dendrimers can act as carriers for medications by connecting with pharmaceuticals by covalent or electrostatic interactions at their end active domains or by encasing the medications beneath the dendrite scaffold (Santos, Veiga, and Figueiras 2019).

The following order is involved in the drug's dendrimer release mechanism: (A) Molecular drugs get entangled in the dendrimer opening, which causes the dispersion of hydrophilic substances to rise. (B) The speed at which medication particles are distributed is regulated by integrating bioactive compounds into their outer coating.

The table 2 below displays various plants and chemical constituents prepared using liposome technology.

Table 3-2 Plants and their chemical constituents incorporated as in formulation

Plant Source	Carrier	Formulation Technique	Consequences
Silybin	PEG-PAMAM-G4	Encapsulation	Elevated solubility
Paclitaxel	PAMAM-G4-DHA	Conjugation	Elevated action in GIT cancer
Berberine	PAMAM	Encapsulation/conjugation	Raise pharmacokinetic outline
Resveratrol	PAMAM-G4	Encapsulation	Increased solubility
Gallic acid	PAMAM	Conjugation	Enhance bioavailability

Niosomes

Non-ionic surfactant-based capsules called niosomes serve the purpose of transporting medicinal drugs and also strengthening their absorption,

stability, and accessibility. A few examples of niosomes formulated as herbal preparation, *Psidium guajava*, using reverse phase evaporation technique incorporated with Span 60, cholesterol, and many more ingredients that are potentially applied to wound healing. In another study, *Garcinia mangostana* extract encapsulated a mixture of Span 60 and cholesterol with the technique of thin film hydration, this niosomal transferring increased the anti-acanthamoeba action and decreased its toxicity (Sangkana et al. 2024).

Microemulsion

A microemulsion is a fluid system consisting of a clear, basic emulsion containing alcoholic or media chains dispersed in an aqueous medium. Because the microemulsion is enhanced in solubility and stability, vital ingredients with varying degrees of lipophilicity and hydrophilicity can be delivered in the same formulation (Sintov and Shapiro 2004). Alternative oil phases Capmul PG-8/NF and Nigella sativa oil, along with surfactants Transcutol and Tween 20, were used to create two distinct types of microemulsions. These formulations aim to enhance the gastrointestinal tract's permeability and improve the bioavailability of oleanolic acid, a compound known for its antioxidant properties (De Stefani et al. 2022). The triptolide molecule found in *Tripterygium wifordii* is an example of a microemulsion in action. As shown in fig 2 below.

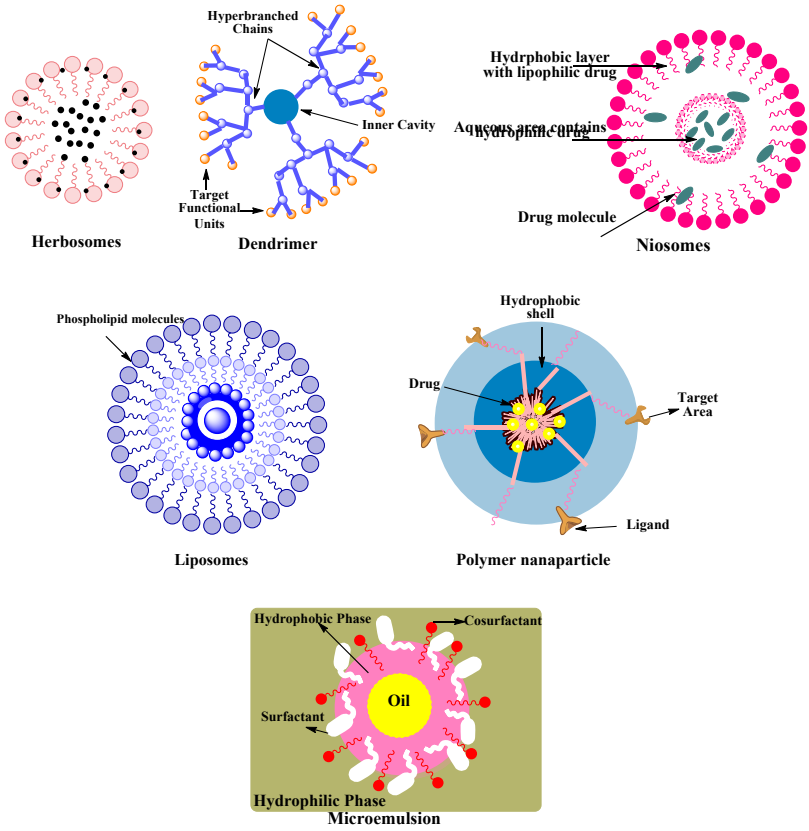

Fig. 3-2 Concise view of nanocarrier in herbal drugs

Conclusion

The vast patchwork of wisdom revealed by the historical background of herbal medicine has greatly influenced contemporary pharmaceuticals. Modern medicine continues to be impacted by its ancient relevance, which provides facts about culturally-based healthy lifestyle methods. To boost the solubility, bioavailability, pharmacological outcomes, strength, efficacy, selectiveness, and medicine accuracy of biologically active substances, nanoparticles like herbosomes, liposomes, microemulsions, dendrimers, and many more can be used to conquer the inadequate uptake

of some phytoconstituents due to their hydrophilic and inability to cross cell lipid their membranes.

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