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Introductory Chapter: Pharmacognosy

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1. Introduction

The word pharmacognosy consists of two Greek words, which mean drug and knowledge. In this field of science, researcher deals with the secondary metabolites found in many plants, animals, and microbial natural sources, for example, plant leaves, seeds, fruits, stem, roots, rhizosphere, herbs, spices, fungus, algae, corals, star fishes, jelly fishes, sponges, sea cucumber, sea urchins, sea weeds, snakes venom, frogs skin, cockroaches, and many more.

The American Society of Pharmacognosy (ASP) defines it as “the study of the physical, chemical, biochemical and biological properties of drugs, drug substances, or potential drugs or drug substances of natural origin as well as the search for new drugs from different natural sources” [1]. Most of the countries in South-East Asia Region of the WHO (World Health Organization) have a heritage of traditional medicine system. According to the recent WHO report, about 80% of world population is still using natural product for their primary healthcare needs. Pharmacognosy can provide safe and effective drugs in combination with modern medicine system.

2. Historical development

The history of herbal medication is as recent as human civilization. Herbal medicines, as the major remedy in ancient system of medicine, are employed in medical practices since antiquity [2, 3].

The early medicines of Pharaohs (3000 BC), the Greek (460–370 BC; Hippocratis), the Roman (37 BC; Dioscorides, a Greek physician of the first century AD was the writer of the first *Materia Medica* (78 AD). They described 600 medicinal plants and those of Middle Ages exemplified by the Arab Physicians (Rhazes 865–925; Avicenna 980–1037) relied mainly on plants for therapy [4].

India has renowned for practicing classical medicinal systems such as: Siddha, Buddha, Ayurveda, and Unani methods of medication and treatment. These medicinal systems are found even in the ancient Vedas and other ancient literatures and scriptures. The Ayurveda concept appeared and grew up between 500 and 2500 BC in India [5]. The authentic meaning of Ayurveda is “science of life,” because ancient Indian system of health care focused on views of human and their sickness. It has been pointed out that the positive health means metabolically well-balanced human beings.

3. Modern concept

Higher medicinal plants have a vital role in the development of new drugs. During the years 1950–1970, nearly hundreds of new drug-based plants were introduced into the USA drug markets, consisting on ricinin, derbipidine, reserbine (**Figure 1**), phenplastin, and phenicristine (**Figure 2**) derived from higher plants. From 1971 to 1990, new drugs, such as octoposide, teneboside, *E*- and *Z*-guggulsterone (**Figure 3**), nebulon, plonotol, and artemisinin (**Figure 4**), appeared all over the world.

About 2% of drugs were introduced from 1991 to 1995 including pacitaxel, toptecan, irinotecan (approved drug, FDA, USA), etc. Plant-based drugs provide outstanding contribution to modern therapeutics; for example, Vinblastine isolated from the *Catharanthus roseus* [6] is used for the treatment of nature preceding: Hodgkin's chorio carcinoma, non-Hodgkin's lymphomas, leukemia in children, testicular, and neck cancer (**Figure 5**).

Vincristine is recommended for acute lymphocytic leukemia in childhood advanced stages of Hodgkin's lymphoma, small cell lung, cervical, and breast cancer [7]. Phophyllotoxin is isolated from *Phodophyllum emodi* (Berberidaceae), and used against small lung cancer cells and lymphomas (testicular cancer). An Asian indigenous tree *Nothapodytes nimmoniana* (Icacinaceae) is traditionally used in Japan for the women cervical cancer treatment (**Table 1**), and the main active compounds of this plant is Camptothecin (monoterpene indole alkaloid). Drugs derived from plants are used for solving many different health issues such as skin diseases, to cure mental sickness, lungs diseases, hypoglycemia, hyperglycemia, disorders of liver function, hypertension, heart problems, and cancer. These medicinal plants play a very important role in the development of potent therapeutic metabolites. Drugs isolated from plants came into human use in the modern way

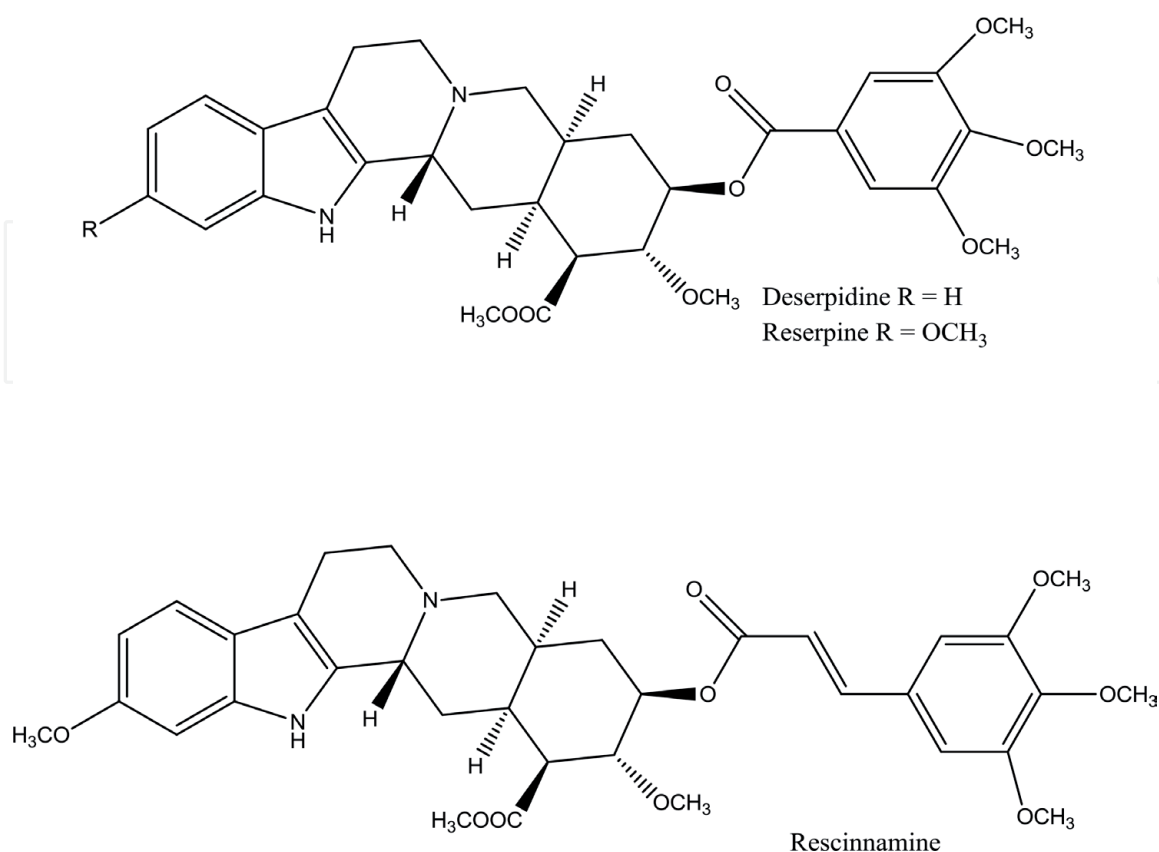


Figure 1.
Reserpine and its derivatives.

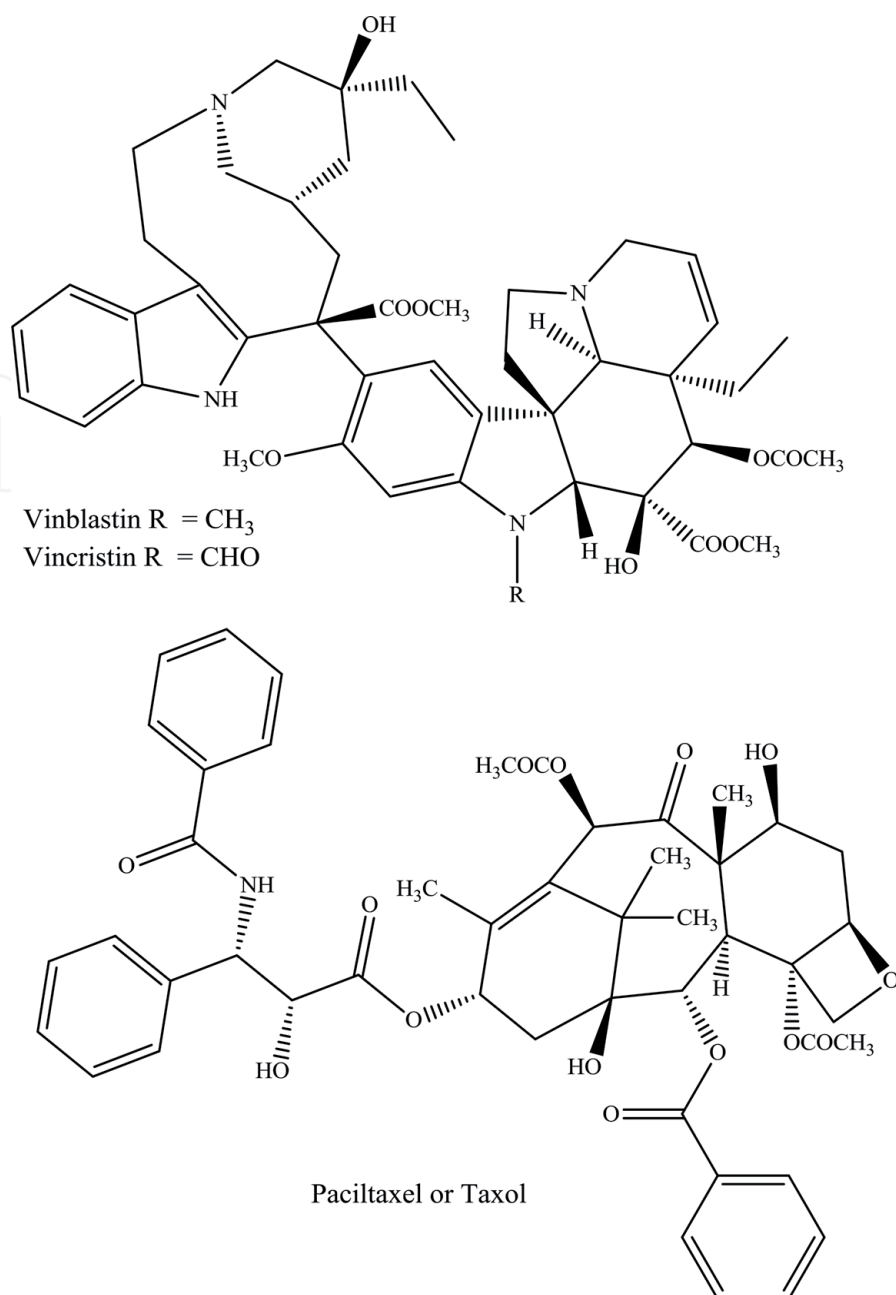


Figure 2.
 Vinblastine and its derivatives.

of medicine through the uses of different plant material (leaves, roots stem, flower, stigma, bulb, and rhizosphere) as indigenous relieve in folk and conventional systems of medicine. More than hundred plants have been found to possess notable antibacterial activities; and many plants have been found to showed strong antidiabetic properties. Two compounds (etoposide and teniposide) isolated from one of the *Podophyllum* species were used for the treatment of testicular and lung cancer. Taxol, a well-known secondary metabolite from *Taxus brevifolius* (Taxaceae), is used for the treatment of lung cancer and ovarian cancer. The above-mentioned drugs came into use through the screening analysis of different medicinal plants, because they showed very little side and harmful effects, were profitable, and possessed good rapport. A racemic mixture ($\pm 1:1$) of harringtonine and homo harringtonine isolated from *Cephalotaxus fortunei* (Cephalotaxaceae) has been used well in China for the treatment of acute chronic myelogenous leukemia and myelogenous leukemia [8]. Elliptinium, a *N*-methyl derivative of ellipticine isolated from *Bleekeria vitensis* (Apocynaceae), is marketed in different places in Europe (France) for the breast cancer treatment (**Table 1** and **Figure 1**) [9].

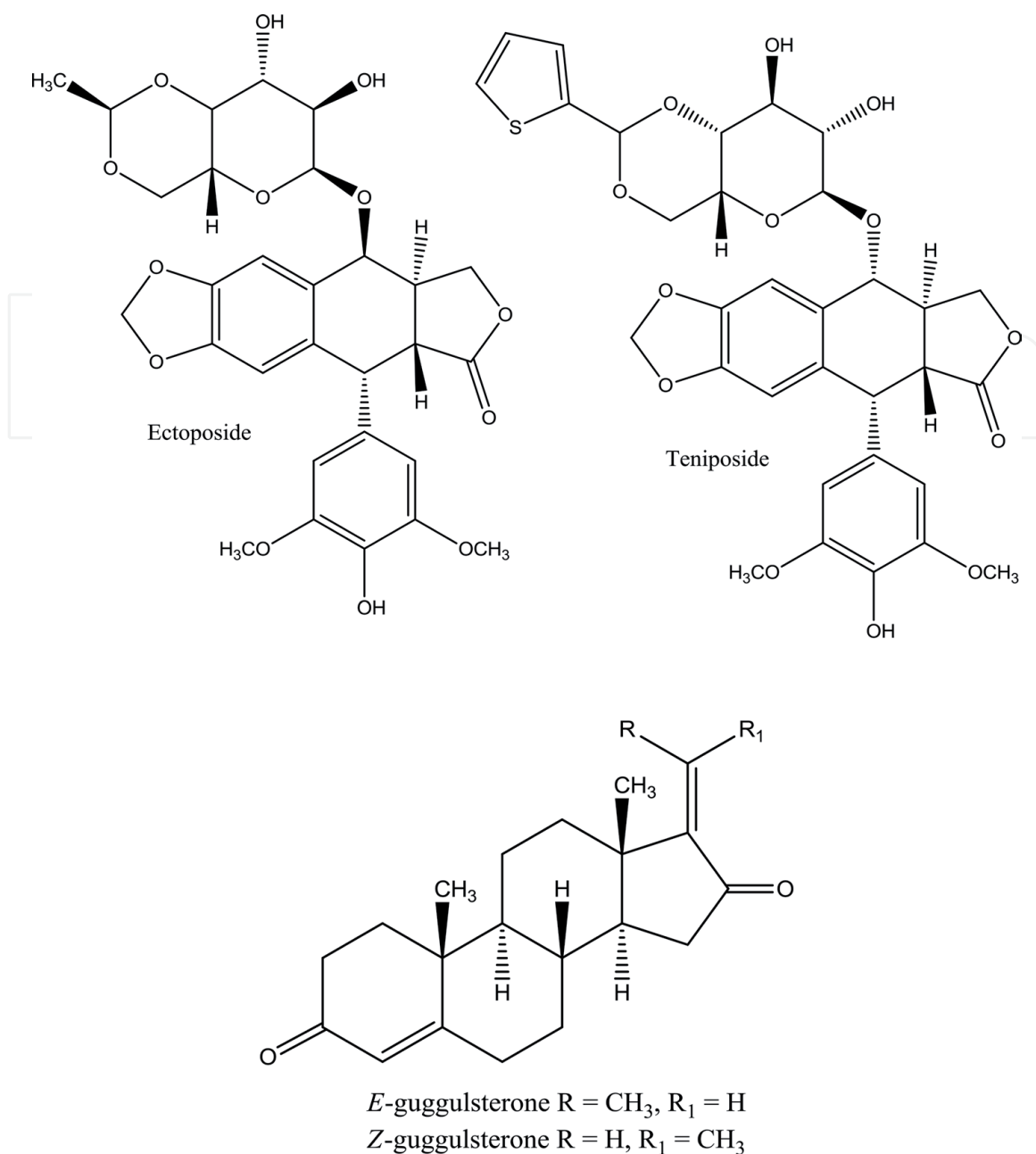


Figure 3.
Ectoposide, teniposide, and E- and Z-guggulsterone.

4. Scope of pharmacognosy and phytochemistry

Pharmacognosy has always been a field of multidisciplinary science, and during the expansion of the orbit of this area, phytochemistry, phytomedicine, and phytochemical analysis have become important parts of this field.

Molecular biology field has become an extremely important area for medicinal plant drug discovery analysis through the determination and application of convenient screening assays directed physiologically related molecular targets, and modern pharmacognosy encapsulates all of these relevant new research areas into a distinct interdisciplinary natural product science.

The insistence and focus of research in pharmacognosy have alternated very significantly, from focusing on isolation and structure elucidation of drugs, including the information of active constituents, along with their biological activity as well as structure activity relationship (SAR) studies. Advanced researches in the field of ethnobiomedicine, ethnobotany, and ethnopharmacology has also become an essential

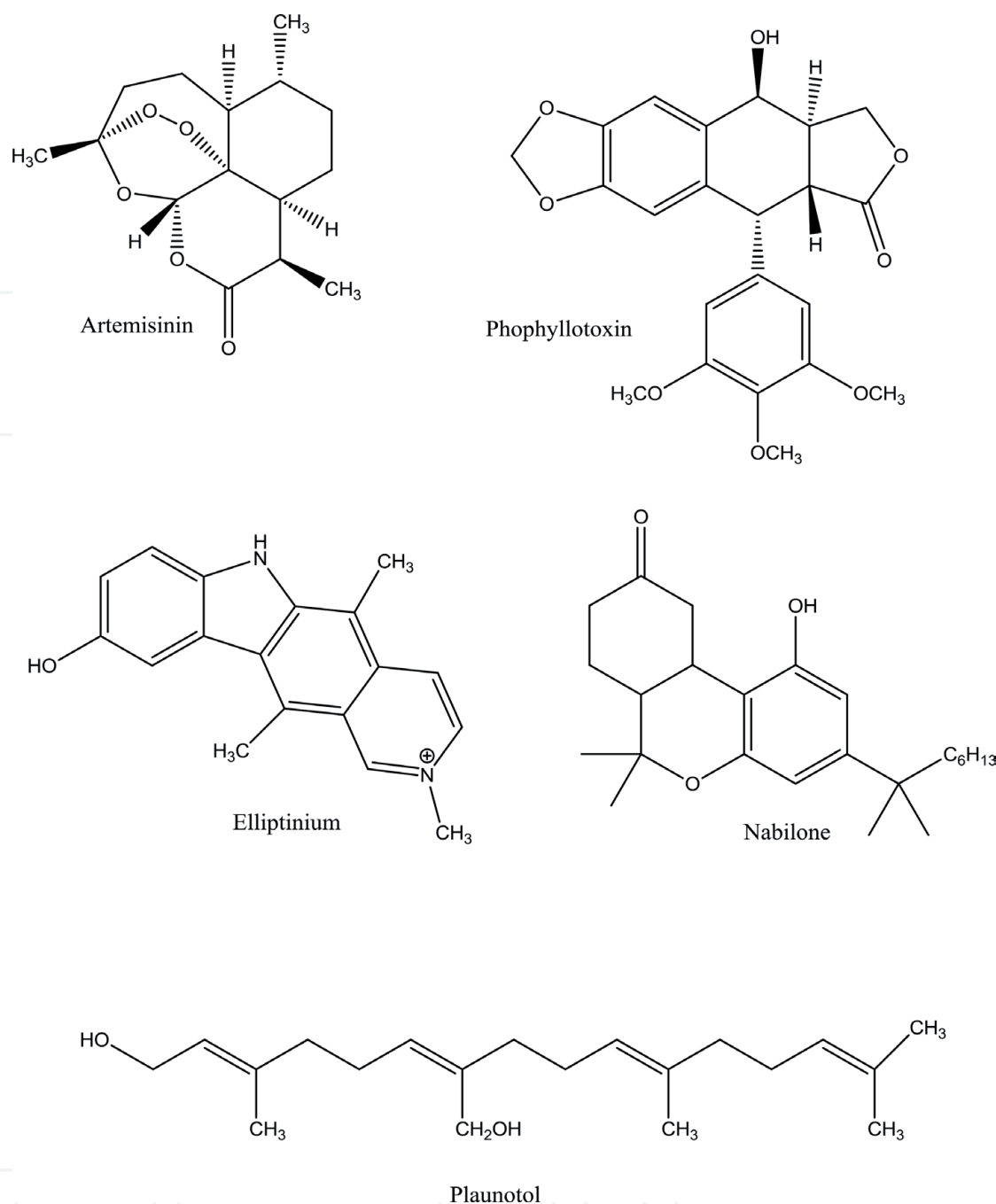


Figure 4.
 Structures of few more anticancer drugs.

element in the orbit of pharmacognosy. Pharmacognosy deals an important association between medicinal chemistry and pharmacological studies (pharmaceutical chemistry) (**Table 2**). In recent years, as a result of fast development of advance phytochemistry and pharmacological testing ways and methods, new plant-derived drugs are finding their way into medicine as single phytochemical, rather than in the mixture form of traditional herbal preparations. The world is now moving toward the herbal medicine or phytomedicines that repair and strengthens bodily systems (especially the immune system, which can then properly fight foreign invaders) and help to destroy offending pathogens without toxic side effects.

However, presently, drug discoveries are increasing rapidly after adopting traditional/folk medicine-based uses/approaches to increase results and with safety concerns. Thus, different sub-branches of pharmacognosy, such as: analytical, industrial, and clinical, have been established as a modern and professional off shoots of specialized pharmacognosy to meet the most productive advancements and collaborations

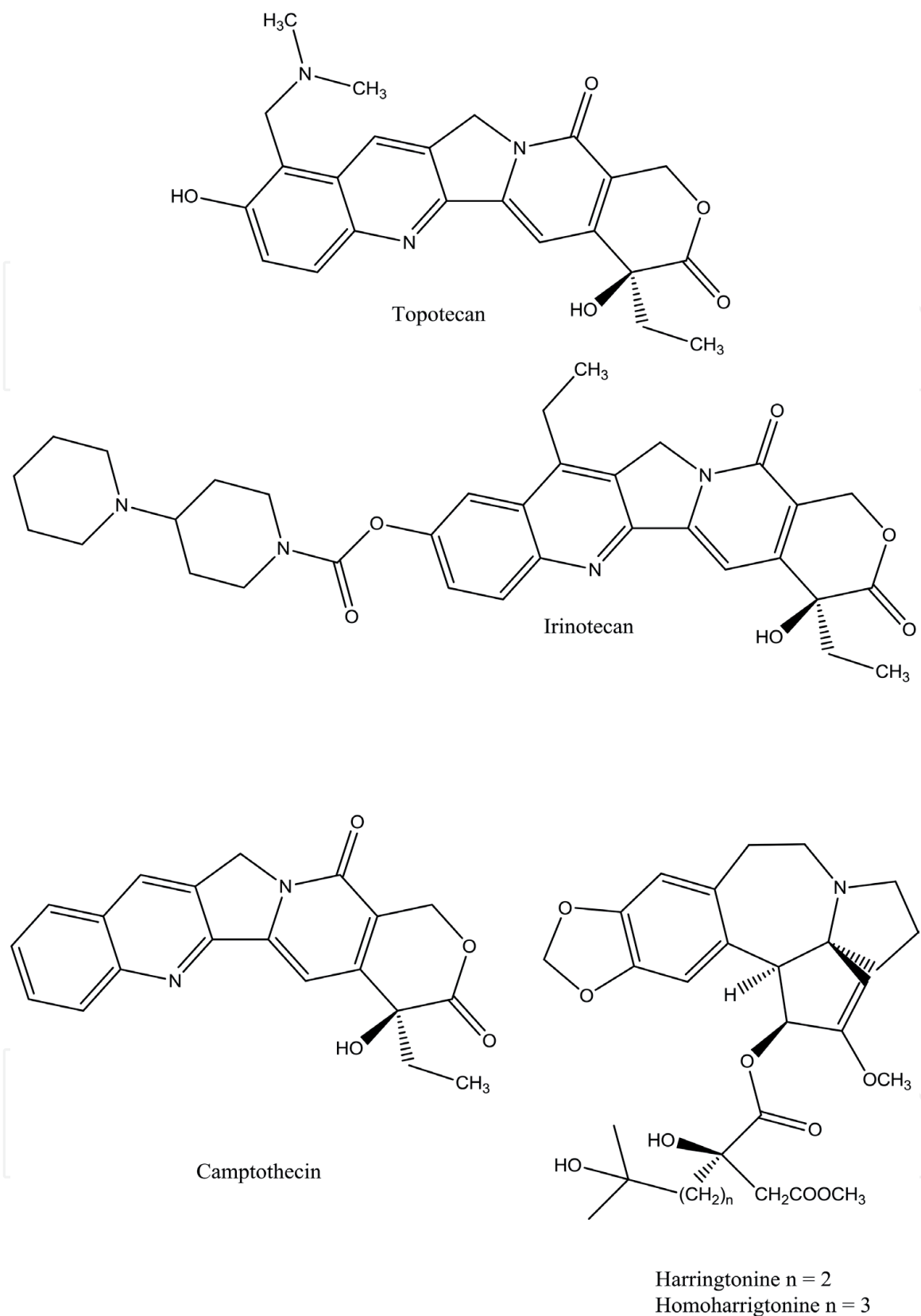


Figure 5.
Topotecan, irinotecan, camptothecin, harringtonine, and derivatives.

in this field. Furthermore, molecular, metabolomic, and genomic pharmacognosy have been introduced as the new and promising targets of research for accommodating future supply and demands in biomedicine, molecular biology, biotechnology, and analytical chemistry of traditional natural medicines and folk medicinal plants. Nevertheless, interdisciplinary combined and collaborative research work is very essential for optimizing the development of traditional biomedicines and pharmacognosy field of research, education, and techniques.

Plant name	Family	Drugs treatment
<i>Cathranthus roseus</i> (Apocynaceae)	Vinblastine and Vincristine	Hodgkin's, Lymphoma, children leukemia, bladder, brain, and melanoma
<i>Podophyllum emodi</i> (Beriberidaceae)	Podophyllotoxin	Testicular cancer, lymphoma, and lungs cancer
<i>Taxus brevifolius</i> (Taxaceae)	Pacitaxel and Taxotere	Ovarian, malignant melanoma, breast, lungs, and pancreatic cancers
<i>Mappia foetida</i> (Icacinaceae)	Camptothecin, Irinotecan, and Topotecan	Lung, cervical, breast, and ovarian cancer
<i>Comptotheca acuminata</i> (Nyssaceae)	Quinoline and Camptothecin	Skin, lungs, and cervical cancer
<i>Juniperus communis</i> (Cupressaceae)	Teniposide and Etoposie	Lung cancer and lymphocytic leukemia in children

Table 1.
Few important medicinal plants used as modern drugs for cancer treatment.

Drug	Basic investigation
Digoxin	<i>Digitalis</i> leaves were being used in heart therapy in Europe during the eighteenth century
Emetine	Brazilian Indians and several others South American tribes used roots and rhizomes of <i>Cephaelis</i> sp. to induce vomiting and cure dysentery
Codeine, morphine	Opium, the latex of <i>Papaver somniferum</i> used by ancient Sumerians. Egyptians and Greeks for the treatment of headaches, arthritis and inducing sleep
Ephedrine	Crude drug (astringent yellow), derived from <i>Ephedra sinica</i> , had been used by Chinese for respiratory ailments since 2700 BC
Quinine	<i>Cinchona</i> sp. were used by Peruvian Indians for the treatment of fevers
Colchicine	Use of Colchicum in the treatment of gout has been known in Europe since 78 AD

Table 2.
Plant-derived ethnotherapeutics and traditional modern medicine.

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