Chapter

Medicinal Plants Used by the Tay Ethnic Group, Thai Nguyen Province, Vietnam

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Abstract

An ethnobotanical study of medicinal plants used by the Tay ethnic group in Thai Nguyen province, Vietnam has been carried out in the present study, especially in the region of Định Hoá, Phú Lương, and Võ Nhai districts. The ethnobotanical survey was conducted between 2018 and 2021 and a catalog of the medicinal plant used by the Tay ethnic group is prepared. The results of the current survey revealed that the plants used by Tay ethnic group consist of 321 species belonging to 253 genera and 103 botanical families. Majority of the plants belonging the family Euphorbiaceae (20 species), Asteraceae (19 species), Acanthaceae and Rutaceae (13 species each), Fabaceae (12 species), and Poaceae (11 species). Leaves were the most frequently used plant part (48.0%) in the preparation of medicines. The most frequent preparation method was decoction (47.7%), followed by crushing (29.9%), sauna (18.0), pickle wine (11.8%), and raw (5.6%). The major plant used by Tay ethnic people were *Schefflera heptaphylla* (L.) Frodin and *Plantago major* L., (2); *Elephantopus scaber* L. and *Achyranthes aspera* L.; *Streblus asper* Lour. We also carried out screening of some of the medicinal plant extracts for their biological activities especially the inhibition of cancer cell lines.

Keywords: medicinal plants, Tay ethnic group, traditional knowledge, biological activities, conservation, Thai Nguyen

1. Introduction

Plant resources have a long history of being used as medicinal materials. It is often cited that 80% of the world's population still relies on traditional medicines to meet their primary health care needs [1] and nearly 25% of modern medicines are derived from nature, many of which were derived from traditional uses [2]. The use of traditional medicines is generally affected by accessibility, availability, and acceptability of health care services. Especially, in remote areas of developing countries, medicinal plants may form the only available source of health care.

Vietnam possesses a vast wealth of historical, cultural, and natural richness that includes big deltas, huge limestone towers, beautiful dunes, lush green forests, and grasslands. The richness can also be seen in the diversity of flora, which is evident with an estimated number of 13,747 vascular plant species [3]. To preserve the rich biodiversity of Vietnam and their sustainable development, the government has demarcated 164 special use forest areas including 30 National Parks, 58 Natural Reserves, 11 Species Conservation Areas, 45 Forest Landscape Protection and 20 Experimental Forests of Scientific Research [3].

The use of traditional medicine in Vietnam has a vibrant history spanning thousands of years. Today, around 75% of Vietnamese people use traditional medicine as their primary source of treatment to meet their health care needs. These users mostly include inhabitants of rural or mountainous areas, which have less accessibility to hospitals or community health care centers [4].

The Tay ethnic people are one of the 54 officially recognized ethnic minorities of Vietnam, whose population is around 150,404 people, accounting for 11.69% of the Thai Nguyen province's population. They are residing mainly in areas such as districts (Định Hoá, Phú Lương, Võ Nhai) (**Figure 1**, [5]). The people belonging to the Tay ethnic group are dependent on forest resources such as wood and non-timber forest products. Their major livelihood activities include the collection of forest products such as wild honey, bamboo shoots, animals, and mushrooms for consumption [6].

Contrary to the growing demand for medicinal plants all over the world, traditional knowledge is declining rapidly, especially in developing countries. Considering the vast floristic wealth of the nature reserve and the rich knowledge of the local community, an urgent need was felt to take over this work, which could help the researchers, forest officials as well as the future generation people involved in ethnobotany research. It is worth mentioning that the knowledge of Tay ethnic people about medicinal plants is vast but poorly documented. Therefore, we were interested in

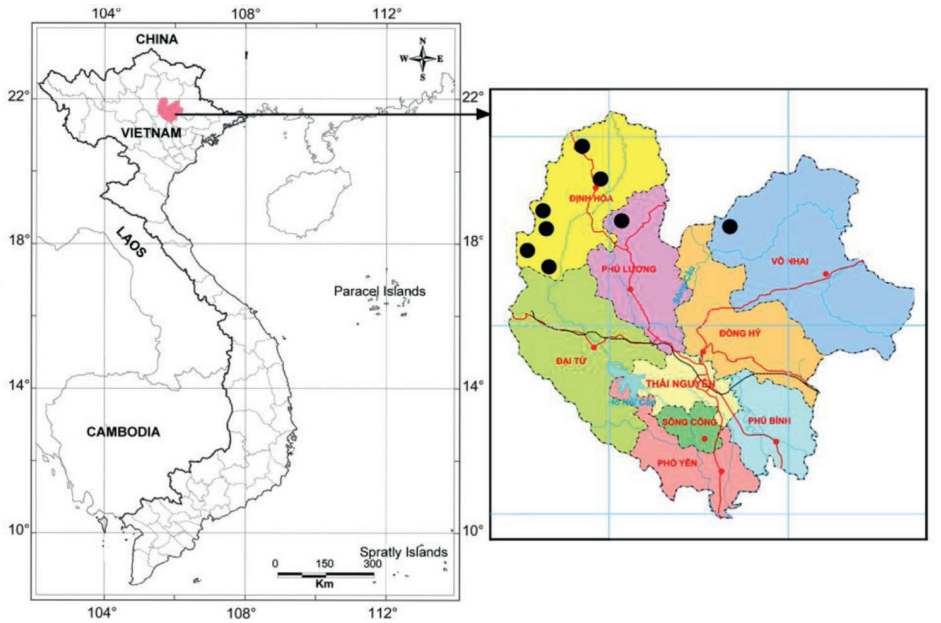


Figure 1.
Studying locations (●).

introducing medicinal plants, medicinal uses, and the experience of recognizing and collecting medicinal plants of the Tay people. Besides, also mentioned some experimental results proving the anti-cancer ability of some herbal species that have been used by the Tay people to treat diseases. Finally, conservation measures to preserve the medicinal plant resources of the Tay people in Thai Nguyen province.

2. General data on medicinal species

In this study, all investigated species were as the scientific names, Vietnamese name, name of Tay ethnic group, parts used, tree-forms, and disease treated (List of medicinal plants of Tay ethnic group in Thai Nguyen province do not show).

During (2018–2021), the result of research on medicinal plants of the Tay ethnic group in Thai Nguyen province obtained 321 species of medicinal plants belonging to 253 genera and 103 families of 3 divisions of vascular plants in Vietnam (**Table 1**, [6]).

Among these, the most diverse families (over 10 species) that the Tay people in Thai Nguyen province use as medicine are the as below: 20 species belonging to Euphorbiaceae, 19 species to Asteraceae, 13 species to Acanthaceae and Rutaceae respectively, 12 species to Fabaceae and 11 species to Poaceae (**Figure 2**). These families have been widely used in the Indo-Burma region for their medicinal properties [7–13].

3. Indigenous knowledge capital in the use of medicinal plants of the Tay ethnic group in Thai Nguyen province

Knowledge of medicinal plants depends upon ecological diversity along with differences in languages and cultures of ethnic communities. The knowledge of the use of plants varies within each ethnic group and between ethnic groups. It is of great significance to learn and research knowledge of using traditional medicinal plants to provide a database for science. Knowledge of using medicinal plants is very diverse, the same species has many different uses. Knowledge of using medicinal plants is often supplemented through experiences from medical practice, as well as from failures in the process of using medicinal plants. The knowledge used is associated with the culture, beliefs, and customs of each ethnic group and each locality.

3.1 Experience in identifying and collecting medicinal plants

Traditional knowledge of plant names and uses depends on the experience of local people. The folk names of plants are the source of the diversity of traditional

Division	Family		Genus		Species	
	Total	%	Total	%	Total	%
Polypodiophyta	9	8,8	10	3,9	11	3,5
Pinophyta	1	0,9	1	0,4	2	0,6
Magnoliophyta	93	90,3	242	95,7	308	95,9
Total	**103**	**100**	**253**	**100**	**321**	**100**

Table 1.
Total of medicinal plants used by Tay ethnic group in Thai Nguyen province.

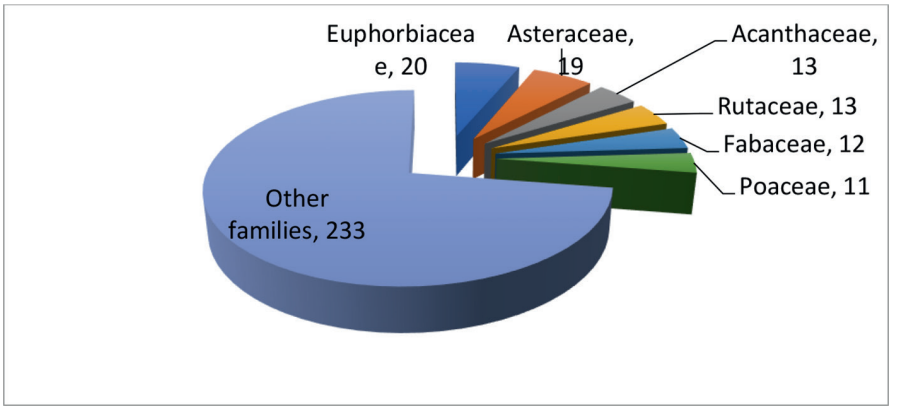


Figure 2.
Number of plant species by most representative family used for medicinal purposes in the study area.

knowledge. In addition, the system of folk names and ways of recognizing plants is passed down from generation to generation in the community.

Through research and interviews with people who have experience in using medicinal plants, it was found that the Tay people in Thai Nguyen province know how to use many types of medicinal plants. Most of the families in the Tay ethnic community know some medicine to cure some common diseases such as fever, headache, and stomachache, and are famous for treating stomach ailments, nervous breakdowns, and fractures. Depending on the type of disease, one tree or several trees can be used. The Tay people have many simple but effective remedies. In general, the use of plants to make medicine is very diverse and depends on each remedy as well as the treatment experience of the physician.

The Tay people have a unique way of naming medicinal plants, the names of medicinal plants are often based on the shape and characteristics of parts of the plant such as leaves, stems, roots, flowers, and fruits, which have similar characteristics to the shape, characteristics of a certain subspecies to name. Or the Tay people have many different ways of recognizing medicinal plants, which can be based on the plant's life form, such as "thảu" is used to indicate the life form of climb; "nhả" refers to a life form that is mainly herbaceous, "khảu" refers to the habitat of medicinal plants in the forest. In addition, based on the color of the parts of the tree to name them: "khảo" means "white"; "đăm" means "black"; "lưởng" means "gold"; "đẻng" means "red". This is a very interesting explanation for the naming of medicinal plants of the Tay people, helping the Tay people remember medicinal plants more easily, avoid confusion and pass it on to the next generation more effectively.

3.2 Plants parts used

Research on the used parts of medicinal plants not only shows the richness and diversity in the healing power of those parts but also has great conservation significance, at the same time, the study of medicinal plant parts partly assesses the sustainability of the exploitation and use of medicinal plant resources in ethnic minority communities. The results of the parts used as medicine according to the experience of the Tay ethnic group in Thai Nguyen province are shown in **Figure 3**, [6].

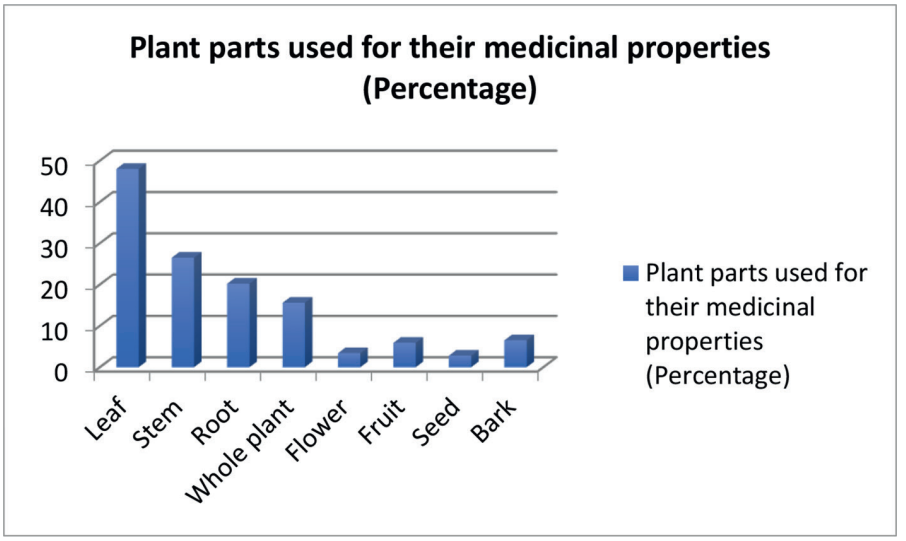


Figure 3.
Plant parts used for their medicinal properties (Percentage).

The research results on the frequency of using plant parts for healing show that leaves and stems are two parts that are used more than other parts such as flowers, fruits, seeds, roots, bark, and sap. The leaf represents the most used plant part (48.0%), followed by stem (26.5%), root (20.2%), whole plant (15.6%), flower (3.4%), fruit (5.9%), seed (2.8%), and bark (6.5%). This can be due to easy accessibility and availability of leaves among other plant parts. The use of leaves for medicinal purposes is preferred by most ethnobotanical studies because it is less likely to affect the survival of the plant as compared to roots [14–16]. Similar results were also shown in the study on medicinal plants of the Co Tu ethnic group in the buffer zone of Bach Ma National Park [17]. Many studies conducted around the world also show that leaves are used more than other parts of the plant [18–20]. The use of medicinal leaves reduces the level of threat to medicinal plants or helps in the sustainable harvesting of medicinal plants. Further, it has been reported that roots and bark are not sustainable for the development of traditional medicine [21].

Five different modes of medicine preparation were documented. Decoction (47.7%) was the most frequently quoted mode of preparation (**Figure 4**, [6]), followed by crushing (29.9%), sauna (18.0), pickle wine (11.8%), and raw (5.6%). It was also found that for some plants, different modes of preparation were used to treat different diseases. For example, leaves of *Glycosmis parviflora* (Sims) Little were prepared as a decoction for treatment of rheumatism and bone pain cure which may also be prepared as a sauna for treatment of edema.

3.3 Combination of medicinal plants

Medicinal plants make important contributions to the health care system of local communities. The collected ethnobotanical data is a valuable source for the development of new drugs in the future. The purpose of research on the conservation of ethnic medicinal plants is not only towards the conservation of medicinal plant genetic resources but also to preserve and promote the experience and knowledge of ethnic groups in the use and development of medicines.

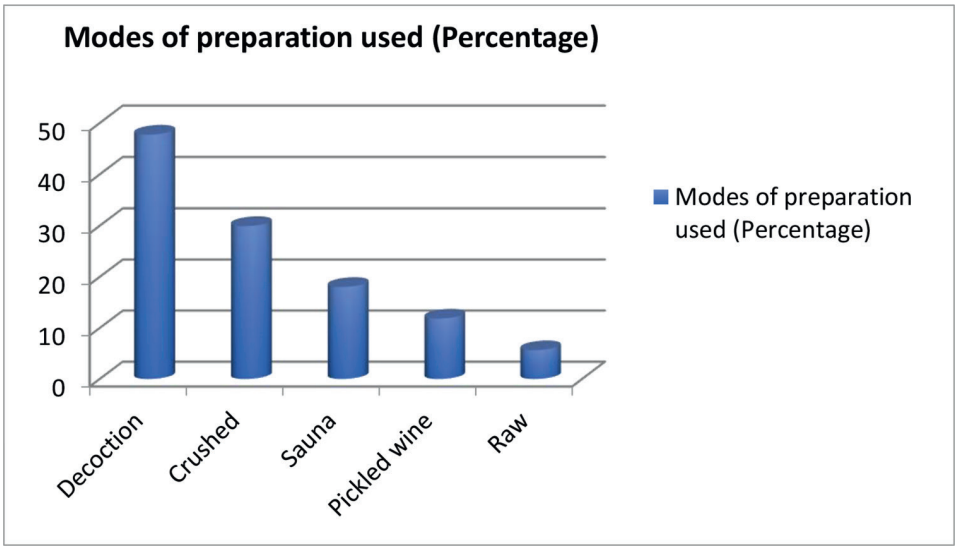


Figure 4.
Modes of preparation used (Percentage).

The Tay ethnic people in Thai Nguyen province combined some species to treat a few diseases (**Table 2**, [6]). For example, a decoction of *Abutilon indicum* (L.) Sweet (leaf), *Trevesia palmata* (Roxb. ex Lindl.) Visan. (stem), *Pandanus tonkinensis* Martelli ex. Stone (fruit), *Eclipta prostrata* L. (stem, leaf), *Schefflera heptaphylla* (L.) Frodin (root), is used to treat kidney disease. Similarly, a decoction of *Schefflera heptaphylla* (L.) Frodin (root), *Argyreia acuta* Lour. (stem and leaf), *Sigesbeckia orientalis* L. (whole plant) and *Schefflera venulosa* (Wight & Arn.) Harms in Engl. & Prantl (root) is used to treat neurological, and cerebrovascular stroke. The plants which were used more than once by Tay ethnic people to treat several diseases are *Schefflera heptaphylla* (L.) Frodin, *Plantago major* L., (2); *Elephantopus scaber* L., *Achyranthes aspera* L., (3); *Streblus asper* Lour. (4).

R = root; S = stems; W = whole plant; L = leaf; F = fruit; B = bark; RF = rind of fruit.

3.4 Rare plants conservation

Out of 321 plant species studied from this region, three plant species have been listed in the IUCN Red list [22], *Cycas balansae* Warb. as Near Threatened (NT), *Cycas bifida* (Thiselton - Dyer) K. D. Hill as Vulnerable (VU) and *Aquilaria crassna* Pierre ex Lecomte as Critically Endangered (CR). That species also is listed by the Vietnam Red book as *C. balansae* Warb. as Vulnerable (VU), *C. bifida* (Thiselton - Dyer) K. D. Hill as Vulnerable (VU), and *A. crassna* Pierre ex Lecomte as Endangered (EN) [22] and another species were listed by the Vietnam Red book and the Decree 06/2019/ND-CP of the Government of Vietnam [23, 24] (**Table 3**, [6, 22–24]).

C. balansae Warb. was distributed in Vietnam and Lao, south of China, and north of Thailand [25]. Plants grow under the forest canopy, on limestone mountains, at an altitude of about 100–500 m. Beautiful tree planted as an ornamental [26]. The studies suggest small population sizes of cycads brought about by fragmentation of their habitats, over-exploitation, and the increasing number of inbred individuals within populations [27].

Scientific name (parts used)	Preparation method	Medicinal use
Clerodendrum japonicum (Thunb.) Sweet (R, S) + *Clerodendrum chinense* (Osbeck) Mabb. (R, S) + *Psidium guajava* L. (L, B) + *Elephantopus scaber* L. (R) + *Achyranthes aspera* L. (R) + *Curcuma longa* L. (S)	Decoction/oral	Intestinal diseases
Ardisia gigantifolia Stapf. (L) + *Croton tonkinensis* Gagnep. (S, L) + *Ficus tinctoria* ssp. *gibbosa* (L) + *Hedyotis capitellata* Wall. ex G. Don (S)	Decoction/oral	Epigastric disease
Abutilon indicum (L.) Sweet (L) + *Trevesia palmata* (Roxb. ex Lindl.) Visan. (S) + *Pandanus tonkinensis* Martelli ex. Stone (F) + *Eclipta prostrata* L. (S, L) + *Schefflera heptaphylla* (L.) Frodin (R)	Decoction/oral	Kidney disease
Streblus asper Lour. (L) + *Costus speciosus* (Koenig) Smith (S, L) + *Plantago major* L. (W) + *A. aspera* L. (S, L) + *Imperata cylindrica* (L.) Beauv. (R)	Decoction/oral	Urinary tract infections
Glycosmis parviflora (Sims) Little (R) + *Sauropus androgynus* (L.) Merr. (L) + *Streblus asper* Lour. (R) + *Melastoma sanguineum* Sims (R) + *Chrysopogon aciculatus* (Retz.) Trin. (R)	Decoction/oral	White discharge in women
Oroxylum indicum (L.) Kurz (B) + *Averrhoa carambola* L. (L) + *Pistia stratiotes* L. (W)	Boil/bath	Skin rash and itching
Schefflera heptaphylla (L.) Frodin (R) + *Argyreia acuta* Lour. (L, S) + *Sigesbeckia orientalis* L. (W) + *Schefflera venulosa* (Wight & Arn.) Harms in Engl.&Prantl (R)	Decoction/oral	Neurological - cerebrovascular stroke
Streptocaulon juventas (Lour.) Merr. (S) + *Tinospora sinensis* (Lour.) Merr. (L, S) + *Piper lolot* C. DC. (S) + *Mimosa pudica* L. (R)	Decoction/oral	Joint pain
Heliciopsis lobata (Merr.) Sleum. (R) + *Glochidion eriocarpum* Champ. (R) + *Streblus asper* Lour. (R) + *E. scaber* L. (R)	Decoction/oral	Growth retardation in children
E. scaber L. (R) + *Scoparia dulcis* L. (W) + *P. major* L. (R) + *Cuscuta australis* R. Br. (S) + *Adenosma caeruleum* R. Br. (S, L)	Decoction/oral	Hepatitis
Aglaia duperreana Pierre (F) + *Raphanus sativus* L. (S) + *Polyscias fruticosa* (L.) Harms (R, L) + *Citrus nobilis* Lour. (RF)	Decoction/oral	Bronchitis
Citrus medica L. (R) + *Streblus asper* Lour. (R) + *A. aspera* L. (R) + *Clausena dimidiata* Tanaka (R)	Boil/ suck	Gingivitis
Morus alba L. (R, B) + *Ageratum conyzoides* L. (L) + *Acorus gramineus* Soland. (R)	Boil/sauna	Sinusitis

Table 2.
List of medicinal plant combinations used by Tay ethnic people.

C. bifida (Thiselton - Dyer) K. D. Hill is distributed in Vietnam, China (southern Guangxi and eastern Yunnan provinces), Southeast Asia, and Australia. The number of mature individuals ranges from 10.000 to 12.000 and the altitude range is 100 to 300 meters above sea level. The sap of cycad treats ulcers, but the megasporophyll of cycad is known to treat pain relief [28]. The Tay people use the leaf of this species to treat bone marrow disease.

Scientific name (Vietnamese name)	Family	Situation		
		IUCN Red List	VNRB	De/06/2019
Cycas balansae Warb. (Tuê ba lăng sa)	Cycadaceae	NT	VU	IIA
Cycas bifida (Thiselton - Dyer) K. D. Hill (Tuê xẻ đôi)	Cycadaceae	VU	VU	IIA
Aquilaria crassna Pierre ex Lecomte (Trâm)	Thymelaeaceae	CR	EN	
Canarium tramdenum Dai ex Yakovl. (Trám đen)	Burseraceae		VU	
Disporopsis longifolia Craib (Hoàng tinh hoa trăng)	Convallariaceae		VU	IIA
Stephania kwangsiensis H. S. Lo (Bình vôi quảng tây)	Menispermaceae			IIA
Fibraurea tinctoria Lour. (Hoàng đăng)	Menispermaceae			IIA
Melientha suavis Pierre (Rau săng)	Opiliaceae		VU	
Anoectochilus setaceus Blume (Kim tuyên tơ)	Orchidaceae		EN	IA
Paris hainanensis Merr. (Trọng lâu hải nam)	Trilliaceae			IIA

Table 3.
List of rare medicinal plants for conservation.

A. crassna Pierre ex Lecomte is endemic to the Indochina region and is known to be used in diverse Southeast Asian traditional medicine systems to treat infectious and inflammatory diseases, arthritis, and cardiac disorders [29]. The Tay people use the leaf of this species to treat cure colds and abdominal pain. According to the Dictionary of Vietnamese Medicinal Plants, *A. crassna* Pierre ex Lecomte has a beneficial effect on digestive diseases, anti-diarrhea, anti-emetic and antipyretic [27]. In the research Ethnobotanical study on medicinal plants used by local Van Kieu ethnic people of Bac Huong Hoa nature reserve, Vietnam reported the Van Kieu people use the root of this species to treat fever and abdominal pain [30]. Studies on *A. crassna* Pierre ex Lecomte revealed that the extracts from leaves and stems possess antioxidant, antimicrobial, cytotoxic, antipyretic, analgesic, antiischemic, laxative, and digestive properties [31–35].

4. Screening of medicinal plants for biological activities

From the collected data on the use of medicinal plants according to the traditional experience of the Tay ethnic people in Thai Nguyen province, the study on extracts of some herbal species *Ardisia gigantifolia* Stapf., *Excoecaria cochinchinensis* Lour., and *Heliciopsis lobata* (Merr.) Sleum. was conducted ability to inhibit cancer cells.

MTT assay (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) was used to check the viability of certain cancer cell lines using the above-listed plant extract. It was shown that the ethanol extract from the leaves of *Ardisia gigantifolia* Stapf. was able to effectively inhibit the proliferation of all three AGS, MKN45, and MKN74 gastric cancer cell lines with IC50 values ranging from 50 to 140 μg/mL. Meanwhile, ethanol extract of *Excoecaria cochinchinensis* Lour. was also shown to inhibit the

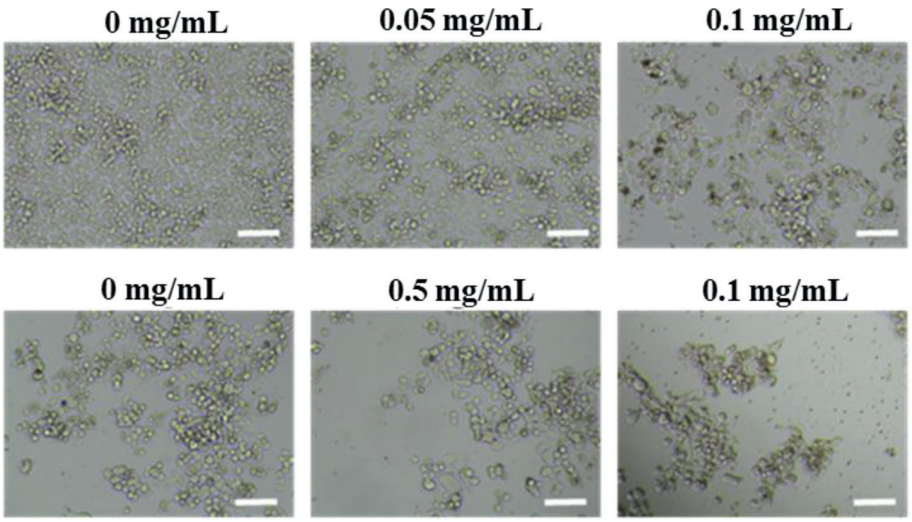


Figure 5.
Effect of Excoecaria cochinchinensis Lour. extracts on MKN45 cell proliferation. Cells were treated with extracts at different concentrations from 0.05 to 1 mg/mL. The control is extract - untreated cells (0 mg/mL): Cell image taken under an inverted microscope, 200X magnification. Scale: 50 μm.

proliferation of gastric cancer cell line MKN45 with IC50 = 70 μg/mL (**Figure 5**, [36]). Also, by MTT screening on HepG2 liver cancer cells, it was shown that the methanol extract of *Heliciopsis lobata* (Merr.) Sleum. plant effectively inhibited cell proliferation after 48 h of treatment with the extract, with IC50 value = 84 μg/mL [37].

Research on the toxicological test of new triterpenoid saponins of *Ardisia gigantifolia* Stapf., results showed that the compound triterpenoid saponin from *Ardisia gigantifolia* Stapf. was able to inhibit the growth of liver cancer cell lines and Hela cells with IC50 values determined ranging from 1.9 to 4.8 μM [38]. A later study, also showed that triterpenoid saponin AG8, an analyzed compound from *Ardisia gigantifolia* Stapf., is capable of the growth mode of various cancer cell lines such as MDA-MB-231, BT-549, and MDA-MB-157 depending on the concentration in the culture medium [39].

The extract from *Excoecaria cochinchinensis* Lour. was determined to inhibit the growth of lung cancer cell lines A549, colorectal cancer cell line Col2, gastric cancer cell line SNU638 with IC50 in the range of 0.25–0.46 μg/mL [40]. The results of the study show that the ethanol extract from *Excoecaria agallocha* L. - a species of the same genus as *Excoecaria cochinchinensis* Lour. can inhibit the growth of breast cancer cell line MCF-7 with IC50 value is 56.5 μg/mL [41].

Invasion is the initiating form of cancer cells during metastasis. Cancer cells have a stronger ability to migrate than normal cells, giving them the ability to invade surrounding tissues and metastasize distantly in the body. Cell migration is indicated by the ability to modify the cell membrane, giving the cell the ability to shift positions. Currently developed anti-cancer drugs are mostly able to attack the ability of cells to migrate to minimize the possibility of spreading to surrounding tissues. One of the effects of herbs on cancer cells of particular interest is their ability to inhibit the spread of several different types of cancer. By analysis of cell migration, it was shown that ethanol extracts of some herbal species significantly reduced the invasion of cancer cells.

This study determined that the extract from the leaves of *Excoecaria cochinchinensis* Lour. was able to inhibit the translocation or migration activity of MKN45 gastric cancer cells (**Figure 6**, [36]). MKN45 cells were treated with the extract for 48 h at concentrations of 0.05 mg/mL; 0.2 mg/mL and 1 mg/mL for 48 h to evaluate its effect on cell migration. The analysis results (**Figure 6**) showed that the extract had a clear effect on cell migration. The ability of cells to migrate into the boundary region was reduced immediately after treatment with low concentrations (0.05 mg/mL), at this concentration, the migration level of cells was determined to be only 81.5 ± 5.3% compared to the control (100%). At higher concentrations (0.2 mg/mL), migration was only approximately 50% of the control (0 mg/mL). The cells observed were mostly dead and completely lost their ability to migrate.

Extracts from *Excoecaria cochinchinensis* Lour. contain many tepotinib compounds. Tepotinib has been shown to inhibit the migration of various gastric cancer cell lines (MKN45, Hs746T, SNU638) [42]. For the first time in this study, we have demonstrated that the extract from *Excoecaria cochinchinensis* Lour. can inhibit the migration of gastric cancer cell line MKN45.

Apoptosis is programmed cell death, and plays an important role in the regulation of the cell life cycle, the balance between living and dead cells, and the prevention of cancer development. Apoptosis offers an important implication in the development of anticancer therapies. The analysis of cell nucleus morphology by nuclear staining method with DAPI (4′,6-diamidino-2-phenylindole) dye showed that herbal extracts increased the number of cells with apoptosis karyotype. The percentage of apoptotic cells was also determined by Flow cytometry. This has shown a potential to kill cancer cells of extracts from some herbal species.

The results of karyotype analysis (**Figure 7A**, [37]) showed that the leaf extract of *Heliciopsis lobata* (Merr.) Sleum. enhanced the appearance of cells with a typical karyotype of apoptosis. The cells after treatment with the extract were analyzed by Flow cytometry to determine the percentage of cells with apoptosis (**Figure 7B**, [37]). At low concentrations (0.1 mg/mL), the extract produced no significant difference in the rate of apoptosis compared with the control in either HepG2 cell line. However, at concentrations of 0.5 mg/mL or more, the increase in the percentage of apoptosis

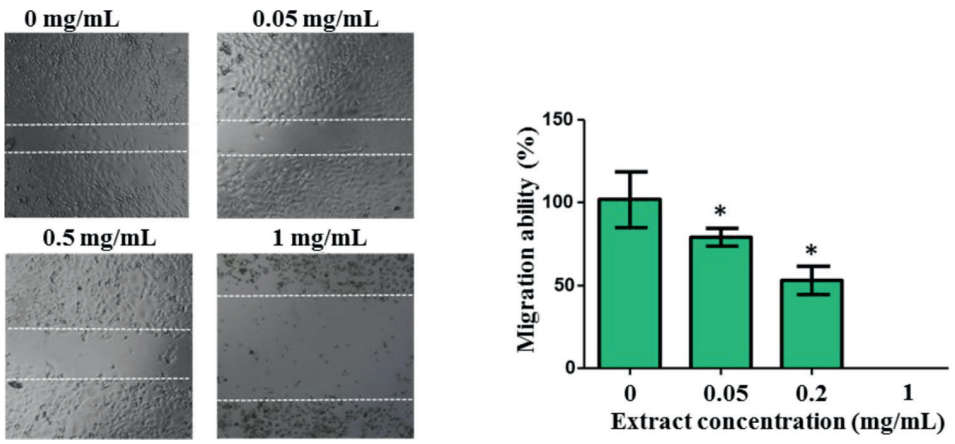


Figure 6.
Effect of Excoecaria cochinchinensis Lour. extracts on MKN45 cell migration. Cells were treated with extracts at different concentrations from 0.05 to 1 mg/mL. The control was cells that were not treated with the extract (0 mg/mL). The image was taken under an inverted microscope, at a magnification of 200X.

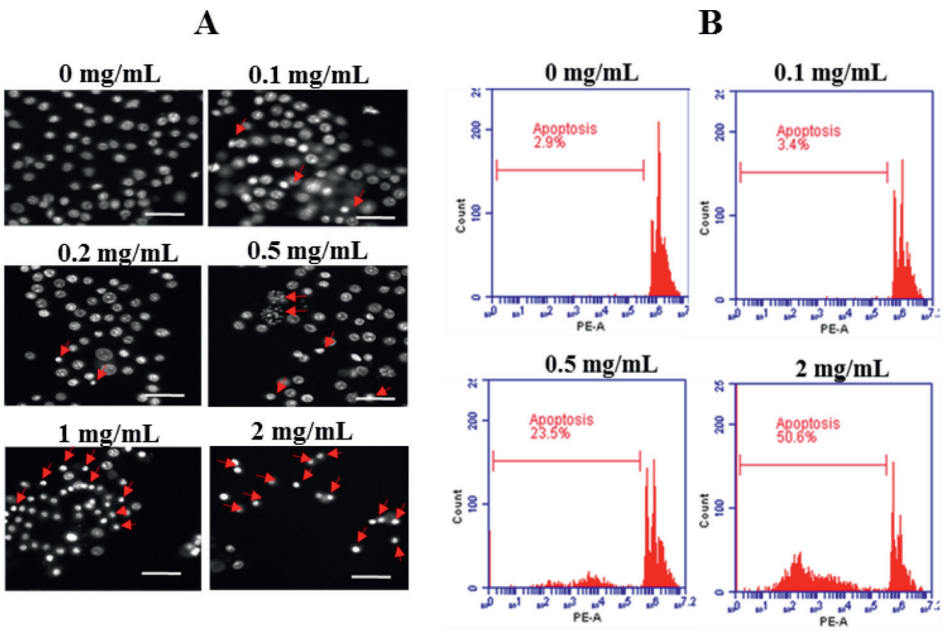


Figure 7.
Effect of Heliciopsis lobata (Merr.) Sleum. extracts on karyotype (A) and apoptosis (B) of HepG2 liver cancer cells. (A) Cells were treated with extracts at different concentrations for 48 h, followed by cell nuclei stained with DAPI dye, observed at 200X magnification, scale: 50 μm. (B) Cells after treatment with the extract were analyzed by Flow cytometry to determine the percentage of apoptosis cells.

cells was different from that of the control. In the HepG2 cell line, the rate of apoptosis induced when treated with the extract at a concentration of 0.5 mg/mL was 22.7 ± 2.7%, compared with the control was 2.5 ± 1.8%. Notably, at a high concentration (2 mg/mL), the methanol extract from the leaves of the *Heliciopsis lobata* (Merr.) Sleum. plant markedly induced apoptosis in the HepG2 cell line (50.5 ± 3.1%).

The composition of *Heliciopsis lobata* (Merr.) Sleum. has been identified to include many compounds, including myricetin, which has a significant ability to inhibit the growth of many different cancer cell lines, including cancer liver through its potentiating effect of apoptosis [43]. The research determined the inhibitory effect on HepG2 liver cancer cell proliferation of extracts from *Heliciopsis lobata* (Merr.) Sleum. through enhanced apoptosis [44]. Another study determined that an ethanol extract from *Excoecaria agallocha* L. was able to inhibit the growth of the breast cancer cell line MCF-7 by promoting the cancer cells to enter the apoptosis pathway [41].

Regulation of the cell division cycle is the way cells ensure division and maintenance of growth and development in the body, and it is strictly controlled by a series of different genes. In cancer cells, changes in genes caused by mutations can lead to changes in the cell cycle and are strongly associated with excessive proliferation compared to normal cells. Therefore, stopping the cell cycle is the anti-cancer approach of many current chemotherapy therapies. Typically, paclitaxel is an anti-cancer drug used in the treatment of cancer that currently inhibits cell division, stopping the cell cycle in the division phase (G2/M) through the mechanism of action on the control point of the mitotic cycle. Stopping the division cycle at this phase will prevent centromeric division between sister chromatids and lead to inhibition of the splitting of the mother cell into two daughter cells.

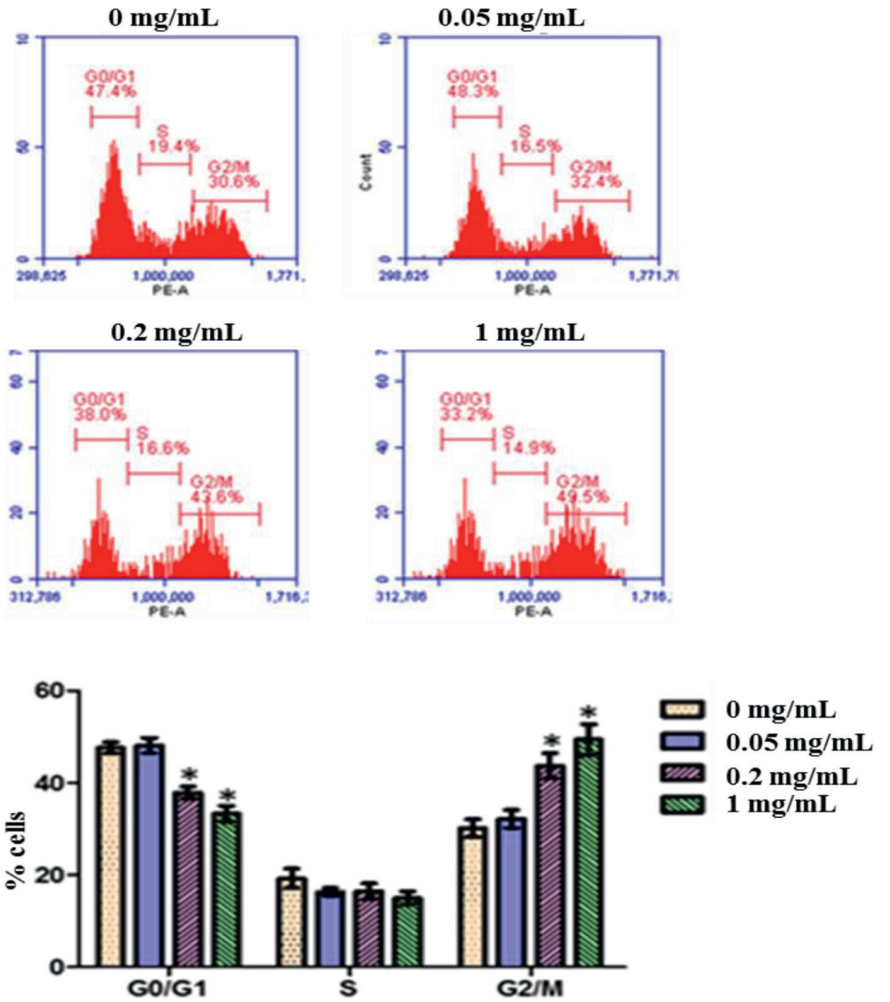


Figure 8.
*Extract of leaves of Excoecaria cochinchinensis Lour. affects the division cycle of gastric cancer cells MKN45. Cells were treated with extracts at different concentrations. The control was cells that were not treated with the extract (0 mg/mL); * $p < 0.05$; $n = 3$.*

Cell cycle arrest at the G2/M division phase is closely related to genes encoding the CDK1-cyclin B1, CDC25 and CHEK1 proteins, and PLK1, which control the phase transition during the mitotic cycle. Analysis of the effect of the extract of *Excoecaria cochinchinensis* Lour. on the division cycle of gastric cancer MKN45 cells (**Figure 8**, [36]) showed that at concentrations of 0.2 mg/mL and 1 mg/mL affected the mitotic phases of gastric cancer MKN45 cells, stopping the cell division cycle at the G2/M phase. Specifically, the percentage of cells in the G2/M phase increased to 43%–49%, compared with 33% of the control. Meanwhile, the percentage of cells in the G0/G1 phase in the treated sample was reduced to 33%–38% compared to 47% in the control.

Similar results were also shown in breast cancer cell line MCF-7 when subjected to ethanol extract from *Excoecaria agallocha* L., according to which, there was a significant increase in the proportion of cancer cells at the stage G2/M after being treated with the extract [41]. The inhibitory effect on cancer cell growth through

the cessation of the cell division cycle in the G2/M phase has also been reported in various plant species. The extract of *Tamarix aucheriana* (Decne. ex Walp.) B.R. Baum inhibits the growth of colon cancer cells by stopping the cell cycle in the G2/M phase, thereby causing the cells to switch to apoptosis [45]. Another study showed the extract of *Calotropis procera* (Aiton) R. Br. enhanced apoptosis in skin melanoma cells through cyclization in the G2/M phase [46].

Experimental results have contributed to showing that the indigenous experiences of the Tay ethnic group in Thai Nguyen province are consistent with the scientific basis for the ability to inhibit some cell lines of stomach cancer and liver cancer. Explaining the scientific basis of indigenous experiences in the use of medicinal plants by experiments will strengthen and promote the conservation of folk knowledge as well as the conservation of ethnobotanical plants.

5. Some solutions for the conservation and sustainable development of medicinal plants and indigenous knowledge capital of the Tay ethnic group in Thai Nguyen province

The preservation of medicinal plants in ethnic communities is closely related to the knowledge of ethnic minorities to use, if the knowledge element is lost, medicinal plants will become wild and ineffective plants. This knowledge exists and is passed on from generation to generation, mostly by word of mouth in each family, clan, and ethnic minority community. Therefore, the conservation of medicinal plants needs to be associated with the preservation of indigenous knowledge of the Tay ethnic group in Thai Nguyen province, there should be a management mechanism and conservation methods suitable to its characteristics of local.

5.1 Conservation of endangered medicinal plants, coupled with the development of complementary planting

5.1.1. Preservation of medicinal plants

For 10 species of medicinal plants in the conservation area of Vietnam found in Thai Nguyen province (IUCN Red list, Vietnam Red Book - Part II Plants (2007), Decree No. 06/2019/ND-CP of the Government of Vietnam). Suggested solutions include:

i. *In situ conservation:* Currently in Thai Nguyen province, there are Than Sa and Võ Nhai Nature Reserves and the buffer zone of Tam Dao National Park at Quan Chu commune, Đại Tú' district, Thai Nguyen province. These are special-use forests with the function of preserving the original genetic resources of existing forest plants and animals, including medicinal plants.

Coordinate with forestry officials to plan in situ conservation of threatened medicinal plant species, specifically as follows:

- Than Sa Nature Reserve: *Stephania* ssp., *Fibraurea tinctoria* Lour.
- The buffer zone of Tam Dao National Park: *Paris hainanensis* Merr., *Disporopsis longifolia* Craib.

2. *Ex situ conservation:* Combined in the construction of the herbal garden of the old men and the mother and the garden of medicinal plants to serve the teaching requirements of professional schools in the province such as the University of Science, University of Medicine and Pharmacy, University of Agriculture and Forestry in Thai Nguyen province; Medical College of Thai Nguyen. Carrying out planting some rare and precious medicinal plants in danger of extinction for conservation and ex-situ. Based on biological characteristics, it is possible to grow most of the species in the list of 10 threatened species mentioned above.

According to ex situ conservation regulations, species need to be planted with a sufficient number of individuals, cared for, and accompanied by a regular monitoring record, to ensure the long-term survival of these species, in favorable human conditions grown, outside their inherent natural ecological environment.

5.1.2 Development of medicinal plants.

i. In-situ planting of some rare and precious medicinal plants: In parallel with the above two conservation methods, it is necessary to promote research and introduce on-site planting of some rare and precious medicinal plants that are currently in demand and have high economic value as:

- *Paris hainanensis* Merr.: Growing by seeds and cuttings. Intercropped under the canopy of moist open forest or in family gardens, in all districts in Thai Nguyen province.

- *Disporopsis longifolia* Craib: Growing by seeds and cuttings. Intercropped under the canopy of a moist forest or in family gardens, in all communes and districts in Thai Nguyen province.

ii. Developing and planting some medicinal plants that are in high demand: Besides the above rare and precious medicinal plants, in Thai Nguyen, it is possible to grow *Amomum longiligulare* T.L. Wu on forestry land for export. *Polyscias fruticosa* (L.) Harms and *Curcuma longa* L. are also medicinal plants with a large market and are perfectly suitable for production in many localities in Thai Nguyen province. The development of growing indigenous medicinal plants and other medicinal plants with high economic value is the right direction, contributing to creating more jobs and increasing incomes for people in the local ethnic communities.

5.2 Reasonable exploitation, pay attention to regeneration protection

Subjects are medicinal plants distributed in Thai Nguyen province, not in the conservation area in Vietnam. Some specific solutions are proposed as follows:

i. Develop a reasonable mining process

According to the regulations on the exploitation of medicinal plants that grow naturally in Vietnam, the sustainability of resources must be ensured. To fulfill this requirement, each medicinal plant species needs to have a technical extraction process

to ensure its ability to regenerate naturally, and at the same time, it does not cause large changes to the population. The content of the mining process includes some notable points as follows:

- The name of the medicinal plant/attach the exact scientific name of the species.
- Parts used as medicine.
- Time of exploitation: In the period when medicinal plants have the highest quality, avoid the fruit season, and at the same time are most beneficial for the ability to regenerate naturally.
- How to exploit: How to collect used parts of medicinal plants to ensure natural regeneration and not affect other plants around.
- Expected volume to be harvested and rate of seed retention in the population. Note that the male/female ratio is kept, suitable for medicinal plants with different flowers.
- Exploitation cycle.

The extraction procedure needs to be compiled separately for each medicinal plant species, printed into documents, distributed to the people, and at the same time organized training to guide these processes specifically for those who harvest.

ii. *Guide the harvesting process to the community:* Depending on the target and the harvesting area, it is necessary to organize training sessions in the community, so that the technical staff can provide specific instructions on harvesting techniques for some medicinal plants for the citizen. Besides theoretical instruction, it is possible to organize direct instruction for 1-2 certain medicinal plants directly in the field. The purpose of this work is to make people more aware of the need to collect medicinal plants reasonably, to ensure natural regeneration, for the next harvest.

5.3 Preserving the indigenous knowledge capital of the community, inheriting and promoting

It is necessary to have a separate plan/program on investigating indigenous knowledge capital of ethnic groups, fully recording, and selectively publishing: Plan/chapter separate program on investigating the indigenous knowledge capital of the ethnic groups to fully record, selectively publish and promote the indigenous knowledge in the treatment of diseases with plants of the Tay ethnic group in the province. Thai Nguyen in two languages (Vietnamese and Tay ethnic language); makes practical contributions to the conservation of folk remedies and the effects of medicinal plants, which have been summed up in experiences and passed down from generation to generation in the community's development.

Select, research, and evaluate several unique remedies of the Tay ethnic group in Thai Nguyen province for wide application in the community.

5.4 Propaganda to raise public awareness

Propaganda to raise public awareness on medicinal plant conservation, indigenous knowledge conservation, sustainable exploitation, and the need to grow more medicinal plants. Integrate into communication programs on the protection of natural resources and the environment, to organize training courses on medicinal plants for the community. The contents of those training courses include:

- Disseminate guidelines and legal documents on the conservation of forest plant resources, including medicinal plants. The importance of preserving and sustainably exploiting locally available natural medicinal plants.

- Guide people to identify medicinal plants that need to be conserved in the locality, absolutely do not exploit and invade, do not collect varieties of preserved medicinal plants, and sell them to traders for illegal export across the border. Gender.

- Encourage the elderly to pass it on to young people, first of all, family members, etc. Educate the younger generation on the awareness and understanding of how to use herbs as medicine, through which the younger generation is proud of the tradition. of their forefathers and learned how to use medicinal plants found around the village.

- Incorporating the subject "Conservation of medicinal plants" into the curriculum of each grade level, to improve the understanding of medicinal plants for generations of students.

Protecting locally available medicinal plant resources needs to be associated with indigenous knowledge, which has even become a source of life for a part of the local community for many generations. If the medicinal plants here are not protected and lost, then their descendants will no longer have those medicinal plants to use. The protection of medicinal plants today also carries meaning and moral responsibility for future generations.

6. Conclusions

The research found 321 plant species belonging to 103 families and 253 genera that were used in the traditional medicine of the Tay ethnic group in Thai Nguyen province. In general, people preferred preparing medicine by boiling them in water for oral ingestion. The most used parts of plants were leaves and stems. The Tay ethnic people rely on herbal remedies for their basic health care, thus indigenous medicinal plant knowledge plays a vital role in solving local health care problems. Most of them had high use values, suggesting that they may produce bioactive compounds with strong physiological effects. That will provide basic data for further research as well as conservation of important medicinal plant including the endangered species in the study area.

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Conflict of interest

The authors declare no conflicts of interest regarding the publication of this book chapter.

Abbreviations

De/06/2019	Decree 06/2019/ND-CP of the Government of Vietnam
IC50	Half-maximal inhibitory concentration
IUCN	The International Union for Conservation of Nature Red List of Threatened Species
MTT	3-(4,5-dimethylthiazol-2-yl)-2,5 diphenyltetrazolium bromide
VNRB	Vietnam Red Data Book - list of rare and endangered species
WHO	World Health Organization

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