Article

High Diversity of Medicinal Uses of Thai Legumes (Fabaceae) and Their Potential in Public Herbal Medicine

Natcha Sutjaritjai [1,2,*], Prateep Panyadee [1], Methee Phumthum [3], Angkhana Inta [4] and Henrik Balslev [5]

1 Queen Sirikit Botanic Garden, The Botanical Garden Organization, Mae Rim, Chiang Mai 50180, Thailand; pt.panyadee@gmail.com
2 The Forest Herbarium, Department of National Parks, Wildlife and Plant Conservation, Bangkok 10900, Thailand
3 Department of Pharmaceutical Botany, Faculty of Pharmacy, Mahidol University, Bangkok 10400, Thailand; m.phumthum@gmail.com
4 Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand; aungkanainta@hotmail.com
5 Department of Biology, Ecoinformatics and Biodiversity, Aarhus University, 8000 Aarhus, Denmark; henrik.balslev@bio.au.dk
* Correspondence: natcha.sutjaritjai@gmail.com; Tel.: +66-8238-512-87

Abstract: Ethnomedicinal studies have demonstrated that Fabaceae include the highest number of medicinal species of all plant families in Thailand. To evaluate which legumes hold the greatest potential for development of public herbal medicines, we used ethnobotanical indices to screen traditional medicinal species from 152 literature sources published from 1986–2019. The homogeneity of each use category was evaluated using the informant consensus factor (ICF). The popularity of the used species was evaluated by percentage of fidelity level (FL) and use value (UV). A total of 261 species from 98 genera of legumes were recorded for their traditional medicinal uses. The uses included 5387 use reports that covered treatments of 420 disorders. The ethnobotanical indices pointed to 15 species with high use values (e.g., *Biancaea sappan* (L.) Tod., *Cassia fistula* L., *Senna siamea* (Lam.) H.S.Irwin & Barneby). Nine of these species are already used in public herbal medicine. The other six species should be studied in greater depth, especially to identify their bioactive compounds so they can be developed for use in public herbal medicine.

1. Introduction

Traditional medicine is based on traditional knowledge and experience of health maintenance over many generations among indigenous people of different cultures. This knowledge has been passed on from generation to generation and is used to treat illness in local communities [1]. Over the past few decades, traditional medicine has achieved public interest, in developed as well as developing countries. Herbal medicine is used by four billion people worldwide [2], and especially in rural areas traditional medicine is often still the primary source of health care [3].

Thailand has practiced traditional herbal medicine over the entirety of its long history. The diversity of ethnic groups has produced a comparable variety of traditional knowledge. The knowledge of ethnobotany in Thailand was prominently presented in the international literature in 1986 [4]. Since then, new studies have continuously been carried out by different researchers who have aimed to collect valuable data of traditional knowledge from various ethnic groups. The Ministry of Public Health of Thailand has promoted herbal medicine as an alternative medicine, some of which has been used in public hospitals. Herbal medicine was officially adopted into the National List of Essential Drugs of Thailand in 1999, with the inclusion of eight herbal medicine recipes [5].

The legumes are the plant family containing the highest number of medicinal species in Thailand [6]. A total of 195 medicinal species of Fabaceae have been reported, and the family has been found to have outstanding use value compared with other medicinal plant families [6]. The recent National List of Essential Medicines (a list of herbal medicine products) mentions 13 legumes in 28 of the total 74 recipes [7]. Although there are many medicinal legume species in Thailand, only a small fraction of these have been developed and promoted for use in public herbal medicine.

This study investigated medicinal uses of legumes in Thailand, with the aim of evaluating the potential of medicinal legume species in Thailand to be used in public herbal medicines. Ethnobotanical indices were used as evaluation tool. In particular, we asked: (1) How many medicinal Fabaceae species are recorded as having been used in Thailand? (2) In which medicinal categories are the legume species used? (3) Which legume species have been used most often in traditional medicine? (4) Which legume species have the potential to be developed for public herbal medicine?

2. Materials and Methods

2.1. Medicinal Legume Data

The data on traditional medicinal legumes were collected from ethnobotanical and traditional medicine studies in Thailand. The bibliographical sources included journal articles, theses, books, and scientific reports. Ethnomedicinal data on legumes were also extracted from online databases of the Thai Library Integrated System [8], Digital Research Information Center [9], Biodiversity Digital Library [10], and Sanga Sabhasri Library research data. In cases when data from publications and theses were duplicated, only the data from the theses were used. Mentions of traditional uses of medicinal plants without reference to a scientifically named plant species were excluded.

Because we could not identify individual informants in the data from primary bibliographical sources, the individual bibliographic references were considered "pseudo-informants" [6]. The data on medicinal legumes were extracted from each bibliographical source, excluding the data on medicine for livestock. The scientific name, plant part used, preparation, route of administration, medicinal purpose, and ethnic group were recorded. Plant parts used, preparation, and route of administration were categorized following the Economic Botany Data Collection Standard [11]. In cases where the original data did not mention the plant part used, preparation, route of administration, or ethnic group, the data were recorded as unspecified. The use reports were defined by medicinal purposes, a single reference to the medicinal use of a species by a particular ethnic group was defined as a use report. The scientific names of legumes from original data sources were updated to recently accepted names according to the Plants of the World Online website [12].

The medicinal use reports were classified according to the International Classification of Primary Care second edition, or ICPC-2. The use reports were divided into 17 medicinal categories, which were: general and unspecified; blood, blood forming organs and immune mechanism; digestive; eye; ear; cardiovascular; musculoskeletal; neurological; psychological; respiratory; skin; endocrine/metabolic and nutritional; urological; pregnancy, childbearing, and family planning; female genital; male genital; and social problems. The ICPC-2 system categorizes disorders based on body systems; disorders affecting three or more body systems cannot be clearly categorized and were therefore placed in the general and unspecified category [13].

2.2. Data Analysis

2.2.1. Statistical Analysis

Pearson's correlation coefficient (r) and species accumulation curves were generated with the R-studio program version 1.3.1093 [14].

2.2.2. The Informant Consensus Factor (ICF)

The informant consensus factor (ICF) was used for evaluating knowledge homogeneity of the informants for a particular symptom or use category [15]. The values of ICF are between 0–1. When the value approaches one (1.0) it indicates that the informants agreed totally about the use of the species. When the value approaches zero (0.0) the informants' agreement about the use of the species was scattered. The ICF was calculated following the formula:

$$ICF = (Nur - Nt)/(Nur - 1)$$

where Nur refers to the total number of use reports for a particular use category and Nt refers to the total number of species used in that category. The calculation of ICF was performed in the Microsoft Excel program.

2.2.3. Fidelity Level (%FL)

The fidelity level shows the extent to which the informants agreed about the preferred use categories for each species. The fidelity level [16] was calculated as:

$$FL\ (\%) = (Np/N) \times 100$$

where Np is the number of use reports in each of the use categories and N is the total number of use reports. The summed fidelity level value for all species is one hundred. A high fidelity value means that a species is more commonly used in a particular category. The calculation of fidelity level was performed in the Microsoft Excel program.

2.2.4. The Use Value (UV)

The use value (UV) index measures how commonly a species is used [17]. In this study, UV was calculated to determine which species of medicinal legumes were most frequently used as traditional medicine. The index was calculated as:

$$UV = \sum Ui/N$$

where Ui referrs to the number of use reports of the species from each pseudo-informant and N refers to the total number of pseudo-informants (N = 152). This study collected the data from secondary sources. Therefore, we modified N by replacing the term "informant" with the term "pseudo-informant". The calculation of UV was performed in the Microsoft Excel program.

3. Results

3.1. The Diversity of Medicinal Legumes

A total of 5387 use reports from 98 genera and 261 species were generated from 152 data sources published during the years 1986–2019 [4,18–168]. The data on medicinal legumes originated from 28 ethnic groups in Thailand (Supplementary Table S1). The geographic locations of the data sources were in 57 out of Thailand's 77 provinces and covered all seven floristic regions of the country.

Crotalaria was the genus with the highest number of medicinal legume species (18 species) followed by *Dalbergia* (16 species) and *Senna* (11 species) (Figure 1, Supplementary Table S2). However, the genera with the highest numbers of use reports were *Senna*, *Biancaea*, and *Mimosa* (752, 363, 292 respectively) (Figure 1, Supplementary Table S2). The number of medicinal species found in each genus was positively, highly, and significantly correlated to the total number of species of each genus in Thailand ($p < 0.01$, r = 0.873) (Supplementary Table S3).

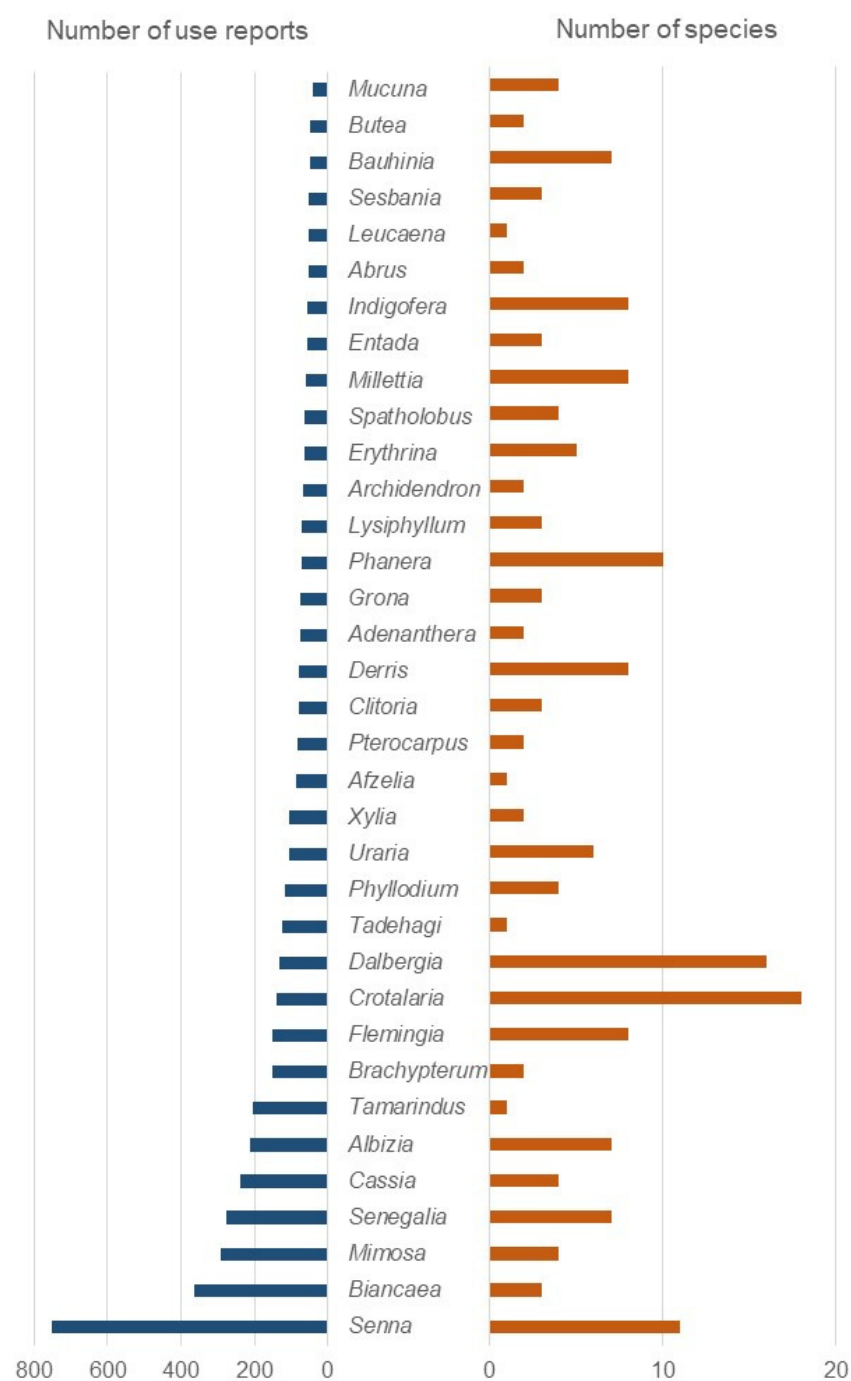**Figure 1.** Numbers of species and use reports for legume genera with medicinal uses in Thailand, derived from 152 primary data sources published from 1986–2019.

A species accumulation curve (Figure 2), generated to observe the trend of medicinal legume data in Thailand, reached close to asymptotic values for the 261 species in the complete dataset, and just above 200 species for data excluding singletons.
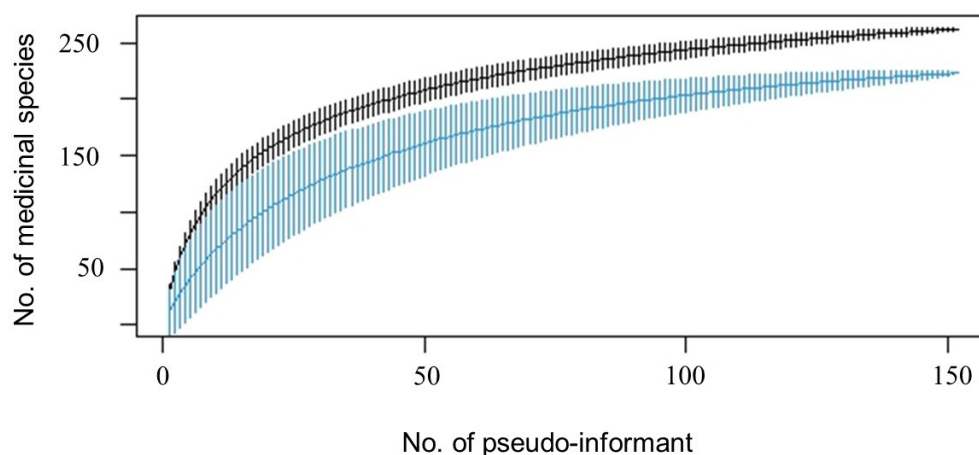
Figure 2. Accumulation curves for medicinal legume species in Thailand, plotted by increasing numbers of primary data sources (pseudo-informants). The black line shows the accumulation of all medicinal legume species in this study, whereas the blue line shows the accumulation when singletons were excluded.

3.2. Medicinal Legumes Parts Used

All parts of the plants were used as medicine. The roots had the highest proportion of use report, followed by stems, leaves, and entire plants (Figure 3, Supplementary Table S4).
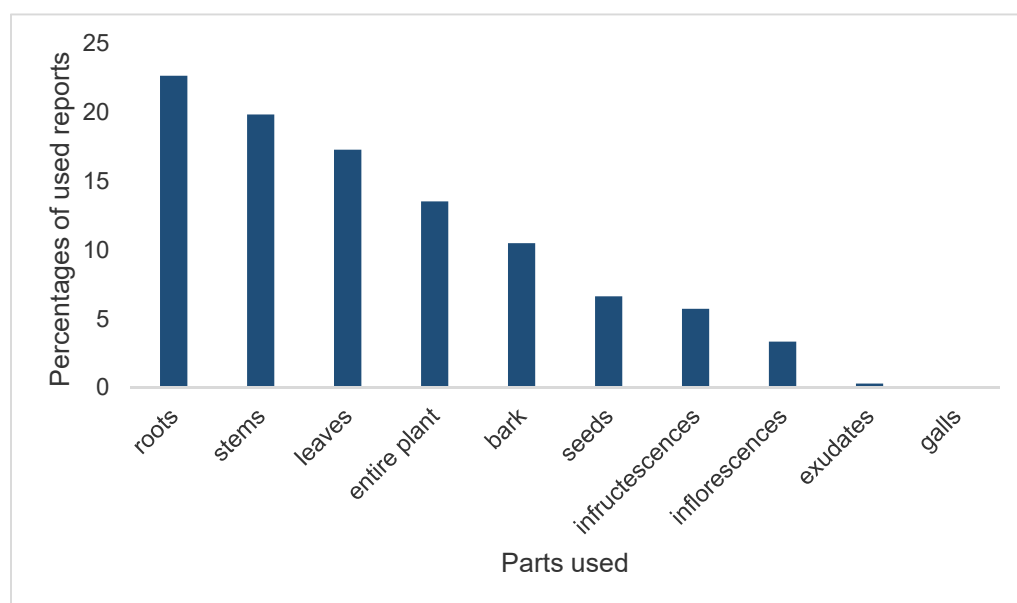
Figure 3. Proportion of use reports for each plant part of legume species in Thailand with medicinal uses, from 152 primary data sources produced from 1986–2019.

3.3. Medicinal Legumes Preparations and Routes of Administration

Fewer than half (2547) of the use reports (total 5387) specified 81 different preparation methods. Some of the use reports mentioned more than one method of preparation and route of administration (Supplementary Table S5). Decoction was the most common preparation method, followed by no preparation, then grating with water, pounding, and cold infusion. Other preparation methods were combined as "miscellaneous" (Figure 4).
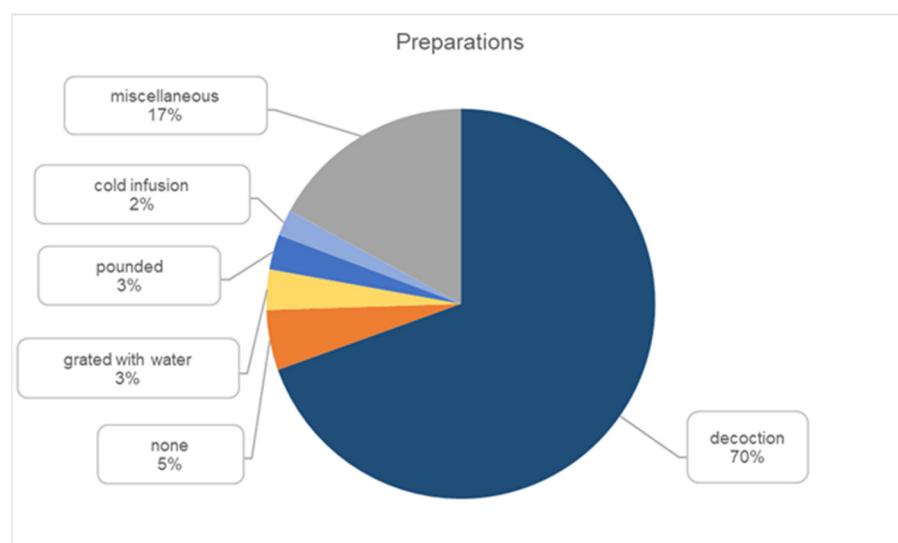
Figure 4. Percentages of use reports for different preparation methods of legume species in Thailand with medicinal uses, derived from 152 primary data sources produced from 1986–2019.

There were 2441 use reports that specified 47 different routes of administration (Supplementary Table S6). Drinking the plant extract was the most common method of administering the medicine, followed by eating the plant, making a poultice, bathing in water with the dissolved plant, and applying a liniment. The other routes of administration were gathered together as "miscellaneous" (Figure 5).
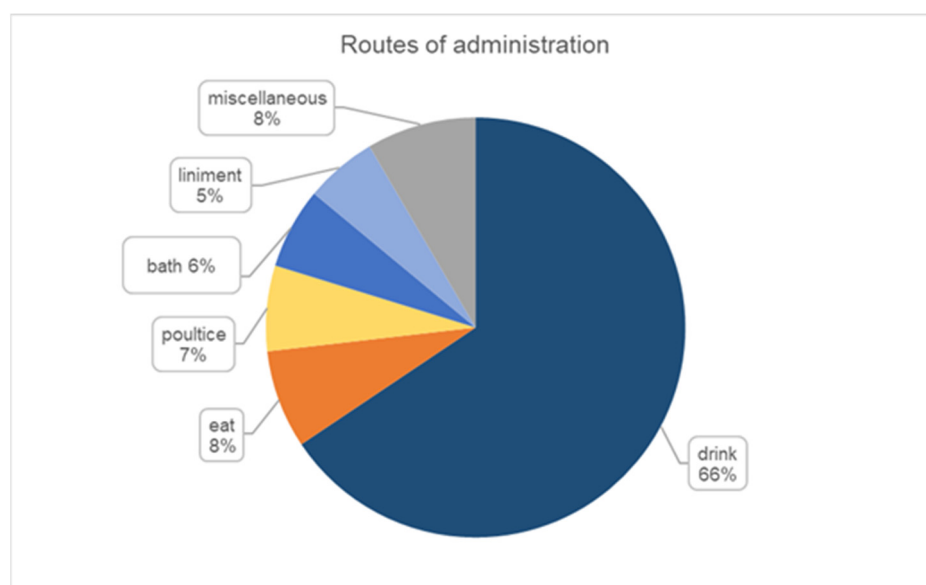
Figure 5. Percentages of use reports for different routes of administration of medicinal legume species from Thailand, mentioned in 152 primary data sources produced from 1986–2019.

3.4. Medicinal Use Categories for Legumes

We found 420 disorders that were treated by legume species (Table 1). The medicinal properties of legumes included 16 out of 17 categories from ICPC-2, excluding only social problems (Table 1). The highest number of use reports were in the category general and unspecified, with 1241 use reports relating to 75 disorders, followed by the categories digestive disorders (1075 use reports; 71 disorders) and musculoskeletal disorders (619 use reports; 30 disorders). The category of general and unspecified disorders contained many different use reports, including treatment of fever, health maintenance, wounds, antidotes,

treatment of bruising, etc. Conditions in the category of digestive disorders were included in a variety of use reports referring to, for example, constipation, diarrhea, abdominal pain, mouth ulcers, worm infection, and flatulence. In the category of musculoskeletal disorders, the conditions with most use reports included muscle pain, lumbago, back pain, muscle tension, joint pain, etc. The lowest number of use reports were in the separate categories male genital and ear, with only nine and two use reports, respectively (Table 1).

Table 1. Categories of disorders, treatments and symptoms related to medicinal legume species in Thailand, derived from 152 primary sources produced from 1986–2019.

Use-Category	Disorders (Number of Use Reports)
Blood, blood forming organs and immune mechanism (206 use reports; 19 disorders)	**Disorders:** anemia (20), lymph disorder (7), leukemia (3), thalassemia (2), HIV-infection/aids (1), polycythemia (1), splenomegaly (1), thrombosis (1). **Symptoms:** blood dysfunction (2), lymph congestion (1), lymph glands enlargement (1), lymph node enlargement (1). **Treatments:** blood nourishment (125), blood purification (32), lymph purification (3), lymph nourishment (2), anticoagulants (1); lymphatic system nourishment (1), lymphatic system purification (1).
Cardiovascular (235 use reports; 10 disorders)	**Disorders:** hypertension (58), CAD (coronary artery disease) (1), heart dysfunction (5), heart disease (4). **Symptoms:** hemorrhoids (77), oedema (28), internal bleeding (1), palpitation (3). **Treatments:** stimulate blood circulation (41), heart nourishment (17).
Digestive (1075 use reports; 71 disorders)	**Disorders:** diarrhea (146), mouth ulcer (67), jaundice (47), food poisoning (27), dysentery (25), peptic ulcer (17), gastritis (15), liver disease (12), IBD (inflammatory bowel disease) (11), hepatitis (7), liver dysfunction (6), GERD (gastroesophageal reflux disease) (5), mumps (5), bilharzia(4), cirrhosis (4), diarrhea (children) (4), gingivitis (4), angular cheilitis (3), colon cancer (3), food poisoning (children) (3), liver cancer (3), pharyngitis (3), sialaporia (3), cholera (2), hepatomegaly (2), hernia (2), saliva dysfunction (2), stomatitis (2), ulcerative colitis (2), hernia (men) (1), hernia (women) (1), gall stone (1), IBS (irritable bowel syndrome) (1), mouth polyp (1), mouth ulcer (children) (1), periodontitis (1), scurvy (1), stomach stone (1), tongue ulcer (1). **Symptoms:** constipation (228), abdominal pain (109), flatulence (59), toothache (49), vomiting (19), indigestion (12), tooth decay (4), white tongue (4), bleeding gums (1), blood in stool (1), chapped lips (1), colon dysfunction (1), constipation (children) (1), digestive tract infection (1), drool (children) (1), encopresis (1), heartburn (1), intestinal pain (1), rectal bleeding (1). **Treatments:** worm infection (71), purgative (18), carminative (16), bile nourishment (7), strengthen teeth (6), emetic (4), colon cleanse (3), liver nourishment (3), hepatoprotective (2), worm infection (children) (1), bile purification (1), gastric nourishment (1), intestinal cleansing (1).
Ear (2 use reports; 2 disorders)	**Disorders:** tinnitus (1). **Symptoms:** ear pain (1).
Endocrine/metabolic and nutritional (188 use reports; 20 disorders)	**Disorders:** diabetes (54), malnutrition (23), gout (13), beriberi (12), goiter (7), hyperglycemia (5), hyperlipidemia (4), malnutrition (children) (2), diabetic ulcer (1); dyslipidemia (1), lipid disorder (1), marasmus (1), nutritional disorder (1), SLE (systemic lupus erythematosus) (1). **Symptoms:** weight loss (3). **Treatments:** appetite stimulant (55), appetite stimulant (children) (1), balance sex hormones (1), body fat reduction (1), cholesterol reduction (1).
Eye (89 use reports; 12 disorders)	**Disorders:** conjunctivitis (14), eye disease (12), cataract (3), dust in the eye (3), eye discharge (2), Bitot's spots (1) ophthalmitis (1). **Symptoms:** bleary-eyed (18), eye pain (10), eye inflammation (6), swollen eye (1). **Treatments:** eye tonic (18).
Female genital (134 use reports; 26 disorders)	**Disorders:** menstruation fever (14), cervicitis (3), uterus dysfunction (3), breast cancer (1), breast tumor (1), cervical cancer (1), hypermenorrhoea (1), oophoritis (1), prolapsed uterus (1), tubo-ovarian abscess (1). **Symptoms:** menstrual pain (12), menstruation absent/scant (10), increased breast size (4), menopause (3); menstruation irregular (3), vaginal bleeding (1). **Treatments:** haemagogue (29), emmenagogue (23), menstrual purification (8), sexual tonic (4), uterus nourishment (3), menstrual cycle adjustment (2), blood nourishment (2), balance female hormones (1), menstrual nourishment (1), vaginal lift (1).

Use-Category	Disorders (Number of Use Reports)
General and unspecified (1241 use reports; 75 disorders)	**Disorders:** cancer (41); common cold (31); malaria (26); chickenpox (12); tuberculosis (12); general venereal disease (12); male and female gonorrhea (7); measles (7); ulcer (7); meningococcal disease (6); typhoid (6); foot and mouth disease (2); blackwater fever (1); chlamydia (1); dengue (1); elephantiasis (1); rabies (1); rubella (1); scarlet fever (1); male and female syphilis (1). **Symptoms:** fever (289); wound (101); bruise (53); flu-like syndrome (15); burns (14); pus wound (14); epistaxis (10); pain (10); chest pain (9); colic (9); hangover (9); inflammation (9); allergy (8); blister (8); fainting (8); chronic wounds (6); fever (children) (5); internal bruise (5); umbilical wound (5); food allergy (4); rotten wound (4); swelling (4); drowsiness (3); feel feverish (3); fatigue (2); follicular pharyngitis (2); hyperhidrosis (2); unconscious (2); bacterial infection (1); breast wound (1); hairy caterpillar allergy (1); herbicide poisoning (1); illness (children) (1); infection (1); infection wound (1); internal pain (1); mushroom poisoning (1); navel wound (children) (1). **Treatments:** health maintenance (288); antidote (81); balance body heat (19); elixir (17); stop bleeding (10); balance body system (9); stimulate sweating (3); health maintenance (children) (3); antiseptic (2); relaxant (2); anti-aging (1); antibiotic (1); antioxidant (1); anuria to release fever (1); neutralize toxins (1); stimulant medicine (1); sweat induction (1).
Male genital (9 use reports; 7 disorders)	**Disorders:** impotence (2); male sexual function problems (2); BPH (benign prostatic hyperplasia) (1). **Symptoms:** circumcision wounds (1); orchitis (1). **Treatments:** balance male hormones (1); prostate nourishment (1).
Musculoskeletal (619 use reports; 30 disorders)	**Disorders:** bone fracture (11); plantar fasciitis (6); bone cancer (3); ameloblastoma (2); bone disease (2); neck pain (2); body pain (1); rheumatoid arthritis (1); tendon cancer (1). **Symptoms:** muscle pain (155); lumbago (119); back pain (102); joint pain (40); knee pain (14); tendon pain (13); tendinitis (12); bone pain (9); leg pain (8); tendon dysfunction (7); sprains (6); foot pain (2); cramp (1); shoulder pain (1); swollen foot (1). **Treatments:** muscle relaxant (67); tendon relaxant (14) tendon nourishment (11); bone nourishment (3); tendon purification (3); joint nourishment (2).
Neurological (165 use reports; 20 disorders)	**Disorders:** paralysis (48); epilepsy (10); paresis (9); herniated nucleus pulposus (3); tetanus (2); loss of taste (1); meningitis (1); migraine (1); slurred speech (1); tongue paralysis (1). **Symptoms:** headache (34); dizziness (30); convulsion (10); numbness (3); car sickness (1); hand numbness (1); severe headache (1). **Treatments:** brain nourishment (4); nerve nourishment (3); sedative (1).
Pregnancy, childbearing, family planning (176 use reports; 20 disorders)	**Symptoms:** post-partum anxiety (9); post-partum haemagogue (4); pregnancy hemorrhage (2); antepartum bleeding (1); bleeding during pregnancy (1); bloody show (1); morning sickness (1); post-partum dizziness (1); post-partum headache (1). **Treatments:** post-partum care (127); labor induction (9); lactation stimulant (9); amniotic fluid elimination (2); breast engorgement (2); abortion induction (1); acceleration of lochia discharge (1); birth control (1); post-partum muscle relaxant (1); prevent abortion (1); retention of placenta (1).
Psychological (82 use reports; 10 disorders)	**Disorders:** insomnia (44); neurosis (5); chronic alcohol abuse (2); insomnia (children) (2); narcolepsy (children) (1). **Symptoms:** insanity (5). **Treatments:** aphrodisiac (general) (17); aphrodisiac (man) (2); aphrodisiac (woman) (2); suicidal drug (2).
Respiratory (332 use reports; 30 disorders)	**Disorders:** asthma (27); pneumonia (7); bronchitis (5); lung disease (4); lung abscess (3); nasal polyp (3); haemoptysis (2); influenza (2); pneumoconiosis (2); asthma (children) (1); diphtheria (1); emphysema (1); lung cancer (1); lung dysfunction (1); pneumonitis (1); respiratory disease (1); sinusitis (1). **Symptoms:** cough (117); phlegm (73); sore throat (29); thirst quenching (24); hiccough (7); thirsty (7); congestion (3); tight chest (2); running nose (1); severe cough (1); whooping cough (1). **Treatments:** lung nourishment (3); bronchodilators (1).
Skin (507 use reports; 49 disorders)	**Disorders:** dermatophytosis (60); skin disease (33); psoriasis (17); dermatosis (15); athlete's foot (11); herpes simplex (11); leprosy (10); scabies (10); herpes zoster (9); skin cancer (4); urticaria (4); eczema (2); erysipelas (2); foot disease (2); freckles (2); tinea capitis (2); hair dysfunction (1); hyperpigmentation (1); smallpox (1); tinea pedis (1). **Symptoms:** rash (64); boil (62); pruritus (31); snake bite (26); itching (23); insect bite/sting (18); centipede bites (7); scorpion sting (4); hair loss (3); yaws (3); dry skin (2); poisonous plant irritation (2); rash (children) (2); acne (1); catfish poison (1); contact dermatitis (1); cutaneous larva migraine (1); itchy scalp (1); jellyfish poison (1); scar (1); sea fish poison (1); skin inflammation (1); tick bite (1); venomous animal bite (1). **Treatments:** anti-dandruff (20); hair nourishment (16); lice killing agent (10); skin nourishment (4); prevent scar (1).

Table 1. *Cont.*

Use-Category	Disorders (Number of Use Reports)
Urological (327 use reports; 19 disorders)	**Disorders:** kidney stone (118); diuretic (98); anuria (37); urinary stones (24); kidney disease (14); kidney dysfunction (8); dysuria (3); urinary disease (3); UTI (urinary tract infection) (3); cystitis (2); dialysis (2); hemodialysis (2); diabetes insipidus (1); diuretic (children) (1); glomerulonephritis (1). **Symptoms:** dark color urine (2); urine turbidity (1). **Treatments:** kidney nourishment (6); kidney detox (1).

59 legume species were used for treatments in only a single medicinal category, while many species were used to treat disorders in up to 15 categories (Figure 6). *Senna siamea* was used for treatments in the greatest number of use categories (15) and the only category in which it was not used was ear diseases. The other medicinal legumes employed to treat disorders from a high number of categories included *Biancaea sappan*, *Mimosa pudica* L., *Senegalia rugata* (Lam.) Britton and Rose, and *Tamarindus indica* L. (each used in 14 categories).
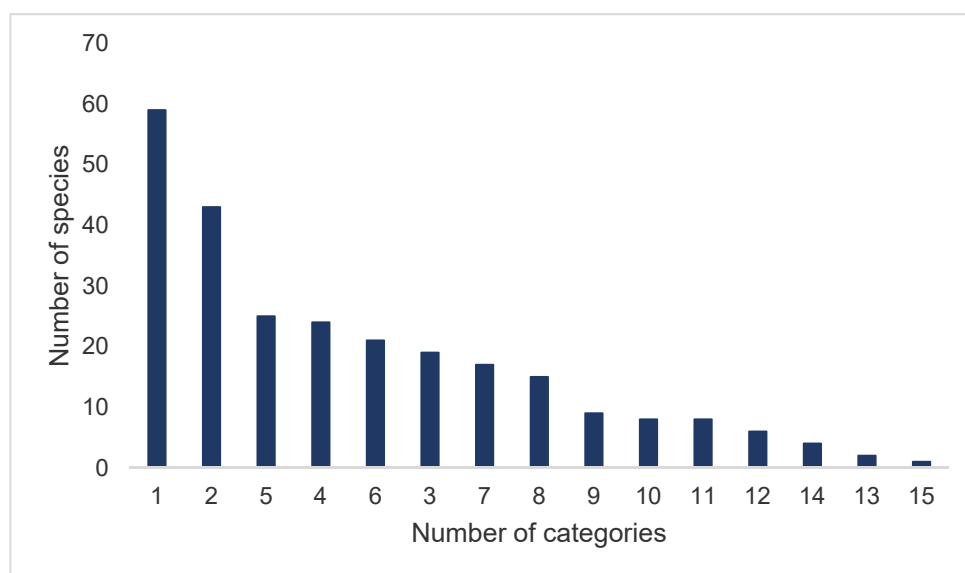

Figure 6. Numbers of medicinal legume species in Thailand and the numbers of categories in which they were used to treat disorders.

3.5. The Informant Consensus Factor (ICF)

The homogeneity of medicinal legume species use in each category was evaluated using the informant consensus factor (ICF), which ranged from 0–0.86 (Table 2). Digestive system disorders had the highest ICF value, at 0.86 based on 1075 use reports and 152 legume species, followed by general and unspecified disorders (ICF = 0.85; 1245 use reports; 184 species) and musculoskeletal (ICF = 0.81; 619 use reports; 116 species).

3.6. Fidelity Level (%FL)

The fidelity level (FL) was calculated to show the proportion of each legume species used in the treatment of disorders with a particular symptom, in the top three ICF value categories (Table 3). The most common disorders in the category of digestive disorders were constipation, diarrhea, and abdominal pain. The most common disorders and treatments in the category of general and unspecified disorders were fever, wounds, and health maintenance, while the most common disorders in the category of musculoskeletal disorders were muscle pain, lumbago, and back pain.

Table 2. Informant consensus factor (ICF) for categories of disorders treated by legumes, as reported in 152 studies of traditional medicine in Thailand published from 1986–2019.

Categories	Number of Use Reports	Number of Species	ICF
Digestive system disorders	1075	152	0.86
General and unspecified disorders	1245	184	0.85
Musculoskeletal disorders	619	116	0.81
Skin disorders	507	112	0.78
Respiratory disorders	332	88	0.74
Eye disorders	88	25	0.72
Urological disorders	327	93	0.72
Cardiovascular disorders	235	73	0.69
Blood, blood forming organs, and immune mechanism disorders	206	75	0.64
Pregnancy, childbearing, family planning related disorders	176	65	0.63
Neurological disorders	165	61	0.63
Female genital disorders	131	49	0.63
Endocrine, metabolic and nutritional disorders	188	71	0.63
Psychological disorders	82	32	0.62
Male genital disorders	9	8	0.13
Ear disorders	2	2	0.00

Table 3. Thai legume species with the highest fidelity level values that were used to treat the most common disorders within top three categories with highest ICF values, derived from 152 studies of traditional medicine in Thailand published from 1986–2019.

Disorder, Symptoms and Treatments	Categories and Species	FL (%)
Digestive		
constipation	*Cassia fistula* L.	20.5
diarrhea	*Tadehagi triquetrum* (L.) H.Ohashi	6.2
abdominal pain	*Tadehagi triquetrum* (L.) H.Ohashi	5.5
General and unspecified		
fever	*Mimosa pudica* L.	5.9
	Senna tora (L.) Roxb.	
health maintenance	*Biancaea sappan* (L.) Tod.	10.8
wound	*Tamarindus indica* L.	9.9
Musculoskeletal		
muscle pain	*Biancaea sappan* (L.) Tod.	11.6
lumbago	*Biancaea sappan* (L.) Tod.	10.1
back pain	*Biancaea sappan* (L.) Tod.	9.8

3.7. Use Value (UV)

The use value of medicinal legumes in Thailand ranged from 0.01–1.30 (Supplementary Table S7). The frequency distribution was used to divide the UV into three levels, the high level (UV ≥ 0.29), middle level (0.15 < UV < 0.29), and low level (UV ≤ 0.15). Of 261 medicinal legume species, 15 had high use value, 22 species had medium use value, and 244 species of legumes had a low use value level. *Biancaea sappan*, *Mimosa pudica* and

Senna siamea had the highest use values, of 1.30, 1.14 and 0.93, respectively. The disorders most commonly treated by the species with high use values were evaluated by fidelity level (Supplementary Table S8).

3.8. The Potential of Medicinal Legumes

The 15 legumes with high use value were considered as having potential to be used in public herbal medicine (Supplementary Table S9). Compared to the 13 legumes used in public herbal medicine in Thailand according to the National List of Essential Medicines (subcommittee for the development of the National List of Essential Drugs, 2020), nine of the high use value legumes recorded in this study belonged to the high use value group (UV ≥ 0.29), one species was in the middle group (0.15 < UV < 0.29), and three species were in the low use value group (UV ≤ 0.15) (Supplementary Table S7). Six of the legume species with high use values have so far not been developed into public herbal medicine, according to the Thailand National List of Essential Medicines. Therefore, three species with outstanding use value, positioned within the top ten ranking of highest UV, should be further investigated for their therapeutic potentials: *Mimosa pudica* (rank 2; UV = 1.14), *Senna tora* (L.) Roxb. (rank 9; UV = 0.48), and *Tadehagi triquetrum* (L.) H.Ohashi (rank 10; UV = 0.46).

4. Discussion

4.1. The Medicinal Legume Species

Previous ethnomedicinal studies in Thailand listed 195 species and 1420 use reports for legumes [6]. Here we report 261 species of medicinally used legumes, based on 5387 use reports. Whereas the data from previous records were compiled from 64 bibliographical sources published during 1990–2014, our current study is based on 152 records published from 1986–2019. Our data originate from all seven floristic regions of Thailand and were partly expanded through collaborations with our colleagues in Thailand's various regions [169]. The increased database includes many newly published studies from the period 2015–2020, demonstrating increased interest and efforts by Thai ethnobotanists over the past decade [170].

The medicinal legumes in this study comprise 38% of the 688 legume species that occur in Thailand [171]. The outstanding number of medicinal legumes is possibly associated with the wide distribution of the family [172]. Legumes grow in many types of vegetation and habitats [173], and their different forms make them available in all seasons [174]. The high diversity, quantity, and distribution of legumes have made it possible for humans to use them in many different ways [172,175,176].

In general, genera with many species have a better chance of being used by humans. For example, *Crotalaria* has the highest number of species among the legumes in Thailand, i.e., 39 species, of which 18 species have been used as medicine (Supplementary Table S2) [171,177]. Other legume genera with high diversity among overall species and medicinally used species include *Dalbergia* and *Phanera*. The correlation between the number of medicinal legume genera and Thailand's overall legume genera is more than 0.7, which is considered a strong relationship [178]. However, the use of each species ultimately depends on its medical efficiency in treatment of illness [179]. For example, *Biancaea* and *Mimosa*, which do not have many medicinal species, have correspondingly few use reports because of their comparatively low efficacy in the treatment of illness.

4.2. Medicinal Legumes Parts Used

Plant roots are commonly used in traditional medicine [180–183]. An ethnobotanical study of legumes used by the Karen in Thailand demonstrated that roots and stems were frequently used for medicine [174]. Another plant part which is often used is leaves, which were mentioned in 17% of the use reports (Figure 3). Leaves are easy to harvest and can be simultaneously used as food and medicine [174]. Many ethnobotanical studies mention the prevalent use of leaves [184–186].

4.3. Medicinal Legumes Preparations and Routes of Administration

The available data on preparation and routes of administration showed that decoction and potions were the most common ways in which legumes were used for medicine. Decoction involves boiling the herbal plant parts in water, and is the simplest way to prepare herbal medicine [187]. Depending on the preparation method, drinking the decoction is the most common route of administration. Many ethnobotanical studies mention that decoction is the most common way of preparing traditional medicine [6,188–190].

4.4. Legume Medicinal Use Categories

Health service units in Thailand recently reported that the most common diseases in the country were in the categories of circulatory system, endocrine, nutritional, and metabolic diseases, and diseases of the respiratory system [191]. In our review of 152 published records of legumes used in traditional medicine, the most frequently cited use categories were general and unspecified, digestive, and musculoskeletal. Traditional medicine emphasizes treatments of common health conditions such as fever, wounds, constipation, diarrhea, and muscle pain. In contrast, the statistics for common diseases provided by national health service units in Thailand include chronic diseases such as heart disease, hypertension, and diabetes, as well as stroke and pneumonia [191]. Traditional medicines are used by local people for basic health care [2,192]. The categories that include more basic disorders are therefore more commonly treated with traditional medicines.

Senna siamea is native to Thailand [193]. This species is also used as a food plant, and it is easily harvested around villages [174]. The plant contains various bioactive compounds with antioxidant and antidiabetic properties that make it useful in the treatment of many disorders; it also has hepatoprotective activity, it is anti-inflammatory, and has wound healing properties [194,195]. Other species which can be used to treat disorders from many categories (*Biancaea sappan*, *Mimosa pudica*, *Senegalia rugata*, and *Tamarindus indica*) can easily be collected in home-gardens and communal village areas. Most species, apart from those mentioned here, were used to treat conditions in only one or two use categories (1 category—56 species; 2 categories—43 species). The species with fewer use reports were mostly used to treat disorders in only a few categories. Therefore, we propose that the potential toxicity and pharmacological activities of the species mentioned here should be further studied, to evaluate whether they should be added to the National List of Essential Medicines and so contribute to Thailand's public herbal medicine.

4.5. The Informant Consensus Factor (ICF)

The category of disorders related to the digestive system had the highest ICF value, because it had many use reports derived from relatively few species. Among the ICPC-2 categories, general and unspecified conditions accounted for many common disorders and those that could not be classified into other categories. Therefore, this category had the most use reports and greatest number of used species, producing a smaller ICF score. The many use reports and few species caused the category to display greater use homogeneity [196]. People of all ages and genders suffer from digestive diseases [197] and in many ethnic communities those disorders are commonly treated with medicinal plants [184,186,198–200].

4.6. Fidelity Level (%FL)

The commonness of used species in the treatment of each disorder was evaluated by percentage of fidelity level (FL), indicating the species that are favored by local people for the treatment of different disorders. A high FL value means that species are commonly used to treat that disorder.

Many use reports of disorders in the digestive category were related to treatments of constipation, diarrhea, and abdominal pain. *Cassia fistula* is particularly popular as a traditional treatment for constipation. According to the National List of Essential Medicines in Thailand, *Cassia fistula* has already been promoted as a public herbal medicine for treatments of digestive disorders by curing constipation [7]. Extracts of *Tadehagi triquetrum*

(Kurz) Craib have antibacterial properties and stomachic activities which makes them useful in the treatment of disorders in the digestive category [201,202].

The category of general and unspecified disorders ranked second in ICF value (Table 3). Disorders and treatments with many use reports in the current study included fever, health maintenance, and treatment of wounds. The legume species most frequently used to combat fever were *Mimosa pudica* and *Senna tora*, with FL values of 5.9. Previous studies have mentioned that *Mimosa pudica* has been used in fever treatment [203,204]. Phytochemical reports mentioned many properties of *Senna tora*, including antitumor, antigenotoxic, antioxidant, anti-inflammatory, antihepatotoxic, anticancer, antimicrobial, and neuroprotective effects, but the phytochemical basis for the efficacy of this use remains understudied [194,205,206]. *Biancaea sappan* was much used for health maintenance, with an FL value of 10.8. This species contains many active chemical compounds, making it useful for health improvement [207]. Another legume species with outstanding FL value for healing wounds is *Tamarindus indica* (FL = 9.9%). In African traditional medicine, *Tamarindus indica* is famous for treating wounds and constipation [208]. Phytochemical studies show that *Tamarindus indica* has antibacterial and antifungal activities [209].

The third-ranked category by ICF value was musculoskeletal disorders (Table 3). A species with outstanding FL value for healing musculoskeletal disorders was *Biancaea sappan*, and many use reports involved treatment with this species. It has antioxidant, anti-inflammatory, and healing properties, which make it useful for treatments in the musculoskeletal category [210,211]. According to the National List of Essential Medicines in Thailand, *Biancaea sappan* has already been promoted as a public herbal medicine in the musculoskeletal category for healing muscle pain [7].

4.7. Use Value (UV)

The use value (UV) index is a measurement of how commonly a species is used [17]. Species with many use reports will have high UVs. A species with high UV demonstrates more than average pharmacological activity for the treatment of illness. According to the UV, the most frequently used medicinal legumes in Thailand were *Biancaea sappan*, *Mimosa pudica*, and *Senna siamea*.

Biancaea sappan was mentioned as useful in the treatment of over 300 disorders and symptoms, including blood nourishment, health maintenance, diarrhea, phlegm, fever, post-partum care, and others. The disorders were mostly in the categories of general and unspecified, blood, blood forming organs and immune mechanism, and digestive. *Biancaea sappan* was often used for blood nourishment, general health maintenance, and to treat muscle pains, with FL values of 13.6, 8.6, and 5.0, respectively (Supplementary Table S8). *Biancaea sappan* has antioxidant, antibacterial, anti-inflammatory, hypoglycemic, vasorelaxant, and hepatoprotective properties [207,210,212]. These properties make *Biancaea sappan* a good medicinal plant that can be used to treat many disorders, and have made it is one of the most popular medicinal plants in Thailand.

Mimosa pudica is outstanding for treatments of disorders in the urological and general and unspecified categories. Treatments of kidney stones, fever, and health maintenance have the highest FL values at 7.2, 6.1, and 5.8 respectively (Supplementary Table S8). Extracts of this plant contain many chemical components such as tannins, steroids, alkaloids, triterpenes, glycosylflavones, and flavonoid glycosides [203,213,214]. The pharmacological properties of these compounds, e.g., antioxidant, antibacterial, antifungal, anti-inflammatory, hepatoprotective, antinociceptive, anticonvulsant, antidepressant, antidiarrheal, and hypolipidemic activities make *Mimosa pudica* well suited to treat many disorders [56]. In Ayurvedic medicine, this species has been used to treat wounds, leprosy, dysentery, vaginal and uterine complaints, inflammations, burning sensations, asthma, leucoderma, fatigue, and blood diseases [215,216].

The medicinal properties of *Senna siamea* are mostly used in treatments in the category of general and unspecified disorders. The most common disorders it treats are insomnia and constipation, and it is used for general health maintenance, with FL values of 7.2, 5.1, and

4.7 respectively (Supplementary Table S8). This species has analgesic, anti-inflammatory, and antipyretic properties that make it effective in the treatment of fever [217,218]. *Senna siamea* contains abundant nutritional iron, magnesium, manganese, potassium, calcium, sodium, copper, and phosphorus, which makes it suitable for body tonics [219].

4.8. The Potential of Medicinal Legumes

Many legume species with high UVs have already been promoted as public traditional medicine, i.e., *Biancaea sappan*, *Cassia fistula*, *Senna siamea*, *Senegalia rugata*, *Senna alata* (L.) Roxb., *Albizia myriophylla* Benth., *Tamarindus indica*, *Brachypterum scandens* (Roxb.) Miq., and *Senna garrettiana* (Craib) Irwin and Barneby [7]. In addition, there are many more species that could be used in public traditional medicine, i.e., *Mimosa pudica*, *Senna tora*, *Tadehagi triquetrum*, *Clitoria ternatea* L., *Pterocarpus macrocarpus* Kurz, and *Senna occidentalis* (L.) Link. These species all have high UVs, and they could be developed into public traditional medicine.

Almost all the species with high UV had corroborating reports of their pharmacological efficacy. In Ayurveda medicine, *Mimosa pudica* has been found to be useful in the treatment of many ailments such as leprosy, dysentery, inflammations, asthma, and blood diseases [215]. *Mimosa pudica* extract has wound healing and anticonvulsant effects [213,216]. For treatment of disorders, species of *Senna* contain compounds such as anthraquinones, flavonoids, alkaloids, phenylpropanoids, and xanthones [194]. Compounds in *Senna tora* have shown antioxidant, anticancer, hepatoprotective, anti-Alzheimer's, anti-inflammatory, antidiabetic, and antifungal activity [194,220,221]. *Tadehagi triquetrum* contains flavonoids, alkaloids, and tannins that provide antioxidant and hypoglycemic activity, and give it antihepatotoxic potential [201,222,223]. *Clitoria ternatea* has antimicrobial, anti-diabetic, anticonvulsant, antidepressant, and anti-inflammation properties, and in Ayurveda therapies in India it is used as a laxative [224–226]. *Pterocarpus macrocarpus* contains compounds that prevent cancer cell activity, reduce antiplasmodial activity, and show anti-Alzheimer's disease and antispasmodic properties [227,228]. Antimicrobial activity, anti-resorptive effects, and anti-diabetes potential were found in *Senna occidentalis* [229–231].

The trend of using public herbal medicine in Thailand is rapidly increasing. The Ministry of Public Health in Thailand has realized the importance of Thai traditional wisdom. The descriptions, anatomy, toxicity, and chemical compositions of herbal species have been recorded by the Department of Medical Sciences in the Thai Herbal Pharmacopoeia, where they have been included since 1995. The latest volume of the Thai Herbal Pharmacopoeia contains monographs of 99 herbal medicinal species [232]. Although Thailand is home to many herbal medicinal species, only seven legumes are included in the Thai Herbal Pharmacopoeia (*Cassia fistula*, *Senna alata*, *Brachypterum scandens*, *Senna tora*, *Albizia procera* (Roxb.) Benth., *Guilandina bonduc* L. and *Pterocarpus santalinus* L.f.). Thailand has many medicinal species but their development within public medicine requires many steps and will take some time. Ethnomedicinal studies can point to new medicinal species which have interesting potential to be developed into public herbal medicine. In this way, the study of ethnomedicinal plants is related to drug discovery and to identifying new drug candidates [233].

5. Conclusions

We recorded an outstanding diversity of 261 medicinal legume species in Thailand, of which 66 were found to be new records when compared to previous compilations of ethnomedicinal studies. These medicinal legumes make up 28 percent of the legume species found in Thailand.

Fifteen species of medicinal legume had high use values (UV) and six of them have not yet been promoted as national public herbal medicine. The species with high use values were considered to have potential for use in public herbal medicine. The knowledge of species with low UV might disappear from communities in the future. The FL values showed which species were commonly used and which disorders were the most

treated. Ethnobotany indices are therefore good tools for assessing the value of each medicinal species.

Thailand has abundant quantities of medicinal legumes, but ethnobotanical and pharmacological research is still lacking for many of them. Further research should focus on individual species with therapeutic potentials that can be developed for public herbal medicine.

6. Patents

The text has already been updated to recent supplementary data.

References

1. WHO. Traditional, Complementary and Integrative Medicine. Available online: https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine#tab=tab_1 (accessed on 6 March 2021).
2. Ekor, M. The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. *Front. Pharmacol.* **2014**, *4*, 177. [CrossRef] [PubMed]
3. WHO. *Traditional Medicine in the WHO South-East Asia Region: Review of Progress 2014–2019*; WHO: New Delhi, India, 2020; ISBN 978-92-9022-829-5.
4. Anderson, E.F. Ethnobotany of hill tribes of northern Thailand. I. Medicinal plants of Akha. *Econ. Bot.* **1986**, *40*, 38–53. [CrossRef]
5. Development of National List of Essential Drugs Subcommittee. *National List of Essential Drugs (List of Herbal Medicine Products)*; The agricultural co-operation federation of Thailand publisher: Bangkok, Thailand, 1999; p. 48.
6. Phumthum, M.; Srithi, K.; Inta, A.; Junsongduang, A.; Tangjitman, K.; Pongamornkul, W.; Trisonthi, C.; Balslev, H. Ethnomedicinal plant diversity in Thailand. *J. Ethnopharmacol.* **2018**, *214*, 90–98. [CrossRef] [PubMed]
7. Development of National List of Essential Drugs Subcommittee. *National List of Essential Drugs (List of Herbal Medicine Products)*; The agricultural co-operation federation of Thailand publisher: Bangkok, Thailand, 2020.
8. Office of Information Technology Administration for Educational Development. Thai Library Integrated System, Thailis Digital Collection. Available online: https://tdc.thailis.or.th/tdc/ (accessed on 8 February 2020).
9. National Research Council of Thailand. Digital Research Information Center. Available online: https://dric.nrct.go.th/Index (accessed on 3 August 2020).

10. BEDO. Biodiversity Digital Library. Available online: http://bedolib.bedo.or.th/?mid=186 (accessed on 19 March 2020).

11. Cook, F.E. *Economic Botany Data Collection Standard*; Royal Botanic Gardens (Kew): Richmond, UK, 1995; ISBN 0947643710.

12. Board of Trustees of the Royal Botanic Gardens Kew. Plant of the World Online. Available online: https://powo.science.kew.org/ (accessed on 11 May 2022).

13. The Wonca International Classification Committee. *International Classification of Primary Care Revised*, 2nd ed.; Oxford university press: Oxford, UK, 2005; ISBN 978-019-85-6857-5.

14. RStudio Team. *RStudio: Integrated Development for R*; PBC, Ed.; RStudio: Boston, MA, USA, 2020.

15. Trotter, R.T.; Logan, M.H. Informant consensus: A New Approach for Identifying Potentially Effective Medicinal Plants. In *Plants in Indigenous Medicine & Diet*; Routledge: New York, NY, USA, 1986; pp. 91–112.

16. Friedman, J.; Yaniv, Z.; Dafni, A.; Palewitch, D. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. *J. Ethnopharmacol.* **1986**, *16*, 275–287. [CrossRef]

17. Phillips, O.; Gentry, A.H. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. *Econ. Bot.* **1993**, *47*, 15–32. [CrossRef]

18. Anderson, E.F. Ethnobotany of hill tribes of northern Thailand. II. Lahu medicinal plants. *Econ. Bot.* **1986**, *40*, 442–450. [CrossRef]

19. Archam, N. *Traditional Medicine Plants of Tai Yai in Laktaeng Village, Wiang Haeng district, Chiang Mai Province*; Biology, Chiang Mai University: Chiang Mai, Thailand, 2011.

20. BEDO. *List of Medicinal Plant Bioresources in Chiang Rai, Chiang Mai, Nan and Lampang Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2018.

21. BEDO. *List of Medicinal Plant Bioresources in Loei, Phitsanulok and Phetchabun Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2018.

22. BEDO. *List of Medicinal Plant Bioresources in Ranong, Suratthani and Phangnga Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2018.

23. BEDO. *List of Medicinal Plant Bioresources in Tak, Kamphaengphet and Phichit Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2018.

24. BEDO. *List of Medicinal Plant Bioresources in Chainat and Suphanburi Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

25. BEDO. *List of Medicinal Plant Bioresources in Chaiyaphum, Buriram and Surin Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

26. BEDO. *List of Medicinal Plant Bioresources in Chonburi and Rayong Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

27. BEDO. *List of Medicinal Plant Bioresources in Nakhonratchasima Province*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

28. BEDO. *List of Medicinal Plant Bioresources in Nakhonsithammarat Province*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

29. BEDO. *List of Medicinal Plant Bioresources in Phayao and Phrae Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

30. BEDO. *List of Medicinal Plant Bioresources in Ratchaburi and Phetchaburi Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

31. BEDO. *List of Medicinal Plant Bioresources in Sukhothai and Uttaradit Provinces*; Biodiversity-Based Economy Development Office (Public Organization): Bangkok, Thailand, 2019.

32. Boonkorn, P. Ethnobotanical Study of the Lisu at Sarm-Kula Village, Wiang Papao, Chiang Rai. Master's Thesis, Biology, Chiang Mai University, Chiang Mai, Thailand, 1997.

33. Boontun, O. Utilization and Conservation of Wild Plants Diversity: A Case Study of Two Karang Villages in Kaeng Krachan national park. Master's Thesis, Technology of Environmental Management, Mahidol University, Bangkok, Thailand, 2010.

34. Borikut, M. *Ethnobotany of Lua in Ban Numpae, Boklua District, Nan Province, Teaching Biology*; Chiang Mai University: Chiang Mai, Thailand, 2019.

35. Burnarak, P. *Ethnobotany of Medicinal Plants in Phuhinlatchofa Nong Bua Lum Phu Province*; Science Education, Udon Thani Rajabhat University: Udon Thani, Thailand, 2008.

36. Bunsongthae, A.; Chaiwong, C. Conservation and utilization of ethnic plants in some areas of Maehongson province. *North. Reg. J. of Sci. Technol.* **2010**, *3*, 22–43.

37. Chamratpan, S.; Homchuen, S.A. Ethnobotany in upper northeastern Thailand. *Acta Hortic.* **2005**, *675*, 67–74. [CrossRef]

38. Chompror, M. *Use of Medicinal Plants of Lawa at Ban Toey Klang, Doi Phuka, Nan Province, Agriculture*; Chiang Mai University: Chiang Mai, Thailand, 1999.

39. Chotchoungchatchai, S.; Saralamp, P.; Jenjittikul, T.; Pornsiripongse, S.; Prathanturarug, S. Medicinal plants used with Thai traditional medicine in modern healthcare services: A case study in Kabchoeng Hospital, Surin province, Thailand. *J. Ethnopharmacol.* **2012**, *141*, 193–205. [CrossRef]

40. Charnprasert, C.; Chansuwanit, N. Exploration and collection of medicinal plants in wasted areas of Muang district, Nonthaburi province. *Kasetsart J. Nat. Sci.* **1992**, *26*, 19.

41. Chaunchom, P. *Ethnobotany of Hmong at Ban Tabboek, Tambon Wangban, Amphoe Lomkao, Changwat Phetchabun, Forest Resource Administration*; Kasetsart University: Bangkok, Thailand, 2011; p. 105.

42. Chiramongkolgarn, U.; Paisooksantivatana, Y. Medicinal plants in Tao Bam forest, Wangkrajae village, Sai Yok district, Kanchanaburi province. *Thai J. Phytopharm.* **2002**, *9*, 10.

43. Chuakul, W. Medicinal plants in Khao Kho district, Phetchabun province, Thailand. *Pharm. Biol.* **2000**, *38*, 61–67. [CrossRef]

44. Chuakul, W.; Saralamp, P.; Boonpleng, A. Medicinal plants used in the Kutchum district, Yasothon Province, Thailand. *Thai J. Phytopharm.* **2002**, *9*, 22–49.

45. Chuakul, W.; Saralamp, P.; Boonpleng, A. Medicinal plants used in the Loengnoktha district, Yasothon province, Thailand. *Thai J. Phytopharm.* **2002**, *9*, 23–46.

46. Chuakul, W.; Boonpleng, A. Survey on medicinal plants in Ubon Ratchathani province (Thailand). *Thai J. Phytopharm.* **2004**, *11*, 33–54.

47. Chuakul, W.; Soonthornchareonnon, N.; Boonjaras, T.; Boonpleng, A. Survey on medicinal plants in Southern Thailand. *Thai J. Phytopharm.* **2004**, *11*, 29–52.

48. Chuakul, W. Medicinal Plants in the Khok Pho District, Pattani Province (Thailand). *Thai J. Phytopharm.* **2005**, *12*, 23.

49. Chuakul, W.; Soonthornchareonnon, N.; Sappakun, S. Medicinal plants used in Kungkrabaen Royal Development Study Center, Chanthaburi province. *Thai J. Phytopharm.* **2006**, *13*, 19.

50. Chuakul, W. Herbal medicine for healing muscular pain. *Thai Pharm. Health Sci. J.* **2010**, *5*, 11–13.

51. Chuntum, K.; Kamlangluea, K. Treatment with herbs and the ancient recipe of traditional medicine. *J. Med. Health Sci.* **2017**, *24*, 48–57.

52. Danphitsanuparn, P. *Ethnobotanical Study of Northern Thai People, Pok Nai Village, Chiangmai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2009.

53. Gunsuwan, P. *Processes of Transferring Local Wisdom on Management of Medicinal Herbs Diversity for Traditional Healing of Hmong Community: A Case Study of Khun Chang Khian Village, Chang Phueak Sub-District, Mueang Chiang Mai District, Man and Environment Management*; Chiang Mai University: Chiang Mai, Thailand, 2011.

54. Hermhuk, S.; Sungpalee, W.; Atnaseo, C.; Pothawong, N.; Sri-Ngernyuang, K. Plants Utilization of Tai Lue at Bann Tapapao Community Forest Mae Tha District, Lamphun Province. *Thai J. For.* **2018**, *37*, 111–120.

55. Imchan, T. *Hmong's Wisdom in the Utilization and Conservation of Medicinal Plants in Bo Phak Subdistict, Chattrakarn District, Phitsanulok Province*; Natural Resource and Environmental Management, Naresuan University: Phitsanulok, Thailand, 2006.

56. Inta, A. *Ethnobotany and Crop Diversity of Tai Lue and Akha Communities in the Upper Northern Thailand and the Xishuangbanna Dai Autonomous Prefecture, China, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2008.

57. Inta, A. *Analysis of Traditional Knowledge of Plants Used of the Communities in the Haripunchai Campus, Chiang Mai University, Lamphun Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2011.

58. Inta, A.; Sirisa-ard, P.; Pongamornkul, W. Medicinal plants in Ban Hua Thung community forest, Chiang Dao wildlife sanctuary, Chang Dao district, Chiang Mai province. *Thai J. Bot.* **2012**, *4*, 213–232.

59. Inta, A.; Panee, S.; Pongamornkul, W. Medicinal plants in Ban Hua Thung Community Forest, Chiang Dao Wildlife Sanctuary, Chang Dao District, Chiang Mai Province. *Thai J. Bot.* **2013**, *4*, 20.

60. Inta, A.; Srisanga, P.; Panyadee, P.; Pongamornkul, W.; Kongphuthorn, N.; Boonrasri, T.; Tanattang, W.; Chaisoung, N.; Punchay, K.; Somjaiai, P.; et al. *Survey of Biodiversity: A Case Study of Medicinal Plants in Nan and Mae Hong Son Community Forest*, 1st ed.; Wanida printing: Chiang Mai, Thailand, 2018.

61. Jeanwitchayakul, P. Diversity of Medicinal Plants and Local Wisdom in Kao Subkangkai Lopburi Province. In Proceeding of the 9th National Conference for Sustainable of Thailand by Phetchaburi Rajabhat University, Phetchaburi Rajabhat University, Phetchaburi, Thailand, 2014.

62. Jearanai, J. *A Study of Traditional Thai Complementary Therapies, Traditional Thai Midwifery, and Herbal Utilization of Traditional Healers: A Case Study of Traditional Healers Living in NumPung Dam, Sakon Nakhon Province*; Suranaree University of Technology Intellectual Repository: Nakhon Ratchasrima, Thailand, 2012.

63. Junkhonkaen, J. *Ethnobotany of Ban Bowee, Amphoe Suan Phueng, Changwat Ratchaburi, Economic Botany*; Kasetsart University: Bangkok, Thailand, 2012; p. 366.

64. Junsongduang, A. *Roles and Importance of Sacred Forest in Biodiversity Conservation in Mae Chaem District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2014.

65. Junsongduang, A.; Sirithip, K.; Nachai, R.; Buakamkoat, L.; Onputtha, B. Dye plants and traditional knowledge of natural dyeing of Tai-Lao ethnicity in At Samat and Pho Chai districts, Roi Et province. *Thai J. Bot.* **2018**, *10*, 109–126.

66. Juntarapol, P.; Tuntian, S.; Neamsuwan, O. Diversity of medicinal plants for fever healing from Khao Phanom Benja National Park, Krabi province. *KKU Sci. J.* **2014**, *42*, 24.

67. Kaewsangsai, S. *Ethnobotany of Karen in Khun Tuen Noi Village, Mae Tuen Sub-District, Omkoi District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2016.

68. Kantasrila, R. *Ethnobotany of Karen at Ban Wa Do Kro, Mae Song Sub-District, Tha Song Yang District, Tak Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2016.

69. Kamwong, K. *Ethnobotany of Karens at Ban Mai Sawan and Ban Huay Pu Ling, Ban Luang Sub-District, Chom Thong District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2010.

70.   Khamfachua, K. *Ethnobotany of Karen at Ban Chan and Chaem Luang Subdistricts, Mae Chaem district, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2008.

71.   Khonkayan, S.; Saengsiri, V.; Thipsontae, H. Medicinal plants in Phu Mae Nang Mon, Phu Sri Tan Wildlife Sanctuary, Mukdahan Province. *Burapha Sci. J.* **2019**, *24*, 500–516.

72.   Khopan, S.; Tanee, T.; Appamaraka, S. Species diversity and utilization of medicinal plants by the Kuoy tribe in Khok Khu Khat-Ban Khu Si Chae community forest, Phrai Bueng district, Sisaket province. *J. Sci. Technol. MSU* **2019**, *38*, 247–262.

73.   Khuankaew, S.; Srithi, K.; Tiansawat, P.; Jampeetong, A.; Inta, A.; Wangpakapattanawong, P. Ethnobotanical study of medicinal plants used by Tai Yai in Northern Thailand. *J. Ethnopharmacol.* **2014**, *151*, 829–838. [CrossRef]

74.   Klamwaewwong, C. *Ethnobotanical Study of H'tin hilltribe at Wangsao village, Nan, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1996.

75.   Krueasan, D. *Management, Conservation and Utilization of Plant Species by Hmong of Pah Poo Chom Village, Mae Taeng District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2000.

76.   Mahawongsanan, A. *Change of Herbal Plants Utilization of the Pgn K'nyau: A Case study of Ban Huay Som Poy, Mae Tia Watershed, Chom Thong District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2008.

77.   Maneenoon, K. *Ethnobotany of Sakai Tribe in Trang, Phatthalung and Yala Provinces, Botany*; Prince of Songkla University: Songkhla, Thailand, 2001; p. 194.

78.   Maneenoon, K.; Khuniad, C.; Teanuan, Y.; Saedan, N.; Prom-in, S.; Rukleng, N. Ethnomedicinal plants used by traditional healers in Phatthalung Province, Peninsular Thailand. *J. Ethnobiol. Ethnomed.* **2015**, *11*, 43. [CrossRef]

79.   Maneenoon, K.; Chatawatee, B.; Damkhong, C.; Khiankhan, N.; Kunworarath, N. Knowledge of traditional healers on utilization of medicinal plants used for menstrual disorders in Krabi and Songkhla provinces, Thailand. *Burapha Sci. J.* **2017**, *22*, 243–258.

80.   Muangyen, N. *Ethnobotany of Tai Lue and Tai Yuan in Samoeng District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2013.

81.   National Park Innovation Institute. *Plants Use of Karang at Lower Ta Now Sri Forest*; Department of National Parks, Wildlife and Plant Conservation: Bangkok, Thailand, 2013.

82.   Neamsuvan, O.; Jaisamut, P.; Maneenoon, K.; Subhateerasakul, S. A survey of medicinal plants for tonic from Ban Toong Soong community forest, Auluk district, Krabi province. *Burapha Sci. J.* **2012**, *17*, 7.

83.   Neamsuvan, O.; Boontong, J.; Boonkaew, M.; Sudrak, N.; Moosigapong, K. A Study on indigenous knowledge of paresis-paralysis treatment from folk healers: A case study of Mrs. Somporn Sudjai, Chumphon province. *Thai Pharm. Health Sci. J.* **2013**, *8*, 8.

84.   Neamsuvan, O.; Charoensuk, N.; Tangrattanasuwan, A.; Khumthong, S.; Sengnon, N. A Survey of Materia Medica for Rid-Si-Duang Healing: A Case Study of Rung Chumanee's Bud Khao Book, Nakhon Si Thammarat Province, Thailand. *Thai Pharm. Health Sci. J.* **2013**, *8*, 8.

85.   Neamsuvan, O. *Ethnobotanical Revision of Medicinal Plants in Vegetable and Grass Type: A Case Study of Local Knowledge from Southern Thailand*; Prince of Songkhla University: Songkhla, Thailand, 2014.

86.   Neamsuvan, O.; Tuntien, S. Medicinal plants used for women's healthcare from Khao Phanom Bencha national park, Krabi province. *Burapha Sci. J.* **2015**, *20*, 15.

87.   Neamsuvan, O.; Madeebing, N.; Mah, L.; Lateh, W. A survey of medicinal plants for diabetes treating from Chana and Nathawee district, Songkhla province, Thailand. *J. Ethnopharmacol.* **2015**, *174*, 82–90. [CrossRef]

88.   Neamsuvan, O.; Sengnon, N.; Seemaphrik, N.; Chouychoo, M.; Rungrat, R.; Bunrasri, S. A survey of medicinal plants around upper Songkhla Lake, Thailand. *Afr. J. Tradit. Complementary Altern. Med.* **2015**, *12*, 133–143. [CrossRef]

89.   Neamsuvan, O.; Bunmee, P. A survey of herbal weeds for treating skin disorder from southern Thailand: Songkhla and Krabi provinces. *J. Ethnopharmacol.* **2016**, *193*, 574–585. [CrossRef]

90.   Neamsuvan, O.; Phumchareon, T.; Bunphan, W.; Kaosaeng, W. Plant materials for gastrointestinal diseases used in Chawang District, Nakhon Si Thammarat Province, Thailand. *J. Ethnopharmacol.* **2016**, *194*, 179–187. [CrossRef]

91.   Neamsuvan, O.; Komonhiran, P.; Boonming, K. Medicinal plants used for hypertension treatment by folk healers in Songkhla province, Thailand. *J. Ethnopharmacol.* **2018**, *214*, 58–70. [CrossRef]

92.   Nguanchoo, V. *Ethnobotany of Hmong in Maerim District, Chiang Mai Province, Thailand, Biology*; Mahidol University: Bangkok, Thailand, 2014.

93.   Noitana, P.; Saipara, S.; Khoomput, K. Ethnobotany of the Hmong at Nanoi District, Nan Province. *Naresuan Phayao J.* **2013**, *6*, 7.

94.   Nuammee, A. *Ethnobotany of Hmong in Ban Pang Chang, Tambon Pong, Amphoe Santisuk, Changwat Nan, Botany*; Chulalongkorn University: Bangkok, Thailand, 2012.

95.   Osiri, S. Folk healers and herbal use in Chonburi Province. *Public Health J. Burapha Univ.* **2001**, *6*, 10.

96.   Osiri, S. Traditional healers and medicinal plants in Chachoengsao Province. *J. Thai Trad. Alt. Med.* **2011**, *9*, 10–19.

97.   Paisooksantivatana, Y.; Kiko, S. Ethnobotany of the Karen Tribe in Western Thailand. In Proceedings of the FORTROP' 96 International Conference: Tropical Forestry in the 21st Century: Volume 3 Ethnobiology, Bangkok, Thailand, 25–28 November 1996; pp. 70–80.

98.   Pannet, P. *Life Belief and Ritual Relating to Herbal Utilization: A Medical Ethobotanic Study in Phu Thai Ethnic Group at Don Mai Khum Village Kalasin Province Thailand, Plant Science*; Mahidol University: Bangkok, Thailand, 2008.

99.   Panta, K. *Ethnobotany of Lisu in Khun Chae Village, Phrao District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2015.

100. Pantarod, B. *A Survey and Collection of Medicinal Plants at Na Kwang Village, Bo Kleau District, Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2002.

101. Panyadee, P. *Plant Utilization and Community Forest Management of Sribuaban Village, Sribuaban Subdistrict, Muang District, Lamphun Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2010.

102. Panyadee, P. *Plant Diversity in Homegardens of Tai Yai Communities in Pang Mapha District, Mae Hong Son Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2012.

103. Panyadee, P. *Comparison of plants composition and structure of homegardens of Ethnic Groups in Chiang Mai Province, Thailand, Biodiversity and Ethnobiology*; Chiang Mai University: Chiang Mai, Thailand, 2017.

104. Panyaphu, K. *Conservation and Sustainable Use of Ethnomedicinal Plants by Mien People in Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2012.

105. Peng-ngummuang, K.; Jansuta, T.; Sangdech, S.; Somkhow, P. Study of medicinal plants utilization in the community of Tambon Kho-ae, Amphoe Khueang Nai, Ubon Ratchathani. *UBRU J. Public Health Res.* **2019**, *8*, 150–165.

106. Phongloy, T. *Biodiversity and Utilization of Plants from Protected and Utilized Forests by Tai Yai Communities in Chiang Mai and Mae Hong Son Province, Biodiversity and Ethnobiology*; Chiang Mai University: Chiang Mai, Thailand, 2015.

107. Phueaknang, C. *Ethnobotany of Local People at Ban Chong Khaeb Samakkhee Forest, Tambon Tha Sao, Amphoe Sai Yok, Changwat Kanchanaburi, Forest Resource Administration*; Kasetsart University: Bangkok, Thailand, 2005; p. 171.

108. Pipitkul, S. *Medicinal Plant Utilization for the Living of Hill Tribes at Doi Musoe, Tak Province, Technology of Environmental Management*; Mahidol University: Bangkok, Thailand, 2001.

109. Pomnat, S. *Ethnobotany of Ban Pong Nuea Village, Hang Dong district, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2013.

110. Pongamornkul, W.; Kumpetch, P.; Panya, R. *Ethnobotanical Studies of Karen in Mae Lid Luang, Mae Hor Subdistrict, Mae Sariang District, Mae Hong Son Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2002.

111. Pongamornkul, W. *An Ethnobotanical Study of the Karen at Ban Yang Pu Toh and Ban Yang Thung Pong, Chiang Dao District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2003.

112. Pongamornkul, W. *Ethnobotany of Lua in Royal Development Project Areas, Mae Hong Son Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2006.

113. Pongamornkul, W.; Muangyen, N. *Ethnobotany of Tai Yai in Khun Yuam District, Mae Hong Son Province*; Chiang Mai University: Chiang Mai, Thailand, 2012.

114. Pongamornkul, W.; Muangyen, N. *Ethnobotany of Karen in Sop Moei District, Mae Hong Son Province*; Chiang Mai University: Chiang Mai, Thailand, 2013.

115. Pongsattayapipat, R. *Survey and Collection of Cereals, Legumes and Earth Crops Consumed by the Minorities in Some Areas of Doi Mae Salong in Chiang Rai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1999.

116. Ponpim, Y. *Ethnobotany of the Hill Tribes in Kaenoy's and Nongkheuw's Royal Project in Chiang Mai, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1996.

117. Poopath, M.; Karaket, P.; Tananthaisong, T.; Srisakorn, K. *Wild Herb*; Forest Botany Division, Department of National Parks, Wildlife and Plant Conservation: Bangkok, Thailand, 2020.

118. Prachuabaree, L. *Medicinal Plants of Karang Hill Tribe in Baan Pong-Lueg, Kaeng Krachan District, Phetchaburi Province, Pharmacy*; Silpakorn University: Bangkok, Thailand, 2008; p. 159.

119. Prasitpuriprecha, C.; Sripanidkulchai, B.; Lulitanond, V.; Saguansermsri, J. Studies on the utilization of medicinal plants as immunomodulators in Ubon Ratchathani Province, Thailand. *KKU Res. J.* **2005**, *10*, 31–41.

120. Puling, W. *Ethnobotany of Karen for Studying Medicinal Plants at Angka Noi and Mae Klangluang Villages, Chomthong District, Chiang Mai, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2001.

121. Purintavaragul, C.; Wongnawa, M.; Thaina, P. Medicinal Plants diversity in Kao-Pra Village, Thumbol Kao-Pra, Amphoe Rattapoom, Songkhla Province. *Thaksin J.* **2012**, *15*, 9.

122. Rattanachittawat, S. *Rattamanee, Plant Diversity in Burapha University, Sa Kaeo Campus, Agricultural Technology*; Burapha University: Chonburi, Thailand, 2017.

123. Satean, G.; Homhuan, S.; Premprasit, S. Plant utilization from Thungluilai community forest in Thungluilai sub-district, Kornsarn district, Chaiyaphum province. *J. Soc. Sci. Naresuan Univ.* **2018**, *14*, 211–245.

124. Sellers, H.A. *A Linguistic Approach to Ethnobotanical Plant Name Classification in Southern Lisu*; La Trobe University, Bundoora: Victoria, Australia, 2015.

125. Sinworn, S.; Viriyawattana, N. The diversity of medicinal plants and utilization in Khoa Phra, Doembangnangbuat district, Suphanburi province. *SDU Res. J. Sci. Technol.* **2014**, *7*, 19.

126. Songsangchun, A. *Plants Usages of Khon Muang and Lawa in Phu Fah Subdistict, Bo Klue District, Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2015.

127. Sonsupub, B. *Ethnobotany of Karen Community in Raipa Village, Huaykhayeng Subdistrict, Thongphahpume District, Kanchanaburi Province, Hoticulture*; Kasetsart University: Bangkok, Thailand, 2010; p. 115.

128. Srisanga, P.; Wongpakam, S.; Kamkuan, W.; Pekthong, T.; Tovaranonte, J.; Yaso, T.; Nontachaiyapoom, S. Ethnobotany of Akha in Huay Yuak Pa So village, Mae Fah Luang district and Ban Mai Patthana village, Mae Suai district, Chiang Rai province. *Thai J. Bot.* **2011**, *3*, 12.

129. Srithi, K. *Comparative Ethnobotany in Nan Province, Thailand, Biodiversity and Ethnobiology*; Chiang Mai University: Chiang Mai, Thailand, 2012.

130. Srithi, K.; Balslev, H.; Tanming, W.; Trisonthi, C. Weed diversity and uses: A case study from tea plantations in northern Thailand. *Econ. Bot.* **2017**, *71*, 147–159. [CrossRef]

131. Sritubtim, S.; Krapeedeang, S.; Wongsa, N. Biological activities on growth inhibition of bacteria of medicinal plant extracts from plants found in the upper northeastern Thailand. *SDU Res. J. Sci. Technol.* **2014**, *7*, 20.

132. Sukkho, T. *A Survey of Medicinal Plants Used by Karen People at Ban Chan and Chaem Luang Subdidtricts, Mae Chaem District, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2008.

133. Suk–ueng, K.; Wongchai, P.; Lakerd, J. A study of medicinal plants source in freshwater swamp forest of Phu Sang national park, Phayao province. *J. Res. Unit Sci. Technol. Environ. Learn.* **2019**, *10*, 263–271.

134. Sumridpiem, P. *Utilization Analysis of Medicinal Plants Between Tai Yong and Tai Yuan in Lamphun Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2017.

135. Supawimolpan, W. *Ethnobotany of Khamu in Ban Huai Sa Taeng, Thung Chang district, Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2011.

136. Sutjaritjai, N. *Taxonomy of Tree at Huay Nam Pam Forest Conservation Unit, San Pan Dan Wildlife Sanctuary, Pang Ma Pha District, Mae Hong Son Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2013.

137. Sutjaritjai, N. *Quantitative Ethnobotany of Fabaceae of Karen Communities in Chiang Mai Province, Thailand, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2019.

138. Suttakun, P. *Medicinal Plants Utilization in Some Areas of Tungyao Forest Community, Tambol Sribuaban, Amphoe Mueng, Changwat Lamphun, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2002.

139. Suwanantawong, N. *Pharmaceutical Ethnobotanical Study of Thai-Khmer Ethnic Group in 2 Villages in the Khukhan District, Si Sa Ket Province, Plant Science*; Mahidol University: Bangkok, Thailand, 2011.

140. Tangjitman, K. *Vulnerability Prediction of Medicinal Plants Used by Karen People in Chiang Mai Province to Climatic Change Using Species Distribution Model (SDM), Biodiversity and Ethnobiology*; Chiang Mai University: Chiang Mai, Thailand, 2014.

141. Tangjitman, K. Ethnobotany of the Karen at Huay Nam Nak village, Tanaostri subdistrict, Suanpheng district, Ratchaburi province. *Thai J. Bot.* **2017**, *9*, 253–272.

142. Tangtragoon, T. *Ethnobotany of the Khamu, Lawa and H'tin in Some Areas of Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1998.

143. Tangtragoon, T.; Tarachai, Y.; Hongwittayakorn, P.; Prokati, V.; Phreechawattanakon, P. *Ethnobotany Studies in Ban Pong, Sansai District, Chiang Mai Province*; Mae Jo University: Chiang Mai, Thailand, 2004.

144. Thaenkham, A.; Tiyaworanant, S.; Padumanonda, T. The ethnobotanical survey of traditional plant of Pamanow subdistrict, Banfang district, Khon Kaen province. *UDRU J. Sci. Technol.* **2019**, *7*, 61–75.

145. Thaewchatturat, A. *Ethnobotany of Moken at Moo Ko Surin National Park, Amphoe Kuraburi, Changwat Phangnga, Silviculture*; Kasetsart University: Bangkok, Thailand, 2000; p. 86.

146. Thammaporn, C. *Study on Medicinal Plants Used by Traditional Healers in Songkhla Province to Trat Liver Diseases and Hepatoprotective Effect of a Selected Prescription on Paracetamol Induced, Thai Traditional Medicine*; Prince of Songkhla University: Songkhla, Thailand, 2015.

147. Thangthaisong, T.; Caichompoo, W.; Phadungkit, M. The ethnobotanical survey of plants used for treatment of bone disorders in Amphur Muang, Mahasarakram province. *Thai Pharm. and Health Sci. J.* **2011**, *6*, 5.

148. Thatsaneeyakorn, J. *Ethnobotany of Akha at Doi Sa-Ngo village, Chiang San District, Chiang Rai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1997.

149. Tichachart, C. *Ethnobotany of Hmong Hilltribe in Tambon Kheknoi, Amphur Khaokor, Changwat Phetchabun, Economic Botany*; Kasetsart University: Bangkok, Thailand, 2004; p. 190.

150. Tongban, S.; Prapalert, W. *Study on Medicinal Bioacvtive Compounds from Herbs in Sa Luang Community Chiang Mai Province*; Chiang Mai Rajabhat University: Chiang Mai, Thailand, 2009.

151. Tovaranonte, J. *Ethnobotanical Study of the Lisu at Lisu Lum Village, Chiang Mai, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1993.

152. Tovaranonte, J. *Ethnobotanical Study of the Tai Lue, Hmong and Yao in Some Areas of Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1998.

153. Tovaranonte, J. *Ethnobotany in Surroundings Area of Mae Fah Luang University*; Mae Fah Luang University: Chiang Rai, Thailand, 2001.

154. Tovaranonte, J. *Ethnobotany of Tai Lue in Chiang Rai Province*; Mae Fah Luang University: Chiang Rai, Thailand, 2003.

155. Trisonthi, C.; Trisonthi, P. Ethnobotanical study in Thailand, a case study in Khun Yuam district Maehongson province. *Thai J. Bot.* **2009**, *1*, 2–23.

156. Trisonthi, C.; Trisonthi, P. Ethnobotany of Lua and H'tin on Doi Phukha, Nan Province. *Thai J. Bot.* **2011**, *3*, 163–185.

157. Trisonthi, C.; Trisonthi, P.; Wangpakapattanawong, P.; Srisanga, P. *Research Project on Gathering of Highland Traditional Biodiversity and Ethnobiology-Based Knowledge*; Highland Research and Development Institute (Public Organization): Chiang Mai, Thailand, 2007.

158. Upho, U. *Ethnobotany of Buddhist and Muslim Thais in Some Locations in the Lower Part of Southern Thailand, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2005.

159. Use, H.; Leeratiwong, C.; Maneenoon, K.; Sawangchote, P. Ethnobotanical study in Ko Hong Hill, Songkhla Province. *Thai J. Bot.* **2016**, *8*, 157–180.

160. Varipo, W. *Ethnobotany of Ban Pok Village, Samoeng district, Chiang Mai Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2012.

161. Wanset, S.; Onchomchant, D. A Study of Medicinal Plants Utilization of Folk Healers: A Case Study of Folk Healers in Chiang Rai Province Thailand. *J. Thai Trad. Alt. Med.* **2018**, *16*, 420–435.

162. Wayo, Y. *A Study on Herbal Plants Used for Healing of Ban Wang Phai Community, Wichian Buri District, Phetchabun Province, Education of Environment*; Uttaradit Rajabhat University: Uttaradit, Thailand, 2012.

163. Winijchaiyanan, P. *Ethnobotany of Karen in Chiang Mai, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1995.

164. Wongaroon, V.; Jongkolnee, V.; Mengkuang, R.; Kwangswas, A.; Sukpat, S.; Duangmala, A. *The Diversity of Medicinal Plants in Sam Roi Yod Fresh Water Marsh*; Rajamangala University of Technology Rattanakosin: Nakorn Phathom, Thailand, 2014.

165. Wongwiwat, W. *Knowledge of Thai Traditional Healer on Utilization of Medicinal Plants for Psoriasis Treatment in Songkhla, Phatthalung, Trang and Satun Provinces, Thai Traditional Medicine*; Prince of Songkhla University: Songkhla, Thailand, 2013.

166. Yaso, T. *Ethnobotanical Study of the Lahu Na at Huay Pong Village, Wieng Pa Pao District, Chiang Rai, Biology*; Chiang Mai University: Chiang Mai, Thailand, 1997.

167. Yaso, T. *Ethnobotany of the H'tin and Lua in Phuphaa Subdistrict, Baugleua District, Nan Province, Biology*; Chiang Mai University: Chiang Mai, Thailand, 2000.

168. Yuyen, Y. Medicinal plants in That Wipagcs textbook. *PNRU Res. J. Sci. Technol.* **2017**, *12*, 109–134.

169. BEDO. Biodiversity Digital Library. Available online: http://bedolib.bedo.or.th/ (accessed on 18 May 2021).

170. Phumthum, M. How far are we? Information from the three decades of ethnomedicinal studies in Thailand. *Ethnobiol. Conserv.* **2020**, *9*, 1–12. [CrossRef]

171. Forest Herbarium. Thai Plant Names. Available online: https://www.dnp.go.th/botany/mplant/index.html (accessed on 19 March 2020).

172. Macêdo, M.J.F.; Ribeiro, D.A.; Santos, M.d.O.; Macêdo, D.G.d.; Macedo, J.G.F.; Almeida, B.V.d.; Saraiva, M.E.; Lacerda, M.N.S.d.; Souza, M.M.d.A. Fabaceae medicinal flora with therapeutic potential in Savanna areas in the Chapada do Araripe, Northeastern Brazil. *Rev. Bras. Farmacogn.* **2018**, *28*, 738–750. [CrossRef]

173. Lewis, G.P.; Schrire, B.; Mackinder, B.; Lock, M. *Legumes of the World*; Royal Botanic Gardens Kew: Richmond, UK, 2005; ISBN 978-190-03-4780-8.

174. Sutjaritjai, N.; Wangpakapattanawong, P.; Balslev, H.; Inta, A. Traditional uses of Leguminosae among the Karen in Thailand. *Plants* **2019**, *8*, 600. [CrossRef] [PubMed]

175. Guarim Neto, G.; Morais, R.G.d. Recursos medicinais de espécies do cerrado de Mato Grosso: Um estudo bibliográfico. *Acta Bot Brasilica* **2003**, *17*, 561–584. [CrossRef]

176. Pinto, A.Z.d.L.; De Assis, A.F.S.; Pereira, A.G.; Pasa, M.C. Levantamento etnobotânico de plantas medicinais comercializadas no mercado do Porto em Cuiabá, Mato Grosso, Brasil. *FLOVET* **2013**, *1*, 51–70.

177. Ninkaew, S.; Balslev, H.; Pornpongrungrueng, P.; Chantaranothai, P. Crotalaria L.(Fabaceae: Faboideae) in Continental Southeast Asia. *Phytotaxa* **2017**, *320*, 1–74. [CrossRef]

178. Mindrila, D.; Balentyne, P. Scatterplots and Correlation. In *The Basic Practice of Statistics*, 6th ed.; Moore, D.S., Notz, W.I., Flinger, M.A., Eds.; W. H. Freeman and Company: New York, NY, USA, 2013.

179. Cordell, G.A. Phytochemistry and traditional medicine–A revolution in process. *Phytochem. Lett.* **2011**, *4*, 391–398. [CrossRef]

180. Fathir, A.; Haikal, M.; Wahyudi, D. Ethnobotanical study of medicinal plants used for maintaining stamina in Madura ethnic, East Java, Indonesia. *Biodiversitas* **2021**, *22*, 386–392. [CrossRef]

181. Maliwichi-Nyirenda, C.P.; Maliwichi, L.L.; Franco, M. Medicinal uses of *Berberis holstii* Engl. (Berberidaceae) in Malawi, the only African endemic barberry. *J. Med. Plant Res.* **2011**, *5*, 1367–1373. [CrossRef]

182. Mounkoro, P.P.; Togola, A.; de Jong, J.; Diallo, D.; Paulsen, B.S.; van't Klooster, C. Ethnobotanical survey of plants used by traditional health practitioners for treatment of schizophrenia Spectrum disorders in Bandiagara, mali, West Africa. *J. Herb. Med.* **2020**, *24*, 100402. [CrossRef]

183. Neangthaisong, T.; Rattanakiat, S.; Phimarn, W.; Joeprakhon, S.; Saramunee, K.; Sungthong, B. Local Wisdom and Medicinal Plant Utilization of Certified Folk Healers for Therapeutic Purposes in Buriram Province, Thailand. *Trop. J. Nat. Prod. Res.* **2021**, *5*, 678–685. [CrossRef]

184. Asiimwe, S.; Namukobe, J.; Byamukama, R.; Imalingat, B. Ethnobotanical survey of medicinal plant species used by communities around Mabira and Mpanga Central Forest Reserves, Uganda. *Trop. Med. Health* **2021**, *49*, 52. [CrossRef] [PubMed]

185. Bosco, F.G.; Arumugam, R. Ethnobotany of irular tribes in redhills, tamilnadu, India. *Asian Pac. J. Trop. Dis.* **2012**, *2*, S874–S877. [CrossRef]

186. Siddique, Z.; Shad, N.; Shah, G.M.; Naeem, A.; Yali, L.; Hasnain, M.; Mahmood, A.; Sajid, M.; Idrees, M.; Khan, I. Exploration of ethnomedicinal plants and their practices in human and livestock healthcare in Haripur District, Khyber Pakhtunkhwa, Pakistan. *J. Ethnobiol. Ethnomed.* **2021**, *17*, 55. [CrossRef] [PubMed]

187. Bozyel, M.E.; Bozyel, E.M.; Canli, K. Turkish Herbal Medicine in the Treatment of Back Pain. In *Ethnomedicinal Plant Use and Practice in Traditional Medicine*; IGI Global: Hershey, PA, USA, 2020; pp. 235–251.

188. Frimpong, E.K.; Asong, J.A.; Aremu, A.O. A review on medicinal plants used in the management of headache in Africa. *Plants* **2021**, *10*, 2038. [CrossRef]

189. Hosseini, S.H.; Bibak, H.; Ghara, A.R.; Sahebkar, A.; Shakeri, A. Ethnobotany of the medicinal plants used by the ethnic communities of Kerman province, Southeast Iran. *J. Ethnobiol. Ethnomed.* **2021**, *17*, 31. [CrossRef] [PubMed]
190. Naive, M.A.K.; Binag, S.D.; Alejandro, G.J.D. Plants with benefits: Ethnomedicinal plants used by the Talaandig tribe in Portulin, Pangantucan, Bukidnon, Philippines. *Indian J. Tradit. Knowl.* **2021**, *20*, 754–766.
191. Office of the Permanent Secretary for Public Health. *Number of Out-Patient by 21 Cause Groups According from Health Service Units, Ministry of Public Health, Whole Kingdom: 2005–2014*; Ministry of Public Health: Bangkok, Thailand, 2011.
192. Tangjitman, K.; Wongsawad, C.; Winijchaiyanan, P.; Sukkho, T.; Kamwong, K.; Pongamornkul, W.; Trisonthi, C. Traditional knowledge on medicinal plant of the Karen in northern Thailand: A comparative study. *J. Ethnopharmacol.* **2013**, *150*, 232–243. [CrossRef]
193. Smitinand, T.; Larsen, K. Flora of Thailand, Volume Four, Part One, Leguminosae-Caesalpinioideae. In *The Forest Herbarium, Royal Forest Department*; Smitinand, T., Larsen, K., Eds.; TISTR Press: Bangkok, Thailand, 1984; pp. 1–129.
194. Khurm, M.; Wang, X.; Zhang, H.; Hussain, S.N.; Qaisar, M.N.; Hayat, K.; Saqib, F.; Zhang, X.; Zhan, G.; Guo, Z. The genus *Cassia* L.: Ethnopharmacological and phytochemical overview. *Phytother. Res.* **2021**, *35*, 2336–2385. [CrossRef]
195. Nuankaew, W.; Heemman, A.; Wattanapiromsakul, C.; Shim, J.H.; Kim, N.W.; Yasmin, T.; Jeong, S.Y.; Nam, Y.H.; Hong, B.N.; Dej-Adisai, S. Anti-insulin resistance effect of constituents from *Senna siamea* on zebrafish model, its molecular docking, and structure–activity relationships. *J. Nat. Med.* **2021**, *75*, 520–531. [CrossRef]
196. Heinrich, M.; Ankli, A.; Frei, B.; Weimann, C.; Sticher, O. Medicinal plants in Mexico: Healers' consensus and cultural importance. *Soc. Sci. Med.* **1998**, *47*, 1859–1871. [CrossRef]
197. Neamsuvan, O.; Ruangrit, T. A survey of herbal weeds that are used to treat gastrointestinal disorders from southern Thailand: Krabi and Songkhla provinces. *J. Ethnopharmacol.* **2017**, *196*, 84–93. [CrossRef] [PubMed]
198. Calvo, M.; Akerreta, S.; Cavero, R. Pharmaceutical ethnobotany in the riverside of Navarra (Iberian Peninsula). *J. Ethnopharmacol.* **2011**, *135*, 22–33. [CrossRef] [PubMed]
199. Rajaei, P.; Mohamadi, N. Ethnobotanical study of medicinal plants of Hezar mountain allocated in south east of Iran. *IJPR* **2012**, *11*, 1153.
200. Tangjitman, K.; Wongsawad, C.; Kamwong, K.; Sukkho, T.; Trisonthi, C. Ethnomedicinal plants used for digestive system disorders by the Karen of northern Thailand. *J. Ethnobiol. Ethnomedicine* **2015**, *11*, 27. [CrossRef]
201. Chit, K.; Myint, W.; Thein, K.; Maw, W.W.; Myint, M.M.; Than, A.; Khin, M. Cyclic AMP phosphodiesterase inhibitory activity and chemical screening of four medicinal plants. *Pharm. Biol.* **2001**, *39*, 181–183. [CrossRef]
202. Xiang, W.; Li, R.-T.; Mao, Y.-L.; Zhang, H.-J.; Li, S.-H.; Song, Q.-S.; Sun, H.-D. Four new prenylated isoflavonoids in *Tadehagi triquetrum*. *J. Agric. Food Chem.* **2005**, *53*, 267–271. [CrossRef]
203. Muhammad, G.; Hussain, M.A.; Jantan, I.; Bukhari, S.N.A. *Mimosa pudica* L., a high-value medicinal plant as a source of bioactives for pharmaceuticals. *Compr. Rev. Food Sci. Food Saf.* **2016**, *15*, 303–315. [CrossRef]
204. Pande, M.; Pathak, A. Preliminary pharmacognostic evaluations and phytochemical Studies on roots of *Mimosa pudica* (lajvanti). *Int. J. Pharm. Sci. Rev. Res.* **2010**, *1*, 50–52.
205. Kwon, J.; Hwang, H.; Selvaraj, B.; Lee, J.H.; Park, W.; Ryu, S.M.; Lee, D.; Park, J.-S.; Kim, H.S.; Lee, J.W. Phenolic constituents isolated from *Senna tora* sprouts and their neuroprotective effects against glutamate-induced oxidative stress in HT22 and R28 cells. *Bioorg. Chem.* **2021**, *114*, 105112. [CrossRef]
206. Shukla, S.; Pandey, R.; Kumar, B.; Tewari, S.; Pal, M. Phenolic compounds and radical scavenging activity of *Senna tora* (L.) Roxb. herbs collected from various geographical locations of India. *Pharm. Chem. J.* **2021**, *55*, 684–690. [CrossRef]
207. Nirmal, N.P.; Rajput, M.S.; Prasad, R.G.; Ahmad, M. Brazilin from *Caesalpinia sappan* heartwood and its pharmacological activities: A review. *Asian Pac. J. Trop. Med.* **2015**, *8*, 421–430. [CrossRef] [PubMed]
208. Havinga, R.M.; Hartl, A.; Putscher, J.; Prehsler, S.; Buchmann, C.; Vogl, C.R. *Tamarindus indica* L. (Fabaceae): Patterns of use in traditional African medicine. *J. Ethnopharmacol.* **2010**, *127*, 573–588. [CrossRef]
209. Escalona-Arranz, J.C.; Pérez-Rosés, R.; Jiménez, I.L.; Rodríguez-Amado, J.; Argota-Coello, H.; Cañizares-Lay, J.; Morris-Quevedo, H.J.; Sierra-González, G. Chemical constituents of *Tamarindus indica* L. leaves. *Rev. Cuba. Quím.* **2010**, *22*, 65–71.
210. Arsiningtyas, I. Antioxidant Profile of Heartwood and Sapwood of Caesalpinia Sappan L. Tree's Part Grown in Imogiri Nature Preserve, Yogyakarta. In *IOP Conference Series: Earth and Environmental Science*; IOP Publishing: Bristol, UK, 2021.
211. Tewtrakul, S.; Tungcharoen, P.; Sudsai, T.; Karalai, C.; Ponglimanont, C.; Yodsaoue, O. Antiinflammatory and wound healing effects of *Caesalpinia sappan* L. *Phytother. Res.* **2015**, *29*, 850–856. [CrossRef] [PubMed]
212. Syamsunarno, M.R.A.; Safitri, R.; Kamisah, Y. Protective effects of *Caesalpinia sappan* Linn. and Its bioactive compounds on cardiovascular organs. *Front. Pharmacol.* **2021**, *12*, 725745. [CrossRef]
213. Bum, E.N.; Dawack, D.; Schmutz, M.; Rakotonirina, A.; Rakotonirina, S.; Portet, C.; Jeker, A.; Olpe, H.-R.; Herrling, P. Anticonvulsant activity of *Mimosa pudica* decoction. *Fitoterapia* **2004**, *75*, 309–314. [CrossRef]
214. Zhang, J.; Yuan, K.; Zhou, W.-l.; Zhou, J.; Yang, P. Studies on the active components and antioxidant activities of the extracts of *Mimosa pudica* Linn. from southern China. *Pharmacogn. Mag.* **2011**, *7*, 35–39.
215. Joseph, B.; George, J.; Mohan, J. Pharmacology and traditional uses of *Mimosa pudica*. *Int. J. Pharm. Sci. Drug Res.* **2013**, *5*, 41–44.
216. Kokane, D.D.; More, R.Y.; Kale, M.B.; Nehete, M.N.; Mehendale, P.C.; Gadgoli, C.H. Evaluation of wound healing activity of root of *Mimosa pudica*. *J. Ethnopharmacol.* **2009**, *124*, 311–315. [CrossRef]

217. Kamagaté, M.; Koffi, C.; Kouamé, N.M.; Akoubet, A.; Alain, N.; Yao, R.; Die, H. Ethnobotany, phytochemistry, pharmacology and toxicology profiles of *Cassia siamea* Lam. *J. Phytopharmacol* **2014**, *3*, 57–76. [CrossRef]

218. Ntandou, G.N.; Banzouzi, J.; Mbatchi, B.; Elion-Itou, R.; Etou-Ossibi, A.; Ramos, S.; Benoit-Vical, F.; Abena, A.; Ouamba, J. Analgesic and anti-inflammatory effects of *Cassia siamea* Lam. stem bark extracts. *J. Ethnopharmacol.* **2010**, *127*, 108–111. [CrossRef] [PubMed]

219. Smith, Y.A. Determination of chemical composition of *Senna-siamea* (*Cassia*) leaves). *Pak. J. Nutr.* **2009**, *8*, 119–121. [CrossRef]

220. Chankana, N.; Prapaiwong, A.; Charoenchai, L. Antifungal effect of Senna tora (L.) Roxb. Seed extract against *Microsporum gypseum*. In Proceedings of the RSU International Research Conference, Bangkok, Thailand, 28 April 2017; p. 81.

221. Sunil, K.R.; Ramesh, B.; Ravi, M.; Girish, T.; Vincent, B. *Cassia tora* extract alleviates Aβ1–42 aggregation processes in vitro and protects against aluminium-induced neurodegeneration in rats. *J. Pharm. Pharmacol.* **2020**, *72*, 1119–1132. [CrossRef]

222. Tang, A.; Chen, X.; Lu, Q.; Zheng, N.; Wei, Y.; Wu, X. Antihepatotoxic effect of tadehaginoside, extracted from *Tadehagi triquetrum* (L.), against CCl 4-lesioned rats through activating the Nrf2 signaling pathway and attenuating the inflammatory response. *Inflammation* **2014**, *37*, 1006–1014. [CrossRef] [PubMed]

223. Vedpal; Jayaram, U.; Wadhwani, A.; Dhanabal, S. Isolation and characterization of flavonoids from the roots of medicinal plant *Tadehagi triquetrum* (L.) H. Ohashi. *Nat. Prod. Res.* **2020**, *34*, 1913–1918. [CrossRef] [PubMed]

224. Jiji, K.; Muralidharan, P. Identification and characterization of phytoconstituents of ethanolic root extract of *Clitoria ternatea* L. utilizing HR-LCMS analysis. *Plant Sci. Today* **2021**, *8*, 535–540. [CrossRef]

225. Lim, T.K. *Edible Medicinal and Non-Medicinal Plants*; Springer: Berlin/Heidelberg, Germany, 2012; Volume 1, ISBN 978-90-481-8661-7.

226. Mukherjee, P.K.; Kumar, V.; Kumar, N.S.; Heinrich, M. The Ayurvedic medicine *Clitoria ternatea*—From traditional use to scientific assessment. *J. Ethnopharmacol.* **2008**, *120*, 291–301. [CrossRef]

227. Chen, J.; Ni, C.; Zhang, Z.; Wang, L.; Liu, Z.; Peng, W. GC–MS explores health care components in the extract of *Pterocarpus macarocarpus* Kurz. *Saudi J. Biol. Sci.* **2018**, *25*, 1196–1201. [CrossRef]

228. Nguyen-Pouplin, J.; Tran, H.; Tran, H.; Phan, T.A.; Dolecek, C.; Farrar, J.; Tran, T.H.; Caron, P.; Bodo, B.; Grellier, P. Antimalarial and cytotoxic activities of ethnopharmacologically selected medicinal plants from South Vietnam. *J. Ethnopharmacol.* **2007**, *109*, 417–427. [CrossRef]

229. Essien, E.E.; Thomas, P.S.; Ascrizzi, R.; Setzer, W.N.; Flamini, G. *Senna occidentalis* (L.) Link and *Senna hirsuta* (L.) HS Irwin & Barneby: Constituents of fruit essential oils and antimicrobial activity. *Nat. Prod. Res.* **2019**, *33*, 1637–1640. [CrossRef]

230. Nde, A.L.; Chukwuma, C.I.; Erukainure, O.L.; Chukwuma, M.S.; Matsabisa, M.G. Ethnobotanical, phytochemical, toxicology and anti-diabetic potential of *Senna occidentalis* (L.) link; A review. *J. Ethnopharmacol.* **2021**, *283*, 114663. [CrossRef]

231. Pal, S.; Kumar, P.; Ramakrishna, E.; Kumar, S.; Porwal, K.; Kumar, B.; Arya, K.R.; Maurya, R.; Chattopadhyay, N. Extract and fraction of *Cassia occidentalis* L. (a synonym of *Senna occidentalis*) have osteogenic effect and prevent glucocorticoid-induced osteopenia. *J. Ethnopharmacol.* **2019**, *235*, 8–18. [CrossRef] [PubMed]

232. Department of Medical Sciences. *Thai Herbal Pharmacopoeia*; Department of Medical Sciences: Bangkok, Thailand, 2020; ISBN 978-61-611-4372-5.

233. Balunas, M.J.; Kinghorn, A.D. Drug discovery from medicinal plants. *Life Sci.* **2005**, *78*, 431–441. [CrossRef] [PubMed]