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INDIGENOUS KNOWLEDGE OF POISONOUS PLANTS FROM VAN KIEU AND PA KO ETHNIC GROUPS IN QUANG TRI PROVINCE, VIETNAM

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ABSTRACT

Poisonous plants are known for toxicity to humans and animals. They comprise a large group of plants in the world. This study aims to collect and systematically document the traditional knowledge of poisonous plants by interviewing Van Kieu and Pa Ko ethnic communities in Quang Tri province. A total of 56 poisonous plant species (27 herbs, 15 shrubs and 14 woody plants) of flowering plants belonging to 26 families and 50 genera were found in the study site. Based on the Recorded Poisonous Plant Proportion (RPPP) values, 25 commonly recorded poisonous plants were selected for analyzing Fidelity Level (FL) and Informants Consensus Factor (ICF). The ICF value of eye irritation, neurologic category, skin irritation, gastrointestinal category and respiratory/cardiovascular category was 0.97, 0.97, 0.96, 0.93 and 0.92, respectively. The most notable species (FL: 100%) in the gastrointestinal category were *Ricinus communis* L. and *Millettia erythrocalyx* Gagnep. In the respiratory/cardiovascular category, the most important species (FL: 100%) were *Gelsemium elegans* (Gardner & Champ.) Benth. and *Strychnos vanprukii* Craib. The presented results will provide fundamental information for further phytochemical and biological investigation to ascertain the toxic compounds of poisonous plants that may be used for the treatment of appropriate diseases.

Keywords: poisonous plant, indigenous knowledge, Van Kieu, Pa Ko, ethnic groups.

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INTRODUCTION

A plant species is defined as poisonous if it can harm humans or animals with a sufficient quantity upon touching or ingesting (Serrano, 2018). For thousands of years, poisonous plants have been used for different purposes such as hunting, fishing or fighting, and also for treating diseases (Anywar, 2020). Besides the poisoning effects, they can act as medicinal herbs if used in small amounts or in correct proportions (Serrano, 2018). Together with the increasing awareness of poisonous plants, the research on their beneficial usage has become progressively urgent and has practical significance, especially in remote and isolated ethnic minority areas in Vietnam.

The data from Table 1 show that, the population of Van Kieu and Pa Ko (Ta Oi) ethnic communities living in Quang Tri is 86,231 people, among them 80,925 Van Kieu and Pa Ko people are living in Dakrong and Huong Hoa districts. These districts are located in the southwest of Quang Tri and consist of 33 communes and 3 towns (Kloong Klang, Khe Sanh and Lao Bao). Two important nature reserves (Dakrong Nature Reserve & Bac Huong Hoa Nature Reserve) are located in two districts, with great biodiversity in flora and fauna (Ninh Khac Ban et al., 2022). Over 80% of the population in these districts depends on agriculture, forestry and rearing livestock, which are the main sources of income in households. In the dry seasons or during food scarcity, the poisonous plants growing in grazing areas are a great threat to animals and even humans. Poisonous plants and their toxic compounds are one of the main reasons leading to losses of livestock industries throughout the world. In the United States, it was estimated that over $340 million was lost annually due to poisonous plants (Panter et al., 2012). Therefore, the significance of the study and awareness of affected poisonous plants on humans and livestock will play an important role not only for the development of ethnic communities in Quang Tri province but also for overall natural resource management. Based on that, we carried out a systematically and scientifically constructed record of poisonous plant knowledge from the Pa Ko and Van Kieu communities in Quang Tri province, before it was lost along with the culture that spawned it.

Table 1. The population of Van Kieu and Pa Ko (Ta Oi) ethnic communities in Dakrong and Huong Hoa districts, Quang Tri province

Administration	Van Kieu population (persons)	Pa Ko population (persons)	Total Van Kieu and Pa Ko population (persons)
Quang Tri	69,785 (*)	16,446 (*)	86,231 (*)
Dakrong	28,537 (**)	7,207 (**)	35,744 (**)
Huong Hoa	40,487 (***)	4,694 (***)	45,181 (***)

Notes: (*) Completed results of the 2019 Vietnam population and housing census; (**) Dakrong district report 2019, unpublished; (***) Huong Hoa statistical yearbook 2019.

MATERIALS AND METHODS

Data collection

A total of 612 local people of the Van Kieu and Pa Ko ethnic groups living in Dakrong and Huong Hoa districts, Quang Tri province were interviewed. The topic of the interview is poisonous plant species and symptoms of poisoning on humans or animals (including fish and insects). The diagnosis of plant poisoning on animals and humans was based on the observed clinical symptoms of the informants. The plant species reported as poisonous by informants were collected, dried and stored at the Institute of Marine Biochemistry. The identification of the plant specimen was done by botanical experts.

Data analysis

Recorded poisonous plant proportion

The recorded poisonous plant proportion value indicates the knowledge of poisonous plant species in a community. RPPP is calculated by using the following formula:

$$\mathrm{RPPP}(\%) = \mathrm{Ni}/\mathrm{N} \times 100\%$$

Where: Ni is the number of citations for each poisonous plant while *N* is the total number of informants.

Informant consensus factor

Various symptoms caused by poisonous plants are classified based on statistics from poisoning records in humans and animals. The ICF value was originally developed by Trotter and Logan (1986), representing the consistency of the interviewees' information about a certain disease symptom caused by poisoning from specific plants. ICF was calculated by the following formula:

$$\mathrm{ICF} = (\mathrm{Nur} - \mathrm{Nt})/(\mathrm{Nur} - 1)$$

Where: Nur is the number of citations about poisonous plant species in each ailment symptom category; and Nt is the number of poisonous plants reported in this ailment symptom category. A value close to 1 indicates a relatively well-known knowledge about the poisonous plants in this ailment symptom category, while a low value close to 0 shows that toxicity of these plant species is not common.

Fidelity level (FL)

The fidelity level value is the ratio between the number of informants providing information about a poisonous plant causing a certain disease symptom (Npi) and the number of informants providing information about this plant for any given purpose (Np) (Friedman et al., 1986). FL is calculated by the following formula:

$$\mathrm{FL}(\%) = (\mathrm{Npi}/\mathrm{Np}) \times 100\%$$

This value is used to identify the most notable poisonous plant causing a certain ailment syndrom category.

RESULTS

Demographic characteristics of informants

Table 2. Demographic characteristics of the informants

Population Characters	Van Kieu people	Pa Ko people	Total
Total	*495* (*80.9%*)	*117* (*19.1*)	*612*
Gender			
Male	314 (63.4%)	94 (80.3%)	408 (66.6%)
Female	181 (26.6%)	23 (19.7%)	204 (33.4%)
Age-group			
18–45	185 (37.4%)	58 (49.6%)	255 (41.7%)
46–65	138 (27.9%)	23 (19.6%)	153 (25%)
Over 65	172 (34.7%)	36 (30.8%)	204 (33.3%)
Educational qualification			
Basic Education	494 (99.8%)	115 (98.3%)	609 (99.5%)
Non-Education	1 (0.2%)	2 (1.7%)	3 (0.5%)
Occupation			
Veterinarian	1 (0.2%)	1 (0.8%)	2 (0.3%)
Healer, Village elder	20 (4%)	5 (4.3%)	25 (4.1%)
Farmer, Forester	474 (95.8%)	109 (93.2%)	583 (95.3%)
Does not answer	0 (0%)	2 (1.7%)	2 (0.3%)

A total of 612 residents, including 408 men and 204 women (Van Kieu informants are four times more than Pa Ko informants) were interviewed to collect traditional knowledge on poisonous plants in the study area. The majority were foresters, farmers and healers. Healers and village elders knew more poisonous plants than younger people. The age of informants was mainly in the range of 18–44 year olds (41.7%) and over 65 year olds (33.3%). Most of them had a basic education degree (99.5%) (Table 2).

Poisonous plant characteristics to animals and humans

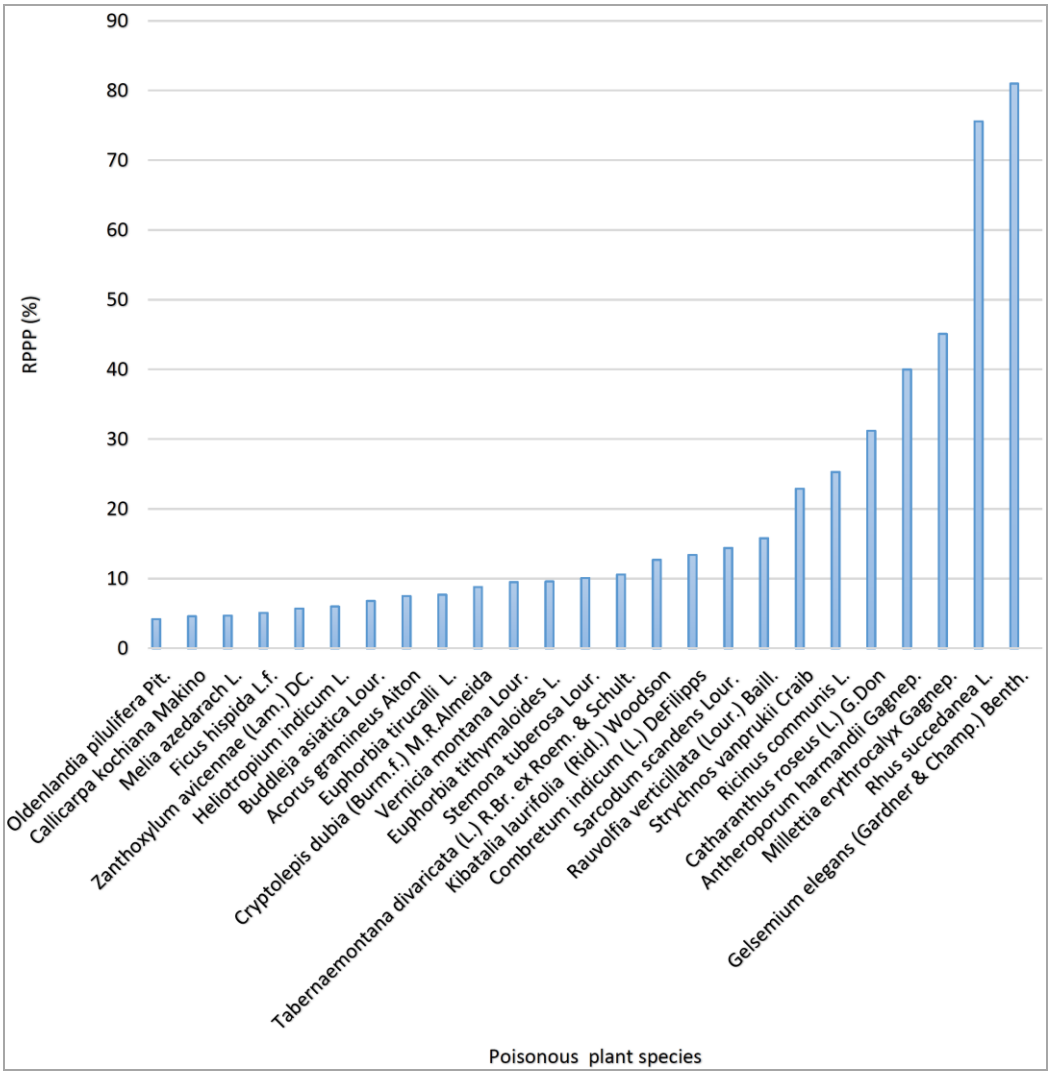

Figure 1. The RPPP of commonly recorded poisonous plants

Based on the information on poisonous plants collected by interviewing local people, the specimens were collected and identified with scientific names. A total of 56 flowering plant species belonging to 26 families and 50 genera were identified in the study site (Supplement 1). The Fabaceae was the dominant family, with 8 species in 7 genera, followed by Euphorbiaceae (7 species in 5 genera), Solanaceae (5 species in 4 genera),

Apocynaceae (5 species in 5 genera), Loganiaceae (4 species in 3 genera), Verbenaceae (3 species in 2 genera), Moraceae (2 species in 2 genera), Asteraceae (2 species in 2 genera) and Caesalpiniaceae (2 species in 2 genera). Similarly, ethnobotanical investigations on five ethnic Chinese groups showed that 118 poisonous plant species belonged to just a few families such as Fabaceae, Asteraceae, Euphorbiaceae, Araceae and Apocynaceae. Only a few species with toxicity are from either Loganiaceae or Moraceae family but they are deadly poisonous (Huai et al., 2010).

Toxic compounds were observed either in the whole plant or confined to only one or more plant parts (Supplement 1). Among the studied plant species, fruits and seeds were the most common parts causing poisonous effects (46.4%), followed by leaves (23.2%), the whole plant (17.8%), resin and essential oil (14.2%), roots (10.7%) and flowers (3.5%). About half of the studied plants were herbs (27 species). The remaining species were shrubs (15 species) and woody plants (14 species).

The 25 common poisonous plants with the Recorded Poisonous Plant Proportion of more than 1% were selected for data analysis. The results show that the highest recorded poisonous plant species were *Gelsemium elegans* (Gardner & Champ.) Benth. (81.0%); followed by *Rhus succedanea* L. (75.6%); *Millettia erythrocalyx* Gagnep. (45.1%); *Antheroporum harmandii* Gagnep. (40.0%); *Catharanthus roseus* (L.) G.Don (31.2%); *Ricinus communis* L. (25.3%); *Strychnos vanprukii* Craib (22.9%); *Rauvolfia verticillata* (Lour.) Baill. (15.8%); *Sarcodum scandens* Lour. (14.4%); *Combretum indicum* (L.) DeFilipps (13.4%); *Kibatalia laurifolia* (Ridl.) Woodson (12.7%); *Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult. (10.6%) and *Stemona tuberosa* Lour. (10.1%); *Euphorbia tithymaloides* L., *Vernicia montana* Lour., *Cryptolepis dubia* (Burm.f.) M.R.Almeida, *Cryptolepis buchananii* Roem. et Schult., *Acorus gramineus* Aiton, *Buddleja asiatica* Lour., *Heliotropium indicum* L., *Zanthoxylum avicennae* (Lam.) DC., *Ficus hispida* L.f. (9.6% - 5.1%); *Melia azedarach* L., *Callicarpa kochiana* Makino, *Oldenlandia pilulifera* Pit. (Under 5%) (Fig. 1).

Both humans and animals could be adversely affected by poisonous plants in the study area. Our research results showed that the number of poisonous plants adversely affected humans was the highest. Humans and animals observation showed various symptoms upon being poisoned by a certain plant species. Most poisonous plant species were responsible for causing abdominal pain, vomiting and diarrhea, followed by skin irritation, eye irritation, abortion, potentially lethal and insecticidal effects.

Informant consensus factor

In order to find the common category caused by the identified poisonous plant species, their ICF values were analyzed (Table 3). It was shown that the neurological category and eye irritation category such as ocular inflammation, blindness, and dilated pupils matched the highest ICF value (0.97). Other categories with high ICF values were skin irritation (0.96), gastrointestinal category (abdominal pain, vomiting, diarrhea) (0.93) and respiratory/cardiovascular category (0.92).

Fidelity level

The most notable plant species in each category of illness was analysed using the FL value. In the gastrointestinal category, *Ricinus communis* L. and *Millettia erythrocalyx* Gagnep. were the most notable species with a fidelity level of 100% each. Other notable species of the category were *Rauvolfia verticillata* (Lour.) Baill. (FL: 85.2%), *Combretum indicum* (L.) DeFilipps (FL: 76,6%), *Melia azedarach* L. (FL: 73.1%) and *Antheroporum harmandii* Gagnep. (FL: 71.4%). In the skin irritation category, the most notable species was *Rhus succedanea* L. (FL: 100%). For the respiratory/cardiovascular category, the most notable species were *Gelsemium elegans* (Gardner & Champ.) Benth. and *Strychnos vanprukii* Craib (FL: 100%). (Table 3).

Table 3. The category of illness and their Informant consensus factors and Fidelity level of important plant species

Category of Illness	Number of Species	Number of reports	ICF	Species names	FL (%)
Gastrointestinal	12	151	0.93	*Ricinus communis* L.	100
				Millettia erythrocalyx Gagnep.	100
				Rauvolfia verticillata (Lour.) Baill.	85.2
				Combretum indicum (L.) DeFilipps	76.6
				Melia azedarach L.	73.1
				Antheroporum harmandii Gagnep.	71.4
				Catharanthus roseus L. G.Don	61.8
				Zanthoxylum avicennae (Lam.) DC.	59.9
				Vernicia montana Lour.	57.4
				Buddleja asiatica Lour.	50.3
				Heliotropium indicum L.	47.2
				Ficus hispida L.f.	38.1
Skin irritation	2	24	0.96	*Rhus succedanea* L.	100
				Euphorbia tirucalli L.	68.9
Eye irritation	2	39	0.97	*Euphorbia tithymaloides* L.	66.5
				Kibatalia laurifolia (Ridl.) Woodson	45.7
Respiratory/ cardiovascular	7	82	0.92	*Gelsemium elegans* (Gardner & Chapm.) Benth.	100
				Strychnos vanprukii Craib	100
				Sarcodum scandens Lour.	60.9
				Tabernaemontana divaricata (L.) R. Br. ex Roem. & Schult.	57.6
				Cryptolepis dubia (Burm.f.) M. R. Almeida	56.1
				Acorus gramineus Aiton	42.3
				Stemona tuberosa Lour.	40.9
Neuro	2	31	0.97	*Callicarpa kochiana* Makino	58.1
				Oldenlandia pilulifera Pit.	49.7

DISCUSSION

The present study is carried out to collect the traditional knowledge of poisonous plants from the Van Kieu and Pa Ko ethnic groups in Quang Tri province. For the first time, a total of 612 people from various age groups and professions were interviewed to gather information regarding traditional knowledge of poisonous plant species. Based on the data analysis, we summarized 5 illness categories of humans and animals: (1) gastrointestinal category (ICF of 0.93 and FL from 38.1% to 100%), (2) skin irritation category (ICF of 0.96; FL from 68.9% to 100), (3) eye irritation category (ICF of 0.97; FL from 45.7% to 66.5%) (4) respiratory/cardiovascular category (ICF of 0.92; FL from 40.9% to 100%) and (5) neurological category (ICF of 0.97; FL from 49.7% to 58.1%).

Our investigation showed that animals are affected more by the consumption of poisonous plants than by coming in contact with them. Accidental poisoning in humans may be caused by confusing poisonous plants with edible plant species, or accidentally touching poisonous plant parts.

Gastrointestinal ailments are the first response to the toxins of poisonous plants when ingested and if not identified and cured at the right time, the digester will be dead. Poisonous plants have different degrees of effect on the digestive system, such as nausea, vomiting, abdominal pain, diarrhea, dehydration, body weakness and death. Skin irritation is the first response to the toxins of poisonous plants when touching. Skin category includes dermatitis, itching, sores, cracking of skin, inflammation,... Some poisonous plant species are used as traditional medicine such *Stemona tuberosa* Lour., *Cinnamomum porrectum* (Roxb.) Kosterm., *Rauvolfia verticillata* (Lour.) Baill., *Achyranthes aspera* L., *Senna tora* (L.) Roxb., *Carica papaya* L., *Acorus gramineus* Aiton. However, these poisonous plants can cause harmful effects, even death, at higher dosages. Seeds of *Antheporum harmandii* Gagnep. and *Millettia erythrocalyx* Gagnep. is used for fishing.

Plant toxins are representative of a large group of structurally diverse small molecules that result from the plant's secondary metabolism (Vickery, 2010). If they are introduced into the body of any animal or human, they can adversely affect health. Those toxic components can affect important ion channels of neuronal cells, inhibit the mitochondrial respiratory chain, disturb the biomembranes, damage the cell, inhibit ribosomal protein biosynthesis and DNA replication... (Wink, 2010). Several poisonous plants in this interview have been reported to contain common toxic compounds. For instance, *Ricinus communis* L. contains ricin is one of the most toxic substances known. Patients experience oropharyngeal irritation, abdominal pain, vomiting, diarrhea in 4–6 hours after *Ricinus communis* L. ingestion because of ricin poisoning (Moshiri et al., 2016). The main toxic components of the *Gelsemium elegans* (Gardner & Champ.) Benth. are indole alkaloids. These molecules cause damage to the nervous system, the digestive system, and the respiratory system (Lin et al., 2021). Common substances in members of the *Euphorbiaceae* are diterpenes, which are classified as phorbol esters and stimulate protein kinase C. Upon direct contact with skin, mucosal tissues or the eye, they cause severe and painful inflammation, with ulcers and blister formation (Wink, 2010).

CONCLUSION

A total of 612 residents, including 408 men and 204 women were interviewed to collect traditional knowledge on poisonous plants at the study site. The 56 flowering plant species belonging to 26 families and 50 genera were presented. Among them, the *Gelsemium elegans* (Gardner & Champ.) Benth. and *Rhus succedanea* L. species are identified as poisonous plants by more than 75% of the interviewees. A total of 25 common poisonous plants with the Recorded Poisonous Plant Proportion (RPPP) of more than 1% were selected for data analysis. The results show that the highest recorded poisonous plant species were *Gelsemium elegans* (Gardner & Champ.) Benth. (81.0%), followed by *Rhus succedanea* L. (75.6%), *Millettia erythrocalyx* Gagnep. (45.1%); *Antheroporum harmandii* Gagnep. (40.0%). The neurological category and eye irritation category such as ocular inflammation, blindness, and dilated pupils matched the highest Informant Consensus Factor (ICF) value (0.97). Other categories with high ICF values were skin irritation (0.96), gastrointestinal category (abdominal pain, vomiting, diarrhea) (0.93) and respiratory/cardiovascular category (0.92). In the gastrointestinal category, *Ricinus communis* L., *Millettia erythrocalyx* Gagnep. were the most notable species with a fidelity level of 100%. Other remarkable species of the category were *Rauvolfia verticillata* (Lour.) Baill. (FL: 85.2%), *Combretum indicum* (L.) DeFilipps (FL: 76,6%), *Melia azedarach* L. (FL: 73.1%) and *Antheroporum harmandii* Gagnep. (FL: 71.4%). In the skin irritation category, the most notable species was *Rhus succedanea* L. (FL: 100%). For the respiratory/ cardiovascular category, the most notable species were *Gelsemium elegans* (Gardner & Champ.) Benth. and *Strychnos vanprukii* Craib

(FL: 100%). The poisonous nature of the above-mentioned plants is due to the presence of toxic substances such as alkaloids, tannins, saponins, glucosides and essential oils,... This knowledge and documentation of poisonous plants will further help protecting Van Kieu and Pa Ko ethnic people from being poisoned. Moreover, the selected poisonous plants species can be chemically analyzed in order to identify the toxic compounds for pharmaceutical application.

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Supplement 1. List of poisonous plants of Van Kieu and Pa Ko ethnic groups, Quang Tri province.
W: Woody plant; H: Herb; S: Shrub; WV: Woody vines

No.	Species name	Vietnamese name	Life style	Family	RPPP (%)	Poisonous parts	Poisoning symptoms
1	*Rhus succedanea* L.	Sơn lắc	W	Anacardiaceae	0.8	Resin	Swelling of sensitive human face, burning, itching sores, blistering, festering and then spreading
2	*Achyranthes aspera* L.	Cỏ xước	H	Amaranthaceae	0.3	Plant	Anorexia and acute diarrhea if cattle accidentally ingest this plant
3	*Annona squamosa* L.	Na	S	Annonaceae	0.5	Seed	Abdominal pain and vomiting in cattle. Killing lice in hair.
4	*Catharanthus roseus* (L.) G. Don	Dừa cạn	H	Apocynaceae	31.2	Root	Abdominal pain, vomiting, blindness, miscarriage in humans.
5	*Kibatalia laurifolia* (Ridl.) Woodson	Thần linh lá quế	S	Apocynaceae	12.7	Resin	Strong eye congestion and burning the cornea. In serious cases can lead to blindness or loss of vision in humans.
6	*Rauvolfia verticillata* (Lour.) Baill.	Ba gạc vòng	S	Apocynaceae	15.8	Resin	Salivation, vomiting in buffaloes and cows.
7	*Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult.	Ớt rừng	S	Apocynaceae	10.6	Plant	Causing respiratory depression and paralysis, hallucinations, slowing heart rate, causing death in animals.
8	*Strophanthus divaricatus* (Lour.) Hook. & Arn.	Sừng dê	S	Apocynaceae	0.5	Seed, resin	Restlessness, vomiting, dehydration, cardiac arrhythmias disturbances, dizziness, breathing difficulty, loss of consciousness, death in humans.
9	*Cryptolepis dubia* (Burm. f.) M. R. Almeida	Dây càng cua	H	Asclepiadaceae	8.8	Plant	Causing arrhythmia, cardiac arrest and death in humans
10	*Ageratum conyzoides* (L.) L.	Cây cứt lợn	H	Asteraceae	0.3	Plant	Intense itching if humans touch the hairy plant. Shivering, high fever, loss of appetite, severe diarrhea and death in animals.
11	*Bidens bipinnata* L.	Đơn buốt	H	Asteraceae	0.7	Fruit	Vomiting if cattle eat too much fruits.

No.	Species name	Vietnamese name	Life style	Family	RPPP (%)	Poisonous parts	Poisoning symptoms
12	*Bombax ceiba* L.	Gòn rừng	W	Bombaceae	0.9	Leaf	Causing stomach cramps, dark yellow urine or difficulty in urinating in cattle and goats.
13	*Heliotropium indicum* L.	Vòi voi	H	Boraginaceae	6.0	Plant	Vomiting, abdominal pain, diarrhea, shortness of breath, severe liver damage in humans and goats.
14	*Senna tora* (L.) Roxb.	Thảo quyết minh	H	Caesalpiniaceae	0.4	Leaf, seed	Having strong diarrhea leading to weakness in cattle.
15	*Erythrophleum fordii* Oliv.	Lim xanh	W	Caesalpiniaceae	0.7	Leaf	Having a runny nose, severe cases of nosebleed. Dizziness, severe hangover, vomiting, diarrhea in cattle
16	*Carica papaya* L.	Đu đủ	H	Caricaceae	0.9	Seed	Used to abort pregnancy in both humans and cattle.
17	*Combretum indicum* (L.) DeFilipps	Dây giun, sử quân tử	H	Combretaceae	13.4	Fruit	To deworm, being used as biological pesticides Vomiting, may lead to unconsciousness if children eat in sufficient quantity
18	*Euphorbia hirta* L.	Cỏ sữa lông	H	Euphorbiaceae	0.3	Plant	Discomfort, salivation, nausea, vomiting, irritation of the gastrointestinal tract in pigs and goats.
19	*Euphorbia tithymaloides* L.	Thuốc dấu	S	Euphorbiaceae	9.6	Plant	Irritating the stomach lining and intestines, vomiting, diarrhea in humans and cattle. Skin irritation and blisters, conjunctivitis, decreased vision if contacting with latex in humans.
20	*Euphorbia tirucalli* L.	Xương khô, Giao	H	Euphorbiaceae	7.7	Resin	Burning tears, mouth foaming, vomiting, diarrhea in buffaloes and cows. Causing human skin blister and irritation, eye damage, vomiting, diarrhea and death.
21	*Jatropha curcas* L.	Dầu mè	W	Euphorbiaceae	0.7	Seed	Salivation, vomiting, body aches, loss of appetite, emaciation, acute or bloody diarrhea, miscarriage in pigs and chickens.

No.	Species name	Vietnamese name	Life style	Family	RPPP (%)	Poisonous parts	Poisoning symptoms
22	*Ricinus communis* L.	Thầu dầu	S	Euphobiaceae	25.3	Seed	Acute diarrhea, abdominal cramps, vomiting, weakness, weak fertility, miscarriage and death in humans, cattle, pigs and chickens.
23	*Vernicia montana* Lour.	Trẩu lá xẻ	W	Euphobiaceae	9.5	Fruit, seed	Causing stomachache, vomiting, drunkenness, heart palpitations, discomfort in human body.
24	*Croton tiglium* L.	Ba đậu	S	Euphorbiaceae	1.6	Seed, oil	Causing human skin acne and peeling, abdominal pain, diarrhea and anus sensation, stomatitis, sore throat, vomiting, low blood pressure and death. Poisoning pigs, chickens, and goats.
25	*Abrus precatorius* L.	Cam thảo dây	S	Fabaceae	0.5	Seed	Vomiting, sore throat, swallowing difficulty, eye inflammation, fever, weakness, severe diarrhea, death in humans; salivation, nasal discharge, acute diarrhea, miscarriage in pigs and goats.
26	*Mucuna pruriens* (L.) DC.	Móc mèo	S	Fabaceae	0.9	Fruit, seed	Causing skin itching and dermatitis, diarrhea in humans and cattle.
27	*Tephrosia purpurea* (L.) Pers.	Cốt khí tía	H	Fabaceae	0.8	Leaf, seed	Causing cattle stomach cramps and body weakness.
28	*Entada phaseoloides* (L.) Merr.	Bàm bàm	WV	Fabaceae	0.5	Flower	Causing human skin itching, red skin, severe cases will blister.
29	*Antheroporum harmandii* Gagnep.	Mát	W	Fabaceae	40.0	Leaf, seed	Causing fish faint; vomiting, diarrhea in humans.
30	*Millettia erythrocalyx* Gagnep.	Thàn mát đài đỏ	W	Fabaceae	45.1	Seed	Causing severe abdominal pain, watery mouth, vomiting, diarrhea, body weakness and death in humans, cattle, pigs and chickens.
31	*Pachyrhizus erosus* (L.) Urb.	Củ đậu	H	Fabaceae	0.9	Seed	Abdominal pain, vomiting, diarrhea, increased salivation, tachycardia, unstable blood pressure, rapid coma, convulsions death in humans, cattle and pigs.
32	*Sarcodum scandens* Lour.	Muồng dây	S	Fabaceae	14.4	Fruit, leaf	Causing mild muscle pain, cramps, muscle necrosis, body weakness and death in cattle.

No.	Species name	Vietnamese name	Life style	Family	RPPP (%)	Poisonous parts	Poisoning symptoms
33	*Cinnamomum porrectum* (Roxb.) Kosterm.	Re hương	W	Lauraceae	0.3	Oil	Having dizziness, abdominal pain, vomiting, mouth foaming and death in humans.
34	*Buddleja asiatica* Lour.	Bọ chó	H	Loganiaceae	6.8	Leaf	Diarrhea in humans. Salivation and bloating in cattle.
35	*Gelsemium elegans* (Gardner & Champ.) Benth.	Lá ngón	H	Loganiaceae	81.0	Plant	Discomfort, fatigue, cold skin, sweating, weakness, breathing difficulty, death in humans and livestock.
36	*Strychnos vanprukii* Craib	Mã tiền cành vuông	WV	Loganiaceae	22.9	Root,seed	Salivation, breathing difficulty, severe coma and death in humans.
37	*Strychnos angustifolia* Benth.	Dây củ chi	H	Loganiaceae	0.7	Root,seed	Having headache, salivation, vomiting, lethargy, rapid pulse, convulsion, difficult to breathe in humans and animals.
38	*Melia azedarach* L.	Xoan	W	Meliaceae	4.7	Fruit, seed	Vomiting, severe abdominal pain, gastroenteritis in humans. Causing tremors, gastroenteritis, liver degeneration, paralysis in cattle, pigs, and goats. Killing slugs and repelling insects
39	*Ficus hispida* L.f.	Ngái	W	Moraceae	5.1	Fruit	Itchy throat, abdominal pain, vomiting, acute diarrhea, fatigue and weakness in human.
40	*Antiaris toxicaria* Lesch.	Cây sui	W	Moraceae	0.9	Resin	Causing eye inflammation and blindness, even death in humans and animals
41	*Embelia tsjeriam-cottam* (Roem. & Schult.) A.DC.	Rè mạnh	S	Myrsinaceae	0.8	Young leaf	Causing body tremors and death in animals, especially cattle and goats.
42	*Persicaria maculosa* Gray	Nghể lá đào, nghể ruộng	H	Polygonaceae	0.8	Fruit	Causing human severe skin inflammation, gastritis, and enteritis. Being used as an insecticide.
43	*Oldenlandia pilulifera* Pit.	An điền nón	H	Rubiaceae	4.2	Plant	Causing shock, nausea, dizziness, and miscarriage in human and cattle.
44	*Zanthoxylum avicennae* (Lam.) DC.	Muồng truổng	W	Rutaceae	5.7	Root, bank	Convulsions, vomiting, acute stomach pain and affect the liver and kidneys in humans.

No.	Species name	Vietnamese name	Life style	Family	RPPP (%)	Poisonous parts	Poisoning symptoms
45	*Physalis angulata* L.	Thù lù cạnh	H	Solanaceae	0.5	Young fruit	Severe diarrhea, miscarriage in cattle, goats and pigs.
46	*Solanum americanum* Mill.	Lu lu đực	H	Solanaceae	0.3	Young leaf and fruit	Dry throat, headache, vomiting, dizziness, abdominal pain, trembling limbs, convulsions and death in humans, pigs, goats and cows.
47	*Solanum torvum* Sw.	Cà nồng	H	Solanaceae	0.3	Fruit	Dry throat, excessive thirst, difficulty swallowing, drowsiness, abdominal pain, restlessness in humans and cattle and goats.
48	*Nicotiana tabacum* L.	Thuốc lá	H	Solanaceae	0.7	Leaf	Getting drunk, headaches, vomiting in humans.
49	*Datura metel* L.	Cà độc dược	H	Solanaceae	0.9	Leaf	Headaches, nausea, dermatitis, dry mouth and throat, lacrimation, dilated pupils, loss of appetite, abdominal pain, dizziness, restlessness and apathy in humans and animals.
50	*Dendrocnide urentissima* (Gagnep.) Chew	Mán voi, Han voi	H	Urticaceae	0.8	Leaf	Itching, red and blistering skin, sores, stinging, allergy to death.
51	*Callicarpa candicans* (Burm. f.) Hochr.	Nàng nàng	S	Verbenaceae	0.3	Flower	Severe abdominal pain, vomiting, strong diarrhea, asthenic physique in humans and cattle.
52	*Callicarpa kochiana* Makino	Tử châu thùy dài	W	Verbenaceae	4.6	Fruit	Dizziness, discomfort, intestinal upset, abdominal pain in cattle.
53	*Lantana camara* L.	Ngũ sắc	S	Verbenaceae	0.5	Leaf	Salivation, watery eyes, intense itching, restlessness, loss of appetite, constipation, yellow skin, peeling skin in castle.
54	*Acorus gramineus* Aiton	Thạch xương bồ	H	Acoraceae	7.5	Root	Causing convulsions and difficulty breathing in animals if over eating. Killing aphids, moths, house flies, lice and fleas.
55	*Commelina benghalensis* L.	Thài lài lông	H	Commelinaceae	0.5	Plant	Gastritis and enteritis in cattle and goats
56	*Stemona tuberosa* Lour.	Bách bộ	H	Stemonaceae	10.1	Root	Paralysis of the respiratory center, vomiting, fatigue, death with large doses in humans. Deworming

Supplement 2a. Some common poisonous plants of Van Kieu and Pa Ko ethnic groups, Quang Tri province

Ricinus communis L.

Stemona tuberosa Lour.

Euphorbia tithymaloides L.

Euphorbia tirucalli L.

Kibatalia laurifolia (Ridl.) Woodson

Sarcodum scandens Lour.

Heliotropium indicum L.

Acorus gramineus Aiton

Callicarpa kochiana Makino

Rauvolfia verticillata (Lour.) Baill

Melia azedarach L.

Ficus hispida L.f.

Supplement 2b. Some common poisonous plants of Van Kieu and Pa Ko ethnic groups, Quang Tri province (continued)

Millettia erythrocalyx Gagnep.

Oldenlandia pilulifera Pit.

Strychonos vanprukii Craib

Cryptolepis dubia (Burm.f.) M.R.Almeida

Zanthoxylum avicennae (Lam.) DC.

Catharanthus roseus (L.) G.Don

Tabernaemontana divaricate (L.) R.Br. ex Roem. & Schult

Combretum indicum (L.) DeFilipps

Gelsemium elegans (Gardner & Champ.) Benth.

Buddleja asiatica Lour.

Antheroporum harmandii Gagnep.

Vernicia montana Lour.