Ethnobotany of Medicinal Aroids in Xishuangbanna, Yunnan Province, China

Bo Liu, Yujing Liu*, Wujisiguleng Cao, Shuang Zhang, Zhengze Liu, Yanan Ni, Feifei Li
College of Life and Environmental Sciences, Minzu University of China
Beijing 100081, China

* Yujing Liu also at: Jiangsu University, Jiangsu, China, 212013

ABSTRACT
Based on ethnobotanical investigation and references review, five species of Araceae are reported as of great medicinal value in Xishuangbanna, Yunnan. They are Alocasia cucullata (Lour.) G. Don, A. odora (Roxb.) C. Koch, Colocasia esculenta (L.) Schott, C. gigantea (Blume) Hook.f. and Lasia spinosa (L.) Thwait. Their scientific name, Chinese name, local name, distribution, use in traditional medicine, a review of natural-product chemical constituents, potential ecological depositions and conservation issue are described and discussed. Conclusion has been made that these aroids have great exploitation and utilization value, but future work is still needed to make full use of these species.

KEY WORDS
Ethnobotany; Araceae; Chemical constituents; Xishuangbanna, China

INTRODUCTION
Araceae Juss. is one of the highly medicinal valuable families in angiosperm, mainly because of its species diversity, occurrence in a wide range of habitats in accordance with hotspots of both biodiversity and ethnic groups, especially in subtropical and tropical area including Southeast Asia, and the New World tropics. Its status as an integral part of the culture and the family-based economy of many traditional communities for therapeutics, food, ornamentation, fence etc.

China harbors a rich Araceae flora, 26 genera and 181 species of aroids, in which 72 species are endemic to the country. The use of aroids as medicine in South China is
very common, and has a long history; taro (Colocasia esculenta) was recorded as an herbal medicine around 220–450 AD; Ban xia (Pinellia ternata) firstly appeared in “Huang Di Nei Jing” as a medicinal plant in 475–221 BC, and other species such as Qiannian Jian (Homalomena occulta) and Yan Yu (Remusatia vivipara) were used early, while the cultivation of konjac (Amorphophallus konjac) in China happened at least 1700 years ago. However, many medicinal species of Araceae in China still need to be explored and testified.

For the research, Xishuangbanna, with high plant diversity and ethnic diversity was chosen as the research site. Field investigation and ethnobotany survey were made to perform an ethnobotanical study involving these aroids in the municipality of Xishuangbanna. The present paper summarized the results of the investigation, and related research about chemical constituents of the selected species have been reviewed. Medicinal aroids plants identified are a potential source for new bioactive compounds of therapeutic value in ethnomedicine.

Materials and Methods

The study site

Xishuangbanna Dai Autonomous Prefecture is a tropical area of China situated in southernmost Yunnan Province, on the border with Laos and Burma (Figure 1). Lying between 21°00’ and 21°30’ North Latitude and 99°55’ and 101°15’ East Longitude, the prefecture occupies 19,220 square kilometers of territory. It is known popularly as the "Kingdom of Plants and Animals". A great diversity of vegetation types including tropical rain forest, seasonal rain forest, montane rain forest. Xishuangbanna lies at the transitional zone between the floras of Malaya, Indo-Himalaya, and South China and therefore boasts a great number of plant species. So far, about 4,000 species of vascular plants have been identified. Meanwhile, there are more than 13 ethnic groups aborigines, who harbor profound traditional knowledge.

Plant collections

The ethnobotanic survey were carried out in Xishuangbanna between 2011 and 2012. The field study was preceded by an ethnobotanical study in which we established the related villages of different ethnic groups. About 60 family in 4 community (Menglun, Jinghong, Manbian, Jinuoshan) were surveyed.

During the investigation, ethnobotanical data were collected through different interview methods: participatory rural appraisal (PRA), direct observation, semi-structured interviews, key informant interviews, individual discussions and focus group discussions (FGD) (Alexiades & Sheldon, 1996; Long & Wang, 1996; Chambers, 1994). At the beginning of the research, we conducted open interviews with tour guides and local leaders in Xishuangbanna. We asked what aroids
species they knew in the region. We wrote down all names, and sorted out the candidate species by its ethnic use, information on traditional ethnoveterinary medicine knowledge and choice of treatment providers was also obtained. Then, for each species, color photographs occurring in the area was shown to the community members being interviewed (Martin, 2010), to record the culture value that may have effects on their traditional life (Li et al., 2014). Specimens of target species were collected, examined and identified by the authors and other taxonomists and deposited in the Herbarium of the Minzu University of China (Beijing).

Results and discussion

A total of 5 ethnospesies, belonging to 5 botanical species are investigated as frequently used medicinal species. Their traditional medicinal use, economic and ethnobotanical applications are presented in this paper listed in Table 1 by Dai, Yi, Yao, Han, Hani, Jinuo and other ethnic groups, in addition to notes on their uses as fences, wild edible plant and fodder.

Ethnobotany informant consensus and chemical components study on medicinal aroid species

The medicinal uses of the different aroid species were classified into two categories: medicines and veterinary drug and fences (Tab. 1). Since the five aroids were used by many different cultures in
Xishuangbanna, the ethnobotanical uses detailed are listed by ethnic groups, besides, chemical composition of each species for testify of ethnomedical uses have been reviewed and synthesized.

1. *Alocasia cucullata*

This species is widely used mainly as medicinal plant by local ethnic groups: Dai people use ground fresh rhizome externally on skins to cure snake and insect bites, cough, pulmonary tuberculosis, bronchitis and so forth. Yao people use its fresh rhizome externally for treating otitis, inflammation and swelling, burnt. Yi people use its fresh rhizome for curing leprosy.

For chemical composition, this species has been reported for the roots containing amino acids 0.99%, and the other containing calcium oxalate and cyanogenic glycosides, etc. (Li, 1990). Other researchers isolated N-acetyl-D-lactosamine (LacNAc) (Xiao et al., 2014; Kaur et al., 2005), and 12 kinds of other chemical components (Xiao et al. 2014), they are steroids, alkaloids and phenolic compounds. Some compounds have good biological activity, 100μg/mL concentration N-acetyl-D-lactosamine has 50% inhibition for human cervical cancer cells, and when in vitro low dose (10μg / mL) have the effect of promoting human peripheral blood mononuclear cells in mitosis (Peng et al., 2013).

2. *Alocasia odora*

The rhizomes are medicinal by local Dao, Yi and Zhuang people, for abdomen
ache, cholera and hernia. Besides, this species has an excellent value for ornamentation for its huge leaves, unique shape, easy cultivation and few insect pests: it has been cultivated indoors or outdoors as an important tropical ornamental plant in Xishuangbanna.

For chemical composition, it is reported a total of 10 compounds were isolated and identified as a triterpenoid glycosides, two flavonoid C-glycosides, 5 lignan glycosides, a lignan and an alkaloid (Viet et al., 2006).

3. *Colocasia esculenta* (taro)

In Xishuangbanna, taro is widely cultivated by local people mainly for food, ornamentals or fodder. Also it is used as a medicine: tubers medicinal for curing mastitis, mouth sores, carbuncles sore treatment, cervical lymphadenopathy, burns, trauma and bleeding; petioles for curing hives and scabies. It is a good drug diet species, it does not contain solanine, is easy to digest and does not cause poisoning. It is a good main food. Due to starch granules in taro, and only one tenth of potato starch, the digestibility is up to 98.8%. However, the whole plant is poisonous, and the tuber especially highly poisonous if it is not fully cooked (if somebody has mistakenly eaten the raw tuber and has the phenomenon of tongue and throat burning, itching, swelling), the use a little vinegar with ginger, taken orally can get rid of the toxin).

It should be noticed that aboriginal peoples have a traditional wisdom for the cultivation of this species, and have handed
down some conventions for planting, such as to use middle sized and undeveloped tuber as seedlings; intercropping with fruit or corn crop to get higher productivity and less plant disease and insect bites; seedling tuber should be placed in a warm, dry and well ventilated cellar or indoor for long time conservation.

Chemical composition of *C. esculenta* has been studied. (Li et al., 2005) showing that the abstraction of taro stems contain hentriaconta-, stigmasterol, canola sterols, β-sitosterol, palmitic acid, daucosterol. Taro contains 19 kinds of trace elements, including K, Ca, Si, P, Fe, Mg, Mn, Na, Al, Cu, Ti, Ba, Sn, Cr, B, Ni, Mo, Ag, V (Li et al., 1996). In addition, it also contains 17 kinds of free amino acids, a total of 89.8mg / 100g, seven kinds of essential amino acids which the body needs for health (total of 17.1mg / 100g), water-soluble polysaccharide 12.0% (Li et al., 1996). Aroma components of taro research shows that the main aroma components contained in fresh taro is 2C, 6C, 8C and 11C of alcohols. Oxalate is ubiquitous substance in Araceae, content of oxalate in taro is 328–460 mg / 100g.

Currently very few studies have been made of the chemical composition of this species. Liu recently used a chemical fingerprint method (LC-MS) for *C. gigantean*, with cultivation and wild-type analyzed, 24 peaks, preliminary judgment mainly glycosides and flavonoids, such as the orientin, isoorientin, isoschaftoside, vicenin, Lut-6-C-Hex-8-C-Pent, etc. In the wild-type Lut-6-C-pent-8-C-Hex and Lut-7-O-Rhmn (1→2) Hex were found, but were not detected in the cultivated-type.

### 4. *Colocasia gigantea*

This species in Xishuangbanna region is very important with *C. gigantea* also used as feed or medicinal source. For example Hani people feed leaves to pigs, they think a small amount of leaf can kill insects inside pig stomach, but too many leaves will cause pig anorexia. Also it can be used as a vegetable good for health, people of many ethnic groups and collect their petioles cultivated for food, fresh leaf petiole is very common sold in the local bazaar. It is widely cultivated in tropical regions since wild individuals are not able to be eaten because of the hemp flavor.

This species’ tender leaves are used frequently by local people for vegetables, some local markets investigated are selling the leaves seasonally. Moreover, the rhizomes are used by Dai, Hani and Jinuo ethnic group as ethnomedicine: Dai people use the rhizome to cure lymphadenopathy, lymph nodes inflammation, gastritis, dyspepsia, snake bites, bruises, rheumatoid arthritis; Hani people use the rhizome function the same as Dai people in Xishuangbanna. Jinuo people use the rhizome for treatment of chronic gastritis, dyspepsia and rheumatic joint pain.
A series of phytochemistry studies have been conducted for its leaves and rhizome, it has been reported to have anticestodal efficacy, antinociceptive efficacy, antioxidants efficacy, leaf extracts showed mild antimicrobial property. The rhizome is a rich source of dietary fiber with 40% - 75% of total dietary fiber on dry weight basis, (7.2% - 7.5% on fresh weight basis) constituting 35% - 60% and 4% - 18% of insoluble and soluble fiber respectively. The rhizome can be considered as a valuable functional food from the viewpoint of its antioxidant and dietary fiber content (Shefana & Ekanayake, 2009).

Pharmacological activities compared with the ethnobotanic uses

Many aroids are used as traditional remedies or food. In our analysis, we have compared the folk phytotherapeutical data collected in our study with data present in the phytochemistry literature, many of new research information reported concerning Alocasia odora, Colocasia esculenta, and Lasia spinosa. On the contrary, for A. cucullata and C. gigantea, few researches have been found for the chemical components. The pharmacological activities of only Colocasia esculenta, and Lasia spinosa are partly in agreement with the ethnobotanic uses reported in this paper.

Traditional knowledge of Araceae still needs to be discovered, inventoried, and verified. For C. esculenta, although it has been cultivated for more than 1700 years, the medical use seems not fully recognized by us, the medicinal value are practiced only in some remote areas such as Xishuangbanna.
For *A. cucullata* and *A. odora*, they are ordinarily known as ornamental or fence plant, while, the medicinal values, according interviews of local people, are very efficient for some disease, while this kind of use is only known and practiced in some restricted parts. For *C. gigantea*, which is famous and well preserved by the tropical ethnic groups, the medicinal value are still being tested.

To sum up, the phytochemistry of these species is poorly known and identifying new bioactive compounds deserves further study. Although further testing is needed, it appears, based on the evidence of these studies and historical use, these species may still have some beneficial applications in modern medicine. Chemical study explained the traditional knowledge of indigenous usage. Future tests on many microorganisms and conditions should be carried out to testify the historical record of use whether they contains some special secondary metabolomics products that are useful for indicating their applications for some traditional ailments.

**Frequency of medicinal and drug diet aroids used in Xishuangbanna**

During the ethnobotanical survey, we found these aroids are frequently used by local people: *A. cucullata, Lasia spinosa* are known by all the families consulted, while *A. odora* is know by 35 families, *Colocasia gigantea* and *C. esculenta* are known mainly for their edible value but not for medicinal value, but as diet drugs *C. gigantea* and *C. esculenta* are very popular too. More than 200 species are recorded used by local people for edible vegetables, while the two species can be seen in most family’s yard and in the traditional market, 45 families out of 60 planted *C. gigantea*, 32 families cultivated *C. esculenta*: they can be listed into the top 10 most frequently eaten vegetables for local people.

**Ecological biomass resources and their commercial potential**

Although the utilization is limited and only regional, wild resources of *C. gigantea, Lasia spinosa* and *A. cucullata* are very abundant in Xishuangbanna. We observed wild populations growing in valleys near the river, hillsides or roadsides during expeditions near villages, consequently, they have great potentials for making medicinal resources and they can easily to be put under mass production. Further researches are still needed to make full utilization of the natural resources.

These species play an important role in providing local people with cheap and effective medicine, and various vital nutrition elements as edible wild plants. And as previous shown *A. cucullata* and *C. esculenta* were reported to have low fat, high dietary fiber, all essential amino acids, various mineral elements and vitamins, we can deduce petioles of *C. gigantea* should have the same nutrition for they have a very close systematic relationship. Wild edible plants can provide resources for future exploitation as new health foods. As living standards improve, there is a globally
increased demand for healthy and safe food... Compared to conventional, cultivated vegetables, wild food plants require less care, are not affected by pesticide pollution, and are a rich source of micronutrients. It is generally believed that local people are more likely to support and participate in conservation initiatives if they can receive direct benefits from such efforts. If managed sustainably, these plants could be a good means of income generation for rural communities.

**Issues of conservation**

Wild resources of Araceae species are threatened by various natural causes and human activities in Xishuangbanna. Extreme weather caused by global climate change, such as severe droughts and accompanied by increasing insect damage, has resulted in the decrease and even loss of plant populations. For *C. gigantea*, which relies on certain kinds of insects for pollination, the increasing temperature has resulted in the upset of insect life cycles so as to make the propagations of *C. gigantea* difficult. Various human activities such as land use change, habitat destruction, overharvesting and over-grazing, are major threats. In recent years, with the decreasing of traditional Swidden Agrosystem, increasing rubber tree farms, construction of roads, reservoirs and other infrastructure, wild habitats for edible plants were severely impacted (Xu et al., 2009). This is especially the case for *C. gigantea* and *A. odora*, which are vulnerable to the change of habitat.

Moreover, the traditional knowledge associated with aroids is also decreasing. Therefore, systematic documentation of indigenous knowledge and biological resources is of great significance. Along with economic development and increasing income, only a few people want to collect or cultivate wild edible or medicinal plants. The younger generation is becoming less interested in them, thus causing the giant loss of traditional knowledge. In Xishuangbanna where tourism is booming and local people eagerly want to serve as guides or drivers in tourist areas to pursue more money or discard their original living style of swidden agriculture and instead grow rubber trees in all their land, which is predicted to have soil organism loss and soil compaction. With the convenience of modern western medicine, residents can buy medicine more cheaply from drugstores than ever before and do not need to collect wild species. However, in more remote rural communities where transportation is still inconvenient and people are very poor, they seldom go to the drugstore, and indigenous knowledge about wild ethnotaxa is relatively intact. During our survey we found that most people are reluctant to cultivate *C. gigantea* now because planting rubber trees can bring more cash income.

**ACKNOWLEDGMENTS**

Thanks to all interviewed local people in Xishuangbanna, leaders and local guides, especially Yi Wan, Qi Xiu, Shifu Zhu; also thanks Dr. Bo Pan from Xishuangbanna tropical botanical garden. Special thanks to
A table showing the uses of medicinal aroids in Xishuangbanna, Yunnan.

<table>
<thead>
<tr>
<th>NAME OF PLANT</th>
<th>CHINESE NAME/PINYIN</th>
<th>LOCAL NAME</th>
<th>ETHNIC USE BY COMMUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alocasia cucullata (Lour.) G. Don</td>
<td>老虎芋/laohu yu</td>
<td>Banbie, manbi (Dai ethnic group); Doubuhou, wogao, luodaiyi (Yao ethnic group)</td>
<td>Medicinal; Hedges</td>
</tr>
<tr>
<td>A. odora (Roxb.) C. Koch</td>
<td>海芋/hai yu</td>
<td>Banbiao (Dai ethnic group)</td>
<td>Medicinal; Ornamentation</td>
</tr>
<tr>
<td>Colocasia esculenta (L.) Schott</td>
<td>芋/yu</td>
<td>Dupiye, Yutou (Local people)</td>
<td>Medicinal; Crop; Fodder</td>
</tr>
<tr>
<td>C. gigantea (Blume) Hook.f.</td>
<td>大野芋/daye yu</td>
<td>Pagfu (Dai ethnic group); Kai yang (Hani ethnic group); Zao liyang (jinho ethnic group); Houbun (Yao ethnic group); Bai yugan (yi ethnic group)</td>
<td>Veterinary drug; Ornamentation; Cultivated as edible plant; Fodder</td>
</tr>
<tr>
<td>Lasia spinosa (L.) Thwait.</td>
<td>刺芋</td>
<td>Panan, Pakena, Heapan (Dai ethnic group); Re yu (Hani ethnic group); Yangduo (jinuo ethnic group)</td>
<td>Medicinal; Veterinary drug; Wild edible plant</td>
</tr>
</tbody>
</table>

Table 1: Five aroids uses by the Xishuangbanna Community: Chinese name, Local name, and Ethnic use.

REFERENCES
