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**Authors' contributions**

CL designed the study, revised and finalized the manuscript; CL, SZ, HS, YJ, QL, JZ, LH, FL, BLu, and BLi performed the field investigations; SZ and HS drafted the manuscript, they contributed equally to this work

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**Competing interests**

No competing interests have been declared.

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## ORIGINAL RESEARCH PAPER

# Ethnobotany of *Acorus* in China

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**Abstract**

In China, species in the genus *Acorus* are used for many different purposes, viz., in traditional medicine, for rituals, and as ornamental plants. *Acorus calamus* (sweet flag) has been a symbolic plant in Chinese culture for many centuries and is used as a ceremonial object in festivals throughout the country. For other *Acorus* species in China, ethnobotanical records are few. During field investigations from 2006 to 2017, we interviewed 573 individuals representing ethnic groups such as the Miao, Yao, Buyi, Shui, Tujia, Dong, She, Maonan, Zhuang, Yi, and Han people. Various ethnobotanical approaches were adopted in the field surveys, including key informant interviews, semistructured interviews, participatory observation, direct observation, etc. The results have revealed a rich treasure trove of traditional knowledge on *Acorus* in China. Two species (*A. macrospadiceus* and *A. gramineus*) were used by ethnic groups as spices to add flavor to meat. Through the study found that all the species of *Acorus* had medicinal value, especially *A. tatarinowii*, deafness, blindness, and digestive disorders were among the conditions commonly treated using these plants. Traditional knowledge of the cultural, ethnomedicinal, and food values of *Acorus*, based on our recent literature surveys and field investigations in China is presented here. A better understanding of *Acorus* is vital for conserving the plants and the traditional knowledge associated with them.

**Keywords**

*Acorus calamus*; *A. gramineus*; *A. macrospadiceus*; *A. tatarinowii*; ethnomedicine; ethnobotany; Dragon Boat Festival; plant culture

**Introduction**

The genus *Acorus* (Acoraceae) is believed to include several species [1–3]. Based on recent morphological, ecological, phytochemical, and molecular investigations, four species of this genus are currently recognized: *Acorus calamus* L. (sweet flag, including two varieties), *A. tatarinowii* Schott, *A. gramineus* Solander ex Aiton, and *A. macrospadiceus* (Yamamoto) F. N. Wei and Y. K. Li. *Acorus calamus*, in particular, has a long history of cultural, medicinal, and culinary uses around the world [4–6]. The sweet flags occur in the wild and are cultivated in many parts of Eurasia and North America, although the exact native range of the genus is still disputed [7]. In some Asian countries, such as Nepal, local people chew the rhizome of *A. calamus* to treat coughs [8]. In India, the rhizomes are widely used in the treatment of ailments such as epilepsy, mental illness, chronic diarrhea, dysentery, fever, abdominal tumors, kidney and liver troubles, and rheumatism [6]. In the state of Assam in Northeastern India, the local people believe *A. calamus* to be a supernatural plant and that spirits and devils cannot enter it, owing to its odor. They put the rhizome at the four corners of the altar or the entrance to a

ritual site [9]. In Japan, Korea, and India, people collect *Acorus* for use as medicine and wear the rhizome in their hair to maintain overall health [10]. In China, all species in the genus *Acorus* can be found, and each ethnic minority has accumulated and documented their particular ways of using the plants.

In Poland, the inner parts of the young shoots of *A. calamus* have been commonly used as a snack for children, and the plant is widely used in many parts of lowland Poland to decorate houses during Pentecost. In the eighteenth century, sweets made from *A. calamus* were very popular in the Polish manor houses [5].

There are three major traditional festivals in China, namely the Spring Festival, the Dragon Boat Festival, and the Mid-Fall Festival. People celebrate the Dragon Boat Festival on the fifth day of the fifth month of the lunar calendar. It is also called “Duan-wujie”, “Nü’erjie”, “Chang-pujie”, “Duanyangjie”, “Tianzhongjie”, and “Zongzizjie” [11], or “Dyng’jit” in Cantonese. During this festival, the Han Chinese and other ethnic groups eat “zong-zi” (a special food with cultural significance made from sticky rice and other foodstuffs), compete in Dragon Boat racing, go hunting, collect herbal medicines, wear colorful ribbons, and hang “chang-pu” (*A. calamus*) with “ai” (*Artemisia argyi*) on the door. The Dragon Boat Festival has been celebrated for some 4,000–5,000 years. There are various explanations for its origin, but the most commonly accepted version is that it commemorates Qu Yuan. Qu was a great poet in the Chu Kingdom during the Warring States period (339–278 BC) and is well known in China for his patriotic spirit [12]. However, Chinese scholars who recently investigated the initial purpose of the Dragon Boat Festival conclude that it was to pray for health and longevity [13], and this is consistent with the role of medicinal herbs during this festival. Unsurprisingly, in China and other Asian countries, *Acorus* has become an important symbol of the Dragon Boat Festival.

*Acorus* was previously placed within the family Araceae, but now it is placed in its own family Acoraceae, under the order Acorales [14], and is regarded as a member of the oldest extant lineage of monocotyledons [15]. The name *acorus* is derived from the Greek word *acoron*, a name used by Dioscorides, which in turn was derived from *coreon*, meaning *pupil*, because it was used in herbal medicine to treat inflammation of the eyes [4,16].

In China, *A. calamus* L., or sweet flag, is called chang-pu or “shui chang-pu”. It is a semievergreen perennial hairless herb with aromatic leaves that can grow up to 2 m height. The plant has a creeping rhizome, which is extensively branched and up to 3 cm in diameter. Internally, the rhizomes are whitish pink in color and pleasantly aromatic, smelling of citrus, with a bitter taste [4]. Each leaf has an obvious midrib. Flowers of *A. calamus* are dioecious, having both male and female organs, and are pollinated by insects [17]. This species is found in the northern temperate and subtropical regions of Asia, North America, and Europe, and is widely distributed in most provinces of China. It lives in aquatic environments: wetlands, shallow water, pond edges, and islands below 2,600 m above sea level [18].

*Acorus tatarinowii* Schott is called “shi chang-pu” in China. It is similar to *A. calamus* morphologically but is smaller, and the leaf lacks a midrib. The rhizomes are more branched than in *A. calamus*, and the rhizomes (0.2–1.0 cm) are smaller in diameter [19]. It has an epiphytic habit and is distributed to the south of the Yellow River watershed in China. It grows at elevations of 20–2,000 m in wetlands, on banks or among stones of brooks with clear water, and thrives on vertical slopes exposed to torrents. The leaves and rhizomes are aromatic, and it is commonly used in traditional Chinese medicine. In addition, it is often cultivated as an ornamental plant in indoors and large gardens.

*Acorus gramineus* Solander ex Aiton is known as “jin xian-pu” or “jin qian-pu”. Its leaves are short and slim, and the rhizomes are similar to those of *A. tatarinowii*, with even more nodes and branches. It is also aromatic and distributed in Southern and Southwestern China. *Acorus gramineus* is not an aquatic plant, but grows in wet and semishady environments below 1,800 m. It is often cultivated as an ornamental and edible plant in rooms and gardens [20].

Although *A. macrospadiceus* (Yamamoto) F. N. Wei is a terrestrial herb with rhizomes, it sometimes grows in wetlands. It is called “shannai” or “shannai chang-pu” or “gourou-xiang” by local ethnic groups including the Miao, Dong, Yao, Shui, and Han Chinese. The plant has a strong fennel-like smell, and indigenous people in Southwest China use

it as an aromatic herb in cooking. *Acorus macrospadiceus* occurs in the mountainous areas of Guizhou, Guangxi, Sichuan, Chongqing, Hunan, and Hainan provinces at an elevation of 400–1,200 m above sea level, and is also grown in home gardens.

*Acorus* species not only have multiple medicinal, nutritive, and aesthetic uses, they also have cultural, economic, and ecological value. China is unique in having all four *Acorus* species, but very little ethnobotanical information about *Acorus* has been systemically documented till date. The objective of this study is to record traditional knowledge about *Acorus* in China, especially among the communities of minority ethnic groups.

## Material and methods

### Literature study

*Acorus* is an important plant group in Chinese history and a large number of records are found in ancient writings. Collections at the National Library of China were frequently accessed and books from ancient to recent times were examined. Information on the flora from every province of China, together with *Flora Reipublicae Popularis Sinicae* (Chinese version) and *Flora of China* (English version) have been intensively studied.

Information in the databases PubMed, Scopus, Web of Science (WoS), and Google Scholar, as well as in that generated by a combined search of available literature in Scopus and WoS have been studied. We have also accessed Chinese databases including WP (China Science and Technology Journal Database) and CNKI (China National Knowledge Infrastructure).

### Field surveys

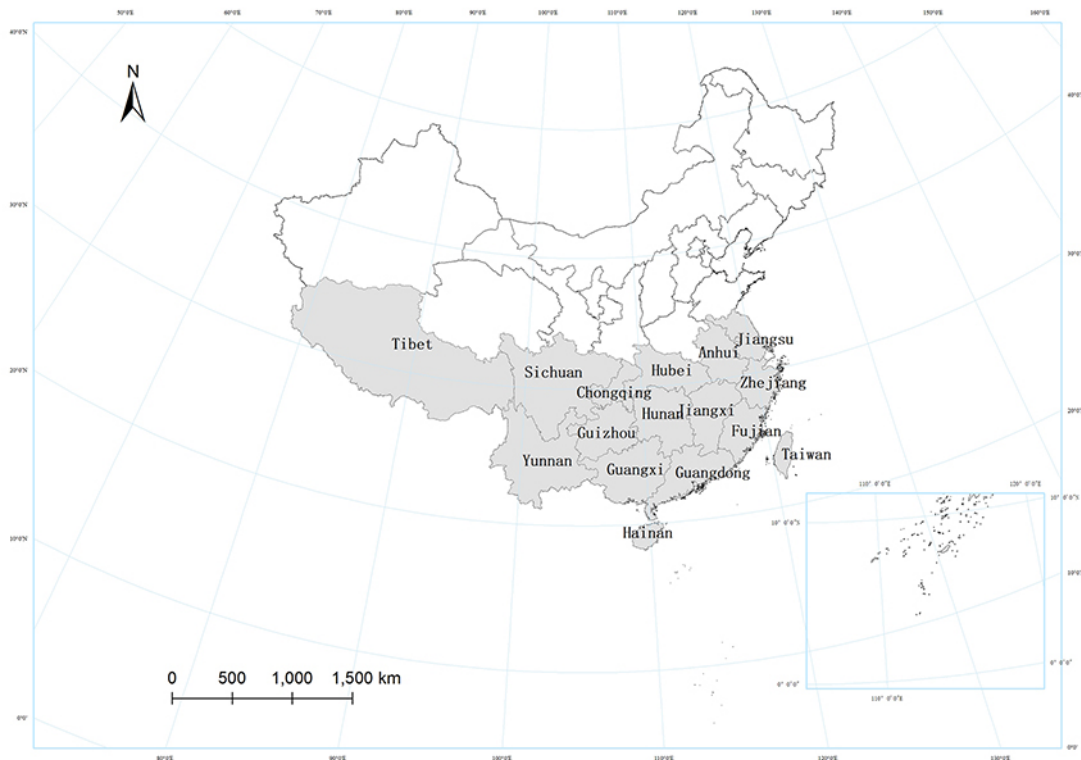
Ethnobotanical investigations were carried out 24 times from March 2006 to June 2017, covering all four seasons. The areas selected for study were places where the local people frequently use *Acorus* species, and included several provinces of Southwestern China. Guizhou Province, Hubei Province, the municipality of Chongqing, Guangxi Zhuang Autonomous Region, Yunnan Province, and Hunan Province were visited during extensive investigations into the uses of *Acorus*. Other provinces surveyed in detail included Sichuan, Tibet, Zhejiang, Anhui, Jiangsu, Fujian, and Taiwan (Fig. 1).

In every study area, we randomly selected two to five villages or local markets and interviewed five to 12 people who had traditional knowledge about *Acorus*. A total of 573 informants, including 262 males and 311 females between 14 and 96 years old, were interviewed. Informants were drawn from the following ethnic groups: Miao, Yao, Buyi, Shui, Tujia, Dong, She, Maonan, Zhuang, and Yi, as well as the Han people, who form the ethnic majority in China. Information about the study areas is given in Tab. 1. Ethnobotanical data were collected by employing different interview methods [participatory rural appraisal (PRA), direct observation, semistructured interviews, key informant interviews, individual discussions, and focus group discussions] [21–25]. During our surveys, we recorded the local names, uses, parts used, preparation methods, and other information. Voucher specimens were collected from the various habitats, and examined and identified by the authors. They were deposited in the Herbarium of the Minzu University of China (Beijing).

## Results

### Cultural value

The local people we interviewed often regarded *Acorus* as a sacred and symbolic plant. A few stories recounted that, in ancient times, people considered the fifth day of the



**Fig. 1** Provinces where the ethnobotanical uses of *Acorus* were investigated

fifth month of the lunar calendar (the day of the Dragon Boat Festival) to be the most inauspicious day of the whole year. It was considered to be a day on which evil posed a severe threat to human beings. A baby born on this day would be threatened by evil or illness. Officials would never be promoted if they began their new positions on May 5th. People would be weak if they lived in houses built on this day [23,24]. Because the leaf of *A. calamus* is similar in shape to a sword, people believe that the leaves can kill the evil spirits and keep people healthy (Fig. 2).

Chang-pu (*A. calamus*) is the most frequently used species at the Dragon Boat Festival. Different names for *A. calamus*, related to the festival, are used by local communities. Apart from chang-pu, other names include: “shi chang-pu”, “puzi”, “bai-chang”, or “da chang-pu”. People hang the whole plant on the top of their front doors or main gates together with ai (*Artemisia argyi*) to keep evil away from the house and family, and they pray for safety for anyone taking trips outside the house. Because *A. calamus* rhizomes are pleasantly aromatic, people put them in small cloth bags, sometimes together with other plants and sometimes alone. It is said that children who wear these cloth bags tied with red string around the neck will not get sick. This custom has been handed down from generation to generation over centuries.

In China, essential foods for a number of festivals include dumplings, moon cakes, “tangyuan” (glutinous rice balls), “zongzi” (a special food with cultural significance made from sticky rice and other ingredients), and “xionghuang” (realgar) wine. The local people drink chang-pu (*Acorus*) wine (liquor containing sliced *Acorus* rhizomes) during the Dragon Boat Festival in Southern China. People believe that those who drink the chang-pu wine will be stronger and healthier. Women wash their hair with hot water infused with *Acorus* leaves to maintain the hair and enjoy good health for a whole year.

#### Food value

During our investigations in Guizhou, Chongqing, and Guangxi provinces, people told us that shannai (or shannai chang-pu) (*Acorus macrospadiceus*) is quite popular as a flavoring agent in the preparation of meat and fish. Leaves and rhizomes are both used

Tab. 1 Information of investigation areas.

No.	Province	County (or county-level city/district)	Linguistic group	<i>Acorus</i> species investigated*
1	Anhui	Huangshan	Han	Ac
2	Chongqing	Shizhu, Chengkou, Xiushan	Tujia, Miao, Han	Ac, Ag, As, At
3	Fujian	Fu'an, Jiaocheng	She, Han	Ac, At
4	Guangdong	Nanxiong, Lianshan, Conghua	Yao, Han	Ac, Ag, As, At
5	Guangxi	Bama, Daxin, Jingxi, Huanjiang, Sanjiang, Longzhou, Napo, Yanshan, Luocheng	Zhuang, Maonan, Molao, Yao, Han	Ac, Ag, As, At
6	Guizhou	Kaili, Leishan, Huangping, Danzhai, Maijiang, Shibing, Zhenyuan, Shiqian, Jiangkou, Liping, Jinping, Rongjiang, Congjiang, Jianhe, Daozhen, Guiding, Zhenfeng, Xingyi, Bijie, Weining, Duyun, Dushan, Sandu, Libo, Shiqian, Wangmo, Ziyun	Miao, Dong, Buyi, Yi, She, Tujia, Shui, Maonan, Yilao, Han	Ac, Ag, As, At
7	Hainan	Ledong, Wuzhishan	Li, Han	Ac, As, At
8	Hubei	Fangxian, Zhuxi, Hefeng	Tujia, Miao, Han	Ac, Ag, As, At
9	Hunan	Yongshun, Fenghuang, Wulingyuan, Sangzhi, Liuyang, Yuele, Lengshuijiang, Xinchao, Dongkou, Suining, Xinning, Chengbu, Hengyang, Nanyue, Shigu, Xinhuang, Xupu, Zhijiang, Huitong, Hecheng, Tongdao, Jianghua, Lanshan	Dong, Miao, Tujia, Yao, Han	Ac, Ag, As, At
10	Jiangsu	Qixia, Wuzhong	Han	Ac
11	Jiangxi	Chongyi, Lushan, Yudu, Liancheng, Nankang	She, Yao, Han	Ac, At
12	Sichuan	Huili, Yanbian, Butuo, Puge	Yi, Han	Ac, As, At
13	Taiwan	Miaoli, Nantou, Taipei	Atayal, Bunun, Han	Ac, At
14	Tibet	Bayi, Milin, Chayu	Tibetan, Lhoba	Ac, At
15	Yunnan	E'shan, Mengla, Jinghong, Mile, Jinping, Luchun, Yuanyang, Chuxiong, Eryuan, Lanning	Bai, Dai, Hani, Jinuo, Lisu, Yi, Han	Ac, Ag, As, At
16	Zhejiang	Jingning, Yiwu, Zhuji	She, Han	Ac

\* Ac – *Acorus calamus*; Ag – *A. gramineus*; As – *A. macrosperadiceus*; At – *A. tatarinowii*.



**Fig. 2** *Acorus calamus* in E'shan Yi Autonomous County, Yunnan (Chunlin Long, November 2012).



**Fig. 3** *Acorus tatarinowii* in Majiang County, Guizhou (Chunlin Long, July 2016).



**Fig. 4** *Acorus macrospadiceus* in a farmer's vegetable garden in Xiushan, Chongqing (Shuang Zhang, September 2014).



**Fig. 5** *Acorus gramineus* in Qiannan Autonomous Prefecture, Guizhou (Hang Shu, July 2016).

in cooking. Shannai is very similar to shi chang-pu (*A. tatarinowii*) morphologically. Indeed, taxonomists often treat it as the same species. However, the local people insist that the two species are not the same. They distinguish them by the smell of the leaves and the habitat in which they are found. Shi chang-pu is epiphytic but shannai is terrestrial (Fig. 3 and Fig. 4). People cultivate shannai in flowerpots or home gardens, depending on their living environment (urban or rural). Our interviews revealed that shannai is most commonly used in Guizhou Province and Guangxi Region. In the municipality of Chongqing, nearly half the local people knew how to use it as a spice; however, in Hubei, Yunnan, and Jiangxi provinces, only a few people mentioned that it was used as a flavoring.

*Acorus gramineus* is also used as a spice in Guizhou, although it is not popular. Nevertheless, some local people said that, when used in cooking, it gave a better flavor than shannai (*A. macrospadiceus*) (Fig. 5).

### Medicinal value

The genus *Acorus* was first recorded as a medicinal plant in the book entitled *Shennong's classic of materia medica*, compiled between 200 BC and 200 AD, where it says that *Acorus* was used to treat deafness, blindness, cramps, and digestive disorders [26]. According to the *Compendium of materia medica* (Chinese medicinal herbs), published in 1552 by Shizhen Li (also known as Li Shih-Chen, founder of theory of traditional Chinese medicine), *Acorus* could prolong life and treat diarrhea. Both *A. calamus* and *A. tatarinowii* could be used for medicinal purposes, but the rhizomes with several nodes were reported to be the most effective. This description matches that of *A. tatarinowii*, which is the species most often used as medicine [27].

There are 56 ethnic groups in China, including the dominant Han people. Many ethnic groups have their own traditional medicine systems, although some medicinal plants are widely used by different groups. The Miao people, for example, have a rich repertoire of medicinal plant knowledge dating back some 4,000–5,000 years. Records state that the Miao people used the rhizomes of *A. tatarinowii* to treat heart disease 900 years ago [28]. *Acorus tatarinowii* is also used to treat dysentery, flatulence, and epilepsy now, as it was in the past.

*Acorus* has traditionally been used as an herbal medicine by 28 ethnic groups in China (Tab. 2), according to the literature [29–32] and our field surveys. Many ethnic minorities in China have a language that is unique to them. Different names for *Acorus* used by ethnic peoples are recorded here in Chinese pinyin (phonetic spelling), as shown in Tab. 2.

All the 29 linguistic groups studied (including Han Chinese) use *A. calamus* as traditional medicine, 16 use *A. tatarinowii*, another 16 use *A. gramineus*, and seven use *A. macrospadiceus* (Fig. 6). Twelve groups use at least three *Acorus* species, namely Miao, Jingpo, A-Chang, Lisu, Zang (Tibetan), De-Ang, Dai, Hani, Yi, Jinuo, Buyi, and Wa.

While the rhizome of *Acorus* is the part most often utilized in treatments, the whole plant, leaves, and inflorescences are also used as medicines. Twenty-one linguistic groups use only the rhizome of *A. calamus*, two groups use the rhizome and leaves (Bulang and Lahu groups), two groups use the rhizome and the whole plant (Zhuang and Chaoxian groups), the Tujia use only the whole plant, and the Mulao use only the inflorescence. The most frequently used part of *A. tatarinowii* is again the rhizome. Seven linguistic groups use the rhizome of *A. tatarinowii*; three groups use the whole plant, five groups use the rhizome and the whole plant, and the Jinuo use the rhizome and leaves.

Tab. 2 *Acorus* used as traditional medicine by ethnic groups in China.

No.	Ethnic group	<i>A. calamus</i>			<i>A. tatarinowii</i>			<i>A. gramineus</i>			<i>A. macrospadicus</i>		
		Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used
1	Miao	Bota, jiabaoweng	Deaf, apoplexy aphasia, traumatic injury, diarrhea, snake wind syndrome, heart stomach pain	Rhizome	Jiabuwei, lubuwei	Heart diseases, dysentery, flatulence, antiepileptic	Whole plant	Wendeng-bo	Resuscitation and phlegm, syncope, chest distention nausea, loss of appetite	Rhizome	Shannai, xiangnai, gourou-xiang	Gastrectasia, nourishing the body	Rhizome
2	Jingpo	Shoubu, sanmubu	Unconsciousness, chronic tracheitis, stomach and abdominal pain	Rhizome	Waisanbu, liudang-baoman	Regulate qi, digestive disorders	Rhizome	Waisanbu	Belly bulge, edema	Rhizome	/	/	/
3	Achang	Changpu	Gastroenteritis, irregular menstruation, cold, headache	Rhizome	Shoumao	Obnubilation, amnesia	Rhizome	Shoumao	Wet disease Mongolian orifices, amnesia and more dreaminess, unconsciousness	Rhizome	/	/	/
4	Lisu	Ajesu	Cold, diarrhea, edema	Rhizome	Kabumajji	Cold, edema, abdominal distention	Rhizome	Kapumoji	Cold, belly bulge	Rhizome	/	/	/
5	Zang	Xudanabao, xiudanabao	Gastritis, arthritis, indigestion, diphtheria, tonsillitis, ulcer, forgetful, anthrax, abdominal pain	Rhizome	Xudagabo	Digestive disorders, unconsciousness	Rhizome	Xidouga-bao, xidouduo-bao	Miasma dampness, phlegm heat syncope, chest distention nausea, diarrhea, deficiency, emaciation, epilepsy	Rhizome	/	/	/
6	Deang	Changrubai	Enteritis caused by abdominal pain, Insect disease, headache, gastroenteritis	Rhizome	Xiaochangpu, changrubai	Gastrelcoma, abdominal pain, obnubilation, amnesia	Rhizome	Xiaochangpu, changrubai	Unconsciousness, wet disease Mongolian orifices, amnesia and more dreams	Rhizome	/	/	/
7	Dai	Shabunan, hanhao	Cold, cough, stomach pain	Rhizome	Hanhao, gemiqin	Abdominal pain, watery diarrhea, prolapse of the anus, skin pruritus, inflammatory rheumatism, asthma, diarrhea	Rhizome, Whole plant	Shamubu-pa, waisanbu	Skin pruritus, watery diarrhea, asthma, prolapse of the anus, abdominal pain	Rhizome	/	/	Whole plant, rhizome
8	Hani	Langxia	Bronchitis, enteritis, Loss of appetite	Rhizome	Lumagui	Soothe the nerves, unconsciousness, regulate qi, promote blood circulation, regulate stomach, dispel dampness	Whole plant	Lumagu-ke	Rheumatic arthritis, dyspepsia	Whole plant	/	/	/

Tab. 2 Continued

<i>A. calamus</i>				<i>A. tatarinowii</i>				<i>A. gramineus</i>				<i>A. macrospadiceus</i>				
No.	Ethnic group	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used
9	Yi	Muji, zangchang-pu	Chronic bronchitis, purulent conjunctivitis, dysentery, enteritis, dyspepsia	Rhizome	Gushou, shichapu	Traumatic injury, phlegm syncope and anepia, stagnation of qi and blood coagulation, anemofrigid-damp arthralgia, chronic cough, inflammatory rheumatism	Whole plant	Muji	Same as <i>A. tatarinowii</i> , and chronic bronchitis, purulent conjunctivitis, dysentery, enteritis, dyspepsia, chest depressed, abdominal distension and pain	Rhizome, whole plant	/	/	/	/	/	/
10	Jinuo	Chuobubu, apaiqaohe-lumaguke	Abdominal pain, fever, ulcer scabies, traumatic injury, rheumatism	Rhizome	Lumaguke, luomao-geqi	Inflammation, traumatic injury, rheumatism, thoracic and abdominal distension	Leaves, rhizome	Luobubu	Indigestion, flatulence	Rhizome	/	/	/	/	/	/
11	Wa	Xibaizhong-changpu	Headache, resuscitation and phlegm, enteritis, chronic bronchitis, diarrhea, loss of appetite, indigestion	Rhizome	Sibailun, xibolaige	Schizophrenia	Rhizome	Shan-changpu	Unconsciousness, amnesia, dreaminess, deaf, chest distention nausea, epigastric pain, carbuncle furuncle	Rhizome	/	/	/	/	/	/
12	Dong	Jiangbulong	Headache	Rhizome	Xigushan, changpu-leng	Stomach ache, seminal emission, cold, epilepsy, abdominal pain, apoplexy aphasia	Rhizome, whole plant	/	/	/	Shannai, gourou-xiang	Gastrointestinal distress, nourishing the body	Rhizome, whole plant	/	/	/
13	Maonan	/	/	/	Xiangfudu, yanfuman	Same as "dong"	Same as "dong"	/	/	/	Wuxiang-cao	Gastrointestinal distress	Rhizome	/	/	/
14	Mulao	Changpu	Wound by knife	Inflorescence	Changbu-nen	Stomach pain, gastritis, seminal emission, cold; abdominal pain	Whole plant	/	/	/	/	/	/	/	/	/
15	Yao	Cheng-baozha, qingbao	Insomnia, seminal emission, stroke, diarrhea, bronchitis, dyspepsia	Rhizome	Hanbaowan, qingbaoduan, chan-bou-mang	Same as "mulao", infantile convulsion, epigastric pain, bronchitis	Rhizome, whole plant	/	/	/	/	/	/	/	/	/
16	Buyi	Shuichang-pu	Abdominal pain, stomach pain, headache	Rhizome	Aiyao, shi chang-pu	Dyspepsia, influenza	Rhizome	Xichangpu, bighan, gourouxiang	Hepatitis, gastritis, nourishing the body	Whole plant	Shannai, wuxiang-cao	Gastroctasia, hepatitis, cold	Rhizome, whole plant	/	/	/
17	Tujia	Dapengzhang	Abdominal pain, toothache, epigastric pain	Whole plant	/	/	/	Shuilazhu	Rheumatism, traumatic injury, abdominal pain, abdominal distension	Rhizome	/	/	/	/	/	/



Tab. 2 Continued

No.	Ethnic group	<i>A. calamus</i>			<i>A. tatarinowii</i>			<i>A. gramineus</i>			<i>A. macrospadicus</i>		
		Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used
18	Uyгур	Yigener	Limb numbness, paralysis, mouth sores, cough and asthma, bronchospasm, red urine, urinary calculi stomach pain, abdominal pain, hypertension, diarrhea, sore throat, sore furuncle swollen poison, damp toxin	Rhizome	/	/	Taxiyigen-er	Palpitations boredom, fever faint, forgetful, hemiplegia, dysuria, limbs dampness, diarrhea abdominal pain, furuncle	Rhizome	/	/	/	/
19	Mongolian	Chaganshudage, Wumogheizhesu	Dampness resuscitation and phlegm, enteritis, diarrhea, chronic bronchitis, loss of appetite, arthralgia due to wind cold, abdominal pain, unconsciousness	Rhizome	/	/	Harishugeda	Resuscitation and phlegm, syncope, chest distention nausea, loss of appetite	Rhizome	/	/	/	/
20	She	Changpu	Gastrointestinal disease	Rhizome	/	/	Xiaoshan-nai	Nourishing the body	Whole plant	/	/	/	Rhizome
21	Bulang	Nankao	Stomach ache, headache	Rhizome, leaves	/	/	/	/	/	/	/	/	/
22	Lahu	Wukeer	Infantile convulsion, abdominal distension, acute gastritis, dyspepsia, dizziness, arthritis	Rhizome, leaves	/	/	/	/	/	/	/	/	/
23	Pumi	Kedimi	Abdominal pain, stomach pain, epilepsy, diarrhea, neurasthenia, rheumatic pain, vomiting acidic water	Rhizome	/	/	/	/	/	/	/	/	/
24	Nu	Changpu, daishigu	Same as "pumi"	Rhizome	/	/	/	/	/	/	/	/	/
25	Zhuang	Shuilazhu	Gonorrhoea, leucorrhoea, spleen enlargement and inflammation, edema	Rhizome, whole plant	/	/	/	/	/	/	Wuxiangcao	Gastreclasia	Rhizome
26	Hasake	Siasikuoha	Rheumatoid arthritis, low back pain, gynaecology	Rhizome	/	/	/	/	/	/	/	/	/

Tab. 2 Continued

			<i>A. calamus</i>			<i>A. tatarinowii</i>			<i>A. gramineus</i>			<i>A. macrospadiceus</i>		
No.	Ethnic group	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	Local name	Uses	Part used	
27	Chaoxian	Baichangcao, cangpao	Chronic gastritis, otitis media, forgetfulness, abdominal pain, scrofula, eczema, vomiting, diarrhea, water tinea, neurasthenia	Rhizome, whole plant	/	/	/	/	/	/	/	/	/	
28	Shui	Jiuhu, changpu	Edema, stomach pain, abdominal bloating	Rhizome	/	/	/	Shannai, gourouxiang	Gastrectasia, lithiasis, nourishing the body	Rhizome, whole plant	/	/	/	

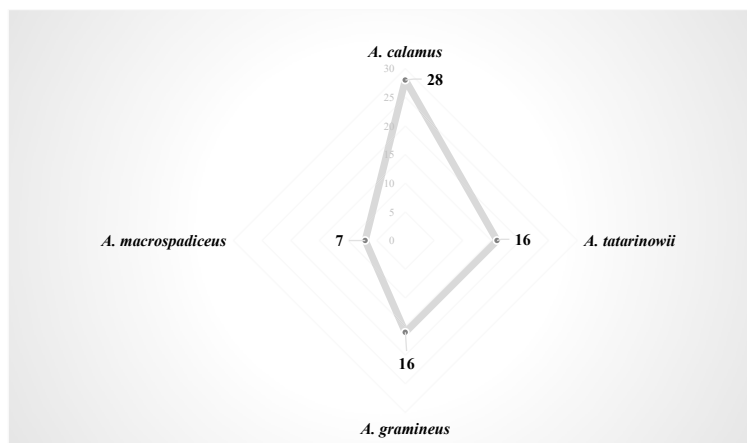


Fig. 6 Number of linguistic groups that use different species of *Acorus* as medicine.

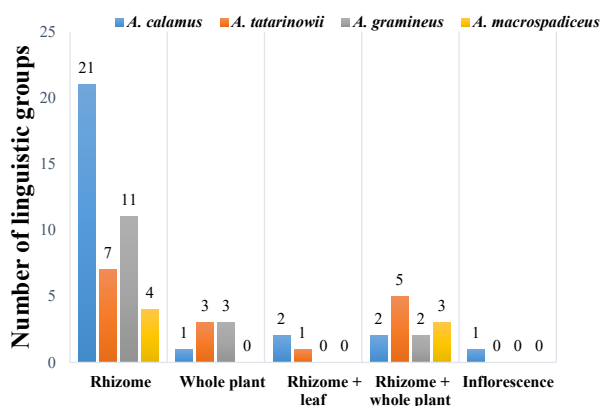


Fig. 7 Number of linguistic groups that use different parts of *Acorus* as ethnomedicine.

With respect to *A. gramineus*, 11 linguistic groups use the rhizome, three groups use the whole plant, and the Dai and Yi people use the rhizome and the whole plant in treatments. Only four linguistic groups use the rhizome or whole plant of *A. macrospadiceus* as ethnomedicine (Fig. 7).

### Nonmedicinal uses in China

According to our field investigations, ethnomedicine is not the only use for *Acorus* in China. Some ethnic groups, such as the Atayal in Taiwan and the Yao in Hunan, wear *Acorus* bracelets or necklaces. They cut the thick rhizomes of *A. calamus* into sections of 1–1.5 cm long, and air-dry them. Around 15 sections of sweet flag rhizome are strung together with a red thread to make a bracelet or 30 sections for a necklace. The local people wear *Acorus* bracelets or necklaces not only for decoration but also for keeping away insects or evil forces.

It is common for people to grow *Acorus* plants as ornamentals [20]. The local people in southern China like to cultivate *A. tatarinowii* in their villages and home gardens, and on roadsides, for aesthetic purposes. In eastern Guizhou and western Hunan, for example, the Miao people collect *A. tatarinowii* to decorate urban landscapes and gardens. Since ancient times, Chinese intellectuals and poets have made bonsai out of *A. gramineus* and kept them in their studies. The tiny, elegant *A. gramineus* bonsai are still fashionable in urban and some rural areas as indoor ornamentals (Fig. 8).



**Fig. 8** Bonsai with *Acorus gramineus* used as decoration (Chunlin Long, Beijing, March 2017).

In some villages we studied, the local people cultivated *A. calamus* or *A. tatarinowii* to clean up water in ponds or drainage channels. Some ethnic groups (such as Yao and Miao) used *A. calamus* as an insect repellent, especially for mosquitoes. The fiber from dry leaves of *A. calamus* had been used for different purposes. For example, the zong-zi can be tied with sweet flag leaves.

## Discussion

The diverse climate and geography, varied terrain, and range of soil types of China harbor an enormous diversity of plants, with 31,142 species of higher plants alone. Over thousands of years, the Chinese have accumulated a rich and valuable trove of traditional knowledge about the use of plants [33]. In China, according to our field surveys and information in the historical records and available literature, plants in the *Acorus* genus have important cultural, medicinal, and nutritive value, and deserve more attention, as such.

In the *Compendium of materia medica*, Shizhen Li recorded five species of *Acorus* and Chinese scholars have described some new species in recent decades. Currently, seven species and two varieties of *Acorus* are recognized. While *Flora Reipublicae Popularis Sinicae* recognizes four species (*A. calamus*, *A. tatarinowii*, *A. gramineus*, and *A. rumphianus*), the *Flora of China* and The Plant List recognizes two species only (namely *A. calamus* and *A. gramineus*). In The Plant List (<http://www.theplantlist.org/>), *A. tatarinowii* is regarded as a variety of *A. calamus*, (*A. calamus* var. *angustatus* Besser), and *A. spadiceus* as a variety of *A. gramineus* (*A. spadiceus* var. *angustatus* Besser). However, many scientific publications still make the distinction between the four taxa discussed in this paper, and we have followed this classification. In some Chinese historical sources, shi chang-pu was regarded as the most effective medicinal *Acorus*. From our investigations, we concluded that it was probably a general name for all medicinal *Acorus*. A taxonomic revision of *Acorus* will be required to ensure that the *Acorus* obtained for medicinal purposes comes from the right sources and institute quality control for *Acorus* medicine.

According to our field surveys and literature records (Tab. 2), *A. calamus*, *A. tatarinowii*, and *A. gramineus* are referred to most often as the species with medicinal value. However, modern pharmacological research has mainly focused on two species, namely *A. calamus* and *A. tatarinowii*. Few researchers have studied *A. gramineus* or *A. macrospadiceus*.

In this study, we found that only the Mulao people collected inflorescences to treat wound. But, up till now, there has been no research on the chemical components or pharmacological activities of the *Acorus* inflorescence. Further studies may help elucidate the process by which the *Acorus* inflorescence can assist with wound-healing.

Our field surveys in China revealed a rich trove of traditional knowledge about *Acorus* across the nation, and *A. calamus* certainly plays a significant cultural role during the Dragon Boat Festival. Unfortunately, only a few young people in our field sites knew about the use of *Acorus* in traditional medicine. Indeed, the traditional knowledge about the medicinal properties of *Acorus* that is described in the literature and historical sources seems to be disappearing. Most of the folk healers are aged, and cannot transfer their knowledge to the next generation because of emigration of young work force to urban areas. There is a need to conserve and pass down traditional lore in local communities.

Shannai (*A. macrospadiceus*) is a popular spice in Guizhou, Guangxi, and surrounding areas, where it is added to meat and fish dishes. It is a widely used every-day ingredient because of the way it enhances the flavor of food. During our field surveys, at least seven ethnic groups and some Han Chinese said they frequently collected *A. macrospadiceus* to use for cooking. The chemical and pharmacological properties of this species should be studied to increase understanding of its traditional applications.

## Conclusions

During a long-term study of *Acorus* over the past 12 years, we have collected a body of ethnobotanical information on *Acorus* in China. We found that Chinese people from 29 linguistic groups have a long tradition of using four *Acorus* species, namely *A. calamus*, *A. tatarinowii*, *A. gramineus*, and *A. macrospadiceus*. They have utilized *Acorus* for medicinal, nutritive, cultural, ornamental, and ecological purposes. This study reveals that Southwestern China, where different linguistic groups have a rich trove of knowledge about all *Acorus* species, is the knowledge center for *Acorus*. Recognition, cultivation, trading, and application of *Acorus macrospadiceus* in Guizhou and its surrounding areas indicates the local people's wisdom. Further phytochemical and pharmacological studies on *A. macrospadiceus* will be essential for resource management and sustainable use. Results from our study also show that transmission of knowledge about *Acorus* between generations is now much reduced, although all linguistic groups are still treating *A. calamus* as a culturally symbolic plant during the Dragon Boat Festival. The young people in local communities know little about the medicinal uses of *Acorus*, which had been common knowledge for traditional healers and villagers for many centuries. Given China's accelerating economic development, the documentation and conservation of the traditional knowledge of plants such as *Acorus* are now urgent, especially in remote areas such as in southwest China's ethnic villages.

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