Aromatic lichen resources in Guizhou Province, China

Bo Liu, Yujing Liu, Jianqin Li, Ronghui Gu, Wujisiguleng, Ping Li and Feifei Li*

College of Life and Environmental Science, Minzu University of China, Beijing 100081, China

Abstract

Based on field investigation and review, seven species of lichen were selected as aromatic resources. They are *Ramalina calicaris var. japonica* Hue, *Ramalia commixta* Ach., *R. fastigiata* Ach., *R. minuscula* Nyl., *R. sinensis* Jatta., *Alectoria sulphata* Nyl., and *Parmelina cirrhata* Fr. Their scientific name, Chinese name, distribution, voucher specimens, ethnobotanical uses, and their natural-product chemical constituents distribution, potential deposits are described. Conclusion has been made that these species have great exploration and utilize value, while synthetic or semisynthetic ways are needed to protect the slow growing lichen resources.

Keywords: Aromatic lichens; Guizhou Province; potential resources; chemical constituents; protection

Introduction

So far, 2000-3000 species of aromatic plant resources have been discovered in the world, including lichens, mosses, ferns and higher plant [1], the abundant aromatic lichen resources have their unique value and have been used for a long history.

Lichens have been used as aromatic materials, which can trace to ancient Egypt, people in Sahara Desert collected *Parmelia andina* Müll. Arg. for tobacco flavors and fragrances at that time [2]. People in Europe use Oakmoss (*Evernia prunastri* (L.) Ach.) as a famous natural fragrance for its unique fragrant flavor ever since the 16th century. And lichens are used in many other Asian countries by ethnic groups [3,4].

As a result, the research of development and application of aromatic lichen, and the chemical constituents of its fragrant flavor have long been preserved in the world, the technique such as HPLC, GC/MS [5-7], UV spectroscopic [8], DFT analysis [9], TLC(thin-layer chromatography) [10] and so on are widely used for extracting chemical components from lichen species[11-13], people discovered lichen have a certain flavor and the persistence of its fragrance, and it can mix with many other kinds of fragrances to form many kinds of odor types.

China harbors a rich lichen flora. Many species from 8 genera of 4 families can be used for producing lichen perfumery products based on the preliminary chemical analysis and evaluation [14]. Now, “Chinese tree moss” from *Ramalina fastigata*, “Chinese oak moss No. 1” from *Evernia mesomorpha* and “Chinese oak moss No.2” from *Cetrariastrum nepalensis*, etc. have been exploited and utilized in perfumery [14]. Guizhou Province are chosen as research site, field investigation and ethnobotany survey were made, seven species have been collected and selected as potential aromatic resources, two are also eaten by the local minority people, the other two have medicinal value. The present paper summarized the results of the investigation and survey.

Materials and Methods

The study site

The study area is Guizhou Province, which lies in the southwest part of the People’s Republic of China. Its lichen flora is especially abundant due to its unique geographical location, completed topography, and climate diversity, it is estimated to have more than 70 species lichens in Guizhou [15].

Plant collections

The investigations were carried out in Guizhou Province between 2010 and 2012. The field study was preceded by a biographical study in which we established the list of lichen plants in the area. And then we went to Dasha River, Kuankuo River, Tree fern Nature Reserve, Xiliang Mountain, Yema Valley, Baili Rododenron Area, Qinglong Mountain, Yushu, Yabren Mountain, Doupeng Moutain, Fanjing Mountain, Xiliang Mountain, together 8 area and 14 spots.

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, focus group discussions and questionnaires) [16-18]. We ask local people for the local aromatic lichen species and other uses in the checklist we done before, and judge the candidate species by smelling the flavor.

Specimens were examined and identified by the authors and other taxonomists and will be deposited in the Herbarium of the Minzu University of China (Beijing).

Results

In the paper we present these seven species from three genera and two families as aromatic resources Table 1.

Discussion

Traditional collections of these aromatic lichens are done by villagers of various ethnic groups such as Yi, Miao, Shui and other ethnic groups for many uses including fragrant flavor, fodder, tobacco flavors, wild edible plant and medicine (Table 2).

Lichens widely used in biomonitoring studies of air pollution, either as bioindicators of air quality or as bioaccumulators of atmospheric deposition [22,23]. All seven selected species grow on tree trunks and branches at high altitude and have a huge biomass amount; they only grow well where there is no pollution, as a result, accompanied

*Corresponding author: Feifei Li, College of Life and Environmental Science, Minzu University of China, Beijing 100081, China, Tel: +86-10-68936070; E-mail: lifefei30761@gmail.com

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Especially for virensic acid and salazinic acid, they are active against Gram-positive, acid-fast, and fungal microorganisms. New uses of lichen resources. An awareness of protecting lichen’s habitat in the forest for sustainable development of aromatic lichens for self-use or commercial; they have developed their traditional management of lichen resources. They get with the long history use of lichen by ethnic groups, local people also examined the chemical constituents of aromatic lichens to have activity against HIV-2 integrase and mammalian topoisomerase I of less than 100 μM.

Table 1: List of investigated aromatic lichens in Guizhou.

<table>
<thead>
<tr>
<th>S/N</th>
<th>FAMILY</th>
<th>NAME OF PLANT</th>
<th>CHINESE NAME/PINYIN</th>
<th>DISTRIBUTION</th>
<th>VOCHER SPECIMENS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PARMELIACEAE</td>
<td>Alectoria sulcata Nyl.</td>
<td>青树发</td>
<td>China (Gansu, Shannxi, Sichuan, Yunnan, Taiwan); widely distributed all over the world</td>
<td>Doupeng Mountain, 1500m; Yusuhe, 1600m; Xiliang Mountain, 2800m; Shuicheng, 2100m.</td>
</tr>
<tr>
<td>2</td>
<td>PARMELIACEAE</td>
<td>Parmelina cirrhata Fr.</td>
<td>留香剂师</td>
<td>China (Gansu, Shannxi, Xizang, Yunnan, Zhejiang, Anhui, Taiwan); Japan, North Korea, India, South America.</td>
<td>Leigong Mountain, 2060m; Xiliang Mountain, 2800m; Doupeng Mountain, 1200m.</td>
</tr>
<tr>
<td>3</td>
<td>RAMALINACEAE</td>
<td>Ramalina calicaris var. japonica Hue</td>
<td>杯树发</td>
<td>Japan (This, Heilongjiang, Yunnan, Taiwan); Japan.</td>
<td>Doupeng Mountain, 1400m; Leigong Mountain, 1800m; Xiliang Mountain, 2750m; Shuicheng, 2100m.</td>
</tr>
<tr>
<td>4</td>
<td>RAMALINACEAE</td>
<td>Ramalia commixta Ach.</td>
<td>棕树花</td>
<td>China (Jiangsu, Zhejiang); Japan.</td>
<td>Xiliang Mountain, 2800m; Kuankuoshui, 1500m.</td>
</tr>
<tr>
<td>5</td>
<td>RAMALINACEAE</td>
<td>Ramalina fastigiata Ach.</td>
<td>从生树发/queue sheng shu hua</td>
<td>China (Hunan, Shandong, Shannxi, Yunnan); also in other countries in Asia, Europe and North America.</td>
<td>Doupeng Mountain, 1561m; Leigong Mountain, 1600m.</td>
</tr>
<tr>
<td>6</td>
<td>RAMALINACEAE</td>
<td>Ramalina minuscula Nyl.</td>
<td>裂树花</td>
<td>China (Shanshi, Shandong, Zhejiang, Xianji, Xiangjiang, Taiwan); widely distributed in North Hemisphere.</td>
<td>Leigong Mountain, 1800m; Shuicheng, 2100m.</td>
</tr>
<tr>
<td>7</td>
<td>RAMALINACEAE</td>
<td>Ramalina sinensis Jatta.</td>
<td>留条梅</td>
<td>China (Shanshi, Shandong, Zhejiang, Xianji, Xiangjiang, Taiwan); widely distributed in North Hemisphere.</td>
<td>Leigong Mountain, 1800m; Shuicheng, 2100m.</td>
</tr>
</tbody>
</table>

Table 2: Chemical constituents and ethnic uses of aromatic lichens in Guizhou.

<table>
<thead>
<tr>
<th>S/N</th>
<th>FAMILY</th>
<th>NAME OF PLANT</th>
<th>VIRENSIC ACID</th>
<th>ETHYL HAEMATOMATE</th>
<th>RHIZONIC ACID</th>
<th>CHEMICAL CONSTITUENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PARMELIACEAE</td>
<td>Alectoria sulcata Nyl.</td>
<td>(10-formyl-3,9-dihydroxy-1,4,7-trimethyl-6-oxobenzofuran[1,4]benzodioxepin-2-carboxylic acid)</td>
<td>Ethyl haematomatic acid</td>
<td>(ethyl-2-furan-2-carbonyl)-3-oxobutanoate</td>
<td>(C10H12O4)</td>
</tr>
<tr>
<td>2</td>
<td>PARMELIACEAE</td>
<td>Parmelina cirrhata Fr.</td>
<td>(1,3-dihydro-4-methoxy-carbonyl-2,5-dimethylphenol)-3-formyl-2,4-dihydroxy-6-methylbenzoic acid</td>
<td>Salazinic acid</td>
<td>(1,3-dihydro-1,4,10-trihydroxy-5-(hydroxy)methyl)-8-methyl-3,7-dioxy-7H-isobenzofuro[4,5-b] [1,4] benzodioxepin-11-carbaldehyde</td>
<td>(C9H13O5)</td>
</tr>
<tr>
<td>3</td>
<td>RAMALINACEAE</td>
<td>Ramalina calicaris var. japonica Hue</td>
<td>(1,3-dihydro-1,4,10-trihydroxy-5-(hydroxy)methyl)-8-methyl-3,7-dioxy-7H-isobenzofuro[4,5-b] [1,4] benzodioxepin-11-carbaldehyde</td>
<td>Sekikaic acid</td>
<td>(2-[(3,4-dihydroxyphenyl)carboxyloxy]-4,6-dihydroxybenzoic acid)</td>
<td>(C18H16O7)</td>
</tr>
<tr>
<td>4</td>
<td>RAMALINACEAE</td>
<td>Ramalia commixta Ach.</td>
<td>Diamicatic acid</td>
<td>Usnic acid</td>
<td>(2,6-Diacetyl-7,9-dihydroxy-8,9b-dimethyldibenzo[b,d]furan-1,3(2H,9bH)-dione)</td>
<td>(C16H16O7)</td>
</tr>
<tr>
<td>5</td>
<td>RAMALINACEAE</td>
<td>Ramalina fastigiata Ach.</td>
<td>Usnic acid</td>
<td>Usnic acid</td>
<td>(2,6-Diacetyl-7,9-dihydroxy-8,9b-dimethyldibenzo[b,d]furan-1,3(2H,9bH)-dione)</td>
<td>(C16H16O7)</td>
</tr>
<tr>
<td>6</td>
<td>RAMALINACEAE</td>
<td>Ramalina minuscula Nyl.</td>
<td>Usnic acid</td>
<td>Usnic acid</td>
<td>(2,6-Diacetyl-7,9-dihydroxy-8,9b-dimethyldibenzo[b,d]furan-1,3(2H,9bH)-dione)</td>
<td>(C16H16O7)</td>
</tr>
<tr>
<td>7</td>
<td>RAMALINACEAE</td>
<td>Ramalina sinensis Jatta.</td>
<td>Usnic acid</td>
<td>Usnic acid</td>
<td>(2,6-Diacetyl-7,9-dihydroxy-8,9b-dimethyldibenzo[b,d]furan-1,3(2H,9bH)-dione)</td>
<td>(C16H16O7)</td>
</tr>
</tbody>
</table>
It is estimated the potential resources are about 30,000 tons in Guizhou Province [27], consequently, they have great potentials for making raw aromatic materials and they can easily be put under mass production. With the Chinese government's environment protection policy, the biomass will increase accompanied with the restoration of forest vegetation. But the lichens are known to have a long lifespan and grow very slowly, if they are over-collected, the resources are really difficult to recover in the local environment and the ecological balance will be severely destroyed.

In future days, synthetic or semisynthetic ways are needed to exploit so as to protect the slow growing lichen resources.

References