Investigation of China’s Yunnan pharmaceutical industry derived from two ethnomedicines, Yi medicine and Dai medicine

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Abstract

Background: Yunnan Province is a multi-ethnic area located in the southwest of China, and she also is rich in Chinese materia medica resources, known as the ‘kingdom of plants’. There is abundant of ethnomedicine resources in Yunnan province and many ethnic minorities inherit and retain numerous knowledge of traditional medicine. The biomedicine and big health industry have been the pillar industry of Yunnan since 2016, which is the important pharmaceutical industrial base for Dai Medicine and Yi Medicine in China, for example Yunnan Baiyao with “amazing efficacy” and originating from a Yi medical formula. Yi medicine and Dai medicine of Yunnan Province were investigated in this work focusing on the basic information of Dai patent medicine (DPM) and Yi patent medicine (YPM), including the clinical indications, herbal resources and their sources of traditional knowledge. Methods: The data and information were collected from the published literatures and some public service websites, and the data base of DPM and YPM was established including the information about manufacturer, approval number, clinical indication, prescription composition, dosage form of drug, etc. We investigated the references and literatures including the publicly available pharmaceutical instructions ensuring the authenticity and reliability of the investigation. Results: The results showed that there were 28 varieties of DPMs and 73 varieties of YPMs approved to use in clinical according to the drug regulatory laws of China. In the DPMs and YPMs, about 109 and 197 herbal medicines are recorded in China Pharmacopoeia, 18 and 52 herbs are recorded in Standards for Chinese medicinal materials in Yunnan Province respectively. Nearly 20 herbs have not any quality standard. Among these herbal medicines, there are 10 herbs considered as Dai Medicine and 30 herbs as Yi Medicine. In order to produce these DPMs and YPMs, about 16 animal medicines and 17 rare and endangered medicinal materials would be collected and used. Conclusions: The investigation would provide a more detailed report on Yunnan ethnic medicine industry, and it should be believed reasonably that the ethnomedicine of Yunnan Province will give more choices for human health through scientific experiments and dealing with the sustainable utilization of medicine resources.

Methods

Data sources

This study focused on the development status of ethnic pharmaceutical industry, especially Yi Medicine and Dai Medicine in Yunnan Province. The review work was dependent on the published literatures (Table 1) and some medical information from public service websites (Table 2). These contents were of interest to us, which include: (1) quantities of CPM from Yi Medicine and Dai Medicine produced by pharmaceutical companies in Yunnan Province; (2) the disease types that these CPM could be used to prevent or treat; (3) the pharmaceutical dosage forms characteristics. (4) The quality standard of medicinal
materials used in DPM and YPM; (5) the utilization of toxic herbal medicine and the rare and endangered herbal medicine in Yunnan ethnic pharmaceutical industry.

| Name of work                                                  | Contributors                | Publisher                                      | Publication Year | lang.     |
|---------------------------------------------------------------|----------------------------|-----------------------------------------------|------------------|-----------|
| Pharmacopoeia of the People’s Republic of China(Chinese Pharmacopoeia) | Chinese Pharmacopoeia Commission | The Medicine Science and Technology Press of China | 2015             | CHS\EN    |
| Ethnic medicine Formula preparation of China                  | Song Minxian               | People’s Medical Publishing House             | 2014             | CHS       |
| Standards for Chinese medicinal materials in Yunnan Province(SYNP) | Yunnan Medical Products Administration | Yunnan Science and Technology Press | 2005             | CHS       |

| Website Name                                                  | Website                     | Site category                                  |
|---------------------------------------------------------------|-----------------------------|------------------------------------------------|
| State Administration of Traditional Chinese Medicine of China | http://www.satcm.gov.cn    | Government Information Portal                   |
| National Medical Products Administration of China             | http://www.nmpa.gov.cn     | Government Information Portal                   |
| Endangered Species Scientific Commission,F.R.C               | http://www.cites.org.cn     | Scientific research institution of China performing for Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| Yaozh Network                                                | https://db.yaozh.com        | Medical Technology Information Service Platform in China |
| China wild plant conservation association                     | https://www.wpca.org.cn     | Associations Information Portal                 |
| Subject Database of China Plant                               | http://www.plant.csdb.cn/   | Plant Information Service Platform in China     |
| Information System of Chinese Rare and Endangered Plants     | http://www.iplant.cn       | Rare and Endangered Plant Information Service Platform in China |

Investigation

In order to achieve these objectives, these methods were accepted and used as follows: (1) The data base of DPM and YPM was established including the information about manufacturer, approval number, clinical indication, prescription composition, dosage form of drug, etc. (2) Drug information in this review was investigated and evidenced depending on various of references and literatures, including the publicly available pharmaceutical instructions. (3) The important medical information was approached with computer automatic recognition and matching, as well as manual reexamination.

Results

Surveys and Statistics on the varieties and clinical indications of DPM and YPM in Yunnan Province

The CPMs were surveyed and counted, on the basis of ethnic medicine formula preparation of China or the pharmaceutical instructions in which their properties of ethnic medicine were claimed. The results showed that there were 28 varieties of DPMs(Table 3)and 73 varieties of YPMs:Table 4, which could be approved to use in clinical according to the drug regulatory laws of China. In the DPMs, 15 varieties of prescriptions such as Biao Re Qing Granular, Guan Tong Shu Oral liquid, Hui Xue Sheng Capsule, have been approved as the over-the-counter drugs (OTC), accounting for 53.57% of the total DPMs, while in the YPMs, 28 varieties of prescriptions such as Bai Bei Yi Fei Capsule, Chang Shu Zhi Xie Capsule, Dan E Fu Kang Ointment, have be approved as OTC drugs, accounting for 37.83% of the total YPMs. In the statistics of clinical indications of these EPMs, it is found that the DPMs and YPMs are used to treat respiratory diseases, cardiovascular diseases, mental and neurological diseases etc (Figure 1). For example, Dan Deng Tong Nao Capsule (DDTN), in which ERIGERONTIS HERBA (Erigeron breviscapus (Vaniot)Hand.-Mazz, Dengzhanxixin) is as one of constituent and recorded in the pattra-leaf scripture of Dai Traditional Medicine for 2500 years, is reported that combined with rehabilitation training, it effectively improve the recovery level of neurological function and improve the life quality of stroke patients with cerebral infarction [9]. And DDTN could prevent cerebral injury of MCAO rats via decreasing the intracellular Ca\[^{2+}\] concentration, and inhibiting the release of excitatory amino acids [10].
| No. | Drug Name               | Chinese Name          | Approval Number | Clinical Indications                               | Dosage form |
|-----|-------------------------|-----------------------|-----------------|----------------------------------------------------|-------------|
| 1   | Biao Re Qing Granular (BRQG) | Z20026794             |                 | Infection of the upper respiratory tract          | Granular    |
| 2   | Dan Lv Bu Shen Capsule (DLBSC) | Z20025620             |                 | Impotence and seminal emission                     | Capsule     |
| 3   | Guan Tong Shu Oral liquid (GTSL) | Z20025408             |                 | Joint pain and lumbar muscle strain                | Oral liquid |
| 4   | Hui Xin Kang Tablet (HXKT)   | Z20026037             |                 | Coronary disease and hypertension                  | Tablet      |
| 5   | Hui Xue Sheng Capsule (HXSC)   | Z20025066             |                 | Anemia                                             | Capsule     |
| 6   | San Yang Xue Dai Oral liquid (SYXDL) | Z20025065             |                 | Anemia and leucopenia causing by tumor chemotherapy| Oral liquid |
| 7   | Lu Xian Bu Shen Tablet (LXBST) | Z20027604             |                 | Impotence and weakness of waist and knee           | Tablet      |
| 8   | 7-Jie Du Huo Xue Ointment (7-JDHXO) | Z20026244             |                 | Soft tissue injury and mild scald                  | Ointment    |
| 9   | Xiao Jie An Capsule (XJAC)   | Z20025617             |                 | Mamphophilia, ovarian cyst and uterine leiomyoma  | Capsule     |
| 10  | Run Yi Rong Capsule (RYRC)   | Z20027531             |                 | Acne                                               | Capsule     |
| 11  | Shanzha Neijin Oral liquid (SNL) | Z20027821             |                 | Infantile malnutrition and indigestion            | Oral liquid |
| 12  | Shen Bei Zhi Ke Granular (SBZKG) | Z20026126             |                 | Chronic bronchitis                                 | Granular    |
| 13  | Shen Cha Teabag (SCT)       | Z20026660             |                 | Urinary tract infection                            | Teabag      |
| 14  | Shu Xin Tong Mai Capsule (SXTMC) | Z20025429             |                 | Coronary disease and angina pectoris              | Capsule     |
| 15  | Shuang Jiang Wei Tong Pills (SJWTP) | Z20026657             |                 | Chronic superficial gastritis                       | Pills       |
| 16  | Xuan Ju Capsule (XJC)        | Z20026658             |                 | Lumbar and knee pain                               | Capsule     |
| 17  | Xue Niao An Capsule (XNAC)   | Z20026104             |                 | Urinary tract infection                            | Capsule     |
| 18  | YaGei Tablet (YGT)          | Z20025088             |                 | Gastric injury by alcohol and overeating           | Tablet      |
| 19  | Ye Xia Zhu Tablet (YXZT)     | Z20026219             |                 | Chronic hepatitis B and jaundice                   | Tablet      |
| 20  | Ye Xia Zhu Capsule (YXZC)    | Z20027597             |                 | Chronic hepatitis B and jaundice                   | Capsule     |
| 21  | Yi Kang Bu Yuan Granular (YKBYG) | Z20026434             |                 | Insomnia and amnesia                               | Granular    |
| 22  | Yi Shen Jian Gu Tablet (YSJGT) | Z20027061             |                 | Chronic limb pain                                 | Tablet      |
| 23  | Yin Qing Capsule (YQC)       | Z20025199             |                 | Infection of the upper respiratory tract           | Capsule     |
| 24  | Zhuzi Gan Tai Capsule (ZGTC) | Z20026111             |                 | Chronic hepatitis B                                | Capsule     |
| 25  | Xiao Jie An Oral liquid (XJAL) | Z20025884             |                 | Mamphophilia, ovarian cyst and uterine leiomyoma  | Oral liquid |
| 26  | Huzhang Fanshi Liniment (HFL) | Z20025342             |                 | Skin burns and scalds                              | Liniment    |
| 27  | Ya Jiao Ha Dun Powder (YJHDP) | Z53021363             |                 | Irregular menstruation and postpartum bleeding in women | Powder |
| 28  | Ru Bi Qing Capsule (RBQC)    | Z20025068             |                 | Mammary gland hyperplasia and menstrual breast pain | Capsule     |
| No | Drug Name                          | Chinese Name                  | Approval Number | Clinical Indications                                      | Dosage form |
|----|-----------------------------------|------------------------------|-----------------|-----------------------------------------------------------|-------------|
| 1  | Bai Bei Yi Fei Capsule (BBYFC)    | 麻黄清肺胶囊                  | Z20025124       | Bronchitis and cough                                      | Capsule     |
| 2  | Chang Shu Tablet (CST)            | 大黄散                       | Z20025848       | Acute enteritis and dysentery                             | Tablet      |
| 3  | Chang Shu Zhi Xie Capsule (CSXZC) | 大黄泻五理散                  | Z20025064       | Chronic diarrhea                                          | Capsule     |
| 4  | Chang Wei Shu Capsule (CWSC)      | 大黄泻五理散                  | Z20026659       | Loss of appetite and abdominal pain                       | Capsule     |
| 5  | Chuan Luo Tong Capsule (CLTC)     | 阔络通胶囊                    | Z20025126       | Bronchial asthma and emphysema                            | Capsule     |
| 6  | Shu Lie An Capsule (SLAC)         | 舒理安胶囊                    | Z20025167       | Chronic prostatitis                                      | Capsule     |
| 7  | Dan E Dong Nao Capsule (DDTNC)    | 丹参益脑胶囊                  | Z20026053       | Ischemic stroke                                           | Capsule     |
| 8  | Dan E Fu Kang Ointment (DEFKO)    | 丹参益脑胶囊                  | Z20025253       | Female irregular menstruation, dysmenorrhea, menstrual discomfort, and pelvic endometriosis | Ointment    |
| 9  | Danshen Yi Xin Capsule (DYXC)     | 大黄泻五理散                  | Z20026028       | Coronary disease and angina pectoris                      | Capsule     |
| 10 | Dan Wei Kang Capsule (DWKC)       | 丹参益脑胶囊                  | Z20025134       | Jaundice, Bile Reflux Gastritis and Cholecystitis         | Capsule     |
| 11 | Deng Yin Nao Tong Capsule (DYNTC) | 胆益脑胶囊                    | Z20026228       | Cerebral ischemia                                         | Capsule     |
| 12 | E Qiu Qi Capsule (EQQC)           | 鳖血胶囊                      | Z20025685       | Diarrhea                                                  | Capsule     |
| 13 | Fan Teng Zhi Injection (FTZI)      | 胆益脑胶囊                    | Z20026309       | Hemoorrhoids                                              | Injection   |
| 14 | Fu Fang Dahongpao Zhi Xue Capsule (FFDZXC) | 丹参益脑胶囊                  | Z20025483       | Various hemorrhagic diseases, such as functional uterine bleeding, bleeding after induced abortion, epistaxis, gastric bleeding and hemorrhoids bleeding | Capsule     |
| 15 | Fu Fang Luxiancao Granular (FFLG) | 丹参益脑胶囊                  | Z20025653       | Primary hepatocellular carcinoma                         | Granular    |
| 16 | Fu Fang Qinghao Spray (FFQS)      | 丹参益脑胶囊                  | Z20025887       | Hemoorrhoids                                              | Spray       |
| 17 | Fu Yi Shen Alcohol (FYSA)         | 丹参益脑胶囊                  | Z20026007       | Insomnia                                                  | Vinum       |
| 18 | Gan Dan Qing Capsule (GDQC)       | 胆益脑胶囊                    | Z20025161       | Cholecystitis and cholelithias                            | Capsule     |
| 19 | Gu Feng Ning Capsule (GFNC)       | 胆益脑胶囊                    | Z20026229       | Rheumatoid arthritis and Ankylosing spondylitis           | Capsule     |
| 20 | He Wei Zhi Tong Capsule (HWZTC)   | 海 Shia Tong胶囊                | B20020328       | Acute and chronic gastroenteritis, gastric and duodenal ulcers, chronic colitis | Capsule     |
| 21 | Wen Zhong He Wei Capsule (WZHC)   | 海 Shia Tong胶囊                | Z20025689       | Chronic gastritis and duodenal ulcer                      | Capsule     |
| 22 | Huzhang Shang Tong Tincture (HSTT) | 海 Shia Tong胶囊                | Z20025395       | Pain and swelling due to external injury                  | Tincture    |
| 23 | Hu Zhang Ye Capsule (HZYC)        | 海 Shia Tong胶囊                | Z20026314       | Dizziness, dizziness and headache caused by hypertension  | Capsule     |
| 24 | Huoxiang Wan Ying Powder (HWYP)   | 海 Shia Tong胶囊                | Z20025180       | Gastrointestinal cold                                     | Powder      |
| 25 | Jiang Zhi Tong Mai Capsule (JZTC) | 海 Shia Tong胶囊                | Z20026429       | Hyperlipidemia                                            | Capsule     |
| 26 | Kang Shen Granular (KSG)          | 黑山颗粒                      | Z20025358       | Uremia                                                    | Granular    |
| 27 | Ke Tan Oral liquid (KTL)          | 黑山颗粒                      | Z20025740       | Bronchitis or upper respiratory tract infection appearing cough and phlegm | Oral liquid |
| 28 | Li Dan Jie Du Capsule (LDJDC)     | 黑山颗粒                      | Z20025384       | Cholecystitis                                             | Capsule     |
| 29 | Lingdiancao Oral liquid (LL)      | 黑山颗粒                      | Z20026041       | Acute pharyngitis, tonsillitis and upper respiratory tract infection | Oral liquid |
| 30 | Long Jing Tong Lin Capsule (LJTL) | 黑山颗粒                      | Z20025499       | Prostatitis, prostatic hyperplasia                        | Capsule     |
| 31 | Lushuicao Capsule (LC)            | 黑山颗粒                      | Z20027532       | Type 2 diabetes                                           | Capsule     |
| 32 | Liyi Ke Chuan Granular (LKCG)     | 黑山颗粒                      | Z20025849       | Cough, night sweat                                        | Granular    |
| 33 | Mitonghua Granular (MG)           | 黑山颗粒                      | Z20027607       | Acute and chronic hepatitis                               | Granular    |
| 34 | Niao Lu Kang Granular (NLKG)      | 黑山颗粒                      | Z20027534       | non-gonococcal urethritis                                | Granular    |
| 35 | Niao Qing Shu Granular (NQSG)     | 黑山颗粒                      | Z20026440       | chronic prostatitis                                      | Granular    |
| 36 | Ping Xuan Capsule (PXG)           | 黑山颗粒                      | Z20025826       | Somnipathy, dizziness, and palpitation                    | Capsule     |
| 37 | Qiancao Nao Tong Oral liquid (QNTL) | 黑山颗粒                      | Z20025214       | Cerebral ischemia                                         | Oral liquid |
| No | Drug Name                                      | Chinese Name | Approval Number | Clinical Indications                     | Dosage form |
|----|-----------------------------------------------|--------------|----------------|------------------------------------------|-------------|
| 38 | Qing Chang Tong Bian Capsule (QCTBC)          |              | Z20025654      | Constipation                             | Capsule     |
| 39 | Rong Shuan Nao Tong Capsule (RSNTC)           |              | Z20025006      | Cerebral ischemia                        | Capsule     |
| 40 | She Chang Zhi Xie Powder (SCZXP)              |              | Z20025892      | Diarrhea                                 | Powder      |
| 41 | Sha Mei Xiao Ke Capsule (SMXKC)               |              | Z20025120      | Type 2 diabetes                          | Capsule     |
| 42 | Shang Yi Aerosol (SYA)                       |              | Z20026238      | Skin scald and injury                    | Aerosol     |
| 43 | Shen An Capsule (SAC)                        |              | Z20025529      | Lower urinary tract infection            | Capsule     |
| 44 | Shen Qi Xin Shu Capsule (SQXSC)               |              | Z20025482      | Coronary disease and angina pectoris     | Capsule     |
| 45 | Shijiaocao Ke Chuan Granular (SKCG)           |              | Z20025635      | Chronic bronchitis                       | Granular    |
| 46 | Shu Mi Tong Capsule (SMTC)                   |              | Z20054802      | Hyperplasia of the prostate              | Capsule     |
| 47 | Shu Wei Yao Alcohol (SWYA)                   |              | Z20025389      | Indigestion                              | Vinum       |
| 48 | Tianhusui Yu Gan Tablet (TYGT)               |              | Z20025236      | Acute and chronic hepatitis              | Tablet      |
| 49 | Tian Xiang Tincture (TXT)                    |              | Z20025711      | Soft tissue sprain and joint pain        | Tincture    |
| 50 | Tian Jing Yang Yan Capsule (TJYYC)            |              | Z20025599      | Irregular menses and Dark skin in women  | Capsule     |
| 51 | Tong Shu Capsule (TSC)                       |              | Z20025478      | Traumatic pain and rheumatoid arthritis  | Capsule     |
| 52 | Tong Shu Kou Shuang Capsule (TSKSC)           |              | Z20026241      | Constipation, gum swelling and pain      | Capsule     |
| 53 | Wei Fu Shu Capsule (WFSC)                    |              | Z20025893      | Chronic superficial gastritis            | Capsule     |
| 54 | Wen Ya Capsule (WYC)                         |              | Z20025645      | Hypertension                             | Capsule     |
| 55 | Wujin Huo Xue Zhi Tong Capsule (WHXZTC)       |              | Z20025249      | Various of pains, including limb pain,   | Capsule     |
|    |                                               |              |                | rheumatic arthralgia and cancer pain     | Capsule     |
| 56 | Xiang Teng Capsule (XTC)                     |              | Z20025211      | Limb pain and rheumatic arthralgia       | Capsule     |
| 57 | Yanhui Wei An Capsule (YWAC)                 |              | Z20026112      | Vomiting, stomachache, indigestion       | Capsule     |
| 58 | Yan Lu Ru Kang Capsule (YLRKC)               |              | Z20025379      | Cyclomastopathy                          | Capsule     |
| 59 | Yan Shu Oral liquid (YSL)                    |              | Z20025601      | Acute and chronic pharyngitis and tonsillitis | Oral liquid |
| 60 | Yi Xin Kang Capsule (YXKC)                   |              | Z20025345      | Coronary diseases, ischemic cerebrovascular disease | Capsule |
| 61 | Yu Mai Kou Yan Oral liquid (YMKYL)            |              | Z20025158      | Mouth ulcer                              | Oral liquid |
| 62 | Yun Wei Ning Capsule (YWNC)                  |              | Z20026811      | Gastric and duodenal ulcers, Chronic gastritis and gastric spasm pain | Capsule |
| 63 | Zhi Xuan An Shen Granular (ZXASG)            |              | Z20027533      | Vertigo, tinnitus, insomnia, palpitation | Granular    |
| 64 | Zhong Tong Liniment (ZTL)                    |              | Z20026008      | Vertigo, tinnitus, insomnia, palpitation, shoulder periartthritis, gout arthritis, breast lobular hyperplasia | Liniment |
| 65 | Zidan Huo Xue Tablet (ZHXT)                  |              | Z20025190      | Coronary heart disease, angina pectoris and cerebral arteriosclerosis | Tablet |
| 66 | Zi Deng Capsule (ZDC)                        |              | Z20025593      | Neck and shoulder pain caused by cervical spondylosis | Capsule |
| 67 | Zi Jiao Xuan Tincture (ZJXT)                 |              | Z20025684      | Tinea manus                              | Tincture |
| 68 | Fu Fang Luxiancao Capsule (FFLC)             |              | Z20110028      | Primary hepatocellular carcinoma         | Capsule     |
| 69 | Hong Jin Xiao Jie Pill (HJXJP)               |              | Z20080315      | Female breast hyperplasia, uterine leiomyoma, ovarian cyst | Pill |
| 70 | Hong Jin Xiao Jie Capsule (HJXJC)            |              | Z20026032      | Female breast hyperplasia, uterine leiomyoma, ovarian cyst | Capsule |
| 71 | Shu Lie An Capsule (SLAC)                    |              | Z20025167      | Chronic prostatitis                       | Capsule     |
| 72 | Wu Jin Huo Xue Zhi Tong Tablet (WJHXZTT)      |              | Z20090688      | Various of pains, including limb pain, rheumatic arthralgia and cancer pain | Tablet |
| No | Drug Name               | Chinese Name | Approval Number | Clinical Indications                                      | Dosage form |
|----|-------------------------|--------------|-----------------|-----------------------------------------------------------|-------------|
| 73 | Jin Wei Tai Capsule (JWTC) |              | Z20026039       | Acute and chronic gastroenteritis, gastric and duodenal ulcers, chronic colitis | Capsule     |

In this review, we also counted and analyzed the information of pharmaceutical enterprises which have the right to produce these EPMs legally in China. According to our statistics, these EPMs are produced by 39 enterprises, including 2 corporations outside Yunnan province. Some of these companies have to be mentioned. Yunnan Baiyao Group Co.LTD, which is famous for producing Yunnan Baiyao (Baibaodan) invented by Qu Huanzhang (A.D.1880–1938), has the abilities to produce more than 300 varieties and 19 dosage forms of drugs. Shu Lie An Capsule, Qiancao Nao Tong Oral liquid, Gu Feng Ning Capsule, Shang Yi Aerosol, Tong Shu Capsule and Zhong Tong Liniment are manufactured by Yunnan Baiyao Group Co.LTD. Another company should be mentioned is Dihon Pharmaceutical Co. Ltd which was purchased by Bayer in 2014, a famous multinational pharmaceutical enterprise group coming from Germany and that was considered as the hallmark event for Bayer to enter the field of traditional Chinese medicine. Dan E Fu Kang Ointment, Gan Dan Qing Capsule, Yu Mai Kou Yan liquid and Wei Fu Shu Capsule are produced by Dihon. Furthermore the dosage forms used in DPMs and YPMs were counted out (Fig. 2) and it could be found that the capsule, tablet and oral liquid are the main dosage forms in these prescriptions under investigation.

Surveys and Statistics on the compositions and their standardization of DPMs and YPMs in Yunnan Province

In China, quality standards of ethnic medicines and their prescriptions are on the basis of the national standards including Chinese Pharmacopoeia (ChP), which collected ethnic medicine beginning since 1977, and the provincial standards relating to Tibet Autonomous Region, the Xinjiang Uygur Autonomous Region, the NeiMongol Autonomous Region, the Guangxi Zhuang Autonomous Region, Qinghai, Sichuan, Yunnan, and Guizhou Provinces. Besides, the academy group standards and enterprise standards also play the role in quality standards of ethnic medicines. In this study, it was found that in the total 28 DPMs, quality standards of 109 herbal medicines come from Chinese pharmacopoeia; quality standards of 27 herbal medicines are collected in Standards for Chinese medicinal materials of Yunnan Province (SYNP) or other provincial herbal quality standard. (Fig. 3) There are 5 herbal medicines including Tuoshu Gen, Dabaijie, Zhuyelan, Mahan, Xiaobaibu and leaf & stem of Vitex trifolia, whose quality standards have not be built. In the total 73 YPMs, 183 herbal medicines have been collected in Chinese pharmacopoeia and 73 herbal medicines are used with SYNP or other provincial herbal quality standard. Otherwise, 16 herbal medicines have no quality standard, which include Gugongguo Gen, Zidiyu, Dahuangteng, Damayao, Zhou YeXiangru, DianCaowu, Lushuicao, Xiaolvji, Yudaicao, Shashen, Daotihu Wanzhangsheng, Yunxiangcao, Ziheche and the extract of Xuedan etc.

In the frequency statistics of herbal medicines used in these prescriptions, the total frequency and frequency in DPMs and YPMs were calculated out (Fig. 4). Besides GLYCICRHIZAE RADIX ET RHIZOMA (Glycyrrhiza uralensis Fisch, Gancao), NOTOGINSENG RADIX ET RHIZOMA (Panax notoginseng Burk.) F. H. Chen, Sanqi), ANGELICAE SINENSIS RADIX, Angelica sinensis Oliv. Diels, Danggu and ASTRAGALI RADIX (Astragalus membranaceus Fisch. Bge. Var. mongholicus Bge. Hsiao, Huangqi, which ranked ahead in this statistics, are considered as genuine medicinal materials of Yunnan province. Otherwise, these herbs used in DPMs and YPMs, which are collected and considered as Dai medicine or Yi medicine in SYNP, their information are listed in Table 5.
| No | Scientific Name                  | Pinyin Name | Chinese name       | Origin                              | MP        | EM  | Frequency | EPM                |
|----|---------------------------------|-------------|--------------------|-------------------------------------|-----------|-----|-----------|--------------------|
| 1  | CAULIS ET FOLIUM PLUMBAGINIS   | Baihuadan   |                     | Stem and leaf                       | Yi        | 1   |           | DLBSC              |
| 2  | CAULIS TODDALIAE               | Feilongzhangxue |                | Toddalia asiatica (L.) Lam.         | Stem      | Yi  | 1         | GTSL               |
| 3  | RADIX TRIPERTYGII HYPOGLAUCI   | Huobahuagen  |                    | Tripterygium hypoglaucum (Levl.)    | Root      | Yi  | 3         | GFNC,ZTL,GTSL      |
| 4  | HERBA INULAE CAPPAE            | Yang’erju   |                    | Inula cappa (Buch.-Ham. ) DC.       | Whole plant | Yi  | 2         | YGT,WZHWC          |
| 5  | HERBA GEI                      | Wuquhuanyangcao |            | Geum alepicum Thumb.var.chinese Bolle | Whole plant | Yi  | 3         | XTC,YXKC,RBQC      |
| 6  | HERBA RHODOBRYI GIGANTEI       | Huixincao   |                    | Rhodobryum giganteum (Hook.) Par.   | Whole plant | Yi  | 2         | HXKT,DYXC          |
| 7  | RHIZOMA POLYGONI PALEACEI      | Caoxuejie   |                    | Polygonum paleaceum Wall.ex Hook.   | Rhizome   | Yi  | 2         | CWSC,EQQC          |
| 8  | RADIX ET CAULIS POLYGALAE ARILLATAE | Jigen   |                | Polygala arillata Buch.Ham.ex D .Dom | Roots and rhizome | Yi  | 1         | CLTC               |
| 9  | RADIX SALVIAE YUNNANENSIS     | Zi Danshen  |                    | Salvia yunnanensis C.H.Wright       | Root      | Yi  | 6         | DEFKO,DYXC,GFNC,LJTLC,ZHXT,ZDC |
| 10 | RADIX AMPELOSIS DELAVAYANAE    | Yuputao gen |                    | Amoelopsis delavayana (Franch.) Planch. | Root      | Yi  | 3         | SYA,TSC,ZTL        |
| 11 | HERBA SWERTIAE PATENSIS       | Xiao’er futong cao |            | Swertia patens Burk.                | Whole plant | Yi  | 3         | XTC,WZHWC,LDJDC    |
| 12 | FOLIUM POLYGONI CUSPIDATI     | Huzhangye   |                    | Polygonum cuspidatum Sieb.et Zucc. | Leaf      | Yi  | 1         | HZYC               |
| 13 | HERBA CYNODONIS               | Qianxiancao  |                    | Cynodon dactylon (L.)Pets.          | Whole plant | Yi  | 1         | JZTMC              |
| 14 | RADIX POTENTILLAE FULGENTIS   | Guanzhong   |                    | Potentilla fulgens Wall.ex Hook.    | Root      | Yi  | 2         | HWZTC,JWTC         |
| 15 | HERBA AINSLIAEAE              | Yexiahua    |                    | Ainsliaea pertyoides Franch.var.albo- tomentosa Beauv. | Whole plant | Yi  | 1         | GFNC               |
| 16 | RADIX ET RHIZOMA VALERIANAE JATAMANSI | Matixiang |                | Valeriana jatamansi Jones           | Roots and rhizome | Yi  | 1         | QCTBC              |
| 17 | HERBA GAULThERIAE             | Tougucao    |                    | Speranskia tuberculata (Bunge) Baillon | Aerial part | Yi  | 3         | XTC,YXKC,LFKC      |
| 18 | RHIZOMA ARTHROMERIS MAIREIS   | Diwugong    |                    | Arthromeris mairei (Brause)Ching    | Rhizome   | Yi  | 1         | QCTBC              |
| 19 | CAULIS ET FOLIUM SCHEFFLERA VENULOSAE | Qiyelian |                  | Schefflera venulosa (Wight et Arn.) Harms | Whole plant, stem and leaf | Yi  | 3         | SYA,TSC,ZTL        |
| 20 | HERBA BOENNINGHAUSENIAE       | Shijiacao   |                    | Boenninghauensia sessilicarpa Lev . | Whole plant | Yi  | 2         | SAC,SKCG           |
| 21 | HERBA OXALIS CORNICULATAE    | Zajiacao    |                    | Oxalis comiculata Linn.             | Whole plant | Yi  | 1         | TYGT               |
| 22 | RADIX ANEMONES RIVULARIS      | Huzhangcao  |                    | Anemone rivularis Bunch.Ham.ex DC.  | Root      | Yi  | 2         | TYGT,YSL           |
| 23 | CAULIS OPUNTIAE              | Xianrencao  |                    | Opuntia stricta (Haw.) Haw.var.dillenii (KerGawl.) Benson. | Stem      | Yi  | 1         | SQXSC              |
| 24 | RHIZOMA DYSOSMATIS            | Bajiaolian   |                    | Dysosma versipellis (Hance)M.Cheng ex Ying | Rhizome | Yi  | 4         | ZTL,HJX,JC,WJH,ZTT, HJX,JP |
| 25 | CORTEX JATROPHAE             | Gaotong     |                    | Jatropha curcas L.                  | Root bark, stem bark | Yi  | 1         | WYC                |

Note: EPM: Ethnic patent medicines, MP: Medicinal parts, EM: Ethnic medicine
Because of the differences in geographical and climatic conditions, residents in various geographical regions in China have distinctive lifestyles, customs, and cultures, as well as the usage of medicinal resources. In general, botanical medicines are the most commonly used in traditional medicine. In this investigation, there are 361 botanical medicines, 22 animal medicines and 9 mineral medicines used in DPMs and YPMs (Fig. 5). It is an interesting discovery that the number of animal medicines in YPMs is more than that in DPMs. The Yi Nationality as excellent hunters with a long history, were adept in using animal medicines, which is proved with many ancient documents. In Yi Yi Nationality Offering Medicine Scriptures (Yi Zu Xian Yao Jing), written in the early Qing Dynasty of China, the ratio of animal medicines was up to 92.8%. And the animal medicines were divided into 12 types including the insects, meats, bones gallbladders, fats, bloods, fish gall bladders, and hairs etc. In another medical work named Book of Good medicines for treating diseases (Yi Bing Hao Yao Shu, AD:1737), the number of animal medicines reached 152, it accounted for 35.68% of the total number of Yi medicines[12].

Indeed, animals are therapeutic arsenals that have been playing significant roles in the healing processes, which are also known as zootherapy. Animal medicines have been elaborated from parts of the animal bodies, from products of their metabolism (corporal secretions and excrements), or from non-animal materials (nests or cocoons) [13]. Since the pertinence of traditional medicine based on animals cannot be denied, animal medicines used in CPM should be strengthened modern scientific research. The animal medicines in DPMs and YPMs were set out in Table 6.

| No | Scientific Name | Pinyin Name | Chinese name | Origin | MP | EM | Frequency | EPM |
|----|----------------|-------------|--------------|--------|----|----|-----------|-----|
| 26 | CAULIS FICI TIKUAE | Dibanteng | Ficus tikoua Bur. | Cane | Yi | 1 | TJJYC |
| 27 | CAULIS KADSURAE | Wuxiangxueteng | Kadsura longipedunculata Finet et Gagnep. | Cane | Yi | 3 | HJXJ,C,HJXJP, WJHXZTT |
| 28 | HERBA LEYCESTERIAE STENOSEPALAE | Dazuifeng | Leycesteria aponic Wall. var.stenosepala Rehd. | Aerial part | Yi | 1 | XTC |
| 29 | HERBA ANAPHALIS | Wuxiangcao | Anaphalis bulleyana (J.F.Jeffr.) Chang | Whole plant | Yi | 1 | YSL |
| 30 | FOLIUM CRABIODENDRONIS | Jinyezi | Craibiiodendron yunnanense W.W.Smith | Leaf | Yi | 1 | ZTL |
| 31 | HERBA PHYLLANTHUS URINARIAE | Yexiazhu | Phyllanthus urinaria L. | Aerial part | Dai | 2 | YXZT,YXZC |
| 32 | SEMEN BRASSIAE INTEGRIFOLIAE | Kuaizi | Brassica integrifolia (West)O.E.Schulz ex Urb. | Seed | Dai | 1 | SJWTP |
| 33 | RHIZOMA ZINGIBERIS PURPUREI | Zisejiang | Zingiber purpureum Rosc. | Rhizome | Dai | 1 | SJWTP |
| 34 | FORMICA NIGERIS | Weimayi | Polyrhachis dives Smith | Body | Da | 4 | FYSA,HJXJ,C,HJXJP, WJHXZTT |
| 35 | HERBA PHYLLANTHIS NIRURI | Zhuzicao | Phyllanthus niruri L | Whole plant | Dai | 1 | ZGTC |
| 36 | RHIZOMA TACCAE | Jiangenshu | Tacc a chantrieri Andre | Stem tuber | Dai | 2 | YGT,YJHDP |
| 37 | RADIX STEPHANIAE EPIGAEA | Diburong | Stephania epigaea H.S.Lo | Root tuber | Dai | 1 | SJWTP |
| 38 | RADIX STREPTOCALI | Tengkushen | Streptocaulon juventas (Lour.) Merr. | Root | Dai | 1 | YJHDP |
| 39 | RADIX ET RHIZOMA INULAE CAPPAE | Yanggerjogen | Inula cappa (Buch –Ham ) DC | Root | Dai | 1 | YJHDP |
| 40 | FRUCTUS BENINCASAE | Kudonggua | Benincasa hispida (Thunb.) Cogn. | Fruit | Dai | 1 | YJHDP |

Note: EPM: Ethnic patent medicines, MP: Medicinal parts, EM: Ethnic medicine

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Medicinal parts of botanical medicines used in DPMs and YPMs

The plant parts used in herbal therapy include seeds, berries, roots, leaves, fruits, barks, flowers, or even the whole plants. From ancient times to the present, people have been mainly dependent on crude botanical material for medical needs to retain vitality and cure diseases. In this work, we have analyzed the amount of medicinal parts of botanical medicines in DPMs and YPMs (Fig. 6). Statistically, the distribution rules of medicinal parts of botanical medicines in DPMs and YPMs showed similarity, and in the usage frequency of plant parts, Top 3 are Root and Rhizome, Fruit and seed and Whole plant respectively. The different medicinal parts are related to the traditional efficacy of herbal medicines, and on the other hand, the shapes of medicinal parts also are concerned with the nomenclature of some herbs. For example, Huangqin (Scutellariae Radix) is called as Rijishi in Yi language, in this name, Ri means it is a herbaceous plant, and Ji means root, the medicinal parts of Scutellaria baicalensis Georgi is called as Rijishi in Yi language, in this name, Ri means it is a herbaceous plant, and Ji means root, the medicinal parts of Scutellaria baicalensis Georgi is called as Rijishi in Yi language.

Surveys and Statistics on the rare and endangered medicinal materials in DPMs and YPMs in Yunnan Province

The rapidly increasing demand for Chinese patent drugs is likely to challenge herbal resources in China. Consequently, 80% of the most usually used species cannot meet medical demand. Data analysis showed that 1,800–2,100 medicinal species were facing the challenge of extinction in China. In the China Plant Red Data Book published in 1992, 388 species of plants are listed as threatened, which include 121 as endangered (i.e., first grade national protection), 110 as rare (second grade national protection), and 157 as vulnerable (third grade national protection). Among these plant species, 77 are typical herbal medicines that account for 19.86% of the total threatened species. Besides, 257 kinds of animal medicines appear in the national key protection name list of wild animals.

Table 6

Animal medicines used in DPMs and YPMs coming from SYNP

| Scientific Name | Pinyin Name | Chinese Name | Origin | MP | Standard | DPM | YPM |
|-----------------|-------------|--------------|--------|----|----------|-----|-----|
| CERVI CORNU PANTOTRICHUM* | Lurong | Cervus nip port Temminck | Antler | ChP | LXBST | - |
| CICADA PERIOSTRACUM Chantui | Chantui | Cryptotympana pustulata Fabricius | Slough | ChP | SNL, SBZKG | - |
| GALLI G IG ERII ENDOTHELIUM CORNEUM Jineijing | Jineijing | Gallus gallus domesticus Brisson | Gizzard | ChP | SNL | GDQC |
| FORMICA NIGERIS Heimayi | Heimayi | Polyrhachis dives Smith | Body | SYNP | XJC | FYS, HJXJC, WJHXZTT |
| GECKO Gejie | Gejie | Gekko gecko Linnaeus | Body | ChP | - | GFNC, RSNTC, WYC, CLTC |
| PHERETIMA* Dilong | Dilong | Pheretima aspergillum (E. Perrier) | Body | ChP | - | GFNC, RSNTC, WYC, CLTC |
| BUFONIS VENENUM* Chansu | Chansu | Bufo bufo gargarizans Cantor | Secretion | ChP | - | CLTC |
| ASPONGOPUS Jiuxiangchong | Jiuxiangchong | Asp pongopus chinensis Dallas | Body | ChP | - | FFLG, FFLC |
| - Xiongdanfen | Xiongdanfen | Selenaretos thibetanus Cuvier | Bile | SYNP | - | LJTLC |
| BOMBYX BATRYTICATUS Jiangchan | Jiangchan | Bombyx mori Linnaeus. | Body | ChP | - | SMXKC |
| PERIPLANETA AMERICANA Feilie | Feilie | Periplaneta aponicas Linnaeus. | Body | SYNP | - | SYA |
| SEPIAE ENDOCONCHA Haipiaoqiao | Haipiaoqiao | Sepiella maindronide Rochebrune | Shell | ChP | - | YWAC |
| MOSCHUS* Shexiang | Shexiang | Moschus berezovskii Er llov | Secretion | ChP | - | ZTL |
| ARMADILLIDIUM Shufuchong | Shufuchong | Armadillidium vulgare Latreille | Body | SSDP | - | HJXJPHJXJJC |
| CERVI CORNU DEGELATINATUM* Lujiaoshuang | Lujiaoshuang | Cervus nip port Temminck | Antler colloid | ChP | RBQC | YLRKC |
| CORDYCEPS Dongchongxiacao | Dongchongxiacao | Cordyceps sinensis (BerK.) Sacc. | Bacterial & insect complex | ChP | HSX, RBQC | RSNTC, WYC |

Note: EPM: Ethnic patent medicines, MP: Medicinal parts, ChP: Chinese Pharmacopoeia, SSDP: Standards for Chinese medicinal materials in Shandong Province (2012), * means the herb has more than 2 origins, and only 1 origin is showed in the table.
such as International Union for Conservation of Nature. This is the truth that CISTANCHES HERBA (Cistanche deserticola Y.C.Ma, Rouchongrong), GINSENG RADIX ET RHIZOMA (Panax ginseng C. A. Mey, Renshen), GLYCyrRHIZAE RADIX ET RHIZOMA (Glycyrrhiza aponic Bat, Gancao/or other rare medicinal materials listed in the catalogues are protected and utilized sustainably in China. But in fact, the number of ethnic specific herbal medicines in danger is far bigger than that recorded in the catalogues. As a example with RHIZOMA RODGERSIAE (Rodgersia sambucifolia Hemsl.or Rodgersia pinnata Franch., Yantu which is the raw material for YPM depending on mining wild resources, the quantity of excavation exceeds 3000 tons per year, and the wild resources of Rodgersia plants are reduced sharply and resources are damaged severely in Luquan, Yongsheng, Yulong, Heqing and Ninglang of Yunnan province[19]. In light of this, 30 herbal medicines were listed to protect in the Rare Traditional Chinese Herbs of Yunnan Province in Urgent Needs (RTCHYN) [20]. These herbs used in DPMs and YPMs were summarized in Table 8.
| Herbal name                        | Pinyin Name | Chinese name | Origin                                      | NPWP | IUCN | Proprietary | NPWM | UF  |
|-----------------------------------|-------------|--------------|---------------------------------------------|------|------|-------------|------|-----|
| GLYCYRRHIZAE RADIX ET RHIZOMA     | Gancao      | Glycyrrhiza uralensis Fisch II LC - |                              | 26   |      |             |      |     |
|                                   |             | Glycyrrhiza inflata Bat. II LC -    |                              |      |      |             |      |     |
|                                   |             | Glycyrrhiza glabra L. II LC -      |                              |      |      |             |      |     |
| GINSENG RADIX ET RHIZOMA          | Renshen     | Pana: c ginseng C. A. Mey I CR -   |                              | 4    |      |             |      |     |
| FORSYTHIAE FRUCTUS                | Lianqiao    | Forsythia suspense (Thunb.) Vahl - |                              | 4    |      |             |      |     |
| SCUTELLARIAE RADIX                | Huangqin     | Scutellaria baicalensis Georgi -   |                              | 4    |      |             |      |     |
| SCHISANDRAE CHINENSIS FRUCTUS     | Wuweizi     | Schisandra chinensis (Turcz.) Baill. II LC - |              | 1    |      |             |      |     |
| CERVI CORNU                       | Lurong      | Cervus nip port Temminck -         |                              | 1    |      |             |      |     |
|                                   |             | Cervus elaphus Linnaeus. -         |                              |      |      |             |      |     |
| CISTANCES HERBA                   | Rouchongrong | Cistanche deserticola Y. C. Ma II EN - |                              | 1    |      |             |      |     |
|                                   |             | Cistanche tubulosa (Schenk) Wight II - |                      |      |      |             |      |     |
| PHELLODENDRI CHINENSIS CORTEX     | Huangbai   | Phellodendron chinense Schneid - |                              | 2    |      |             |      |     |
| EUCOMMIAE CORTEX                  | Duzhong     | Eucommia ulmoides Oliv. -         |                              | 1    |      |             |      |     |
| GENTIANAE RADIX ET RHIZOMA        | Longdan     | Gentiana manshurica Kitag. -      |                              | 3    |      |             |      |     |
|                                   |             | Gentiana scabra Bge -             |                              |      |      |             |      |     |
|                                   |             | Gentiana triflora Pall. -         |                              |      |      |             |      |     |
|                                   |             | Gentiana regescens Franch. -      |                              |      |      |             |      |     |
| COPTIDIS RHIZOMA                  | Huanglian   | Coptis chinensis Franch -         |                              | 1    |      |             |      |     |
|                                   |             | Coptis deltoidea C. Y. Cheng et Hsiao - | Unique to China |      |      |             |      |     |
|                                   |             | Coptis teetoides C. Y. Cheng. -     |                              |      |      |             |      |     |
| MAGNOLIAE OFFICINALIS CORTEX      | Houpu       | Magnolia officinalis Rehd. et Wils II NT | Unique to China | 1    |      |             |      |     |
|                                   |             | Magnolia officinalis Rehd. et Wils. var. biloba Rehd. et Wils II - | Unique to China |      |      |             |      |     |
| PHELLODENDRI CHINENSIS CORTEX     | Huangbai   | Phellodendron chinense Schneid - |                              | 2    |      |             |      |     |
| ARNEBIAE RADIX                    | Zicao       | Arnebia euchroma (Royle) Johnst - |                              | 1    |      |             |      |     |
| GENTIANAE MACROPHYLLAE RADIX      | Qingjiao    | Gentiana macrophylla Pall. -      |                              | 1    |      |             |      |     |
|                                   |             | Gentiana macrophylla Maxim. -      |                              |      |      |             |      |     |
|                                   |             | Gentiana crassicaulis Duthie ex Burk. - |                              |      |      |             |      |     |
|                                   |             | Gentiana dahurica Fisch -         |                              |      |      |             |      |     |
| MOSCHUS                           | Shexiang    | Moschus berezovskii Flerov. -     |                              | 1    |      |             |      |     |
|                                   |             | Moschus sifanicus Przewalski. -   |                              |      |      |             |      |     |
|                                   |             | Moschus moschiferus Linnaeus. -   |                              |      |      |             |      |     |
| PARIDIS RHIZOMA                   | Chonglou    | Paris polyphylla Smith var. chinensis (Franch.) Hara II - |             | 7    |      |             |      |     |

Note: NPWP: National key protected wild plants of China (Aug 4th, 1999), NPWM: National key protected species of wild medicinal materials of China (Dec. 1th, 1987), IUCN: List of International Union for Conservation of Nature (CR: Critically Endangered, LC: Least Concern, EN: Endangered, VU: Vulnerable, NT: Near Threatened), UF: Usage frequency in DPMs and YPMs.
Table 8
Information of herbal medicines in RTCHYN

| Scientific Name | Pinyin Name | Chinese Name | Origin | Medicinal parts | Distribution** | Standard | UF | EP |
|-----------------|-------------|--------------|--------|-----------------|----------------|----------|----|----|
| ERIGERONTIS HERBA | Dengzhaxixin | Erigeron breviscapus (Vaniot) Hand.-Mazz. | Whole plant | Areas except southwest of Yunnan | ChP 7 | DD† DY† ZTL |
| CORDYCEPS | Dongchongxiacao | Cordyceps sinensis (BerK.) Sacc. | Bacterial & insect complex | Deqin, Shangri-La, Lijiang, Binchuan, Lvfeng, Guangdong | ChP 4 | HX† RSN |
| RESINA DRACAENIS | Longxuejie | Dracaena cochinchinensis (Lour.) S.C.Chen A | Resin | Jinping, Menglian, Pu'er, Jinghong, Zhenkang, | SGZP 2 | HX† HX† |
| - | Lushuicao | Cyanotis arachoids C.B.Clarke | Whole plant | Menghai, Menglian, Jinghong, Jingdong, Mengzi | No 1 LC |
| SWERTIAE MILEENSI HERBA | Qingyedan | Swertia mileensis T. N. He et W. L. Shi | Whole plant | Mile | ChP 2 | DW |
| RADIX ANISODI* | Sanfensan | Anisodus acutangulus C.Y.Wu et C.Chen | Roots | Lijiang | SYNP 1 TX1 |
| - | Xuedan | Hemsleya amabilis Diels | Roots | Kunming, Chongning, Binchuan, Eryuan, Dali, Heqing | NO 1 RSN |
| BERGENIAE RHIZOMA | Yanbaicai | Bergenia purpurascens (Hook.f.et Thoms.) Engl. var. delavayi (Franch.) Engl. et Irn. | Rhizome | Deqin, Weixi, Shangrila, Lijiang, Dali, Qujing, Ludian, Zhaotong, Gongshan, Fugong | ChP 1 | YW |

Note: * means the herb has more than 2 origins, and only 1 origin is showed in the table. ** The distribution information comes from Flora of Yunnan (Science China, 2006), UF : Usage frequency, SGZP: Standards for Chinese medicinal materials in Guizhou Province (2009).

Surveys and Statistics on the toxic herbal medicines in DPMs and YPMs in Yunnan Province

In traditional medicine of ethnic minorities, herbs with pharmacological activity are likely to be clinically useful, but may also be toxic, especially if used incorrectly or do not master the correct use method. Different from modern drugs, efficacy and toxicity assessments of herbal medicines are based on traditional knowledge and clinical experience rather than evaluation in a laboratory [21]. The causes of toxic medicine usage in Chinese ethnomedicine are related with living environments, religious belief and medical practices concerned with poisons. In China, 83 herbal medicines are officially recorded and defined as toxic according to the Chinese Pharmacopoeia and the certain number of toxic herbs is also recorded in provincial standards for herbal medicine. Toxic herbal medicines are classified into three categories: high toxicity, medium toxicity, and low toxicity [22]. According to the statistics, there are 10 toxic herbs used in 11 DPMs, and 6 toxic herbs recorded in Chinese Pharmacopoeia and 4 toxic herbs recorded in SYNP. Among them, 1 herb is called Dai medicine and 2 herbs belong to Yi medicine. In the 40 YPMs, the toxic herbs are counted to 24, and the number of 12 toxic herbs is collected in Chinese Pharmacopoeia, 12 herbs recorded in SYNP. 4 herbs are known as Yi medicine. These results are showed in Table 9 and Table 10.
| Scientific Name | Pinyin Name | Chinese Name | Origin | Toxicity degree | Standard | DPM | Modern toxicology | Ref. |
|----------------|-------------|--------------|--------|-----------------|----------|-----|------------------|-----|
| PARIDIS RHIZOMA* | Chonglou | Chonglou | Paris polyphylla Smith var. chinensis (Franch) Hara | LT | ChP | RBQC | Toxic to digestive system and have cardio toxicity and neurotoxicity, LD$_{50}$ = 2.68 g/kg (mice, p.o.) | [27] |
| CURCULIGINIS RHIZOMA | Xianmao | Xianmao | Curculigo orchioides Gaertn | MT | ChP | LXBST | LD$_{50}$ = 215.9 g/kg (ethanol extract, rats p.o.), injury to liver, kidney and reproductive organs with oral administration of 120 g/kg (ethanol extract, rats, 6 months) | [28] |
| CNIDII FRUCTUS | Shechuangzi | Shechuangzi | Cnidium monnieri (L.) Cuss. | LT | ChP | LXBST | Nausea and vomiting, decreased spontaneous activity, shortness of breath, unstable gait and tremor (ethanol extract), LD$_{50}$ = 17.45 g/kg (mice, p.o.), MTD = 1.50 g/kg or LD$_{50}$ = 3.45 g/kg (Osthol, mice, p.o.) | [29] [30] [31] |
| ZANTHOXYLRADIX | Liangmianzhen | Liangmianzhen | Zanthoxylum nitidum (Roxb.) DC. | LT | ChP | 7JDHXO | Nitidine chloride could damage liver and kidney cells, and lead to the decrease of heart rate in zebrafish | [32] |
| PINELLIAE RHIZOMA | Banxia | Banxia | Pinellia ternatae (Thunb.) Breit. | MT | ChP | SBZKG | LD$_{50}$ = 42.7 ± 1.27 g/kg (mice, p.o.), it would cause renal and liver damage, induce serious damage of gastric mucosa. A significant toxicity on pregnancy maternal mice and embryo has been found and total alkaloids are one of the toxic substances. | [33] |
| ARMENIACAE SEMEN AMARUM* | Kuxinren | Kuxinren | Prunus armeniaca L. var. ansu Maxim | LT | ChP | SBZKG | LD$_{50}$ of Amygdalin is 25 g/kg (mice, i.v.), 887 mg/kg (mice, p.o.), and hydrocyanic acid produced by Amygdalin could inhibit the activity of cytochrome oxidase, leading to cell respiration inhibition and cell death. | [34] |
| CAULIS ET FOLIUM PLUMBAGINIS | Bhuadan | Bhuadan | Plumbago zeylanica Linn. | LT | SYNP | DLBSC | Skin redness, swelling and peeling contacted with Baihuadan, plumbagin free alcohol extract. Root and leaves have the reversible antiovulation activities for female rats | [35] [36] |
| RHIZOMA TACCAE | Jiangenshu | Jiangenshu | Tacca chantrieri Andre | MT | SYNP | YGT | Diarrhoea and vomiting have been reported in patients with mild intoxication, and intestinal mucosal exfoliation and hemorhhoa could appear in severe poisoning patients. | [37] |
| RADIX TRIPTERYGII HYPOGLAUCI | Huobahuagen | Huobahuagen | Tripterygium hypoglaucum (Levl.) Hutch | LT | SYNP | GTSL | LD$_{50}$ = 79 g/kg (male mice, p.o.) and 95% confidence limit is 69 ~ 89 g/kg, LD$_{50}$ = 100 g/kg (female mice, p.o.) and 95% confidence limit is 90 ~ 112 g/kg. It has the reversible antifertility effect. | [38] [39] |
| ERYTH RINAE CORIEX * | Haitongpi | Haitongpi | Erythina variegata L. Var. orientalis (L.) Merr | MT | SSCP | GTSL | Unknown | |

Note: HT: high toxicity, MT: medium toxicity, LT: low toxicity, * means the herb has more than 2 origins, and only 1 origin is showed in the table. SSCP: Standards for Chinese medicinal materials in Sichuan Province (2010)
| Scientific Name | Pinyin Name | Chinese Name | Origin | Toxicity degree | Standard | YPM | Modern toxicology |
|----------------|-------------|--------------|--------|-----------------|----------|-----|------------------|
| PARIDIS RHIZOMA* | Chonglou | | Paris polyphylla Smith var. chinenisi (Franch)Hara | LT | ChP | GFNC,NQSG,SYATSC,ZTL | - |
| OSMUNDAE RHIZOMA | Ziqiguanzhong | | Osmanda aponica Thunb. | LT | ChP | SWYA | Unknown |
| EUODIAE FRUCTUS | Wuzhuyu | | Evodia rutaecarpa(Juss.)Benth. | LT | ChP | GDQC,HWYP | LD50 of its volatile oil is 2.70 ml/kg(95% confidence limit: 2.58 ~ 2.84 ml/kg, mice, p.o.), one of main target organ is liver. |
| BUFONIS VENENUM* | Chansu | | Bufo bufo gargarizans Cantor | MT | ChP | CLTC | Toad Venom (90 mg/kg) caused opisthotonus, ventricular arrhythmias, and increases in cardiac levels of Ca2+, CK and LDH. |
| ARTEMISIAE ARGYI FOLIUM | Aiye | | Artemisia argyi Levl. Et Vant. | LT | ChP | KSG | LD50 of aqueous extract is 80.2 g/kg(95% confidence limit:77.4 ~ 83.4 g/kg, mice, p.o.), LD50 of volatile oil is 1.67 mL/kg(95% confidence limit:1.55 ~ 1.80 mL/kg ,mice, p.o.), MTD of ethanol extract is 75.6 g/kg(mice, p.o.). |
| ACONITI KUSNEZOFFII RADIX | Caowu | | Aconitum kusnezoffii Reichb. | HT | ChP | TXT | It can cause serious cardiac dysfunction, and be damage to nervous system. LD50 of Aconitine is 1.8 mg/kg, for mice is 0.3 mg/kg. LD50 of Hypaconitine is 5.8 mg/kg, and LD50 of Meseaconitine is 1.9 mg/kg. |
| PAPAVERIS PERICARPIUM | Yingsuqiao | | Papaver somniferum L. | MT | ChP | KLT | The main toxic components are morphine and codeine. Morphine with 60 mg could cause poisoning, and 250 mg could cause death. |
| ARISAEMATIS RHIZOMA* | Tiannanxing | | Arisaema erubescens (Wall.)Schott. | MT | ChP | TXT | Producing folate deficiency and injury of kidneys |
| LAGGERAE HERBA | Choulingdan | | Laggera pterodonta (DC.)Benth. | MT | ChP | LL,SKCG | LD50 of water extract is 1.19 g/kg (mice,ip). |
| ARMENIACAE SEMEN AMARUM* | Kuxinren | | Prunus armeniaca L. var. ansu Maxim | LT | ChP | SKCG,CLTC | - |
| PINELLIAE RHIZOMA | Banxia | | Pinellia ternate (Thunb.) Brett | MT | ChP | WFSC,ZXASG | - |
| PSAMMOSILENES RADIX | Jintiesuo | | Psammosielen tunicoides W. C. Wu et C. Y. Wu | LT | ChP | ZTL | LD50 = 4.847195% confidence limit : 4.3251 ~ 5.4508 g/kg, mice, p.o.), the toxic target organs include lung, spleen and stomach |
| HERBA BOENNINGHAUSENIAE | Shijiaocao | | Boenninghausenia sessilicarpa Levl. | LT | SYNP | SAC,SKCG | The ether extract could reduce the activity in mice by intraperitoneal injection. |

Note: HT: high toxicity, MT: medium toxicity, LT: low toxicity, * means the herb has more than 2 origins, and only 1 origin is showed in the table.

SGZP: Standards for Chinese medicinal materials in Guizhou Province (2009), SGDP: Standards for Chinese medicinal materials in Guangdong Province (2009), SHNP: Standards for Chinese medicinal materials in Hunan Province (2009).
Discussion

Yunnan. While modern toxicology experiments have provided more toxicity information of these toxic herbs, which are beneficial to use them safely and efficaciously, ancient documents would be researched deeply to record the application of these toxic herbs in the medical practice of Yi, Dai or other ethnic minorities in Yunnan.

Zanthoxylum bungeanum in *Medica* characteristics is bitter, pungent and warm, and it could treat chest pain or heartache, stomachache and abdominal distension. According to ancient Yi medicine classics, it could be used to treat the arthritis, joint swelling and pain, bruise and sprain ([23](#)).

Due to the lack of more pharmaceutical information disclosed, as well as the lack of basic research, the safety information of these DPMs and YPMs including toxic herbal medicines is insufficient. The modern toxicological evidences of these toxic herbal medicines were collected and also showed in Table 9 and Table 10. Our focus is on these toxic herbal medicines which are known as Dai medicines or Yi medicines. Root of *Tripterygium hypoglaucum* (Levl.) Hutch (Huobahuagen) soaked in wine as oral medicine was recorded in *AilaoMateria Medica*, a book translated and published according to *Wa Die Yi Medical book* ([24](#)) written by Lan Mao, its medicine property characteristics is bitter, pungent and warm, and it could treat chest pain or heartbeat/stomachache and abdominal distension. According to *AilaoMateria Medica*, its toxicity to heart, and has the influence on central nervous system appearing excited then inhibited.

### Table 9. Selected Toxic Herbal Medicine in DPMs or YPMs

| Scientific Name | Pinyin Name | Chinese Name | Origin | Toxicity degree | Standard | YPM | Modern toxicology |
|----------------|-------------|--------------|--------|----------------|----------|-----|-------------------|
| RHIZOMA DYOSOSMATIS | Bajiaolian | 柴胡 | Dyososa versipellis (Hance) M. Cheng ex Ying | LT | SYNP | ZTL,HJXJC, SLAC, WJHXZT | LD₅₀ = 0.493 ± 0.032 g/kg (mice, p.o.), it is toxicity to heart, and has the influence on central nervous system appearing excited then inhibited. |
| RAdIX MILLETTIAE BONATIANAE | Dafahan | 丹参 | Milletia bonatiana Pamp. | MT | SYNP | HSTT | Damage to stomach |
| FOLIUM CRAIBIODENDRONIS | Jinyezi | 银杏叶 | Craibiodendron yunnanense W.W. Smith | HT | SYNP | ZTL | Unknown |
| RADIX TRIPETYRGII HYPOGLAUCI | Huobahuagen | 豪华| Tripterygium hypoglaucum (Levl.) Hutch | MT | SYNP | ZTL,GFNC | - |
| RADIX ANEMONES RIVULARIS | Wuzhangcao | 麻花头 | Anemone rivularis Bunch. Ham. ex DC. | LT | SYNP | TYGT,YSL | Unknown |
| - | Daotihu | 桑叶 | Delphinum yunnanense Franch. | MT | SGZP | WHXZTC | Unknown |
| RHIZOMA DIOISOCOREAE BULBIFERAE | Huangyaozi | 黄花药 | Dioscorea bulbifera L. | LT | SGDP | FFLC, FFLG | LD₅₀ = 25.49 g/kg (mice, i.p.), LD₅₀ = 79.98 g/kg, 250.3 g/kg or 544/g/kg (mice, p.o.), toxic target organs include liver and kidney. |
| CAULIS CLEMATIDIS ARGENTILUCIDAE | Shanmutong | 竹叶 | Clematis apifolia var. argentilucida (H. Leveille Ë vaniot) W. T. Wang | LT | SHNP | NQSG | Unknown |
| RADIX ANISODI | Sanfensan | 阿胶 | Anisodus acetangulus C. Y. Wu et C. Chen | HT | SYNP | TXT | Unknown |
| FOLIUM DATURAE STRAMONII | Mantuolouye | 陈连 | Datura stramonium L. | MT | SYNP | YWNC | Shortness of breath and death after nerve stimulation |
| RADIX ACONITI BRACHYPODI SEU PENDULI | Xueshangyizhihao | 雪上衣 | Aconitum brachypodum Diels | HT | SHNP | ZTL | Petroleum ether extracts and N-butanol extracts are 676.928, 549.237 mg/kg (mice, p.o.). |

Note: HT: high toxicity, MT: medium toxicity, LT: low toxicity, * means the herb has more than 2 origins, and only 1 origin is showed in the table.

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Although some toxic herbs used in DPMs and YPMs, these proprietary medicines are considered safe and applied in clinical legally in China because of the unique set of pharmaceutical theories that include particular methods for processing, combining and decocting, which contribute to reducing toxicity as well as enhancing efficacy. For example, in traditional Dai medicine (TDM), the herbs used to reduce poison of toxic herbs are called “YaGei”, and “YaGei” theory (YGT or Detoxification theory) is considered as a unique supplementary theory of TDM ([24](#)). The Dai herbal medicines named “YaGei” as antidotes could relieve all kinds of adverse reactions caused by food poisoning, drug poisoning and other substances. Besides, in order to keep healthy, Dai people also take antidotes regularly to eliminate the micro toxins in the body, and thus reduce the chance of illness and prolong life.

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Ethnomedicine is the important part of traditional Chinese medicine, which has formed its own unique medical theoretical system. During the course of thousands of years of ethnic amalgamation, traditional medicine of different nationalities has appeared a phenomenon of "diversity, integration and difference". According to statistics, about 8000 medicinal species are used in 40 ethnomedicines, which account for over 70% of total traditional Chinese medicine resources in China. Data from National Medical Products Administration of China shows that there are more than 600 kinds of EPMs[11]. EPMs including DMP were collected from 1977 edition of Chinese Pharmacopoeia, some Miao patent medicines and YMPs were collected in Chinese Pharmacopoeia (2015 Edition), and the total number of EPMs reached 39. 26 prescription drugs and 13 OTC drugs are involved[7]. Furthermore, varieties of non-governmental prescriptions that cannot be counted are still use in clinical in the regions inhabited by ethnic groups of China.

This article focuses on traditional Dai medicine and traditional Yi medicine in Yunnan province because their long histories and ancient medical literature. The earliest ancient book of Yi Medicine that can be verified is Yuyoung Yi Medicine book, which was found in Yuyoung County of Yunnan Province in 1985 and written in 957 A.D[12]. The earliest ancient book of Dai Medicine that can be verified is Ge Ya San Ha Ya, which was considered to write in 964 – 884 B.C, and another work named Dang Ha Ya Long written in 1323 A.D[13]. According to statistic, there are 1666 Dai medicine (Dai Medicine Records of China, People's Medical Publishing House,2018) and nearly 1400 Yi Medicine[14], and 400 herbs are recorded in Yi Materia medica (Yi Yao Ben Cao, Yunnan Science and Technology Press, 2019). The number of Yi medical prescriptions is 478 collated and published by Chinese Yi Medicine Prescriptions (Yunnan Ethnic Publishing House, 2017), and the number of Dai medical prescriptions is 200 collated and published by Study on Dai Traditional Medicine Prescriptions of China (Yunnan Ethnic Publishing House, 2013). The folk prescriptions from Dai or Yi medicine are not available to count out yet. Just as the example of Yunnan Baiyao mentioned before, series of ethnic medicines in Yunnan are successfully industrialized and modernized to promote the modem vitality of ancient ethno medicines and thus serve a wide population range. Tong Shu Capsule, an YPM produced by Yunnan Baiyao Group Co., Ltd., has been approved recently to conduct phase II clinical research in the United States. According to the plan of Yunnan Province, the total output value of pharmaceutical industry will reach 140 billion RMB, with an average annual growth of more than 15% and traditional Chinese medicine including ethnic medicine and natural products account for 75% until 2020[15]. The conclusions could be obtained from this investigation on Dai medicine and Yi medicine, and we summarized them into 5 aspects.

(1) Except Yunnan Baiyao Group Co., Ltd. and Dihon Pharmaceutical Co. Ltd, most of pharmaceutical enterprises of Yunnan Province for EPMs are small in the production scale, which lead to the limit on abilities and development on EPMs. We searched the number of publications of DPMs in CNKI (www.cnki.net), and until now the total number of 163 articles about these 28 DPMs has been published, while the number of documents about Yunnan Baiyao Aerosol has reached 59. It should be known that Yunnan Baiyao Aerosol is only one of CPMs produced by Yunnan Baiyao Group Co., Ltd., and just in 2015, 100 million bottles of Yunnan Baiyao Aerosol were produced, its output value exceeded 1.5 billion RMB. In the same year, the overall sales revenue of Yunnan Baiyao Group Co., Ltd. already achieved 20.74 billion RMB[5].

(2) Although it could not be acquired about the sales volume of YPMs and DPMs, and whether the herbal sources used in YPMs and DPMs are from wild collection, from the usage frequency in YPMs and DPMs, Ganca, Sanqi and Dengzhanhxin have a high proportion in YPMs and DPMs. The challenges of these herbal resources for sustainable utilization have been discussed before.

(3) The use of toxic herbal medicine is always affecting people's worries about the safety of TCM. Aristolochic acid nephropathy in Belgium and the adverse events of Xiao Chaifu Tang in Japan are the warning of the safety of CPM. More scientific evidence is needed to prove the rationality and necessity of using toxic herbs in EPMs.

(4) In the medical practice and the process of identifying and using herbal medicine, every ethnic minority mastered and formed their own experiences of using herbs. In this study, the characteristics of using animal medicines by Yi people were found out through the surveys and statistics on the herbal resources in DPMs and YPMs. And it also is certificated by the ancient medical literature of Yi minority.

(5) The usage methods of Dai and Yi medical prescriptions were recorded with Dai and Yi language historically; the clinical indications DPMs and YPMs are described with Chinese language. It is difficult to master more accurate usage information of DPMs and YPMs because of translation and it will be the next important work.

Conclusions

In the investigation, we can't get the selling information of these DPMs and YPMs because it's a trade secret for the enterprise, which affect our access to collect more information about DPMs and YPMs. On the other hand, it is a hard work to translate ancient Yi and Dai languages to Chinese; we cannot review the records of ethnic medicine formula in ancient medical literature. But abundant of medical practice and culture of ethnic minorities have existed in Yunnan for thousands of years, there are more than 1300 kinds of ethnic medicinal materials recorded in writing, and near to 30000 folk prescriptions in Yunnan Province. The medical information was recorded scatteredly in oral experiences or ancient documents written in various ethnic minority languages, such as San Ma Tou Yi Medical book (written 957 A.D) and Lao Wu Dou Yi Medical book (written in late Qing Dynasty of China). It should be believed reasonably that the ethnomedicine of Yunnan Province will provide more choices for human health through scientific experiments and dealing with the sustainable utilization of medicine resources.

Abbreviations

CPT: Chinese patent medicine; ChP: Chinese Pharmacopoeia; CK: creatine kinase; CR: Critically Endangered; Ca²⁺: calcium ion; DPM: Dai patent medicine; DDTN: Dan Deng Tong Nao Capsule; EM: Ethnic medicine; EN: Endangered; HT: high toxicity; IUCN: List of International Union for Conservation of Nature; LC: Least Concern; LT: low toxicity; LDH: lactate dehydrogenase; LD₅₀: Median lethal dose; i.v.: intravenous; MP: Medicinal parts; MT: medium toxicity; NPWP: National key protected wild plants of China (Aug 4th, 1999); NPWM: National key protected species of wild medicinal materials of China (Dec.1th, 1987); NQS:
Declarations

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Availability of data and materials

We are willing to share the data generated or analyzed during the current study.

Authors’ contributions

LZY and HLQ conceived of and designed the study, conducted the data collection, and interpreted the data. LCF undertook the work of drawing, and evaluation of clinical indications was done by TSH and HXL. The herbal resource information was collected by ZXB and CXM. LZY and YHJ analyzed the data, and LZY drafted the manuscript. All authors read and approved the final manuscript.

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Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Figures

Figure 2
Statistics of clinical indications of DPM and YPM

![Figure 2: Statistics of clinical indications of DPM and YPM](image)

Figure 4
Statistics of dosage forms of DMP and YMP

![Figure 4: Statistics of dosage forms of DMP and YMP](image)

ChP: China Pharmacopoeia, SYNP: Standards for Chinese medicinal materials in Yunnan Province, SPOP: Standards for Chinese medicinal materials in other Province except Yunnan, NQS: No Quality Standard

Figure 5
Quality standard levels of herbal medicines in DPMs (inner circle) and YPMs (external circle)
Figure 8
Usage frequency of herbal medicines in DPMs and YPMs

Figure 10
Source statistics of medical resources in DPMs and YPMs

Figure 12
Statistics on Medicinal parts of Botanical medicines in DPMs and YPMs