青藏高原生态经济植物资源研究与开发学科组

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学科组长:索有瑞，博士、研究员、博士生导师，生于1960年7月。1998年享受国务院政府特殊津贴。1985—1986年期间获得全国五一劳动奖章、全国新长征突击手、边陲优秀儿女金质奖章；1999年获得青海省青年科学家奖等荣誉称号。

先后主持国家“863”计划、星火计划、国家科技攻关计划，青海省重点科技攻关计划等多项研究课题，取得了丰硕的研究成果:

2007年获得国家科技进步二等奖、2006年获得青海省科技进步一等奖，另获得青海省科技进步二等奖2项、科技进步三等奖2项、国土资源部科技三等奖1项、西宁市科技进步一等奖1项。取得省级科技成果40余项、申请国家发明专利41项(15项已授权)。出版专著1部；发表论文190余篇。

作为研究生导师，始终为人师表，培养出了一批优秀人才。培养硕士研究生10名，博士研究生8名。其中培养的3名博士2004～年2007年以优异的成绩3次获得中国科学院“西部之光”人才培养计划资助项目；4名博士2006年、2007年和2008年获得科学院院长优秀奖学金，另有硕士生4次获得地奥奖学金，并有多人获得三好学生、优秀毕业生等称号。

学科组主要研究方向

主要从事青藏高原生态经济植物资源的研究与开发工作，包括天然药物化学、生物分析化学、生物资源可持续利用、传统藏药现代化改造和特色保健食品开发等方面的研究。

2011年代表性研究成果

2011年项目组完成了“青海生态经济林浆果资源研究开发及产业化”项目并通过了成果评价，该项目完成了沙棘9个县区种源的选择和育苗，中国沙棘雌雄搭配推广造林2.8万亩；优选了白刺种源，开展了种植试验，并示范造林200亩，为生态经济林建设 奠定了基础。解决了浆果果实采集、分离、浓缩技术；果汁降铅、降酸、除盐技术；浓缩果汁、活性果粉和籽油的产业化生产技术；沙棘维生素P、沙棘黄酮、沙棘 叶黄酮、原花青素和白刺色素、白刺多糖等10余项活性成分提取分离技术，获得了50余件专利。通过技术集成与产业化，形成了产业集群，开发了药品类、保健 食品类、果汁类、果粉类、籽油类、化妆品及中间体等七大类50多个产品，取得了10项国内、国际认证，制定了50余项地方、行业和企业标准。累计新增产值 12.95亿元，利税3.89亿元，

科技成果

申请专利:专利名称、申请人、申请号、受理日期

1、 枸杞种子细胞快速破壁及籽油提取工艺，索有瑞;李国梁;王洪伦， 201110004255.1，2011.01.07。

2、波棱瓜籽油滴丸制备工艺，王洪伦，索有瑞，201110004253.2， 2011.01.07。

3、柠条籽油超临界CO2萃取工艺及其在抗炎作用中的应用， 索有瑞;尤进茂;王洪伦;强伟，201110004254.7，2011.01.07。

4、 沙棘、白刺果粉含片及其制备方法，索有瑞;王洪伦，201110004291.8，2011.01.07。

授权专利

专利名称:蜂花粉中功能性多不饱和脂肪酸的制备工艺
申请人:索有瑞，王小艳，王洪伦
专利号:ZL200910021890.3
授权公告日:2011年1月12日

1、成果名称:藏药材波棱瓜子活性成分提取、分析及功效学研究
主要完成人:王洪伦、索有瑞、赵先恩、尤进茂、杨黎彬、周昌范、宁春兰、库进良
成果登记号:9632011Y0013

2、成果名称:青海生态经济林浆果资源研究开发及产业化
主要完成人:索有瑞、鲁长征、李刚、王洪伦、李树志、孙允午、尤进茂、山永凯、丁晨旭、王 宁、马正创、马宁安
成果登记号:9632011Y0253

Qinghai-Tibet Plateau Ecological and Economic Plant Resources Research and Development Research Group

学科组成员
王洪伦(研究员)　丁晨旭(副研究员)
王小艳(助理研究员)
博士后
赵云峰　杨黎彬
博士研究生
利毛才让　李春婷　范宝磊　陈向明
硕士研究生
郑杰　强伟　朱丽娜　杨仁明　胡娜　何彦峰
李文聪　韩丽娟　吕欢欢

Group Leader: Professor Suo Yourui, the supervisor of Ph.D students. He earned Ph.D in Natural Product Chemistry from Lanzou Institute of Chemical Physics, Chinese Academy of Science in 2004. Between September and December of 2006, he became a senior visiting-scholar of Canadian SUF University. His research focus on. He once won the National Scientific and Technological Progress Award second class in 2007, the Scientific and Technological Progress Award of Qinghai Province in 2006, the Scientific and Technological Progress Award two second and third class of Qinghai Province in 2006, the Scientific and Technologica Progress Award third class of the Ministry of Land and Resources in 2006. 41 national patents (15 ones have been authorized) has been acquired. And more than 190 papers have been published.

Research Interests

The natural medicinal chemistry, bio-analytical chemistry, the sustainable use of characteristic biotic resources of Qinghai-Tibet Plateau, modernization reform of the traditional Tibetan medicine and characteristic exploitation of health hood

Research Progress in 2011

The project "Research Development and Industrialization on Qinghai Ecological Economic Forest Berries Resources", was accomplished in by Northwest Institute of Plateau Biology, CAS, Qinghai Tsinghua Biotry Bio-Tech Co., Ltd, Qinghai General Health Bio-science Co., LLC and Qinghai Academy of Agricultural Forestry Sciences, was appraised by expert committee organized by Qinghai Science and Technology Department on September 27, 2011.

Led by Northwest Institute of Plateau Biology, CAS and under the cooperation of relative enterprise and research institution, this project reached the goal of resource protection, ecological restoration, industrial upgrading and farmers' income increasing.

There are more than 50 kinds of products developed, including medicine, health food, fruit juice, seed oil, cosmetics and so on. Through the efforts of all the participated units, ten of the domestic and international authentication, more than 50 local, industry and enterprise standards were obtained. Accumulative value brought by this research reached up to 1.295 billion yuan, with the tax 0.389 billion yuan, added value of farmers' income 0.315 billion yuan. From the above, the economic benefit was remarkable.

Publications

1. Honglun Wang, Lily M. L. Ou, Yourui Suo, Hua-Zhong Yu. Computer-Readable DNAzyme Assay on Disc for ppb-Level Lead Detection. Analytical chemistry, 2011, 83 (5): 1557-1563.

2. Jie Zheng, Chenxu Ding, Liangsheng Wang, Guoliang Li, Junyou Shi, Hui Li, Honglun Wang, Yourui Suo. Anthocyanins composition and antioxidant activity of wild Lycium ruthenicum Murr. from Qinghai-Tibet Plateau.Food Chemistry, 2011,126(3), 859-865.

3. Jie Zheng, Hui Li, ChenXu Ding, YouRui Suo, LiangSheng Wang, HongLun Wang. Anthocyanins composition and antioxidant activity of two major wild Nitraria tangutorun Bobr. variations from Qinghai-Tibet Plateau.Food Research International, 2011,44(7), 2041-2046.

藏药新药研究与开发学科组

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学科组长:陶燕铎，研究员，博士生导师，河南南阳人。1985年7月，毕业于西北林学院获农学学士学位。同年8月，进入中科院西北高原生物研究所工作至今。2000年作为创新研究员进入中国科学院知识创新工程，在所内9个学科方向中任中药藏药新药研发方向学术带头人。1994年至2011年期间，先后赴美国、西班牙、澳大利亚等国进行科学讲学及学习交流，2011年享受国务院政府特殊津贴。主要从事青藏高原药用和特色生物资源的基础和应用基础研究与开发，先后在国内外学术刊物上共发表论文120余篇，申请专利26项。目前主持有国家计划委员会的高新技术产业化重大专项项目、国家科技支撑计划项目、中国科学院生命科学与生物技术局“十五”预研项目、国家重大基础研究前期研究专项项目等多个项目。

学科组主要研究方向

青藏高原特色生物资源有效化学成分提取，分离及分析鉴定。
青藏高原特色生物资源化合物库的构建。
天然药物及其衍生物的活性筛选研究。

2011年代表性研究成果

1. 以青藏高原特色野生生物资源黄绿蜜环菌为研究对象，应用先进的提取分离技术，确定了黄绿蜜环菌多糖提取物的生产工艺路线，实现了规模化生产。起草了黄绿蜜环菌多糖提取物的质量标准及企业标准，建立了生产工艺规程。完成了多糖提取物的中试生产，验证了提取物生产的各项技术指标。项目成功培养出黄绿蜜环菌菌丝体，为人工培育黄绿蜜环菌奠定了基础。

2. 项目开展了暗紫贝母、羌活、湿生扁蕾、野生唐古特白刺、黑果枸杞和青海柴达木地区枸杞规范化种植、野生植物的驯化和抚育的研究。栽培羌活和暗紫贝母，药材有效成分指标达到了《中国药典》2010版要求, 编写了相应的SOP, 完成了其栽培基地建设

3.以青藏高原资源量丰富的野生唐古特白刺、黑果枸杞为示范，建立了其水溶性色素的溶剂提取、大孔树脂分离技术；制定了白刺和黑果枸杞红色素2个食品添加剂的质量标准、生产标准操作规程及生产工艺规程；并与企业合作，进行了产业化应用研究，建设了1条10吨色素生产线。按照卫生部《食品添加剂卫生管理办法》完成了白刺和黑果枸杞两种红色素食品添加剂新产品申报所需的全部工作，并已通过卫生部初审。

4.以青藏高原枸杞、黑果枸杞、白刺3种大宗植物资源为示范，完成了万余亩有机种植基地的建设；并开发了枸杞子等5种有机食品，通过了欧盟、美国等相关机构的有机食品认证；与合作企业共同完成了枸杞干果等3条有机食品生产线的建设，并通过保健食品GMP认证，具备保健食品的生产能力。

授权专利

专利名称	申请人	申请号	授权日期
一种抗氧化白刺提取物的制备方法	陶燕铎	201010542517.5	2011/11/02

科技成果

成果名称	主要完成人	成果登记号
有机食品柴达木地区枸杞生产技术规程	陶燕铎	9632011YB068
藏药黑果枸杞色素提取及药理活性研究	邵赟	9632011Y0070
青海柴达木枸杞叶黄酮精致技术研究	于瑞涛	9632011Y0040

Research and Development of Tibetan medicine

学科组成员

邵赟(副研究员)　梅丽娟(副研究员)

王启兰(副研究员)　于瑞涛(研究实习员)

毕宏涛(研究实习员)　高婷婷(研究实习员)

周志军(实验师)　孙策(工程师)

博士研究生

刘增根　党军

硕士研究生

罗智敏　张兴旺　党军　刘增根　陈晨

江磊　张琳　王瑛

Group Leader:Professor Tao Yanduo was graduated from Northwest A & F University with bachelor degree in July, 1985. He had been working in Northwest Plateau of Biology Institute, Chinese Academy of Sciences up to now. In 2000, professor Tao as an innovative researcher was engaged into the Knowledge Innovation Project of CAS, and worked as an academic leader of research and development of Tibetan medicine. Between 1994 and 2011, he had been to the United States, Spain, Australia and other countries for scientific investigation. He had enjoyed special government allowances of the State Council in 2011. Research Group is mainly engaged in the applied basic research and development of Qinghai–Tibet Plateau medicinal and biological resource. Until 2011, more than 130 papers and 26 patents have been published and applied. During 2011, more than 20 papers have been published in academic journals at home and abroad. The studies were supported by the Major Projects of High–Tech industrialization of National Planning Commission; National Natural Science Foundation of China; "15" Pre–Research Program of Bureau of Life Sciences & Biotechnology of the Chinese Academy of Science; Special Project of National Key Basic Research, etc.

Research Interests:

Extraction, separation and identification of chemical composition from biological resources of the Qinghai–Tibet Plateau; Construction of compound libraries of biological resources in the Qinghai–Tibet Plateau; Activity screening of natural product and its derivatives.

Research Progress in 2011

1. Constructing the production process route of Armillaria luteo–virens polysaccharide extract and achieving a large–scale production by the application of advanced extraction and separation technology. Drafting the quality and enterprise standards of Armillaria luteo–virens polysaccharide extract; establishing the corresponding technological process of production. Completing the pilot production of the polysaccharide extract, and verifing the technical indicators of the corresponding extract production. The project yellow–green Armillaria The mycelium of Armillaria luteo–virens was successfully cultured, which laid the foundation for the artificial cultivation of Armillaria luteo–virens

2. Carrying out the standardized planting of *Fritillaria unibracteat*a Hsiao et K. C. Hsia, *Rhizoma Notopterygii*, *Gentianopsis paludosa* (Munro) Ma, *Nitraria tangutorum* Bobr., *Lycium ruthenicum* Murr and Lycium, and conducting the domestication and upbringing for the corresponding wild plants. The *Fritillaria unibracteata* Hsiao et K. C. Hsia and *Rhizoma Notopterygii* were successfully cultivated, and the corresponding active ingredient indicators have achieved the "Chinese Pharmacopoeia 2010 requirements. In addition, we have writed the corresponding SOP, and completed its cultivation bases.

3. Constructing the extraction and separation technique of water–soluble pigment in wild *Nitraria tangutorum* Bobr. and *Lycium ruthenicum* Murr. by using macroporous resin; Developing the food additives quality standards, the production of standard operating procedures and production instructions of the two red pigment in *Nitraria tangutorum* Bobr. and *Lycium ruthenicum* Murr.; Developing the industrial application of research, and building a 10 tons of pigment production line by the cooperation with enterprises; Completing the whole work of new product declaration of food additives about the two red pigment in *Nitraria tangutorum* Bobr. and *Lycium ruthenicum* Murr. according to the Ministry of Health "food additives, health management approach", and having passed the preliminary examination of the Ministry of Health.

4. Completing the construction of a million acres of organic planting base about the Lycium, *Nitraria tangutorum* Bobr. and *Lycium ruthenicum* Murr. in the Qinghai–Tibet Plateau; Developing the five kinds of organic food, and passing the organic food certification of relevant institutions such as the European Union, and the United States; Completing the construction of three organic food production line, passing the health food GMP certification, and possessing the production capacity of the health food by the cooperation with enterprises.

Publications

1. Ruitao Yu, Zhong Liu, Yanduo Tao, et al. A simple method for isolation and structural identification of arctigenin from Saussurea Medusa Maxim. by preparation chromatography and single crystal X–ray diffraction. Journal of medicinal plants research. 2011, 5 (6):979–983.

2. Zhi–min Luo, Elisalinares Navaro, et al. Determination of ursolic acid and Oleanolic Acid in *Sambucus adnata* Wall by HPLC–DAD. Natureal Product Rresearch and Development. 2011, 23 (6):1095–1098.

资源植物遗传与繁育技术组

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学科组长:李毅，研究员、硕士生导师，1987年获武汉大学遗传学专业学士学位，同年分配到中国科学院西北高原生物研究所。青海省生物学学科带头人，青海省农作物品种审定委员会委员，国家濒危物种科学委员会协审专家。主要从事青藏高原特有濒危植物的组织培养及有效成分变化与调控、植物资源的可持续利用与保护研究。近年来，发表论文40多篇(SCI论文6篇)，完成省部级以上成果5项，授权专利3项。主持国家科技支撑计划课题、国家农业科技成果转化项目、中国科学院、中组部“西部之光”人才培养计划项目、中国科学院仪器设备功能开发技术创新项目等多项。

学科组主要研究方向

利用生物技术手段开展青藏高原特色植物资源的可持续利用与保护研究，近期主要研究包括以下几个方面:

1. 组织培养快繁与定向分化

课题组通过组织培养技术，对唐古特大黄、印度獐牙菜等重要药用植物等进行了组织快繁技术研究，成功获得了组培快繁苗。同时实现了青藏高原濒危物种藏红花柱头与暗紫贝母鳞茎的定向分化。

2. 水母雪莲细胞大规模培养、毛状根诱导及有效成份的积累与调控

探讨离体条件下水母雪莲中有效成份的积累与调控。通过细胞发酵技术，实现了水母雪莲细胞大规模培养。同时对Ri质粒转化诱导水母雪莲发根，获取优良毛状根系一个。

3. 遗传背景与品质形成的相关性

利用分子标记技术研究唐古特大黄等的遗传背景，结合其主要蒽醌类有效成分的变化，探讨遗传背景对品质形成的影响，为筛选优良种质资源奠定基础。

2011年代表性研究成果

亚麻产业化技术研究与示范

研究亚麻指纹图谱、种子繁育技术、栽培生产技术及亚麻高附加值产品等方面，并进行了产业化示范，建立了较为完整的亚麻产业化技术体系，为亚麻产业化的发展提供了技术支撑。

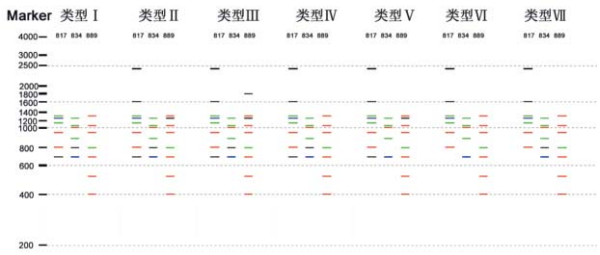


图 陇亚10号标准指纹图

注:红色条带:亚麻共有带；蓝色条带:陇亚10号共有带；绿色条带:陇亚10号父本或父母本共有带

科技成果

1. 成果名称:胡麻品种观察记载规范

主要完成人:李毅、王莉、王慧、贺庆安、王志远、胡延萍、杨建。赵利、任钢

成果登记号:9632011Y0065

2. 成果名称:胡麻陇亚10号丰产栽培技术规范

主要完成人:李毅、王慧、王莉、贺庆安、任钢、杨威、刘珍珍、白生录、赵利、胡延萍

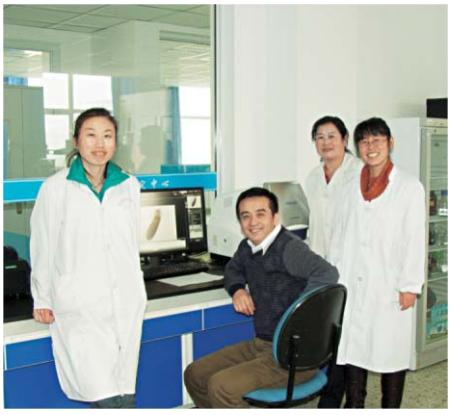
成果登记号:9632011Y0066

3. 成果名称:胡麻陇亚10号种子生产技术规程

主要完成人:李毅、王慧、王莉、贺庆安、赵利、白生录、胡延萍、杨建、任钢

成果登记号:9632011Y0067

Plant Biotechnology



学科组成员

王莉(副研究员)

胡延萍(助理研究员)

陈伟民(工程师)

Group Leader:Professor Li Yi received his Bachelor's degree in Genetics from Wuhan University in 1987. From then on, he has worked in Northwest Institute of Plateau Biology, CAS. He is an academic leader in Biology of Qinghai Province, one of the members of Qinghai Crop Variety Approval committee, and assistant review expert of endangered species scientific commission of China. His research focuses on the tissue culture, regulation and control of active constituents, and conservation and sustainable utilization of threatened plants endemic to Qinghai–Tibetan Plateau. More than 40 scientific papers including 6 cited by SCI wore published, 5 achievements were accomplished and 3 patents were authorized to him. He has taken part in many research projects as a Principle Investigator such as National Key Technology R&D Program, Agriculture Science Technology Achievement Transformation Fund, West Light Foundation of the Chinese Academy of Sciences, the Function and Technology Innovation Projects of Instrument Equipment of the Chinese Academy of Sciences and other programs of Qinghai Province.

Research Interests

1. Secondary metabolites, tissue culture and micropropagation of endangered medicinal plants on Qinghai–Tibetan Plateau.

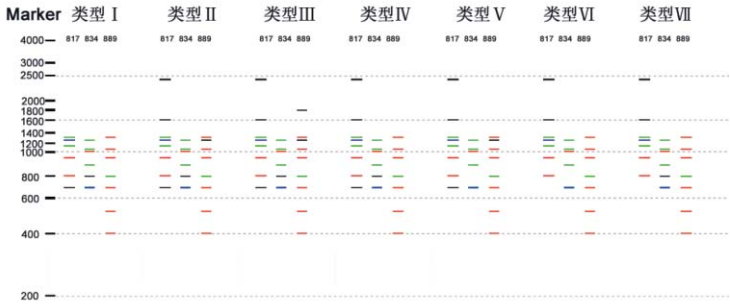
2. Agrobacterium rhizogenes mediated transformation of *Saussurea medusa*

3. Genetic diversity and germplasm screening of medicinal plants such as *Rheum tanguticum* and flax cultivar.

Research Progress in 2011

Industrialization technology research and demonstration of Flax

The fingerprint, seed breeding technology, cultivation production and high added–value products of flax were studied and demonstrated. A more complete flax industrialization technology system was established. All the study above provided technical support for the development of the industrialization of flax.



fingerprint of Flax cultivar (Longya 10)Note: red bands represent common bands of flax cultivars. Blue bands represent common bands of Longya 10. Green bands represent common bands of Longya 10 paternal or maternal line.

Publications

1. Yanping Hu, Li Wang, Yi Li. New occurrence of B chromosomes in *Rheum tanguticum* Maxim. ex Balf. (Polygonaceae). Caryologia. 2011, 64(3): 3207–324.

2. Yanping Hu, Li Wang, Yi Li. Inter–simple sequence repeats (ISSR) primer screening and preliminary evaluation of genetic diversity in *Rheum tanguticum*. Journal of Medicinal Plants Research. 2011, 5(24): 5907–5911.

青藏高原特色植物化学成分研究组

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邮箱:jmyou6304@163.com

学科组长:尤进茂，博士，研究员，博士生导师，中国科学院“百人计划” 获得者。1988年获中国科学院兰州化学物理研究所硕士学位；1999年获中国科学院兰州化学物理研究所博士学位；1999-2001年在中国科学院大连化学物理研究所做博士后研究工作，师从张玉奎院士；2001-2002出站后回曲阜师范大学工作；2003年受聘为中国科学院西北高原生物研究所客座研究员(博士生导师)；2004年担任山东省生命有机分析重点实验室主任；2008受聘为山东大学环境科学与工程学院，分析化学专业(博士生导师)。长期从事新型标记分子的开发应用，先后开发了多种高灵敏识别材料，主要包括具有特定结构、高灵敏度、近红外的中、长波荧光及紫外探针分子材料的合成。借助探针分子携带的高活性官能团实现待测底物分子在化学环境下的分子识别，通过现代荧光、色谱/质谱和电泳等技术，获得多种生物代谢物如DNA、氨基酸、多肽、胆固醇、雌激素、类固醇等生物分子的快速、灵敏测定或结构鉴定。先后在国内外重要学术刊物上发表论文140余篇。其中被SCI收录近90篇。

学科组主要研究方向

主要从事新型标记分子的开发应用；通过现代荧光、色谱/质谱和电泳等技术结合高灵敏探针分子，对植物中的有效成分进行分析。

2011年代表性研究成果

采用新型荧光衍生试剂与液相色谱-质谱技术相结合，对几种水果中的三萜酸成分进行分析。首先用响应面法优化衍生化反应参数，提高衍生化效率和产率，然后用吖啶酮-9-乙基对甲苯磺酸酯(AETS)对三萜酸进行柱前衍生，最后利用高效液相色谱-质谱联用技术对几种水果中的三萜酸含量进行分析，检测限可达 1.68-2.04 ng/mL。此种方法有较满意的耐用性和重复性，在测定其他食品以及天然产物中有较好的应用前景。

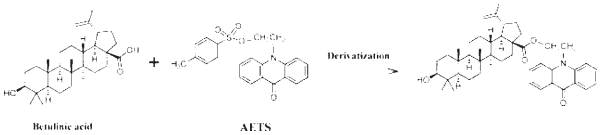

图1 AETS 衍生桦木酸反应图

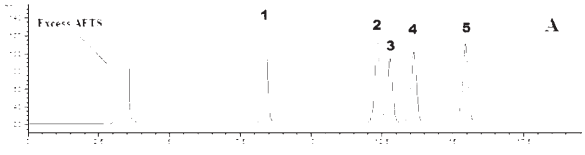

图2 AETS衍生化标准三萜酸色谱图
注:1=山楂酸；2=熊果酸；3=齐墩果酸；4=桦木酸；5=桦木酮酸

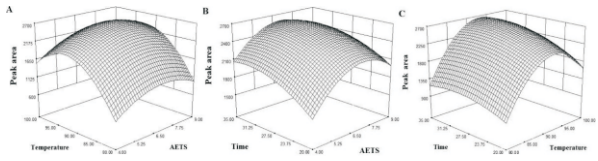

图3 响应面法测定衍生变量之间关系的三维图
注:A图是衍生温度与衍生剂摩尔比率同时对峰面积的影响三维图；B是衍生时间与衍生剂摩尔比率同时对峰面积的影响三维图；C是衍生温度和衍生时间同时对峰面积的影响三维图

科技成果

*授权专利:
专利名称:蜂花粉中功能性多不饱和脂肪酸的制备工艺
申请人:王小艳
专利号:ZL 2009 1 0021890.3
授权公告日:2011.01.12
*申请专利:
专利名称:一种具有保护肝损伤活性的丽江大黄提取物及其制备方法
申请人:王小艳
申请号:CN 201110404970.4
受理日期:2011.12.07

Qinghai-Tibet Plateau CharacteristicPlant chemicalIngredients Research Group

学科组成员

王小艳(助理研究员)

博士研究生

孙志伟　夏莲　陈光　李国梁　张世娟

硕士研究生

康丽　景年华　王爱红

Group leader: Professor You Jinmao , the supervisor of Ph.D students. He received his bachelor's degree from Lanzhou Institute of Chemical Physics, Chinese Academy of Science in 1988. He then earned his doctor's degree in 1999 from Lanzhou Institute of Chemical Physics, Chinese Academy of Science. From 1999–2001, he worked as postdoctoral in Dalian Institute of Chemical Physics, Chinese Academy of Science, learning from academician Yu–Kui Zhang. He has been a doctoral supervisor of Northwest Plateau Institute of Biology, Chinese Academy of Science since 2003. In 2004, he was appointed as the director of Shandong Province Key Laboratory of Life–Organic Analysis. In 2008, he became a doctoral supervisor of Shandong University and was awarded "Hundred–Talent Award Program" from Chinese Academy of Science. His research focus on the study and application of new labeling reagent. Many sensitive labeling reagents possessing special structure, high sensitivity and excellent fluorescence or ultraviolet properties have been synthesized and applied to the analysis of organism metabolites such as DNA, amino acid, polypeptide, cholesterol, estrogens and so on. More than 140 papers have been published in important journals home and abroad, among which 90 articles have been indexed by SCI.

Research Interests

Study and application of sensitive labeling reagent; Analysis of active ingredients of plants by fluorescence, chromatography and mass spectrometry using sensitive labeling reagents.

Research Progress in 2011

Triterpenic acids in friuts were analyzed by using acridone–9–ethyl–p–toluenesulfonate (AETS) as fluorescent labeling reagent by HPLCwith fluorescence detection (FLD). Response surface methodology was employed to optimize the derivatization reaction, ensuring the sufficient labeling of the analyzed components. This developed method offered the exciting detection limits of 1.68–2.04 ng/mL. When applied to several popular fruits in China, it revealed satisfactory applicability and reproducibility. This developed method also exhibits powerful potential for accurate detection of triterpenic acids from other foodstuffs and nature products.

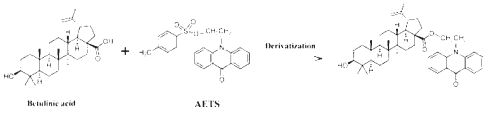

Fig1. The representative derivatization scheme for AETS with betulinic acid.

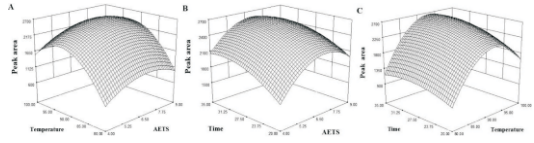

Figure 3. The 3D response surface of the derivatization yield (expressed in terms of peak area) affected by the varying derivatization temperature and molar ratio of AETS to triterpenic acids (A), derivatization time and the molar ratio of AETS to triterpenic acids (B), and the varying derivatization time and temperature ©.

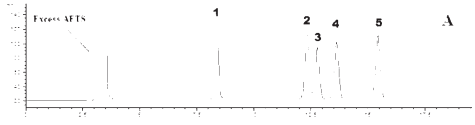

Fig2. a Chromatogram of a mixture of triterpenic acids standards derivatized by AETS; peak labels: maslinic acid (1), ursolic acid (2), oleanolic acid (3), betulinic acid (4) and betulonic acid (5).

Publications

1. Development of a New HPLC Method with Pre–column Fluorescent Derivatization for Rapid, Selective and Sensitive Detection of Triterpenic Acids in Fruits. Journal of Agricultural and Food Chemistry, 2011, 59(7): 2972–2979

2. Highly sensitive and selective pre–column derivatization HPLC approach for rapid determination of triterpenes oleanolic and ursolic acids and application to Swertia species: Optimization of triterpenic acids extraction and pre–column derivatization using response surface methodology. Analytica Chimica Acta, 2011, 688(2): 208–218

3. Composition Analysis of Free Fatty Acids from Swertia Species by a Novel Pre–column Fluorescence Labelling Method Using HPLC–FLD. Journal of the American Oil Chemists' Society,2011, DOI 10.1007/s11746–011–1947–0

4. Highly selective and sensitive determination of free and total amino acids in Apocynum venetum L. (Luobuma tea) by a developed HPLC–FLD method coupled with pre–column fluorescent labelling. International Journal of Food Sciences and Nutrition, 2011, DOI: 10.3109/09637486.2011.610780

5. Identification and determination of carboxylic acids in food samples using 2–(2–(anthracen–10–yl)–1H–phenanthro[9,10–d]imidazol–1–yl)ethyl 4–methylbenzenesulfonate (APIETS) as labeling reagent by HPLC with FLD and APCI/MS. Talanta, 2011, 85: 1088–1099

6. Determination of amino acids in rat brain microdialysate with 1,2,5,6–dibenzocarbazole–9–ethyl chloroformate as labeling reagent by high performance liquid chromatographic fluorescence detection and mass spectrometric identification. Journal of Chromatography B, 2011, 879: 1367–1374

7. LC Determination of Trace Biogenic Amines in Foods Samples with Fluorescence Detection and MS Identification. Chromatographia, 2011, 73: 43–50

8. A developed pre–column derivatization method for the determination of free fatty acids in edible oils by reversed–phase HPLC with fluorescence detection and its application to Lycium barbarum seed oil. Food Chemistry. 2011, 125(4): 1365–1372

9. Determination of trace amino acids in human serum by a selective and sensitive pre–column derivatization method using HPLC–FLD–MS/MS and derivatization optimization by response surface methodology. Amino acids, 2011, 40(4): 1185–1193

10. Optimisation of red pepper seed oil extraction using supercritical CO2 and analysis of the composition by reversed–phase HPLC–FLD–MS/MS. International Journal of Food Science & Technology, 2011, 46(1): 44–51

11. A sensitive fluorescence reagent, 2–[2–(7H–dibenzo [a, g] carbazol–7–yl)–ethoxy] ethyl chloroformate, for amino acids determination in Saussurea involucrate and Artemisia capillaris Thunb using high - performance liquid chromatography with fluorescence detection and identification with mass spectroscopy/electrospray ionization source. Biomedical Chromatography, 2011, 25(6): 689–696

12. Compositional and Antioxidant Activity Analysis of Zanthoxylum bungeanum Seed Oil Obtained by Supercritical CO2 Fluid Extraction. Journal of the American Oil Chemists Society, 2011, 8(1): 23–32.

13. The determination of amino acids composition of the traditional food Potentilla anserina L. root by high–performance liquid chromatography via fluorescent detection and mass spectrometry. International journal of food science and technology, 2011, 46(6):1164–1170

青藏高原药用植物资源与植被恢复学科组

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学科组长:周国英，博士，副研究员，硕士生导师。1998年获西北农林科技大学林学专业学士学位，2005年获中国科学院西北高原生物研究所生态学专业硕士学位，2010年获中国科学院西北高原生物研究所生态学专业博士学位。2010年2月-8月美国University of Oklahoma高级访问学者。国家自然科学基金委评审专家；国家濒危物种保护委员会协审专家；青海省第六批自然科学与工程技术学科带头人。

目前承担国家科技支撑课题:西北区域大黄、青海冬虫夏草、荒漠肉苁蓉、新疆马鹿等大宗中药材规范化种植/养殖基地及其SOP优化升级研究（2011BAI05B03）、国家“973”项目专题:青藏高原冻土工程走廊重大工程建设对环境影响的后评估（2012CB026105-01）、国家自然科学基金项目:青藏高原多年冻土区重大工程迹地植被自然恢复的生态学过程与冻土演变的关系研究（40801076）、中国科学院 “西部之光”人才培养项目（后续择优）:青海珍稀濒危药材羌活的原产地引种驯化研究等。

学科组主要研究方向

青藏高原珍稀药用植物资源繁育与可持续利用

通过青藏高原特色药用植物（唐古特大黄、羌活、麻花艽、桃儿七、以及藏茵陈类）资源调查，筛选优质种源和适宜生境，进而开展引种驯化、植物细胞和组织培养、药效物质和生态环境关系研究，种苗繁育和规范化栽培等方面工作，为珍稀、濒危药用植物资源保护和可持续利用探索一条新途径、新措施，为青藏高原中藏药资源产业化规范化种植技术以及生产基地建设提供模板和示范；同时应用HPLC、GC-MS对栽培药材进行品质评价，探讨栽培药材替代野生药材，以期从根本上解决高原特色药用植物资源问题。

青藏高原脆弱区域植被恢复研究与示范

以多年冻土区重大工程(青藏铁路等)迹地植被自然恢复过程中的植物群落、土壤和冻土环境为研究对象，采用生态学和相关学科的研究手段和方法，通过时空数据转换，对重大工程迹地植被自然恢复的生态学过程及其冻土演变的关系进行研究，揭示该地区工程迹地植被自然恢复的规律和影响恢复的主导因素，阐明制约工程迹地植被恢复演替的关键因子，并深入分析工程迹地植被自然恢复的机理。为人工采取辅助措施来加速青藏铁路、青藏交直流联网工程等工程迹地和青海湖地区退化草地进展演替提供有效借鉴和技术支持。

2011年代表性研究成果

1.蚕羌

2.竹节羌

3.大头羌

4.条羌

5.须根

珍稀濒危药材羌活的原产地引种驯化研究

(1) 不同产地羌活药材挥发油、有机酸和香豆素类含量比较

不同产区羌活挥发油含量范围0.58%-7.98%。15个产地羌活挥发油含量的顺序为班玛>大通>乐都>平安>互助>称多>玛沁>门源>兴海>天祝>河南>达日>祁连>囊谦>久治。不同产区宽叶羌活挥发油含量范围0.24%-5.38%，15个产地宽叶羌活挥发油含量的顺序为同仁>湟源>湟中>大通>平安>乐都>门源>民和>天祝>互助>甘肃合作>河南>同德>班玛>四川若尔盖。

26个产地羌活药材绿原酸的含量范围为3.095~9.324mg/g；阿魏酸的含量范围为0.968~4.746mg/g；紫花前胡苷的含量范围为0.513~2.930mg/g；佛手柑内酯的含量范围为0.040~0.307mg/g；羌活醇的含量范围为2.656 ~26.280 mg/g；异欧前胡素的含量范围为0.774~16.397 mg/g。

(2) 不同采收期栽培羌活挥发油含量、有机酸和香豆素类含量的比较

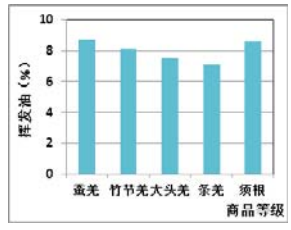
随着采集月份的变化，栽培宽叶羌活挥发油相对含量也发生了变化，α-蒎烯、β-蒎烯、D-柠檬烯的相对含量表现为高——低——高的趋势，5月相对含量较高，7月份达到最低点，然后又上升；γ-萜品烯的相对含量表现为低——高——低的趋势，含量呈先上升(5-7月)后降低(7-9月)的趋势；4-异丙基-甲苯和罗勒烯的含量从5月到9月呈升高趋势；芹菜脑、乙酸龙脑酯和α-红没药醇的含量在5月和7月份的含量较高；愈创醇的含量在7月份含量最高，6月份含量最低，其他三个月的差异不大。

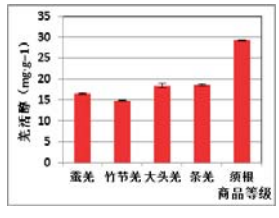
栽培2年生和3年生宽叶羌活中主要有机酸和香豆素类化合物总量的变化趋势基本一致。2年生和3年生栽培宽叶羌活羌活醇和异欧前胡素含量之和分别为21 mg/g-1和27 mg/g-1远高于药典所规定的4 mg/g-1标准，活性成分总含量5-9月份间分别在70mg/g-1和100mg/g-1。随着生长年限的延长，活性成分得到积累，羌活品质也越好。

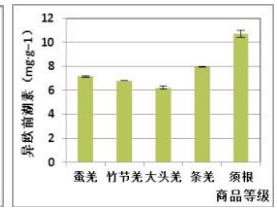
(3) 不同商品等级羌活挥发油、有机酸和香豆素类化合物的含量比较

蚕羌、竹节羌、大头羌、条羌、须根中挥发油总量分别为8.7%、8.1 %、7.5%、7.1%、8.6%。须根中挥发油含量次于蚕羌，在传统商品中属等外品。

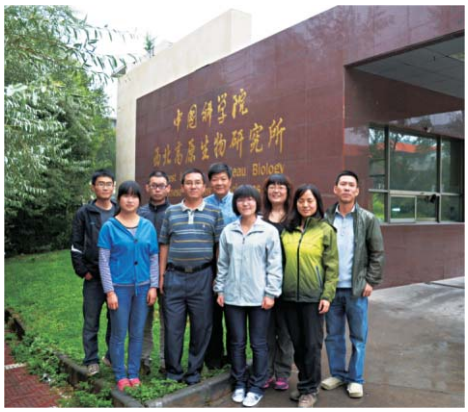
羌活醇和异欧前胡素的含量与传统相悖，在条羌、须根中的含量反而高于蚕羌、竹节羌、大头羌中的含量。







Research Group of Medicinal Plant Resources and Vegetation Restoration of Qinghai-Tibetan Plateau



学科组成员

徐文华（副研究员） 宋文珠（助理研究员）

张庆云（七级职员）

硕士研究生

刘卫根 李璠 钟泽兵 刘何春 李艳玲

Group Leader:Guoying Zhou, Ph.D., Associate Professor, Supervisor of Master students. Guoying Zhou graduated from Northwest Agriculture & Forestry University with Bachelor Degreee of Agriculture in1998. He obtained his M.D. in 2004 and Ph. D. in 2010 in Ecology in Northwest Institute of Plateau Biology, CAS. In 2010, he studied in the University of Oklahoma in the United States of American as a senior visiting scholar.

He serves as the following positions: evaluation expert of the National Natural Science Fund Committee, assistant expert of the National protection of endangered species committee, reviewer of "The Journal of ecology", "Journal of Glaciology and Geocryology", and discipline leader of the Sixth Batch of natural science and engineering of Qinghai Province.

Dr. Zhou has been working on Medicinal plant resources and Vegetation restoration of Qinghai–Tibetan Plateau for many years and the programs are listed as follow: (1) National Key Technologies Research and Development Program of China: The standardized planting / breeding base and its SOP optimization and upgrading of larger sum of Chinese medicine, such as Rheum in Northwestern Region, Cordyceps sinensis (Berk.)Sacc. in Qinghai, Desertliving Cistanche, red deer in Xinjiang (2011BAIO5B03). (2) The Major State Basic Research Development Program of China (973 Program): The later assessment of the impact of the major construction project of the Permafrost Region Corridor of the Qinghai–Tibetan Plateau on environment (2012CB026105–01). (3) National Natural Science Foundation of China: The relationship between ecological processes of vegetation natural restoration and evolvement of frozen soil within fields emerged after construction project in Permafrost Region of The Qinghai–Tibetan Plateau（ 40801076 ）. (4)West Light Foundation of the Chinese Academy of Sciences: Origin introduction and domestication of rare and endangered medicinal plant, *Notopterygium incisum*, in Qinghai.

Research Interests

Breeding and sustainable utilization of QTP rare medicinal plant resources

Through the survey of the Qinghai–Tibetan plateau, characteristic medicinal plant resources which are highly qualified seed sources and suitable habitats, such as *Rheum tanguticum*, *Notopterygium incisum*, *Gentiana straminea*, *Sinopodophullum hexandrum* and *Swertia* were selected. And introduction and domestication, plant cell and tissue culture, and the relationship between efficacy material and ecological environment were studied. Key technologies such as seed breeding and field standardization of artificial cultivation can explore new measures for conservation and sustainable use of rare and endangered medicinal plants resources. And it also provides templates and demonstration for the industrialization of standardized planting of the origin and production base construction of medicine resources of the Qinghai–Tibetan Plateau. Meanwhile, we used cultivation medicinal plants substitute for wild medicinal plants through the quality evaluation of the cultivated medicinal plants by using HPLC, GC–MS, which can fundamentally solve the problem of the Qinghai–Tibetan Plateau characteristic medicinal plant resources.

Vegetation restoration research and demonstration of the Qinghai–Tibetan Plateau fragile region

The plant community, soil and permafrost environment in the process of natural vegetation recovery in the warm permafrost regions of major project (the Qinghai–Tibetan railway, etc.) were studied by ecological and related disciplines research methods. Relationship between the ecological process of natural recovery of vegetation and its evolution of frozen soil was studied by transferring space and time data, and it revealed that natural vegetation recovery in this region and the dominant factors influenced the recovery, in the meanwhile, it clarified the key factors that restricted vegetation restoration succession in the project region. We also analyzed the mechanism of natural vegetation recovery in project region. It can provide effective reference and technical support for the acceleration of Qinghai–Tibetan railway by artificial auxiliary measures, the Qinghai–Tibet Interconnection Project, and for the progressive succession of degraded Qinghai Lake grassland.

Research Progress in 2011

Origin domesticated research of rare and endangered medicinal plant, *Notopterygium incisum*

1. Comparisons of the content of volatile oil, organic acid and coumarin in Notopterygium collected from different habitats

The content of volatile oil in Notopterygium incisum collected from different habitats varied from 0.58% to 7.98%. The sequence of the content of volatile oil in Notopterygium incisum collected from 15 different habitats was: QinghaiBanma > QinghaiDatong > QinghaiLedu > QinghaiPingan > QinghaiHuzhu > QinghaiChenduo> QinghaiMaqin > QinghaiMenyuan > QinghaiXinghai > GansuTianzhu > QinghaiHenan > QinghaiDari > QinghaiQilian > QinghaiNangqian > QinghaiJiuzhi. The content of volatile oil in different habitats in Notopterygium forbesii Boiss varied from 0.24% to 5.38%. The sequence of the content of volatile oil in Notopterygium forbesii collected from 15 different habitats was: QinghaiTongren > QinghaiHuangyuan > QinghaiHuangzhong > QinghaiDatong > QinghaiPingan > QinghaiLedu > QinghaiMenyuan > QinghaiMinhe > GansuTianzhu > QinghaiHuzhu > GansuHezuo > QinghaiHenan > QinghaiTongde > QinghaiBanma > SichuanReergai.

The content of Chlorogenic Acid in *Notopterygium* collected from 26 different habitats ranged from 3.095 mg/g to 9.324 mg/g; the content of Ferulic Acid ranged from 0.968 mg/g to 4.746mg/g; the content of Purple Peucedanum Glycosides ranged from 0.5136mg/g to 2.9306mg/g; the content of Bergapten varied from 0.040 mg/g to 0.307 mg/g; the content of Notopterygium alcohol ranged from 2.656 mg/g to 26.280 mg/g; and the content of Isoimperatorin varied from 0.774 mg/g to 16.397 mg/g.

The content ranges of chlorogenic acid, ferulic acid, nodakenin, bergapten, notopterol and isoimperatorin in *Notopterygium* collected from 26 different areas were 3.095 mg/g~9.324 mg/g, 0.968 mg/g~4.746mg/g, 0.5136mg/g~2.9306mg/g, 0.040 mg/g ~0.307 mg/g, 2.656 mg/g ~26.280 mg/g and 0.774 mg/g ~16.397 mg/g, respectively.

2. Seasonal dynamics of volatile oil, organic acids and coumarin compounds in cultivated *Notopterygium forbesii*

With the changing acquisition, the relative content of volatile oil in cultivated *Notopterygium forbesii* also changed. The relative contents of α –pinene, β –pinene, D–limonene displayed a high–low–high trend. The relative content was high in May, and reached a low point in July, and then up. The relative content of γ –terpinene showed low–high–low trend, which increased first from May to July and then decreased from July to December. The content of 4 – isopropyl – toluene and ocimene showed an increasing trend from May to September. The content of Celery brain, bornyl acetate and α –bisabolol was high in May and July. The content of Guaiac alcohol reached the highest point in July, and the lowest point in June, and it was almost the same in the other three months.

The trends of total content of main organic acids and coumarins compounds in 2–year and 3–year cultivated *Notopterygium forbesii* were basically the same. The sums of the content of notopterol and isoimperatorin in 2–year and 3–year cultivated *Notopterygium forbesii* were 21 mg/g^{-1} and 27 mg/g^{-1}, respectively, which were much higher than 4 mg/g^{-1} standards prescribed by the Pharmacopoeia. And the average total contents of active ingredient were 70mg/g^{-1} and 100mg/g^{-1} from May to December, respectively. With the extension of the growing years, active ingredient accumulated, and the quality of *Notopterygium* became better.

3. Comparisons of the content of volatile oil, organic acid and coumarin in different commercial parts of *Notopterygium incisum*

The yields of volatile oil in Silkworm *Notopterygium*, bamboo *Notopterygium*, irregular–nodal *Notopterygium*, striped *Notopterygium*, fibrous roots from the same origin extracted by steam distillation (SD) were 8.7%, 8.1 %, 7.5%, 7.1% and 8.6%, respectively. The yield of volatile oil in fibrous roots was rather high, and it was only lower than Silkworm *Notopterygium*. However, fibrous roots were substandard products in traditional *Notopterygium* levels. The contents of chlorogenic acid and ferulic acid in *Notopterygium* incisum were consistent with the traditional evaluation method, however, the contents of nodakenin, bergapten, isoimperatorin and notopterol in fibrous roots and striped *Notopterygium* were higher than those in silkworm *Notopterygium*, bamboo *Notopterygium* and irregular–nodal *Notopterygium*, especially the contents of two main constituents, notopterol and isoimperaorin, in fibrous roots were higher than any other parts of *Notopterygium incisum*.

药材GAP生产与质量标准研究学科组

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学科组长:马世震，学士，副研究员，硕士生导师。1984年青海大学毕业，学士学位，2002年-2003年中国科学院兰州化学物理研究所2002年天然药物学春季博士班学习。2011年1月-7月苏黎世大学 高级访问学者。国家濒危物种保护委员会专家；国家自然科学基金委评审专家；《兰州大学学报》期刊审稿人；青海省三江源生态环境保护专家委员会委员；国家环保部环境影响评价评审专家，青海省第四批自然科学与工程技术学科带头人。

自2001年开始，重点开展了中国科学院院地合作项目，先后在甘肃、四川、西藏和青海等省、区与当地企业联合攻关，取得了多项推广应用性研究成果并推广。目前，成果推广应用累计取得的经济效益达到了27700万元的经济效益。为甘肃、青海、西藏和四川等省区的中藏药材产业发展做出了积极贡献。

目前承担国家科技部中药现代化专项蒙古黄芪规范化栽培与深加工关键性技术研究；国家科技部中小型创新企业资金项目-暗紫贝母药材规范化栽培与推广；中国科学院院地合作项目-青海地道药材GAP生产技术与药材质量标准研究等。

学科组主要研究方向

地道药材GAP生产技术与药材质量标准研究

青藏高原及毗邻地区地道药用植物资源分布特征调查，遴选优质种源进行引种驯化。通过对种子生物学特征研究，利用物理与生化方法，促进种子胚后熟，提高种子萌发水平。设计田间对比试验，研究掌握药材生长发育动态和药材活性成分变化规律，依照高产的栽培技术方案与最高活性成分含量的耦合制定药材规范化栽培技术规程，推广应用该技术规程建立规范化药材生产示范基地。

依照中华人民共和国药典要求，按照药材的生物学特征和药用功效成分，选取不同地区野生与栽培药材样品，利用HPLC、GC-MS等测试技术手段测试药材活性成分等表征性指标(指纹图谱)和其他辅助性指标，并通过统计学分析研究，确定各项指标的阈值范围。从而制定能够系统评价和反映药材质量的标准体系，为建立药材GAP基地，实现规模化生产药材产品提供实用技术与标准，规范中藏药材资源的生产与质量。

2011年代表性研究成果

(1)主持完成青海省重点科技攻关项目“总状土木香规范化栽培技术研究与示范”，通过青海省科技厅成果验收(成果登记号9632011Y0007)。

利用HPLC法对总状土木香的表征性成分Different Isoalantolactone和 Isoalantolactone的测试对比，遴选了西藏林芝地区的野生藏木香种子进行引种栽培，通过不同田间对比试验与追踪测试不同生长期Different Isoalantolactone, Isoalantolactone的含量与产量的耦合，制定了SOP规程并推广应用到药材生产基地内。药材产量可达1009.5kg/亩，Different Isoalantolactone和 Isoalantolactone分别达到2.86%和1.02%，分别是野生药材含量的96%和118.6%。利用HPLC方法建立了药材表征性指标Different Isoalantolactone和Isoalantolactone的含量指纹图谱，并选取了性状鉴别、显微鉴别、理化鉴别和薄层鉴别等辅助性指标，建立了总状土木香药材质量标准。

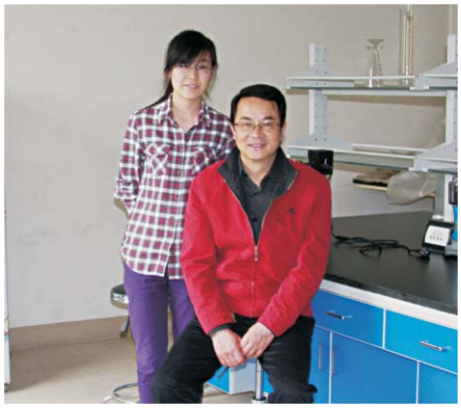
(2)主持完成青海省科技厅重点科技项目“宽叶羌活规范化栽培技术与示范”(成果登记号9632011Y0008)。

在充分开展种质资源调查和品质测试与分析的基础上，选择了优质种质资源，通过种子生物学特征研究，利用GA和变温处理方式对种子处理，使种子的萌发率由17%提高到75%以上。通过不同田间对比试验与追踪测试不同生长期Isoimperatorin和Volatile oil的含量与产量的耦合，制定了SOP规程并推广应用到药材生产基地内。药材产量可达145kg/亩，Isoimperatorin和Volatile oil的含量分别达到2.29%和2.48%，分别比野生药材高出5.13%和4.72%。利用HPLC方法建立了药材表征性指标Different Isoalantolactone和Isoalantolactone的指纹图谱，并选取了性状鉴别、显微鉴别、理化鉴别和薄层鉴别等辅助性指标，建立了总状土木香药材质量标准。

(3)主持完成青海省地方标准《桃儿七药材规范化种植技术规程》；

(4)主持完成青海省地方标准《总状土木香药材规范化种植技术规程》。

GAP Production and Qualily Standard Study Group of Medicine Plants



硕士研究生

张海娟

Group Leader:Associate Professor Ma Shizhen was graduated form Qinghai University with Bachelor Degree in Grassland science, China, in 1984. Form 2002 to 2003, he was Studied at the Lanzhou Institute of Chemical Physics Chinese Academy of Sciences in natural medicine science. Form January to July in 2011, he as a visiting Scholar studied at the University of Zurich.

He was Expert of the National Endangered Species Protection Committee and Evaluation expert of the National Natural Science Foundation of China. He also was Peer reviewers of Lanzhou University journal and Expert of The sources of Rivers Ecological Environmental Protection Committee of Qinghai. Since 1998, he was engaged Expert of Environmental Protection Environmental Impact Assessment evaluation of Ministry of Environmental protection The People's Republic of China, he also was Academic leader of natural sciences and engineering of Qinghai Province.

Since 2001,Shizhen Ma focus on the Chinese Academy of Sciences Cooperation with enterprises project worked in Gansu, Sichuan, Tibet and Qinghai regions, and enterprises of joint research, a number of applied research results and promotion. At present, the results of popularization and application of the cumulative economic benefits yielded reached 277 million Yuan of economic returns. Made a positive contribution to Tibetan medicine industry development such as Gansu, Qinghai, Tibet and Sichuan provinces.

Research Interests

Shizhen Ma was major studied on Qinghai–Tibet Plateau and adjacent areas of medicinal plants resource distribution characteristics investigation, the selection good quality seed source introduction and domestication.Design field comparison test, study and master the herbs growth and development of dynamic and medicinal active ingredient variation, in accordance with the high–yield cultivation technology solutions and the highest content of active ingredient coupling herbs standardized cultivation techniques to develop and promote the use of the technical regulations establishing a standardized medicine production base model.

Select different regions Herbs according to the Pharmacopoeia of the People's Republic of China, as well as medicinal biology and medicinal effectiveness of the composition between wild and cultivated medicinal herbs samples using HPLC, GC–MS test techniques test herbs active ingredient characterization index (fingerprint) and use other complementary indicators, and statistical analysis to determine the threshold range of indicators. So as to formulate able to systematically evaluate and reflect medicinal plants quality standard system, and provide practical techniques and standards for the establishment of herbs GAP base, to achieve large–scale production of medicinal products, Tibetan medicine resources, production and quality specifications.

Research Progress in 2011

1. Presided over the completion of Qinghai Province key scientific and technological project "peaches seven standardized cultivation tec(1) presided over the completion of key scientific and technological project in Qinghai Province "racemose Civil Hong standardized cultivation technology research and demonstration" by the results of acceptance of the Qinghai Provincial Department of Science and Technology (outcomes registration number 9632011Y0007) .

Use of HPLC method on the Inula racemosa Hook. f. representational composition Different Isoalantolactone Isoalantolactone test comparison, the selection of the wild in Tibet Nyingchi Tibet woody seed for the introduction and cultivation of different field comparison test and track test different growth stages Different Isoalantolactone, Isoalantolactone content and yield of the coupling to develop the SOP procedures and promote the use of medicine production base, has been tested and medicine production up 1009.5kg / mu, Different Isoalantolactone Isoalantolactone 2.86% and 1.02%, respectively, 96% of the wild herbs 118.6%. HPLC method for the the herbs characterization indicators of Different Isoalantolactone and Isoalantolactone the content fingerprint, and select a character identification, microscopic identification, physical and chemical identification and TLC of the secondary indicators, the establishment of the Inula racemosa Hook. f.quality standards of fragrant herbs.

2.Presided over the completion of Qinghai Province Science and Technology Agency key technology projects, " Standardized cultivation technology and demonstration of Notopterygium forbesii" (Major Achievements No: 9632011Y0008).

Investigation and quality testing analysis on the basis of high–quality seeds biological characteristics, the use of GA and temperature changes method on the seed treatment, seed germination rate from 17% to more than 75%. Through the coupling of different field comparison test and yield test different growth stages Isoimperatorin and the Volatile oil of content and production to develop the SOP procedures and promote the use of medicine production base, up to 2175kg / ha, the Isoimperatorin and the Volatile oil production by the test herbs content, respectively, 2.29% and 2.48%, respectively 5.13% and 4.72% higher than that of wild herbs. HPLC method was established, the fingerprints of herbs characterization indicators of Different Isoalantolactone and Isoalantolactone, and select a character identification, microscopic identification, physical and chemical identification and TLC of the secondary indicators Inula racemosa Hook. f quality standards.

3. Presided over completion of the Qinghai Province local standards:Standardization Technical Specification planting of Sinopodophullum hexandrum.

4. Presided over the completion of Qinghai Province, the local standards.Standardized planting technical regulations of Inula racemosa Hook. f .

Publications

1. Haijuan Zang ,Shiazhen Ma Tian Ji,ect. Determination of elements in wild Fritillaria unibracteata Hsiao. laboratory of action spectrum.(already accept).

2. Simultaneous determination of ten nucleosides and nucleobases in Fritillaria unibracteata by RP–HPLC journal of medicament analyse(already accept).

3. Haijuan Zang ,Shiazhen Ma Xiaoli Jiao etc. Determination of total Alkaloids in Bulbus Fritillariae Cirrhosae in different region. analyse laboratory (already accept).

高寒生态系统与全球变化学科组

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学科组长:贺金生，博士，研究员，国家杰出青年基金获得者，2009年入选中科院西北高原生物所百人计划。1988毕业于兰州大学生物系，1998年在中国科学院植物研究所获得博士学位，1999-2002年在哈佛大学进化生物学系从事博士后研究。主要从事草地碳循环、化学计量生态学、以及高寒生态系统对全球变化响应和适应的研究。

近年来在以下几个方面取得了重要进展:(1)在植物功能属性方面，发现叶片形态结构和生理功能 (如最大光合速率等)之间存在统一的权衡关系，这种权衡不因植物的生活型和研究区域而发生变化(Ecology 2009)；发现青藏高原极端环境下植物生态属性之间的关系遵循热带、温带地区的规律，证明植物生态属性之间存在趋同演化关系(New Phytologist 2006)(2)在化学计量生态学方面，系统研究并阐明了我国草地优势植物C 、N、P化学计量特征及其控制因子，发现中国草地优势植物C:N和N:P 比率相对稳定，其调控因素是物种组成而不是气候的直接作用(Oecologia 2006, 2008)；(3)在生物多样性方面，证明野外观察到的生物多样性-生产力的正相关关系是生物多样性、生产力随环境梯度独立变化的表观现象，而非本质的联系(Global Ecology & Biogeography 2010)。他有关中国草地的研究得到了国内外同行的高度评价，被聘为包括Frontiers in Ecology and the Environment 在内的4个国际重要专业期刊的编委。

学科组主要研究方向

(1)高寒草地对全球变化的响应与适应；
(2)高寒湿地温室气体排放及其对全球变化的反馈；
(3)青藏高原草地生态系统固碳现状、速率、机制和潜力；
(4)高寒草地碳、氮循环模式及调控。

2011年代表性研究成果

(1)植物功能属性和分布区大小之间关系的研究

自然界一个明显的现象是，有些物种是广布种，分布区很广，而有些物种是狭域种，分布区面积很小。生态学上前者被称为Generalist，后者被称为Specialist。我们利用在内蒙和青藏高原178个地点208个物种数据，结合土壤及气候数据，分析了广布种和狭域种功能属性的差异，以及广布种和狭域种功能属性和环境关系的差异。结果表明，广布种和狭域种在叶片功能属性上没有明显差异；狭域物种的功能属性和环境关系比广域物种密切，说明狭域物种对环境要求方面的特殊性 (Geng et al. 2011,GEB)。

(2)建立了高寒草地“增温-降水”控制实验 (图 1)

青藏高原也是全球变化的敏感地带，正经历着明显的变暖过程。最新的IPCC报告显示，亚洲高海拔地区变暖的速度是全球平均值的三倍。从1960s以来高原内部降水格局也在发生变化。2011年研究组建立了高寒草地“增温-降水”控制实验，针对的科学问题是“温暖化如何影响高寒草地生态系统的结构和功能？它和降水格局的交互作用如何？”。实验设计: 2温度水平 (对照，增温2℃) × 3降水水平 (对照，-50%，+50%) × 6重复 = 36个实验单元。

(3)建立了高寒草地、湿地温室气体排放的长期监测设施 (图 2)

由于全球和区域气候变化，近30-40年来青藏高原高寒湿地经历着明显的干化作用，部分沼泽湿地由于冻土退化演变为高寒草甸和草原，而这必然会导致湿地温室气体通量发生改变，从而对气候变化产生反馈作用。研究组建立了由三种方法组成的温室气体排放长期监测平台:传统的静态箱-气相色谱法 (2010-7-1开始)；全自动静态箱实时监测 (2011-7-23开始)；涡度相关法 (Li-7500和Li-7700)(2011-6-1开始)

图1. 研究组在青海海北高寒草地生态系统国家野外科学观测研究站建立的“增温-降水”控制实验(2011.7-)。

图2. 研究组在青海海北高寒草地生态系统国家野外科学观测研究站建立的湿地温室气体监测设施(2011.7-)。

Global Change and Alpine Ecosystem Research Group

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Group Leader: Dr. Jin-Sheng He, the winner of the National Fund for Distinguished Young Scientists, and Hundred Talents Program of Chinese Academy of Sciences, was graduated from Department of Biology, Lanzhou University in 1988. He obtained his Ph.D. in Institute of Botany, Chinese Academy of Sciences in 1998. He pursued Postdoctoral research with Dr. Fakhri Bazzaz in Department of Organismic and Evolutionary Biology, Harvard University from 1998 to 2002. In 2002, Dr. He joined the Department of Ecology, Peking University, dedicating to studies on carbon stocks and dynamics, C:N:P stoichiometry across Chinese grassland biomes, and the response and adaptation of alpine ecosystem to global change. Dr. He joined Northwest Institute of Plateau Biology, Chinese Academy of Sciences in 2009 as senior scientist of Hundred Talents Program.

In recent years, Dr. He's group has made considerable progress in following areas: (1) Plant functional traits: They found consistent trade-offs between leaf productivity and persistence which are independent of plant life form and research regions (Ecology 2009). They reported that co-variations of leaf traits on the Tibetan Plateau were consistent with those on the global scale, demonstrating convergent evolution in plant functioning (New Phytologist 2006). The paper was regarded as one of the cutting-edge international research in New Phytologist (Woodward and Slater 2007); (2) Ecological Stoichiometry: They conducted a systematic census of foliar C:N:P stoichiometry and examined factors regulating the grassland foliar stoichiometry. Although the grasslands of China are widely distributed, the ratios of C:N and N:P in dominant species are relatively constant. Species composition, rather than direct climatic variables, is the major determinant of grassland foliar stoichiometry (Oecologia 2006, 2008); (3) Biodiversity and ecosystem functioning: they revealed that the positive Species Richness-ANPP relationship across large-scale environmental gradients was mostly likely the result of climatic variables influencing SR and ANPP in parallel. There is no direct relationship between SR and ANPP (Global Ecology & Biogeography 2010).

Research Interests

(1) Responses and adaptations of alpine grassland to global climate change; (2) Alpine wetland GHGs emissions and its feedback to global climate change; (3) Rate, mechanism and potential of carbon sequestration in the grassland ecosystems on the Tibetan Plateau; (4) Carbon and nitrogen cycling and their regulation mechanisms in alpine grasslands.

Research Progress in 2011

1. Relationship between plant functional traits and geographic range size

It is a common natural phenomenon that some species are widely distributed while other species have narrow ranges. As habitat heterogeneity tends to increase with geographical distance, wide-ranging species is usually defined as "generalists" and narrow-ranging species as "specialists". We collected data on leaf traits, species range sizes, soil and climate information of 208 species over178 sites along a transect in Inner Mongolia and Tibetan Plateau. Our results showed that while there was little evidence that narrow-ranging species had particular leaf traits, they did show stronger leaf-environment relationships compared with wide-ranging counterparts, indicating a high specialization of narrow-ranging species to particular habitats.

2. "Warming-Precipitation" manipulative experiment on the alpine grassland

The Tibetan Plateau is thought to be highly sensitive and vulnerable to global climate change with rapid rise in its air temperature during the past several decades. According to the latest IPCC report, high-altitude areas in Asia is undergoing significant warming at a speed three times higher than the global average. The rainfall pattern has also changed within the plateau since the 1960s. We launched the "Warming-Precipitation" manipulative experiment on the alpine grassland from 2011 to answer the scientific questions that how does warming affect the structure and function of the alpine grassland ecosystem, and how does it interact with precipitation regime. The experiment design include two temperature levels (CK, +2℃) , and three precipitation levels (Ambient, −50%, +50%) , with six replicates in a full factorial design (36 plots) (Fig. 1)

3. Long-term monitoring of greenhouse gas emission in alpine grassland and wetland

Drying process caused by global and regional climate change is significant on the Tibetan Plateau over the past 30-40 years. Some wetlands have been converted to alpine meadow and alpine steppe due to permafrost degradation, resulting in shift in the greenhouse gas flux which further feedback to the climate change. We established the long-term greenhouse gas monitoring platform with three approaches: traditional static closed chamber/GC technique (started at 2010-7-1); Automated static closed chamber with Pricarro 2301 real-time GHG analyzer (started from 2011-7-23); eddy covariance method (Li-7500 & Li-7700, started at 2011-6-1) (Fig.2)

Publications

1. Chu ZY, Lu YJ, Chang J, Wang M, Jiang H, He J-S, Peng CH, Ge Y, Leaf respiration/photosynthesis relationship and variation: an investigation of 39 woody and herbaceous species in east subtropical China. Trees-Structure and Function 25: 301-310

2. Geng Y, Wang ZH, Liang CZ, Fang JY, Frank B, K ü hn P, Scholten T, He J-S*. 2011. Effect of geographical range size on plant functional traits and the relationships between plant, soil and climate in Chinese grasslands. Global Ecology and Biogeography, DOI: 10.1111/j.1466-8238.2011.00692.x

3. Tao S, Wang WT, Liu WX, Zuo Q, Wang XL, Wang R, Wang B, Shen GF, Yang YH, He JS. 2011. Polycyclic aromatic hydrocarbons and organochlorine pesticides in surface soils from the Qinghai-Tibetan plateau. Journal of Environmental Monitoring 13: 175-181

4. Bruelheide H, Bohnke M, Both S, Fang T, Assmann T, et al. 2011. Community assembly during secondary forest succession in a Chinese subtropical forest. Ecological Monographs 81: 25-41.

高寒草地生物地球化学过程学科组

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学科组长:曹广民，博士，研究员。1986年7月获西北农业大学土壤农化专业学士学位，2010年12月获甘肃农业大学草业科学博士学位。1986年毕业以来一直在西北高原生物研究所从事高寒草地生态系统物质循环研究。任生态中心主任，海北站业务站长。中国生态学会第八届理事，中国土壤学会第十届理事。长期从事高寒草地生态系统生物地球化学循环方面的研究工作。

提出了高寒草地被动-主动退化理论，发现高寒草地退化可分为“四个时期，三个阶段、两种动力”；首次发现处于小嵩草群落草毡表层极度加厚期的高寒草甸其土壤碳贮最大，而草地稳定性处于崩溃的边缘，高寒草甸生产与碳生态服务功能最佳状态是不同步的。发现青藏高原高寒草甸生态系统中，不同的植物类群对大气甲烷的行为不同，草本植物群落具有排放甲烷的能力，而木本灌木群落具有吸收大气甲烷的能力，其分异可能与植物腔体结构和生理特性有关。目前承担国家自然科学基金、国家科技支撑和中科院先导性项目。

学科组主要研究方向

开展高寒草地对自然与人类活动干扰的适应与响应研究，揭示高寒草地演化过程与发生机制，提出其各阶段分异的特征及定量化判别指标；以高寒草地退化演替过程生态水文学特征为基础，探讨草地演化对系统水源涵养功能、系统碳贮及碳增贮潜力的影响；应用培养实验，明细高寒草地主要植物种对大气甲烷行为分异的特征及发生机理。

2011年代表性研究成果

青藏高原草地生态系统碳过程

青藏高原高寒草甸退化演替过程分为7个标志性阶段，即禾草-矮嵩草群落、矮嵩草群落、正常小嵩草群落、小嵩草群落草毡表层加厚期、开裂期和剥蚀期以及黑土滩-杂类草次生裸地，其碳储能力随草地退化程度的加深先增高后降低趋势，最高值出现在小嵩草群落草毡表层开裂期，草地的碳储能力同草地稳定性、植物群落生产能力不同步，小嵩草群落草毡表层加厚期是草地碳功能源汇转化的拐点，而矮嵩草群落是平衡草地碳储能力、系统稳定性及牧草生产能力的适宜碳容管理阶段。

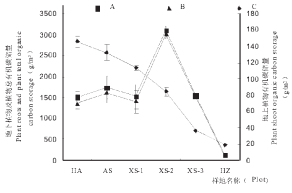

图1植物有机碳储量特征

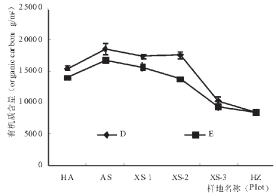

图2土壤、植物-土壤有机碳储量特征

注:A为植物地下有机碳贮量，B为植物总有机碳贮量，C为植物地上有机碳贮量，D为植物-土壤系统总有机碳储量，E为土壤有机碳储量;HA-禾草-矮嵩草群落，AS-矮嵩草群落，XS-1-正常小嵩草群落，XS-2-小嵩草群落草毡表层开裂期。XS-3-小嵩草群落草毡表层剥蚀期，HZ-黑土滩-杂类草次生裸地

青藏高原高寒草原和芨芨草温性草原退化演替过程同高寒草甸存在明显差异，其气候顶级群落碳储量最高，草地退化或改变草地固有的土地利用方式(建植人工草地或农田)，均可不同程度的降低草地的碳增汇潜力，且短时间内对极度退化草地采取退耕还草和人工草地等恢复措施其碳储能力没有明显改善，推断随着草地不断向地带性植被演替，其很可能成为未来的碳增汇区。

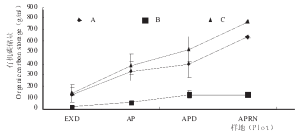

图3人工草地不同演替阶段植物有机碳贮量

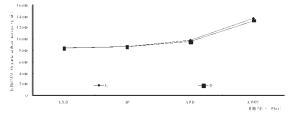

图4人工草地不同演替阶段植物-土壤系统固碳能力

注:A为地下植物有机碳贮量，B为地上植物有机碳贮量，C为植物总有机碳贮量，D 为土壤有机碳贮量，E 为植物-土壤系统有机碳贮量；EXD-人工草地建植前，AP-人工草地建植初期，APD-人工草地建植5年，APRN-人工草地建植14年。

高寒草甸生态系统CH4分异行为特征

利用静态箱-气相色谱法对青藏高原高寒草甸优势植物沙培下的甲烷通量测定，结果显示:大气甲烷的源植物，多为草本植物，大气甲烷汇植物多为灌木。对植物体进行机械损伤处理(横切、纵切)可以加强植物原有的大气甲烷源汇效应，据此推测植物种类及植物维管束气腔微结构对大气甲烷行为分异可能具有重要贡献。

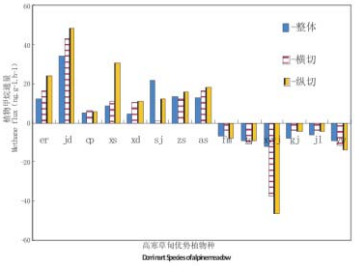

图5植物横切纵切对植物甲烷通量的影响

注:er.鹅绒委陵菜，cp.垂穗披碱草，xs.小嵩草，xd.线叶龙胆，s.沙棘，zs.藏嵩草，as.矮嵩草，xj.小叶杜鹃，dj.大叶杜鹃，fm.风毛菊，tc.苔草，xyyj.细叶亚菊，gj.鬼箭锦儿，jl.金露梅，yw.鸢尾

Alpine Grassland Piogeochemistry Process

学科组成员

杜岩功(助理研究员)

硕士研究生

郭小伟　李婧　刘淑丽

Droup Leaders: Professor Cao Guangmin received his bachelor degree in soil agrochemical from Northwest Agriculture and Forestry University. He then got his Ph.D. in Pratacultural science from Gansu Agriculture University. His main studies are on the biogeochemical cycling in alpine grassland in Northwest Institute of Plateau Biology, Chinese Academy of Sciences from 1986. He was the director of the eighth ecological society and the tenth soil science society.

The main findings in his studies were Passive–Active degradation theory in alpine degradation grassland, the theory could be divided degradation *Kobresia humilis* meadow succession process into four phases and three stages, and the retrogression driving force factors of the grassland was two. He was the first discoverer of which the largest organic carbon reserves was appeared in *Kobresia pygmaea* mattic epipedon crack phase in *Kobresia humilis* meadow degradation succession process, but this kinds of grassland ecological system stability and carbon sink ability was asynchrony, so there must be a optimum management stage which can consideration to carbon sink capacity and the forage productivity.

Another researches was CH_4 release and absorption characteristics in different plants in alpine grassland, the research showed that: the shrub community had the ability to absorb the CH_4, and herb community had the ability to release CH_4, the reasons why different plants release and absorption CH_4 characteristics might be associated with the plants vascular bundle structures and physiological characteristics.

He is the director of the National Natural Science Foundation, National Science and Technology Support Project and Pilot Project of Chinese Academy of Sciences.

Research interests

The researches are distributed in alpine grassland，the first research interest is to study the biochemistry process in alpine grassland succession process in order to discovery the succession process and mechanism by human activity and climate change, establish the discrimination quantitative index system of alpine grassland degradation succession stages. The second research interest is to explore alpine grassland water conservation function, organic carbon increasing sink potentiality capacity and it's reserve. The third research interest is to study the characteristics and theory of plants CH_4 release and absorption characteristics in alpine grassland ecosystem.

Research Progress in 2011

1. Response of Potential Carbon Sink Capacity in Different Grassland Land Use Patterns and Succession Process in Qinghai–Tibetan Plateau

Experiments used spatial series instead of time series, to research the organic carbon potential sink in alpine meadow, alpine grassland and *Achnatherum splendens* grassland, the results showed that: 1) There were 7 marker stages in *Kobresia humilis* meadow degradation succession process, there were gramineae grass–*Kobresia humilis* community, *Kobresia humilis* community, normal *Kobrecia pygmaea* community , mattic epipedon crakes *K. pygmaea* meadow, mattic epipedon thicking *K. pygmaea* meadow , mattic epipedon collapse *K. pygmaea* meadow and Forbs–" Black soil beach" in order, the largest organic carbon sink was appeared in K. pygmaea which mattic epipedon were cracks stage, but this kinds of grassland ecological system stability and carbon sink ability was asynchrony, so there must be a optimum management stage which can consideration to carbon sink capacity and the forage productivity.2)In alpine grassland and Achnatherum splendens grassland, the degradation succession process was different from the alpine meadow, the largest organic carbon sink was occurred in climate climax community, the organic carbon sink would be lower when the grassland could be used as artificial grassland or farmland, it was no significant effect to increase the organic carbon sink using planting artificial grassland and returning cultivated land to grassland in a short time. The degradation grassland, artificial grassland and farmland had lower organic carbon sink compared with climate climax community, so they would become the organic carbon sink regional.

2. Methane Flux of Dominant Species of Alpine Meadow on the Qinghai–Tibetan Plateau

To determine the methane flux of dominant species of alpine meadow, we had done a indoor cultivation of 15 kinds of dominant species by using closed chamber–GC method, and did a comparative study on cross–section treatment and longitudinal treatment to find the effect factors of plants methane emission rate. The results shows that, the shrub community had the ability to absorb the CH_4, and herb community had the ability to release CH_4, the reasons why different plants release and absorption CH_4 characteristics might be associated with the plants vascular bundle structures and physiological characteristics.

Publications

1. HAN D R, CAO G M, Guo X W, Zhang F W, LI Y K, LIN L, LI J, TANG Y H, GU S. The potential of carbon sink in alpine meadow ecosystem on theQinghai–Tibetan Plateau. Acta Ecologica Sinica,2011,31(24): 7408–7417.

2. GUO X W, HAN D R, ZHANG F W,LI Y K, LIN L, LI J, CAO G M. The response of potential carbon sequestration capacity to different land use patterns in Alpine Rangeland. Acta agrestia sinica, 2011,19(5):740–745.

3. ZHANG F W, HAN D R,GUO X W,LI Y K,CAO G M. Response of potential carbon sequestration capacity to different dand use patterns in *Achnatherum splendens* grassland in Qinghai–Tibetan Plateau. Acta bot.boreal.–occident.Sin. 2011,31(9):1866–1872

4. GUO X W, HAN D R, DU Y G, LIN L1,ZHANG F W, LI Y K, LI J, LIU S L, CAO G M.Methane Flux of dominant dpecies of alpine meadow on the Qinghai–Tibetan Plateau. Journal of mountain science, Accept

陆地生态系统过程和功能对全球变化的响应和适应

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学科组长:李英年，1962年9月出生，研究员。现中国科学院西北高原生物研究所/海北高寒草甸生态系统国家野外科学观测研究站从事高寒草甸生态系统对全球变化响应与反馈方面的研究工作。2005年以来主持或参加中国科学院知识创新工程重大项目、国家973计划项目、国家自然基金面上项目、中国科学院战略性先导科技专项等近8项。研究了高寒草甸生态系统能量和碳通量的时间变动特性、碳汇功能及光温水等因子对碳收支的影响；探讨了不同放牧强度、不同封育时间、不同海拔高度梯度上植被-土壤碳氮密度时空分布、生态系统呼吸、生态系统CO_2净交换量分布格局以及水碳氮耦合关系；2011年度“三江源湿地变化与修复研究与示范”获青海省科技进步二等奖(第7完成人)。先后发表研究论文及专著近200余篇(部)，其中SCI收录近20余篇。

学科组主要研究方向

1)生态系统碳通量；碳氮水热耦合；固碳潜力；

2)植被净初级生产力对全球变化的响应与适应。

2011年代表性研究成果

1)祁连山南坡不同海拔高度土壤与植被位移后土壤碳氮的短期变化特征:

祁连山冷龙岭南麓坡地进行不同海拔高度的土壤—植被的整体双向移地，探讨气候变化对土壤碳、氮含量及其比例的影响。移地后土壤有机质含量总体表现出随海拔升高而升高，3600m到3800m处略有下降；

2)围栏放牧下土壤-植被碳密度空间分布格局:

对围封13年且放牧的冷季矮嵩草草甸进行植被和土壤碳密度调查发现，A.植被碳密度自出入口到50m较高，60～180m有所下降，200～300m升高。B.从围栏入口到草场内部土壤碳密度自出入口到100m增加，100～170m减小，然后略有升高。这种分布趋势与放牧过程中绵羊觅食频度和强度有关。

3)放牧格局和生境资源对矮嵩草分株生物量分配和补偿性生长的影响:

表明在研究地区放牧扰动格局对克隆植物矮嵩草分株的生物量分配和补偿生长具有重要影响,适度放牧利用更利于引起超补偿,而重度利用可能会对该种群的长期保持产生不利影响。

4)刈割、施肥和浇水对矮嵩草补偿生长的影响:

通过对海北高寒矮嵩草草甸进行为期3年的野外控制试验处理，发现矮嵩草在刈割后可通过增加分株密度和相对增长率等途径来提高补偿能力, 弥补在生长高度上出现的低补偿, 而施肥可显著抵消刈割的不利影响, 提高矮嵩草的补偿能力。

科技成果

2011年度“三江源湿地变化与修复研究与示范”获青海省科技进步二等奖(7完成人)。

Response and Adaptation of Process and Function of Terrestrial Ecosystem to Climate Change

学科组成员

李红琴

硕士研究生

刘晓琴　吴启华　毛绍娟

Group Leader:Li Yingnian, researcher, born in 1962. He was engaged in the study about the response and feedback of the alpine meadow ecosystem to the climate change. He was in charge of 8 project including Knowledge Innovation Project of the Chinese Academy of Sciences, National Key Basic Research Program, National Natural Science Foundation of China , Strategic Pilot Science and Technology Projects of Chinese Academy of Sciences since 2005. He studied characteristics of the change of the energy and carbon flux, carbon sink function of the alpine meadow, and the influence of light, temperature and water on carbon budget. He also explored the temporal and spatial distribution of carbon and nitrogen density, ecosystem respiration, net CO_2 exchange of ecosystem and coupling relationship of water, carbon and nitrogen. As the 5th co-author for "Alpine meadow Ecosystem and Climate Change", he won the first prize for Scientific and Technology Progress of Qinghai Province on May, 2010. As the 7th co-author for "Repair Study and Demonstration in Changing Wetland Ecosystem of Sanjiangyuan", he won the second prize for Scientific and Technology Progress of Qinghai Province in 2011. He wrote nearly 200 papers and monographs, 20 of which were included by SCI.

Research Interests

1 Carbon flux of ecosystem; Coupling of carbon, nitrogen and water; Carbon sequestration potential;

2 Response and adaptation of the vegetation's net primary production to global change.

Research Progress in 2011

1. In the southern slope of Lenglongling of Qilian mountain, a reciprocal translocation experiment of coherent quadrafts of soil and turf was conducted and the influence of climate change on the content and ratio of carbon and nitrogen was analyzed. Generally, the content of soil organic matter appeared to increase with the elevation rising but decreased a little from 3600m to 3800m.

2. Spatial distribution pattern of carbon density of soil-vegetation under 13-year enclosed and grazing alpine meadow were as follows: From the entrance to the inside 50 m, the carbon density of vegetation was higher. It decreased at inside 60-80m, and increased at inside 200-300m; Carbon density in soil had the same variation trend which was related to foraging frequency and grazing intensity of sheep.

3. Effects of grazing disturbance pattern and nutrient availability on biomass allocation and compensatory growth in *Kobresia humilis*: Grazing defoliation significantly affected the patterns of biomass allocation and compensatory growth of *Kobresia humilis*. Moderate defoliation caused the overcompensation. But heavy defoliation would have a negative effect on long-term persistence of the population in the area.

4. Effects of clipping, fertilizing and watering on compensatory growth in *Kobresia humilis*: A 3-years field-manipulative experiment was conducted in the *Kobresia humilis* meadow in Haibei research station. The compensatory capability of *Kobresia humilis* could be enhanced by improving the community density and increasing the relative growth rate after being clipped. Fertilizing could significantly offset the negative effect of clipping and improve the compensation ability.

小哺乳动物种群调节及有害鼠类生物防治

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学科组长:边疆晖，博士，研究员，博导。1985年毕业于甘肃农业大学，1998年在中科院西北高原生物研究所获动物生态学硕士学位，2001年在中科院西北高原生物研究所获动物生态学博士学位。2003年在浙江大学生命科学学院博士后流动站从事博士后研究2年。兼任《兽类学报》编委 、中国生态学会动物生态专业委员会委员、中国动物学会兽类学分会理事等职。主要从事小哺乳动物种群生态学及鼠害防治的研究。先后参加国家七五科技攻关项目、中国科学院八五重大项目题等，主持国家自然科学基金4项，以及西北之光联合学者项目、国家科技支撑项目子专题、中国科学院知识创新工程重要方向项目、中国科学院院长择优基金和中国博士后基金等各1项。发表论文40余篇，作为主要参加者，1991年获中国科学院科技进步二等奖1项，以及1998年方树泉奖学金一等奖1项。

学科组主要研究方向

以青藏高原小哺乳动物为研究对象，野外与实验研究相结合，采用种群生态学、生理学、免疫学和神经生物学的方法和技术手段，整合研究动物生理和行为及种群统计参数的功能及其近因和远因，探讨动物种群调节机理及有害啮齿动物的生物防治途径。 主要研究兴趣包括: 1. 小哺乳动物种群的调节机理 2.有害啮齿动物的生物防治 。

2011年代表性研究成果

1.母体密度应激对根田鼠种群繁殖的影响

野外围栏种群密度调控实验结果表明，本单一的母体应激没有影响根田鼠种群的繁殖，但在母体密度应激与当前高密度环境的共同作用下，可显著降低了根田鼠子代种群的繁殖，并使种群年龄结构趋于老龄化，该老龄化种群在冬季环境因子的作用下，以迟滞性密度制约方式显著降低了根田鼠种群繁殖，并对种群数量产生了重要的影响。

2.艾美耳混合球虫对高原鼠兔繁殖

在繁殖中期，高原鼠兔雌性成体的繁殖概率及其性腺指数与球虫感染率呈负相关关系，但该效应在其他季节没有发现。雄性成体在3个繁殖阶段均无发现睾丸及附睾指数与感染率间的相关关系。野外观测和实验调控球虫感染实验发现，感染球虫可显著降低胚胎的重量。说明，艾美尔球虫对高原鼠兔繁殖存在偏于性别的季节性影响，且感染球虫后可延缓胚胎的发育。

3.艾美耳混合球虫对高原鼠兔致死性的研究

前期室内研究表明，艾美尔球虫对高原鼠兔有较强的致死性。为此，将球虫研制成复合球虫毒饵后，在野外进行了灭效实验。研究果表明， 300万球虫卵囊复合毒饵可导致54.88%的成体和70.97%的幼体死亡，且可抑制残存妊娠雌体的胚胎发育。此外，投放毒饵样地的球虫感染率和感染强度显著大于对照样地。上述结果说明，将艾美尔球虫应用于防治高原鼠兔具有较好的速效性，同时还可能具有长效性的优点。

Population Regulation for Small Mammal Population and Biological Control.

学科组成员

景增春 (副研究员)

曹伊凡 (副研究员)

硕士研究生

杨乐　杜寅　何慧　聂绪恒

Group leader: Bian Jianghui was graduated from Gansu Agricultural University with Bachelor Degree. In 2001, he obtained his Ph. D. in animal ecology in Northwest Institute of Plateau Biology, the Chinese Academy of Sciences. In 2003, he was Postdoctoral fellow in College of Biology, Zhejiang University. He is editorial member of *Acta Theriologica* Sinica, member of the Division of Animal Ecology, China Ecological Society, and member of the Division of Mammalogy, China Zoological Society. His research interests were population ecology and biological rodent control. In recent years, he take charge of Project supported by the National Natural Science Foundation of China, West Light Foundation of the Chinese Academy of Sciences, Knowledge Innovation Program of the Chinese Academy of Sciences, The National Key Technology R&D Program *et al*.

research interests

1. Population ecology
2. Animal behavior and rodent pest management.

Research Progress in 2011

1. Effect of maternal density stress on reproduction in root vole populations

Our results in enclosure populations showed that maternal stress alone induced by high density did not affect reproduction performance of their offspring, but prenatally stressed adult offspring reduced reproduction when they were exposed to high density during breeding period, which result in population age display senescent. Under the interaction of the senescent and factors of winter environment, maternal stress affects reproduction performance of root vole populations in delayed density–dependent manner.

2. Effects of coccidian parasites (Protozoa) on Reproduction in Plateau Pika (*Ochotona curzoniae*)

In mid–period of breeding, reproductive probability of female adults was negatively related to prevalence of coccidian parasite, and there was a negative relationship between ovary index and infection intensity. However, these effects were not found in the other two periods. No significant relationship between infection intensity and testis index were found in males in any breeding period. Interestingly, field observation and experimental manipulation showed that infection with coccidian did not alter litter size, but significantly decreased weight of embryos. Our results suggest that the seasonal and sex–biased effects on plateau pika's reproduction may be related to seasonal variation in incidence of occidian parasites and different adaptive breeding strategies of males and females for harsh environment in Qinghai–Tibet plateau. Our results firstly demonstrated an influence of parasites infection on embryos' development.

3. Effects of Parasitic Eimerians on mortality of plateau pika

Our previous study found that the mortality rate among infected pikas was dependent on the initial quantity of oocysts administered. To examine the effect of coccidia, as agents of biological rodent control, on decrease in the damages of pika to grassland, we carried out a field study. We found that the bait (containing 300×104 oocysts and synergist) can cause 54.88% and 70.97% decrease in number of adults and juveniles. Besides, the bait can influence embryo development in field. Infection rate and intensity is significant higher after treatment. Our results suggest that coccidian parasites have good effectiveness for pika control, and may have long–term effect on plateau pika populations.

高山植物的光合及生理生态适应研究学科组

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学科组长:师生波，研究员，博士，硕士生导师。

在中国科学院海北高寒草甸生态系统定位站主要从事高山植物的光合生理和极端环境的生理生态适应性研究。近年来，针对青藏高原强太阳可见光和UV-B辐射的特点，开展了高山植物对强太阳光的适应性研究，在非辐射能量耗散、光合电子传递活性、光合机构的光抑制等方面做了大量探索。阐明了叶片光形态结构变化，紫外线吸收物质和抗氧化系统在强光胁迫中的作用，提出强UV-B辐射“促进”叶片光合色素含量的升高是一种表象的观点。已主持有国家自然科学基金，国际科技合作重点项目计划(纳入973计划)等项目。曾在中科院上海植物生理研究所和北京植物研究所做国内访问研究，并多次到瑞典、日本、英国进行交流和访问进修。现任中国植物生理学会第十届理事会理事，并担任中国植物生理学会西部开发工作委员会副主任委员。

学科组主要研究方向

集中在平流层臭氧耗损导致的太阳UV-B辐射增强对青藏高原植物的胁迫驯化适应等方面。光合作用气体代谢和荧光动力学技术是野外条件下研究植物与环境之间能量与物质交换的重要途径，对于揭示植物的进化适应有重要意义，是研究高原胁迫环境中植物光合机构适应性的有利工具。结合室内生理生化分析，本学科组开展高原极端环境下典型高山植物的生理生态适应机理研究；同时，以青藏高原强太阳UV-B辐射为切入点，模拟全球气候变化背景太阳UV-B辐射增强对高寒草地生态系统主要植物光合生理的影响。

2011年代表性研究成果

基于青藏高原上空臭氧变化趋势和近地表面太阳UV-B辐射特性，本学科组以中国科学院海北高寒草甸生态系统实验站为基地，开展了系列模拟研究试验。主要包括野外自然光背景下的长期和短期模拟增补UV-B辐射试验，主要结论表明:UV-B辐射增强可加剧PSII反应中心的光抑制程度，叶片光合功能的发挥取决于光抑制和光形态适应的平衡；自然太阳光谱中的UV-B组分是引起光合机构光抑制的一个原因，并可导致稳态作用光下PSII光化学效率的降低，叶片净光合速率的降低与气孔限制无关。并认为可见光辐射是影响稳态作用光下PSII反应中心光化学效率的主要因素；叶片厚度的增加是植物应对强UV-B辐射的策略之一；强UV-B辐射“促进”叶片光合色素含量的升高是一种表象；叶表皮层细胞中高含量的UV-B吸收物质在保护光合机构以及生物大分子DNA等免受损伤的方面具有重要作用。显然，长期生存在青藏高原的高山植物具有一系列形态和生理的适应方式，可应对强可见光和UV-B辐射构成的光抑制。

Adaptation of Photosynthesis of Alpine Plants

硕士研究生

尚艳霞　朱鹏锦　杨莉

Group leader: Professor Dr. Shi Shengbo mainly engaged in eco-physiological adaptability and photosynthesis study of alpine plants in Haibei Alpine Meadow Ecosystem Station, CAS. In recent years, based on strong solar visible and UV-B radiation in the Qinghai-Tibet plateau, the adaptive characteristics of alpine plants to strong solar light was researched. A lot of explorations were made in the radiation energy dissipation, photosynthetic electronic transfer activity, and photoinhibition of photosynthetic apparatus. The results indicated that changes of the leaf photomorphology, UV-B-absorbing compounds and antioxidant system play the main role against strong light stress, put forward that strong UV-B radiation "promotion" the increasing of photosynthetic pigment content is a representation of the view. He already have presided over some funds from national natural science and key international technology cooperation plan (belong to 973 plan) and other projects. As visiting scholar, he visited and studied in Sweden, Japan, and Britain in recent years.

Research Interests:

Recent research interesting was focused on the adaptability of alpine plants to increased UV-B radiation caused by depletion of stratospheric ozone layer over Qinghai-Tibet region. In the field of natural environment, using photosynthetic gas metabolism and the chlorophyll fluorescence method, together with the physiological and biochemical analysis, the eco-physiological adaptation mechanism were carried out in plateau harsh environmental condition; At the same time, based on strong solar UV-B radiation in Qinghai-Tibet plateau, simulating increased solar UV-B intensity as global climate change background, physiological effect of photosynthetic apparatus were studied in some native alpine plants.

Research Progress in 2011

Based on the trend of stratospheric ozone over Qinghai-Tibet plateau and solar UV-B radiation characteristics near earth surface, we carried out a series of simulation test alpine plants in Haibei Alpine Meadow Ecosystem Station, CAS. The recent works include long-term and short-term simulation supplemented UV-B radiation experiment in the field under the background of natural light. The main results indicated that increasing of UV-B radiation can aggravate photoinhibition on PSII reaction centers, photosynthetic functions depends on the balance of photoinactivation and light stress acclimation; UV-B spectrum in natural sunlight is one of the main reason of photoinactivation of photosynthetic apparatus, and can lead to reduction of efficiency of PSII photochemistry in steady state sunlight. We considered that visible light is the primary factor which influence PSII photochemical efficiency; Leaf thickness of plants increased after UV-B enhancement is the one adaptation strategy; Strong UV-B radiation "promote" photosynthetic pigment content increase is a kind of appearance; High content of UV-B absorbing compounds in leaf epidermis cells play an important role in photodamage in photosynthetic apparatus and DNA macromolecule. Obviously, the long-term survival of alpine plants on the Qinghai-Tibet plateau with a series of morphological and physiological can deal with strong visible and UV-B radiation stress.

高原生物分析化学学科组

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学科组长:胡风祖，研究员，硕士生导师。1980年毕业于北京大学生物系生化专业，目前担任中国科学院西北高原生研究所分析测试中心主任，青海女科技工作者协会副会长，中国化学学会青海化学分会副会长，西北色谱学会理事，青海色谱分会理事长。主要从事藏药，民族保健食品和新资源食品的研制开发工作和生物化学、中藏药化学的分析研究工作。在本领域中先后发表论文50余篇，获成果20多项，先后主持和参加项目20项，申报专利4项。

学科组主要研究方向

1. 通过对青藏特色生物资源化学分析，揭示其在极端环境下的生长特性，为合理开发和保护提供科学依据；

2. 进行藏药材质量控制关键技术与评价标准体系研究，为藏药新药研发及濒危药材的驯化、人工种植等提供科学依据；

3. 开展食品中有害物质分析的新技术和新方法研究，解决食品安全质量控制中关键环节，为食品安全质量体系建立提供技术支撑。

2011年代表性研究成果

38种有机磷、有机氯和菊酯类成分GC-MS分析

科技成果

专利

专利名称:从红景天药材中提取红景天苷、多糖和鞣质类物质的方法

发明人:胡风祖 董琦 杜玉芝

授权公开号:CN 10158026 B

论文

1. CHI Xiao-feng, DONG Qi, XIAO Yuan-can, PI Li, HU Feng-zu. Analysis of the Nutritional Components of Sphallerocarpus gracilis. Acta Nutrimenta Sinica.2011, 33(2)207-208

2. XU Yan-li, DONG Qi, HU Feng-zu. Simultaneous Determination of Viterxin, Quercetin and Quercitrin in Polygonum viviparum in Tibet Plateau by RP-HPLC. Natural Product Research and Development 2011, 23:894-897

Bioanalytical Chemistry

学科组成员

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硕士研究生

矫晓丽 曹静亚

Group Leader: Hu Fengzu, Professor, Master Instructor. Graduated from the Biology Department of Beijing University in 1980, and majored in Biochemistry. She currently serves as Director of Analysis and Test Center in Northwest Plateau Institute of Biology, Chinese Academy of Sciences. At present, her research focuses on Tibetan medicine, health food and new resourceful food. In her research field, 50 papers published, almost 20 outcomes gained, 4 patents declared.

Research Interests

1. Research in the chemical analysis of idiomatical Qinghai–Tibetan biological resources to reveal the characteristics of the growth in extreme environments, and provides the scientific basis for the rational exploitation and protection;

2. Research in the key technologies of quality control and evaluation of standard system of Tibetan medicine, to provide a scientific basis for the Tibetan New Drug R & D and the domestication of endangered herbal drugs;

3. Research in the new technologies and new methods of harmful substances analysis in food, to solve the key link in the food safety and quality control, and to provide technical support for the establishment of food safety and quality system.

Research Progress in 2011

Analysis of 38 kinds of organic phosphorus, organic chlorine and permethrin by GC–MS.

Publications

1. Chi Xiao–Feng, Dong Qi, Hu Feng–Zu. Determination of Seventeen Trace Elements in Hordeum Vulgare L.var. nudum Hook.f by ICP–AES with Microwave Digestion. Chinese Journal of Spectroscopy Laboratory.2011,27(6) 2177–2180

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3. XU Yan–li, DONG Qi, HU Feng–zu. Simultaneous Determination of Viterxin, Quercetin and Quercitrin in Polygonum viviparum in Tibet Plateau by RP–HPLC. Natural Product Research and Development 2011, 23:894– 897

4. JIAO Xiao–li, CHI Xiao–feng, DONG Qi, XIAO Yuan–can, HU Feng–zu. Analysis of the Nutritional Components of Lycium ruthenicum. Amino Acids & Biotic Resources.2011, 33(3): 60–62

5. CHI Xiao–feng, DONG Qi, XIAO Yuan–can, PI Li, HU Feng–zu. Analysis of the Nutritional Components of Sphallerocarpus gracilis. Acta Nutrimenta Sinica.2011, 33(2)207–208

6. CHI Xiao–feng, XING Yu–xiu, DONG Qi, HU Feng–zu. Determination Contents of Twenty Elements in Different Cultivars of Naked Barley by ICP–AES. Food Science 2011, 32(10)130–132