生薬資源科学分野　　Division of Pharmacognosy

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◇研究目的

地球環境の変化により，薬用天然資源の減少が危惧される。そこで本分野では，生薬資源の現状の把握と代替生薬の開発，生薬の特徴を把握した効率的利用の促進並びに栽培薬用植物の選択と栽培拡充を目的にして，アジアにおける漢薬資源の調査と薬用生物の遺伝学的，成分化学的，薬理学的多様性の解析を行う。また，天然薬物の標準化を目的にして，遺伝子多型に基づく生薬同定法の開発並びに成分・活性情報の融合による生薬機能の解析を行う。

◇研究概要

Ⅰ）薬用生物及び伝統薬物の調査研究

1) ベトナム北部～中部で *Panax* 属，*Acanthopanax* 属，*Salacia* 属及び *Cinnamomum* 属植物，インドの Andhra Pradesh 州及び Karnataka 州で *Salacia* 属などの資源調査を行い，同時に伝統薬物を収集した。
2) 金沢大学資源生薬学研究室と共同で，北海道にて薬用植物栽培の調査を行った。また，生薬資源調査アンケートを日本漢方生薬製剤協会員加盟企業の協力を得て実施した。

Ⅱ）薬用植物・生薬の多様性の解析

1) インド及びスリランカ産 *Salacia* 属由来生薬について，核 ITS 領域及び葉緑体 *trn*K-*rps*16 spacer 領域の解析を行い，*S. oblonga* 及び *S. reticulata* の遺伝子多型を明らかにした。
2) 中国産 *Codonopsis* 属植物 2 種 1 変種 100 検体余の ITS 領域を解析し，各分類群を同定するためのマーカー配列を明らかにし，中国及び日本市場の党参の基原を同定した。

Ⅲ）漢方方剤・生薬・健康食品の品質評価とレギュレーション

医薬基盤研究所薬用植物資源研究センターに協力して，日本で流通している人参及び芍薬の 18S rRNA 遺伝子・*trn*K 遺伝子及び ITS 領域の塩基配列の解析を行った。

Ⅳ）薬用植物の二次代謝の変動解析

イチイ，ウコンなどの薬用植物について，メタボローム解析により二次代謝変動の植物生理学的解析を行った。

Ⅴ）伝統医薬データベースの構築

日本市場の生薬約 50 種類について遺伝子解析を行い，その結果をデータベースに構築した。和漢医薬学総合研究所の研究者と共同で伝統医薬データベース Ver.2 を完成させ、Web 上で公開した（ほくりく健康創造クラスター広域化プログラム）。

◇原著論文

1) **Zhu S., Bai Y. J., Oya M., Tanaka K., Komatsu K., Maruyama T., Goda Y., Kawasaki T., Fujita M., Shibata T.: Genetic and chemical diversity of *Eleutherococcus senticosus* and molecular identification of Siberian ginseng by PCR-RFLP analysis based on chloroplast *trn*K intron sequence. Food Chemistry, 129: 1844-1850, 2011.**

Abstract: Siberian ginseng (SG), the rhizome and root of *Eleutherococcus senticosus*, has been used as a tonic and anti-fatigue agent in northeastern Asia from ancient time. In recent years, SG has been becoming fairly popular as dietary supplements and health foods worldwide. In order to establish a convenient and sensitive method for authentication, chloroplast *trn*K intron sequences of 6 *Eleutherococcus* species were determined and compared. Genetic polymorphism, representing by 14 types of *trn*K intron sequence, in *E. senticosus* was observed. However, characteristic nucleotide markers stable within this species enabled clear discrimination of it from other congeners. A PCR-RFLP method was further developed, which was demonstrated to be efficient for authentication of crude drugs as well as health foods. Quantitative evaluation of three main bioactive constituents indicated chemical diversity in *E. senticosus* collected from northeast China and the results suggested good producing areas of SG. The chemical data clearly revealed that *E. sessliflorus* was unsuitable to be used as SG.

2) **Kitani Y., Zhu S., Batkhuu J., Sanchir C., Komatsu K.: Genetic diversity of *Ephedra* plants in Mongolia inferred from internal transcribed spacer sequence of nuclear ribosomal DNA. Biol. Pharm. Bull., 34: 717-726, 2011.**

Abstract: Ephedrae Herba has been used for treating colds, relieving coughs and asthma from ancient times. We previously reported the distribution of *Ephedra sinica*, *E. equisetina*, *E. przewalskii*, *E. regeliana*, *E. monosperma* and *Ephedra* sp. in Mongolia, and among them *E. sinica* and *E. equisetina* were potential new resources of Ephedrae herba of Japanese pharmacopoeia grade, based on our field survey and the subsequently molecular and chemical assessments. However, population in southwestern areas showed high possibility of having hybrid origins. Further field survey in southwestern areas and sequence analysis of partial nuclear internal transcribed spacer 1 (ITS1) region besides *trn*K gene and 18S rRNA gene regions were conducted in order to obtained detailed evidences of hybridization status. As results, distribution of *E. glauca* in western area and *E. lomatolepis* in westernmost area was confirmed. The ITS sequences from all 8 *Ephedra* species collected in Mongolia were roughly divided into 5 types (types I - V). Type II sequence having several additive nucleotides and was found in *Ephedra* sp., *E. glauca*, *E. regeliana* and *E. sinica*, which provided useful information for tracing hybrid origin. Morphological, genetic and distribution evidences suggested that hybridization of *Ephedra* species occurred in wide range of southwestern Mongolia and several *Ephedra* species including *E. przewalkskii* and *E. intermedia* were involved in these events. Integrated with our previous report, *trn*K-, 18S- and ITS-types from pure line of each species could be proposed. In addition, we proposed a practicable method for detecting additive peaks on direct sequencing electropherogram.

3) **Bai Y. J., Tohda C., Zhu S., Hattori M., Komatsu K.: Active components from Siberian ginseng (*Eleutherococcus senticosus*) for protection of amyloid β(25-35)-induced neuritic atrophy in cultured rat cortical neurons. J. Nat. Med., 65: 417-423, 2011.**

Abstract: Not only neuronal death but also neuritic atrophy and synaptic loss underlie the pathogenesis of Alzheimer's disease as direct causes of the memory deficit. Extracts of Siberian ginseng (the rhizome of *Eleutherococcus senticosus*) were shown to have protective effects on the regeneration of neurites and the reconstruction of synapses in rat cultured cortical neurons damaged by amyloid β (Aβ)(25-35), and eleutheroside B was one of the active constituents. In this study, a comprehensive evaluation of constituents was conducted to explore active components from Siberian ginseng which can protect against neuritic atrophy induced by Aβ (25-35) in cultured rat cortical neurons. The ethyl acetate, *n*-butanol and

water fractions from the methanol extract of Siberian ginseng showed protective effects against Aβ-induced neuritic atrophy. Twelve compounds were isolated from the active fractions and identified. Among them, eleutheroside B, eleutheroside E and isofraxidin showed obvious protective effects against Aβ (25-35)-induced atrophies of axons and dendrites at 1 and 10 μM.

4) **Rinthong P. O., Zhu S., Komatsu K., Chanama S., De-Eknamkul W.: Genetic variation of *Croton stellatopilosus* Ohba based on non-coding DNA sequences of ITS, *trn*K and *trn*L-F regions. J. Nat. Med., 65: 641-645, 2011.**

Abstract: *Croton stellatopilosus* Ohba (Plau-noi), a well-known Thai medicinal plant, was investigated for its genetic variation by analyzing three DNA regions, one nuclear internal transcribed spacer (ITS) region and two chloroplast *trn*L-F intergenic spacer and *trn*K intron regions. The results of ITS sequencing from 30 leaf samples showed that there were two major genotypes of *C. stellatopilosus* which were designated as STEL Type A and B. In addition, various nucleotide additive sequences which had presumably arisen from these two groups were also found. These so-called "putative hybrids", interestingly, displayed *trn*K intron sequences identical to the STEL Type B but different from the Type A. For the *trn*L-F region, all the 30 samples showed identical sequences. Thus, it was suggested that in the hybridization of C. stellatopilosus, the Type A genotype acts as paternal parent whereas the Type B genotype acts as maternal parent. In addition, all *C. stellatopilosus* samples were analyzed for their plaunotol content using TLC densitometry. We found that the Type A genotype, hybrid group and Type B genotype had plaunotol content in the ranges 0.209-0.492, 0.319-0.896 and 0.442-1.000% (w/w) dry weight, respectively. The results indicated that there is a correlation between the plaunotol contents and non-coding DNA sequences of ITS, *trn*K and *trn*L-F regions of *C. stellatopilosus*.

5) **Nakamura K., Nishihata T., Jin J. S., Ma C. M., Komatsu K., Iwashima M., Hattori M.: Determination of the sugar moiety after cleavage of a C-glucosyl bond of puerarin by a human intestinal bacterium strain PUE. Chem. Pharm. Bull., 59: 23-27, 2011.**

Abstract: *C*-Glycosides are usually resistant against acidic hydrolysis and enzymatic treatments because C-1 of the sugar moiety is directly attached to the aglycone by C-C bonding. Nevertheless, a human intestinal bacterium, strain PUE, can cleave the *C*-glucosyl bond of puerarin to yield its aglycone daidzein. To clarify the mechanism of the cleaving reaction, we tried to identify the structure of the metabolite derived from the sugar moiety of puerarin. To detect it easily, deuterium labeled puerarin, [6″,6″-D_2]puerarin, was prepared in 7 steps. Sugars contained in a metabolite mixture from [6″,6″-D_2]puerarin was analyzed by an HPLC-electrospray ionization (ESI)-MS method after treatment of sugars with 1-phenyl-3-methyl-5-pyrazolone (PMP). Since deuterium labeled glucose was detected in the metabolite mixture of [6″,6″-D_2]puerarin, we concluded that puerarin was metabolized to daidzein and an intact glucose by strain PUE. As C-1 of the sugar was hydroxylated instead of hydrogenating, *C*-glucosyl bond-cleaving reaction is not reduction but hydrolysis. This is the first report of revealing the reaction manner and the exact products of *C*-glucosyl bond-cleaving reaction.

6) **Hung T. M., Cuong T. D., Dang N. H., Zhu S., Long P. Q., Komatsu K., Min B. S.: Flavonoid glycosides from *Chromolaena odorata* leaves and their *in vitro* cytotoxic activity. Chem. Pharm. Bull., 59: 129-131, 2011.**

Abstract: Two new flavonoid glycosides, (1, 2), and eleven known compounds, (3-13), were isolated from a 70% EtOH extract of the leaves of *Chromolaena odorata* (Asteraceae). Their structures were elucidated by 1D and 2D NMR spectroscopic interpretation as well as by chemical studies. The newly isolated compounds were tested *in vitro* for their cytotoxic activities against the LLC and HL-60 cancer cell lines. Compound 1 showed cytotoxicity against LLC and HL-60 cancer cell lines with IC_{50} values of 28.2 and 11.6 μM, respectively. Compound 2 exhibited significant cytotoxic activity in the inhibition of HL-60 cancer cell lines with IC_{50} value of 10.8 μM.

7) **Hou X. L., Hayashi-Nakamura E., Takatani-Nakase T., Tanaka K., Takahashi K., Komatsu K., Takahashi K.: Curdione plays a key role in the inhibitory effect of *Curcuma aromatica* on CYP3A4 in Caco-2 cells. Evid. Based Compl. Alt. Med., 2011: 913898, 2011. (doi:10.1093/ecam/nep229)**

Abstract: *Curcuma aromatica* is a plant belonging to genus *Curcuma* of family Zingiberaceae and is widely used as supplements in Japan. Rhizomes of *C. aromatica* have curcumin as a major yellow pigment and curdione as a main ingredient of essential oils. In this study, we investigated the affect of *C. aromatica* on CYP3A4 using 1α,25-$(OH)_2$-D_3-treated Caco-2 clone cells. Caco-2 cells were treated with methanol extract (0.1 mg ml^{-1}), its hexane soluble fraction (0.1 mg ml^{-1}), curcumin (4 μM) and curdione (20 μM) for 72 h. Nifedipine was used as a substrate of CYP3A4. Methanol extract, hexane fraction and curdione inhibited the formation of oxidized nifedipine by 50-70%, and curcumin showed no effect. The IC50s of methanol extract, hexane fraction and curdione to oxidized nifedipine formation were 21, 14 and 3.9 μg ml^{-1} (16.9 μM), respectively. The content of curdione in methanol extract was 11.4%. Moreover, all of methanol extract, hexane fraction and curdione decreased CYP3A4 protein expression but had no affect on CYP3A4 mRNA expression. Our results showed that these drugs further decreased the CYP3A4 protein expression level after the protein synthesis was inhibited by cychroheximide. These findings suggest that curdione plays an important role in the CYP3A4 inhibitory activity of *C. aromatica* and curdione might inhibit the activity by accelerating the degradation of CYP3A4.

8) **Tanaka K., Hayashi K., Fahad A., Arita M.: Multi-stage mass spectrometric analysis of saponins in Glycyrrhizae radix. Nat. Prod. Comm., 6: 7-10, 2011.**

Abstract: The fragmentation pathways of six triterpenoid saponins from Glycyrrhizae radix were investigated using LC-MS/MS. Depending on the structure and the substitution pattern, different molecular adduct ions, [M+NH4]+ or [M+H]+, were observed in the positive ESI spectra. In the positive MSn spectra from the molecular adduct ions, characteristic product ions corresponding to the loss of dehydrated glucuronic acid or glucuronic acid were detected and they indicated the type of substitution and structural modification. Fragment ions originating from the sapogenin moiety in the positive mass spectra were predominantly provided by saponins having an 11-oxo-12-ene structure. On the other hand, the saponins gave fragment ions corresponding to the sugar moiety in the negative mass spectra. These results indicate the specific property of saponins that have the 11-oxo-12-ene structure to localize positive or negative charge in the mass spectrometric ionization and fragmentation process. Information obtained from the present study can be utilized for structural elucidation of triterpenoid saponins in the Glycyrrhizae radix by LC-MS.

9) **Yamada M., Hayashida M., Zhao Q., Shibahara N., Tanaka K., Miyata T., Matsumoto K.: Ameliorative effects of yokukansan on learning and memory deficits in olfactory bulbectomized mice. J. Ethnopharmacol., 135: 737-746, 2011.**

Abstract: Aim of the study: Yokukansan (YKS) is a Japanese traditional herbal medicine and has been used for the treatment of the behavioral and psychological symptoms of dementia (BPSD). The present study aimed to clarify the effects of YKS on learning and memory impairments, and its mechanisms of action in olfactory bulbectomized (OBX) mice, one of the animal models of Alzheimer's disease (AD). Materials and methods: OBX or sham-operated ddY mice were treated with YKS or donepezil (DPZ), a reference drug, and their cognitive performances were tested by the modified Y-maze test, novel object recognition test, and fear conditioning test to elucidate the spatial working memory, non-spatial shortterm memory, and long-term memory, respectively. After completing the behavioral experiments, the expression level of cholinergic marker proteins and the activity of acetylcholinesterase (AChE) in the brain were analyzed by western blotting and Ellman's method, respectively. **Results:** OBX caused spatial working memory and non-spatial working memory impairments that were reversed by YKS and also by DPZ; however, YKS failed to affect the long-term memory deficits. Amelioration of the spatial working memory by YKS was reversible by scopolamine, a muscarinic receptor antagonist. YKS treatment reversed OBX-induced down-regulation of choline acetyltransferase and muscarinic muscarinicM1 receptor expression without affecting muscarinicM3 receptor expression or AChE activity. **Conclusion:** These results demonstrate that YKS improves short-term memory deficit caused by OBX and that the effect is at least partly mediated by muscarinic receptor stimulation and the normalization of central cholinergic systems. The present findings also suggest that YKS has a therapeutic effect not only on BPSD, but also on memory impairment of AD.

10) **Tanaka K., Li F., Morikawa K., Nobukawa T., Kadota S.: Analysis of biosynthetic fluctuations of cultured *Taxus* seedlings using a metabolomic approach. Phytochemistry, 72:**

1760-1766, 2011.

Abstract: Fluctuations in the biosynthesis of taxoids in 1-5 year old cultured seedlings of Taxus chinensis var. mairei were investigated using LC-IT-TOF-MS and a metabolomics approach. In the total ion chromatogram (TIC) of the extracts, 16 prominent peaks were observed. Ten compounds were identified by comparison of retention times and MS/MS spectra with those of reference compounds. An additional 6 taxoids were isolated by preparative HPLC and identified by comparison of their spectroscopic data with those reported in the literature. It was clarified that the relative concentrations of taxoids with 4(20) double bonds are high at early stages of cultivation. On the other hand, relatively higher amounts of 5-acetoxy taxoids oxidized at the 4- and 10- positions and taxoids having 5(20)-oxetane rings were found at later stages of cultivation. This approach provides practical information on the biosynthetic flow of taxoids in cultured yew seedlings.

11) **Zhao Q., Yokozawa T., Tsuneyama K., Tanaka K., Miyata T., Shibahara N., Matsumoto K.: Chotosan (Diaoteng San)-induced improvement of cognitive defivits in senescence-accelerated muse (SAMP8) involves the amelioration of angiogenic/neurotropic factors and neuroplasticity systems in the brain. Chinese Med., 6: 33-51, 2011.**

Abstract: Background: Chotosan (CTS, Diaoteng San), a Kampo medicine (ie Chinese medicine) formula, is reportedly effective in the treatment of patients with cerebral ischemic insults. This study aims to evaluate the therapeutic potential of CTS in cognitive deficits and investigates the effects and molecular mechanism(s) of CTS on learning and memory deficits and emotional abnormality in an animal aging model, namely 20-week-old senescenceaccelerated prone mice (SAMP8), with and without a transient ischemic insult (T2VO). **Methods:** Age-matched senescence-resistant inbred strain mice (SAMR1) were used as control. SAMP8 received T2VO (T2VO-SAMP8) or sham operation (sham-SAMP8) at day 0. These SAMP8 groups were administered CTS (750 mg/kg, p.o.) or water daily for three weeks from day 3. **Results:** Compared with the control group, both sham-SAMP8 and T2VO-SAMP8 groups exhibited cognitive deficits in the object discrimination and water maze tests and emotional abnormality in the elevated plus maze test. T2VO significantly exacerbated spatial cognitive deficits of SAMP8 elucidated by the water maze test. CTS administration ameliorated the cognitive deficits and emotional abnormality of sham- and T2VO-SAMP8 groups. Western blotting and immunohistochemical studies revealed a marked decrease in the levels of phosphorylated forms of neuroplasticity-related proteins, N-methyl-D-aspartate receptor 1 (NMDAR1), Ca^{2+}/calmodulin-dependent protein kinase II (CaMKII), cyclic AMP responsive element binding protein (CREB) and brain-derived neurotrophic factor (BDNF) in the frontal cortices of sham-SAMP8 and T2VO-SAMP8. Moreover, these animal groups showed significantly reduced levels of vasculogenesis/angiogenesis factors, vascular endothelial growth factor (VEGF), VEGF receptor type 2 (VEGFR2), platelet-derived growth factor-A (PDGF-A) and PDGF receptor α (PDGFRα). CTS treatment reversed the expression levels of these factors down-regulated in the brains of sham- and T2VO-SAMP8. **Conclusion:** Recovery of impaired neuroplasticity system and VEGF/PDGF systems may play a role in the ameliorative effects of CTS on cognitive dysfunction caused by aging and ischemic insult.

12) **Zhao Q., Matsumoto K., Tsuneyama K., Tanaka K., Li F., Shibahara N., Miyata T., Yokozawa T.: Diabetes-induced central cholinergic neuronal loss and cognitive deficit are reversed by tacrine and a Chinese herbal prescription, kangen-karyu: elucidation in type 2 diabetes *db/db* mice. J. Pharmacol. Sci., 117: 230-242, 2011.**

Abstract: We investigated the effect of kangen-karyu (KK), a Chinese herbal prescription, on cognitive deficits and central cholinergic systems of type 2 diabetic *db/db* mice. Seven-week-old *db/db* (Y-*db/db*) mice received daily administration of test drugs during an experimental period of 12 weeks. At 18 weeks of age (O-*db/db*), the animals underwent the water maze test. Compared with age-matched control strain mice (O-*m/m*), vehicle-treated O-*db/db* mice showed impaired learning and memory performance. KK (100 – 200 mg/kg per day) and the reference drug tacrine(THA: 2.5 mg/kg per day) ameliorated the performance of O-*db/db* mice without affecting theirserum glucose level. O-*db/db* mice had lower levels of brain-derived neurotrophic factor (BDNF) mRNA and its protein in the brain than O-*m/m* mice. Expression levels of central cholinergic marker proteins in the hippocampus and the number of cholinergic cells in the medial septum and basal forebrain were also significantly lower in O-*db/db* than in O-*m/m* mice, whereas no significant differences in the expression levels of these factors and the cell

number were found between Y-*m/m* and Y-*db/db* mice. KK and THA treatment significantly reversed the down-regulated levels of cholinergic markers, choline acetyltransferase–positive cell number, and BDNF expression in *db/db* mice. These findings suggest that KK as well as THA prevents diabetes-induced cognitive deficits by attenuating dysfunction of central cholinergic systems.

13) Arita M., Yoshimoto M., Suwa K., Hirai A., Kanaya S., Shibahara N., Tanaka K.: Database for crude drugs and kampo medicine. Genome Inform., 25: 1-11, 2011.

Abstract: A wiki-based repository for crude drugs and Kampo medicine is introduced. It provides taxonomic and chemical information for 158 crude drugs and 348 prescriptions of the traditional Kampo medicine in Japan, which is a variation of ancient Chinese medicine. The system is built on MediaWiki with extensions for inline page search and for sending user-input elements to the server. These functions together realize implementation of word checks and data integration at the user-level. In this scheme, any user can participate in creating an integrated database with controlled vocabularies on the wiki system. Our implementation and data are accessible at http://metabolomics.jp/wiki/.

◇学会報告 （*: 特別講演，シンポジウム，ワークショップ等）

* 1) Komatsu K., Zhu S.: Genetic, chemical and pharmacological diversity of Ginseng drugs. The 10th Annual Oxford International Conference on the Science of Botanicals (ICSB), 2011, 4/11-15, Oxford, Mississippi, USA.

* 2) Tanaka K., Komatsu K.: Quantitation of Curcuminoids in Curcuma Rhizome by Near-infrared Spectroscopic Analysis. The 2nd International Symposium on Temulawak and The 40th Meeting of National Working Group on Indonesian Medicinal Plant, 2011, 5/26-27, Bogor, Indonesia.

* 3) Komatsu K., Zhu S., Tohda C.: Genetic, chemical and pharmacological diversity of Ginseng drugs. The 6th JSP-CCTCNM-KSP International Conference on Pharmacognosy, 2011, 10/21-22, Shengyang, China.

4) Zhu S., He J. Y., Komatsu K., Samarakoon S. P., Nagatomo A., Nishida N., Matsuura Y.: Molecular identification of *Salacia* plants and the related crude drugs based on DNA sequence of two non-coding regions. The 6th JSP-CCTCNM-KSP International Conference on Pharmacognosy, 2011, 10/21-22, Shengyang, China.

5) Nakamura Y., Shimada K., Kawase M., Komatsu K., Saito T., Takahashi K.: Quality characterization of Paeoniae Radix using a metallomics analysis. The 6th JSP-CCTCNM-KSP International Conference on Pharmacognosy, 2011, 10/21-22, Shengyang, China.

* 6) 小松かつ子：薬用資源植物の多様性の解析：大黄と黄耆について．日本東洋医学会平成 22 年度千葉県部会，2011，1/23，千葉.

7) 木谷友紀，朱姝，田中謙，小松かつ子，辰尾良秋，Batkhuu J.：モンゴル国栽培品 *E. sinica* のエフェドリンアルカロイド含量による品質評価と栽培条件の検討．日本薬学会第 131 年会，2011，3/28-31，静岡.

8) 吉川文音，島田佳代子，中村勇斗，川瀬雅也，小松かつ子，斎藤直，東由子，高橋京子：*Curcuma* 属生薬の品質評価におけるメタロミクスの応用．日本薬学会第 131 年会，2011，3/28-31，静岡.

9) 北村亮，安東嗣修，伏見裕利，小松かつ子，柴原直利，倉石泰：マウスにおける抗癌薬誘発疼痛に対する牛車腎気丸と関連方剤の抑制効果．日本薬学会第 131 年会，2011，3/28-31，静岡.

10) 中村憲夫，宮部智美，小西天二，内山奈穂子，小松かつ子，服部征雄：タイ民族薬物 Ka-tuir の抗トリパノソーマ活性．日本薬学会第 131 年会，2011，3/28-31，静岡.

11) 安食菜穂子，細江潤子，伏見裕利，小松かつ子，蔡少青，池崎秀和，御影雅幸，川原信夫，合田幸広：味認識用脂質膜センサによる生薬「カッセキ」の日本及び中国市場品の識別に関する検討．日本薬学会第 131 年会，2011，3/28-31，静岡.

12) 田中謙，櫻井宏明，済木育夫，小林博：玄米麹発酵物の網羅的成分分析．日本薬学会第 131 年会，2011，3/28-31，静岡.

13) 田中謙，有田正規：和漢薬 Wiki データベースの構築．第 28 回和漢医薬学会学術大会，

2011，8/27-28，富山.

14) 吉川文音，島田佳代子，中村勇斗，川瀬雅也，小松かつ子，斎藤直，高橋京子：ウコン類生薬の品質評価：メタロミクス解析による検討．第 28 回和漢医薬学会学術大会，2011，8/27-28，富山.

15) 北村亮，安東嗣修，伏見裕利，小松かつ子，柴原直利：マウスにおける抗癌薬誘発疼痛に対する 5 種類の漢方方剤の薬効評価. 第 28 回和漢医薬学会学術大会, 2011, 8/27-28, 富山.

16) 柴原直利，東田千尋，朱姝，櫻井宏明，数馬恒平，山本武，小泉桂一，紺野勝弘，門脇真，小松かつ子：「伝統医薬データベース」の構築．第 28 回和漢医薬学会学術大会，2011，8/27-28，富山.

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5) 小松かつ子：野外で薬草を観察する会．富山県薬事研究所，2011，7/3，富山．
6) 小松かつ子：「医食同源」と薬膳．平成 23 年度漢方医学と生薬講座（第 4 回），NPO 法人富山のくすし，2011，7/9，富山．
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11) 小松かつ子：体験実習 1. 和漢薬鑑定に挑戦．第 16 回和漢医薬学総合研究所夏期セミナー，2011，8/22-24，富山．
12) 田中謙：Wiki による生薬・漢方方剤のデータベース．第 16 回和漢医薬学総合研究所夏期セミナー，2011，8/22-24，富山．
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2) Suchada Sukrong（タイ・Chulalongkorn University）: タイ産 *Salacia* 属植物及び生薬の遺伝子解析，2009～
3) 蔡少青（北京大学薬学院）: Aristolactans の生薬類における分布と腎毒性に関する研究，2010～2011.
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5) Suchada Sukrong，Suchaya Wiriyakarun（タイ・Chulalongkorn University）: タイ産生薬 “Kwao Khruea”の同定法の開発，2011～

◇研究費取得状況

1) 文部科学省地域イノベーションクラスタープログラム　グローバル型（Ⅱ期）「ほくりく健康創造クラスター」広域化プログラム「天然薬物の遺伝子解析等に基づく標準化研究」（代表：小松かつ子，分担：朱姝）
2) 日本学術振興会科学研究費，基盤研究(B)（第 3 年度）（代表：小松かつ子，分担：田中謙，連携：朱姝）「サステイナブル伝統薬を志向した薬用資源植物の多様性の解析」，220 万
3) 日本学術振興会科学研究費，基盤研究(A)（第 3 年度）（分担：小松かつ子）「うつ病のすべてがわかる和漢薬：発病機序の分子的解明から新規抗うつ薬開発まで」
4) 日本学術振興会科学研究費，基盤研究(C)（第 1 年度）（分担：小松かつ子）「日本民間薬の現地調査と民族薬物データベースの充実」
5) （財）ヒューマンサイエンス振興財団，政策創薬総合研究事業，厚生労働科学研究費（分担：小松かつ子）「天然物医薬品の評価手法と標準化に関する研究」:「生薬の品質評価手法と標準化に関する研究」，100 万
6) 厚生労働科学研究費，創薬基盤推進研究事業（分担：小松かつ子）「漢方薬に使用される薬用植物の総合情報データベース構築のための基盤整備に関する研究」，200 万
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8) 厚生労働科学研究費，地域医療基盤開発推進研究事業（分担：小松かつ子）「生薬を用いた東アジア地区伝統医学と漢方医学の構成薬物及び配合比，表記法などに関する比較研究とデータベース作成」，100 万
9) 科学技術振興機構「A-Step」探索タイプ（代表：田中謙）「非線形多変量解析による生薬活性の解析」，170 万

10) 知的クラスター地域プロジェクト事業，富山型アンチエイジング医療研究費（分担：小松かつ子)「植物由来の薬用入浴剤開発を目的とした富山県内における作物および薬用植物資源の探索」
11) 平成 23 年度和漢医薬学総合研究所公募型共同研究，一般研究Ⅰ（分担：小松かつ子）「国産漢方生薬資源の現状調査と今後の開発に関する研究」，72.8 万
12) 平成 23 年度和漢医薬学総合研究所公募型共同研究，一般研究Ⅰ（分担：田中謙）「琉球特産生薬データベースの開発」，80 万

◇研究室在籍者

大学院修士 1 年：冷正鵬
大学院修士 2 年：于暁麗
大学院博士 2 年：何敬愉
大学院博士 3 年：中村賢一
研究員：白焱晶（2011, 4/1～）
文部科学省国費留学生：何毓敏（2011, 10/11～2012, 3/31）
協力研究員：高橋京子（大阪大学，2011, 4/1～2012, 3/31）
技術補佐員：幸雅子（2010, 4/1～），海老原あゆみ（2011, 4/1～）
外国人客員研究員： Suchaya Wiriyakarun（タイ・Chulalongkorn University，2011, 6/2～11/30）