

## Not a Possibility, but a Reality: Sharing Unique Content via Open Access

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### Abstract:

*Libraries are fully aware that sharing unique collections through open access is becoming critically important. Many institutions have attempted to take on the task of digitizing their local unique content in their collections and present it openly accessible to the world. This paper describes the award winning Chinese Medicine Digital Project which has been developed by the Hong Kong Baptist University (HKBU) Library in close collaboration with faculty in the School of Chinese Medicine at HKBU to integrate traditional unique content of Chinese medicine into the learning, teaching and research of the HKBU community and beyond. Research shows that access to Chinese medicinal content has been limited and scarce. In recent years, there has witnessed an increasing demand for health information related to Chinese medicine throughout the world. Making such unique content available to the world is of great significance to scholars, doctors as well as those who need medical treatment. Because of the open access nature to the unique content, these databases have been accessed by many users around the world with valuable information not otherwise available to them. They serve as examples of how knowledge can be managed and packaged in a way that provides easy and convenient access to users. The lifecycle of these databases illustrates how Chinese medicinal information is created and recreated, organized, disseminated, preserved and more importantly openly accessed. The success of such projects can serve as a model which demonstrates how technology is used to present the unique content in a local context to the outside world and at the same time to enhance learning, teaching and research of the institution.*

**Keywords:** Chinese medicine, open access, knowledge management, award-winning, unique content

## Introduction

Libraries are fully aware that sharing unique collections through open access is becoming critically important. Many institutions have attempted to take on the task of digitizing their local unique content in their collections and present it openly accessible to the world. Examples include the Scholar's Bank project at the University of Oregon Libraries which houses the collection of local documents for cities and counties in the state (Stave, 2006), the Northeastern University Library's digital collections on Latino community and Freedom House Photographs (Northeastern University Library, 2013), and the North Carolina State University Libraries' Rare and Unique Digital Collections, documenting NC State and North Carolina through historic photographs, architectural drawings, etc. (NCSU Libraries, 2013). Access to these collections has been made publicly available to scholars worldwide who can fully utilize the unique content for their research. This is also what Lizabeth Wilson (2008) describes as the "Emerging Research Library," with the "ability to move effortlessly from local to global..." to allow unique local content to be publically and easily available to anyone, anywhere on the globe.

This paper describes the award winning Chinese Medicine Digital Project which has been developed by the Hong Kong Baptist University (HKBU) Library in close collaboration with faculty in the School of Chinese Medicine (SCM) at HKBU to integrate traditional Chinese medicine unique content into the teaching, learning and research of the HKBU community and beyond, as well as to provide open access as the most effective way to facilitate knowledge dissemination of this traditional content to the wider community.

To explore the current situation about the sharing of the unique Chinese herbal content with the global community, a literature search was conducted in available alternative medicine sources. The findings indicate that a few review articles exist to evaluate published databases in the area of complementary and alternative medicine (CAM) (Boehm et al., 2010, Ningthoujam et al., 2012). Boehm (2010) summarized 45 published CAM databases and grouped them into various categories. This literature review shows that while the herbal therapy category contains 11 resources, only four of them are openly accessible. Others are either subscription based or with restricted online access. For the four open access herbal resources, they are either documented using vernacular languages, or with content limited to the local herbal collections only.

A Google search was also conducted and results include eight open access Chinese herbal therapy databases which have been developed in Asia. Six of them are documented in Chinese, and the other two are in English. Five out of the total eight databases gave attention to specialized regional content. Also one database collected nation-wide plants, but each record in its herbal subset contains only limited information, e.g. without herbal images and detail properties. For the two English sources, one is focused on herbal chemistry; and the other provides information on the various aspects of TCM, including the property of herbs, formulation, and herbal ingredients. Even

though each record has detailed documentation, one obvious weakness appears that no herb images are provided to the user to visualize the plant morphology, which is a critical step in the process of herb authentication. Therefore, the literature search and the Google assessment on the existing Chinese herbal therapy resources, found the scholarly information on herbal therapy databases was limited; many of these resources are not openly accessible; and the quality of available information is in question, of whether they reach international standards, which also indicates the need to establish the metadata standards in herbal therapy resources is necessary.

### **Hong Kong Baptist University and its School of Chinese Medicine**

Hong Kong Baptist University (HKBU) was founded in 1956 as a private college imbued with the unique vision of Whole Person Education. In 1994, the institution achieved University status awarding degrees in its own right. Since then, the University has been enjoying dynamic growth in both physical size and academic stature. Today, the University has emerged as a center of creativity, innovation and academic excellence. HKBU is committed to academic excellence in teaching, research and service, and devoted to delivering whole person education that fosters spiritual, intellectual, humane, social and physical development of our students, nurturing them to become confident, caring leaders who possess integrity, perseverance and a sense of responsibility for themselves and others (HKBU, 2013).

The HKBU Libraries are committed to academic excellence in support of teaching, learning, scholarly research, and community services as a partner in whole person education. Through teamwork and innovation, the library responds dynamically to the emerging needs of the University and the community.

The HKBU School of Chinese Medicine (SCM) is the first Hong Kong government funded institution that provides higher education in Chinese medicine in Hong Kong. Through the unwavering efforts over the years, the School has already become the leading institution in Chinese medicine education in Hong Kong. SCM launched the first Bachelor of Chinese Medicine program in 1998, and introduced the Bachelor of Pharmacy in Chinese Medicine program in 2001 as the only one of its kind in Hong Kong. SCM has already put in place a comprehensive educational structure, providing master and PhD degree programs in Chinese Medicine and Pharmacy, postdoctoral research fellowships, and professional and continuing education courses/programs.

The School has made every endeavor to promote the internationalization of Chinese medicine. Taking a collaborative approach to develop key areas in teaching, research, clinical service, technology and knowledge transfer, the School continues to make great strides to the benefit of Hong Kong, China and other parts of the world.

## **The Need of Knowledge Dissemination of Chinese Medicine**

The therapeutic principles and goals of traditional Chinese medicine are different from those in Western medicine. While Western medicine is closely linked to the evidenced based approach and emphasizes empirically measurable biochemical processes, Traditional Chinese Medicine (TCM) favors a holistic approach and concentrates on the overall functional state of the patient (Knowledge@Wharton 2007).

Chinese medicine (CM) is a broad range of medicine practices sharing common concepts which have been developed in China and are based on a tradition of more than 5,000 years. It has been used in health maintenance and disease treatment in the Chinese communities. In recent years especially since China opened its doors to the world, this “mysterious” medical treatment has received wider attention from different parts of the globe. Because of its effectiveness (Stone et al., 2009), many other countries have gradually adopted this practice in various degrees. Data shows that more and more people start to explore the mystery of Chinese medicine and the need to seek quality information related to Chinese medicine has become much greater.

National Health Statistics Reports showed 38.1 million adults made an estimated 354.2 million visits to CAM practitioners, spending a total of \$14.8 billion dollars on non-mineral, non-vitamin natural products (Nathin et al., 2009). Such increasing uses of Chinese Medicine have created growing demand on knowledge dissemination of authentic information to the public. Quality information on Chinese medicine is found to be critical for scholars to expand their research, but also for the public to understand this traditional approach for medical treatment.

There are many advantages for Hong Kong to become the hub of disseminating knowledge in Chinese Medicine. The role of Chinese Medicine as a part of the Hong Kong health care system was formally recognized after the handover from the United Kingdom to mainland China in 1997. The 2003 News Focus in *Science* reported that Hong Kong former Chief Tung Chee Hwa laid out a 10 year plan for making the city an “international center for Chinese Medicine”, and subsequently much funding for research followed in the area of Chinese medicine (Normile, 2003). As a Chinese dominant community, the majority of the population in Hong Kong believe the efficacy and demand on Chinese medical treatment and health prevention (Lam, 2001), which has been evident even in their daily diet (Koo, 1987). These serve the driving forces for the promotion of the culture for Chinese Medicine development. The HKBU School of Chinese Medicine is taking a leading role in Chinese medicine education in Hong Kong. It is logical and inevitable for HKBU librarians to use their information management knowledge and skills to create/recreate, organize, process and disseminate the CM knowledge from the scholars/experts to the world. In addition, both Chinese and English are official languages in Hong Kong, which places Hong Kong as an ideal place to serve as a window of world and a visible platform to disseminate CM knowledge to the wider world.

## Chinese Medicine Digital Project

### Overview

The Chinese Medicine Digital Project was established with the aim to support teaching, learning, research and service for faculty, students, scholarly and the general community; to advocate the advantages of open access to digitized CM information; and to advance internationalization of Chinese medicine through presenting the quality information from CM experts and making it publicly available online.

Beginning in 2006, the HKBU Librarians and SCM faculty members initiated and have been working together on the Chinese Medicine Digital Project to provide accurate and rich information resources in support of teaching, learning and research as well as for the general public. The content in these databases has been verified by scholars as high quality, authentic, and useful sources of medicinal plants and herbs as popularly demanded by users today.

It is the first Hong Kong-developed series of CM databases which are openly accessible to the world online. The Chinese Medicine Digital demonstrated the knowledge and expertise of our multidisciplinary team. The team members include Chinese medicine subject professors, the Chinese Medicine librarian, the systems librarian, and the computer officer from HKBU. The subject professor provided scientific data and authenticated images to assure the quality of data. The librarians used their skills in information management and retrieval to build a powerful searchable database and present quality information to users in an organized way. The IT specialist investigated and adopted new technology to enhance system performance.

**Chinese Medicine Specimen Database (CMSD)** (see Appendix 1) was launched in 2007. CMSD is a searchable database capable of retrieving images and description of 686 specimen exhibits displayed in CM Specimen Centre. It was established to help student learn the variety, authenticity, and use of CM.

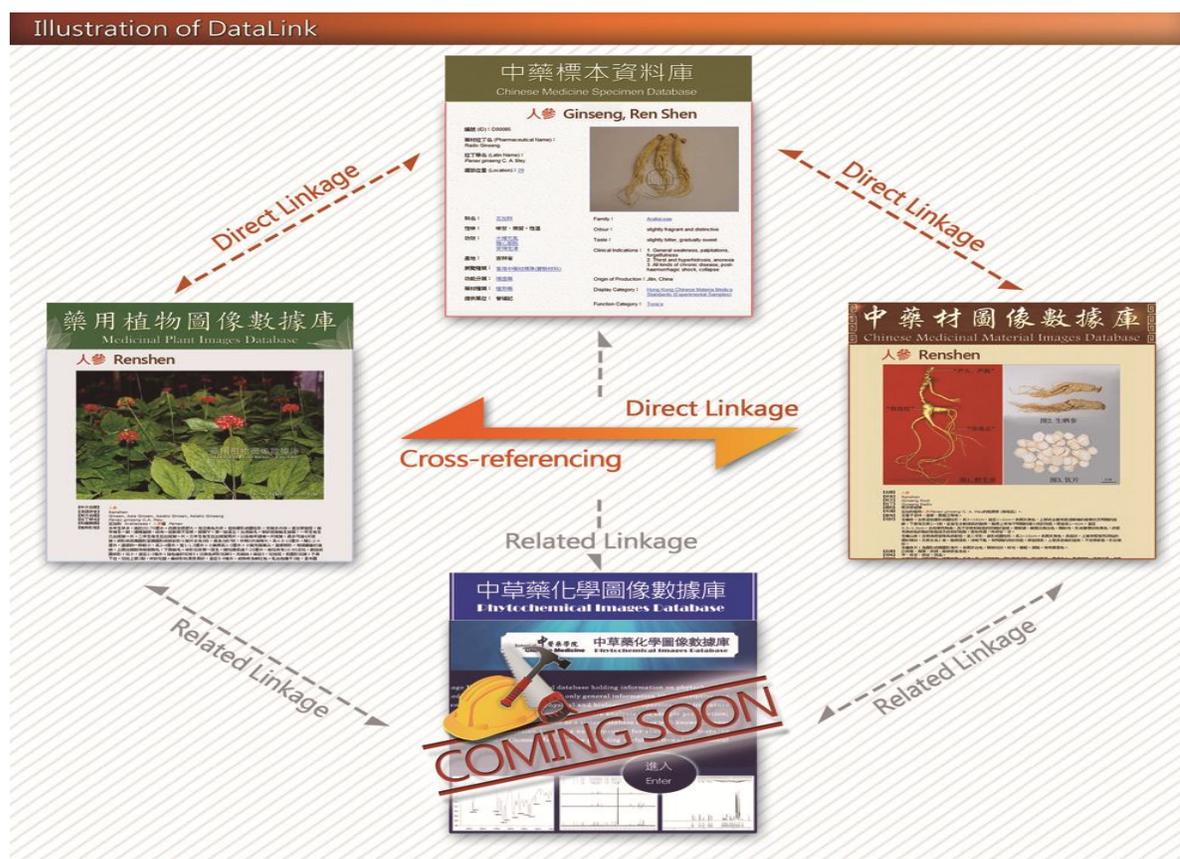
**Medicinal Plant Images Database (MPID)** was launched in 2012. Appendixes 2 and 3 show the screen captures and database navigation. It is the first Hong Kong-developed online medicinal plant database and freely accessible to the world. Currently 1,160 commonly used species of medicinal plants were systematically consolidated and summarized in the form of plant images and descriptions. All records in the Chinese content have corresponding mirror English records to form a bilingual database. The database provides students with perceptual and systematic knowledge through friendly search tools. It is designed for teaching & learning for subject course of *Medicinal Botany*. The English version is particularly useful for HKBU students and international learners.

The Chinese Medicinal Material Images Database (CMMID) (see Appendix 4) was completed in May 2013. It contains a collection of 420 commonly used crude drugs, and demonstrates their apparent characteristics via high resolution photos with detailed annotations. While MPID serves as important e-learning tool for the subject course of *Medicinal Botany*, CMMID will be an essential e-learning tool for the subject course of *Authentication of Chinese Materia Medica*.

## TRS Technology

All the Chinese medicine databases have been developed with the aim of open access to the world. To that end, TRS technology, a search and content management technology provider in China has been used, which provides software products in the fields of information retrieval, content management and text mining. TRS, as it claims on its website, is the initiator of Chinese full text retrieval technology (TRS, 2010), known for its innovation in “unstructured data management” in China. For the Chinese Medicine Digital Project, all, three databases have been completed by employing the TRS technology platform.

**Figure 1. Illustration of DataLink Function for CM Digital Project**



The DataLink feature (see Figure 1) was built in at the record level between MPID and CMMID

via their common Latin names of plants. The DataLink feature not only links related drug information, but also the knowledge and content among different subject courses for students. For example, the original ecological Ginseng plant in MPID that students learned in *Medicinal Botany* course will be linked to its processed Ginseng crude drug in CMMID which students learned in *Authentication of Chinese Materia Medica* course. As a result, the two databases highly complement each other. The DataLink serves as an active database agent, a powerful way to facilitate student learning, and results in sustainable and recurrent benefits to students and community in the years to come.

### **Summary of Features**

All databases that have been developed are Chinese medicine related. Even though each database focuses on a specific CM subject area, they are sister databases. They have many features in common which are summarized as following:

- ▶ All are open access databases.
- ▶ Librarians use their information management skills to incorporate the knowledge from subject experts and present the unique CM content in a well-organized way.
- ▶ All commonly used materials in particular CM subject area were identified, documented in the databases, and presented with clear and vivid images and detailed annotation and description.
- ▶ Serves as an important e-learning tool for instructors and students to enhance their teaching and learning pedagogy, helps student learning in-class and after-class.
- ▶ Openly accessible in bilingual format which benefits the user from the HKBU community, as well as interested learners from the world.
- ▶ The powerful search functions including facet, keyword and advance features which allow users to access the information easily.
- ▶ Professionally authenticated data insures the quality of information.
- ▶ The DataLink not only links related records, but also links the knowledge and content among different subject courses.
- ▶ Dynamic trace and display of usage statistics indicated the extensive use and the popularity of these databases.
- ▶ New information technology used to present the unique traditional Chinese medicine content raises more awareness of Chinese medicine and promotes the open access feature.

### **Awards and Recognition**

Because of the tremendous team efforts by team members and the high quality of the Chinese Medicine Digital Project through open access, the databases are heavily used as indicated by data collected. Because of the significant and wide impact, the Project has been awarded and recognized through different channels.

## American Library Association (ALA) Presidential Award

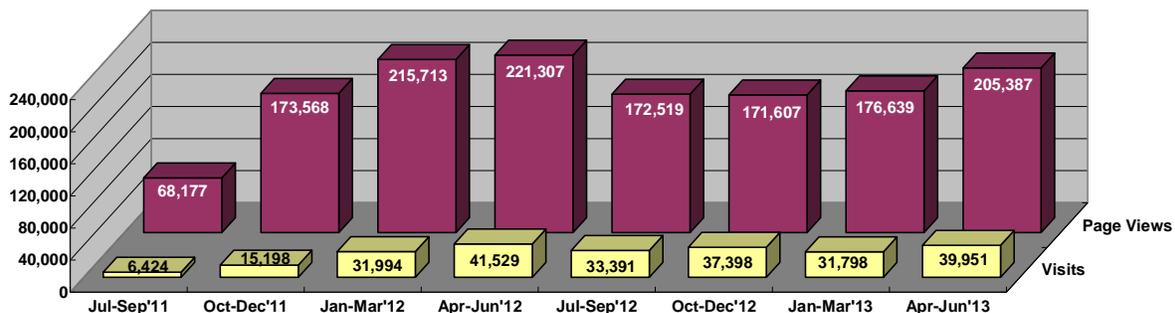
The Chinese Medicine Digital Project received 2012 American Library Association (ALA) Presidential Citation for Innovative International Library award in 2012. HKBU Library is one of four libraries in the world and also the only university library selected by the award selection panel. The innovative approach adopted to support teaching, learning and research, and the promotion of open access to CM resources, was recognized. The Award Ceremony was conducted at the International Librarians Reception at the American Library Association's Annual Conference in Anaheim, California in June of 2012.

## Reward and Recognition Scheme for Non-teaching Staff from Hong Kong Baptist University

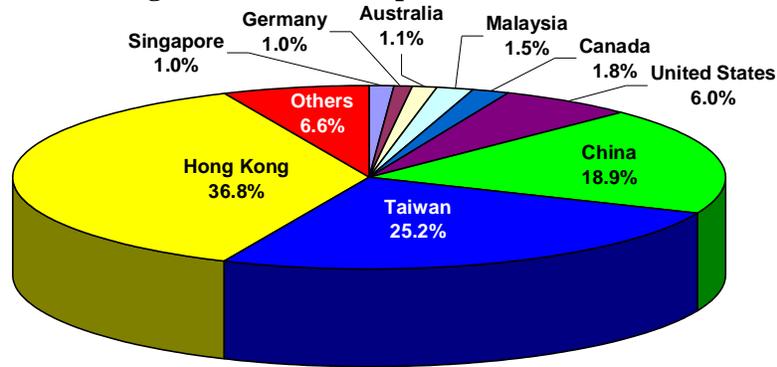
The Review Panel of the Reward and Recognition Scheme for Non-teaching Staff at the Hong Kong Baptist University recognized and appreciated the strong collaboration between academic and non-teaching staff in this project at HKBU. Making the best use of the existing resources, the Review Panel indicated that the team had made an impact on teaching, learning and research in Chinese Medicine both within the University as well as all over the world. The Award was given in May of 2013 at the Hong Kong Baptist University.

The increased usage statistics indicate the demand of quality information of CM. The databases are used heavily by the HKBU and users elsewhere. Google analytics which was installed in June 2011, recorded 238,688 visits to MPID from 174 countries / territories and pages viewed reached 1,422,106 (Figure 2-3), and 65,242 visits to CMSD from 141 Countries / Territories and pages viewed reached 238,082 (Figure 4-5).

**Figure 2 No. of Visits & Page Views for MPID (Statistics since Jun. 2011)**

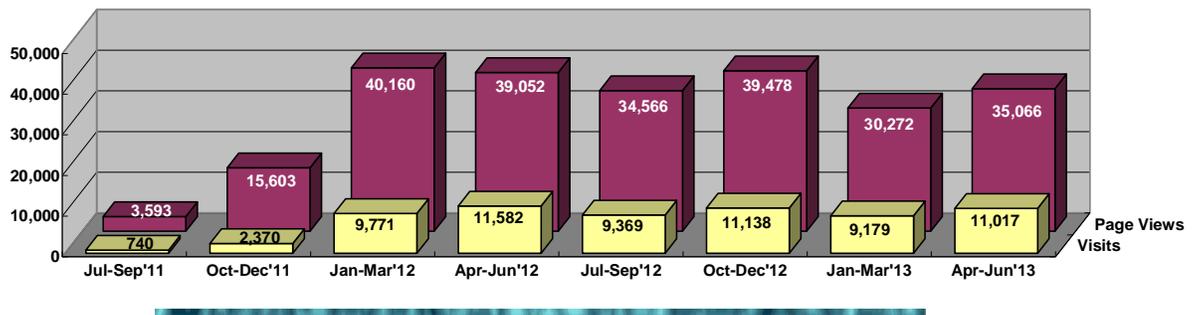


**Figure 3 Percentage of Visits from Top Ten Countries for MPID (Since Jun. 2011)**

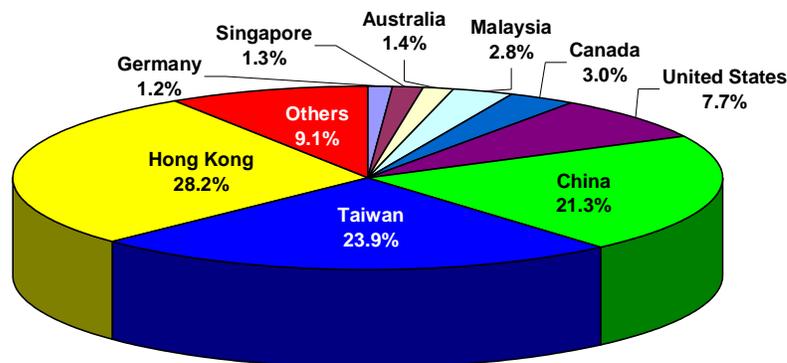


The usage statistics of MPID and CMMID show that the users from Hong Kong account for the highest visit percentage, which reflects our primary purpose of the database developments. The additional bonus for us is the 65-72 percentages of users from the communities outside of Hong Kong who also benefited from the open access efforts. It demonstrated the powerful effect of sharing unique content via open access, and magnified the influence of the database via Knowledge dissemination.

**Figure 4 No. of Visits & Page Views for CMSD**



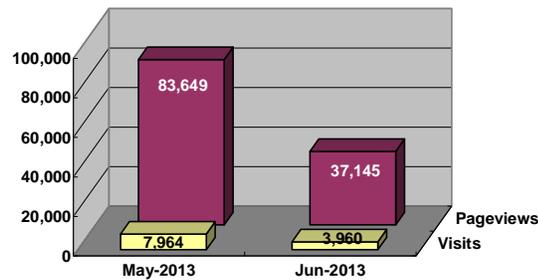
**Figure 5 Percentage of Visits from Top Ten Countries/Territories for CMSD**



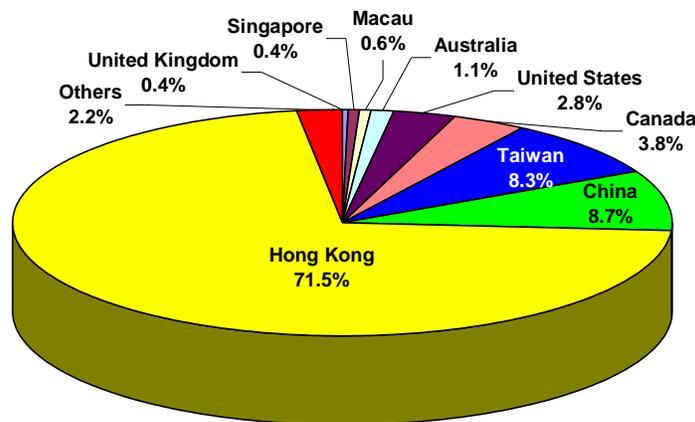
It is worth mentioning that the CMMID, the new database which was launched in May 2013, recorded 13,306 times of visits from 51 countries/territories. The number of pages viewed reached

134,444 within about 2 months (Figure 6-7). It is reasonable to see that the majority of users came from Hong Kong, our local community. Almost 30% of users (over 352,000 visits) from outside of Hong Kong visited the new database within two months time. It revealed how fast that Internet technology could speed up the knowledge dissemination process via open access.

**Figure 6 No. of Visits & Page Views for CMMID**



**Figure 7 --- Percentage of Visits from Top Ten Countries/Territories for CMMID**



### Impact on Knowledge Management

The implementation of the CM Digital Project demonstrates an example of how to make knowledge management applicable in the area of teaching and learning at HKBU as well as to the wider communities. This example shows how the CM Digital Project facilitates the knowledge in storing, sharing, creating, applying, and re-using processes to demonstrate how information is processed, recreated as knowledge n how the explicit knowledge and tacit knowledge interacts with each other,

as described by Lat Long and Alex Lai in their article, “Knowledge Management for Chinese Medicines: a Conceptual Model (Long and Lai, 2005).

### **Storing.**

The faculty member in the School of Chinese Medicine has collected a sizable collection of medicinal herbs and has the rich knowledge and experience over many years of practices who even at beginning of the project, was asked to identify the list of commonly used herbal medicine, and to provide the illustrated photos of plants or herbs. He also was able to provide detailed documentation of related morphology and property of these herbs. The photos and documentation are written forms of knowledge from the subject expert. The databases provided an opportunity and a process to convert the expert’s tacit knowledge to explicit knowledge which then was preserved and captured in the databases developed by librarians.

### **Sharing.**

In the classroom, the database was used by the subject professor for the purpose of demonstration in teaching, which allowed the professor more flexibility and convenience and enhanced his teaching pedagogy. The instant online demonstration helped to gauge student learning interest. With the aid of database demonstration, easier facilitation of sharing the expert knowledge with the students, and converted internal concepts and values from the expert into explicit knowledge took place.

### **Creation.**

The student may create the tacit knowledge directly through the expert’s teaching process with the aid of clear and vivid images and detailed descriptions. Because of the open access nature of the databases, students were able to gain the knowledge by using the information provided after class or 24/7 for assignments and revisions, whenever needed, and even after the graduation for their life long learning. The bilingual feature helps the user to master the subject knowledge in both Chinese and English languages which especially benefits international learners. The DataLink not only mutually links the related records, but also links the knowledge and content among different subject courses. All these effects foster the knowledge creation process.

### **Application.**

To apply the herbal tacit knowledge of the students to practice, the professors often organize field trips and ask students to identify the different kinds of medicinal plants in the natural environment. Use of mobile devices is also made available via mobile apps, which serves as a

convenient tool for student to do the verification when applying their tacit knowledge in practice.

### **Re-use.**

The subject professors used the databases for classroom teaching on a regular basis. The students as well as international learners use the database as a learning tool on daily basis as well. The databases save the instructor much time as they are integrated into the course. They also offer a 24x7 learning environment, and are catered to the different e-learning styles and needs. The user is able to use and reuse them anywhere and anytime. The databases provide sustainable and recurrent benefits. Therefore the CM Digital Project provides an effective and innovative way to support teaching, learning, research and practice.

### **Innovation -- a model for other libraries**

The success of CM Digital Project can serve as a model which demonstrates how technology is used to present the unique content in a local context to the outside world and at the same time to enhance learning, teaching and research of the institution. The following are the highlights of the project in the area of innovation.

- ▶ **Multidisciplinary collaboration** produces innovative electronic product and service which integrates the expertise, strengths and experience from SCM faculties, librarians, and computer experts. The e-service incorporated the knowledge from subject professors with information management skill from librarians
- ▶ **Integrating the project into subject courses** gave more flexibility in classroom demonstration, enhanced teaching pedagogy, fostered student learning, and catered different learning styles.
- ▶ **DataLink** not only mutually links the related information across the databases, but also link the knowledge acquired across subject courses for students
- ▶ **Librarians play a partnership role** with the faculty in the database development instead of an assistant role. The outreach service by librarians creates a new model to support teaching and learning.
- ▶ **Advocate open access** of unique digital collection, promote knowledge dissemination, and cultivate the **life-long learning** of our students and the interested learners from the wider community.

## Future Development

While maintaining the existing databases by adding additional updated information on herbs and high quality images, the team makes consistent endeavor to carry on new developments of the CM Digital Project, subsequently developing additional modules of e-resources one after another. While working on one database, the team is looking for the next potential project and seeking financial support, if possible. The Team has also adopted a new technology such as the facet browsing feature to enhance search capability and Google Analytics to collect usage statistics.

The new development on Phytochemical Images Database (PID) (see Appendix 5) is in progress. PID will initially consist of over 200 bioactive phytochemicals, containing basic phytochemical information, methods of sample preparation and quality analysis. More importantly, the images of UV/IR/MS/ NMR spectra will be provided. DataLink will be built in which links related records among the different databases. PID will be a very important e-learning tool for the subject course of *Phytochemistry* to complement the weakness of the textbook content.

## Conclusion

Currently there are limited Chinese herbal therapy resources freely available online. In addition, the quality of available open-accessed resources in this area is not up to the accepted standards. Therefore the establishment of the metadata standard in herbal therapy resources is necessary. In recent years, there has witnessed an increasing demand for health information related to Chinese medicine throughout the world. Making such unique content available to the world is of great significance to scholars, doctors as well as those who need medical treatments. The database usage demonstrates that the Chinese Medicine Digital Project has been heavily used and has become a very authoritative authentication tool for Chinese traditional medicinal plants and herbs as of today. The lifecycle of CM Digital Project illustrates how Chinese medicinal knowledge is stored, shared, created, applied, re-used and more importantly openly accessed. Through collaboration and innovation, it is possible and realistic to share by making the unique content freely available to the wider community.

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**Appendix 1 Screen Capture for Chinese Medicine Specimen Database (CMSD)**  
[http://library.hkbu.edu.hk/electronic/libdbs/scm\\_specimen.html](http://library.hkbu.edu.hk/electronic/libdbs/scm_specimen.html)

**Main Page**

**Browse Page**

**Advanced Search Page**

**Content Page**



# Appendix 3 Database Navigation for Bilingual Medicinal Plant Images Database (MPID)

<http://library.hkbu.edu.hk/electronic/libdbs/mpd/index.html>

## Basic Navigation of Medicinal Plant Images Database

**Main Page**

- Introduction
- Visit counter

Details of the ALA Award

Development team, Copyright

**中文版面**

**進入  
Enter**

**English Version**

**Browse Page**

- Search & refine
- Facet browsing
- Thumbnails

關鍵字搜尋  
進階搜尋

Keyword search  
Advanced search

**Advanced Search**

- Combined search
- Pull-down menus

拉下選擇  
Pull Down to Select

**Search Result - Content Page**

- Plant photo and description
- Multiple access points

中文名稱	漢語拼音	Latin Name
英文名稱	拉丁學名	English Name
科屬歸類	植物形態	Family & Genus
生境分佈	藥用部位	Description
採收加工	主要成份	Distribution
藥理作用	性味功能	Part Used
主治用法	應用舉例	Harvest & Processing
連結		Chemistry
		Pharmacology
		Properties & Actions
		Indications & Usage
		Examples

**Appendix 4 Screen Capture for Chinese Medicinal Material Images Database (CMMID)**  
<http://library.hkbu.edu.hk/electronic/libdbs/mmd/index.html>

**Main Page**



**Browse Page**



**Content Page**



**Advanced Search Page**

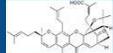


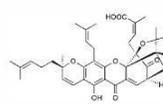
## Appendix 5 Phytochemical Images Database (PID) (Under Construction)


  
 Select of | View selected items | View all items | SCM | Library | Main Page  
 Keyword search:     
 Advanced search:

No.	Name	CAS No.	Formulae	Molecular Weight	Structure
1	Astragaloside I	84680-75-1	C <sub>28</sub> H <sub>42</sub> O <sub>8</sub>	869.05	
2	Astragaloside II	84676-89-1	C <sub>28</sub> H <sub>42</sub> O <sub>8</sub>	827.02	
3	Astragaloside III	84667-42-3	C <sub>28</sub> H <sub>42</sub> O <sub>8</sub>	784.99	
4	Astragaloside IV	84687-43-4	C <sub>28</sub> H <sub>42</sub> O <sub>8</sub>	784.99	


  
 Select of | SCM | Library | Main Page  
 Sort by:     
**Advanced search**  
 Name:   
 CAS No.:   
 Molecular weight:   
 Natural resources:   
 Bioactivities:   
  Match all items Sort by:

Random picture  



  
 Select of | SCM | Library | Main Page  
 Keyword search:     
 Previous Record | Back to Browse Page | Next Record  
 Sort by:     
**GAMBOGIC ACID**  

  
 CAS No. 2755-65-4  
 Fresh yellow powder  
 C<sub>28</sub>H<sub>38</sub>O<sub>8</sub>

**NATURAL RESOURCES:** The resin of *Garcinia hanburyi*. [1]  
**BIOACTIVITIES:** Gambogic acid showed potent anticancer effects against a variety of cancers, such as human breast cancer [2] human hepatoma [3] human leukemia [4] human gastric carcinoma [5] pancreatic cancer [6] etc. The mechanism of action is complicated, involving cytotoxicity, apoptosis induction [7] and antiangiogenesis [8] etc.

**IDENTIFICATION**  
**MELTING POINT [9]** 147-149 °C (mp. of a gambogic acid pyridine salt, orange needles)  
**OPTICAL ROTATION [10]** [α]<sub>D</sub>20 = -570° (c 0.26, CHCl<sub>3</sub>)

**UV [11]:** (MeOH) see Fig. 1-1  
**IR [9]:** (KBr) see Fig. 1-2  
**ES-MS [10]:** see Fig. 1-3  
**NMR [10]:** see Fig. 1-4 and 1-5

**CHROMATOGRAPHIC ANALYSIS**  
**TLC**  
**PLATE:** silica GF254  
**SOLVENT SYSTEM:** CHCl<sub>3</sub>/MeOH (arctic acid) (9/0.9/0.1)  
**DETECTION:** UV 260 nm  
**R<sub>F</sub> VALUE:** 0.6  
**HPLC**  
**1 [11] INSTRUMENT:** Agilent 1100 series  
**COLUMN:** Alltima C18 column (250 × 4.6 mm, 5 μm, Alltech)  
**MOBILE PHASE:** Acetonitrile (A) in 0.1% trifluoroacetic acid (B)  
**FLOW RATE:** 1.0 mL/min  
**DETECTION:** UV 330 nm  
**RETENTION TIME:** 14.5 min  
**2 [12] INSTRUMENT:** Waters HPLC system equipped with a 2695 Separation Module  
**COLUMN:** SunFire C18 column (150 × 2.1 mm, 5.3 μm, Waters Corp., USA)  
**MOBILE PHASE:** Acetonitrile / MeOH / 0.1% trifluoroacetic acid (35.5/33.5/31)  
**FLOW RATE:** 0.22 mL/min  
**DETECTION:** UV 330 nm  
**RETENTION TIME:** 2.58 min  
**3 [13] INSTRUMENT:** Waters ACQUITY UPLC/MS system  
**COLUMN:** Waters ACQUITY BEH C18 column (150 × 2.1 mm, 1.7 μm, Waters Corp., Ireland)  
**MOBILE PHASE:** (A) 0.1% formic acid in water and (B) acetonitrile containing 0.1% formic acid. The HPLC eluting conditions were optimized as follows: isocratic at 60% B (0-0.5 min), linear gradient from 60% to 75% B (0.5-1 min), isocratic at 75% B (2-6 min), linear gradient from 75% to 95% B (6-7 min), and isocratic at 95% B (7-8 min).  
**FLOW RATE:** 0.3 mL/min  
**DETECTION:** A Waters ACQUITY Premier (MicroMass) MS Technology, Manchester, UK) operating in positive ion mode. The nebulization gas was set to 60 L/h, at 300 °C the cone gas was set to 50 L/h, the source temperature set to 90 °C. The capillary voltage and cone voltage were set to 2700 and 45V, respectively.  
**RETENTION TIME:** 4.92 min

**SAMPLE PREPARATION**  
**Method 1 [10]**  
**EXTRACTION:** The gambogic resin (20 mg) was dissolved in 2 mL acetone and filtered.  
**SOLVENT:** The acetone solution was loaded on the preparative HPLC system (Agilent 1100, Alltima C18, 10 μm, 22 × 220 mm) to give a mixture of gambogic acid isomers (32 mg). The mobile phase was MeOH (A) / H<sub>2</sub>O (B) (90/10). The flow rate was 20 mL/min, UV detection wavelength was set at 360 nm. These two isomers were further separated by preparative HPLC on OJ column (Alltima C18, 10 μm, 22 × 220 mm), yielding gambogic acid (12 mg) and isogambogic acid (16 mg). The mobile phase was CHCl<sub>3</sub> (A) / MeOH (B) / acetic acid (25/25/5) at a flow rate of 20 mL/min.  
**Method 2 [14]**  
**PREPARATION:** Dry gambogic powder (140 g) was extracted with methanol (3 × 600 mL) at room temperature for 1 week. The mixture was filtered and the filtrate was concentrated under reduced pressure to give a yellow powder (140 g).


  
 The Phytochemical Image Database is a structured database holding information on phytochemical substances found in medicinal herbs. It includes not only general information like descriptive and numerical data on chemical, CAS No., names, physical and biological properties, and literature references, but also useful methods of qualitative/quantitative analysis and sample preparation, as well as the unique part real NMR spectra. It arose as a sister database of our well-known Chinese Crude Drugs Image Database, with mission to offer a new approach for studying and learning Phytochemistry and Quality Control of Chinese Medicines by providing useful and free phytochemical information.

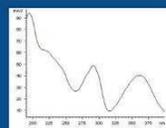


Fig. 1-1 The UV spectrum of gambogic acid.



Fig. 1-2 The IR spectrum of gambogic acid.

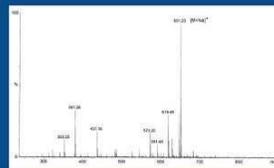


Fig. 1-3 The MS spectrum of gambogic acid.

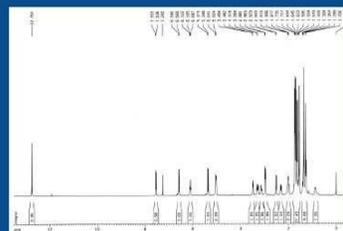


Fig. 1-4 The <sup>1</sup>H NMR (CDCl<sub>3</sub>, 400 MHz) spectrum of gambogic acid.

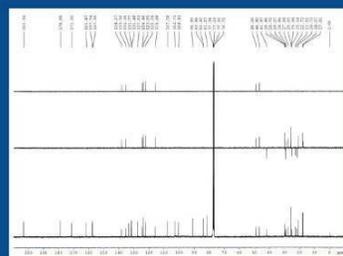


Fig. 1-5 The <sup>13</sup>C NMR (CDCl<sub>3</sub>, 100 MHz) spectrum of gambogic acid.