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Economic botany collections: A source of material evidence for exploring historical changes in Chinese medicinal materials

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ABSTRACT

Ethnopharmacological relevance: Many Chinese medicinal materials (CMMs) have changed over centuries of use, particularly in terms of their botanical identity and processing methods. In some cases, these changes have important implications for safety and efficacy in modern clinical practice. As most previous research has focused on clarifying the evolution of CMMs by analyzing traditional Chinese materia medica ("*bencao*") literature, assessments of historical collections are needed to validate these conclusions with material evidence.

Aim of the study: Historical collections of Chinese medicines reveal the market materials in circulation at a given moment in time, and represent an underexploited resource for analyzing the evolution of Chinese herbal medicines. This study compares specimens from a rare collection of CMMs from the 1920s with contemporary market materials; by highlighting examples of changes in botanical identity and processing that remain relevant for safe clinical practice in the modern era, this work aims to stimulate further research into previously unexplored historical collections of Chinese medicines.

Materials and methods: 620 specimens of CMMs that were collected from Chinese pharmacies in the Malay peninsula in the 1920s were examined macroscopically and compared with current pharmacopoeia specifications and authentic contemporary samples. These historical specimens, which are stored in the UK in the Economic Botany Collections (EBC) of Royal Botanic Gardens Kew, were morphologically examined, photographed, and compared to authentic CMMs stored at the Bank of China (Hong Kong) Chinese Medicines Center at Hong Kong Baptist University, as well as authentic herbarium-vouchered specimens from the Leon Collection (LC) at the Kew EBC. Case studies were selected to illustrate examples of historical changes in botanical identity, used plant parts, and processing methods.

Results: This investigation confirmed that confusion due to shared common names and regional variations in the botanical identity of certain CMMs has been a persistent issue over time. Additionally, historical changes in processing methods and the plant parts used were observed for some CMMs. In some cases, these changes have direct implications for the safe clinical practice of Chinese medicine.

Conclusions: This preliminary assessment illustrated the significant potential of collections for clarifying historical changes in CMMs. More research is needed to investigate pre-modern collections of CMMs, including a more comprehensive assessment of the holdings in the Kew EBC and other European collections that have not yet been explored from the perspective of Chinese medicine.

1. Introduction

Chinese herbal medicine has been extensively documented for nearly 2000 years, and many individual Chinese medicinal materials (CMMs) have been used continuously from ancient times to the present. However, some CMMs have changed over time, particularly in terms of their botanical identity, processing methods, and growing conditions (Zhao et al., 2012). These changes have influenced safety, quality, and efficacy for centuries and continue to have important implications for practitioners in the modern era.

The use of many CMMs preceded the arrival of modern taxonomy in China, and traditional Chinese drug names often represent "plant

Abbreviations: CMM, Chinese Medicinal Material (plural=CMMs); TCM, Traditional Chinese Medicine; HP, Hooper Collection; EBC, Economic Botany Collection; AA, aristolochic acid; CP, Chinese Pharmacopoeia

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complexes" that include more than one species (Linares and Bye, 1987). In China, Latin scientific names only began to be systematically applied for the botanical identification of CMMs in the early 20th century (Zhao and Chen, 2014), and significant research is thus necessary to identify which species were in use during different historical periods.

The current state of knowledge surrounding the historical prevalence of various accepted species and adulterants remains incomplete in Chinese herbal medicine (Chen and Huang, 2005). Most previous research to evaluate historical changes has largely focused on *bencao* literature, which refers to pre-modern Chinese texts that focus on the origins, properties, and effects of medicinal substances. By combining contemporary field research with *bencao* literature review, the historical evolution of Chinese medicinal materials (CMMs) has been well summarized in Chinese publications such as *Chinese Medicinal Varieties: Theory and Use* by Xie (2008). However, many of the conclusions supported by *bencao* literature research have not yet been confirmed by assessing physical samples from pre-modern collections of CMMs.

As early collections provide valuable material evidence that complements literature-based research, more work is needed to systematically investigate pre-modern collections of CMMs. By comparing the CMMs found in pre-modern collections with current pharmacopoeia specifications and authentic contemporary specimens, it is possible to compare modern CMMs with the materials used in earlier eras.

1.1. Previous research on historical collections of CMMs

A variety of publications have attempted to clarify the historical development of CMMs based on the botanical illustrations and morphological descriptions found in ancient *bencao* texts (Xie, 2008; Chen and Huang, 2005). Additionally, contemporary research has shown that many CMMs that are currently prone to confusion in terms of botanical identity can be traced to historical changes, regional differences, and shared common names (Zhao et al., 2006b; Zhao, 2007).

Beyond the context of modern field research and literature review, physical specimens from ancient collections of CMMs have been analyzed using a variety of techniques, including macroscopic identification, microscopic identification, and chemical analysis. For example, 60 CMMs were originally included in the Shōsōin collection in Japan, which has been preserved since 756 CE; of the 38 intact specimens that survived, all but one specimen has been identified (Shibata, 1999; Sashida et al., 2009). Microscopy has been successfully used to identify specimens of Chinese herbal medicines recovered from a 900-year-old shipwreck site in Quanzhou Bay (Chen et al., 1979), and the discovery of nine herbal materials excavated from the Mawangdui tombs in China led to numerous publications with significance for early Chinese medical history (Chen and Li, 2009; Lu and Lo, 2015). However, previous research into ancient specimens of CMMs has been limited by the small number of known collections.

In a recent investigation at the Natural History Museum in London, members of our research group identified 84 CMMs in Sir Hans Sloane's nearly 300-year-old collection of "vegetable substances" (Zhao et al., 2015). These specimens revealed differences in the processing methods and specifications of several commonly used CMMs, and helped to clarify the botanical identity of some historical materials that are easily confused in the contemporary market. The integration of historical specimens complements our previous research into commonly confused Chinese medicines in regional markets such as Hong Kong (Zhao et al., 2006a) and the USA (Brand and Zhao, 2014), as well as the evolution of medicinal processing (Guo et al., 2015).

In addition to the Sloane Collection at the Natural History Museum, London is also home to a unique collection of pre-modern CMMs that are stored in the Economic Botany Collections (EBC) of the Royal Botanic Gardens Kew. In addition to a large modern collection of approximately 4500 accessions of herbarium-vouchered authentic CMMs (herein referred to as the Leon Collection), the Kew EBC features early collections of medicinal materials from around the world. Notably, the EBC features at least 1,268 samples of CMMs that were collected between the early 1800s and 1929, most of which have not been systematically assessed. Among the holdings relevant to Chinese medicine is a collection known as the "Hooper Collection" (HC), which includes 620 botanical, mineral, and animal drugs that were acquired from Chinese pharmacies in the Malay peninsula in 1924; this collection was the focus of our research.

2. Materials and methods

The HC results from an early European attempt to identify the diverse range of CMMs employed in Chinese pharmacies during the British Colonial Era (Hooper, 1929), and stands out as the only Kew EBC collection that attempts to represent the range of CMMs found in trade at a specific time and place. The HC specimens were acquired from Chinese pharmacies in Malaya by the botanist Isaac Henry Burkill, who served as the Director of the Singapore Botanic Gardens from 1912 to 1924, and were then curated into the EBC in London in 1929. Thus, the HC represents a "time capsule" for investigating the early 20th century Chinese herbal market in the Malay peninsula.

An initial attempt by David Hooper to identify the items in this collection was summarized and published in 1929 in *The Gardens' Bulletin: Straits Settlements*, in a monograph entitled "On Chinese Medicine: drugs of Chinese pharmacies in Malaya" (Hooper, 1929). In his effort to identify the substances, Hooper consulted numerous contemporary sources and referenced comparative samples of CMMs collected by Porter Smith and Daniel Hanbury that were stored at the Museum of the Pharmaceutical Society in the UK (Hooper, 1929).

The majority of the samples in the HC contain original labels that feature Chinese characters, and most of the samples with Chinese labels can be linked to Hooper's textual analysis, which described 456 drugs and included both Latin and Chinese names. Hooper's text also appears to include entries for specimens that no longer contain original Chinese labels, as well as a variety of mineral and animal drugs that are no longer present in the HC. While the samples that contain original Chinese labels are nearly certainly primary samples that Burkill collected in the Malay/Singapore region, the provenance of the samples in the HC that lack Chinese labels is less definitive. This latter group likely includes both original samples from Burkill as well as comparison CMM specimens from the Museum of the Pharmaceutical Society that Hooper used in the identification process (Smith, 1871; Hooper, 1929). These two groups of specimens were thus evaluated separately.

The specimens (and their corresponding text) were first examined macroscopically at Kew by Eric Brand, a Chinese medicine practitioner with training in the morphological identification of CMMs, with additional support from Christine Leon, a botanist with training in CMM identification. Photographs of the samples were then further evaluated by members of our research team with extensive expertise in CMM identification (Ran Huang, Zhongzhen Zhao, and Ping Guo). Vouchered CMM reference specimens from the Leon Collection at Kew (part of the EBC collection) and authenticated crude drug samples at the Bank of China (Hong Kong) Chinese Medicines Center at Hong Kong Baptist University were used for comparison during the process of identification. The original specimens were retained in the Kew EBC, and were evaluated based on the current specifications of the Chinese Pharmacopoeia Commission (2015) and contemporary professional textbooks focused on macroscopic identification of CMMs (Kang, 2003; Zhao and Chen, 2014).

The samples were further evaluated based on their Chinese nomenclature and the identifications made by Hooper in 1929 were reviewed. After an initial assessment, specimens that could not be morphologically identified due to degradation from prolonged storage

or insufficient sample size were excluded, as were specimens that lacked adequate identifying features or lacked reference materials for comparison (as in the case of some drugs that are no longer encountered in commerce or pharmacopoeias). The specimens that were investigated are detailed in Appendix A.

Based on our previous research into commonly confused CMMs and historical changes in CMMs and their processing (Zhao et al., 2006a, 2012; Guo et al., 2015), specimens were selected as case studies to highlight the potential for collections to clarify issues that remain of clinical concern today. In the context of commonly confused CMMs, the HC was investigated for specimens that mirror current marketplace confusion, as demonstrated by a systematic study of over 10,000 samples of commercial medicinal materials conducted in Hong Kong from 2004 to 2005 (Zhao and Li, 2008). Additional case studies were selected as examples of differences between the historical samples and current market materials, such as changes due to processing or changes in the plant parts used as a given Chinese drug. By presenting case studies that illustrate prominent themes that remain relevant in the quality control of CMMs today, it is hoped that this preliminary study will stimulate systematic future research into historical collections of CMMs.

3. Results and discussion

The HC is one of the few known collections that aims to capture the range of CMMs in trade in a specific location and historical period, and its specimens illustrate how CMMs from nearly 100 years ago share many similarities and differences with the materials in use today. In this study, case studies were selected to highlight issues that relate to authentication and safety, with an emphasis on easily confused CMMs and changes in processing and plant parts used. By applying additional analytical techniques, the HC and similar collections could be effectively used to systematically investigate many topics related to historical changes, regional practices, herbal quality, and the evolution of CMMs.

3.1. Case studies of commonly confused CMMs

Over 50 pairs of commonly confused CMMs have been reported in modern trade (Zhao et al., 2006a), but the historical and geographic prevalence of this confusion is unclear in many cases. The HC specimens demonstrate that many CMMs that are commonly confused in the modern era were already prone to confusion in the Malay peninsula prior to 1929. Our assessment of HC specimens with intact Chinese drug names revealed 14 examples of confused drugs, all of which have been associated with contemporary marketplace confusion (Zhao et al., 2006a, 2006b).

3.2. Regional substitutes

CMMs are prone to regional variations in botanical identity, producing a situation in which the botanical sources used in given region do not match the official source of a drug as specified in the Chinese Pharmacopoeia (Zhao, 2007). In such cases, different plants share the same Chinese drug name, leading to confusion and uncertainty surrounding identity, safety, and efficacy.

Items that are considered “customary regional substitutes” are often herbal medicines with a long history of local use in a specific geographic region. In many cases, these local substitutes are accepted by provincial authorities and are included in materia medica texts, frequently with traditional properties that mirror the actions ascribed to the official drug. In some cases, customary regional substitutes have even become incorporated into the Chinese Pharmacopoeia, as in the case of baphicacanthus root (*nanbanlangen, Strobilanthes cusia* (Nees) Kuntze. [listed under the synonym *Baphicacanthus cusia* (Nees) Brem. in the CP], Acanthaceae), which is a customary regional substitute for isatis root (*banlangen*, *Isatis tinctoria* L., Brassicaceae). As many customary regional substitutes are sold under the same name as official drugs derived from different species, they are often regarded as confused or misidentified drugs; however, in many cases these substitutes have a long history of established use in specific geographic areas (Zhao et al., 2006a).

The HC features at least 14 confused drugs that remain commonly encountered in trade. All the substitutes found in the HC have been reported as confused drugs in southern Chinese regions such as Hong Kong (Zhao et al., 2006a). As Hong Kong plays a key role in the international trade of CMMs, confused drugs from the Hong Kong market often influence and reflect the market situation overseas (Zhao, 2016). The specimens from the HC suggest that many of the CMMs that are commonly confused in the Hong Kong market today were also confused in the Malay peninsula prior to 1929, which may have been influenced by the fact that Cantonese-speaking pharmacists were reported to have provided many of the CMMs for the HC (Hooper, 1929).

For example, inula flower (*xuanfuhua*, *Inula japonica* Thunb., Asteraceae) is the official source of the CMM “*xuanfuhua*” according to the Chinese Pharmacopoeia (CP, 2015). However, the flower of *Anisopappus chinensis* Hook et Arn. (Asteraceae) is often encountered as a substitute for inula flower in Hong Kong and other regions (Zhao, 2007). In the HC, *Anisopappus chinensis* was used as *xuanfuhua* (EBC#69184, Fig. 1), suggesting that regional substitution regarding these two substances was already established in the Malay peninsula in the early 20th century.

Another example of regional confusion of CMMs due to shared common names can be seen in the HC specimen associated with pulsatilla root (*baitouweng*, *Anemone chinensis* Bunge [syn. *Pulsatilla chinensis* (Bunge) Regel], Ranunculaceae). The whole herb of *Polycarpaea corymbosa* (L.) Lam. (Caryophyllaceae) is customarily used as *baitouweng* in certain geographic regions, particularly in Southern China and Hong Kong (Zhao, 2007). In the HC, *Polycarpaea corymbosa* was labeled in Chinese as *baitouweng* (EBC#69515), while a pre-modern specimen of *Anemone chinensis* was included in the same container as a comparison sample. Ancient texts often lacked detailed descriptions of the appearance of *baitouweng*; its name literally means “gray-haired old man,” which refers to the grayish filaments that are found at the head of its root. However, over time many plants with white aerial portions have been used under this name (Zhao et al., 2006a).

Additional examples of regional substitutes that were seen in the HC are described in Table 1, above. For example, in the HC, the leaves of *Strobilanthes cusia* (Nees) Kuntze. [syn. *Baphicacanthus cusia* (Nees) Brem] (Acanthaceae) were used as the CMM *daqingye* (EBC#69426). In the modern era, the roots of both *Strobilanthes cusia* and *Isatis tinctoria* L. are official forms of the drug *banlangen*, but only the leaves of *I. tinctoria* are an official source of *daqingye*. The

Fig. 1. *Anisopappus chinensis.*

Table 1
Chinese medicinal materials with customary regional substitutes in the HC.

Chinese Drug Name	Official Source as Defined in 2015 Chinese Pharmacopoeia	Macroscopic identification of HC Sample
Baitouweng (白頭翁)	*Anemone chinensis* Bunge [syn. *Pulsatilla chinensis* (Bunge) Regel] (Ranunculaceae)	*Polycarpaea corymbosa* (L.) Lam. (Caryophyllaceae)
Baiwei (白薇)	*Cynanchum atratum* Bge. (Asclepiadaceae)	*Gerbera piloselloides* (L.) Cass. (Asteraceae)
Daqingye (大青葉)	*Isatis tinctoria* L. (Brassicaceae)	*Strobilanthes cusia* (Nees) Kuntze. [syn. *Baphicacanthus cusia* (Nees) Brem] (Acanthaceae)
Fuping (浮萍)	*Spirodela polyrrhiza* (L.) Schleid (Lemnaceae)	*Pistia stratiotes* L. (Araceae)
Heshi (鶴蝨)	*Carpesium abrotanoides* L. (Asteraceae)	*Torilis japonica* (Houtt.) DC. (Umbelliferae)
Kunbu (昆布)	*Laminaria japonica* Aresch. (Laminariaceae)	*Ulva lactuca* L. (Ulvaceae)
Shihu (石斛)	*Dendrobium nobile* Lindl. and other closely related species in the same genus (Orchidaceae)	*Dendrobium plicatile* Lindl., *D. nobile* Lindl., *D. fimbriatum* Hook (Orchidaceae)
Wangbuliuxing (王不留行)	*Vaccaria hispanica* (Mill.) Rausch. (Caryophyllaceae)	*Ficus pumila* L. (Moraceae)
Xuanfuhua (旋覆花)	*Inula japonica* Thunb. (Asteraceae)	*Anisopappus chinensis* Hook et Arn. (Asteraceae)
Yinchen (茵陳)	*Artemisia scoparia* Waldst. et Kit. or *A. capillaris* Thunb. (Asteraceae)	*Origanum vulgare* L. (Lamiaceae)

aerial portion of *S. cusia* is often used as an alternative to *I. tinctoria* for indigo production in parts of southern China (Chang and Ho, 2001), and the HC specimen suggests that its leaves were also used instead of the leaves of *I. tinctoria* as the drug *daqingye*.

In some cases, the customary substitutes observed are likely related to economic substitution. For example, in the case of dendrobium stem (*shihu*, *Dendrobium nobile* and other closely related species in the same genus, Orchidaceae), multiple different specifications were observed in the HC. These specifications include *Dendrobium fimbriatum* Hook (EBC#69353), *D. nobile* EBC#69349, 69350, 69351), and *D. plicatile* Lindl. (EBC#69352); while all three of these species remain common in the contemporary market, the latter species is often regarded as an economic adulterant (Zhao et al., 2006a).

Additionally, some economic substitutes that are often confused in the modern era were clearly differentiated in the HC. For example, in the case of Sichuan fritillaria bulb (*chuanbeimu*, *Fritillaria cirrhosa* D.Don, *F. unibracteata* P.K.Hsiao & K.C.Hsia, *F. przewalskii* Maxim. ex Batalin., or *F. delavayi* Franch., Liliaceae), samples of the genuine article (EBC#69396, Fig. 2) were well-differentiated from *Fritillaria ussuriensis* Maxim. (*pingbeimu*, EBC#69397, Fig. 3). *F. ussuriensis* is often encountered as an economic adulterant in the modern era (Zhao et al., 2006a), and was recorded as an inexpensive substitute in China as early as 1930 (Chen, 1999).

3.3. Confused CMMs with known safety issues

While the confused species described above are sometimes regarded as customary substitutes that are widely accepted in certain geographic regions, the HC also illustrates examples of substitutes with known safety risks. For example, nephrotoxicity and carcinomas resulting from exposure to aristolochic acids (AAs) have been linked to misidentified CMMs, including akebia stem (*mutong*, *Akebia quinata* (Houtt.) Decne., *A. trifoliata* (Thunb.) Koidz, and *A. trifoliata* (Thunb.) Koidz. var. *australis* (Diels) Rehd., Lardizabalaceae) (Wu, 1964; Lord et al., 1999) and stephania root (*fangji*, *Stephania tetrandra* S.Moore, Menispermaceae) (Vanherweghem et al., 1993; Nortier and Vanherweghem, 2002). Several examples of substitute species with known safety risks were identified in the HC, as detailed below (see Table 2).

Fig. 2. *Chuanbeimu* (*Fritillaria cirrhosa/F. unibracteata/F. przewalskii*).

Fig. 3. *Fritillaria ussuriensis*.

The risk of exposure to AAs through misidentified CMMs is related to substitution with species from the genus *Aristolochia*. In the case of stephania root (*fangji*), the risk of AA exposure is due to the substitution of *Stephania tetrandra* with the root of *Aristolochia fangchi* Y.C.Wu ex Chow et Hwang (Aristolochiaceae). In the HC, the specimen marked as "*fangji*" (EBC#69322, originally catalogued as *Cocculus trilobus* DC.) was derived from the root of *Aristolochia fangchi* (also known as "*guangfangji*"), which indicates that *A. fangchi* was already established in local trade by the 1920s.

In the case of akebia stem (*mutong*), AA contamination can result from substitution with Manchurian aristolochia stem (*guanmutong*, *Aristolochia manshuriensis* Kom., Aristolochiaceae), which is now widely banned from trade. In addition to akebia stem, the Chinese Pharmacopoeia also includes a form of "*mutong*" known as "*chuanmutong*," which is derived from *Clematis armandii* Franch. or *Clematis montana* Buch.-Ham. (Ranunculaceae). In the HC, three "*mutong*" specimens were identified, consisting of two samples derived from the genus *Clematis* (EBC#69221, 69635) and one specimen derived from *Aristolochia manshuriensis* (EBC#69220, Fig. 4).

In other cases, misidentification of CMMs can expose patients to potentially toxic cardiac glycosides, as in the case of confusion between acanthopanax root bark (*wujiapi*, *Eleutherococcus nodiflorus* (Dunn) S.Y.Hu [syn. *Acanthopanax gracilistylus* W.W. Smith], Araliaceae) and periploca root bark (*xiangjiapi*, *Periploca sepium* Bunge, Apocynaceae) (Zhao et al., 2015). Additionally, acanthopanax root bark (*wujiapi*) is also confused with species such as *Hedyotis hedyotidea* (DC.) Merr. (Rubiaceae) and *Acanthopanax giraldii* Harms (Araliaceae) (Xie, 2008; Zhao, 2007; Zhao et al., 2015).

In the HC, a pre-modern comparison specimen of *Hedyotis hedyotidea* was labeled as "*wujiapi*" (EBC#69655, Fig. 5), while a

Table 2
Commonly confused CMMs with known safety concerns.

Chinese Drug Name	Official Source as Defined in 2015 Chinese Pharmacopoeia	Macroscopic identification of HC Sample
Mutong (木通)	**Mutong (木通):** *Akebia quinata* (Houtt.) Decne., *A. trifoliata* (Thunb.) Koidz, and *A. trifoliata* (Thunb.) Koidz. var. *australis* (Diels) Rehd., (Lardizabalaceae) **Chuanmutong (川木通):** *Clematis armandii* Franch. or *Clematis montana* Buch.-Ham. (Ranunculaceae)	EBC#69220: *Aristolochia manshuriensis* Kom. (Aristolochiaceae) EBC#69221, 69635: *Clematis* sp. (Ranunculaceae)
Fangji (防己)	*Stephania tetrandra* S.Moore, (Menispermaceae)	EBC#69322: *Aristolochia fangchi* Y.C.Wu ex Chow et Hwang (Aristolochiaceae)
Wujiapi (五加皮)	*Eleutherococcus nodiflorus* (Dunn) S.Y.Hu [listed in the Chinese Pharmacopoeia by the synonym *Acanthopanax gracilistylus* W.W. Smith] (Araliaceae)	EBC#69655: *Hedyotis hedyotidea* (DC.) Merr. (Rubiaceae) EBC#69611: *Acanthopanax giraldii* Harms (Araliaceae) EBC#69364: *Periploca sepium* Bunge (Apocynaceae)

Fig. 4. *Aristolochia manshuriensis.*

Fig. 5. *Hedyotis hedyotidea.*

Fig. 6. *Acanthopanax giraldii.*

specimen of *Acanthopanax giraldii* (EBC#69611, Fig. 6) was labeled in Chinese as "*chuanjiapi*" ("*wujiapi* from Sichuan province"). The HC also contained a comparison specimen that was consistent with *Periploca sepium* (EBC# 69364), as well as a specimen described by Hooper as *Eleutherococcus henryi* that could not be botanically identified. Thus, material derived from several different species was grouped together under the name "*wujiapi*" in the HC.

Historical confusion surrounding the origin of "*wujiapi*" has been referenced in *bencao* texts for centuries (Xie, 2008; Liu et al., 2009). The substitutes observed in the HC continue to be present in the modern market (Zhao et al., 2006a), and closely match the nomenclature and descriptions of different forms of "*wujiapi*" that were discussed by the Chinese author Chen Renshan in 1930 (Chen, 1999; Hooper, 1929). Thus, the EBC samples suggest that the *wujiapi* substitutes that are currently encountered in the market were also present in the Malay peninsula in the 1920s.

Several of the confused species described above are closely related to the geographic distribution and/or abundance of natural resources. For example, in the case of akebia stem (*mutong*) and acanthopanax root bark (*wujiapi*), insufficient natural resources are closely related to the rise of substitutes from other species and genera (Lou and Qin, 1996; Xie, 2008). In addition to giving rise to confused drugs, historical changes due to insufficient natural resources are also related to changes in species, potential differences between wild and cultivated sources, and changes in the medicinal plant parts used for CMMs.

3.4. Changes in medicinal plant parts used

In the HC, some CMMs feature plant parts that differ from contemporary market materials and/or the official specifications of the Chinese Pharmacopoeia. For example, in modern practice the seeds are removed in the preparation of cornus fruit (*shanzhuyu, Cornus officinalis* Sieb. et Zucc., Cornaceae); however, in the two specimens contained within the HC (EBC#69638, Fig. 7), the seeds were not removed. Historical *bencao* texts are divided regarding the used medicinal part for cornus fruit; some ancient texts indicate that the seed should be retained while others indicate that the seed should be

Fig. 7. *Cornus officinalis.*

removed (Xie, 2008). In another case, the seeds and pericarps of Sichuan peppercorn (*huajiao* [pericarps], *jiaomu* [seeds], *Zanthoxylum bungeanum* Maxim., Rutaceae) are separated and employed as separate drugs in the modern era (Zhao and Chen, 2014), but the specimen labeled as *huajiao* in the HC contains a mixture of the seeds and pericarps (EBC#69599).

In some cases, the use of different plant parts is subject to regional variations. For example, in the case of eriocaulon (*gujingcao*, *Eriocaulon buergerianum* Koern., Eriocaulaceae), the whole herb plus capitulum is the official source specified by the Chinese Pharmacopoeia. However, in some regions of China only the capitulum of a related species (*Eriocaulon sexangulare* L.) is used. In the HC, the *gujingcao* specimen (EBC#69372) consisted of the capitulum of *E. sexangulare*, which is similar to the contemporary market material often seen in Hong Kong (Zhao, 2016).

The use of different plant parts is also sometimes related to economic substitution as well as regional trends. For example, the pollen of *Typha angustifolia* L. (Typhaceae) is specified in the Chinese Pharmacopoeia as the official source of the drug typha pollen (*puhuang*) (CP, 2015). However, the HC specimen (EBC#69588) featured a mixture of the pollen and flower; this combination of pollen and flower (known as "*cao*" *puhuang*) is often encountered in southern China in the contemporary market as well (Zhao, 2007). Similarly, in the case of juncus pith (*dengxincao*, *Juncus effusus* L., Juncaceae), the official source is the pith only (CP, 2015), but the whole plant is often tied into bundles with the pith in southern China (Zhao, 2007). In the HC, the whole plant was tied into bundles with the pith (EBC#69429, Fig. 8), which may reflect regional habits or economic substitution given the light weight of the pith alone.

Economic substitution can be seen in other examples of CMM materials with variable purity. For example, the CMM agarwood (*chenxiang, Aquilaria agallocha* Roxb. or *A. sinensis* (Lour.) Spreng., Thymelaeaceae) exhibits a wide range of purity depending on the relative abundance of resinous vs. non-resinous wood; in the specimen observed in the HC (EBC#69241), significant amounts of non-resinous wood were observed. In the case of aloe latex (*luhui*, the concentrated latex of *Aloe barbadensis* Mill. or *A. ferox* Mill., Xanthorrhoeaceae, EBC#69225, Fig. 9), significant adulteration was seen via the presence of wood debris that appeared to be deliberately lodged deep into the mass of concentrated latex, presumably to increase its weight.

In the case of lonicera flower (*jinyinhua*, *Lonicera japonica* Thunb., Caprifoliaceae), the HC specimen (EBC#69438) included leaf matter and other material in addition to the immature flower buds. The HC sample of *jinyinhua* was thus similar to a nearly 300-year-old sample observed at the Sloane Collection at the British Natural History Museum, which also included leaf material mixed with the immature flower buds (Zhao et al., 2015); furthermore, additional 19th and early 20th century crude drug samples in the Kew EBC also feature a mixture of leaf and flower tissue in specimens of L. *japonica*. This suggests that the material used may have historically featured impurities or mixed medicinal plant parts.

Fig. 9. Concentrated latex of *Aloe sp.*

Another representative example of historical changes in the plant parts used involves asarum (*xixin*, root and rhizome of *Asarum heterotropoides* Fr. Schmidt var. *mandshuricum* (Maxim.) Kitag., *A. sieboldii* Miq. var. *seoulense* Nakai, or *A. sieboldii* Miq., Aristolochiaceae). From the 5th century AD through the Qing Dynasty (1644–1911 CE), *bencao* texts consistently emphasized that the aerial portion was toxic and only the root should be used (Liu et al., 2009). However, due to a shortage of medicinal material, the whole plant began to be used as *xixin* in the 1950s (Lai and Li, 2001; Xie, 2008), posing a risk of unnecessary exposure to aristolochic acids (Zhao et al., 2008). In the HC, two specimens of asarum (*xixin*) are present (EBC#69256, Fig. 10 and EBC#69621, Fig. 11); labeled as *A. sieboldii*, both specimens consist of primarily root and rhizome material. This suggests that the primary medicinal material used as *xixin* in the Malay region in the early 20th century was the root and rhizome rather than the whole herb.

3.5. Case studies of specimens subjected to medicinal processing (pao zhi)

Post-harvest handling and processing methods influence the constituents and clinical applications of CMMs. Processing is often applied to CMMs to reduce side effects, enhance or modify therapeutic effects, or facilitate transportation and storage (Guo et al., 2015). Medicinal processing (*pao zhi*) is a distinctive feature of Chinese medicine, and often involves methods that involve heat (such as stir-frying, roasting, or charring) and/or water (including soaking, boiling, or steaming), as well as techniques that incorporate adjuvants such as vinegar, alcohol, and honey (Brand and Wiseman, 2008).

As the methods of processing used in modern times often differ from the methods applied in ancient times (Zhao et al., 2010), historical samples can potentially clarify which processing methods were applied in earlier eras. For example, the tuberous root of flowery knotweed (*heshouwu*, *Reynoutria multiflora* (Thunb.) Moldenke [syn. *Polygonum multiflorum* Thunb.], Polygonaceae) has a purgative effect in its unprocessed form; after processing it is used as a tonic. The HC sample (EBC#69521, Fig. 12) featured clear evidence of processing,

Fig. 8. *Juncus effusus* whole plant with pith.

Fig. 10. *Asarum sp.* sample #1.

Fig. 11. *Asarum sp.* sample #2.

Fig. 12. Processed *Polygonum multiflorum* root.

and appeared as very thin slices that are remarkably similar to the medicinal material commonly seen in the Hong Kong market today (Zhao et al., 2011). As multiple processing methods for flowery knotweed (*heshouwu*) are described in ancient texts (Zhao et al., 2010), further research into historical collections could help to clarify whether pre-modern materials were processed differently from contemporary materials. Clarifying the processing of "*heshouwu*" is an important issue, as reports of liver toxicity have been linked to its use in recent years (Dong et al., 2014) and research is being conducted to investigate whether these adverse events are related to inadequate processing (Liang et al., 2011).

Processing is frequently applied to reduce the toxicity of certain CMMs. The HC features two processed forms of pinellia rhizome within a single container (*banxia*, *Pinellia ternata* (Thunb.) Makino, Araceae, EBC#69080, Fig. 13). Three processed forms of pinellia are detailed in the 2015 Chinese Pharmacopoeia to reduce toxicity and highlight specific therapeutic effects (CP, 2015); with further research, it may be possible to compare how the processing methods used nearly 100 years ago compare with the processing methods specified in the Chinese Pharmacopoeia today.

Another example of processing can be seen in HC specimens of the processed lateral root of aconite (*fuzi*, *Aconitum carmichaelii* Debx., Ranunculaceae, EBC#69612). Different processing methods and adjuvants influence the toxicity of aconite products in TCM (Lu et al., 2010), and over forty different processing methods for aconite have been recorded in classical TCM texts (Ye et al., 2011). Thus, further assessment using chemical analysis could help to clarify the adjuvants used in previous eras, as well as the toxicity of pre-modern medicinal material.

Fig. 13. Processed *Pinellia ternata* rhizome.

In addition to reducing toxicity, processing is used to alter the therapeutic effects of some CMMs. Evidence of such processing was observed in the HC, including in CMMs such as rehmannia root (*dihuang*, *Rehmannia glutinosa* Gaertn., Plantaginaceae, EBC#69547), *huangjing* (*Polygonatum sibiricum* Red., Asparagaceae, EBC#69518), and *chuanxiong* (*Ligusticum striatum* DC., Apiaceae, EBC#69493). In the case of peony root, white peony root (*baishao, Paeonia lactiflora* Pall., Paeoniaceae, EBC#69662) and red peony root (*chishao*, *P. lactiflora* Pall. or *P. veitchii* Lynch, EBC#69481) exhibited different methods of processing; the former had its cortex removed and its fractured surface suggested it had been boiled before drying, while the latter was used crude. These features of peony root closely correspond with contemporary market materials (Wang et al., 2014).

Differences in the appearance of decoction pieces can also be seen between the HC specimens and contemporary materials. For example, many medicinal materials in the HC were sliced more thinly than contemporary materials, which increases their surface area and likely influences the efficiency of extraction; examples of CMMs with very thinly sliced decoction pieces in the HC include areca seed (*binglang, Areca catechu* L., Arecaceae, EBC#29243), anemarrhena rhizome (*zhimu*, *Anemarrhena asphodeloides* Bunge, Asparagaceae, EBC#69236), and alisma rhizome (*zexie*, *Alisma orientale* (Sam.) Juzep., Alismataceae, EBC#69222). In the case of ephedra (*mahuang*, *Ephedra sinica* Stapf., Ephedraceae, EBC#69367), the HC specimen featured stems with the internodes partially removed; while current market materials retain the internodes, the internodes were similarly removed in a specimen from the Sloane Collection at the British Natural History Museum (Zhao et al., 2015).

In the case of the pericarp of the opium poppy (*yingsuqiao*, *Papaver somniferum* L., Papaveraceae, EBC#69487), modern textbooks on CMM authentication invariably emphasize the distinctive feature of visible cuts on the outer surface of the opium poppy capsule, which are produced from the harvesting of opium (Kang, 2003). However, no cuts are present in the specimen observed in the HC, suggesting that the HC material used was derived from opium poppy capsules that were not previously cut to extract opium. While further research would be required to assess whether this has implications for potency, the lack of scarification marks suggests that some poppy plants were deliberately left uncut to supply the material used in Chinese medicine. This sample was thus similar to a previously reported specimen from the Sloane Collection at the British Natural History Museum, which also lacked scars from cutting (Zhao et al., 2015).

3.6. Future avenues for research

Beyond clarifying the botanical sources and processing methods of CMMs from different eras, the HC is a valuable resource for further research on a variety of topics. For example, systematic research into the specifications, grades, nomenclature, and origins of the specimens would have significant scientific value, as would chemical and genetic analysis to investigate issues related to botanical identity, adjuvants used in processing, and toxicity. Collections such as the HC also reveal which local and exotic medicines were integrated into trade, and can help to clarify the historical exchange of knowledge and medicinal substances. The HC also reveals that some items that were once in local circulation are no longer commonly used, while others remain almost identical to the current market materials; additionally, the CMMs present provide insight into the range of diseases that were commonly

treated with Chinese medicine at the time.

3.6.1. Clarifying the historical sources of CMMs derived from multiple species

The HC samples provide evidence of historical changes in the species used for a given CMM. For example, *bencao* literature suggests that the primary species used historically as phellodendron bark (*huangbai, Phellodendron chinense* C.K.Schneid., Rutaceae,) was *P. chinense*. However, in modern times, both phellodendron bark (*chuanhuangbai*, *P. chinense*) and Amur cork tree bark (*guanhuangbai*, *P. amurense* Rupr.) are used as forms of "*huangbai*." In the HC, only *P. chinense* (*chuanhuangbai*) is present (EBC#69497), which aligns with *bencao* literature research that suggests *P. chinense* was the main material in circulation during this time period (Xie, 2008).

Historical changes in the species used are also evident in the case of coptis rhizome (*huanglian*, *Coptis chinensis* Franch., *C. teeta* Wall., or *C. deltoida* C.Y.Cheng et Hsiao, Ranunculaceae). In addition to the three species officially listed in the Chinese Pharmacopoeia, a number of other wild-crafted species from the *Coptis* genus have also been used historically as *huanglian* (Xie, 2008). *C. chinensis* is widely cultivated and predominant in modern trade, but some species such as *C. omeiensis* (Chen) C.Y. Cheng that are now scarce in the wild were traditionally regarded as superior (Xie, 2008). In the HC, three different specifications of coptis rhizome are present, which include *C. chinensis* Franch. (EBC#69326) and *C. teeta* Wall. (EBC#69327), as well as an unusual form (EBC#69325, Fig. 14) that includes a portion of aerial stem tissue and may be derived from *C. omeiensis* or another wild-crafted species that is no longer in use. These samples thus suggest that the species used have changed over time in response to advances in cultivation and limitations of wild resources.

3.6.2. Clarifying the prominence of wild vs. cultivated sources

Over centuries of use, advances in cultivation have been necessary to supply many CMMs that cannot be sustained solely by wild populations. As wild and cultivated materials often differ in their macroscopic features, in some cases it is possible to ascertain information about the wild vs. cultivated origin of CMMs by examining specimens organoleptically. A review of the materials in the HC reveals several striking examples of differences between pre-modern and modern materials, which may help to clarify the timeline surrounding their transition from wild to cultivated sources.

Several CMMs in the HC differed dramatically in size from contemporary market materials. These materials may be derived from wild-crafted rather than cultivated plants, or may reflect differences that relate to cultivar selection or fertilizer application. For example, the goji berries (*gouqizi*, *Lycium barbarum* L. or L. *chinense* Mill., Solanaceae, EBC#69443, Fig. 15) and ophiopogon tubers (*maidong*, *Ophiopogon japonicus* (Thunb.) Ker Gawl., Asparagaceae, EBC#69472) in the HC were much smaller than contemporary cultivated specimens.

In some cases, wild materials have been scarce for centuries. For example, specimens of ginseng roots (*renshen, Panax ginseng* C.A.Mey., Araliaceae) in the HC were derived from cultivated roots.

Fig. 14. *Coptis* sp.

Fig. 15. *Lycium* sp.

In the case of notoginseng (*sanqi, Panax notoginseng* Burk., Araliaceae), no wild populations are known to remain and few other samples from ancient collections have been evaluated; it is thus unknown if there are morphological differences between cultivated and wild roots. As the EBC samples may represent some of the earliest known specimens of *P. notoginseng*, further research using DNA analysis may be desirable to assess the degree of similarity between historical specimens and contemporary cultivars.

3.6.3. Incorporation of local and exotic drugs into Malay Chinese pharmacies

Herbal medicines sourced from outside of China have long been incorporated into Chinese medicine. While the vast majority of CMMs in the HC appear to have come from China, a number of notable examples of CMMs sourced from outside of China can also be seen. This feature of the collection was noted by Hooper in his introduction, which stated: "From it we are able to learn that while the Chinese on the whole adhere to the use of drugs of their own country, probably on account of the geographical position of Singapore and neighbourhood, the materia medica has been decidedly influenced by the introduction of local and Indian products" (Hooper, 1929).

For example, the HC included a sample of senna leaf (*fanxieye*, *Senna alexandrina* Mill., Leguminosae). Notably, the specimen of senna leaf in the HC preceded its formal inclusion in *bencao* literature (EBC#69287). Senna leaf was first formally described in the *bencao* literature in 1936 (Wang, 1936). Chinese customs records show that senna leaf was imported into China by sea via India and Japan and overland through Yunnan and Sichuan by 1889 (Hu, 1990), suggesting that its clinical use in China preceded its formal documentation in *bencao* texts. It is thus likely that senna leaf was gradually integrated into Chinese medicine through cultural exchange and was incorporated into texts after being established in clinical use; its presence in Chinese pharmacies in the Malay peninsula may be early evidence of this exchange.

Additionally, local herbs such as the root of *Eurycoma longifolia* Jack (Simaroubaceae), known in Malaysia as "tongkat ali," were found in the HC (EBC#69386), suggesting that some prominent local herbal medicines were found in Chinese pharmacies as well. The HC also contained *Cinchona sp.* (Rubiaceae, EBC#69307) from South America, as well as frankincense (*ruxiang*乳香, the resin of *Boswellia sacra* Flueck, Burseraceae, EBC#69206) and myrrh (*moyao*沒藥, *Commiphora myrrha* (Nees) Engl., Burseraceae, EBC#69324) from the Middle East.

As many herbal medicines are common to both Chinese and European herbal medicine, research into historical collections provides a valuable means of comparing the quality and specifications of drugs that were common to different medical traditions. For example, Hooper's (1929) report noted that the myrrh sample in the HC was "inferior" to the material used in Europe (Hooper, 1929); while the HC sample is morphologically similar to the material currently found on the Chinese market, it is indeed quite different from other myrrh specimens in the EBC. Thus, historical collections play an important role in comparing the quality of herbal medicines that are common to different cultures.

4. Conclusion

By selecting case studies that illustrate issues in Chinese medicinal authentication that remain relevant today, this study aims to draw attention to the value of historical collections and their importance in pharmacognosy. Many of the quality and safety issues encountered in the contemporary Chinese herbal market are rooted in historical changes that gradually arose over a long history of use, and physical specimens from pre-modern collections offer an unparalleled evidence base for evaluating such changes. European collections such as the Kew EBC thus offer a rich and largely untapped resource for investigating historical changes in CMMs.

This preliminary investigation of the Hooper Collection at Kew represents the first time since 1929 that the HC has been comprehensively assessed. In addition to the HC, the Kew EBC has many CMM samples with historical significance that have not been scientifically evaluated in the modern era, and our preliminary investigation of several individual genera suggests that the EBC may be one of the richest sources of well-preserved CMM historical specimens in the world. As a given collection such as the HC only illustrates the situation at a specific place and time, multiple collections are needed to capture a more complete picture.

The reliance on macroscopic identification is a limiting feature of this preliminary study, and the inclusion of additional methods would allow the HC to be more comprehensively and definitively assessed. While macroscopic identification remains indispensable for screening large numbers of samples at a low cost without damaging unique historical specimens, the availability of modern analytical techniques opens a wide range of options for assessing individual materials in future research. For example, in addition to clarifying issues related to confused drugs and processing methods, historical collections have the potential to illuminate other questions relevant to quality control, such as probing the levels of heavy metals found in CMMs prior to the industrial revolution and modern agricultural techniques.

This preliminary investigation of the HC illustrates the potential of collections for clarifying questions that have been advanced via *bencao* literature research, particularly in areas such as botanical identity, medicinal plant parts used, processing methods, and issues of confused species. These issues have had important implications for the safe clinical practice of TCM from ancient times to the present, and will remain important in the future. Historical materia medica collections are cultural treasures with medical significance, and are worthy of multi-disciplinary research for generations to come.

Conflict of interest

The authors declare that they have no conflicts of interest relevant to the publication of this document.

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Appendix A. Specimens investigated in the Hooper collection of the Kew economic botany collection

EBC# (specimen number)	Label data (as described in Kew database)	Plant Part (as described in Kew database)
69356	122.0 ACANTHACEAE Dicliptera chinensis Nees.	Flowering tops
69212	191.02 ACORACEAE Acorus calamus L.	Slices of root or stem
69214	191.02 ACORACEAE Acorus gramineus Soland.	Rhizome
69213	191.02 ACORACEAE Acorus gramineus Soland.	Root
69082	194.01 ALISMATACEAE Alisma flava	
69222	194.01 ALISMATACEAE Alisma plantago L.	Root slices
69143	194.01 ALISMATACEAE Alisma sp	
69223	175.27 ALLIACEAE Allium bakeri Regel	Tuber
69224	175.27 ALLIACEAE Allium odorum L.	Seed
69225	175.22 ALOACEAE Aloe chinensis	Resin
69077	130.0 AMARANTHACEAE Achyranthes aspera	Root
69161	130.0 AMARANTHACEAE Achyranthes bidentata Blume	
69076	130.0 AMARANTHACEAE Achyranthes bidentata Blume	Root
69210	130.0 AMARANTHACEAE Achyranthes bidentata Blume	Root
69211	130.0 AMARANTHACEAE Achyranthes bidentata Blume	Stem
69156	130.0 AMARANTHACEAE Achyranthes bidentata Blume var japonica	
69190	130.0 AMARANTHACEAE Celosia argentea L.	Seed
69289	130.0 AMARANTHACEAE Celosia argentea L.	Seeds
69290	130.0 AMARANTHACEAE Celosia sp. Linn.	Cockscomb
69088	175.28 AMARYLLIDACEAE Amaryllis sp.	
69551	53.01 ANACARDIACEAE Rhus semialata Murray	Galls
69552	53.01 ANACARDIACEAE Rhus vernicifera DC.	Resin
69615	175.23 ANTHERICACEAE Anemarrhena asphodeloides Bunge	Rhizome
69236	175.23 ANTHERICACEAE Anemarrhena asphodeloides Bunge	Sliced root
69681	80.0 APIACEAE	Root
69195	80.0 APIACEAE	Seeds
69616	80.0 APIACEAE Angelica anomala Pall.	Root slices
69146	80.0 APIACEAE Angelica anomala Pall.	Wood
69099	80.0 APIACEAE Angelica anomala Pall.	Root

69237	80.0 APIACEAE Angelica anomala Pall.	Root
69134	80.0 APIACEAE Angelica decursiva	Root
69147	80.0 APIACEAE Angelica inaequalis	Wood
69238	80.0 APIACEAE Angelica polymorpha Max.	Root
69239	80.0 APIACEAE Angelica sp	Infested wood
69280	80.0 APIACEAE Bupleurum falcatum Linn.	Roots
69136	80.0 APIACEAE Bupleurum sp	Root
69135	80.0 APIACEAE Bupleurum sp	Root
69185	80.0 APIACEAE Cnidium monnieri (L.) Cusson	Seed
69328	80.0 APIACEAE Coriandrum sativum Linn.	Fruits
69645	80.0 APIACEAE Foeniculum vulgare	Seeds
69651	80.0 APIACEAE Ligusticum acutilobum	
69652	80.0 APIACEAE Ligusticum acutilobum	Root
69085	80.0 APIACEAE Ligusticum acutilobum	
69093	80.0 APIACEAE Ligusticum sinense Oliv.	
69667	80.0 APIACEAE Peucedanum decursirum	
69494	80.0 APIACEAE Peucedanum japonicum Thunb.	Sliced root
69493	80.0 APIACEAE Peucedanum japonicum Thunb.	Root
69665	80.0 APIACEAE Peucedanum japonicum Thunb.	
69492	80.0 APIACEAE Peucedanum medicum Dunn.	Sliced root
69495	80.0 APIACEAE Peucedanum praeruptorum Dunn.	Root slices
69496	80.0 APIACEAE Peucedanum sp	Root pieces
69666	80.0 APIACEAE Peucedanum sp	
69107	80.0 APIACEAE Pleurospermum davidi	
69098	80.0 APIACEAE Siler divaricatum	Root
69180	80.0 APIACEAE Torilis japonica (Houtt) DC.	Flowers
69514	106.0 APOCYNACEAE Plumeria acutifolia Poir.	Flowers
69513	106.0 APOCYNACEAE Plumeria acutifolia Poir.	Flowers
69671	106.0 APOCYNACEAE Plumeria acutifolia Poir.	Flowers
69422	46.01 AQUIFOLIACEAE Ilex latifolia Thunb.	Leaves
69617	191.01 ARACEAE	Rootstock
69103	191.01 ARACEAE Amorphophallus sp.	
69089	191.01 ARACEAE Arisaema elephas Buchet	
69092	191.01 ARACEAE Arisaema erubescens (Wall.) Schott	Roots
69247	191.01 ARACEAE Arisaema erubescens (Wall.) Schott	Root resin
69246	191.01 ARACEAE Arisaema erubescens Schott	Root gum
69155	191.01 ARACEAE Arisaema serratum (Thunb.) Schott	
69087	191.01 ARACEAE Arisaema sp	Tuber
69122	191.01 ARACEAE Arisaema sp	
69157	191.01 ARACEAE Arisaema sp	
69248	191.01 ARACEAE Arisaema sp	Sliced rhizome
69249	191.01 ARACEAE Arisaema sp	Tuber slices
69158	191.01 ARACEAE Arisaema yunnanense Buchet	
69417	191.01 ARACEAE Homalomena sp	Root
69080	191.01 ARACEAE Pinellia ternata (Thunb.) Breitenb.	
69502	191.01 ARACEAE Pinellia tuberifera (Thunb.) Druce	Tubers
69508	191.01 ARACEAE Pistia stratiotes L.	Plant
69364	81.01 ARALIACEAE Eleutherococcus henryi Oliv.	Root bark
69162	81.01 ARALIACEAE Eleutherococcus henryi Oliv.	Wood
69611	81.01 ARALIACEAE Eleutherococcus spinosus (L.f.) S.Y.Hu	Hairy branches
69209	81.01 ARALIACEAE Eleutherococcus spinosus Miq.	Stems
69485	81.01 ARALIACEAE Panax ginseng C.A.Mey.	Ginseng
69483	81.01 ARALIACEAE Panax ginseng C.A.Mey.	Rootlets
69663	81.01 ARALIACEAE Panax ginseng C.A.Mey.	Roots
69144	81.01 ARALIACEAE Panax ginseng C.A.Mey.	
55783	81.01 ARALIACEAE Panax ginseng C.A.Mey.	Root
69486	81.01 ARALIACEAE Panax repens Max.	Ginseng leaves
69484	81.01 ARALIACEAE Panax schin-seng D Hanbury	Root
69389	81.01 ARALIACEAE Tetrapanax papyrifera (Hook.) K. Koch	Pithy stem slices
69607	187.0 ARECACEAE	Palm seed
69215	187.0 ARECACEAE Actinorhytis calapparia Blume	Seed
69243	187.0 ARECACEAE Areca catechu Linn.	Sliced Areca nut
69244	187.0 ARECACEAE Areca sp	Husk
69245	187.0 ARECACEAE Areca sp	Fruit stalks
69250	138.0 ARISTOLOCHIACEAE Aristolochia debilis Sieb. & Zucc.	Fruits
69142	138.0 ARISTOLOCHIACEAE Aristolochia recurvilabra	

69138	138.0 ARISTOLOCHIACEAE Aristolochia recurvilabra Hance	
69252	138.0 ARISTOLOCHIACEAE Aristolochia sp	Rhizome
69251	138.0 ARISTOLOCHIACEAE Aristolochia sp	Sliced root
69621	138.0 ARISTOLOCHIACEAE Asarum sieboldi Miq.	Roots
69256	138.0 ARISTOLOCHIACEAE Asarum sieboldi Miq.	Rootlets/plant
69257	138.0 ARISTOLOCHIACEAE Asarum sp	Root
69341	107.0 ASCLEPIADACEAE Cynanchum japonicum Hemsl. var purpurascens Maxim.	Root
69587	107.0 ASCLEPIADACEAE Tylophora sp	Leaves
69081	107.0 ASCLEPIADACEAE Vincetoxicum sp	Root
69258	175.03 ASPARAGACEAE Asparagus cochinchinensis Merr.	Sliced tuber
69203	175.03 ASPARAGACEAE Barnardia japonica (Thunb.) Schult. & Schult.f..	
69340	327.0 ASPLENIACEAE Cyclophorus porosus Presl.	Fronds
69109	327.0 ASPLENIACEAE Polypodium fortunei	
69523	327.0 ASPLENIACEAE Polypodium sp	Sliced fern root
69368	7.01 BERBERIDACEAE Epimedium sagittatum Baker	Leaves
69268	159.01 BETULACEAE Betula utilis D.Don. Var	Bark
69474	120.01 BIGNONIACEAE Oroxylum indicum Vent.	Seeds
69512	120.01 BIGNONIACEAE Tecoma grandiflora Juss.	Flowers
69269	328.0 BLECHNACEAE Blechnum orientale	Fern root
69272	31.02 BOMBACACEAE Bombax malabaricum DC.	Flowers
69273	31.02 BOMBACACEAE Bombax malabaricum DC.	Root _
69435	112.01 BORAGINACEAE Lithospermum erythrorhizon Sieb. & Zucc.	Bark
69628	11.0 BRASSICACEAE Brassica campestris	Seeds
69276	11.0 BRASSICACEAE Brassica chinensis Linn.	Dried cakes
69168	11.0 BRASSICACEAE Brassica juncea (L.) Czern. & Coss.	
69629	11.0 BRASSICACEAE Brassica juncea Coss.	Seeds
69277	11.0 BRASSICACEAE Brassica juncea Coss.	Seeds
69164	11.0 BRASSICACEAE Descurainia sophia (L.) Webb ex Prantl	
69546	11.0 BRASSICACEAE Raphanus sativus L.	Seeds
69571	11.0 BRASSICACEAE Sisymbrium sophia L.	Seeds
69279	108.02 BUDDLEJACEAE Buddleja officinalis Maxim.	Leaves & Fruits
69206	42.0 BURSERACEAE Boswellia sacra Flueck.	Resin
69627	42.0 BURSERACEAE Boswellia serrata	Gum
69324	42.0 BURSERACEAE Commiphora sp.	Resin
69636	42.0 BURSERACEAE Commiphora sp.	Bark
69613	91.01 CAMPANULACEAE Adenophora polymorpha Ledeb.	Root
69216	91.01 CAMPANULACEAE Adenophora polymorpha Ledeb.	Root
69217	91.01 CAMPANULACEAE Adenophora sp	Root
69284	91.01 CAMPANULACEAE Campanumoea pilosula Franch.	Root
69283	91.01 CAMPANULACEAE Campanumoea pilosula Franch.	Root
52042	91.01 CAMPANULACEAE Codonopsis tangshen	Root
69119	91.01 CAMPANULACEAE Codonopsis tangshen	Root
69511	91.01 CAMPANULACEAE Platycodon grandiflorum DC.	Root
69670	91.01 CAMPANULACEAE Platycodon grandiflorus DC.	Root
69171	153.04 CANNABACEAE Cannabis sativa	Seed
69438	83.01 CAPRIFOLIACEAE Lonicera japonica Thunb.	Flower
69354	22.01 CARYOPHYLLACEAE Dianthus superbus L.	Plant
69515	22.01 CARYOPHYLLACEAE Polycarpaea corymbosa Lam.	Plant
69172	22.01 CARYOPHYLLACEAE Stellaria dichotoma L. var. lanceolata Bge.	
69379	47.01 CELASTRACEAE Euonymus pellucidifolius Hay.	Stem
69545	66.0 COMBRETACEAE Quisqualis indica L.	Fruits
69544	66.0 COMBRETACEAE Quisqualis indica L.	Fruit
69578	66.0 COMBRETACEAE Terminalia chebula Roxb.	Fruit
69685	88.0 COMPOSITAE	Seeds
69184	88.0 COMPOSITAE	Flowers
69200	88.0 COMPOSITAE Arctium lappa	Seeds
69618	88.0 COMPOSITAE Arctium lappa L.	Seeds
69253	88.0 COMPOSITAE Artemisia annua Linn.	Flowering branches
69620	88.0 COMPOSITAE Artemisia vulgaris	Leaves
69619	88.0 COMPOSITAE Artemisia vulgaris L.	Leaves
69254	88.0 COMPOSITAE Artemisia vulgaris L.	Dried leaves
69255	88.0 COMPOSITAE Artemisia vulgaris L.	Leaf
69259	88.0 COMPOSITAE Aster trinervius Roxb.	Root
69623	88.0 COMPOSITAE Atractylis lancea	Woody slices
69624	88.0 COMPOSITAE Atractylis lancea	Woody pieces
69622	88.0 COMPOSITAE Atractylis ovata Thunb.	Wood

69262	88.0 COMPOSITAE Atractylis ovata Thunb.	Root
69263	88.0 COMPOSITAE Atractylis ovata Thunb.	Rhizome
69625	88.0 COMPOSITAE Atractylis sp	Woody section
69139	88.0 COMPOSITAE Atractylis sp	Root
69271	88.0 COMPOSITAE Blumea chinensis DC.	Leafy stalks
69199	88.0 COMPOSITAE Carthamus tinctorius L.	Florets
69286	88.0 COMPOSITAE Carthamus tinctorius L.	Florets
69291	88.0 COMPOSITAE Centipeda orbicularis Lour.	Herb
69296	88.0 COMPOSITAE Chrysanthemum indicum L.	Flowers
69295	88.0 COMPOSITAE Chrysanthemum indicum L.	Flowers
69297	88.0 COMPOSITAE Chrysanthemum indicum L.	Flowers eaten by beetles
69631	88.0 COMPOSITAE Chrysanthemum sp	Flowers
69321	88.0 COMPOSITAE Cnicus japonicus Max.	Sliced root & stem
69361	88.0 COMPOSITAE Eclipta alba Hassk.	Plant
69363	88.0 COMPOSITAE Elephantopus scaber L.	Dried leaf and root
69380	88.0 COMPOSITAE Eupatorium sp	Stem & leaves
69381	88.0 COMPOSITAE Eupatorium sp	Stem & leaves
69410	88.0 COMPOSITAE Gynura ovalis DC.	Root
69133	88.0 COMPOSITAE Gynura sp	Tuberous root
69565	88.0 COMPOSITAE Saussurea lappa C.B.Clarke	Root
69564	88.0 COMPOSITAE Saussurea lappa C.B.Clarke	Sliced Stem
69573	88.0 COMPOSITAE Solidago virga-aurea Linn.	Dried stem & leaves
69586	88.0 COMPOSITAE Tussilago farfara L.	Flowers
69598	88.0 COMPOSITAE Xanthium strumarium L.	Fruits
69682	88.0 COMPOSITAE Xanthium strumarium L.	Fruits
69472	175.02 CONVALLARIACEAE Ophiopogon japonicus Ker.	Tubers
69659	175.02 CONVALLARIACEAE Ophiopogon japonicus Ker.	Tubers
69110	175.02 CONVALLARIACEAE Polygonatum canaliculatum	Root
69518	175.02 CONVALLARIACEAE Polygonatum falcatum A. Gray.	Root
69519	175.02 CONVALLARIACEAE Polygonatum officinale All.	Root
69427	113.01 CONVOLVULACEAE Ipomoea batatas (L.) Lam.	White sliced tuber
69330	82.01 CORNACEAE Cornus officinalis Sieb. & Zucc.	Fruits
69638	82.01 CORNACEAE Cornus officinalis Sieb. & Zucc.	Fruits
69267	75.0 CUCURBITACEAE Benincasa cerifera Savi	Fruit skins
69169	75.0 CUCURBITACEAE Benincasa hispida Cogn.	
69634	75.0 CUCURBITACEAE Citrullus vulgaris	Seeds
69335	75.0 CUCURBITACEAE Cucumis melo L.	Bitter Root
69334	75.0 CUCURBITACEAE Cucumis melo L.	Peduncles
69457	75.0 CUCURBITACEAE Momordica charantia L.	Sliced fruit
69458	75.0 CUCURBITACEAE Momordica cochinchinensis Spreng.	Seeds
69174	75.0 CUCURBITACEAE Trichosanthes kirilowii Maxim.	
69150	75.0 CUCURBITACEAE Trichosanthes multiloba	
69583	75.0 CUCURBITACEAE Trichosanthes multiloba Miq.	Fruit & Seed
69680	75.0 CUCURBITACEAE Trichosanthes multiloba Miq.	Starch
69163	210.0 CUPRESSACEAE Platycladus orientalis (L.) Franco	
69580	210.0 CUPRESSACEAE Thuja orientalis L.	Seed
69579	210.0 CUPRESSACEAE Thuja orientalis L.	Leaves
69091	216.0 CYCADACEAE Cycas circinalis	
69339	216.0 CYCADACEAE Cycas sp	Fruits
69342	199.0 CYPERACEAE Cyperus rotundus L.	Tubers
69343	199.0 CYPERACEAE Cyperus sp	Sliced Tuber
69536	322.0 DENNSTAEDTIACEAE Pteridium aquilinum Kuhn.	Starch
69300	316.0 DICKSONIACEAE Cibotium barometz J.Sm.	Root fern
69632	316.0 DICKSONIACEAE Cibotium barometz J.Sm.	Fern Rhizome
69298	316.0 DICKSONIACEAE Cibotium barometz J.Sm.	Fern stem
69299	316.0 DICKSONIACEAE Cibotium barometz J.Sm.	Hairy rhizome
69555	2.01 DILLENIACEAE Tetracera sp	Root
69640	174.02 DIOSCOREACEAE Dioscorea japonica Thunb.	
69128	174.02 DIOSCOREACEAE Dioscorea sp	
69421	174.02 DIOSCOREACEAE Hypoxis aurea Lour.	Root
69130	174.02 DIOSCOREACEAE Hypoxis minor Don.	Root
69083	86.01 DIPSACACEAE Dipsacus asper	
69124	86.01 DIPSACACEAE Dipsacus asper Wall.	
69123	86.01 DIPSACACEAE Dipsacus asper Wall.	
69294	323.02 DRYOPTERIDACEAE Dryopteris crassirhizoma	Charcoal
69360	323.02 DRYOPTERIDACEAE Dryopteris sophoroides O. Kuntze.	Fern fronds

69358	102.0 EBENACEAE Diospyros kaki L.	Calyces and peduncles
69359	102.0 EBENACEAE Diospyros lotus L.	Seed
69641	102.0 EBENACEAE Diospyros lotus L.	Seeds
69369	205.0 EPHEDRACEAE Ephedra	Root
69367	205.0 EPHEDRACEAE Ephedra sinica Stapf.	Stems
69370	253.0 EQUISETACEAE Equisetum arvense L.	Stem & leaves
69371	253.0 EQUISETACEAE Equisetum hyemale L.	Stems
69540	93.01 ERICACEAE Pyrola media Sw.	Leaves
69372	196.0 ERIOCAULACEAE Eriocaulon willdenovianum Moldenke	Flower heads
69376	153.03 EUCOMMIACEAE Eucommia ulmoides Oliv.	Bark
69643	153.03 EUCOMMIACEAE Eucommia ulmoides Oliv.	Bark
69333	151.01 EUPHORBIACEAE Croton tiglium L.	Fruit
69137	151.01 EUPHORBIACEAE Elaeococca spinosa	
69382	151.01 EUPHORBIACEAE Euphorbia lathyris L.	Seeds
69383	151.01 EUPHORBIACEAE Euphorbia pekinensis Rupr.	Root
69151	151.01 EUPHORBIACEAE Euphorbia pekinensis Rupr.	Root
69384	151.01 EUPHORBIACEAE Euphorbia sieboldiana M. & D.	Root
69500	151.01 EUPHORBIACEAE Phyllanthus sp	Leaves & twigs
69553	151.01 EUPHORBIACEAE Ricinus communis L.	Seeds
69543	159.03 FAGACEAE Quercus infectoria Oliv.	Galls
69684	999.99 FAMILY UNKNOWN	Mineral and burnt shell
69686	999.99 FAMILY UNKNOWN	Mixed unidentified
69608	999.99 FAMILY UNKNOWN	Unnamed
69609	999.99 FAMILY UNKNOWN	Various animal specimens
69610	999.99 FAMILY UNKNOWN	Various minerals
69126	999.99 FAMILY UNKNOWN	
69165	999.99 FAMILY UNKNOWN	
69176	999.99 FAMILY UNKNOWN	
69192	999.99 FAMILY UNKNOWN	Seeds
69196	999.99 FAMILY UNKNOWN	Powder
69116	999.99 FAMILY UNKNOWN	Bark
69207	999.99 FAMILY UNKNOWN	
69419	17.03 FLACOURTIACEAE Hydnocarpus anthelmintica Pierre	Seed
69597	3000.0 FUNGI	Wood fungus
69596	3000.0 FUNGI	Wood Fungus
69447	3000.0 FUNGI Lycoperdon sp	Brown mould
69446	3000.0 FUNGI Lycoperdon sp	Fungus
69131	3000.0 FUNGI Poria cocos	Sliced root
69090	3000.0 FUNGI Poria cocos	
69189	109.01 GENTIANACEAE Gentiana crassicaulis Duthie et Burk.	Root
69402	109.01 GENTIANACEAE Gentiana loureirii Griseb.	Stem & leaves
69647	109.01 GENTIANACEAE Gentiana loureirii Griseb.	Stem/leaf/flower
69403	109.01 GENTIANACEAE Gentiana rigescens Franch.	Root & stem
48989	109.01 GENTIANACEAE Gentiana scabra Bunge var buergeri (Miq.) Maxim.	Roots
69373	38.01 GERANIACEAE Erodium sp	Stem
69404	119.0 GESNERIACEAE Gesneria sp?	Roots & leaves
69148	116.0 GLOBULARIACEAE Aeginetia indica	
69398	27.01 GUTTIFERAE Garcinia dulcis Kurz.	Oily seeds
69399	27.01 GUTTIFERAE Garcinia mangostana L.	Fruit rind
69420	27.01 GUTTIFERAE Hypericum japonicum Thunb.	Stems
69355	59.06 HYDRANGEACEAE Dichroa febrifuga Lour.	Plant & leaves
69637	3112.01 HYPOCREACEAE Cordyceps sinensis Berk.	Fungus
69633	3112.01 HYPOCREACEAE Cordyceps sp	Cordyceps on Cicadas
69423	4.03 ILLICIACEAE Illicium verum Hook.f.	Fruits
69424	4.03 ILLICIACEAE Illicium verum Hook.f.	Fruits
69266	178.05 IRIDACEAE Belamcanda chinensis (L.) DC.	Root slices
69428	156.01 JUGLANDACEAE Juglans regia L.	Fruits
69429	186.01 JUNCACEAE Juncus effusus L.	Stem & Pith
69439	126.01 LAMIACEAE Agastache rugosa (Fisch. & Mey.) O.Ktze.	Stem & Leaf
69240	126.01 LAMIACEAE Anisomeles ovata Benth.	Stem and leaf
69365	126.01 LAMIACEAE Elsholtzia ciliata	Dried parts
69432	126.01 LAMIACEAE Leonurus japonicus	Stem & leaves
47751	126.01 LAMIACEAE Leonurus japonicus	Seeds
69193	126.01 LAMIACEAE Leonurus japonicus	Seeds
69456	126.01 LAMIACEAE Mentha arvensis L.	Leaves & Stems
69466	126.01 LAMIACEAE Nepeta tenuifolia Benth.	Flowering heads

69465	126.01 LAMIACEAE Nepeta tenuifolia Benth.	Flowering heads
69658	126.01 LAMIACEAE Nepeta tenuifolia Benth.	Flowering spikes
69473	126.01 LAMIACEAE Origanum vulgare L.	Leaves
69170	126.01 LAMIACEAE Perilla frutescens (L.) Britt.	
69490	126.01 LAMIACEAE Perilla nankinensis Decne.	Stems and leaves
69491	126.01 LAMIACEAE Perilla nankinensis Decne.	Seeds
69664	126.01 LAMIACEAE Perilla nankinensis Decne.	Leaves
69529	126.01 LAMIACEAE Prunella vulgaris L.	Flower heads
69560	126.01 LAMIACEAE Salvia miltiorhiza Bunge.	Root
69159	126.01 LAMIACEAE Salvia miltiorhiza Bunge.	
69201	126.01 LAMIACEAE Scutellaria baicalensis Georgi	Bark or wood
69431	4249.02 LAMINARIACEAE Laminaria saccharina Lam.	Seaweed
69220	7.02 LARDIZABALACEAE Akebia quinata Dec.	Woody stem (sliced)
69221	7.02 LARDIZABALACEAE Akebia quinata Dec.	Woody stem (Slices)
69149	143.01 LAURACEAE Cinnamomum aromaticaum Nees.	Wood
69301	143.01 LAURACEAE Cinnamomum camphora Nees	Fruits
69303	143.01 LAURACEAE Cinnamomum cassia Blume	Sliced branches
69305	143.01 LAURACEAE Cinnamomum cassia Blume	Sliced twigs
69304	143.01 LAURACEAE Cinnamomum cassia Blume	Bark
69306	143.01 LAURACEAE Cinnamomum cassia Blume	Long sliced root
69302	143.01 LAURACEAE Cinnamomum cassia Blume	Sliced stem
69129	143.01 LAURACEAE Daphnidium sp	
69105	143.01 LAURACEAE Lindera sp	
69606	143.01 LAURACEAE Lindera strychnifolia Villar	Root
69437	143.01 LAURACEAE Litsea sp	Calyces
69436	143.01 LAURACEAE Litsea sp	Bark
69175	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Caesalpinia minax Hance	
69630	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Caesalpinia sappan L.	Wood
69282	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Caesalpinia sappan L.	Wood chips
69281	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Caesalpinia sappan L.	Wood
69287	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Cassia angustifolia Vahl.	Leaves
69166	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Cassia tora	
58246	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Cassia tora L.	Seeds
69292	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Cercis chinensis Bunge.	Bark/wood?
69293	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Cercis chinensis Bunge.	Bark
69405	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Gleditschia officinalis Hemsl.	Pods
69648	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Gleditschia sinensis	Stem chips
69406	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Gleditschia sinensis Lam. -previous name: LEGUMINOSAE-MIMOSOIDEAE Mimosa fera Lour.	Sliced stem
69570	57.02 LEGUMINOSAE-CAESALPINIOIDEAE Sindora siamensis Teysm.	Fruit
69488	57.03 LEGUMINOSAE-MIMOSOIDEAE Parkia roxburghii	Seeds
69260	57.01 LEGUMINOSAE-PAPILIONOIDEAE Astragalus henryi Oliver	Sliced root
69261	57.01 LEGUMINOSAE-PAPILIONOIDEAE Astragalus sp	Sliced stem
69285	57.01 LEGUMINOSAE-PAPILIONOIDEAE Canavalia gladiata DC.	Seeds
69535	57.01 LEGUMINOSAE-PAPILIONOIDEAE Cullen coryifolia Linn.	Fruits
69642	57.01 LEGUMINOSAE-PAPILIONOIDEAE Dolichos lablab L.	Beans
69182	57.01 LEGUMINOSAE-PAPILIONOIDEAE Dolichos lablab L.	Seed
69374	57.01 LEGUMINOSAE-PAPILIONOIDEAE Erythrina indica Lam.	Sliced root or stem
69407	57.01 LEGUMINOSAE-PAPILIONOIDEAE Glycyrrhiza sp	Root
69408	57.01 LEGUMINOSAE-PAPILIONOIDEAE Glycyrrhiza sp	Powdered root
69649	57.01 LEGUMINOSAE-PAPILIONOIDEAE Glycyrrhiza sp	Sliced root
69426	57.01 LEGUMINOSAE-PAPILIONOIDEAE Indigofera tinctoria L.	Leaves & Stems
69100	57.01 LEGUMINOSAE-PAPILIONOIDEAE Lespedeza sp	
69661	57.01 LEGUMINOSAE-PAPILIONOIDEAE Pachyrhizus sp	
69121	57.01 LEGUMINOSAE-PAPILIONOIDEAE Pachyrhizus sp	
69538	57.01 LEGUMINOSAE-PAPILIONOIDEAE Pueraria hirsuta Schneider	Root slices
69537	57.01 LEGUMINOSAE-PAPILIONOIDEAE Pueraria hirsuta Schneider	Flowers
69575	57.01 LEGUMINOSAE-PAPILIONOIDEAE Sophora flavescens Ait.	Root
69115	57.01 LEGUMINOSAE-PAPILIONOIDEAE Sophora flavescens Ait.	Root
69576	57.01 LEGUMINOSAE-PAPILIONOIDEAE Sophora japonica L.	Flower buds
69676	57.01 LEGUMINOSAE-PAPILIONOIDEAE Sophora japonica L.	Flower buds
69591	57.01 LEGUMINOSAE-PAPILIONOIDEAE Vigna catiang Walp.	Beans
69592	57.01 LEGUMINOSAE-PAPILIONOIDEAE Vigna catiang Walp.	Pod fibre
69411	2000.0 LICHENS Gyrophora vellea Ach.	Plant
69375	178.03 LILIACEAE Erythronium dens-canis L.	Tuber
69396	178.03 LILIACEAE Fritillaria cirrhosa D. Don.	Corms

69646	178.03 LILIACEAE Fritillaria cirrhosa D. Don.	Corms
69397	178.03 LILIACEAE Fritillaria sp	Corms
69395	178.03 LILIACEAE Fritillaria verticillata Willd. var. thunbergii Bak.	Starchy corms
69434	34.01 LINACEAE Linum usitatissimum L.	Seeds
69441	148.01 LORANTHACEAE Loranthus yadoriki Sieb. & Zucc.	Stem & branch
69449	250.0 LYCOPODIACEAE Lycopodium serratum Thunb.	Plant
69448	250.0 LYCOPODIACEAE Lycopodium serratum Thunb.	Plant
69539	69.01 LYTHRACEAE Punica granatum L.	Fruit rind
69574	69.01 LYTHRACEAE Sonneratia sp	Wood/stem
69453	4.01 MAGNOLIACEAE Magnolia officinalis Rehder & Wilson	Flower
69451	4.01 MAGNOLIACEAE Magnolia officinalis Rehder & Wilson	Flower bud
69452	4.01 MAGNOLIACEAE Magnolia officinalis Rehder & Wilson	Bark
69454	4.01 MAGNOLIACEAE Magnolia sprengeri Pamp. ssp diva Stapf	Flower
41998	4.01 MAGNOLIACEAE Magnolia stellata (Siebold & Zucc.) Maxim.	Flower buds
69208	31.01 MALVACEAE Abutilon indicum G.Don	Seeds
69202	31.01 MALVACEAE Abutilon indicum G.Don.	Seeds
69409	31.01 MALVACEAE Gossypium sp	Cotton & Seed
69412	31.01 MALVACEAE Hibiscus mutabilis L.	Flowers
69413	31.01 MALVACEAE Hibiscus rosa-sinensis L.	Bark
69414	31.01 MALVACEAE Hibiscus syriacus L.	Flowers
69415	31.01 MALVACEAE Hibiscus tiliaceus L.	Fibre
69416	31.01 MALVACEAE Hibiscus trionum Linn.	Bark
69590	176.0 MELANTHIACEAE Veratrum nigrum L.	Root
69079	176.0 MELANTHIACEAE Veratrum nigrum L.	
69078	43.01 MELIACEAE Cedrela sp	Bark
69455	43.01 MELIACEAE Melia toosendan Sieb. & Zucc.	Fruit
69653	43.01 MELIACEAE Melia toosendan Sieb. & Zucc.	Fruit
63528	43.01 MELIACEAE Melia toosendan Sieb. & Zucc.	Fruit
69322	6.01 MENISPERMACEAE Cocculus trilobus DC.	Root slices
69390	6.01 MENISPERMACEAE Fibraurea tinctoria Lour.	Root/Stem
69581	6.01 MENISPERMACEAE Tinospora cordifolia Miers	Stem
69678	6.01 MENISPERMACEAE Tinospora cordifolia Miers	Stem
69117	6.01 MENISPERMACEAE Tinospora cordifolia Miers	Wood
69118	6.01 MENISPERMACEAE Tinospora sp	Wood
69084	153.05 MORACEAE Ficus bengalensis	Rootlets
69391	153.05 MORACEAE Ficus retusa L.	Adventitious roots
69392	153.05 MORACEAE Ficus sp	Fruits
69095	153.05 MORACEAE Morus alba L.	Root
69197	153.05 MORACEAE Morus alba L.	
69101	153.05 MORACEAE Morus sp	
69460	141.0 MYRISTICACEAE Myristica fragrans Houtt.	Fruit
69242	100.01 MYRSINACEAE Ardisia sp	Root
69377	67.01 MYRTACEAE Eugenia aquea	Woody seeds
69378	67.01 MYRTACEAE Eugenia caryophyllata Willd.	Flowers
69385	8.01 NYMPHAEACEAE Euryale ferox Salisb.	Fruits
69104	8.01 NYMPHAEACEAE Nelumbium sp	Meal from root
69462	8.01 NYMPHAEACEAE Nelumbium speciosum Willd.	Flowers
69463	8.01 NYMPHAEACEAE Nelumbium speciosum Willd.	Stamens
69464	8.01 NYMPHAEACEAE Nelumbo nucifera Gaertn.	Root
69657	8.01 NYMPHAEACEAE Nelumbo nucifera Gaertn.	Seed
69173	8.01 NYMPHAEACEAE Nelumbo nucifera Gaertn.	
69393	104.0 OLEACEAE Forsythia suspensa Vahl.	Fruit valves
69394	104.0 OLEACEAE Fraxinus bungeana A.DC.	Bark
69433	104.0 OLEACEAE Ligustrum lucidum Ait.	Small black fruits
69141	169.0 ORCHIDACEAE Bletia hyacinthina R. Br.	Corm
69270	169.0 ORCHIDACEAE Bletia hyacinthina R. Br.	Root/corm
69349	169.0 ORCHIDACEAE Dendrobium nobile Lindl.	Yellow stems
69351	169.0 ORCHIDACEAE Dendrobium nobile Lindl.	Stems
69352	169.0 ORCHIDACEAE Dendrobium nobile Lindl.	Root
69350	169.0 ORCHIDACEAE Dendrobium nobile Lindl.	Stems
69353	169.0 ORCHIDACEAE Dendrobium sp	Stems
69127	169.0 ORCHIDACEAE Dendrobium sp	Stems
69469	169.0 ORCHIDACEAE Nervilia fordii Schlecht.	Leaves
69481	1.03 PAEONIACEAE Paeonia lactiflora Pall.	Root bark
69662	1.03 PAEONIACEAE Paeonia lactiflora Pall.	
69154	1.03 PAEONIACEAE Paeonia officinalis Thunb.	Root

69482	1.03 PAEONIACEAE Paeonia suffruticosa Andrews	Root Bark
69205	1.03 PAEONIACEAE Paeonia veitchii Lynch.	Root or stem sections
69331	10.0 PAPAVERACEAE Corydalis ambigua Cham. et Schlecht.	Tuber slices
69487	10.0 PAPAVERACEAE Papaver somniferum Linn.	Capsule
69125	132.01 PHYTOLACCACEAE Phytolacca sp	
69504	208.0 PINACEAE Pinus sinensis Lam.	Wood
69503	208.0 PINACEAE Pinus sinensis Lam.	Resin
69505	139.01 PIPERACEAE Piper longum Linn.	Fruit spike
69506	139.01 PIPERACEAE Piper nigrum Linn.	Peppercorns
69668	139.01 PIPERACEAE Piper nigrum Linn.	Seeds
69507	139.01 PIPERACEAE Piper sp	Seed
69198	127.0 PLANTAGINACEAE Plantago asiatica L.	Seeds
69509	127.0 PLANTAGINACEAE Plantago major Linn.	Plant in flower
69510	127.0 PLANTAGINACEAE Plantago major Linn.	Seeds
69669	127.0 PLANTAGINACEAE Plantago major Linn.	Seeds
69626	200.0 POACEAE	Bamboo shoots
69264	200.0 POACEAE Bambusa bambos (L.) Voss	Manna
69265	200.0 POACEAE Bambusa bambos (L.) Voss	Manna
69323	200.0 POACEAE Coix lacryma-jobi L.	Popped seeds
69425	200.0 POACEAE Imperata cylindrica (L.) Beauv. var. cylindrica	Roots
69097	200.0 POACEAE Imperata cylindrica (L.) Beauv. var. cylindrica	
69440	200.0 POACEAE Lophatherum gracile Brongn.	Leaves
69181	200.0 POACEAE Oryza	
69477	200.0 POACEAE Oryza sativa L.	Red rice
69475	200.0 POACEAE Oryza sativa L.	Rice sprouts
69476	200.0 POACEAE Oryza sativa L.	Broken grains _
69498	200.0 POACEAE Phragmites australis (Cav.) Trin. ex Steud.	Root and stem
69499	200.0 POACEAE Phragmites australis (Cav.) Trin. ex Steud.	Root/stem
69585	200.0 POACEAE Triticum aestivum L.	Seeds
69584	200.0 POACEAE Triticum aestivum L.	Seeds
69516	20.01 POLYGALACEAE Polygala reinii Franch. & Sav.	Root
69517	20.01 POLYGALACEAE Polygala tenuifolia Willd.	Root
69388	134.0 POLYGONACEAE Fagopyrum esculentum Moench.	Seed
69191	134.0 POLYGONACEAE Fagopyrum esculentum Moench.	Seeds
69520	134.0 POLYGONACEAE Polygonum aviculare Linn.	Plant
69521	134.0 POLYGONACEAE Polygonum multiflorum Thunb.	Sliced tuber
69522	134.0 POLYGONACEAE Polygonum sp	Rhizome rootlets
69548	134.0 POLYGONACEAE Rheum officinale Baill.	Root
69673	134.0 POLYGONACEAE Rheum palmatum Linn.	Sliced root
69549	134.0 POLYGONACEAE Rheum sp	Leaves
69550	134.0 POLYGONACEAE Rheum sp	Root
69650	3204.02 POLYPORACEAE Hinneola polytricha?	
69459	3204.02 POLYPORACEAE Mylitta lapidescens Horan.	Sliced fungus tuber
69660	3204.02 POLYPORACEAE Pachyma cocos Fries	Fungus
69479	3204.02 POLYPORACEAE Pachyma cocos Fries.	Slices
69478	3204.02 POLYPORACEAE Pachyma cocos Fries.	Fungus
69480	3204.02 POLYPORACEAE Pachyma hoelen (Rumph) Fries	Fungus
69524	3204.02 POLYPORACEAE Polystictus sanguineus Fries.	Fungus
69096	99.0 PRIMULACEAE Lysimachia foenum graecum Hance.	Root
69450	99.0 PRIMULACEAE Lysimachia foenum-graecum Hance	Plant
69612	1.01 RANUNCULACEAE Aconitum carmichaeli Debeaux var. carmichaeli	
69160	1.01 RANUNCULACEAE Anemone cernua	
69132	1.01 RANUNCULACEAE Anemone cernua	Root
69320	1.01 RANUNCULACEAE Clematis chinensis Retz.	Rhizome & stem
69086	1.01 RANUNCULACEAE Clematis chinensis Retz.	
69635	1.01 RANUNCULACEAE Clematis montana Buch-Ham. ex DC.	
69325	1.01 RANUNCULACEAE Coptis japonica (Thunb.) Makino	Root and stem
69326	1.01 RANUNCULACEAE Coptis teeta Wall. var chinensis Franch.	Rhizome
69327	1.01 RANUNCULACEAE Coptis teeta Wall. var. chinensis Franch.	Root
69470	1.01 RANUNCULACEAE Nigella sativa L.	Seeds_
69418	49.01 RHAMNACEAE Hovenia dulcis Thunb.	Fruitbearing Peduncles
69683	49.01 RHAMNACEAE Zizyphus jujuba	Fruit
69332	58.01 ROSACEAE Crataegus pinnatifida Bunge	Fruits & Seeds
69152	58.01 ROSACEAE Potentilla chinensis	
69527	58.01 ROSACEAE Potentilla cryptotaenia Max.	Leaf and stem
69526	58.01 ROSACEAE Potentilla cryptotaenia Max.	Stem & Leaves

69528	58.01 ROSACEAE Potentilla sericea Linn.	Root, stem & leaves
69188	58.01 ROSACEAE Prinsepia sp	
69532	58.01 ROSACEAE Prunus japonica Thunb.	Kerels
8513	58.01 ROSACEAE Prunus laurocerasus L.	Wood
69530	58.01 ROSACEAE Prunus mume Sieb. & Zucc.	Kernel
69178	58.01 ROSACEAE Prunus mume Sieb. et Zucc.	
69533	58.01 ROSACEAE Prunus persica Sieb & Zucc.	Kernels
69531	58.01 ROSACEAE Prunus persica Sieb. & Zucc.	Kernels
69672	58.01 ROSACEAE Prunus persica Sieb. & Zucc.	Kernels
69111	58.01 ROSACEAE Prunus pseudocerasus	Bark
69534	58.01 ROSACEAE Prunus sp.	Kernels
69541	58.01 ROSACEAE Pyrus cathayensis Hemsl.	Sliced fruit
69542	58.01 ROSACEAE Pyrus sinensis Lindl.	Peel and pulp
69554	58.01 ROSACEAE Rosa laevigata Mich.	Fruits
69556	58.01 ROSACEAE Rosa multiflora Thunb.	Stalked fruits
69559	58.01 ROSACEAE Rubus sp	Fruits
69561	58.01 ROSACEAE Sanguisorba officinalis Linn.	Root
69113	58.01 ROSACEAE Sanguisorba sp	Root
69307	84.01 RUBIACEAE Cinchona calisaya Weddell.	Bark
69400	84.01 RUBIACEAE Gardenia florida Linn.	Fruits
69401	84.01 RUBIACEAE Gardenia sp	Stem
69655	84.01 RUBIACEAE Hedyotis hedyotidea Merr.	Wood chips
69654	84.01 RUBIACEAE Hedyotis hedyotidea Merr.	Wood chips
69461	84.01 RUBIACEAE Nauclea sinensis Oliver.	Thorny climber
69656	84.01 RUBIACEAE Nauclea sinensis Oliver.	Stems
69471	84.01 RUBIACEAE Oldenlandia heynii G.Don.	Fruit
69557	84.01 RUBIACEAE Rubia cordifolia Linn.	Root
69558	84.01 RUBIACEAE Rubia sp	Stems
69309	39.01 RUTACEAE Citrus aurantium Linn.	Sliced peel
69308	39.01 RUTACEAE Citrus aurantium Linn. var	Flowers
69311	39.01 RUTACEAE Citrus aurantium Linn. var	Flowers
69310	39.01 RUTACEAE Citrus aurantium Linn. var	Peel
69186	39.01 RUTACEAE Citrus decumana Risso.	Seed
69312	39.01 RUTACEAE Citrus grandis Osbeck.	Seeds
69314	39.01 RUTACEAE Citrus japonica Thunb.	Sliced fruit
69315	39.01 RUTACEAE Citrus medica Risso	Dried slices
69316	39.01 RUTACEAE Citrus medica Risso	Flowers
69317	39.01 RUTACEAE Citrus sp	Stem & Root
69313	39.01 RUTACEAE Citrus sp	Flowers
69319	39.01 RUTACEAE Clausena wampi Oliver	Root slices
69318	39.01 RUTACEAE Clausena wampi Oliver	Seeds
69357	39.01 RUTACEAE Dictamnus albus Linn.	Sliced root/stem
69387	39.01 RUTACEAE Evodia rutaecarpa Benth.	Fruits
69644	39.01 RUTACEAE Evodia rutaecarpa Benth.	Fruits
69497	39.01 RUTACEAE Phellodendron amurense Rupr.	Wood/bark strips
69106	39.01 RUTACEAE Poncirus sp	
69525	39.01 RUTACEAE Poncirus trifoliata Rafinesque	Fruit
69599	39.01 RUTACEAE Zanthoxylum alatum Roxb.	Fruits
69600	39.01 RUTACEAE Zanthoxylum piperitum DC.	Stem
69094	39.01 RUTACEAE Zanthoxylum piperitum DC.	Flowers
69602	39.01 RUTACEAE Zanthoxylum sp	Stem
69601	39.01 RUTACEAE Zanthoxylum sp	Fruits
69467	51.01 SAPINDACEAE Nephelium litchi Camb.	Seed
69468	51.01 SAPINDACEAE Nephelium longana Camb.	Small flowers/leaves
69562	51.01 SAPINDACEAE Sapindus mukorossi Gaertn.	Berries
69563	4250.05 SARGASSACEAE Sargassum siliquastrum Agardh.	Seaweed
69567	4.06 SCHISANDRACEAE Schizandra chinensis Baill.	Fruits
69566	4.06 SCHISANDRACEAE Schizandra chinensis Baill.	Fruits
69218	115.0 SCROPHULARIACEAE Adenosma caeruloea R. Br.	Fruiting tops
69274	115.0 SCROPHULARIACEAE Bonnaya reptans Benth.	Herb
69275	115.0 SCROPHULARIACEAE Bonnaya reptans Benth.	Herb
69278	115.0 SCROPHULARIACEAE Buchnera cruciata Ham.	Stems and Flowers
69145	115.0 SCROPHULARIACEAE Herpestis momcient?	
69489	115.0 SCROPHULARIACEAE Paulownia tomentosa Steud.	Root bark
69501	115.0 SCROPHULARIACEAE Picrorhiza kurroa Royle	Rhizome
69547	115.0 SCROPHULARIACEAE Rehmannia chinensis Libosch.	Root slices

69568	115.0 SCROPHULARIACEAE Scrophularia oldhami Oliv.	Root skin
69674	115.0 SCROPHULARIACEAE Scrophularia oldhami Oliv.	Root
69112	115.0 SCROPHULARIACEAE Siphonostegia sinensis	
69569	251.0 SELAGINELLACEAE Selaginella involvens Spring.	Plant
69219	40.01 SIMAROUBACEAE Ailanthus glandulosa Desf.	Fruits
69386	40.01 SIMAROUBACEAE Eurycoma longifolia	Woody stem
69140	174.07 SMILACACEAE Smilax glabra Roxb.	
69675	174.07 SMILACACEAE Smilax sp	
48018	114.01 SOLANACEAE Datura metel L.	Flowers
69347	114.01 SOLANACEAE Datura metel Linn.	Flowers
69348	114.01 SOLANACEAE Datura metel Linn.	Flowers
69445	114.01 SOLANACEAE Lycium chinense Miller	Stem
69443	114.01 SOLANACEAE Lycium chinense Miller	Berries
69442	114.01 SOLANACEAE Lycium chinense Miller.	Roots
69444	114.01 SOLANACEAE Lycium chinensis Miller.	Root & stem
69153	114.01 SOLANACEAE Mandragora officinalis	Root
69572	114.01 SOLANACEAE Solanum sp	Woody stems
69114	174.04 STEMONACEAE Stemone tuberosa	Bark
69187	32.0 STERCULIACEAE Firmiana simplex (L.) Wight.	
69167	32.0 STERCULIACEAE Scaphium affine (Mast.) Ridl.	
69577	24.01 TAMARICACEAE Tamarix chinensis Lour.	Stems
69677	24.01 TAMARICACEAE Tamarix chinensis Lour.	Stems & leaves
69582	213.0 TAXACEAE Torreya nucifera Sieb. & Zucc.	Seeds
69336	209.0 TAXODIACEAE Cunninghamia sinensis R. Br.	Wood shavings
69241	145.01 THYMELAEACEAE Aquilaria sp	Wood
69345	145.01 THYMELAEACEAE Daphne genkwa Sieb. & Zucc.	Flowers
69344	145.01 THYMELAEACEAE Daphne genkwa Sieb. & Zucc.	Flowers
69346	145.01 THYMELAEACEAE Daphne odora Thunb.	Stem
69362	145.01 THYMELAEACEAE Edgeworthia gardneri Meissn.	Stem/root
69329	33.01 TILIACEAE Corchorus capsularis Linn.	Seeds
69679	70.02 TRAPACEAE Trapa natans L. var bispinosa (Roxb.) Makino	Fruits?
69588	190.01 TYPHACEAE Typha orientalis Presl.	Stamens
69366	4410.03 ULVACEAE Enteromorpha intestinalis Link.	Fronds
69108	153.01 URTICACEAE Pouzolzia tuberosa	
69589	85.0 VALERIANACEAE Valeriana sp	Root
69594	125.01 VERBENACEAE Vitex negundo L.	Berries
69593	15.0 VIOLACEAE Viola sp	Stem, leaves & fruits
69595	50.01 VITACEAE Vitis serianifolia Max.	Roots
69120	50.01 VITACEAE Vitis serianifolia Max.	Root
69179	170.01 ZINGIBERACEAE Alpinia galanga (L.) Sw.	Fruits
69226	170.01 ZINGIBERACEAE Alpinia galanga (L.) Sw.	Fruits
69177	170.01 ZINGIBERACEAE Alpinia hainanensis K. Schum.	Fruits
69614	170.01 ZINGIBERACEAE Alpinia japonica (Thunb.) Miq.	
69194	170.01 ZINGIBERACEAE Alpinia officinarum Hance	Bark?
69228	170.01 ZINGIBERACEAE Alpinia officinarum Hance	Flowers and stems
69227	170.01 ZINGIBERACEAE Alpinia officinarum Hance	Herb
69229	170.01 ZINGIBERACEAE Alpinia officinarum Hance	Flowers and stems
69230	170.01 ZINGIBERACEAE Amomum amarum F.P.Sm.	Seeds
69232	170.01 ZINGIBERACEAE Amomum aromaticum Roxb.	Fruit & Wood
69231	170.01 ZINGIBERACEAE Amomum aromaticum Roxb.	Fruits
69233	170.01 ZINGIBERACEAE Amomum echinosphaera K.Schum.	Fruits
69234	170.01 ZINGIBERACEAE Amomum krervanh Pierre ex Gagnep.	Fruit
69235	170.01 ZINGIBERACEAE Amomum krervanh Pierre ex Gagnep.	Fruits
69183	170.01 ZINGIBERACEAE Amomum xanthioides	Fruits
69430	170.01 ZINGIBERACEAE Boesenbergia rotunda (L.) Mansf.	Sliced tuber
69337	170.01 ZINGIBERACEAE Curcuma longa L.	Rhizome
69639	170.01 ZINGIBERACEAE Curcuma longa L.	Fruit slices
69338	170.01 ZINGIBERACEAE Curcuma longa L. var macrophylla Miq.	Sliced root
56647	170.01 ZINGIBERACEAE Amomum maximum	Fruits
69604	170.01 ZINGIBERACEAE Zingiber officinale Roscoe	Root
69605	170.01 ZINGIBERACEAE Zingiber officinale Roscoe	Dried ginger
69603	170.01 ZINGIBERACEAE Zingiber officinale Roscoe	Rhizome
69102	37.0 ZYGOPHYLLACEAE Peganum harmala	Seed

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