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Review

Revision and Improvement of Criterion on Traditional Chinese Medicines in *Chinese Pharmacopoeia* 2015

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ABSTRACT

Chinese Pharmacopoeia is updated every five years, of which traditional Chinese medicine (TCM) is the most important part. The 2015 version completed by the 10th Pharmacopoeia Commission has come into operation since December 1, 2015. Here we introduced the revision and improvement of quality evaluation and control standards of TCMs in *Chinese Pharmacopoeia* 2015.

Key words

Chinese Pharmacopoeia 2015; quality control; safety control; traditional Chinese medicines

1. Background

The *Chinese Pharmacopoeia* is updated every five years and promulgated by the China Food and Drug Administration. In *Chinese Herbal Medicines* (No. 2, Vol. 2, 2010), we introduced the 2010 version (Qian et al, 2010). Nowadays the 2015 version (Pharmacopoeia Committee of P. R. China, 2015), the 10th Pharmacopoeia in China has come into operation since December 1, 2015. The updated Pharmacopoeia is requested to be improved in Chinese Pharmacopoeia system structure, and the criterion of quality evaluation and safety control, and to largely cover drugs in the *National Essential Drugs List* (2004 edition) *of China*. The updated criterion on chemical drugs and biological products is required to be parallel with or close to the international standards, and the criterion on traditional Chinese medicines (TCMs) is expected to take the leading level around the world. The updated Pharmacopoeia will play more important roles in promoting technical development in pharmaceutical industry and optimizing the structure of pharmaceutical industry in China.

As one of the important features of the *Chinese Pharmacopoeia*, TCM is the most interested part. It is an important issue for TCM modernization that TCM is controllable in quality and safety. Upon TCMs, this version is requested to be improved mainly in the following guidelines: reference drug standards are expected to be established, in order to improve Chinese Pharmacopoeia standard system itself; homogeneous drugs are expected to have a general quality standard because various quality standards of homogeneous drugs are present in the pharmacopoeia; the approach of drug safety control is expected to be improved, especially for "toxic" TCMs, it is dispensable to know safe formulas, use

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dosage, and safe contents. For a long term in the TCM field, it is highly concerned that what are the most suitable quality evaluation and control models or approaches for TCMs, and nowadays diverse models have been or being developed, e.g., quantitative analysis of multi-components by single marker (QASM), chemical fingerprinting and analyte-specific chromatograms, DNA molecular identification, and bioassay.

Being the key techniques in TCM quality evaluation and control system, they are used more widely in 2015 version than before. Since China is the major country in production, consume, and export of TCMs in the world, it is a mission that China should develop a set of the quality criterion of TCMs leading the world in the TCM field. The improvement of TCM quality evaluation, and control systems in the 2015 version are shown in the following aspects.

2. *Chinese Pharmacopoeia* system improvement

2.1 Compiling structures of 2015 version revised

The *Chinese Pharmacopoeia* system basically consists of three parts such as general notices, general rules, and monographs, which are individually covered in a total of three volumes in previous versions. The 2015 version is composed of four volumes, Volume I−III cover traditional Chinese medicines (TCMs), chemical medicines, and biological medicines respectively, which include information on the standards of purity, description, test, dosage, precaution, storage, and the strength for each drug, and Volume IV is a new block specifically responsible for general rules and pharmaceutic adjuvants ever admitted to the appendix of previous Volumes I−III.

2.2 New principles

The 2015 version first covers several principles about the national criterion of reference drug preparation, drug package materials, and glass vessel of drugs. So the individual chains of drug production and circulation can be fully supervised by the official agencies according to the *Chinese Pharmacopoeia*. TCM related principles have been improved in several rules: the general rule on identification and quantitative determination of Chinese medical materials (CMMs) and prepared slices, the general rule on CMM processing, and the general rule on pharmaceutic adjuvants. Several principles are first established in the 2015 version directly related to CMMs: the guidance on DNA barcoding identification in CMMs (9107), the guidance on allowed contents of harmful residuals in CMMs (9302), and the guidance on fungi toxins detection in CMMs (9305). Based on those principles, several parameters are subjected to CMM identification and content allowance in CMMs, e.g., SO_2, heavy metals, harmful elements, pesticide residuals, and afltoxins.

3. More drugs admitted

A total of 5608 drugs are admitted to the 2015 version, of which 1082 are more admitted to and 43 are expunged from the 2015 version due to backward production and poor in quality, safety, and stability. So 90% of drugs in the *National Essential Drugs List of China* (2004 edition) have been covered. Volume I covered a total of 2598 TCMs including CMMs, prepared slices, plant oils and extracts, and Chinese patent medicines (CPMs), of which 440 were more admitted, 517 revised, and seven expunged. In the 2010 version, crud drugs, prepared slices, and CPMs are all greatly increased in variety (Qian et al, 2010), while in the 2015 version, crud drugs are increased by only three, and CPMs greatly increased by 400. CPMs that are ingredient with *Saigae Tataricae Cornu*, *Os Draconis*, apatite, and fossil have been expunged from the 2015 version.

CMMs are also revised or completed in botanical resource, character description, identification, quantitative determination, and atomic absorption to improve the quality control criterion (Tables 1−4). Twenty-three Chinese herbal medicines are revised in character description: *Smilacis Glabrae Rhizoma*, *Lonicerae Flos*, *Chuanxiong Rhizoma*, *Gastrodiae Rhizoma*, *Pseudostellariae Radix*, *Fritillariae Ussuriensis Bulbus*, *Luffae Fructus Retinervus*, *Lilii Bulbus*, *Angelicae Sinensis Radix*, *Saposhnikoviae Radix*, *Ophiopogonis Radix*, *Euryales Semen*, *Citri Sarcodactylis Fructus*, *Alismatis Rhizoma*, *Aurantii Immaturus Fructus*, *Citri Fructus*, *Nelimbinis Semen*, *Platycodonis Radix*, *Codonopsis Radix*, *Chrysanthemi Flos*, *Puerariae Lobatae Radix*, *Propolis*, and *Ziziphi Spinosae*.

4. Drug safety control

The 2015 version showed maximum allowance quantities of harmful and residual substances based on their toxicity, exposure level, residual levels, and transmission in environment. How to control harmful substances in TCMs, both endogenously and exogenously, is thought to be the key issue for developing TCM quality standards. So the quality standards admitted in the 2015 version are therefore believed to be important references for quality control of other similar drugs.

4.1 Chinese medical materials

4.1.1 More parameters admitted

TCM safety control system is updated for TCMs in the following parameters: contents of SO_2 residual, heavy metals, harmful elements, pesticides, fungi toxin, pigments, microorganism, and pathogens (Table 5).

The 2015 version first describes that residual SO_2 is not allowed over 150 mg/kg in CMMs and the corresponding prepared slices except special ones. Since historically multi-pesticides are not allowed in CMMs and the residual contents are controlled as stringent as in foods, more pesticides, in a total of 16, are admitted in the list of prohibition in the 2015 version, seven of which are admitted for the first time. *Ginseng Radix* et *Rhizoma* and *Panacis Quinquefolii Radix* are first requested in the maximum allowed residual contents of pesticides as well as the corresponding prepared slices. In the 2010 version, only *Glycyrrhizae Radix* et *Rhizoma* and *Astragali Radix* were

Table 1 TCMs more admitted to and some expunged from 2015 version

TCMs more admitted	Botanical resources	
	2015 version	Previous
Hibisci Mutabilis Folium	Dried leaves of *Hibiscus mutabilis* L. (Malvaceae)	CMM I in Drug Standard promulgated by the former Ministry of Health of the People's Republic of China
Entianae Rhodanthae Herba	Dried herbs of *Gentiana rhodantha* Franch. (Gentianaceae)	*The Chinese Pharmacopoeia* 1977
Bergeniae Rhizoma	Dried roots and rhizomes of *Bergenia purpurascens* (Hook. F. et Thoms.) Engl. (Saxifragaceae)	*The Chinese Pharmacopoeia* 1977
Expunged TCMs		
Hominis Placenta		*The Chinese Pharmacopoeia* 2010
Xiaoer Fuxie Waifu Powder		*The Chinese Pharmacopoeia* 2010
Shengxue Pill		*The Chinese Pharmacopoeia* 2010
Ankun Zanyu Pill		*The Chinese Pharmacopoeia* 2010
Heche Dazao Pill		*The Chinese Pharmacopoeia* 2010
Bushen Guchi Pill		*The Chinese Pharmacopoeia* 2010
Yixuesheng Capsule		*The Chinese Pharmacopoeia* 2010

Table 2 TCMs revised in resource

TCMs	2015 version	2010 version
Cannabis Fructus	Dried mature fruits of *Cannabis sativa* L. (Moraceae)	Dried mature seeds of *Cannabis sativa* L. (Moraceae)
Ophicalcitum	Largely containing $CaCO_3$	
Aconm Lateralis Radix Praeparaia	…immersed in bittern liquid…	…immersed in edible bittern liquid…
Chrysanthemi Flos	Admitted "Huaiju", Chrysanthemum morifolium originated from Qinyang city, Mengzhou city, Boai county, Wuxiu county, and Wen county in Henan province, China	
Propolis	Sticky solid glue, a mixture of resin of nectar provider plants and discharge from the infracapitular gland and wax gland of *Apis mellifera* L. (Apidae)	Dried resin of *Apis mellifera* L. (Apidae)
Aloe	Concentrated dried sap of leaves of *Aloe barbadensis* Miller, *Aloe ferox* Miller, or other *Aloe* species (Liliaceae)	Concentrated dried sap of leaves of *Aloe barbadensis* Miller (Liliaceae)

Table 3 Main contents of liquid extracts of TCMs revised or newly added

TCMs	2015 version / %	2010 version / %
Toxicodendri Resina	1.2	−
Gastrodiae Rhizoma	15.0	10.0
Acanthopanacis Cortex	10.5	−
Menispermi Rhizoma	13.0	−
Vignae Semen	7.0	−
Celosiae Cristatae Flos	17.0	−
Laminariae Thallus or *Eckloniae Thallus*	7.0	−
Euphorbiae Pekinensis Radix	8.0	−
Sargassum	6.5	−
Mume Flos	30.0	−
Gecko	8.0	−
Rubi Fructus	9.0	−

Table 4 TCMs revised in quantitative determination

TCMs	2015 version / %	2010 version
Vladimiriae Radix	Costunolide together with dehydrocostus lactone no less than 3.2	−
Hibisci Mutabilis Folium	Dehydrorutin no less than 0.070	−
Aristolochiae Herba	Aristolochic acid I no more than 0.01	−

To be continued

Continued Table 4

TCMs	2015 version / %	2010 version
Oroxyli Semen	Oroxin B no less than 2.0	−
Bovis Calculus	Free bilirubi detected in allowed content by HPLC; bilirubi no less than 25.0%	Free bilirubi detected in allowed content by Ultraviolet
Rosae Chinensis Flos	Hyperoside together with isoquercitrin no less than 0.38%	−
Granati Pericarpium	Tannins no less than 10.0%; ellagic acids no less than 0.30%	−
Sauropi Folium	Kaempferol-3-O-gentiobioside no less than 0.035%	−
Menispermi Rhizoma	Daurisoline together with dauricine no less than 0.60%	−
Zingiberis Rhizoma Recens	Essential oils no less than 0.12% mL/g; 6-gingerol no less than 0.050%; 8-gingerol together with 10-gingerol no less than 0.040%	6-Gingero
Benzoinum	Benzoic acid no less than 27.0%, for calculating total balsamic acids	−
Knoxiae Radix	3-Hydroxymorindone no less than 0.030%; lucidin at the level of 0.040%−0.15%	−
Entianae Rhodanthae Herba	Mangiferin no less than 2.0%	−
Xanthii Fructus	Chlorogenic acid no less than 0.25%	−
Cooked Xanthii Fructus (decoction pieces)	Atractyloside at the level of 0.10%−0.30%	−
Aquilariae Lignum Resinatum	Agarotetrol no less than 0.10%	−
Swertiae Mileensis Herba	Swertiamarin no less than 8.0%	−
Laminariae Thallus or *Eckloniae Thallus*	For calculating polysaccharide in *Laminariae Thallus*; fucosylated ogligosaccharides no less than 2.0%	−
Bergeniae Rhizoma	Bergenin no less than 8.2%	−
Coptidis Rhizoma “Yalian”	For calculating berberine hydrochloride, berberine no less than 4.5%	−
Coptidis Rhizoma “Yunlian”	For calculating berberine hydrochloride, berberine no less than 7.0%	−
Potentillae Chinensis Herba	Gallic acid no less than 0.024%	−
Euphorbiae Pekinensis Radix	Euphol no less than 0.60%	−
Leonuri Fructus	Stachydrine hydrochloride no less than0.050%	−
Impatientis Semen	Hosenkoside K together with hosenkoside A no less than 0.20%	−
Bistortae Rhizoma	Gallic acid no less than 0.12%	−
Sepiae Endoconcha	$CaCO_3$ no less than 86.0%	−
Sargassum	Fucosylated ogligosaccharides no less than 1.70%, for calculating seaweed polysaccharide	−
Mume Flos	Chlorogenic acidno less than 3.0%; hyperin together with hyperin and isoquercitrin no less than 0.35%	−
Polygoni Avicularis Herba	Myricitrin no less than 0.030%	−
Talci Pulvis	$Mg_3(Si_4O_{10})(OH)_2$ no less than 88.0%	−
Ricini Semen	Icinine no less than 0.32%	−
Rubi Fructus	Ellagic acid no less than 0.20%; (Kaempferol-3-*O*-rutinoside, Nicotiflorin, no less than 0.03%	−
Ganoderma	For calculating Ganoderma lucidum polysaccharide, anhydrous glucose no less than 0.90%; for calculating triterpenes and sterols, oleanolic acid no less than 0.50%	*Ganoderma lucidum* polysaccharide
Rhei Radix et *Rhizoma*	Aloe-emodin together with hein, emodin, hrysophanol and physcion no less than 1.5%, for calculating total anthraquinones	Emodin
Polygoni Multiflori Radix	Emodin together with physcion no less than 0.10%, for calculating unfree anthraquinone	Emodin
Polygoni Multiflori Radix Praeparata	Emodin together with physcion no less than 0.10%, for calculating free anthraquinone	Emodin
Corni Fructus	Morroniside together with loganin no less than 1.2%	Loganin
Gastrodiae Rhizoma	Gastrodin together with p-2-hydroxybenzyl alcohol no less than 0.25%	Gastrodin
Siphonostegiae Herba	luteoloside no less than 0.050%; Verbascoside no less than 0.060%	Luteoloside
Salviae Miltiorrhizae Radix et *Rhizoma*	Tanshinone II_A together with cryptotanshinone and tanshinone I no less than 0.25%	Tanshinone II_A
Propolis	Chrysin no less than 2.0%, galangin no less than 1.0%, caffeic acid phenethyl ester no less than 0.50%, pinocembrin no less than 1.0%	Chrysin

To be continued

Continued Table 4

TCMs	2015 version	2010 version
Mel	Fructose together with glucoseno less than 60.0%; the ratio of Fructose and glucose no less than 1; sucrose and maltose no less than 5.0%, respectively, as detection items	Reducing sugar
Callicarpae Caulis et *Folium*	Forsythoside A together with poliumoside no less than 0.50%	Forsythoside B
Clematidis Radix et *Rhizoma*	Oleanolic acid no less than 0.30%	Hederagenin; oleanolic acid
Testudinis Carapacis et *Plastri Colla*	*L*-Hydroxyproline no less than 5.4%; glycine no less than 12.4%; alanine no less than 5.2%; *L*-proline no less than 6.2%	Total nitrogen
Cervi Cornus Colla	*L*-Hydroxyproline no less than 6.6%; glycine no less than 13.3%; alanine no less than 5.2%; *L*-proline no less than 7.5%	Total nitrogen
Mahoniae Caulis	Columbamine together with gatrorrhizine, palmatine and berberine no less than 1.5%	Berberine hydrochloride
Suis Fellis Pulvis	Taurohyodeoxycholic acid no less than 2.0%	Hyodeoxycholic acid
Pseudostellariae Radix		Heterophyllin B
Sappan Lignum		Brazilin; protosappanin B
Smilacis Chinae Rhizoma		Astilbin together with engelitin
Marsdeniae Tenacissimae Caulis	Enacissoside H no less than 0.12%	–
Aconm Lateralis Radix Praeparais	Mesaconitine together with hypaconitine and aconitine no more than 0. 020%, for calculating aconitum alkaloids. For a dry sample, benzoylmesaconine together with benzoylaconine, and benzoylhypaconine no less than 0.010%	Total alkaloids
Valerianae Jatamansi Rhizoma et *Radix*		Valtrate together with acevaltrate

Table 5 Drug safety control in TCMs in 2015 version

Parameters	Max allowed contents	Related drugs
SO_2 residual	≤ 150 mg/kg	For all TCMs except special ones and mineral drugs
	≤ 400 mg/kg	*Dioscoreae Rhizoma*, *Achryranthis Bidentatae Radix*, *Puerariae Thomsonii Radix*, *Asparagi Radix*, *Gastrodiae Rhizoma*, *Trichosanthis Radix*, *Bletillae Rhizoma*, *Paeoniae Radix Alba*, *Atractylodis Macrocephalae Rhizoma*, *Codonopsis Radix*, and the corresponding prepared slices
Heavy metals		
Pb	≤ 10 mg/kg	Hirudo
	≤ 8 mg/kg	Propolis
	≤ 5 mg/kg	*Ostreae Concha*, *Laminariae Thallus* or *Eckloniae Thallus*, Margarita, *Sepiae Endoconcha*, *Sargassum*, *Gecko*
Cd	≤ 5 mg/kg	*Sepiae Endoconcha*
	≤ 4 mg/kg	*Laminariae Thallus* or *Eckloniae Thallus*, *Sargassum*
	≤ 1 mg/kg	*Hirudo*
	≤ 0.3 mg/kg	*Ostreae Concha*, *Margarita*, *Gecko*
As	≤ 10 mg/kg	*Sepiae Endoconcha*
	≤ 5 mg/kg	*Hirudo*
	≤ 2 mg/kg	*Ostreae Concha*, *Margarita*, *Gecko*
Hg	≤ 1 mg/kg	*Hirudo*
	≤ 0.2 mg/kg	*Ostreae Concha*, *Margarita*, *Sepiae Endoconcha*, *Gecko*
	≤ 0.1 mg/kg	*Laminariae Thallus* or *Eckloniae Thallus*, *Sargassum*
Cu	≤ 20 mg/kg	All CMM
	≤ 20 mg/kg	*Ostreae Concha*, *Laminariae Thallus* or *Eckloniae Thallus*, Margarita, *Sepiae Endoconcha*, *Sargassum*, *Gecko*
Pesticides		
Total content of α-BHC, β-BHC, γ-BHC, and δ-BHC	≤ 0.2mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*, *Glycyrrhizae Radix* et *Rhizoma*, *Astragali Radix*
Total content of pp′-DDE, pp′-DDD, op′-DDT, and pp′-DDT	≤ 0.2mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*, *Glycyrrhizae Radix* et *Rhizoma*, *Astragali Radix*

To be continued

Continued Table 5

Parameters	Max allowed contents	Related drugs
Quintozene	≤ 0.1mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*, *Glycyrrhizae Radix* et *Rhizoma*, *Astragali Radix*
Hexachlorocyclohexane	≤ 0.1mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*
Total of heptachlor, heptachlor-exo-epoxide, and heptachlor-endo-epoxide	≤ 0.05mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*
Aldrin	≤ 0.05mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*
Total contents of *cis*-Chlordane, *trans*-Chlordane, and oxy-Chlordane	≤ 0.05mg/kg	*Ginseng Radix* et *Rhizoma*, *Panacis Quinquefolii Radix*
Fungi toxins		
Aflatoxin B1	≤ 5 μg/kg	*Jujubae Fructus*, *Hirudo*, *Pheretima*, *Myristicae Semen*, *Scorpio*, *Cassiae Semen*, *Hordei Fructus Germinatus*, *Polygalae Radix*, *Citri Reticulatae Pericarpium*, *Qutisqualis Fructus*, *Platycladi Semen*, *Sterculiae Lychnophorae Semen*, *Nelumbinis Semen*, *Persicae Semen*, *Scolopendra*, *Arecae Semen*, *Ziziphi Spinosae Semen*, *Bombyx Batryticatus*, *Coicis Semen*
Total content of aflatoxins G2, G1, and B2	≤ 10 μg/kg	Same as varieties in Aflatoxin B1

controlled in pesticides (the total of α-BHC, β-BHC, γ-BHC, and δ-BHC, the total of pp′-DDE, pp′-DDD, op′-DDT, and pp′-DDT, and quintozene). Fourteen Chinese herbal medicines vulnerable to aflatoxins contamination are first requested in the maximum allowed residual contents, only five in the 2010 version (*Sterculiae Lychnophorae Semen*, *Persicae Semen*, *Ziziphi Spinosae Semen*, *Bombyx Batryticatus*, and *Citri Retliculatae Pericarpium*).

Except mineral, marine, and animal drugs, the maximum allowed residual contents of Pb, Cd, As, and Hg in all CMMs are 10, 1, 5, and 1 mg/g, respectively, which are all allowed more than those in the 2010 version. Cu residual content is allowed 20 mg/kg as same as before. Prior to the 2015 version, only 20 Chinese herbal medicines were controlled in the maximum allowed residual contents of heavy metals in the 2010 version: *Crataegi Fructus*, *Salviae Miltiorrhizae Radix* et *Rhizoma*, *Glycyrrhizae Radix* et *Rhizoma*, *Gypsum Fibrosum*, *Gypsum Ustum*, *Paeoniae Radix Alba*, *Alumen*, *Natrii Sulfas Exsiccatus*, *Pheretima*, *Natrii Sulfas*, *Mirabilitum Praeparatum*, *Panacis Quinquefolii Radix*, *Borneolum Syntheticum*, *Testudinis Caeapacis* et *Plastri Colla*, *Asini Corii Colla*, *Lonicerae Japonicae Flos*, *Lycii Fructus*, *Astragali Radix*, *Cervi Cornus Colla*, and *Talci Pulvis*.

4.1.2 More techniques admitted

Since the mass analysis is more accurate than the HPLC analysis which is the major method for chemical residual detection, HPLC/MS, HPLC/EMS, and GC/MS techniques are widely used in quality control of CMMs in the 2015 version. HPLC/MS is first adopted in aflatoxin detection; It is more stable and reliable by which not only four aflatoxins but also seven classes of toxins from 11 fungi species can be detected. GC/MS and iron chromatography are applied in SO_2 residual determination, which makes the more reliable detection methods available. Owning to high sensitivity of GC-MS and HPLC-MS techniques, more residual pesticides, in a total of 229, can be detected. HPLC-ICP-MS is applied to determine Hg and As states and the corresponding element valence states, so that cinnabar and realgar in the hiding dangerous status can be detected.

In addition, several advanced techniques are admitted as stock techniques. DNA barcoding technique has been widely used in CMM identification, pigment, fungi toxin in CMMs. In spite of absent from individual drug in this version, it has been widely used in practice.

4.2 Chinese patent medicines

TCM safety control systems are improved in detection of endogenous and exogenous harmful substances for CPMs. The content of the total ginkgolic acids in the extracts from *Ginkgo biloba* leaves can be increased from 0.61 mg/L extracted with aether petrolei in the 2010 version to 5.7 mg/L with methonal in the 2015 version. Avoiding toxic to the operators, the splitting solvent benzene has been substituted by methylbenzene in TLC detection of 67 CPMs (Table 6).

5. Drug valid control

In terms of drug valid control, several models or approaches including microscopic identification, QAMS, chemical fingerprinting chromatograms and analyte-specific chromatograms, and reference extracts from TCMs, have been admitted to tally with the holism of TCM theory. Therefore the 2015 version is promoting Chinese pharmaceutical enterprises to choose the identification and detection methods of more specific, efficient, and stable when drugs are qualitatively and quantitatively determined under and after manufacture.

Table 6 Drug safety control in CPMs

Endogenous harmful substances	Resources	Identification methods
Total ginkgolic acids referenced by ginkgolic acid	Extract of *Ginkgo biloba* leaves	Allowed content detection by HPLC
Exogenous harmful substances		
Free bilirubin and hyodeoxycholic acid	Xihuang Pill, Liuying Pill, Niuhuang Baolong Pill	HPLC detection
Reference Gallbladders of swine, sheep and bovine	Bibaike Capsule	TLC detection
Ginseng saponins and pseudo-ginseng saponins	Xinyue Capsule	TLC detection
Saponines of Notoginseng stems and leaves	Fufang Xueshuantong Capsule	TLC detection
Diester aconitum	Fenghan Shuangliguai Tablet, Huoxue zhuangjing Powder and the corresponding drugs that are prepared with Processed *Aconiti Radix* and *Aconiti Kusnezoffii Radix Preparata*.	TLC detection
Mesaconine and hypaconitine	Homogeneous drugs of Xiaojin (capsule, tablet, pill)	Allowed content detection by TLC
Rhapontin	Zhikang Capsule, Jiuwei Gantai Capsule	HPLC detection
Macranthoidin B	Qingkailing Zhusheye, Lianhua Qingwen Capsule,	TLC detection
Arsenic salt, heavy metals, harmful elements	Fubishu Yindao Tablets Effervescents, Dangshi Capsule	Atomic absorption spectrometry and inductively coupled plasma massspectrometry
Asbestos	Talci Pulvis	Single crystal X-ray diffraction method
Toxic solvent		
Benzene	Sixty-seven CPMs	TLC

5.1 Chinese medical materials

5.1.1 Microscopic identification

The microscopic identification is a traditional method in CMM identification. In the 2015 version, it has been specifically used in a total of 1303 Chinese herbal medicines, 56 of which are more completed with it. They are *Berberidis Radix*, *Toxicodendri Resina*, *Crataegi Fructus*, *Desmodii Styracifolii Herba*, *Ligustri Lucidi Fructus*, *Aristolochiae Fructus*, *Hyoscyami Semen*, *Cimicifugae Rhizoma*, *Zingiberis Rhizoma Recens*, *Polygalae Japonicae Herba*, *Trichosanthis Pericarpium*, *Eeodii Herba*, *Geranii Herba*, *Chebulae Fructus Immaturus*, *Knoxiae Radix*, *Zanthoxyli Pericarpium*, *Ophicalcitum*, *Eucommiae Folium*, *Amomi Fructus Rotundus*, *Ostreae Concha*, *Phyllanthi Fructus*, *Astragali Complanati Semen*, *Chebulae Fructus*, *Psoraleae Fructus*, *Armeniacae Semen Amarum*, *Meliae Cortex*, *Polygoni Cuspidati Rhizoma et Radix*, *Anemarrhenae Rhizoma*, *Quisqualis Fructus*, *Tinosporae Radix*, *Lonicerae Japonicae Flos*, *Houttuyniae Herba, Selaginellae Herba*, *Pini lignum Nodi*, *Allii Tuberosi Semen*, *Drynariae Rhizoma*, *Uncariae Ramulus Cum Uncis*, *Sterculiae Lychnophorae Semen*, *Prunellae Spica, Spirodelae Herba*, *Akebiae Fructus*, *Chrysanthemi Flos*, *Stauntoniae Caulis et Folium*, *Farfarae Flos*, *Trachycarpi Petiolus*, *Perillae Folium*, *Perillae Caulis*, *Cynomorii Herba*, *Gei Herba*, *Sophorae Fructus*, *Physalis Calyx Seu Fructus*, *Siegesbeckiae Herba*, *Syringae Cortex*, *Allii Macrostemonis Bulbus*, *Dianthi Herba*, and *Potentillae Discoloris Herba*.

5.1.2 PCR identification

The PCR technique was first admitted to the 2010 version to identify snake crude durgs, by which specific DNA bands can be amplified from Zaocys and Agkistrodon, respectively. In the 2015 version, the PCR-RFLP technique is used to distinguish *Fritillariae Cirrhosae Buibus* from the related adulterants, by which the samples with two amplified specific DNA bands of 100−250 bp are the genuine.

5.1.3 Specific peptides

Specific peptides from five glues can be accurately and specifically identified by HPLC-MS/MS, including deerhorn glue, tortoise shell glue, donkey-hide gelatin, bovine-hide gelatin, and pig-hide gelatin (Cheng et al, 2015). The 2015 version shows three glues, *Cervi Cornuscolla*, *Testudinis Carapacis* et *Plastri Colla*, and *Asini Corii Colla*, so the first authoritative method for glue identification is established in the 2015 version.

5.1.4 QAMS

Since CMMs are characterized with multiple compounds and multiple efficiency, multiple chemical markers are requested upon evaluating CMMs. As a result, more reference chemicals and more cost are required. QAMS, a method more suitable for those characters with low cost, was first admitted to the 2010 version for evaluating *Coptidis Rhizoma* quality. In QAMS, both single and multiple reference substances can be used depending on the situation: i) single quantitative chemical reference, ii) multiple quantitative chemical references, iii) single quantitative chemical reference jointly used with single qualitative reference extract, and iv) single reference extract in which the chemical markers have been already qualitatively and quantitatively determined (Peng et al, 2015). In the 2015 version, QAMS is

used in more drugs such as *Salviae Miltiorrhizae Radix* et *Rhizoma* and *Manoniae Caulis*. For *Salviae Miltiorrhizae Radix* et *Rhizoma*, cryptotanshinone, tanshinone I, and tanshinone II_A are quantitatively determined using i with the single chemical reference, totanshinone II_A. For *Manoniae Caulis*, the contents of columbamine, jatrorrhizine, palmatine, and berberine are determined according to iv; The corresponding chemical references have been quantitatively determined in the reference extract of *Manoniae Caulis*. For more information on CPMs, see 4.2.2.

5.1.5 Chemical fingerprinting and analyte-specific chromatograms

Chemical fingerprinting chromatograms indicate the overall chemicals in TCMs, with the advantage in determining chemical variation in different batches within a sample, and analyte-specific chromatograms show the specific chemicals in TCMs, an identification method of more specific. Over the past decade, chemical fingerprinting chromatograms and analyte-specific chromatograms have been widely used in TCM quality evaluation. So the identification model has been improved from the base of single compound or the major dots in the HPLC or TLC chromatograms to the base of overall chemical features. In the 2010 version a total of nine TCMs were completed with chemical fingerprinting chromatograms and a total of 13 with analyte-specific chromatograms, and in the 2015 version eight more with chemical fingerprinting chromatograms and 23 more with analyte-specific chromatograms (Table 7). Only two herbs (*Aquilariae Lignum Resinatum* and *Notopterygii Rhizoma* et *Radix*) and three plant extracts (*Acanthopanax* extract, *Glabrous Sarcandra* extract, and *Belladonna* liquid extract) are more completed with analyte-specific chromatograms. For more information on CPMs, see 4.2.3.

Table 7 Analyte-specific and chemical fingerprinting chromatograms in more TCMs in 2015 version

TCMs in 2015 version	Reference substances	Chemical fingerprinting chromatograms	Analyte-specific chromatograms
Aquilariae Lignum Resinatum	Aquilariae Lignum Resinatum		Six specific peaks
Notopterygii Rhizoma et *Radix*	Reference extract of *Notopterygii Rhizoma* et *Radix*		Four specific peaks
Acanthopanax Extract	Syringin		Nine specific peaks
Glabrous Sarcandra Extract	Chlorogenic acid; Isofraxidin; rosmarinic acid		Six specific peaks
Belladonna Liquid Extract	scopolamine hydrobrominde, (*Z*)-Racanisodamine, atropine sulfate, scopoletin		Six specific peaks
Wuzi Yanzong Pill	Hyperi; Actsoside; Kaempferide; Chizandrol A; *Rubi Fructus*		Five specific peaks, four of which are identical to the chemical references, one identical to the major peaks of TCM reference
Zaoren Anshen Capsule	*Salviae Miltiorrhizae Radix* et *Rhizoma*; *Schisandrae Chinensis Fructus*		Eight specific peaks, including liposoluble constituents from *Salvia Miltiorrniza* and lignans from *Schisandrae Fructus* treated with vinegar
Xinkeshu Tablet	*Salviae Miltiorrhizae Radix* et *Rhizoma*, *Puerariae Lobatae Radix*, the chemical references of *Salviae Miltiorrhizae Radix* et *Rhizoma* and *Puerariae Lobatae Radix*		Eight specific peaks, four of which identical to the chemical references, and five identical to TCMs references
Homogeneous drugs of Xinnaojian (Tablet and Capsule)	Caffeine; Epicatechin; Allicaci; (−)-epicatechin gallate; (−)-epigallocatechin gallate		Seven specific peaks, five of which are identical to references in Rts, respectively
Kangbingdu Koufuye	(R,S) -goitrin; Phillyrin		Seven specific peaks, two of which are identical to references in retention times, respectively
Homogeneous drugs of Yinzhihuang (Soft Capsule, PaotengTablet, Capsule, and Granule)	Chlorogenic acid		Six specific peaks
Homogeneous drugs of Yinhuang (Oral Liquid, Tablet, and Granule)	Chlorogenic acid		Seven specific peaks

To be continued

Continued Table 7

TCMs in 2015 version	Reference substances	Chemical fingerprinting chromatograms	Analyte-specific chromatograms
Homogeneous drugs of Qinghuo Zhimai (Pill, Tablet, and Capsule)	*Gardeniae Fructus*; *Andrographis Herba*; Geniposide; andrographolide; dehydroandrographolide		Six major specific peaks
Gegen Qinlian Tablet	Puerarin; erberinehydrochlorid		Eight specific peaks
Houtou Jianweiling Tablet	Ergosterol		Four specific peaks
Kanglaite Ruan Capsule	Reference extract of *Coicis Semen* oil; triolein		Eight major peaks, one identical to that of triolein reference and the rest seven peaks identical to the major seven peaks of reference extract of *Coicis Semen* oil
Xiasangju Granule	Chlorogenic acid; rosmarinic acid; inarin	Seven common peaks	
Fufang Xueshuantong Capsule	Salvianolic acid B; calycosin-7-*O*-β-*D*-glycoside; harpagoside; tanshinone II-A	12 common peaks	
Sanqi Tongshu Capsule	Ginsenoside Rg_1, ginsenoside Re and Sanchinoside R_1	Five major peaks	
Homogeneous drugs of Xuezhikang (Tablet and Capsule)	Lovastatin	10 common peaks no less than 85% similar to the reference	
Homogeneous drugs of Kanggongyan (Tablet, Capsule and Powder)	Norisoboldine; Forsythoside B; poliumoside	11 common peaks	
Qingkailing Injection	Geniposide	10 common peaks no less than 80% similar to the reference	

5.1.6 Reference extracts from TCMs

Reference extracts from TCMs are a group of the major efficient chemical compounds or marker components extracted from the corresponding CMMs. As one of TCM reference substances, obviously they can be used in qualitative and quantitative determination of TCMs, especially for those references of expensive, instable, toxic, complex extraction and preparation, and rare content. Actually reference extracts of TCMs have not being widely used in CMMs but are under-trial led. They were first admitted to the 2005 version covering 11 reference extracts, in the 2010 version 16 covered, and in the 2015 version 21 covered, mainly detected by the TLC qualitative identification (Table 8). *Coicis Semen* was the first CMM accessed using this approach in 2010 version, and *Manoniae Caulis* is the secondary one admitted to the 2015 version. For *Manoniae Caulis* authentification, it is hard to prepare individual reference compounds of columbamin, gatrorrhizine, palmatine, and berberine, fortunately when they are quantitatively determined in the reference extract from *Manoniae Caulis*, it is easy to identify *Manoniae Caulis* by comparing with the reference extract of *Manoniae Caulis*. For more information on CPMs, see 4.2.4.

5.2 Chinese patent medicines

5.2.1 Multiple efficient herbs and multiple compounds

A CPM is usually composed of multiple herbs containing multiple compounds which are jointly efficient in treating diseases. The efficient compounds-based quality assessment with holism is the trend for development of the TCM quality standard. So multiple efficient herbs and multiple compounds are required items in more CPMs in the 2015 version as well as total contents of efficient compounds (Table 9).

Table 8 Reference extracts from TCMs in CPMs in 2015 version

TCMs in 2015 version	Reference extracts	Application
Manoniae Caulis	Reference extract of *Manoniae Caulis*	QAMS for qualitative determination
Zaoren Anshen Granule	Reference extract of *Ziziphi Spinosae Semen*	TLC identification
Kanglaite Soft Capsule	Reference extract of *Coicis Semen* oil	Analyte-specific chromatogram for identification
Yunnan Baiyao/Yunnan Baiyao Capsule	Reference extract of Yunnan Baiyao	TLC identification
Homogeneous drugs of Yinxing Ye (*Ginkgo Folium*) such as tablet, capsule, and dropping pill	Reference extract of *Ginkgo Folium*	TLC identification

Table 9 Multiple efficient herbs and multiple compounds more admitted to 2015 version

CPMs	Multiple herbs	Multiple components		
		Quantitative determination	HPLC identification	TLC identification
Homogenous drugs of Biantong (Capsule and Tablet)	*Aloe*	Aloin		
	Cistanches Herba	Echinacoside		
Guishao Dihuang Pill		Simultaneously determination of morroniside, laganin, paeoniflorin, and paeonol		
	Corni Fructus	Morroniside, laganin		
	Paeoniae Radix Alba + *Moutan Cortes*	Paeoniflorin		
	Moutan Cortes	Paeonol		
Xiaoyan Zhike Tablet	*Papaveris Pericarpium*	Total content of morphine, codeine phosphate, and papaverine hydrochloride		
	Ephedrae Herba	Total content of ephedrine hydrochloride and *D*-pseudo-ephedrine;		
	Andrographis Herba	Total content of andrographolide and dehydroandrographolide		
Gegen Qinlian Tablet	*Puerariae Lobatae Radix*	Puerarin	Analyte-specific chromatograms	
	Coptidis Rhizoma	Berberine hydrochlorid	Analyte-specific chromatograms	
	Scutellariae Radix	Baicalin		
Xinkeshu Tablet	*Notoginseng Radix* et *Rhizoma*			*Notoginseng Radix* et *Rhizoma* reference, ginsenoside Rg_1, ginsenoside Re, notoginsenoside R_1
	Salviae Miltiorrhizae Radix et *Rhizoma*	Simultaneous determination of Tanshinol sodium, protocatechuic aldehyde, and salvianolic acid B	Analyte-specific chromatograms of *Salviae Miltiorrhizae Radix* et *Rhizoma* and *Puerariae Lobatae Radix*	
Xinkeshu Tablet	*Puerariae Lobatae Radix*	Puerarin		
	Crataegi Fructus		Hyperin	
	Aucklandiae Radix	Total content of costunolide together with dehydrocostuslactone		
Homogenous drugs of Ciwujia (Tablet, Granule, Capsule)	Acanthopanax extract	Simultaneous determination of Syringin, aleutheroside E, and isofraxidin, major bioactive compounds		
Homogenous drugs of Jinlianhua (Oral Liquid, Tablet, Granule)	*Trollius chinensis* Bge.	Orientin, the major bioactive compound		
Xiaoyan lidan Tablet	*Andrographis Herba*	Total content of andrographolide and dehydroandrographolide Allowed content of andrographolide, the major anti-inflammation compound		

5.2.2 QAMS

QAMS is first admitted to the 2015 Pharmacopoeia in quality control of CPMs. For example, for calculating the total flavones of homogeneous drugs (tablet, capsule, and dropping pill) of *Yinxing* leaves (*Ginkgo Folium*), quercetin, kaempferide, and isorhamnetin are simultaneously determined by single chemical reference, quercetin.

5.2.3 Chemical fingerprinting chromatograph and analyte-specific chromatograms

In the 2015 version, chemical fingerprinting chromatograph and analyte-specific chromatograms are used in more CPMs. Compared with the reference in the common peaks, the samples are believed qualified and uniform and stabled if more than 90% slimily to the reference, except that special ones have 80% or 85% similarity. The samples should be consistent with the reference in specific peak numbers and the corresponding retention times, showing identification features of CPMs (Table 7).

5.2.4 Reference extracts from TCMs

Following 4.1.6, reference extracts from TCMs are used in more CPMs, coupled with QAMS, TLC, and analyte-specific chromatogram, leading to more specific and practicable identification and less cost. Reference extract from *Ziziphi Spinosae Semen* and reference extract of *Coicis Semen* oil for identification from Zaoren Anshen Granule and Kanglaite Soft Capsule, respectively, are first admitted to the 2015 version (Table 8).

5.2.5 Homogeneous drugs qualified with partly same criterion

Homogeneous drugs are derived from the same traditional formulae and usually present in various forms widely used in various clinical practices. About half of major drugs in China are present in various forms, e.g., Qinkailing, Shuanghuanglian, Fufang Danshen, Huoxiang Zhengqi, and Yinhuang. Actually homogeneous drugs are often different in detection parameters, detection methods, use dosage, even in herbal allocation and efficiency. They are essentially sorted out of chaos based on a general quality standard of homogeneous drugs. When a general quality standard of homogeneous drugs is being established, the facts should be considered that individual forms of homogeneous drugs, with different features, are possibly different in efficient compounds and extract yields under different preparation. In the 2015 version, some homogeneous drugs are partly given such general quality standards, by which homogeneous drugs are expected to consistent in chemical content in the same formulae, detection parameters and methods, allowance contents individually reasonable, etc. Table 10 showed some homogenous drugs with greater revision in unification.

There are six homogenous drugs in Fufang Danshen (Pill, Tablet, Capsule, Spraying agent, Granule, and Dropping Pill) in the 2015 version. Pill, Capsule, and Spraying agent are the new admitted forms. Four forms of Tablet, Capsule, Pill, and Granule, are unified in preparation or quantitative determination of some items. For the homogenous drugs of Jingzhi Guanxin (Oral liquid, Tablet, Soft capsule, and Granule), Oral Liquid and Soft Capsule are first admitted to the 2015 version. The tablet, soft capsule, and granules are unified in parameters such as TLC identification with TCM references, simultaneously determination of chemicals, and allowed contents of the target chemicals.

Four homogenous drugs in Niuhuang Shangqing (Pill, Tablet, Capsule, and Soft capsule) are admitted to the 2015 version, in which Soft Capsule is the first admitted form. The tablet, pill, capsule and soft capsule shared the same parameters: TLC identification of *Bovis Calculus Artifactus* reference, HPLC identification of four chemical compounds, simultaneous determination of three chemicals, and the corresponding allowed contents. In three homogenous drugs of Yinhuang (Oral liquid, Tablet, and Granule) in the 2015 version, Tablet is the new form. All forms are completed with analyte-specific chromatograms of *Lonicerae Japonicae Flos* and *Scutellariae Radix,* detection of *Lonicera Flos*. Both Oral liquid and Tablet are completed with quantitative determination of *Lonicerae Japonicae Flos* extract and *Scutellariae Radix* extract, and unified in allowed contents. Homogenous drugs, e.g., Qingkailing (Oral liquid, Tablet, and Granule), Shuanghuanglian (Oral liquid, Tablet, Shuan/ Suppository, Capsule, and Granule), are unified in the following aspects: detection items, detection indexes, allowed content.

6. Discussion

6.1 2015 Chinese Pharmacopoeia greatly improved

The quality evaluation and control system of TCMs has been elementarily established in conformity with TCM features in the 2015 *Chinese Pharmacopoeia*, leading the world in TCM criterion and showing the current level of pharmaceutical production and quality control in China. CMM in the *National Essential Drugs List of China* (2004 edition) have been largely admitted to the 2015 version. Diverse models such as QASM, chemical fingerprinting chromatograms and analyte-specific chromatograms, are good advertisement of the holism of TCM. A few reference extracts of TCMs are being used in identification. Advanced techniques such as MS and DNA molecular markers, and several parameters, especially on toxic or harmful substances, have been employed in valid evaluation and safety control of TCMs. Harmful residues will be controlled more rigidly in the 2020 *Chinese Pharmacopoeia*. The 2015 *Chinese Pharmacopoeia* showed that omics technology especially metabonomics technology has being widely used in an overview of chemical characterization of TCMs. Although some biotechniques such as DNA molecular mark identification, have been admitted in this version, genomics technology will be used in bioassay in the 2020 version, e.g., gene chip, a ship high throughput screening that shows gene expression profiles of living samples en bloc, will be employed in TCM safety control.

6.2 Challenges in research of quality evaluation and control system of TCMs

Although achievements have been obtained, the quality

Table 10 Some homogeneous drugs revised in 2015 version

Homogeneous drugs	Forms	Revised and admitted items
Fufang Danshen	Tablet	i) Admitted quantitative determination of *Notoginseng Radix* et *Rhizoma*
	Capsule	ii) Preparation admitted as same as the tablet
		iii) Quantitative determination of Salvianolic acid B admitted as same as the tablet
		iv) Quantitative determination of *Notoginseng Radix* et *Rhizoma* admitted as same as the tablet
		v) Quantitative determination of tanshinone IIA revised
	Pill	Same as the tablet in iii and iv
	Granule	Same as the tablet in i and iii
Jingzhi Guanxin	Tablet	i) TLC identification with *Chuanxiong Rhizoma* reference revised;
		ii) TLC identification with *Carthami Flos* reference admitted more;
		iii) Simultaneously quantitative determination of Salvianolic acid B and Paeoniflorin admitted more;
		iv) Allowed contents of salvianolic acid B and paeoniflorin admitted more
	Soft capsule	Same as the tablet in i, ii, and iii;
		v) More admitted TLC identification with *Salviae Miltiorrhizae Radix* et *Rhizoma*;
		vi) Quantitative determination of tanshinone IIA as same as the tablet
		vii) Unified allowed contents of salvianolic acid B, paeoniflorin, and tanshinone IIA as same as the tablet
	Granule	Same as capsule in v
		Same as the tablet in i, ii, iii, vi, and vii
		viii) *Paeoniae Radix Rubra* reference expunged
Niuhuang Shangqing	Tablet	i) More admitted TLC identification with *Bovis Calculus Artifactus* reference;
		ii) Preparation of mixed solution of chemical references of cholic acid and hyodesoxycholic acid revised;
		iii) More admitted HPLC identification with references of baicalin, gardenoside, forsythoside A, and paeoniflorin;
		iv) Simultaneous determination of baicalin and gardenoside;
		v) Unified allowed contents of baicalin and gardenoside
	Pill	Same as the tablet in i, iii, iv, and v
		vi) TLC identification with berberine hydrochloride reference revised
	Capsule	Same as the tablet in i, ii, iii, iv, and v
		Same as the pill in vi
	Soft capsule	Same as the tablet in i, ii, iii, iv, and v
		Same as the pill in vi
Yinhuang	Oral liquid / Koufuye	i) More admitted analyte-specific chromatograms of *Lonicerae Japonicae Flos* and *Scutellariae Radix*;
		ii) quantitative determination of *Lonicerae Japonicae Flos* extract and *Scutellariae Radix* extract;
		iii) unified in allowed contents of chlorogenic acid and baicalin;
		iv) detection of *Lonicera Flos* admitted more
	Tablet / Tablet	Same as the oral liquid in i, ii, iii, and iv
	Granules / Granule	Same as the oral liquid in i; ii, iii, and iv

evaluation and control system of TCMs is still far away from the essence of the traditional theory of TCM (Xiao et al, 2012). It is unknown that how the medicinal property and efficiency are endowed into plants according to the view of the traditional theory of TCM. It is challenge to know the mechanism of herbal combination in a formula, the complex relationship of multiple herbs, and the resulting efficency based on the current technology. TCMs would not be qualified in the view of the traditional theory of TCM unless they meet the current criterion in *the Chinese Pharmacopoeia*? It is also challenge to evaluate the medicinal property and efficiency of TCMs in the view of the traditional theory of TCM using current techniques.

Extracts of TCMs, either directly used as drugs or one of the gradients of drugs, are not greatly developed in the 2015 version. Only 47 are admitted in the 2015 version as same as the 2010 version, three of which are admitted with analyte-specific chromatograms. Moreover, there are only extracts of plants and essential oils in the 2015 version, so more varieties should be developed such as extracts of prepared slices, extracts of formulas, extracts of efficient parts of plants, and TCM extracts for quantitative determination to lead to detection methods of more rapid and accurate and less cost. Actually most extracts of TCMs in China are still lack of national criterion, largely up to requirements of vendees or manufacturers (Lu et al, 2013).

TCM injection is a new form rapidly developed in China but a week subject in the 2015 version. A total of 134 TCM injections with 1255 liquid and solid forms have been approved by drug

administration in China, 50 of which are commonly used in clinical practice. Five have been admitted to the 2015 version. Since TCM injections are increasingly reported in adverse drug reactions and adverse events, it is urgent to study quality evaluation and safety control models of TCM injections so that TCM injections can be largely supervised for a safe use.

6.3 Good Pharmacopoeia Practice (GPhP)

On March 4, 2016, the China State Council issued a document for promoting the healthy development of the pharmaceutical industry. It said that improving *the People's Republic of China Pharmacopoeia* as the core of the national drug standards through improving the basic quality standards. To improve scientific rationality and operability of the standard, as well as to strengthen the authority and seriousness of the standard are significant, especially, for specifications and the importance of quality control standards of traditional, herbal and folk medicines and these productions.

We know that the drug regulation is a multi-faceted activity, and Pharmacopoeia plays a special role in Drug Administration. Today, the Good Pharmacopoeia Practice (GPhP) regulation (Figure 1) is being implemented, and also increasingly subjects to international attention. Therefore, the establishment of regulational Pharmaceutical preparation is very necessary.

Figure 1 Development of Chinese Pharmacopoeia

6.4 Pharmaceutical enterprises required to actively participate in pharmacopoeia improvement

The *Chinese Pharmacopoeia* is the fundamental law in pharmacy, to align with which pharmaceutical enterprises should direct and supervise production process from field to manufactory to market. They are encouraged to participate in development of quality criterion of TCMs.

Conflict of interest statement

All authors declare no conflicts of interest.

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