Chinese Herbal Medicines 15 (2023) 6–14

Contents lists available at ScienceDirect

Chinese Herbal Medicines

journal homepage: www.elsevier.com/locate/chmed

Review

‘Food and medicine continuum’ in the East and West: Old tradition and current regulation

Ruyu Yao, Chunnian He *, Peigen Xiao *

Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100193, China

ARTICLE INFO

Article history:
Received 7 November 2022
Revised 28 November 2022
Accepted 10 December 2022
Available online 17 December 2022

Keywords:
cross-cultural communication
food and medicine continuum
food-medicine products
regulation
tradition

ABSTRACT

Food-medicine products are important materials for daily health management and are increasingly popular in the global healthy food market. However, because of the biocultural difference, food-medicine knowledge may differ among regions, which hinders the global sharing of such health strategies. Aim at bridging the food-medicine knowledge in the East and West, this study traced the historical roots of food and medicine continuum of the East and West, which was followed by a cross-cultural assessment on the importance of food-medicine products of China, thereafter, the current legislative terms for food-medicine products were studied using an international survey. The results show that the food and medicine continuum in the East and West have their historical roots in the traditional medicines since antiquity, and the food-medicine knowledge in the East and West differs substantially; although the food-medicine products have common properties, their legislative terms are diverse globally; with proofs of traditional uses and scientific evidence, food-medicine products are possible for cross-cultural communication. Finally, we recommend facilitating the cross-cultural communication of the food-medicine knowledge in the East and West, thus to make the best use of the traditional health wisdom in the globe.

Contents

* Corresponding authors.
E-mail addresses: cnhe@implad.ac.cn (C. He), pgxiao@implad.ac.cn (P. Xiao).

https://doi.org/10.1016/j.chmed.2022.12.002
1674-6384/

1. Introduction

Many foodstuffs are also with health-promoting effects, therefore, 'food as medicine' or 'medicine as food' are commonly seen, which have been recognized as the phenomenon 'food and medicine continuum' (Adelman & Haushofer, 2018; Etkin & Ross, 1982; Leonti, 2012). Products used as both food and medicine are thought to be pivotal materials in sustaining human health especially for the prevention of chronic diseases and geriatrics (Heinrich, Yao, & Xiao, 2022). While there is a steady increase in healthcare needs, such (local / regional) products have attracted more and more attention in the worldwide. In recent decades, we have seen that many of local / regional used food and medicine stuffs are turning into global market, such as goji (fruits of *Lycium barbarum* L., Gouqizi in Chinese) and reishi (*Ganoderma*, Lingzhi in Chinese) (Heinrich, Kum, & Yao, 2022; Yao, Heinrich, & Weckerle, 2018). However, because of the biocultural difference, people of the West and East have accumulated different knowledge on food and medicine continuum. Specifically, the used species, plant part used or usages may differ between the West and East (Heinrich, Yao, & Xiao, 2022). These differences have led to barriers for the cross-cultural communication of food and medicine knowledge between West and East.

Aiming at removing the cultural barrier, this study will analyze the differences in the knowledge of food and medicine continuum between the West and East from their historical roots and current regulations, thus, to facilitate the cross-cultural communication of 'food and medicine continuum' in the East and West.

2. Materials and methods

2.1. Old tradition of food and medicine continuum

To study the old tradition of food and medicine continuum in the East and West, a thematic literature research was performed, which focused on the dietetic therapy in traditional Chinese medicine, Hippocratic and Galenic diet, and Ayurveda.

To disclose the different opinions on the traditional food-medicine products in the East and West, an expert of the western cultural background was invited to evaluate the food-medicine dual-use products in the official list of China. Accordingly, their importance for the usages of "healthy food", "spice" and "medicine" in Europe was evaluated.

2.2. Current definition for interface of food and medicine in globe wide

To study the current definition for the interface of food and medicine in the globe wide, an international technical survey was conducted. (1) The following questions were prepared: How is food defined in your country? How is medicine defined in your country? Is there any intermediate categories of food and medicine in your country? What are the statutory documents for the regulation of food and medicine in your country? (2) Experts of food and medicine research or regulation from the following countries were consulted by e-mails: Japan, South Korea, Thailand, Malaysia, Singapore, Australia, New Zealand, India, Pakistan, Saudi Arab, Turkey, Nigeria, South Africa, Russia, European Union (EU), Canada, United States (US), Mexico and Brazil. (3) The responses were complied, and the referred statutory documents was searched, as a result, the stuffs in the interface of food and medicine were sorted out.

3. Results and discussion

3.1. Old tradition of food and medicine continuum: Historical roots

3.1.1. Tradition of food and medicine continuum in the West

In the West, the knowledge of using herbs as food or medicine can be found in the historical medical texts. *The Hippocratic Corpus* might include the earliest records, which comprises about 60 medical texts written in around 5th to 4th century BCE (Totelin, 2021). There is a saying attributed to Hippocrates, "Let medicine be thy food and let food be thy medicine" (Fig. 1, left). The definitions of 'food' and 'medicine' were found in some texts of this collection; interestingly, food was subject to medicine at that time, along with pharmacology and surgery (Totelin, 2015). Touwaide and Appetiti (2015) analyzed the plant materials used in remedies included in this collection, to find that 33 of the 44 sampled medicinal plants are also used for nutritional purposes. Subsequently, this tradition developed and was succeeded by Galenic humoral food and medicine, which further influenced the Islamic medicine (Chen, 2008). In the Galenic humoral theory, all stuffs, whether food or medicine, were attributed with properties of warm, cool, dry or moist, so food and medicine were thought to be equal as a matter acting on human body. In his works of *On the Powers of Food*, Galen addressed the important function of nutrition in medical practice using the classic humoral ideas (Grant, 2002). Accordingly, it can be seen that 'food and medicine continuum' was prevalent since Antiquity in the West, and the boundary between food and medicine was blurry since then.

3.1.2. Tradition of food and medicine continuum in the East

With its long history of civilization, China has the most influential traditional medicine system in the East. Thanks to the time-continuous Chinese herbals in the past two millennia, the knowledge of food and medicine continuum in the East still can be traced. The earliest record might be in *Shennong*'s *Classic of Materia*

Medica (Shén nóng běn cǎo jīng in Chinese) of the first century CE, in which 120 meteria medica was classified into "top grade", hinting their uses as both food and medicine (Liu, Xiao, Qin, & Xiao, 2015). Dietary therapy, or Shizhi in Chinese, was first interpreted in one chapter of the medical monograph of Simiao Sun in the Tang Dynasty (Fig. 1, right) (Sun, 1998). Theoretically, all foodstuffs are endowed with taste(s), and the taste endows the foodstuff with functions, which is the same as the theory of traditional Chinese medicine (TCM). Additionally, it cited the viewpoints of Zhongjing Zhang, who was a famous doctor of the Han Dynasty, saying that the dietary therapy should be prior to the medical therapy. Moreover, this chapter also listed the fruits, vegetables, grains, and animal products with therapeutic uses. Later, the first monograph for dietary therapy, namely *Shiliao Bencao* in Chinese, was published, which elaborated the therapeutic foods and their usages (Meng & Zhang, 1984). The food-medicine tradition was succeeded in a series of dietary therapy herbals, such as *Yinshan Zhenyao* of the Yuan Dynasty, *Jiuhuang Bencao* of the Ming Dynasty, etc. In TCM, a medicinal material (or sometimes also used as food) is with traditional properties of four properties (ascending, descending, floating and sinking) and five tastes (pungent, sweet, sour, bitter and salty). With these properties, anything, whether used as food or medicine, can be used to balance the *Yin-Yang* of human body.

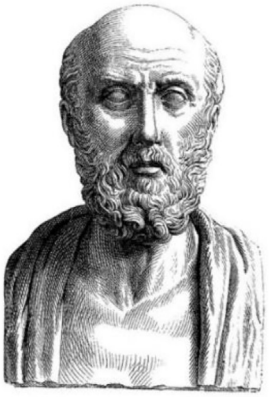
Food also plays an important role in Ayurveda, a traditional medical system stems from the South Asia subcontinent. The idea of dietary therapy was found in *Charaka Samhita*, an Ayurvedic classics of no later than 2nd century CE (Rastogi, 2014). Ayurvedic practitioners give advice on food based on diseases, the condition of diseases, and the status of dosha of individuals; moreover, the quantity of food should also be determined by both the digestibility of food and the digestive capacity of people (Kumar, Dobos, & Rampp, 2017; Rastogi, 2014). In Ayurvedic theory, every food or medicine has its traditional properties, including Rasa (taste), Guna (effect on the digestion, fluid system and tissues in the body), Virya (effect on the metabolic thermal body), Vipaka (post-digestive effect) and Karma (action). With these traditional properties, a food / medicine can be used to balance the dosha of human body. Therefore, anything, either food or medicine, is used to sustain health based on its traditional properties, and food as medicine is also a tradition in South Asia.

3.1.3. Western opinion on food-medicine dual-use products of China

Up to now, the list for food-medicine dual-use substance of China has included 109 entities (including the pilot list), which are sourced from 151 species (Table 1). The evaluation for their importance in usages of "healthy food", "spice" and "medicine" in Europe indicates that only 37 of the 151 species are very important in healthy food use, such as *Glycyrrhiza uralensis* Fisch., *Myristica fragrans* Houtt., *Cannabis sativa* L., *Dimocarpus longan* Lour., *Hippophae rhamnoides* L., *Lycium barbarum* L., *Morus alba* L., and so on. Additionally, 17 species are found to be used as a popular spice, and eight species are used as important medicines (excluding the medicinal use as a TCM in Europe). In the meanwhile, we find that 86 of them are not used for healthy food, 119 of them are not for spice uses, while 108 species are not used as a medicine other than TCM. These include the very commonly used species in China, such as *Polygonatum odoratum* (Mill.) Druce, *Lilium lancifolium* Thunb., *Euryale ferox* Salisb., *Nelumbo nucifera* Gaertn., *Perilla frutescens* (L.) Britt., etc. It is worth noting that the animal products are not accepted in the European healthy food market, or the Western traditional medicine, while this food-medicine list of China includes seven animal products.

Accordingly, most of the Chinese food-medicine species (as a representative of the East) are still not used / accepted in the West (as represented by the Europe), suggesting the differences in the food-medicine knowledge between the East and West. For example, the very commonly used *Lonicera* in China is not consumed in Europe at all. In the meanwhile, some of the species are used in both sides, but the usages might differ. Such as *Crataegus*, which is for digestion in China while for cardiovascular in Europe, and the different usages may be attributed to their independent historical origins (Caliskan, 2015).

Moreover, we have seen knowledge of some species have transmitted (partially) directly from China to the Europe, such as goji berry and ginseng. Another example is Ginkgo, the seed of which is used in China as a traditional food-medicine, while its leaf is developed in Europe as a source of flavonoids in food supplement. In recent decades, China has adopted the ginkgo leaf as a food ingredient and drug material, but the seed is still not accepted by European market.



"Let medicine be thy food and let food be thy medicine" --attributed to Hippocrates, (460-377 BCE)

"If the sick does not recover with food therapy, medicine should then be applied. The sick should be cured with food and medicine. " -- Simiao Sun (541-682 CE)

Fig. 1. Typical old saying on food and medicine continuum in the West (left) and East (right).

Table 1
A total of109 food-medicine entities (including the pilot) of China and their importance as food / spice/ medicine in the West.

No.	Chinese (Pinyin) names	Source species	Parts used	Importance* in the West		
				Food	Spice	Medicine**
1	dīngxiāng	*Eugenia caryophyllata* Thunb.	Bud	2	3	3
2	bājiǎohuíxiāng	*Illicium verum* Hook.f.	Fruit	2	3	2
3	dāodòu	*Canavalia gladiate* (Jacq.) DC.	Seed	2	0	0
4	xiǎohuíxiāng	*Foeniculum vulgare* Mill.	Fruit	2	2	2
5	xiǎojì	*Cirsium setosum* (Willd.) MB.	Aerial part	0	0	0
6	shānyào	*Dioscorea opposita* Thunb.	Root and fruit	3	0	0
7	shānzhā	*Crataegus pinnatifida* Bge. var. *major* N.E.Br.	Fruit	2	2	2
8	shānzhā	*Crataegus pinnatifida* Bge.	Fruit	2	2	2
9	mǎchīxiàn	*Portulaca oleracea* L.	Aerial part	3	0	2
10	wūméi	*Prunus mume* (Sieb.) Sieb. et Zucc.	Fruit	3	0	2
11	mùguā	*Chaenomeles speciosa* (Sweet) Nakai	Fruit	0	0	0
12	huǒmárén	*Cannabis sativa* L.	Seed	3	0	3
13	dàidàihuā	*Citrus aurantium* L. var. *amara* Engl.	Bud and fruit	3	3	1
14	yùzhú	*Polygonatum odoratum* (Mill.) Druce	Rhizome	0	0	0
15	gāncǎo	*Glycyrrhiza uralensis* Fisch.	Root and rhizome	3	3	2
16	gāncǎo	*Glycyrrhiza inflata* Bat.	Root and rhizome	1	1	0
17	gāncǎo	*Glycyrrhiza glabra* L.	Root and rhizome	3	3	1
18	báizhī	*Angelica dahurica* (Fisch. ex Hoffm.) Benth. et Hook.f.	Root	0	0	1
19	báizhǐ	*Angelica dahurica* (Fisch. ex Hoffm.) Benth. et Hook.f. var. *formosana* (Boiss.) Shan et Yuan	Root	0	0	1
20	báiguǒ	*Ginkgo biloba* L.	Seed	1	0	3
21	báibiǎndòu/ báibiǎndòuhuā	*Dolichos lablab* L.	Seed and flower	3	0	0
22	lóngyǎnròu	*Dimocarpus longan* Lour.	Aril	3	0	0
23	juémíngzi	*Cassia obtusifolia* L.	Seed	0	0	3
24	juémíngzi	*Cassia tora* L.	Seed	0	0	0
25	bǎihé	*Lilium lancifolium* Thunb.	Bulb	0	0	0
26	bǎihé	*Lilium brownii* F.E. Brown var. *viridulum* Baker	Bulb	0	0	0
27	bǎihé	*Lilium pumilum* DC.	Bulb	0	0	0
28	ròudòukòu	*Myristica fragrans* Houtt.	Seed	3	3	1
29	ròuguì	*Cinnamomum cassia* Presl	Bark	3	3	2
30	yúgānzǐ	*Phyllanthus emblica* L.	Fruit	2	0	2
31	fóshǒu	*Citrus medica* L. var. *sarcodactylis* Swingle	Fruit	0	0	0
32	kǔxìngrén	*Prunus armeniaca* L. var. *ansu* Maxim	Seed	3	0	0
33	kǔxìngrén	*Prunus sibirica* L.	Seed	0	0	0
34	kǔxìngrén	*Prunus mandshurica* (Maxim) Koehne	Seed	0	0	0
35	kǔxìngrén	*Prunus armeniaca* L.	Seed	3	0	0
36	tiánxìngrén	*Prunus armeniaca* L.	Seed	0	0	0
37	tiánxìngrén	*Prunus armeniaca* L. var. *ansu* Maxim	Seed	0	0	0
38	shājí	*Hippophae rhamnoides* L.	Fruit	3	2	1
39	qiànshí	*Euryale ferox* Salisb.	Seed	0	0	0
40	huājiāo	*Zanthoxylum schinifolium* Sieb.et Zucc.	Peel	0	1	0
41	huājiāo	*Zanthoxylum bungeanum* Maxim.	Peel	0	1	0
42	chìxiǎodòu	*Vigna umbellata* Ohwi et Ohashi	Seed	3	0	0
43	chìxiǎodòu	*Vigna angularis* Ohwi et Ohashi	Seed	2	0	0
44	màiyá	*Hordeum vulgare* L.	Sprout	3	0	1
45	kūnbù	*Laminaria japonica* Aresch.	Thallus	3	0	0
46	kūnbù	*Ecklonia kurome* Okam.	Thallus	3	0	0
47	zǎo (dàzǎo, hēizǎo)	*Ziziphus jujuba* Mill.	Fruit	3	0	2
48	luóhànguǒ	*Siraitia grosvenorii* (Swingle.) C. Jeffrey ex A.M. Lu et Z.Y. Zhang	Fruit	1	1	0
49	yùlǐrén	*Prunus humilis* Bge.	Seed	0	0	0
50	yùlǐrén	*Prunus japonica* Thunb.	Seed	0	0	0
51	yùlǐrén	*Prunus pedunculata* Maxim.	Seed	0	0	0
52	jīnyínhuā	*Lonicera japonica* Thunb.	Bud and flower	0	0	0
53	qīngguǒ	*Canarium album* Raeusch.	Fruit	1	0	0
54	yúxīngcǎo	*Houttuynia cordata* Thunb.	Whole plant	2	0	0
55	jiāng	*Zingiber officinale* Rosc.	Rhizome	3	3	2
56	zhìjǔzǐ	*Hovenia dulcis* Thunb.	Fruit and carpopodium	0	0	0
57	gǒuqǐzǐ	*Lycium barbarum* L.	Fruit	3	0	0
58	zhīzi	*Gardenia jasminoides* Ellis	Fruit	0	0	0
59	shārén	*Amomum villosum* Lour.	Fruit	0	1	0
60	shārén	*Amomum villosum* Lour. var. *xanthioides* T.L. Wu et Senjen	Fruit	0	1	O
61	shārén	*Amomum longiligulare* T.L.Wu	Fruit	0	0	0
62	pàngdàhǎi	*Sterculia lychnophora* Hance	Seed	1	0	0
63	fúlíng	*Poria cocos* (Schw.) Wolf	Sclerotium	0	0	0
64	xiāngyuán	*Citrus medica* L.	Fruit	3	3	3
65	xiāngyuán	*Citrus wilsonii* Tanaka	Fruit	2	0	0
66	xiāngrú	*Mosla chinensis* Maxim.	Aerial part	0	0	0
67	xiāngrú	*Mosla chinensis* 'jiangxiangru'	Aerial part	0	0	0
68	táorén	*Prunus persica* (L.) Batsch	Seed	3	0	1
69	táorén	*Prunus davidiana* (Carr.) Franch.	Seed	1	0	0
70	sāngyè	*Morus alba* L.	Leaf	0	0	0

(*continued on next page*)

Table 1 (*continued*)

No.	Chinese (Pinyin) names	Source species	Parts used	Importance* in the West		
				Food	Spice	Medicine**
71	sāngshèn	*Morus alba* L.	Infructescence	3	0	0
72	júhóng	*Citrus reticulata* Blanco	Peel	0	0	0
73	jiégěng	*Platycodon grandiflorum* (Jacq.) A. DC.	Root	0	0	0
74	yìzhìrén	*Alpinia oxyphylla* Miq.	Seed	0	0	2
75	héyè	*Nelumbo nucifera* Gaertn.	Leaf	2	0	0
76	láifúzǐ	*Raphanus sativus* L.	Seed	3	3	3
77	liánzǐ	*Nelumbo nucifera* Gaertn.	Seed	0	0	0
78	gāoliángjiāng	*Alpinia officinarum* Hance	Rhizome	2	3	1
79	dànzhúyè	*Lophatherum gracile* Brongn.	Stem and leaf	0	0	0
80	dàndòuchǐ	*Glycine* max (L.) Merr.	Fermented seed	3	0	0
81	júhuā	*Chrysanthemum morifolium* Ramat.	Infructescence	1	0	0
82	júqǔ	*Cichorium glandulosum* Boiss.et Huet	Whole plant	0	0	0
83	júqǔ	*Cichorium intybus* L.	Whole plant	3	0	0
84	huángjièzǐ	*Brassica juncea* (L.) Czern. et Coss	Seed	0	2	0
85	huángjīng	*Polygonatum kingianum* Coll.et Hemsl.	Rhizome	0	0	0
86	huángjīng	*Polygonatum sibiricum* Red.	Rhizome	0	0	0
87	huángjīng	*Polygonatum cyrtonema* Hua	Rhizome	0	0	0
88	zǐsū	*Perilla frutescens* (L.) Britt.	Leaf	0	0	0
89	zǐsūzǐ	*Perilla frutescens* (L.) Britt.	Fruit	0	0	0
90	gěgēn	*Pueraria lobata* (Willd.) Ohwi	Root	2	0	0
91	gěgēn	*Pueraria thomsonii* Benth.	Root	2	0	0
92	hēizhīma	*Sesamum indicum* L.	Seed	3	3	0
93	hēihújiāo	*Piper nigrum* L.	Fruit	3	3	1
94	huáihuā、huáimǐ	*Sophora japonica* L.	Flower and bud	0	0	0
95	púgōngyīng	*Taraxacum mongolicum* Hand.-Mazz.	Whole plant	0	0	0
96	púgōngyīng	*Taraxacum borealisinense* Kitam.	Whole plant	0	0	0
97	púgōngyīng	*Taraxacum* spp.	Whole plant	0	0	2
98	fěizi	*Torreya grandis* Fort.	Seed	0	0	0
99	suānzǎo/suānzǎorén	*Ziziphus jujuba* Mill. var. *spinosa* (Bunge) Hu ex H.F. Chou	Pulp and seed	3	0	0
100	xiānbáimáogēn	*Imperata cylindrica* Beauv. var. *major* (nees) C.E. Hubb.	Rhizome	0	0	0
101	xiānlúgēn	*Phragmites communis* Trin.	Rhizome	0	0	0
102	júpí (huò chénpí)	*Citrus reticulata* Blanco	Peel	3	2	2
103	bòhe	*Mentha haplocalyx* Briq.	Aerial part	2	2	2
104	yìyǐrén	*Coix lacryma-jobi* L. var. *mayuen* (Roman.) Stapf	Seed	2	0	1
105	xièbái	*Allium macrostemon* Bge.	Bulb	0	0	0
106	xièbái	*Allium chinense* G.Don	Bulb	0	0	0
107	fùpénzǐ	*Rubus chingii* Hu	Fruit	0	0	0
108	huòxiāng	*Pogostemon* cablin (Blanco) Benth.	Aerial part	0	0	0
109	huòxiāng	*Agastache rugosus* (Fisch. et Mey.) O. Ktze.	Aerial part	0	0	0
110	wūshāoshé	*Zaocys dhumnades* (Cantor)	Body	0	0	0
111	mǔlì	*Ostrea gigas* Thunberg	Shell	0	0	0
112	mǔlì	*Ostrea talienwhanensis* Crosse	Shell	0	0	0
113	mǔlì	*Ostrea rivularis* Gould	Shell	0	0	0
114	ējiāo	*Equus asinus* L.	Skin jelly	0	0	0
115	jīnèijīn	*Gallus gallus domesticus* Brisson	Gizzardskin	0	0	0
116	fēngmì	*Apis cerana* Fabricius	Honey	0	0	0
117	fēngmì	*Apis mellifera* Linnaeus	Honey	3	1	1
118	fùshé (qíshé)	*Agkistrodon acutus* (Güenther)	Body	0	0	0
119	rénshēn	*Panax ginseng* C.A. Mey	Root and rhizome	3	0	2
120	shānyínhuā	*Lonicera confuse* DC.	Bud and flower	0	0	0
121	shānyínhuā	*Lonicera hypoglauca* Miq.	Bud and flower	0	0	0
122	shānyínhuā	*Lonicera macranthoides* Hand. -Mazz.	Bud and flower	0	0	0
123	shānyínhuā	*Lonicera fulvotomentosa* Hsu et S.C. Cheng	Bud and flower	0	0	0
124	yánsuī	*Coriandrum sativum* L.	Fruit and seed	0	0	0
125	méiguīhuā	*Rosa rugosa* Thunb	Bud	0	0	0
126	méiguīhuā	*Rose rugosa* cv. Plena	Bud	0	0	0
127	sōnghuāfěn	*Pinus massoniana* Lamb.	Pollen	0	0	0
128	sōnghuāfěn	*Pinus tabuliformis* Carr.	Pollen	0	0	0
129	sōnghuāfěn	*Pinus* spp.	Pollen	0	0	0
130	fēngé	*Pueraria thomsonii* Benth.	Root	2	0	0
131	bùzhāyè	*Microcos paniculata* L.	Leaf	0	0	0
132	xiàkūcǎo	*Prunella vulgaris* L.	Infructescence	0	0	0
133	dāngguī	*Angelica sinensis* (Oliv.) Diels.	Root	0	0	0
134	shānnài	*Kaempferia galanga* L.	Rhizome	3	3	2
135	xīhónghuā	*Crocus sativus* L.	Stigma	3	3	1
136	cǎoguǒ	*Amomum tsao-ko* Crevost et Lemaire	Fruit	0	0	0
137	jiānghuáng	*Curcuma Longa* L.	Rhizome	3	3	3
138	bìbá	*Piper longum* L.	Infructescense	3	3	3
139	dǎngshēn	*Codonopsis pilosula* (Franch.) Nannf. L.T. Shen	Root	0	0	0
140	dǎngshēn	*Codonopsis pilosula* Nannf. var. *modesta* (Nannf.) L.T.Shen	Root	0	0	0
141	dǎngshēn	*Codonopsis tangshen* Oliv.	Root	0	0	0
142	ròucōngróng (huā ngmò)	*Cistanche deserticola* Y.C. Ma	Stem	1	0	1
143	tiěpíshíhú	*Dendrobium officinale* Kimura et Migo	Stem	0	0	0

Table 1 (*continued*)

No.	Chinese (Pinyin) names	Source species	Parts used	Importance* in the West		
				Food	Spice	Medicine**
144	xīyángshēn	*Panax quinquefolium* L.	Root	0	0	0
145	huángqí	*Astragalus membranaceus* (Fisch.) Bge. var. *mongholicus* (Bge.) Hsiao	Root	0	0	1
146	huángqí	*Astragalus membranaceus* (Fisch.) Bge.	Root	0	0	1
147	língzhī	*Ganoderma lucidum* (Leyss. ex Fr.) Karst.	Sporophore	2	0	0
148	língzhī	*Ganoderma sinense* Zhao, Xu et Zhang	Sporophore	2	0	0
149	shānzhūyú	*Cornus officinalis* Sieb. et Zucc.	Pulp	0	0	0
150	tiānmá	*Gastrodia elata* Bl.	Rhizome	0	0	0
151	dùzhòngyè	*Eucommia ulmoides* Oliv.	Leaf	0	0	0

Note: * 0 means no such use, while 3 indicates a popular use; 1 and 2 are in-between. ** These are the medicinal use excluding TCM.

It is found that many China-sourced entities, which are with a plenty of scientific data on phytochemistry, pharmacology and safety, have been accepted in Europe, e.g., *Lycium barbarum* L., *Panax ginseng* C.A. Mey, and *Ganoderma lucidum* (Leyss. ex Fr.) Karst. Therefore, scientific evidence on safety and bioactivity should be the premise for the cross-cultural acceptance of the traditional food-medicine products.

The legislative terms used for the interface of food and medicine in 20 countries / regions were compiled based on our survey (Fig. 2). The definitions of these terms are presented in supplement (Table S1).

3.2. Current definitions of interface of food and medicine

3.2.1. China

In China, food, medicine, and their interface are formally categorized into food, healthy food, food-medicine-dual-use substance, novel food ingredients, and medicine. Food Safety Law of China plays a key role in the regulation of food related substance in China. It is worth noting that a food is not for curative purposes but can be the stuff traditionally used as both food and Chinese materia medica. The healthy food is kind of special food for specific people to regulate health but are not for curative purposes. However, a healthy food is allowed for the recognized 24 function claims once it is proven by the official functional assessments. Food-medicine-dual-use substance must be adopted in Chinese Pharmacopoeia with a food use tradition, and the National Health Commission has published an updating list for these substances. The recognition of novel food ingredients allows for using new food sources. Lastly, medicine refers to the substance for curative purposes.

Accordingly, there are intersections among these categories. For instance, a Food-Medicine-dual-use substance must be a medicine in pharmacopoeia, but only when it is not used for curative purposes it belongs to food. The ingredient of healthy food is open to the substances of food safety and with proven health benefits, while is not listed in the official forbidden list. Novel food ingredients have higher potential compatibility with others. Taking goji as an example: as a traditional food, it is adopted in the Chinese Pharmacopoeia as well as in the list of Food-Medicine-dual-use substance, in the meanwhile, it is not in the official forbidden list for healthy food. Therefore, goji can be a medicine, food-medicine-dual-use substance, and an ingredient for healthy food.

3.2.2. Japan

In Japan, food includes (a) food with health claims (FHC), (b) food for special dietary uses (FOSDU), and (c) other foods (may include so-called functional foods) (MHLW, 2022). FHC has two sub-categories: foods with nutrient function claims (FNFC) and foods for specified health uses (FOSHU). FOSDU includes five categories. In 2015, a new system was termed "foods with function claims (FFC)", and was integrated into the FHC (Shimizu, 2019).

It can be seen that boundaries among these sub-categories are not clear. For example, FOSDU and FHC have an intersection, which

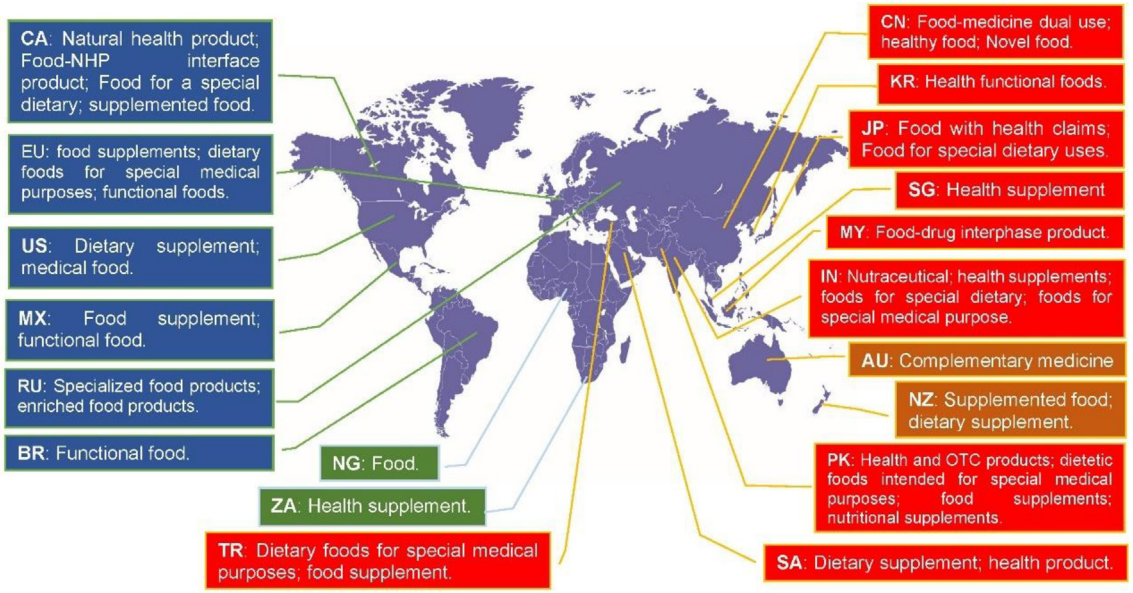


Fig. 2. Legislative terms for the interface of food and medicine in selected countries / regions.

is FOSHU. Moreover, the new category FFC is similar to FOSHU, and their differences are found in the application process for the health claim labeling, and some of the health claims of FFC have already been adopted in the FOSHU system (Shimizu, 2019).

3.2.3. South Korea

Health functional foods includes all the interface of food and medicine in South Korea. It is defined as "foods manufactured (including processing; hereinafter the same shall apply) with functional raw materials or ingredients beneficial to human health" (Korean National Law Information Centre, 2019).

3.2.4. Thailand

Foods in Thailand are classified into four categories based on their safety risk, namely: (a) specially controlled food, (b) standardized food, (c) food with labeling and (d) general food (Ratanakorn, 2016). The interface of food and medicine may be found in (a), (b) or (c). For example, herbal tea and food supplements are included in standardized food, and the specially purposed food such as medical food belongs to food with labeling.

3.2.5. Malaysia

In Malaysia, products with combination of food ingredients and active ingredients for oral consumption are recognized as food-drug interphase (FDI) products (Ministry of Health of Malaysia, 2021). FDI products are not clearly defined as food or drug. FDI is not a product category, and it is important to determine whether the products are regulated as drug or as food because different regulatory requirements apply.

3.2.6. Singapore

In Singapore, health supplement means a product that is used to supplement a diet with benefits beyond those of normal nutrients, and to support or maintain the healthy functions of the human body. However, it cannot be an item of a meal or diet (Singapore Food Agnecy, 2022). Products in the food Health product interface includes (a) part of a daily diet, including Chinese medicinal material commonly used in food, (b) supplementation to a diet, and (c) those used for a medicinal purpose.

3.2.7. Pakistan

In Pakistan, "Health and OTC products", "Dietetic foods intended for special medical purposes", "food supplements" and "nutritional supplements" are assigned (Drug Regulatory Authority of Pakistan, 2012; 2014). Although defined separately, these terms have overlaps of different extent, and food-medicine products may be included in any of these categories.

3.2.8. India

In India, the interface of food and medicine may fall into "nutraceutical", "health supplements", "foods for special dietary" or "foods for special medical purpose" (Food Safety and Standards Authority of India, 2020). Of these, only the source of "nutraceutical" is determined as naturally occurring ingredients, others are all defined based on their extra health purposes other than food.

3.2.9. Saudi Arabia

In Saudi Arabia, "dietary supplement" and "health product" are defined (Saudi Food & Drug Authority, 2020), and the food-medicine products may belong to either of them. "Dietary supplement" is not in a pharmaceutical dosage form while the latter is, but their purposes are compatible to some extent.

3.2.10. Turkey

"Dietary foods for special medical purposes" and "Food supplement" are defined in Turkey (Council of Ministers of Turkey, 2010). Besides their similarity in nutritional properties, they are both used for dietary management.

3.2.11. Australia

In Australia, products for oral consumption are regulated by the Australian government as either foods or therapeutic goods. Therapeutic goods can be represented in any form and are for therapeutic use. The interface of foods and therapeutic good is called complementary medicines, which include herbal medicines, traditional medicines, vitamins, special purpose foods, nutritional supplements, homoeopathic and naturopathic products (Legislative Council Secretariat of Australia, 2001).

3.2.12. New Zealand

In New Zealand, "supplemented food" and "dietary supplement" are applied (Minister for Food Safety of New Zealand, 2016; Ministry of Health of New Zealand, 1985). "Supplemented food" is represented as a food while the later is in controlled dosage, although there is a big overlap.

3.2.13. Russia

The food-medicine products may fall into "specialized food products" or "enriched food products" in Russia (Urazbaeva, 2018). The former is with an established ratio of composition, which are intended for safe use by certain categories of people, while the later sets a limitation for the biologically active substances content at safe level of consumption.

3.2.14. South Africa

In South Africa, "Health supplement" include stuffs for restoring, correcting or modifying any physical or mental state but not in forms of medicines (Drugs Control Council of South Africa, 1965).

3.2.15. Nigeria

The category in Nigeria is different, since the food and medicine interface products are included in food (National Agency for Food and Drug Administration and Control of Nigerias, 2004).

3.2.16. European Union

"Food supplement", "dietary foods for special medical purposes" and "functional food" are defined in the EU. "Food supplements" is to supplement the normal diet with a nutritional or physiological effect, designed to be taken in measured small unit quantities (Directive 2002/46/EC). "Dietary foods for special medical purposes" are for the dietary management of patients and to be used under medical supervision. (Directive 1999/21/EC). "Functional food" are food which beneficially affects one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease (EC 1924/2006) (Duttaroy, 2019).

3.2.17. Canada

In Canada, "natural health product (NHP)", "food-NHP interface product", "food for a special dietary" and "supplemented food" are the intermediate (Minister of Justice of Canada, 2022). "Food-NHP interface product" means any product that is in a food format, and meets the scope of natural health product (Minister of Health of Canada, 2017). "Food for a special dietary" means a food that has been specially processed or formulated to meet the particular physical or physiological requirements (Minister of Justice of Canada, 2021). "Supplemented food" may contain added vitamins, minerals, amino acids, herbal or bioactive ingredients, and may have extra physiological role other than nutrition (Food Directorate of Canada, 2016).

3.2.18. United States

"Dietary supplement" and "medical food" are defined in the US. "Dietary supplement" may contain vitamin, mineral, botanical, amino acid or the concentrate of them (US FDA, 2021). "Medical food" is for the specific dietary management and should be consumed under the supervision of a physician (Lewis, Jackson, & Bailey, 2019).

3.2.19. Mexico

In Mexico, "food supplement" and "functional food" are defined. Although both them are for health purposes, the former may be presented in a pharmaceutical form, while the later is enriched with additional nutrients (the General Health Law of Mexico; Official Mexican Standard "NOM-086-SSA1-1994", Goods and Services).

3.2.20. Brazil

Brazilian legislation does not provide a definition of functional foods, but it is possible to claim that certain foods have functional health properties (Silveira, Vianna, & Mosegui, 2009).

3.2.21. Summary

It can be seen food and medicine continuum is a common phenomenon in the worldwide, although the legislative terms for the food-medicine entities may differ among regions. Japan has a sophisticated classification system for food-medicine, while health functional foods include all these stuff in South Korea, differently, the food-medicine is included in "food" in Nigeria. The term "food-NHP interface product" in Canada is quite similar to "FDI product" of Malaysia. In China, food-medicine-dual-use substance and healthy food have an overlap, while in Japan, FHC and FOSDU intersect. As a result, globally there are diverse legislative terms for food-medicine products, the scope of these terms may be different, as well, the boundaries among these terms are blurry.

Although food-medicine products are defined differently, basically, their common property is that they have extra healthy functions beyond their normal nutritional functions. Fortunately, we have seen that the regulations for these have emphasized their function claims. For example, healthy food in China can make health claims of 24 categories, which must be based on standard assessments. Similar regulations are found in other countries / regions, e.g., EC 1924/2006 is technically for the health claims of functional foods in the EU market. Additionally, these products are requested to register, by which a list for the approved products is published formally as a reference for market access, and this policy is effective in maintaining this high-profit market.

There are still food-medicine products whose health benefits are based on traditional uses, as the long term used in history can be a reliable proof for their safety. As a typically example, food-medicine dual-use substances of China are allowed for food consumption, although they are all medicinal materials in pharmacopoeia. To control these products, the government has published an updating list for the permitted materials, which must be evaluated by a working panel. The situation in the EU is similar, that the traditional use can be alternative evidence for the safety of traditional food (EU-efsa Panel on Dietetic Products et al., 2021).

It is worth noting that the cross-cultural communication of food-medicine products are possible based on current regulations. One of the pathways is the adoption of traditional uses. For example, many of the Chinese herbal medicines are with food use tradition, and these has already been adopted in many countries, e.g., Singapore adopts some of the Chinese medicinal materials to be used as part of a diet, which belong to the category of "health supplement". Besides, novel food paves a pragmatical way for adopting a foreign food-medicine. In most of the regions, those exotic food products are allowed to be imported on the promise of application. For example, when a foreign food-medicine product imports to China, the technical documents of this product as well as the historical use proof in its origin country are requested. The new Novel Food Regulation (EU) 2015/2283 has declared the requirements for importing into the EU.

4. Conclusion

Food and medicine continuum is a global phenomenon. The present study traced the historical roots and the current regulations on the interface of food and medicine in both the East and West of the world. The historical root of food and medicine continuum lie in the herbal traditions of millennia, such as traditional Chinese medicine of China, Ayurveda of South Asia, Hippocratic and Galenic medicine of the West. The food-medicine knowledge in different regions is different since the biocultural diversity. Currently, food-medicine products are increasingly popular. Although the legislative terms for food-medicine products may differ among regions, the regulations are similar, which allows for their cross-cultural communication. The long-term uses are recognized as reliable proofs for the safety of these traditional foods, moreover, the studies on safety and bioactivity provide sufficient scientific evidence for their safety and functions. Besides, laws on novel food pave a pragmatic pathway for the cross-cultural exchange of the traditional food-medicine products. Finally, we recommend facilitating the cross-cultural communication of the food-medicine knowledge in the East and West, thus to make the best use of the traditional health wisdom in the globe.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The present work was supported financially by the Strategic Consulting Project of Chinese Academy of Engineering (No. 2021-X2-10) and Innovation Team and Talents Cultivation Program of National Administration of Traditional Chinese Medicine (No. ZYYCXTD-D-202005). The authors would like to sincerely thank Prof. Michael Heinrich from UCL School of Pharmacy for his valuable supports in the survey and consulting activities.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chmed.2022.12.002.

References

Adelman, J., & Haushofer, L. (2018). Introduction: Food as medicine, medicine as food. *Journal of the History of Medicine and Allied Sciences, 73*(2), 127–134.
Caliskan, O. (2015). Mediterranean hawthorn fruit (*Crataegus*) species and potential usage. In V. R. Preedy & R. R. Watson (Eds.), *The mediterranean diet* (pp. 621–628). Elsevier: Academic Press.
Chen, N. (2008). *Food, medicine, and the quest for good health*. New York: Columbia University Press.
Council of Ministers of Turkey (2010). *Law on veterinary services*. Food and Feed: Plant Health.
Drug Regulatory Authority of Pakistan (2012). *Drug Regulatory Authority of Pakistan Act*.
Drug Regulatory Authority of Pakistan (2014). *Alternative Medicines and Health Products (Enlistment) Rules*.
Drugs Control Council of South Africa (1965). *Drugs Control Act*.
Duttaroy, A. K. (2019). Regulation of functional foods in European Union: Assessment of health claim by the European Food Safety Authority. In D.

Bagchi (Ed.), *Nutraceutical and functional food regulations in the united states and around the world* (third ed., pp. 267–276). UK and US: Academic Press.
Etkin, N. L., & Ross, P. J. (1982). Food as medicine and medicine as food: An adaptive framework for the interpretation of plant utilization among the Hausa of northern Nigeria. *Social Science & Medicine, 16*(17), 1559–1573.
EU-efsa Panel on Dietetic Products Nutrition and Allergies, Turck, D., Bresson, J. L., Burlingame, B., Dean, ... van Loveren, H. (2021). Guidance on the preparation and submission of the notification and application for authorisation of traditional foods from third countries in the context of Regulation (EU) 2015/2283 (Revision 1). *EFSA Journal*, *19*(3), e06557.
Food Directorate of Canada (2016). *Category Specific Guidance for Temporary Marketing Authorization: Supplemented Food*.
Food Safety and Standards Authority of India (2020). *Guidance Note on Food for Special Medical Purposes*.
Grant, M. (2002). *Galen on food and diet*. London and New York: Routledge.
Heinrich, M., Kum, K. Y., & Yao, R. (2022). Decontextualized Chinese Medicines – Their uses as health foods and medicines in the 'global West'. In V. Lo & M. Stanley-Baker (Eds.), *Routledge handbook of Chinese Medicine* (pp. 721–741). London: Routledge.
Heinrich, M., Yao, R., & Xiao, P. (2022). 'Food and medicine continuum' – why we should promote cross-cultural communication between the global East and West. *Chinese Herbal Medicines, 14*(1), 3–4.
Korean National Law Information Centre (2019). *Statutes of the Republic of Korea*.
Kumar, S., Dobos, G. J., & Rampp, T. (2017). The significance of ayurvedic medicinal plants. *Journal of Evidence-Based Complementary and Alternative Medicine, 22*(3), 494–501.
Legislative Council Secretariat of Australia (2001). *Regulation of Health Food in Australia*.
Leonti, M. (2012). The co-evolutionary perspective of the food-medicine continuum and wild gathered and cultivated vegetables. *Genetic Resources and Crop Evolution, 59*(7), 1295–1302.
Lewis, C. A., Jackson, M. C., & Bailey, J. R. (2019). Understanding medical foods under FDA regulations. In *Nutraceutical and functional food regulations in the united states and around the world* (pp. 203–213). UK and US: Academic Press.
Liu, Y., Wei, X., Qin, Z., & Xiao, P. (2015). Annotation of drug and food are the same origin and its realistic significance. *Modern Chinese Medicine*, *17*(12), 1250–1252, 1279.
Meng, S. (725). Meng, S., Zhang, D., & Xie, H. (1984). *Shi Liao Ben Cao*. Beijing: People's Health Press.
MHLW (2022). Food with Health Claims, Food for Special Dietary Uses, and Nutrition Labeling. https://www.mhlw.go.jp/english/topics/foodsafety/fhc/. (Accessed 17-10-2022).
Minister for Food Safety of New Zealand (2016). *New Zealand Food (Supplemented Food) Standard*.
Minister of Health of Canada (2017). *Classification of Products at the Food-natural Health Product Interface: Products in Food Formats*.
Minister of Justice of Canada (2021). *Food and Drugs Act*.
Minister of Justice of Canada (2022). *Natural Health Products Regulations*.
Ministry of Health of Malaysia (2021). *Drug Registration Guidance Document (DRGD)*.
National Agency for Food and Drug Administration and Control of Nigerias (2004). *National Agency For Food And Drug Administration And Control Act*.
Rastogi, S. (2014). *Ayurvedic science of food and nutrition*. New York: Springer.
Ratanakorn, S. (2016). *Food Regulations and Enforcement in Thailand, Reference Module in Food Science*.
Saudi Food & Drug Authority (2020). *Saudi FDA Products Classification Guidance*.
Shimizu, M. (2019). History and current status of functional food regulations in Japan. In *Nutraceutical and Functional Food Regulations in the United States and around the World* (pp. 337–344). UK and US: Academic Press.
Silveira, T., Vianna, C., & Mosegui, G. (2009). Brazilian legislation for functional foods and the interface with the legislation for other food and medicine classes: Contradictions and omissions. *Physis, 19*(4), 1189–1202.
Singapore Food Agency (2022). *General Classification of Health and Food Products*.
Sun, S. M. (652). Sun, S. M., & Liu, Q. (1998). Bei Ji Qian Jin Yao Fang. Beijing: China TCM Press.
Totelin, L. (2015). When foods become remedies in ancient Greece: The curious case of garlic and other substances. *Journal of Ethnopharmacology, 167*, 30–37.
Totelin, L. (2021). Hippocratic corpus. *Oxford Classical Dictionary*. https://doi.org/10.1093/acrefore/9780199381135.9780199381013.9780199388525.
Touwaide, A., & Appetiti, E. (2015). Food and medicines in the Mediterranean tradition. A systematic analysis of the earliest extant body of textual evidence. *Journal of Ethnopharmacology, 167*, 11–29.
Urazbaeva, A. N. (2018). Russian food law: Legal systems of the Russian federation and the Eurasian economic union (EAEU). *And food safety technical regulation*. Wageningen University.
US FDA (2021). *Federal Food, Drug, and Cosmetic Act*.
Yao, R., Heinrich, M., & Weckerle, C. S. (2018). The genus *Lycium* as food and medicine: A botanical, ethnobotanical and historical review. *Journal of Ethnopharmacology, 212*, 50–66.