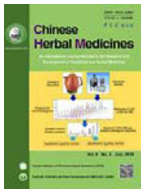

Available online at SciVarse ScienceDirect

Chinese Herbal Medicines (CHM)

ISSN 1674-6384

Journal homepage: www.tiprpress.com E-mail: chm@tiprpress.com

Review

A Review of Quality Assessment and Grading for Agarwood

Yang-yang Liu[1, 2], Jian-he Wei[1, 2*], Zhi-hui Gao[1], Zheng Zhang[1, 2], Jun-chen Lyu[2]

1. *Institute of Medicinal Plant Development (Key Laboratory of Bioactive Substances and Resources Utilization of Chinese Herbal Medicine, Ministry of Education), Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100193, China*
2. *Hainan Branch of Institute of Medicinal Plant Development (Hainan Provincial Key Laboratory of Resources Conservation and Development of Southern Medicine), Chinese Academy of Medical Sciences and Peking Union Medical College, Haikou 570311, China*

ARTICLE INFO

Article history

Received: July 10, 2015

Revised: August 31, 2015

Accepted: April 25, 2016

Available online: January 9, 2017

DOI: 10.1016/S1674-6384(17)60072-8

ABSTRACT

Agarwood is an important non-timber forest product widely used in religious and cultural activities as perfume and fragrance and as traditional medicine in Asia. The high value of agarwood and the inflated consuming market have led to constant rising of the prices. In general, the price of the agarwood is determined according to its quality, which can be divided into different grades. But up to now, there is not any standard quality grading system which could be used overwhelmingly throughout the agarwood producing, commerce and consumption. Therefore, we reviewed agarwood in diversified grading indexes, systems and methods.

Key words

agarwood; agarwood trade; grading; quality-assess

1. Introduction

Agarwood or eaglewood (also known as *chen xiang* in China; *agar* in India; *oud* in the Middle East; *gaharu* in the South East Asia, and *jinkoh* in Japan) is the resinous wood of the *Aquilaria* spp. (Thymelaeaceae), including 19 *Aquilaria* species in China, India, Burma, Laos, Vietnam, Cambodia, Malaysia, Sumatra, Borneo, Philippines, Bangladesh, and Papua-New Guinea (For a compilation, see appendix A; Rogers, 2009; Akter et al, 2013; Abdin, 2014). Only four species, i.e. *A. malaccensis* Lam., *A. crassna* Pierre ex Lecomte, *A. sinensis* (Lour.) Spreng., and *A. filaria* (Oken) Merr. are being largely used to produce agarwood (Table 1). Agarwood is absent from *Aquilaria* trees unless they are attacked by physical force (Liu et al, 2013; Li et al, 2014), insects (Kalita et al, 2015) or bacteria/fungi infection (Novriyanti et al, 1999; Mohamed, Jong, and Kamziah, 2014; Chong et al, 2015). In response to attack, agarwood is yearly embedded around the wound where amount of volatile constituents are accumulated.

*Corresponding author: Wei JH Tel/Fax: +86-10-5783 3363 Email: wjianh@263.net

Funds: National Natural Science Foundation of China (No. 81403055, 81303312); Science & Technology Programs from Hainan Province of China (No. ZDKJ2016004); CAMS Initiative for Innovative Medicine (CAMS-I2M-2-003)

Table 1 Four major species that produce agarwood and corresponding producing and consuming areas

Species	Major producing areas	Major consumer areas	Main uses
A. malaccensis	Malaysia, India, Burma, Sumatra, Borneo, Philippines	Middle East	Pharmacy, Religion, Commodity
A. crassna	Vietnam, Cambodia, Laos, Thailand	Middle East, Japan	Pharmacy, Religion, Collection
A. sinensis	China	China, Japan	Pharmacy, Religion, Collection
A. filaria	Philippines	Middle East	Commodity

Agarwood was first used as one of traditional Chinese medicines from the 5th century. It was used in more than 1500 kinds of preparations of Chinese medical materials. Agarwood tastes in bitterness which is used as sedative, carminative, and to relieve gastric problems, coughs, rheumatism, and high fever. It can promote *qi* circulation to relieve pain, warm middle energizer to arrest vomiting, and promote inspiration to relieve asthma (Pharmacopoeia Committee of P. R. China, 2015). In *Chinese Pharmacopoeia*, there are 35 Chinese medical material preparations including agarwood such as "*Chenxiang Huazhi Wan*". Agarwood also has been used for centuries as incense in Buddhist, Hindu, and Islamic ceremonies. In traditional Ayurveda medicine, agarwood incense has been used to remove curse. In traditional Arab medicine, agarwood essential oil has been used for aromatherapy.

Nowadays more than 18 countries throughout Southeast Asia and Middle East have participated in agarwood trade. Although different countries or medical systems have different agarwood grades, several indexes such as resin, sinkage, color, and scent have been basically assessed in grading agarwood across the world. For the medical purpose, the more important parameters are the effective chemical compounds and resin content. For the religion purpose, color and scent/aroma are preferred. And for the collection purpose, shape and scent/aroma are prior to others. In addition, agarwood grades are being improved due to developing techniques. Here we reviewed agarwood in traditional and modern quality assessment for the medicinal and relevant usage.

2. Traditional systems of quality assessment grading

Agarwood is traditionally graded by physical senses. It is evaluated in resin content, sinkage in water, color, scent/aroma, agarwood-inducing method, formation time, place of origin (Table 2).

Table 2 Major items in agarwood quality assessment in trade markets

Items	Pharmacy			Religion	Collection	Commodity
	TCM	traditional Ayurveda medicine	traditional Arab medicine			
Resin content	√√	√	√	–	√	√
Sinkage	√	–	–	–	√√	–
Color	√	√	–	√√	√	√√
Secent/aroma	–	√√	√√	√	√	√√
Agarwood-inducing method	√	–	–	–	√√	√
Formation time	√	√√	–	√	√√	√
Place of origin	√√	√	√	√	√	√√

"√√": Primary item has been considered; "√": Secondary item has been considered; "–": Item has been considered scarcely.

2.1 Sinkage

As known, agarwood, called *Chenxiang* in Chinese, means the fragrant resin-embedded wood that can sink down in water. Agarwood pieces which sink in water are assumed to have higher resin content and higher density. Therefore, the quality of agarwood is determined by sinkage in water. In the agarwood market, the most common method of grading is to place agarwood pieces into water, and then the pieces are classified into three basic grades: sinkage, half-sinkage (or half-floating), and full-floating (Figure 1). *The Compendium of Materia Medica* (*Bencao Gangmu* in Chinese, a famous medical book on traditional Chinese medicines), records that the sinkage is agarwood, the half-sinkage is stack incense, and the full-floating is half-mature incense. Sinkage agarwood is designated to a higher grade than the others, but this test is rarely performed for the customers. Actually, not all of the high grade agarwood are sinkage. Most of the high grade Hainan agarwood (origin from Hainan island of China) and all of *tagara* (Top-grade agarwood) are half-sinkage or full-floating. Actually, sinkage related the wood texture and density of *Aquilaria* tree. Among the four major species of agarwood tree (Table 1), the wood density of *A. malaccensis* is harder than the other three, and *A. sinensis* is the loosest one.

2.2 Resin content

Resin is the main component of agarwood (Peng et al, 2014). Heartwood of *Aquilaria* trees in health has low density with a yellow-whitish color. Normally, the higher the resin content is, the higher the grade is. Therefore, people