MÖSSBAUER STUDY OF CHINESE ANCIENT MINERAL DRUGS*

Qin Guangyong (秦广雍)

(Fundamental and Applied Science Research Institute of Henan, Zhengzhou University, Zhengzhou 450052, China)

and Li Shi (李 士)

(Institute of High Energy Physics, Academia Sinica, Beijing 100080, China)

(Received December 1991)

ABSTRACT

About 100 crude Chinese mineral drug samples were investigated with Mössbauer spectroscopy, X-ray diffraction analysis and atomic absorption spectroscopy. The classifications, species and components of Chinese mineral drugs are elucidated. The pharmaceutic and curative mechanisms of these mineral drugs are discussed.

Keywords: Mössbauer spectroscopy XRD Atomic absorption spectroscopy Chinese ancient mineral drugs

1 INTRODUCTION

The same as plant and animal ingredients in prescriptions, the discovery and application of minerals as drugs is an important aspect in the formation and development of traditional Chinese medicine. Within the book of "Shen Nong's Cannon of Materia Medica" (A.D. 100–180) 365 species of drugs were recorded, among which 46 were minerals. Another modern textbook "Traditional Chinese pharmacology" (1985) covered 424 species of drugs including 23 species of minerals as drug ingredients. But, Li Shizhen (the great pharmacologist of the Chinese Ming Dynasty) made a description of 375 species of mineral drugs (both natural and manufactured) in "Compendium of Materia Medica" in 1578. There is an enormous potential to develop application of mineral drugs through modern research as well as its exploitation as a resource.

Mineral drug directly supplies minor and trace elements to the body. The virtue of a drug is determined by its mineral structure and biochemical and biophysical effect of supplied elements. The curative effect is not only a biochemical effect, but also a biophysical effect (especially magnetism).

The mineralogical and geochemical applications of the Mössbauer spectroscopy

* The Project Supported by National Natural Science Foundation of China

have developed rapidly over the last few years. The vast majority of reported Mössbauer spectra were iron spectra, mainly because of the wide and varied occurrence of iron in the earth's crust. Most of the applications in this area can be considered as fingerprint applications of varying degrees of sophistication. Much of the information obtainable from the Mössbauer spectra cannot be obtained by other techniques[1].

2 EXPERIMENTAL PROCEDURE

About 100 crude Chinese mineral drug samples were investigated with Mössbauer spectroscopy, X-ray diffraction and atomic absorption spectroscopy. These samples were collected from the Henan museum of geology (HM), Henan hospital (HH) and Beijing samples' factory (BF). Mössbauer spectra were taken at room temperature with powder absorbers of about 50 mg/cm^2 and a source of ^{57}Co in palladium. The spectra were least-squares fitted with a superposition of Lorentzian lines. Mössbauer hyperfine parameters of these samples are partly listed in Table 1.

3 RESULTS AND DISCUSSION

3.1 Zirantong

Zirantong (pyritum) is a commonly used mineral drug. As listed in Table 1, the spectrum of HH sample consisted of a central doublet (FeS_2 pyrite) and a sextet (hematite). A chalcopyrite ($CuFeS_2$) component was found in the spectrum of HM sample, but the spectrum of BF sample consisted only of a central doublet of pyrite. The X-ray diffraction analysis showed that the crude Zirantong is a pyrite or chalcopyrite compound, while after calcining, it revealed the characteristic value of a pyrrhotite. It is suggested that crystal lattices of pyrite exist in metallic bonds promoting biochemical actions, which is the main curative mechanism of pyrite. The active ingredients are readily soluable after calcining and quenching.

3.2 Cishi

Cishi (magnetitum) plays an important role in Chinese traditional mineral drugs. As listed in Table 1, the spectrum of an HH sample consists of two sextets indicating the presence of magnetite. The spectrum of an HM sample consists only of a sextet of hematite proving that this sample was probably calcined. But almost no absorbed peaks appeared in spectrum of a BF sample. The changes of Fe^{2+} content in the drugs were also studied for these samples prepared by magnetitum at various calcining temperatures, calcining time and concentrations of acetic acid. The atomic absorption analysis results show that the preparation process should be done at 650 °C for 30-50 min, and then tempered three times by dipping in rice vinegar. The magnetitum powder should be so fine that the effective composition can be fully utilized. The

curative mechanism of magnetitum is partly due to its magnetic effect on the biological electric and magnetic field in the body.

Table 1

Mössbauer parameters of some mineral drugs

Sample		Fe^{3+}			Fe^{2+}			Magnetic			
		IS* (mm/s)	QS (mm/s)	RA* * (%)	IS (mm/s)	QS (mm/s)	RA (%)	IS (mm/s)	QS (mm/s)	*H* (×10⁴A/m)	RA (%)
Zirantong	HM	0.30	0.61	85				0.25	-0.02	2.84	15
	BF	0.30	0.61	100							
	HH	0.31	0.62	73				0.37	-0.24	4.07	27
Cishi	HM							0.38	-0.19	4.10	100
	HH							0.36	-0.11	3.99	56
								0.65	0.06	3.66	44
	BF							almost	no	iron	
Daizheshi	BF							0.37	-0.19	4.03	100
	HM							0.39	-0.20	4.09	100
	HH							0.53	-0.20	4.09	100
Yuliangshi	HM1	0.33	0.53	95							<5
	HM2	0.36	0.45	60				goethite			40
	HH	0.27	0.69	95							<5
Micas	HM	0.23	0.86	62	1.15	2.99	38				
	BF1	0.33	0.89	40	1.10	2.53	60				
	BF2	0.28	0.87	66	1.08	3.08	34				

* All isomer shifts are referred to α -Fe * * RA—Relative area

3.3 Daizheshi

Daizheshi (red ochre) is also a commonly used mineral drug. According to the traditional Chinese pharmacology, the clinic curative function of red ochre is ascribed to the iron mineral hematite, and can be used only after calcining and quenching by vinegar. As listed in Table 1, it was found that the spectra of these samples generally consist of a sextet of hematite. Therefore, it is reasonable to deduce that the main curative composition of red ochre is hematite, since it has a large hyperfine field and a high chemical activity.

3.4 Yuliangshi

Yuliangshi is one of the most important minerals, it has been used for more than two thousand years in the medical history of China. The samples look earthy yellow to purplish brown in colour and rough on the surface. The spectra of HH and HM1 samples consist of a central doublet. A goethite component appeared in the spectrum of an HM2 sample. X-ray diffraction analyses proved that it contains minor quartz, illite and other clay minerals.

3.5 Micas

With a broad doublet due to Fe^{3+} in one or both octahedral sites, one ferrous doublet arises in the Mössbauer spectra of BF and HM samples. As listed in Table 1, BF1 sample was proved to belong to trioctahedral biotite, but HM and BF2 samples

belong to dioctahedral muscovite.

Other mineral drugs, including Shehanshi, Mengshi, Shizhi, Yangqishi, Maifanshi, *etc.* were also studied, and the results can be seen in Ref[2].

4 CONCLUSIONS

The traditional Chinese mineral drugs have the characteristics of being precise in function, quick in action and obvious in curative effect. As mentioned above, with the Mössbauer spectra, we can identify quickly and precisely not only every kind of mineral drug, but also its true (good) or false (bad) product. After acetic quenching, the ferric iron is reduced to ferrous iron, stimulation is reduced, and it is easy to be absorbed and utilized by human body. The verification of the mineral as drug should be done in order that mineral drugs could be used to cure the diseases safely and effectively, and the curative effect could be improved by the processing.

REFERENCES

[1] Heller-Kallai L, Rozenson I. *Phys Chem Miner*, 1981, 7:223.

[2] Qin Guangyong, Gao Zhengyao, Gao Guozhi. The 15th general meeting of the international mineralogical association. Beijing, 1990. Beijing: The Printing House of Chinese Institute of Geology and Mineral resources Information. Vol 2, 625.