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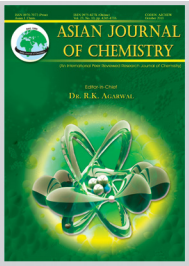

NOTE

Determination of Nine Heavy Metals by Inductively Coupled Plasma Mass Spectroscopy in Groundwater from Northeast Rural of China

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The safety of drinking water is dangered by many factors, especially groundwater surounding animal breeding waste and toilet. Nine heavy metals in drinking water from northeast rural of China were determined by inductively coupled plasma mass spectroscopy (ICP-MS.) The results showed that ICP-MS for detecting heavy metals simultaneously is accurate and precise. Drinking water (groundwater) from northeast rural of China often exceed the limits of drinking water sanitary standard, especially the content of Mn and Fe. The construction scheme of drinking water project was optimized, scientifically planning water projects, increasing rural water supply project, strengthening the monitoring of water quality and the protection of water sources, preventing rural water pollution, innovating safety management system of rural drinking water, perfecting the supervisory system of rural drinking water and actively studying the safety of rural drinking water.

Key Words: Groundwater, Northeast rural of China, Heavy metals, Environmental safety, ICP-MS.

Today 70 % of Chinese people are still living in rural, whose drinking water is mostly groundwater. Because the safety of drinking water are often affected by many factors, including agricultural production, animal breeding, industrial pollution, automobile exhaust, especially when agricultural production and animal breeding waste cannot be correctly managed, rural groundwater will be polluted severely.

In northeast rural of China, because of the local custom, animal breeding waste is usually put on the street and toilet are near from drinking well (Figs. 1 and 2), both of which will damage the environment, human health and pollute the drinking water safety. It is therefore very important to investigate the content of hazardous substances in drinking water from northeast rural of China.

In detection methods of heavy metals, ICP-MS has many advantages, such as the ability to detect many elements simultaneously and high accuracy[1], it has become the most important technique for detecting heavy metals[2-4]. In this study, we selected the ICP-MS as the method to determine heavy metals in drinking water from northeast rural of China.

Eight groundwater samples were sampled at Xihe village, Xiaokuan town of Lishu county, Jilin province of China. All these eight drinking well are surrounded by animal waste and near the toilet from 2 m to 8 m. The ICP-MS instrument was the PQ Excell instrument (ELAN DRCII, PE Company, USA).

Instrument parameters were as described in the literature[5,6], with some modifications, given in Table-1.

Accuracy and precision of the method: Correlation coefficients of nine detected elements were from 0.783 to 0.996, limits of detection were lower than 0.80 ng/mL, except Mn 1.42 ng/mL) and eight of nine relative standard deviations are lower than 6 % ranged from 1.20 to 8.91 % (Table-2), only relative standard deviation of Hg is higher than 10 (10.2). These results showed that this method for detecting heavy metals simultaneously is accurate and precise.

Content of heavy metals in groundwater from Northeast rural of China: From the data (Table-3), most of groundwater of northeast rural of China contain Zn, Cu, As, Cd, Mn and Fe. According to drinking water sanitary standard[7], contents of Zn, Cu, As, Cd, Pb, Hg and Cr in all these detected samples meet the standard, but contents of Mn in six of eight samples exceed the limits and contents of Fe in four of eight samples exceed the limits (Table-3).

Lower concentration of heavy metals in drinking water can affect human health and they are easily accumulated the body and are difficult to clearup. Heavy metals can result in carcinogenesis, teratogenesis, mutagenesis and especially embryonic malformation in human beings. Therefore, it is important to monitor the heavy metal content in drinking water. Data from this study showed that drinking water (groundwater)

TABLE-3
CONTENT OF HEAVY METALS IN GROUNDWATER FROM CHINA VILLAGE (ng/mL)

Heavy metals	Content (ng/mL)							
	1	2	3	4	5	6	7	8
Zn	12.752	18.133	16.222	16.113	22.924	20.465	18.129	9.138
Cu	3.205	5.64	11.739	2.236	3.093	3.853	2.587	2.77
As	1.418	1.416	1.746	0.996	1.746	1.055	1.458	2.5
Cd	Nil	0.036	0.037	0.021	0.030	0.056	0.086	0.018
Pb	Nil	Nil	0.099	Nil	Nil	0.020	0.025	0.044
Hg	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cr	Nil	Nil	0.146	Nil	Nil	Nil	Nil	Nil
Mn	595.4	83.7	7.4	389	648.1	189.9	176.7	1014
Fe	308.3	354.2	267.5	251.3	388	235.6	352.6	296.8

from northeast rural of China often exceed the limits of drinking water sanitary standard, especially the content of Mn and Fe, which is similar to former researches[8]. The cause why Fe and Mn exceed the limits of drinking water sanitary standard could be relative to feed and feed additives[9,10].

Fig. 1. Well is near the toilet

Fig. 2. Animal waste is put on the street

We have optimized the construction scheme of drinking water project, scientifically planning water projects, increasing rural water supply project, rationally adopting water treatment technological facilities, strengthening the monitoring of water quality and the protection of water sources, preventing rural water pollution, innovating safety management system of rural drinking water, perfecting the supervisory system of rural drinking water and actively studying the safety of rural drinking water[11].

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TABLE-1
OPERATING PARAMETERS FOR ICP-MS

Method parameters	Value
Power (W)	1350
Plasma flow (L/min)	13.0
Nebulizer flow (L/min)	0.98
Auxiliary flow (L/min)	1.25
Scanning times	180
Pump rate (rpm)	20
Rinse time (s)	10
Replicates	6
Replicate read time (s)	8
Instrument stabilization (s)	8
Sample delay uptake (s)	56

TABLE-2
CORRELATION COEFFICIENT, LIMITS OF DETECTION AND RELATIVE STANDARD DEVIATIONS

Heavy metals	Correlation coefficient	Limits of detection (ng/mL)	Relative standard deviations (RSD) (%)
Zn	0.993	0.34	1.40
Cu	0.946	0.58	4.78
As	0.863	0.23	5.14
Cd	0.941	0.01	3.17
Pb	0.957	0.01	5.60
Hg	0.783	0.02	10.20
Cr	0.996	0.05	2.54
Mn	0.925	1.42	4.19
Fe	0.932	0.79	3.66

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