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Applied Orthogonal Experiment Design for the Optimum Extraction Conditions of High Concentration Selenium from Maifanite

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Abstract

In order to improve the concentration of selenium in the maifanite concentrate, the optimum experimental conditions were obtained by orthogonal experimentas follows: size of maifanite was 10 mesh, concentration of maifanite was 15 (expressed as the quality of maifanite divided by that of water), soaking time was 60 min at room temperature, heating temperature was 70°C, heating time was 20 min, pH value was 6. Under this condition, the concentrations of each element (ppm)determined by ICP-AES were: Fe 0.099, Cu 0.035, Mn 0.051, Zn 0.019, Se 0.028, Al 0.000.a ven in this document.

Keywords

Selenium, Maifanite, ICP-AES, Style, Styling

1. Introduction

Metal dyshomeostasis was one of pathological characterizations of Alzheimer's disease (AD) [1] [2] [3] [4]. Maifanite, a mineral medicine and was used in many fields for a long time in East Asia countries such as China and Japan [5] [6]. It might be the ideal metal homeostasis reagent. In our previous study, we found that maifanite could balance the dyshomeostasis of trace elements in A β-induced AD rats, and the trace element Se was very important, and its level in high dose maifanite group was higher than that in normal control group [7]. There has been heightened interest in the role of the trace element Se in health and neurologic disorders including AD [1].

Many mineral elements were produced after the primary maifanite mineral was immersed into water [6]. The major elements in the aqueous extract of mai-

fanite were K, Na, Ca, Mg, Sr, Zn, Cu, Fe, Mn and Se etc. [4] [5] [6]. In order to improve the concentration of selenium in the maifanite concentrate, we designed the orthogonal experiments from six factors: size of maifanite, concentration of maifanite, soaking time at room temperature, heating temperature, heating time and pH value. The optimum dissolution conditions of maifanite were studied by using Se content as the index of dissolution performance.

2. Experiment

The maifanite was purchased from the Guifeng Maifanite Company in Guangxi Guiping City, China. Deionized water (18 MΩ cm, Milli-Q gradient system, Millipore) was used throughout the experiments.

By the inductively coupled plasma-atomic emission spectroscopy (ICP-AES; IRIS Intrepid II XSP, USA Thermo Elemental), the elements Fe, Cu, Zn, Mn, Se, and Al were analyzed in the optimum dissolution conditions of maifanite. The measurement conditions were 1200 W from the radio-frequency generator, a plasma argon flow rate of 15 L/min, a cooling gas flow of 14 L/min, a carrier gas flow of 1.0 L/min, a 20-μm entrance slit, a 30-μm exit slit, a height of observation of 15mm, and an integration time lapse of 5s.

Software of orthogonal designing assistant II V3.1 was used for the evaluation of the statistical experimental design. A five-level and six-factor orthogonal experiment (Table 1) was designed according to the L25-5-6 table as follow.

3. Results

According to the orthogonal experiment design (L25-5-6 table), twenty-five experiments should be accomplished. As shown in Table 2, the results of Se content were determined by ICP-AES in water extract of maifanite. Regarded Se content as the index of dissolution performance, the optimum dissolution conditions of maifanite were obtained as follow: size of maifanite was 10 mesh, concentration of maifanite was 15 (expressed as the quality of maifanite divided by that of water), soaking time was 60 min at room temperature, heating temperature was 70˚C, heating time was 20 min, pH value was 6. Under this condition, the concentrations of each element (ppm) determined by ICP-AES were: Fe

Table 1. Afive-level and six-factor orthogonal experiment was designed according to the L25-5-6 table by orthogonal designing assistant II V3.1.

No.	1	2	3	4	5	6
Factor name	Size/mesh	Concentration[1]	soaking time/min[2]	heating temperature/˚C	heating time/min	pH value
level 1	10	1	10	50	20	5.00
level 2	50	5	30	60	40	6.00
level 3	100	10	60	70	60	7.00
level 4	150	15	90	80	80	8.00
level 5	200	25	120	90	120	9.00

[1]expressed as the quality of maifanite divided by that of water. [2]soaking time at room temperature.

Table 2. The results of Se content were determined by ICP-AES in water extract of maifanite.

column	1	2	3	4	5	6	
Factor name	Size/mesh	Concentration[1]	soaking time/min[2]	heating temperature/°C	heating time/min	pH value	Results/ppm
experiment 1	1	1	1	1	1	1	0.035
experiment 2	1	2	2	2	2	2	0.022
experiment 3	1	3	3	3	3	3	0.038
experiment 4	1	4	4	4	4	4	0.036
experiment 5	1	5	5	5	5	5	0.014
experiment 6	2	1	2	3	4	5	0.031
experiment 7	2	2	3	4	5	1	0.023
experiment 8	2	3	4	5	1	2	0.026
experiment 9	2	4	5	1	2	3	0.027
experiment 10	2	5	1	2	3	4	0.025
experiment 11	3	1	3	5	2	4	0.022
experiment 12	3	2	4	1	3	5	0.019
experiment 13	3	3	5	2	4	1	0.021
experiment 14	3	4	1	3	5	2	0.019
experiment 15	3	5	2	4	1	3	0.015
experiment 16	4	1	4	2	5	3	0.027
experiment 17	4	2	5	3	1	4	0.024
experiment 18	4	3	1	4	2	5	0.022
experiment 19	4	4	2	5	3	1	0.029
experiment 20	4	5	3	1	4	3	0.027
experiment 21	5	1	5	4	3	2	0.023
experiment 22	5	2	1	5	4	3	0.026
experiment 23	5	3	2	1	5	4	0.017
experiment 24	5	4	3	2	1	5	0.038
experiment 25	5	5	4	3	2	1	0.029
mean value 1	0.029	0.028	0.025	0.025	0.028	0.027	
mean value 2	0.026	0.023	0.023	0.027	0.024	0.018	
mean value 3	0.019	0.025	0.030	0.028	0.027	0.032	
mean value 4	0.026	0.030	0.027	0.024	0.027	0.025	
mean value 5	0.027	0.022	0.022	0.023	0.020	0.025	
range	0.010	0.008	0.008	0.005	0.008	0.014	

[1]expressed as the quality of maifanite divided by that of water. [2]soaking time at room temperature.

0.099, Cu 0.035, Mn 0.051, Zn 0.019, Se 0.028, Al 0.000.

4. Conclusion

According to the orthogonal experiment design, regarded Se content as the index of dissolution performance, the optimum dissolution conditions of maifanite were obtained as follows: size of maifanite was 10 mesh, concentration of maifanite was 15 (expressed as the quality of maifanite divided by that of water), soaking time was 60 min at room temperature, heating temperature was 70°C,

heating time was 20 min, pH value was 6. Under this condition, the concentrations of each element (ppm) determined by ICP-AES were: Fe 0.099, Cu 0.035, Mn 0.051, Zn 0.019, Se 0.028, Al 0.000 ure/K".

Acknowledgements

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