Detection of ions in human urine

Introduction:

The ion content in human urine can reflect the metabolic level of the body and potential disease risks. For example, urinary tract stones are a common and frequently occurring disease in daily life, with calcium oxalate, calcium phosphate stones, and magnesium ammonium phosphate stones accounting for more than 95%. An increase in the concentration of crystals in urine, such as oxalates and phosphates, can lead to the precipitation of crystalline substances and the formation of stones; The pH value of urine can affect the degree of crystal solution, and alkaline urine is conducive to the formation of calcium phosphate, magnesium ammonium phosphate, and calcium oxalate stones; Citric acid and its salts are important inhibitory factors for urinary tract stones. Therefore, monitoring the concentrations of oxalic acid, phosphate, and citric acid in urine is crucial for studying and diagnosing urinary tract stones.

Detection items (Table 1):

Anion	SO_4^{2-}	$C_2O_4^{2-}$	PO_4^{3-}	Citric acid	-
Cation	Na^+	NH_4^+	K^+	Mg^{2+}	Ca^{2+}

Keywords: Ions， Ion chromatography, Urine.

Instruments and equipment

- **Ion chromatograph**: CIC-D260
- **Ultra pure water machine**:ECO-S15

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Requirements

Reagents

Unless otherwise specified, all reagents used are superior grade. Commercially available certified standard solutions for sulfate ions, phosphate ions, sodium ions, ammonium ions, potassium ions, magnesium ions, and calcium ions (1000 mg/L); Laboratory self prepared oxalate and citrate standard solutions (1000 mg/L).

Deionized Water

When preparing standard samples manually or diluting real samples, please use ASTM filtration and deionization requirements that meet the specifications listed in the table 2.

Table 2: Deionized water specification.

Specification	
Ions Resistivity	≥18.25MΩ·cm
Organics-TOC	<10ppb
Iron/Transition Metals	<1ppb
Pyrogens	<0.03Eu/mL
Particulates（>0.2μm）	<1unit/mL
Colloids-Silica	<10ppb
Bacteria	<1cfu/mL

Chromatography conditions(Anions)

Table 3: Analysis conditions

Instrument	CIC-D260
Eluent	0-20 min，10 mM KOH 20-45 min，10-35 mM KOH 45.1-55 min，10 mM KOH
Flow rate	0.7 mL/min
Injection volume	25 μL
Analytical Column	SH-AP-1
Column oven temperature	35℃
Conductivity cell temperature	35℃
Suppressor current	100 mA

Sample preparation

Take 1 mL of the sample into a 100 mL volumetric flask, add 1 mL of hydrochloric acid to fully dissolve it, and add ultrapure water to a constant volume and shake well.

Anions: Passing through two Ag columns, one C18 column, Sample injection analysis after pass through 0.22 μm membrane filtration.

Standard chromatogram (Anions)

Standard chromatogram, As shown in below:

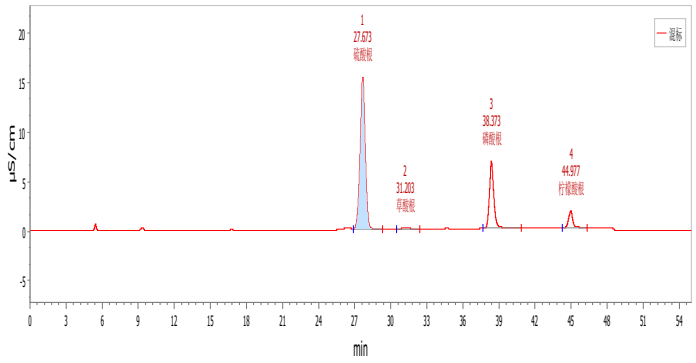


Figure 1. Chromatogram of standard sample.

Table 4: Concentration of anions standard

No.	Anions	Concentration mg/L
1	SO_4^{2-}	20
2	Oxalate	0.5
3	PO_4^{3-}	20
4	Citric acid	6

Sample chromatogram (Anions)

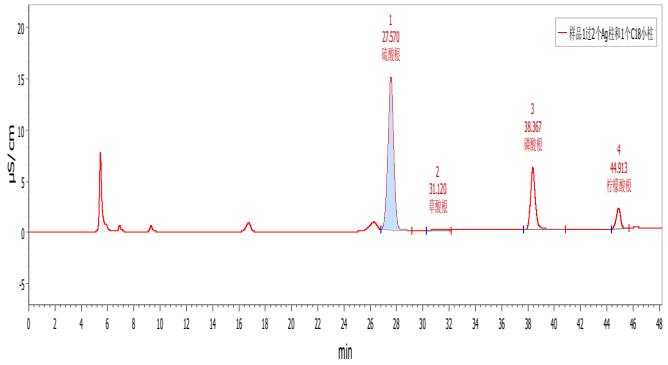


Figure 2. Chromatogram of sample(Anions)

Chromatography conditions(Cations)

Table 3: Analysis conditions

Instrument	CIC-D260
Eluent	5 mM MSA
Flow rate	1.0 mL/min
Injection volume	25 μL
Analytical Column	SH-CC-3L
Column oven temperature	35℃

Conductivity cell temperature	35℃
Suppressor current	15 mA

Sample preparation

Take 1 mL of the sample into a 100 mL volumetric flask, add 1 mL of hydrochloric acid to fully dissolve it, and add ultrapure water to a constant volume and shake well. Anions: Passing through two Ag columns, one C18 column, Dilute 10 times again and pass 0.22 μm filter membrane injection analysis.

Standard chromatogram (Cations)

Standard chromatogram, As shown in below:

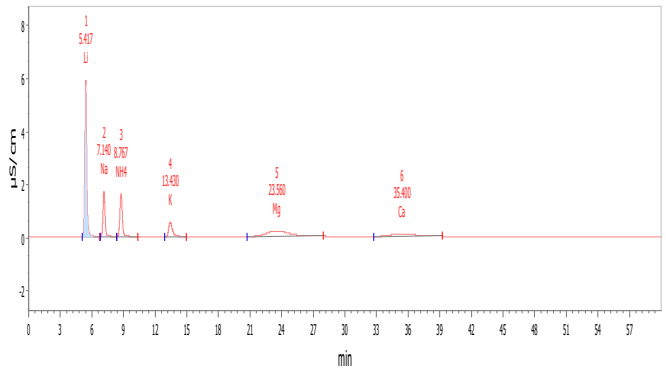
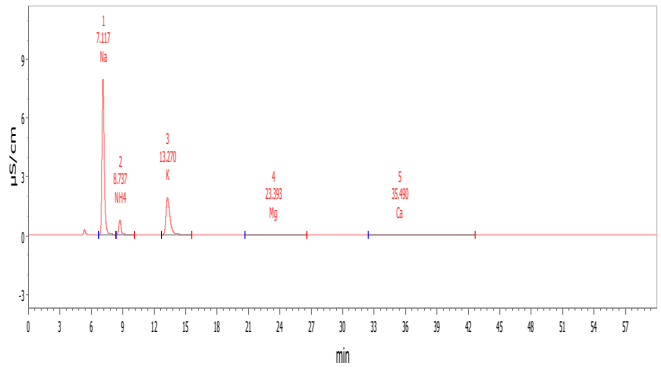


Figure 1. Chromatogram of standard sample.

Table 4: Concentration of cations standard

No.	Anions	Concentration mg/L
1	Na^+	1
2	NH_4^+	1
3	K^+	1
4	Mg^{2+}	1
5	Ca^{2+}	1

Sample chromatogram (Cations)



Results and calculations

Table 7: Sample test result (mg/L)

Anion	SO_4^{2-}	$C_2O_4^{2-}$	PO_4^{3-}	Citric acid	-
	5197.18	441.21	3764.19	56.01	-
Cation	Na^+	NH_4^+	K^+	Mg^{2+}	Ca^{2+}
	200.15	5197.18	441.21	3764.19	56.01

Remarks: ① The measured value has been deducted from the blank value; ② There may be differences in testing results between different methods and laboratories;

Feasibility analysis and conclusion

The above experiments prove that the detection method has good resolution and is suitable for the determination of the content of the components to be measured in the sample.