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**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

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**Determination of the contents of calcium, copper, iron,  
magnesium, manganese, potassium, sodium and zinc in feeds  
-- Method using atomic absorption spectrometry**

饲料中钙、铜、铁、镁、锰、钾、钠和锌含量的测定 原子吸收光谱法

**(English Translation)**

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### 1 Scope

This document specifies the method that uses atomic absorption spectrometry to determine the contents of calcium (Ca), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), potassium (K), sodium (Na) and zinc (Zn) in feeds.

This Standard is applicable to the determination of the contents of calcium (Ca), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), potassium (K), sodium (Na) and zinc (Zn) in compound feeds, concentrate feeds, concentrate supplements, additive premixes and feed ingredients.

The detection limit of each element content of this method is:

K, Na: 500mg/kg;

Ca, Mg: 50mg/kg;

Cu, Fe, Mn, Zn: 5mg/kg.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 6682, Water for analytical laboratory use - Specification and test methods (GB/T

6682-2008, ISO 3696:1987, MOD)

GB/T 14699.1, Feeding stuffs - Sampling (GB/T 14699.1-2005, ISO 6497:2002, IDT)

GB/T 20195, Animal feeding stuffs - Preparation of test samples (GB/T 20195-2006, ISO 6498:1998, IDT) constant. The contents of Cu, Fe, Mn and Zn in this Standard solution are all 20µg/mL.

The standard solution shall be prepared on the day of use.

4.9 Standard stock solutions of Ca, K, Mg, Na: Weigh the following reagents into a 1L volumetric flask:

- 1.907g of potassium chloride (KCl);
- 2.028g of magnesium sulfate (MgSO<sub>4</sub>·7H<sub>2</sub>O);
- 2.542g of sodium chloride (NaCl).

Weigh 2.497g of calcium carbonate (CaCO<sub>3</sub>) into the beaker. Add 50mL of hydrochloric acid solution (4.3).

CAUTION: Be careful of the carbon dioxide produced.

Heat on a heating plate for 5min. After cooling, transfer the solution to a volumetric flask containing K, Mg, Na salts. Use hydrochloric acid solution (4.4) to set the volume constant. The contents of Ca, K and Na in this stock solution are all 1mg/mL. The content of Mg is 200µg/mL.

**NOTE:** Commercially available standard solutions can be used.

4.10 Standard solutions of Ca, K, Mg, Na: Accurately pipette 25.0mL of stock solution (4.9) into a 250mL volumetric flask. Use hydrochloric acid solution (4.4) to set the volume constant. The contents of Ca, K and Na in this standard solution are all

100µg/mL. The content of Mg is 20µg/mL. The prepared standard solutions are stored in polyethylene bottles. They can be used within 1 week.

#### **4.11 Lanthanum/cesium blank solution: Take 5mL of lanthanum nitrate solution, 5mL**

of cesium chloride solution and 5mL of hydrochloric acid solution (4.3) into a 100mL volumetric flask. Use water to set the volume constant.

## 5 Instruments and equipment

All containers, including pipettes for preparing standard solutions, are rinsed with hydrochloric acid solution (4.4) before use. If special ashing crucibles and glassware are used, there is no need to boil them with hydrochloric acid solution before each use.

Common laboratory equipment and special equipment are as follows.

### 5.1

#### **Analytical balance**

The resolution is 0.1mg.

### **5.2 Crucible: platinum, quartz or porcelain; free of potassium and sodium; the inner**

layer is smooth and not corroded; the upper diameter is 4cm~6cm; the lower diameter is 2cm~2.5cm; the height is about 5cm; boil with hydrochloric acid solution (4.3) before use.

### **5.3 Rigid glassware. Boil with hydrochloric acid solution (4.3) before use. Rinse off**

with water.

### 5.4 Heating plate.

5.5 High temperature resistance furnace: the temperature can be controlled at 550°C±15°C.

### **5.6 Atomic absorption spectrophotometer: the wavelength range complies with the**

provisions of 8.6.1 and 8.7.1. It is with air-acetylene flame and background correction.

5.7 Ca, Cu, Fe, K, Mg, Mn, Na, Zn hollow cathode lamps or electrodeless discharge lamps.

5.8 Quantitative filter paper.

## 6 Sampling

This Standard does not specify the sampling method. It is recommended to sample according to the method in GB/T 14699.1.

It is very important for the laboratory to obtain representative samples. Samples must not be damaged or deteriorated during transportation and storage. The preserved samples shall be protected from deterioration and other changes.

## 7 Preparation of specimens

Prepare specimens according to GB/T 20195. The crushed particle size of the specimen shall pass through a 0.45mm analytical sieve.

### 8.1 Check for organic matter

Take some of the test material with a flat spoon. Heat it over a flame. If the test material melts without smoke, there is no organic matter present. If the color of the test material changes and does not melt, the test material contains organic matter.

### 8.2 Test material

Weigh 1g~5g of test material according to the estimated content, accurate to 1mg. Put it in the crucible. For test material containing organic matter, start from 8.3. For test material not containing organic matter, start directly from 8.4.

solution (4.4) and the absorbance of the standard solution. Subtract the absorbance of the hydrochloric acid solution (4.4) from the absorbance of the standard solution. The calibration curve is plotted against the contents of Cu, Fe, Mn and Zn with the corrected absorbance values.

**NOTE 1:** Most atomic absorption spectrophotometers have the function of automatically drawing curves.

**NOTE 2:** Non-linearly drawn curves are not required. If the curve presents a high-order function shape, the method of drawing the curve nonlinearly can improve the accuracy of the measured data.

### 8.6.3 Determination of test material solution

Under the same conditions, measure the absorbance of the test material solution (8.4) and blank solution (8.5). The absorbance of the test material solution minus the absorbance of the blank solution. Calculate the concentration of elements in the test material solution from the standard curve. Calculate the content according to Chapter

9. If necessary, dilute the sample solution and blank solution with hydrochloric acid solution (4.4). Make its absorbance within the linear range of the standard curve.

**NOTE 1:** Most atomic absorption spectrophotometers have the function of automatically calculating the concentration of elements in the test material solution.

**NOTE 2:** Background correction is not required. If there is a background value, the use of background correction can improve the accuracy of the measured data.