NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB 31604.21-2025

Replacing GB 31604.21-2016

National food safety standard - Food contact materials and products - Determination of migration of benzoic acid

食品安全国家标准 食品接触材料及制品 苯甲酸、苯二甲酸和苯三甲酸迁移量的测定

Issued on: September 2, 2025 **Implemented on: March 2, 2026**

Issued by: the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, National Health Commission of the People's Republic of China

Table of Contents

1 Scope

GB 31604.21 is the Chinese national food safety method for the migration of benzoic acid, phthalic acids and trimellitic acids from food contact materials and articles. These are the acid building blocks of the polyesters and the plasticisers used in packaging, and what migrates into the food is normally not the ester but the free acid formed when it hydrolyses. The method is therefore the one that catches the degradation product rather than the parent substance. The document describes the determination by high performance liquid chromatography, and covers the principle, the reagents and materials, the apparatus, the food simulants and the migration test conditions, the analytical procedure, the calculation of results, the precision and the limit of quantification. It is part of the GB 31604 series supporting the GB 4806 framework. The 2025 edition, effective 2 March 2026, replaces GB 31604.21-2016.

This Standard specifies the liquid chromatography method for the determination of migration amount of benzoic acid, 1,2-benzenedicarboxylic acid (also known as phthalic acid), 1,3-benzenedicarboxylic acid (also known as isophthalic acid), 1,4-benzenedicarboxylic acid (also known as terephthalic acid), 1,3,5-benzenetricarboxylic acid (also known as trimesic acid), 1,2,4-benzenetricarboxylic acid (also known as trimellitic

acid), and 1,2,3-benzenetricarboxylic acid (also known as hemimellitic acid) in food contact materials and articles. This Standard applies to the determination of migration amount of benzoic acid, phthalic acid, isophthalic acid, terephthalic acid, trimesic acid, trimellitic acid, and hemimellitic acid in food contact plastic materials and articles, food contact paper and paperboard materials and articles, adhesives for food contact materials and articles, and paintings and coatings for food contact.

2 Principle

After migration tests on food contact materials and articles according to GB 31604.1 and

GB 5009.156, the target analytes in olive oil and isooctane soaking solutions are extracted with 50 % (volume fraction) ethanol solution or acetonitrile solution (5+1); the ethanol volume fraction is diluted by 95 % (volume fraction) ethanol soaking solution to below 50 %; other soaking solutions are directly injected for determination. The target analytes are separated by liquid chromatography, determined by ultraviolet detector or diode array detector, and quantified using the external standard method.

3 Reagents and materials

Unless otherwise specified, all reagents used in this method are of analytical grade, and the water is grade 1 water as specified in GB/T 6682.

3.1 Reagents

3.1.1 Glacial acetic acid (C2H4O2). to the mark with water, and mix well. The mass concentrations of trimesic acid in the obtained standard series working solutions are

0.031 mg/L,

0.10 mg/L,

0.25 mg/L,

0.50 mg/L,

0.75 mg/L, and

1.0 mg/L, respectively. The mass concentrations of the other 6 types of target analytes are

0.375 mg/L,

9.0 mg/L, and 12 mg/L, respectively. Prepare fresh before use. When the mass concentrations of benzoic acid and phthalic acid in the sample solution exceed the above linear range, accurately transfer

6.0 mL of the mixed standard intermediate solution C into six 10 mL volumetric flasks, respectively, dilute to the mark with water, and mix well. The mass concentrations of the 7

types of target analytes in the obtained standard series working solutions are 10 mg/L, 20 mg/L, 30 mg/L, 40 mg/L, 50 mg/L, and 60 mg/L, respectively. Prepare fresh before use.

3.4.5.2 Mixed standard working solution series E (applicable to quantitative analysis of target analytes in other food simulants and chemical substitute solvents) Accurately transfer

0.10 mL,

0.125 mL,

0.40 mL,

4 Instruments and equipment

4.1 Liquid chromatograph. Equipped with a UV detector or diode array detector.

4.2 Water bath shaker.

4.3 Vortex shaker.

4.4 Balance. Sensitivities of

0.01 g and

0.1 mg, respectively.

4.5 Centrifuge. Speed >= 3000 r/min.

4.6 Pipettes. Capacities of 100 µL, 1 mL, and 5 mL, respectively.

4.7 Rotary evaporator or nitrogen evaporator.

5 Analytical procedure

5.1 Migration test Food contact materials and articles shall undergo migration test in accordance with the requirements of GB 31604.1 and GB 5009.156.If the soaking solution obtained from the migration test cannot be tested immediately, it can be stored at 0 °C ~ 4 °C protected from light for no more than 3 days. If further test is to be performed, the soaking solution shall be brought back to room temperature before use.

5.2.1 Treatment of olive oil soaking solution

5.2.1.1 Benzenedicarboxylic acid and benzenetricarboxylic acid test solution. Accurately weigh

5.0 g (to the nearest

0.01

g) of the olive oil soaking solution obtained from the migration test into a 25 mL stoppered

glass centrifuge tube, add

5.00 mL of n- heptane and

4.00 mL of 50 % (volume fraction) ethanol solution sequentially, vortex at 1500 r/min for 15 min, centrifuge at 3000 r/min for 10 min, and collect the ethanol solution on the lower layer and filter through a filter membrane, for later test.

5.2.1.2 Benzoic acid test solution. Accurately weigh

10.0 g (to the nearest

0.01

g) of the olive oil soaking solution obtained from the migration test into a 25 mL stoppered glass centrifuge tube, add

4.00 mL of acetonitrile solution (5+1), vortex at 1500 r/min for 15 min, centrifuge at 3000 r/min for 10 min, take approximately 2 mL of the supernatant and filter through a filter membrane, accurately transfer

1.00 mL of the filtrate and add

1.00 mL of water, and mix well, for later test.

5.2.2 Treatment of isooctane soaking solution

5.2.2.1 Benzenedicarboxylic acid and benzenetricarboxylic acid test solution. Accurately transfer

5.00 mL of the isooctane soaking solution obtained from the migration test into a 25 mL stoppered glass centrifuge tube, add

4.00 mL of 50 % (volume fraction) ethanol solution, vortex at 1500 r/min for 15 min, centrifuge at 3000 r/min for 10 min, and collect the ethanol solution on the lower layer and filter through a filter membrane, for later test.

5.2.2.2 Benzoic acid test solution. Accurately transfer

10.0 mL of the isooctane soaking solution obtained from the migration test to a 25 mL stoppered glass centrifuge tube, add

4.00 mL of acetonitrile solution (5+1), vortex at 1500 r/min for 15 min, centrifuge at 3000 r/min for 10 min, take approximately 2 mL of the lower layer solution and filter

5.4.6 UV detector or diode detector. For trimesic acid, trimellitic acid, hemimellitic acid, phthalic acid, and isophthalic acid, the detection wavelength is 214 nm; for benzoic acid and terephthalic acid, the detection wavelength is 230 nm. The acquisition time for each detection wavelength is determined based on the retention time of each target analyte.