

Food safety

Determination of benzoate in soy sauce using a compact IC system

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Introduction

Sodium benzoate and potassium benzoate are added to acidic foods as preservatives. The United States Food and Drug Administration regulates sodium benzoate as a food additive that is considered generally regarded as safe (GRAS) with limits to 0.1%.¹ In the European Union (EU), benzoate as benzoic acid (E 210) and benzoic acid salts (sodium (E 211), potassium (E 212), and calcium (E 213)) are similarly regulated by the EU Commission Regulation 1129/2011 with varying maximum limits.² The EU maximum limit (ML) for sauces is 1,000 mg/kg total benzoic acid and benzoic acid salts, expressed as benzoic acid. For fruit juices and flavored drinks, the EU ML are 200 mg/kg and 150 mg/kg total benzoic acid and benzoic acid salts (expressed as benzoic acid), respectively. To meet these regulatory limits and to maintain product quality, an accurate and precise analytical method is needed. Ion chromatography with suppressed conductivity detection was previously demonstrated in Thermo Scientific Application Note 165: Determination of benzoate in liquid food products³ to be accurate and sensitive. In this application proof note, the application is demonstrated on the same column, a Thermo Scientific™ Dionex™ IonPac™ AS18 (4 × 250 mm) anion-exchange column, using eluent generation and a suppressor upgraded to current technology. The application is facilitated by the Thermo Scientific™ Dionex™ Inuvion™ ion chromatography system.

Method

Reagents and standards

- DI water, ASTM Type I
- Sodium benzoate, 99% (CAS 532-32-1), Fisher Chemical
P/N AC447800010

Instrument method parameters

Instrument	Dionex Inuvion IC system, including column heater, pump degas module, and eluent generation (P/N 22185-60108)
Autosampler	Thermo Scientific™ Dionex™ AS-DV autosampler (P/N 068907) with 5 mL Thermo Scientific™ Dionex™ PolyVials™ and filter caps (P/N 038141)
Columns	Dionex IonPac AS18, 4 mm i.d. column set (P/N 060549, 060551)
Eluent gradient	35 mM KOH from -3 to 5 min, 35–50 mM KOH from 5 to 7 min, 50 mM KOH from 7 to 20 min
Eluent source	Thermo Scientific™ Dionex™ EGC 500 KOH cartridge (P/N 075778), Thermo Scientific™ Dionex™ CR-ATC 600 continuously regenerated anion trap column (P/N 088662), Thermo Scientific™ Dionex™ RFIC™ eluent degasser module (P/N 106-60001)
Flow rate	1.0 mL/min
Inj. volume	25 µL
Column temp.	30 °C
Detection	Suppressed conductivity, Thermo Scientific™ Dionex™ ADRS 600 (4 mm) suppressor (P/N 088666CMD or 088666), 124 mA, constant current, recycle mode
Background conductance	<1 µS/cm
System backpressure	~2,500 psi with 500 psi backpressure coil (100 psi = 0.6894 MPa)
Run time	20 min
Software	Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software version 7.3.2

Results

Several samples were analyzed, including soy sauces, diet cola, lemon juice, and browning sauce. All samples were diluted from 20-fold to 500-fold prior to analysis. To quantify the benzoate in these samples, the response of benzoate to concentration was determined using triplicate injections of 1, 2, 5, 10, and 20 mg/L benzoate. The response was shown to be linear without forcing through zero, with a coefficient of determination of $r^2 = 0.99985$.

Figure 1A shows the chromatogram of 20-fold diluted soy sauce sample. Figure 1B shows a zoomed in view of the same sample. The 20-fold diluted soy sauce sample had 6.89 mg/L (total 0.0134%) of benzoate. The total concentration, 0.0134% (134 mg/kg), is well within the FDA limits of 0.1% and the EU limit of 1,000 mg/kg.

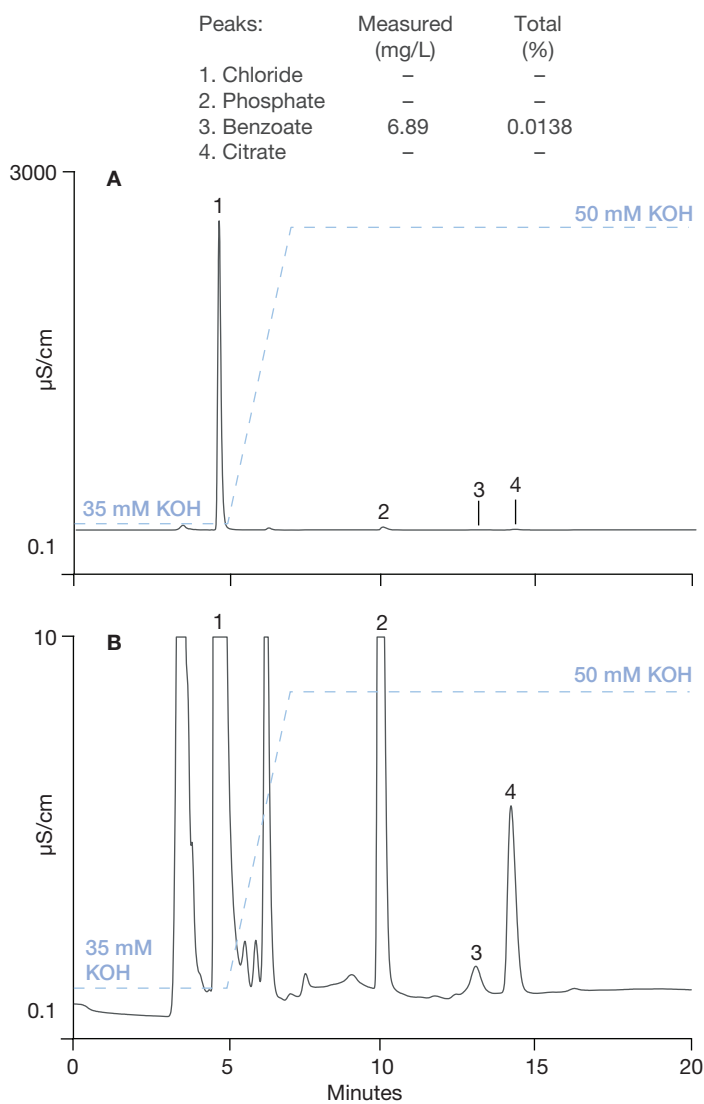


Figure 1. (A) Benzoate in 20-fold diluted soy sauce sample and (B) benzoate in 20-fold diluted soy sauce sample with zoomed in signal scale

References

1. U.S. FDA. [Food Additive Status List](#) | FDA. [accessed May 2023]
2. EFSA, EU Commission Regulation (EU) No 1129/2011 of 11 November 2011 amending Annex II. [Food and Feed Information Portal Database | FIP \(europa.eu\)](#) (accessed May 2023)
3. Thermo Scientific Application Note 165: Determination of benzoate in liquid food products by Reagent-Free™ ion chromatography. 2016 (accessed May 2023)

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