

# ChromaDex®

## Application Note

As published in "The Handbook of Analytical Methods for Dietary Supplements"

### 0046 - Ginger for Phenolic Acids by HPLC

**Botanical Name:** *Zingiber officinale* Roscoe

**Common Names:** Jiang, Sunthi

**Parts of Plant Used:** Roots

**Uses:** Treatment of motion sickness, nausea, and osteoarthritis

#### Modes of Action:

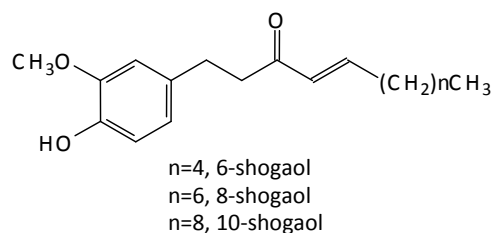
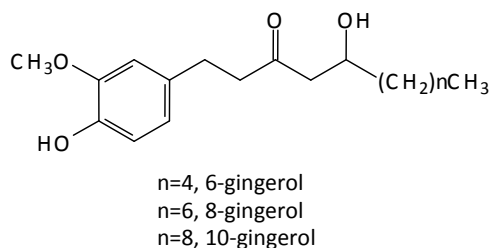
Ginger is one of the most important and popular spices and is used in traditional Chinese, Indian, Indonesian, and Japanese medicine. Several clinical trials have involved ginger; most showed positive effects against motion sickness, nausea, and osteoarthritis. Ginger was found to act directly at the gastric level for an anti-nausea effect, to reduce stimuli in the gastrointestinal tract, and to block the feedback loop between the brain stem and track.<sup>1,2</sup> In mechanism studies, ginger was found to inhibit prostaglandin and leukotriene synthesis and to inhibit cyclo-oxygenase and lipo-oxygenase pathways to produce anti-inflammatory effects.<sup>3-5</sup> Gingerols in ginger are well-known antioxidants and anti-inflammatory agents.<sup>6,7</sup>

#### Chemical Markers:

Ginger rhizomes contains from 4% to 10% oleoresin. The pungent components of ginger are the gingerols with 6-gingerol (a decane substituted with a 4-hydroxy-3-methoxyphenyl group, a carbonyl group, and a hydroxyl at C-1, C-3, and C-5, respectively) as the major pungent compound. Other well-known gingerols include the 3, 4, 7, 8, 10, or 12-gingerol with a 7, 8, 11, 12, 14, or 16 carbon chain length, respectively; demethoxygingerols; 4-methylated gingerols; shogaols (6, 8, or 10-shogaol); 3,5-dihydroxy and diacetoxy derivatives of gingerols; and gingerdiones.

Two other types of unique phenolic compounds found in ginger are diarylheptanoids and cyclic diarylheptanoids. Ginger diarylheptanoids are heptanes substituted with phenyl groups at the C-1 and C-7 positions, with a similar substitution pattern as the gingerols. Cyclic diarylheptanoids in ginger usually form an additional six-member ring.<sup>6,8,9</sup> The compounds in ginger exist not only in free form but also as glycosides.<sup>10,11</sup> Recently, anthocynins were also found in many kinds of Japanese ginger, with peonidin-3-rutinoside and cyanidin-3-glucoside as the major ones.<sup>12</sup> The volatile ginger oil was characterized by the presence of geranial, neral, 1,8-cineole, zingiberene,  $\beta$ -sesquiphellandrene, ar-curcumene, and  $\beta$ -bisabolene by GC and GC-MS.<sup>13,14</sup> The volatile oil content and the total amount of gingerols are used as quality control standards for ginger powder, oil, and extracts in the U.S. market.





## Methods of Analysis

Various methods (GC–MS, HPLC, LC–MS, TLC) have been used to analyze the chemical components of ginger because ginger is such an important spice and traditional medicine. As gingerols are thermally unstable and may form many artifacts at high temperature during GC and GC–MS analysis, HPLC is the most favorable method for accurate analysis of gingerols in ginger.

Extraction is key for accurate analysis of total gingerols. As fat-soluble compounds, gingerols are easy to extract by pure methanol, acetone, and other organic solvents.

### Method 1:

The method found at [www.nsfina.org](http://www.nsfina.org) was used.

#### Sample Preparation:

For root material, sonicate 0.4 to 0.5 g of ground material with 20 mL of methanol for 12 hours. Cool to room temperature, and bring to 25 mL with methanol.

#### Chromatography:

Column: YMC-Pack Pro C18, 5  $\mu\text{m}$ , 4.6  $\times$  250 mm, 120  $\text{\AA}$ , or equivalent.

Mobile phase: Solvent A = water, solvent B = acetonitrile.

Gradient:

Time (minutes)	%A	%B
0	55	45
8	50	50
15	45	55
40	10	90
45	55	45
55	55	45

Flow rate: 1.0 mL/minute  
Injection volume: 20  $\mu\text{L}$   
Detection wavelength: 282 nm  
Column temperature: 30°C

**Validation Data:**

Not available, but this method is known to be a fully validated method.

**Method 2:**

The method of He et al.<sup>15</sup> was used.

**Sample Preparation:**

Grind 1 g of fresh ginger and extract by refluxing with 20 mL of methanol for 1 hour.  
For ginger oleoresin, dissolve 50 mg in 10 mL of methanol.

**Chromatography:**

Column: Water Symmetry C18, 5  $\mu$ m, 150  $\times$  2.1 mm.  
Mobile phase: Solvent A = water, solvent B = acetonitrile.  
Gradient:

Time (minutes)	%A	%B
0	55	45
8	50	50
17	35	65
32	0	100
38	0	100
40	55	45

Flow rate: 0.2 mL/minute  
Injection volume: 8  $\mu$ L  
Detection wavelength: 282 nm  
Column temperature: 48°C

**Validation Data:**

Not available.

**Method 3:**

The method of Balladin et al.<sup>16</sup> was used.

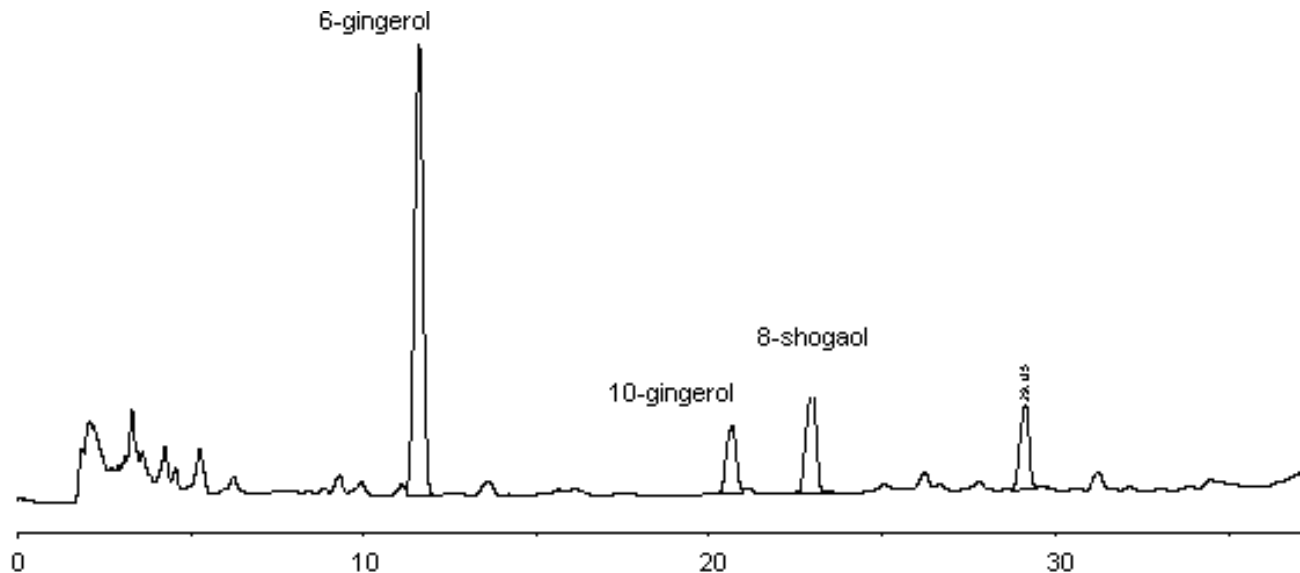
**Chromatography:**

Column: Ultra Sphere ODS C18, 150  $\times$  4.6 mm with a guard column (2.5  $\times$  4.6 mm).  
Mobile phase: Solvent A = water, solvent B = methanol.  
Gradient: Isocratic 70%B.  
Flow rate: 1.2 mL/minute  
Injection volume: 20  $\mu$ L  
Detection wavelength: 282 nm

**Validation Data:**

Not available.

**Representative HPLC Chromagram of a Ginger Extract Run by Method 1 Using a Different HPLC Column (Phenomenex Luna C18 (2), 5  $\mu$ m, 4.6  $\times$  250 mm).**



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