Analysis of Gingerols using HPLC from commercially available food and nutraceutical products

Zeshan Aqeel and J Preston, Ph.D.

Introduction

Gingerol, a bioactive compound found in ginger, has been studied for its potential health benefits, including anti-inflammatory, antioxidant, and anti-cancer properties. In this study, we aimed to quantify the Gingerol content in different food and nutraceutical products using High-Performance Liquid Chromatography (HPLC). Samples of ginger-containing products, including ginger tea, ginger candies, ginger supplements, and fresh ginger root, were extracted and analyzed using an HPLC system equipped with a YMC Triart 3 µm C18 column and a UV detector set at 280 nm. A gradient elution program with a mobile phase consisting of water and acetonitrile with 0.1% formic acid was used for separation.

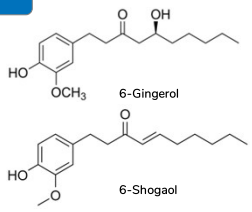
The Gingerol content in each sample was quantified based on the peak area compared to a standard curve were made based on the highest abundant Gingerols and Shogaols present such as 6-Gingerol. Our results showed varying levels of Gingerol in different products, with the highest content found in fresh ginger root and ginger supplements. These findings highlight the importance of analyzing Gingerol content in ginger-containing products to ensure their quality and potential health benefits

HPLC Running Conditions

Column: Triart 3 µm C18
Dimensions: 100 x 4.6 mm
Part No.: TA12S03-1046WT
Mobile Phase: A: 0.1 % Formic Acid in Water
B: 0.1 % Formic Acid in Acetonitrile
Gradient:

Time (min)	% B
0	30
0.5	30
12.5	100
14.5	100
15	30
17	30

Flow Rate: 1.3 mL/min
Injection Volume: 2 µL
Temperature: 25 ° C
LC System: Agilent 1100
Detection: UV @ 282 nm

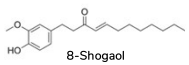


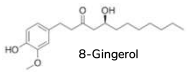
Sample Preparation

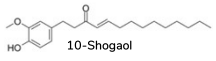
Sample Prep conditions

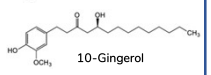
- **Carbonated Sample**
  - Degassed for 15 mins using sonication
  - Filter using 0.45 µm Nylon syringe filter
- **Tea Sample**
  - Steep tea bag for 10 minutes in 8 oz of boiling water
  - Filter using 0.45 µm Nylon syringe filter
- **Ginger Root and Cookie Sample**
  - Weigh out 5 g of crushed sample
  - Add 10 mL of 50:50 Methanol:Water
  - Vortex for 1 minute
  - Sonicate for 5 minutes in glass scintillation vial
  - Filter using 0.45 µm Nylon syringe filter
- **Candy Sample**
  - Weigh out 6 g of candy
  - Dissolve in 10 mL of Methanol using Vortex for 5 minutes
  - Sonicate for 5 minutes in scintillation vial
  - Filter using 0.45 µm PTFE filter

Results

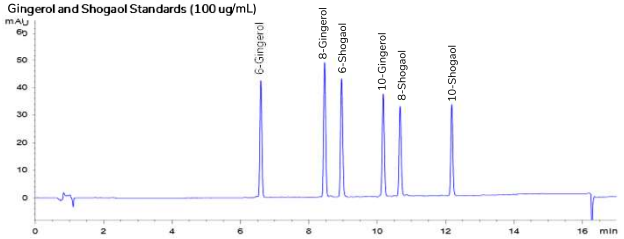

8-Shogaol


8-Gingerol


10-Shogaol


10-Gingerol

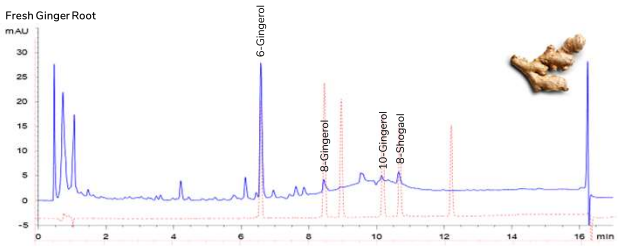
Gingerol and Shogaol Standards (100 ug/mL)



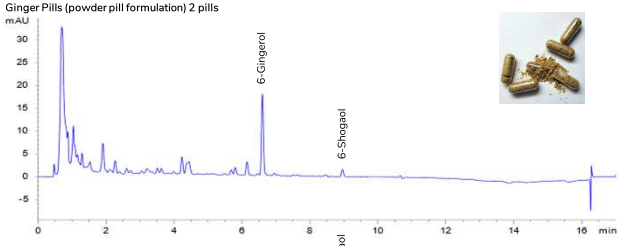
Standards purchased from Med Chem Express®

Results

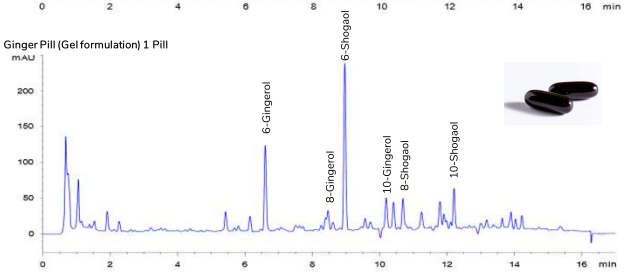
Fresh Ginger Root



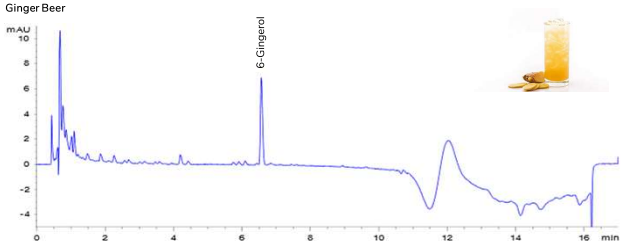
Ginger Pills (powder pill formulation) 2 pills



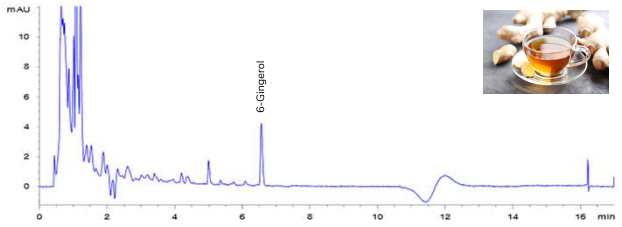
Ginger Pill (Gel formulation) 1 Pill



Ginger Beer

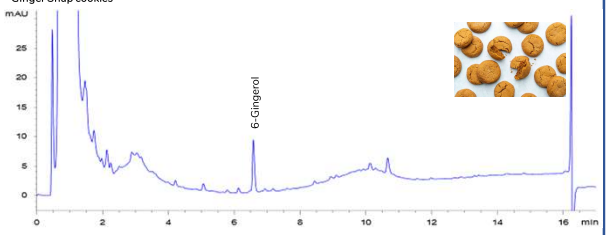


Ginger Tea in 8 oz of hot water

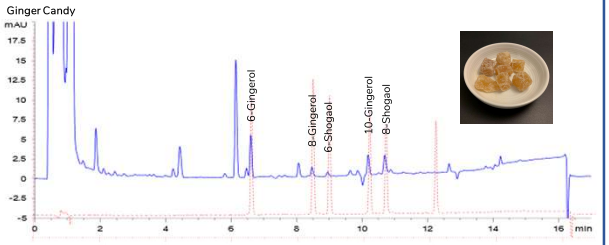


Results

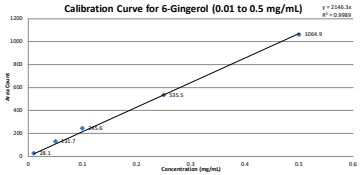
Ginger Snap cookies



Ginger Candy



Calibration Curve and Recovery Table



Sample	6-Gingerol µg/mL	Related back to sample
Fresh Ginger Root	57	0.11 mg/g of root
Ginger Pill (powder formulation) 2 pills	34.6	1.7 µg/pill
Ginger Pill (gel formulation) 1 pill	230	2.3 mg/pill
Ginger Ale Soda	14.1	5 mg/ 355 mL can
Ginger Tea	8.2	1.95 mg/ 237 mL cup of tea
Ginger Snap Cookies	17	34 µg/g cookie (5 g)
Ginger Candy	20.1	201 µg/candy piece (6 g)

Discussion and Conclusions

Gingerols and Shogaols are bioactive compounds in ginger which offer promising health benefits as a supplement. They exhibit strong anti-inflammatory and antioxidant properties which may reduce the risk of chronic diseases. In these experiments, we were able to witness many Gingerols and Shogaols present in different beverages, foods and dietary supplements.

While 6-Gingerol is the pungent principle in fresh ginger, 6-Gingerol can be dehydrated to produce 6-Shogaol under high temperature and acidic conditions commonly done by cooking or processing. In this study, we focused primarily on 6-Gingerol because it was the most prominent compound in all samples. Some products, such as nutraceutical supplements, may have label claims of higher potency than what is in the sample. For example, the powder formulation had ~1.7 µg (per pill) of 6-Gingerol, relative to a gel formulation of ~2.3 mg, a difference by a factor of 1300x. These are important details for a consumer to realize when purchasing supplements which are not regulated by the Food and Drug Administration.

The YMC Triart C18 columns are renowned for their superior selectivity and efficiency in separating Gingerols and Shogaols, particularly in complex food matrices where other columns may struggle. The Triart technology integrates hybrid silica particles with a proprietary bonding process, enhancing both durability and performance. This enables precise identification and quantification of Gingerols, amidst a myriad of co-extracted substances like sugars, lipids, and proteins found in food samples. Researchers benefit from the column's ability to maintain peak resolution and sensitivity over extended analytical runs, ensuring reliable data for nutritional labeling, quality control, and safety assessments in food industry applications.

YMC America
8 Charlestown St.
Devens, MA 01434
ZAqeel@YMCamerica.com