Phenolic Acids

What We Know

› The phenolic acids (i.e., phenolcarboxylic acids) are a category of phenolic phytochemical (i.e., plant metabolites) compounds consisting of carboxylic acids containing a phenolic ring with hydroxyl groups attached in varying numbers and positions. There are many different phenolic acids found in a wide variety of fruits, vegetables, and legumes that exhibit beneficial effects on human health, including protection against cardiovascular disease (CVD), diabetes, and cancer (1,3,5,8,11).

• Most of the known phenolic acid compounds are categorized as either hydroxybenzoic acid (e.g., gallic, p-hydroxybenzoic, protocatechuic, vanillic, and syringic acids) or hydroxycinnamic acid (e.g., ferulic, caffeic, p-coumaric, chlorogenic, and sinapic acids) (5,11).

› Action of Phenolic Acids

• There are many combinations of phytochemicals that contribute to the health-promoting actions of edible plants. Although it is important to understand the unique mechanisms and nutraceutical significance of each compound, researchers agree that the greatest nutritional benefit is achieved when phytochemicals are consumed collectively in whole foods rather than consumed as individual supplements (8).

– Phenolic acids exhibit many cancer-fighting properties, including preventing oxidation and inflammation, promoting detoxification, inhibiting the formation of nitrosamines, and regulating cellular proliferation, differentiation, angiogenesis, and apoptosis (1,5,8).

- Ellagic and rosmarinic acids exhibit anti-inflammatory and anticarcinogenic properties (5,8).

- Ellagic acid is shown to inhibit or prevent the formation and proliferation of cancer cells and tumors in animal models of colon, liver, lung, and skin cancer. It helps the body remove carcinogens and helps prevent overproduction and overactivity of pro-inflammatory enzymes, including cyclooxygenase (3,8).

- Ellagittannins are hydrolyzable tannins made from ellagic esters that might induce apoptosis in cancer cells (2,8).

- Chlorogenic acid, an ester of caffeic acid, and neochlorogenic acid, an isomer of chlorogenic acid, have proven cancer-preventive antioxidant activity as demonstrated by their effective neutralization of the dangerous free radical superoxide anion (7,8,9).

- Gentisic acid inhibits LDL oxidation (5).

- Caffeic acid is believed to inhibit the buildup of LDL cholesterol (8).

- 3-hydroxybenzoic and vanillic acids exhibit anti-sickling activity (5).
- Gallic and rosmarinic acids exhibit potent anti-inflammatory activity\(^{(5)}\)

–Laboratory and animal studies suggest that various phenolic acids may have anti-diabetes effects by increasing insulin secretion and glucose uptake, increasing insulin sensitivity, and inhibiting hepatic gluconeogenesis\(^{(11)}\)

–Other documented health-promoting actions of phenolic acids include stimulation of immune system function, repair of damaged deoxyribonucleic acid (DNA), regulation of hormones, stimulation of enzymatic activity, and activity that is antibacterial and antiviral\(^{(5,2)}\)

- Phenolic acids, including ferulic, caffeic, and vanillic acids, inhibit the adhesion of bacteria (e.g., *Helicobacter pylori*, *Escherichia coli*) to the uroepithelial cells lining the bladder wall. Similar anti-adhesion mechanisms protect against periodontal disease\(^{(5,8)}\)

- Ellagitannins exhibit significant antimicrobial and antifungal activity\(^{(5,6,8)}\)

- 3-hydroxybenzoic acid exhibits antifungal and estrogenic activities\(^{(5)}\)

- Gallic acid acts as an antihistamine, reducing symptoms of allergies\(^{(5)}\)

〉 Sources of Phenolic Acids\(^{(3,5)}\)

• Most edible plants are a food source of phenolic acids, including
  –fruits, especially berries and citrus
  –vegetables, particularly the leaves of vegetables
  –grains
  –legumes
  –seeds
  –herbs
  –coffee
  –tea
  –spices
  –honey

〉 Recommended Intake of Phenolic Acids

• There is no official recommendation for the intake of phenolic acids

〉 Phenolic Acid Nutrient Deficiency

• A recent review of available research found no information on phenolic acid deficiency

〉 Phenolic Acid Toxicity

• A recent review of available research found no information on phenolic acid toxicity

〉 Relevant Laboratory Values

• A recent review of available research found no information on relevant laboratory values related to phenolic acid consumption

〉 Risk of Interaction with Medications/Other Substances

• A recent review of available research found no information on the interaction of phenolic acids with medications or other substances

〉 Additional Findings of Research about Phenolic Acids

• Coffee is a good source of phenolic acids, including ferulic, vanillic, caffeic, and chlorogenic acid, which demonstrate strong antioxidant, antibacterial, and cancer-inhibiting properties. Evidence from numerous studies, including a meta-analysis of 105 studies, indicates that coffee consumption is associated with a reduced risk of multiple cancers, including oral, liver, bladder, breast, pharyngeal, colon, endometrial, esophageal, and skin cancers. Researchers note that this protective effect appears to be related to the phenolic compounds provided by coffee more than the caffeine content\(^{(7,10)}\)

–Researchers report that caffeine and caffeic acid impair the cell-cycle progression and induce apoptosis in breast cancer tumor cells\(^{(9)}\)

–An increase in lung cancer risk has been reported with coffee consumption\(^{(10)}\)

What We Can Do

› Learn about phenolic acids so you can accurately assess your patients’ personal characteristics and health education needs; share this information with your colleagues
Assess your patients’ health and diet history and educate regarding appropriate dietary and lifestyle changes

Educate your patients on eating a balanced diet that includes a variety of fruits, vegetables, whole grains, lean proteins, low-fat dairy, and appropriate dietary fat options

- Emphasize the benefits of consuming a variety of plant-based foods, which are rich in cancer-preventing phenolic acids and other phytochemicals

**Coding Matrix**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Published meta-analysis</td>
</tr>
<tr>
<td>SR</td>
<td>Published systematic or integrative literature review</td>
</tr>
<tr>
<td>R</td>
<td>Published research (randomized controlled trial)</td>
</tr>
<tr>
<td>RCT</td>
<td>Published research (not randomized controlled trial)</td>
</tr>
<tr>
<td>R</td>
<td>Published research (not randomized controlled trial)</td>
</tr>
<tr>
<td>C</td>
<td>Case histories, case studies</td>
</tr>
<tr>
<td>G</td>
<td>Published guidelines</td>
</tr>
<tr>
<td>RV</td>
<td>Published review of the literature</td>
</tr>
<tr>
<td>RU</td>
<td>Published research utilization report</td>
</tr>
<tr>
<td>QI</td>
<td>Published quality improvement report</td>
</tr>
<tr>
<td>L</td>
<td>Legislation</td>
</tr>
<tr>
<td>PGR</td>
<td>Published government report</td>
</tr>
<tr>
<td>PFR</td>
<td>Published funded report</td>
</tr>
<tr>
<td>X</td>
<td>Practice exemplars, stories, opinions</td>
</tr>
<tr>
<td>GI</td>
<td>General or background information/texts/reports</td>
</tr>
<tr>
<td>U</td>
<td>Unpublished research, reviews, poster presentations or other such materials</td>
</tr>
<tr>
<td>CP</td>
<td>Conference proceedings, abstracts, presentation</td>
</tr>
</tbody>
</table>

**References**


