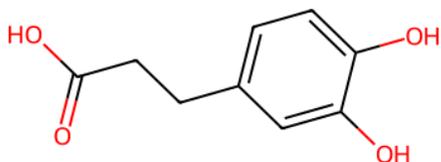


Dihydrocaffeic Acid

Main functional characteristics: Antioxidant, anti-inflammatory, cardiovascular protective

Molecular weight: 182.18 g/mol



Scientific description

Dihydrocaffeic acid (DHCA, 3-(3,4-dihydroxyphenyl)propionic acid) is a major microbial metabolite of caffeic acid and caffeoylquinic acids, generated by hydrogenation of the double bond in the side chain within the colon. It is detectable in plasma and urine after the ingestion of polyphenol-rich foods, making it a relevant bioactive mediator of diet-derived phenolics.

Structurally, DHCA retains the catechol moiety, preserving its high redox activity, while saturation of the side chain confers greater stability against auto-oxidation and prolongs its half-life in biological systems. This enhanced stability supports its role as a significant active metabolite compared with caffeic acid.

Pharmacologically, DHCA activates the Nrf2/ARE pathway, inducing the expression of antioxidant enzymes such as SOD, CAT, and GPx, thereby strengthening cellular resistance to oxidative stress. In parallel, it suppresses NF- κ B activation, downregulating pro-inflammatory mediators including iNOS, COX-2, TNF- α , and IL-6. These dual actions contribute to protection against chronic inflammation and tissue injury.

In preclinical models, DHCA has been shown to attenuate hepatic ischemia/reperfusion injury by reducing oxidative stress and pro-inflammatory cytokines. It also helps preserve intestinal barrier integrity, lowering permeability and endotoxemia.

From a cardiovascular perspective, DHCA reduces lipid peroxidation and protects LDL particles from oxidation, lowering atherogenic risk. Its presence has been associated with improvements in lipid profile and systemic inflammation markers.

In longevity models such as *Caenorhabditis elegans*, DHCA supplementation extended lifespan and improved stress resistance, suggesting a potential role in promoting healthy aging.

Overall, DHCA acts through a dual mechanism: direct antioxidant activity combined with pro-resolutive signaling (via Nrf2) and inhibition of inflammatory cascades (via NF-κB). Its generation by the gut microbiota highlights the importance of host–microbiome interactions in shaping phenolic bioactivity and supports its inclusion as a biomarker and target molecule in standardized botanical extracts.

References

1. Zieniuk B, et al. Dihydrocaffeic Acid—Is It the Less Known but Equally Important Phenolic Acid? *Biomolecules*. 2023;13(5):859. doi:10.3390/biom13050859.
2. Li R, et al. 3,4-Dihydroxyphenylpropionic acid alleviates hepatic ischemia/reperfusion injury. *Acta Pharm Sin B*. 2022;12(1):182-196. doi:10.1016/j.apsb.2021.06.009.
3. Baeza G, et al. Dihydrocaffeic acid shows protective effects against oxidative stress. *Food Chem*. 2016;207:407-414. doi:10.1016/j.foodchem.2016.03.119.
4. Serra A, et al. Metabolic pathways of olive oil phenolics. *J Agric Food Chem*. 2012;60(4):1065-1075. doi:10.1021/jf2040284.
5. Selma MV, et al. Interaction between phenolics and gut microbiota. *J Agric Food Chem*. 2009;57(15):6485-6501. doi:10.1021/jf902107d.
6. Monagas M, et al. Bioactivity of microbial metabolites of dietary flavan-3-ols. *Food Funct*. 2010;1(3):233-253. doi:10.1039/C0FO00132E.
7. Campos-Vega R, et al. Microbial metabolites of flavan-3-ols and their biological activity. *Food Res Int*. 2019;120:221-235. doi:10.1016/j.foodres.2019.02.014.
8. Pasinetti GM, et al. Role of gut microbiota in metabolism and bioavailability of dietary polyphenols. *Mol Nutr Food Res*. 2018;62(1):1700959. doi:10.1002/mnfr.201700959.
9. Havlik J, et al. Dietary fibres impact production of phenolic metabolites including 3,4-dihydroxyphenylpropionic acid. *Nutrients*. 2020;12(6):1577. doi:10.3390/nu12061577.
10. Gutiérrez-Zetina SM, et al. Caffeic and dihydrocaffeic acids promote longevity and stress resistance in *C. elegans*. *Int J Mol Sci*. 2021;22(6):3014. doi:10.3390/ijms22063014.