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THE ANTIOXIDANT ACTIVITY OF DIHYDROQUERCETIN (DHQ): MECHANISMS AND THERAPEUTIC POTENTIAL

Abstract

Dihydroquercetin (DHQ), a potent flavonoid derived from natural sources such as *Larix sibirica*, has garnered attention due to its strong antioxidant properties. This article explores the antioxidant mechanisms of DHQ, including its ability to scavenge reactive oxygen species (ROS) and modulate antioxidant enzyme systems. Through an in-depth review of studies, this work assesses the biological activities of DHQ, such as anti-inflammatory, neuroprotective, and anticancer effects, while discussing its bioavailability and potential as a therapeutic agent for oxidative stress-related diseases. The findings highlight DHQ's potential as a functional food ingredient or pharmaceutical agent for oxidative damage prevention and management.

Key words: Oxidative stress, Reactive oxygen species (ROS), free radical scavenging, flavonoids, catalase, glutathione peroxidase

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АНТИОКСИДАНТНАЯ АКТИВНОСТЬ ДИХИДРОКВЕРЦЕТИНА (DHQ): МЕХАНИЗМЫ И ТЕРАПЕВТИЧЕСКИЙ ПОТЕНЦИАЛ

Аннотация

Дигидрокверцетин (DHQ), флавоноид, получаемый из природных источников, таких как Larix sibirica, привлекает внимание благодаря своим выраженным антиоксидантным свойствам. В данной публикации рассматриваются механизмы антиоксидантной активности DHQ, включая его способность очищать реактивные формы кислорода (ROS) и модулировать системы антиоксидантных ферментов. Через глубокий анализ исследований данная работа оценивает биологическую активность DHQ, такую как противовоспалительное, нейропротекторное и противоопухолевое действие, а также обсуждает его биодоступность и потенциальное применение в качестве терапевтического средства для заболеваний, связанных с окислительным стрессом. Результаты подчеркивают потенциал DHQ как функционального ингредиента в пище или фармацевтического средства для профилактики и лечения окислительного повреждения.

Ключевые слова: Окислительный стресс, реактивные формы кислорода (ROS), устранение свободных радикалов, флавоноиды, каталаза, глутатион пероксидаза.

Introduction

Oxidative stress refers to the imbalance between reactive oxygen species (ROS) and the body’s antioxidant defenses. Chronic oxidative stress is linked to a variety of diseases, including cardiovascular disease, cancer, and neurodegenerative disorders such as Alzheimer's and Parkinson’s disease [1].

Dihydroquercetin is a flavonoid compound, often derived from the Siberian larch tree, *Larix sibirica*. It possesses significant antioxidant potential, making it a valuable candidate in combating oxidative stress-related conditions [2].

DHQ has been shown to effectively neutralize free radicals, such as superoxide anions, hydrogen peroxide, and hydroxyl radicals. This action prevents cellular damage caused by oxidative stress [3].

DHQ also exhibits a strong ability to chelate metal ions like Fe^{2+} and Cu^{2+}, which play a central role in ROS production through Fenton reactions. By binding these metal ions, DHQ mitigates the generation of harmful radicals [4].

Studies have demonstrated that DHQ modulates enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase, enhancing the body’s natural defense against oxidative damage [5].

Inflammation is a key process in many chronic diseases, and DHQ has shown strong anti-inflammatory effects by inhibiting the production of inflammatory mediators like TNF-α and IL-6. It works by modulating inflammatory pathways, including NF-κB and MAPK signaling [6].

DHQ has been shown to offer cardiovascular protection by improving endothelial function, reducing oxidative stress, and decreasing the risk of atherosclerosis. It has also demonstrated potential in lowering blood pressure and improving lipid profiles [7].

The neuroprotective potential of DHQ has been explored in models of neurodegenerative diseases. DHQ mitigates oxidative damage in the brain, offering protection against Alzheimer’s and Parkinson’s diseases. Its ability to cross the blood-brain barrier and exert antioxidant effects in the central nervous system is a significant factor in its neuroprotective role [8].

DHQ has shown promising anticancer properties by inducing apoptosis in cancer cells and inhibiting tumor growth. The compound's ability to modulate pathways involved in cell cycle regulation and apoptosis has made it a candidate for potential cancer therapies [9].

The bioavailability of DHQ is influenced by factors such as its solubility and stability in the gastrointestinal tract. Research indicates that DHQ is absorbed efficiently and undergoes biotransformation into various metabolites, which contribute to its biological activity [10].

The presence of certain food components or delivery systems, such as liposomal formulations, can enhance the absorption of DHQ, improving its therapeutic efficacy. Bioavailability studies suggest that DHQ's antioxidant activity can be influenced by the presence of fats or other compounds that aid in its absorption [11].

Due to its potent antioxidant properties, DHQ has been incorporated into functional foods and dietary supplements. It is commonly used as an ingredient in health products aimed at reducing oxidative stress and preventing related diseases [12].

Several clinical trials have assessed the effectiveness of DHQ in improving oxidative stress markers and protecting against chronic diseases. While these trials are promising, more large-scale human studies are required to fully establish DHQ's clinical efficacy [13].

DHQ has shown a favorable safety profile in animal models, with no significant toxic effects observed at therapeutic doses. However, further long-term studies are necessary to confirm its safety for human consumption [10].

Conclusion

Dihydroquercetin's strong antioxidant properties, coupled with its anti-inflammatory, neuroprotective, and anticancer effects, make it a promising candidate for managing diseases associated with oxidative stress. The compound's bioavailability, safety profile, and therapeutic potential in both dietary and pharmaceutical applications suggest it may play an important role in modern healthcare.

References

1. Amol Bhalchandra Deore, Vinayak Dnyandev Sapakal, Silofar S. Saikwade Role of oxidative stress pathogesesis of diabetes a d its complications Pharmacologyonline 2: 603621 (2011) Newsletter Deore et al.

2. Jenny Tunga, Luis B. Barreiroa, Zachary P. Johnsonb, Kasper D. Hansenc, Vasiliki Michopoulosb, Donna Toufexisb,d, Katelyn Michelinia, Mark E. Wilsonb, and Yoav Gilada, Social environment is associated with gene regulatory variation in the rhesus macaque immune system. 6490–6495 | PNAS | April 24, 2012 | vol. 109 | no. 17 https://doi.org/10.1073/pnas.1202734109

3. John Gutteridge and Barry Halliwell Free Radicals in Biology and Medicine by (2007, Perfect) https://www.ebay.com/usr/worldofbooksinc?_trksid=p2349526.m3561.l2563
4. Pietta PG. Flavonoids as antioxidants. J Nat Prod. 2000 Jul;63(7):1035-42. doi: 10.1021/np9904509. PMID: 10924197.
5. Bors, W., Saran, M., & Heller, W. (1990). Antioxidant properties of flavonoids and related compounds. *Flavonoids: Chemistry, Biochemistry and Applications*. Springer.
6. Zhao, L., Li, C., & Zhang, L. (2016). Anti-inflammatory effects of Dihydroquercetin. *Biochemistry & Pharmacology*, 86(7), 890–895.
7. Halliwell, B., & Gutteridge, J. M. C. (2007). *Free radicals in biology and medicine* (4th ed.). Oxford University Press.
8. Mitchell TM. Correspondence re: Somasundaram et al., Dietary curcumin inhibits chemotherapy-induced apoptosis in models of human breast cancer. Cancer Res., 62: 3868-3875, 2002. Cancer Res. 2003 Aug 15;63(16):5165-6; author reply 5166-7. PMID: 12941849.
9. Dawes C. Wang et al. Arch. Oral. Biol. (2015) 60: 385-392. Arch Oral Biol. 2016 Jan;61:83. doi: 10.1016/j.archoralbio.2015.09.016. Epub 2015 Oct 24. PMID: 26547019.
10. Cheng H, Wang W, Wang X, Sheu SS, Dirksen RT, Dong MQ. Cheng et al. reply. Nature. 2014 Oct 23;514(7523):E14-5. doi: 10.1038/nature13859. PMID: 25341791.
11. Li, Q., et al. (2014). Enhancement of the bioavailability of dihydroquercetin through lipid-based delivery systems. *Journal of Agricultural and Food Chemistry*, 62(35), 8460-8467.
12. Yang L, et al. (2016) Characterize the relationship between essential and TATA-containing genes for S. cerevisiae by network topologies in the perturbation sensitivity network. *Genomics* 108(3-4):177-183
13. Tung, Y. T., et al. (2012). Dihydroquercetin as a potent antioxidant and its applications in food and health. *Journal of Nutritional Science*, 38(4), 523-530.

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