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Hypocholesterolemic Effects of *Spirulina*: A Natural Approach for Cholesterol Management

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ABSTRACT

Spirulina, a blue-green alga, has gained significant attention for its potential hypocholesterolemic properties. This study includes current research on the mechanisms by which *Spirulina* exerts cholesterol-lowering effects, evaluating its bioactive compounds and their roles in lipid metabolism. Numerous animal and human studies indicate that *Spirulina* supplementation leads to a reduction in total cholesterol, low-density lipoprotein (LDL) cholesterol and triglyceride levels, while potentially increasing high-density lipoprotein (HDL) cholesterol. The underlying mechanisms include the inhibition of cholesterol absorption in the intestine, enhancement of cholesterol excretion and modulation of lipid metabolism pathways. *Spirulina's* high content of phycocyanin, gamma-linolenic acid and other bioactive compounds is believed to contribute to these effects by exerting antioxidant and anti-inflammatory actions, thus improving overall cardiovascular health. Despite promising results, further clinical trials with larger sample sizes and longer durations are necessary to establish standardized dosages and fully elucidate the long-term benefits and safety of *Spirulina* as a hypocholesterolemic agent. This review aims to provide a comprehensive overview of Spirulina's potential in managing hypercholesterolemia and its implications for cardiovascular disease prevention.

Keywords: *Spirulina*, Hypocholesterolemic, Cholesterol, Lipid metabolism, Cardiovascular health, Bioactive compounds.

INTRODUCTION

Spirulina, a cyanobacterium often referred to as blue-green algae, has gained recognition for its diverse health benefits and its potential application as nutritional and therapeutic supplement Belay[1]. There are no any adverse effects reported due to *Spirulina* administration[2]. It is listed by the US Food and Drug Administration under the category Generally Recognized as Safe (GRAS)[3]. This chapter aims to explore the scientific basis of *Spirulina*'s ability to lower cholesterol levels, examining its bioactive compounds, mechanisms of action and implications for cardiovascular health. By reviewing animal studies, clinical trials and biochemical analyses, this comprehensive overview will highlight the potential of *Spirulina* as a dietary supplement for managing hypercholesterolemia and particularly its hypocholesterolemic properties.

Composition of *Spirulina*

Spirulina is rich in essential nutrients and bioactive compounds that contribute to its health benefits. Key components include proteins, vitamins, minerals, essential fatty acids and pigments such as phycocyanin and beta-carotene [4]. The high protein content (up to 58% by dry weight) is particularly notable. The presence of gamma-linolenic acid (GLA) is also gaining attention. These components are believed to play a crucial role in *Spirulina*'s hypocholesterolemic effects, providing a basis for its use in dietary interventions aimed at lowering cholesterol levels.

Mechanisms of Cholesterol Reduction

Spirulina's cholesterol-lowering effects are attributed to several mechanisms. Firstly, it inhibits the absorption of cholesterol in the intestines by binding bile acids, which are then excreted. This process forces the body to utilize more cholesterol to produce new bile acids, thus reducing circulating cholesterol levels[5]. Additionally, *Spirulina* enhances the activity of enzymes involved in lipid metabolism, such as lipoprotein lipase, which facilitates the clearance of triglycerides from the bloodstream. Kishibuchi *et al.*[6] observed that the *Spirulina* extract inhibits lipase activity and prevent the postprandial elevation of blood triglyceride (TG) levels as a result of reducing the digestion and absorption of lipids in the intestinal tract. Hypolipidemic activity of *Spirulina* is reported by Ama Moor *et al.* [7] through the activation of lecithine cholesterol acyl transferase (LCAT). There are reports that *Spirulina* feeding increases anitioxidant enzymes[8] . Its antioxidant properties also play a role in preventing oxidative damage to LDL

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cholesterol, reducing the risk of atherosclerosis.

Animal Studies

Numerous animal studies [9-16] have demonstrated the hypocholesterolemic effects of *Spirulina*. For instance, in hyperlipidemic rats, *Spirulina* supplementation significantly reduced total cholesterol, LDL cholesterol and triglyceride levels while increasing HDL cholesterol. These findings are supported by similar studies in rabbits and hamsters, where *Spirulina* not only lowered cholesterol levels but also improved liver function and reduced lipid peroxidation. These preclinical studies provide a foundation for understanding the potential mechanisms and efficacy of *Spirulina* in cholesterol management.

Human Clinical Trials

Human clinical trials further substantiate the hypocholesterolemic properties of *Spirulina*. Several studies have shown that daily supplementation with *Spirulina* can significantly reduce total and LDL cholesterol levels in patients with hypercholesterolemia. Studies demonstrated that *Spirulina* supplementation led to a significant decrease in serum cholesterol and triglycerides over a particular period. Very few studies performed like Ramamoorthy and Premakumari[17], Nakaya *et al.*[18] , Mani *et al.*[19] , Torres-Duran *et al.*[20] reported hypocholsterolemic effects of *Spirulina* in Human models. These trials highlight *Spirulina*'s potential as a complementary therapy for managing hypercholesterolemia and preventing cardiovascular diseases.

Bioactive Compounds and Their Roles

Phycocyanin, a major pigment in *Spirulina*, is particularly noteworthy for its antioxidant and anti-inflammatory properties. Research indicates that phycocyanin can inhibit the activity of enzyme, which is involved in cholesterol synthesis[15, 16]. Additionally, gamma-linolenic acid (GLA) in *Spirulina* contributes to its hypocholesterolemic effects by modulating inflammatory responses and improving lipid profiles[21]. The synergistic effects of these bioactive compounds enhance *Spirulina*'s overall efficacy in lowering cholesterol levels.

Safety and Dosage

The safety profile of *Spirulina* is well-documented, with most studies reporting no significant adverse effects[2]. However, determining an optimal dosage for cholesterol management requires further research. Current studies suggest that daily doses ranging from 1 to 8 grams can effectively lower cholesterol levels without causing harm. Studies shows that commercial *Spirulina* products contained mercury or lead at the levels much lower than the guidelines for daily intake of those elements by the WHO's Food and Agriculture Organization (FAO)[22]. Ensuring the purity of *Spirulina* supplements and avoiding contamination with heavy metals or microcystins is crucial for safety.

In addition to its hypocholesterolemic properties, *Spirulina* offers other health benefits, such as improving immune function, reducing inflammation and providing antioxidant protection. These benefits contribute to overall cardiovascular health and may enhance the therapeutic effects of *Spirulina* in managing hypercholesterolemia. The multifaceted health benefits of *Spirulina* make it a valuable dietary supplement for promoting general well-being.

CONCLUSION

Spirulina presents a promising natural intervention for managing hypercholesterolemia, supported by its rich composition of bioactive compounds and demonstrated efficacy in reducing cholesterol levels. While current evidence is encouraging, further research is essential to establish standardized dosages, long-term benefits and comprehensive safety profiles. Large-scale clinical trials with diverse populations and longer durations are necessary to confirm its efficacy and safety. Additionally, studies exploring the synergistic effects of *Spirulina* with other dietary interventions or medications could provide valuable insights into comprehensive cholesterol management strategies.

As a functional food with multifaceted health benefits, *Spirulina* holds potential for significant contributions to cardiovascular health and overall well-being.

This study provides a detailed examination of *Spirulina*'s hypocholesterolemic properties, from its biochemical mechanisms to its potential as a therapeutic agent, underscoring the importance of continued research in this area.

Conflict of interest

There is no conflict of interest.

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REFERENCES

1. Belay A. The potential application of Spirulina (Arthrospira) as a nutritional and therapeutic supplement in Health management. Journal of the American Nutraceutical Association. 2002; 5:27–48.
2. Chamorro G, Salazar M, Favila L and Bourges H. Pharmacology and toxicology of Spirulina alga. Rev Invest Clin. 1996; 48:389–399.
3. Tarantino LM. Agency Response Letter GRAS Notice No. GRN000127. FDA Home page. 2003.
4. Dubey A. Biochemical composition of Spirulina fusiformis cultivated under outdoor conditions. J. Phytol. Res. 2014; 27(1&2): 79-82.
5. Nagaoka S, Shimizu K, Kaneko H, Shibayama F, Morikawa K, Kanamaru Y and Kato T. A novel protein C-phycocyanin plays a crucial role in the hypocholesterolemic action of Spirulina platensis concentrate in rats. Journal of Nutrition, 2005; 135(10), 2425–2430.
6. Kishibuchi R, Nishibori N, Sagara T and Morita K. Putative Effect of Spirulina Extract on Enzyme Activities Participating in Lipid and Carbohydrate Digestion Processes. J Diet Suppl. 2019; 16(5):521-529.
7. Ama Moor VJ, Nya Biapa PC, Nono Njinkio BL, Moukette Moukette B, Sando Z, Kenfack C and Ngogang J. Hypolipidemic effect and activation of Lecithin Cholesterol Acyl Transferase (LCAT) by aqueous extract of Spirulina platensis during toxicological investigation. BMC Nutrition, 2017; 3(1).

8. Guldas M, Ziyanok-Demirtas S, Sahan Y, Yildiz E and Gurbuz O. Antioxidant and anti-diabetic properties of Spirulina platensis produced in Turkey. Food Science and Technology (Brazil), 2021; 41(3), 615–625.
9. Chen LC, Chen JS and Tung TC. Effects of Spirulina on serum lipoproteins and its hypocholesterolemic activities. Taiwan Yi Xue Hui Za Zhi. 1981; 80(9):934-42.
10. Devi MA and Venkataraman LV. Hypocholesterolemic effect of blue-green algae Spirulina platensis in albino rats. Nutrition Reports Int, 1983; 28(3):519-530.
11. Kato T and Takemoto K. Effects of Spirulina on hypercholesterolemia and fatty liver in rats. Japan Nutr. Foods Assoc. Journal. 1984; 37:323.
12. Kato T, Takemoto K, Katayama H and Kuwabara Y. Effects of Spirulina (Spirulina platensis) on dietary hypercholesterolemia in rats. J. Jap. Soc. Nutr. Food Sci., 1984; 37:323-332.
13. Iwata K, Inayama T and Kato T. Effects of Spirulina platensis on plasma lipoprotein lipase activity in fructose-induced hyperlipidemic rats. J Nutr Sci Vitaminol (Tokyo). 1990; 36(2):165-71.
14. Colla LM, Muccillo-Baisch AL and Costa JAV. Spirulina platensis Effects on the Levels of Total Cholesterol, HDL and Triacylglycerols in Rabbits Fed with a Hypercholesterolemic Diet. Brazilian Arch Biol and Technol.2008; 51:405–411.
15. Sakthivel K and Kathiresan K. Cholesterol Degradation Effect Analyzed using Marine Cyanobacterial Species Spirulina subsalsa. J Microb Biochem Technol 2015; 7: 120-123.
16. Al-Otaibi MIM, Abdellatif HAE, Al-Huwail AKA, Abbas AO, Mehaisen GMK and Moustafa ES. Hypocholesterolemic, Antioxidative and Anti-Inflammatory Effects of Dietary Spirulina platensis Supplementation on Laying Hens Exposed to Cyclic Heat Stress. Animals, 2022; 12(20).
17. Ramamoorthy A and Premakumari S. Effect of Supplementation of Spirulina on hypercholesterolemic Patients. J. Food Sci. Technol. 1996; 33(2) 124-128.
18. Nakaya N, Homa Y and Goto Y. Cholesterol lowering effect of Spirulina. Atherosclerosis. 1998; 37:1329–1337.
19. Mani UV, Desai S and Iyer U. Studies on the long-term effect of Spirulina supplementation on serum lipid profile and glycated proteins in NIDDM patients. Journal of Nutraceuticals, Functional and Medical Foods. 2000; 2(3):25–32.
20. Torres-Duran PV, Ferreira-Hermosillo A and Juarez-Oropeza MA. Antihyperlipemic and antihypertensive effects of Spirulina maxima in an open sample of Mexican population: a preliminary report. Lipids Health Dis. 2007; (33):1–8.
21. Samuels R, Mani UV, Iyer UM and Nayak US. Hypocholesterolemic effect of Spirulina in patients with hyperlipidemic nephrotic syndrome. Journal of Medicinal Food, 2002; 5(2), 91–96.
22. Slotton DG, Goldman CR and Franke A. Commercially grown Spirulina found to contain low levels of mercury and lead. Nutr Rep Int. 1989; 40:1165–1172.

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