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Spirulina: A Potential Complementary Therapy for Pediatric H*elicobacter Pylori*-Induced Iron Deficiency Anemia

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Dear Editor,

The global prevalence of *Helicobacter pylori* infection in children is approximately 32.3% (1). It is a well-established cause of iron deficiency anemia (IDA) (2), affecting up to 53.1% of infected pediatric populations (3). *Helicobacter pylori* is suggested to disrupt gastric acid secretion and compete with the host for iron, potentially through genes encoding major outer membrane proteins (OMPs) — a mechanism proposed to contribute to the pathogenesis of *H. pylori*-associated anemia (2). Although combining *H. pylori* eradication therapy with oral iron supplementation is effective, treatment adherence is often compromised by the gastrointestinal side effects of iron supplements, which can exacerbate infection-related distress (3, 4).

To address this challenge, we hypothesize that *Spirulina* — a nutrient-dense cyanobacterium — could represent a promising dual-action approach for managing *H. pylori*-induced iron deficiency in children. *Spirulina* is a rich source of protein, essential amino acids, carbohydrates, lipids, essential fatty acids, fiber, vitamins (such as β-carotene, vitamin C, D, E, and especially B vitamins), and minerals including calcium, magnesium, manganese, selenium, and zinc, with iron content ranging from 28.5 to 100 mg per 100 g (4, 5). Preclinical studies suggest that it may enhance iron absorption by forming soluble complexes with both heme and non-heme iron via its phycocyanin and polysaccharide components, and it has been proposed to upregulate divalent metal transporter 1 (DMT1) and promote ferritin synthesis in enterocytes (6). Its broad micronutrient profile could further support erythropoiesis and child development (7). *Spirulina* may compensate for iron deficiency or reduce the required dosage of iron supplements, thereby improving treatment tolerability.

Some clinical studies indicate *Spirulina*'s efficacy in improving hematological parameters and alleviating anemia in children, pregnant women, and patients with ulcerative colitis, effects that may be related to its antioxidant, anti-inflammatory, and iron-mobilizing properties (4, 8-11). However, direct evidence in pediatric *H. pylori* infection is lacking. Additionally, preclinical research indicates that *Spirulina*-derived bioactive peptides and polysaccharides exhibit anti-*H. pylori* activity by inhibiting bacterial adhesion and colonization, protecting the gastric mucosa, and modulating oxidative and inflammatory pathways. These compounds interact with key *H. pylori* enzymes, such as alkyl hydroperoxide reductase (AhpC) and urease; suppress reactive oxygen species and NF-κB-mediated proinflammatory cytokines (TNF-α and IL-8); and enhance antioxidant defenses (12-15). Phycocyanin, a purified *Spirulina* protein, has been shown in vitro to suppress *H. pylori*-induced gastric epithelial hyperproliferation by modulating the ROS/MAPK signaling cascade and downregulating c-Myc and cyclin D1, highlighting its potential for further investigation in *H. pylori*-associated gastric disorders and carcinogenesis (16, 17).

Based on this emerging preliminary evidence, we propose the following hypothesis: *Spirulina* may play a dual role in attenuating *H. pylori* infection and enhancing iron metabolism. Its phycocyanin and

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polysaccharides could provide synergistic antioxidant, anti-inflammatory, and iron-boosting effects, potentially alleviating *H. pylori*-associated anemia by reducing bacterial iron competition and restoring host iron balance. We conclude that this safe, nutrient-rich supplement warrants rigorous randomized clinical trials — especially in children with *H. pylori*-induced anemia — to validate the proposed hypothesis and establish optimal dosing and efficacy.

Footnotes

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