

Ameliorative effects of *Spirulina* supplementation on high fat and micronutrient deficiency associated complications in wistar rats

Ajana Pathikkal^{1,3}, Madhubalaji Chegu Krishnamurthi¹, Neenu Ravikumar^{1,3}, Amala Claret Eugene^{1,3},
Bijesh Puthusseri¹, Siva Sankara Reddy Singam², Mathen Mathew² & Vikas Singh Chauhan^{1,3*}

¹Plant Cell Biotechnology (PCBT) Department, ²Food Safety & Analytical Quality Control Laboratory (FSAQCL), CSIR-Central Food Technological Research Institute (CFTRI), Mysuru 570020, India

³Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India

Received 14 August 2024; revised 26 November 2025

Dietary patterns characterised by excessive fat intake combined with inadequate micronutrient consumption are increasingly associated with metabolic disturbances, including obesity, insulin resistance, dyslipidemia, and organ-level dysfunction. Although *Spirulina* is recognised for its nutrient density and metabolic benefits, its efficacy under the compounded stress of a high-fat diet and concurrent micronutrient deficiency has not been systematically evaluated. Addressing this gap is important for developing nutritional strategies relevant to real-world dietary imbalances. This study investigated the ameliorative effects of *Spirulina* (*Arthrospira*) supplementation in Wistar rats fed either a high-fat (HF) diet or a micronutrient-deficient high-fat diet (HFD). Rats were initially maintained on Control (AIN-93G), HF, or HFD diets for 90 days. Thereafter, HF and HFD groups were subdivided to receive either the same diet or the respective diet enriched with 6.5% *Spirulina* biomass for an additional 60 days. HF and HFD feeding resulted in significant body-weight gain, elevated fasting glucose levels, impaired glucose tolerance, dyslipidemia, and marked histopathological alterations in the liver, heart, kidney, and testis. *Spirulina* supplementation moderated body-weight gain, restored fasting glucose and oral glucose tolerance to control levels, and normalised lipid parameters in both HF- and HFD-fed rats. Histological analyses further confirmed substantial recovery of tissue morphology following *Spirulina* intervention. In summary, *Spirulina* supplementation effectively mitigated metabolic and histological impairments induced by combined high-fat intake and micronutrient deficiency. These findings highlight *Spirulina*'s potential as a functional dietary adjunct for managing complex, diet-induced metabolic disorders.

Keywords: Microalgae, Obesity, Glucose homeostasis, Dyslipidemia, Histology