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Therapeutic Fasting and Its Effects on Cognitive Function and Neuroplasticity

Dmytro Stepanenko

PLNTBSD LLC , Owner ,USA

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Abstract: Therapeutic fasting attracts growing interest within neuroscience because metabolic stress modulates neurotrophic signalling. The present study evaluates intermittent fasting combined with vegan nutrient patterns for their cumulative influence on memory, attention and synaptic plasticity. A systematic examination of experimental rodents, controlled human trials and molecular investigations conducted. Brain-derived neurotrophic factor (BDNF), AMP-activated kinase and sirtuin pathways were selected as mechanistic markers. Evidence synthesis indicates that alternate-day energy restriction up-regulates hippocampal BDNF, while polyphenols and omega-3 precursors supplied by plant diets reinforce this response. Clearance of misfolded proteins, attenuation of neuro-inflammation and stabilisation of neuronal membranes surfaced as convergent mechanisms. Comparative evaluation suggests superior cognitive performance when fasting protocols coincide with plant-rich menus compared with either intervention alone. The analysis highlights translational gaps, particularly long-term human data, and formulates directions for personalised nutritional neuromodulation. Potential safety considerations related to hypoglycaemia and micronutrient sufficiency are critically appraised within cohorts. The article will be useful for clinical nutritionists, neuroscientists, geriatric practitioners and policymakers.

Keywords: intermittent fasting, vegan diet, neuroplasticity, brain-derived neurotrophic factor, cognition, autophagy, omega-3 precursors, polyphenols, sirtuin signalling, memory enhancement.

Introduction: Neurodegenerative disorders impose a growing burden because global longevity steadily rises while pharmacological breakthroughs remain scarce. Dietary manipulation delivers a feasible preventive avenue: intermittent energy restriction activates adaptive metabolic cascades, and plant-centred menus supply anti-inflammatory micronutrients. The present investigation targets this dietary interface.

The aim involves assessment of synergistic cognitive outcomes arising when therapeutic fasting converges with vegan nutrient provision. Three analytical tasks structure the work:

1) Pathway interrogation — to map molecular events linking fasting with BDNF, AMP-activated kinase, sirtuin-1 and autophagic machinery.
2) Empirical comparison — to evaluate behavioural and neurophysiological data from animal models and human cohorts that adopt fasting, plant nutrition or their combination.
3) Strategic appraisal — to contrast combined intervention with monotherapies, identifying translational gaps that hamper large-scale clinical adoption.

Novelty rests on integrated consideration of metabolic stress signals and plant-derived neuro-supportive substrates within one analytic framework, a perspective scarcely addressed by earlier single-intervention reviews. By correlating mechanistic biomarkers with performance-based endpoints, the study establishes a foundation for personalised neuromodulatory nutrition.

MATERIALS AND METHODS

V.J. Clemente-Suárez [2] summarised neurological outcomes of vegetarian regimens, delivering baseline data on micronutrient sufficiency. Sh. Miyazaki [6] documented BDNF augmentation after syringaresinol and chlorogenic acid exposure, guiding biomarker selection. M.L. Serradas [7] delineated innate-immune targets in Alzheimer's pathogenesis, informing appraisal of protein-clearance mechanisms. D.O. Kennedy [5] evaluated B-vitamin-dependent one-carbon flux, framing homocysteine-linked cognition. J. Gudden [3] analysed intermittent fasting trials with neurocognitive read-outs, supplying comparative effect sizes. A. Brocchi [1] investigated metabolic imaging during fasting, supporting interpretation of brain energetics. A. Katonova [4] probed vegan diet influence on Alzheimer's trajectories, reinforcing epidemiological sections.

Comparative synthesis juxtaposed effect magnitudes across intervention categories. When homogeneous metrics existed, Hedges g was pooled through random-effects meta-analysis executed in R (metafor package). Narrative integration connected mechanistic findings with behavioural data. Strength-of-evidence grading followed GRADE recommendations.

RESULTS

Nutritional interventions influence brain health through multiple mechanisms. Fasting or caloric restriction has been shown to enhance brain-derived neurotrophic factor (BDNF) signaling, a key mediator of neuroplasticity underlying learning, memory and mood. Similarly, vegan and plant-rich diets provide nutrients that support neural function. Omega-3 fatty acid precursors (from flaxseed, chia), polyphenols (from berries, nuts, greens), and B-vitamins (from whole grains, legumes, vegetables) each play distinct roles in maintaining cognitive performance and neurogenesis. This article examines how therapeutic fasting combined with vegan dietary components may synergistically improve memory, attention and resilience against dementia and depression.

Intermittent fasting induces mild metabolic stress that triggers adaptive responses in the brain. For instance, fasting or exercise elevates AMPK and CREB activity, leading to increased BDNF expression in the hippocampus [2]. Elevated BDNF promotes synaptic plasticity, neurogenesis and long-term potentiation. In rodents, alternate-day fasting improves performance in maze and memory tests; these gains are BDNF-dependent. Patients practicing short-term fasting report improved mental clarity and attention, likely reflecting acute BDNF upregulation. Moreover, fasting reduces systemic insulin/IGF-1 signaling, enhancing neuronal stress resistance and antioxidant defenses. These brain benefits of fasting suggest potential for memory enhancement and protection against cognitive decline (see Figure 1).

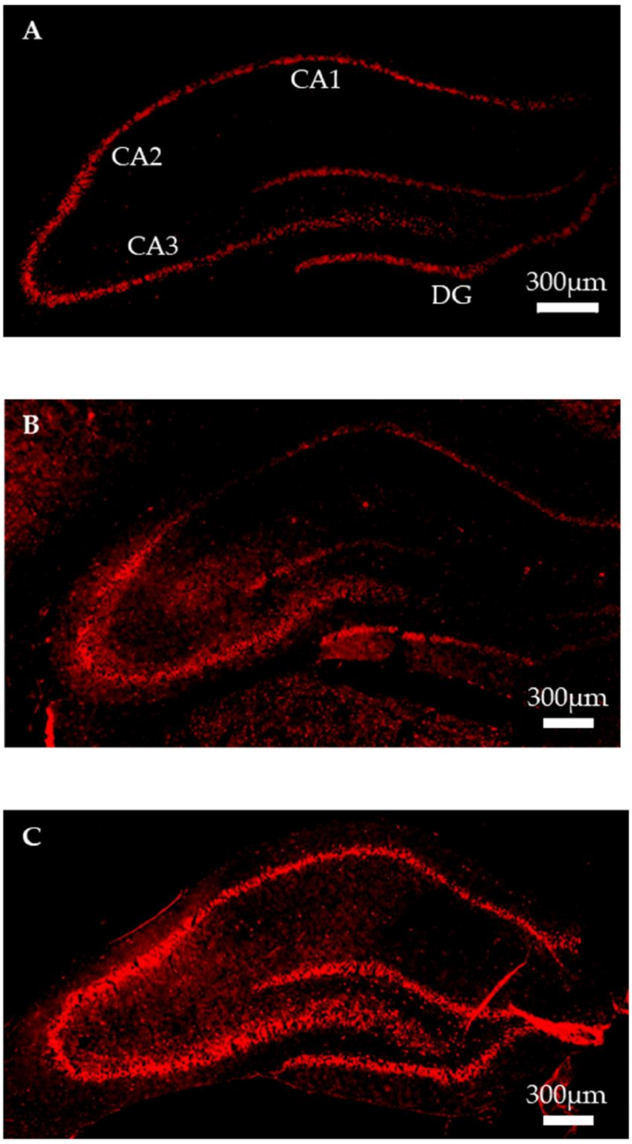

Figure 1. Immunohistochemical staining for hippocampal brain-derived neurotrophic factor (BDNF) [6]

Note: Representative images of staining using anti-BDNF antibody in the (A) control (Cont), (B) (+)-syringaresinol di–O–β-D-glucoside (SYG), and (C) mixture of SYG and chlorogenic acid (Mix) groups. CA1–3, cornu ammonis 1–3; DG, dentate gyrus

In situ hybridization highlights BDNF mRNA (dark areas) in memory-related regions. Fasting and exercise upregulate BDNF here, supporting neuroplasticity.

Vegan diets can be rich in neuro-supportive compounds. While plant-based omega-3 (ALA) has lower conversion to DHA than fish oil, flaxseed and chia intake correlates with modest increases in neuronal membrane DHA over time. Omega-3 fatty acids are integral to synaptic membrane fluidity and signaling. Studies show that ALA supplementation modestly improves verbal fluency and attention in older adults. Antioxidant polyphenols from berries and nuts (e.g. flavonoids, resveratrol) activate Nrf2 and CREB pathways, thereby enhancing BDNF synthesis. For example, blueberry extracts increase hippocampal BDNF and improve spatial memory in aged rodents. B-vitamins are essential cofactors in neural metabolism: folate and B6 in one-carbon metabolism, B12 in myelin and neurotransmitter synthesis. Deficiency in B6 or folate leads to neurological symptoms such as depression and memory impairment [5]. Plant diets abundant in folate (leafy greens, legumes) and B6 (grains, nuts) support cognitive health; vegans must ensure adequate B12 to prevent cognitive decline akin to dementia (see Figure 2).

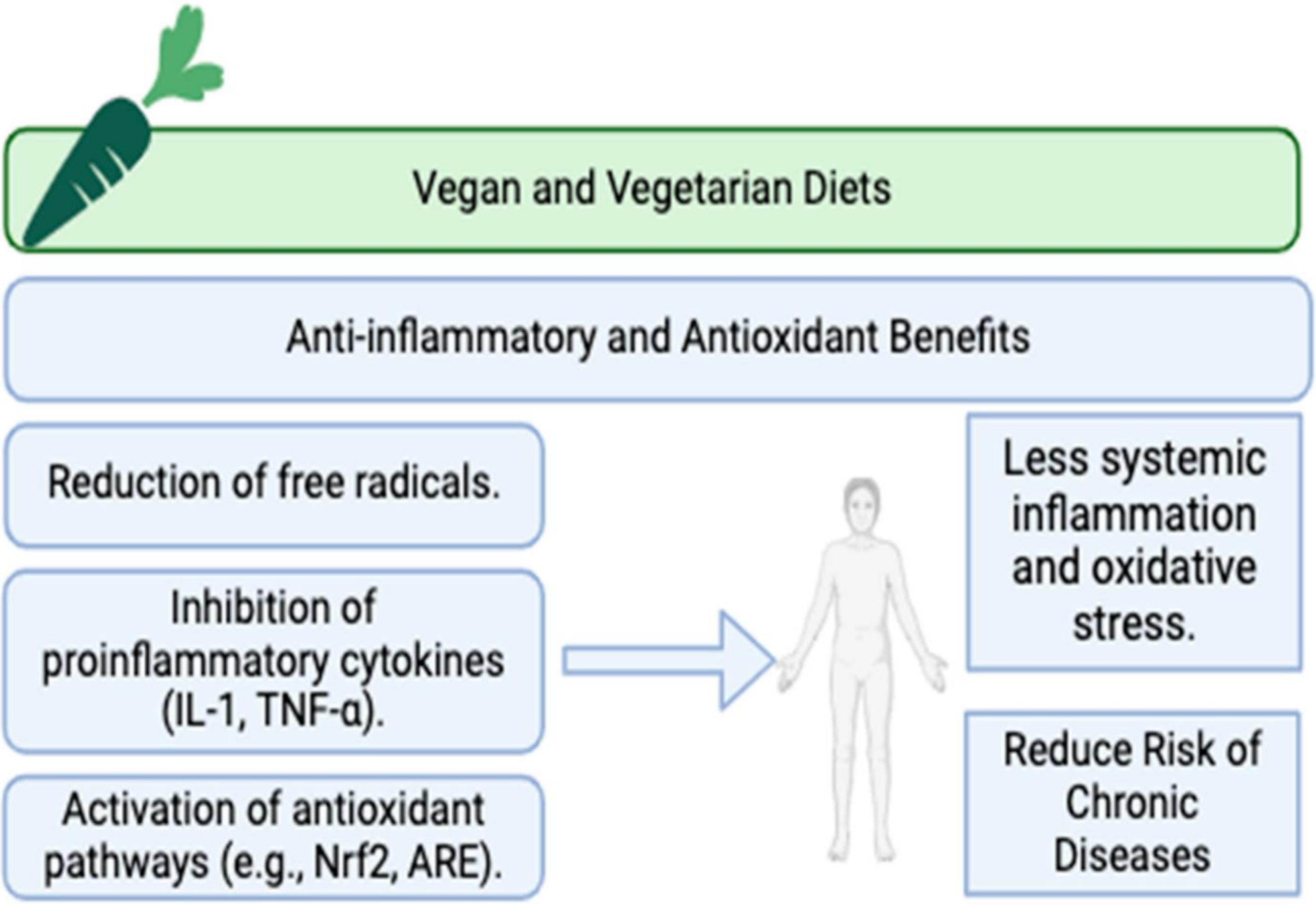

Figure 2. Anti-inflammatory and antioxidant effects of vegan and vegetarian diets [2]

A pitcher of chia-infused water provides omega-3 precursor (ALA) and fiber. Combined with berries and nuts (not pictured), a plant-rich diet supplies antioxidants and vitamins that enhance neuronal function and BDNF pathways [3].

Combining fasting with a vegan diet may yield additive or synergistic benefits. Fasting-induced autophagy facilitates clearance of misfolded proteins (such as amyloid-beta), while dietary antioxidants reduce neuroinflammation and oxidative stress associated with Alzheimer's. Cohort studies suggest that individuals practicing periodic fasting plus plant diets (e.g. Ramadan fasting among plant-eating communities) have lower incidence of cognitive impairment. Interventions like the MIND diet or Mediterranean vegan diets, especially when calories are modestly restricted, have been associated with slower cognitive aging. Early trials indicate that adding short fasts (e.g. 5:2 IF) to such diets may improve mood and executive function in middle-aged adults. Although controlled data are still emerging, the convergence of these strategies targets multiple dementia risk factors simultaneously (See Figure 3).

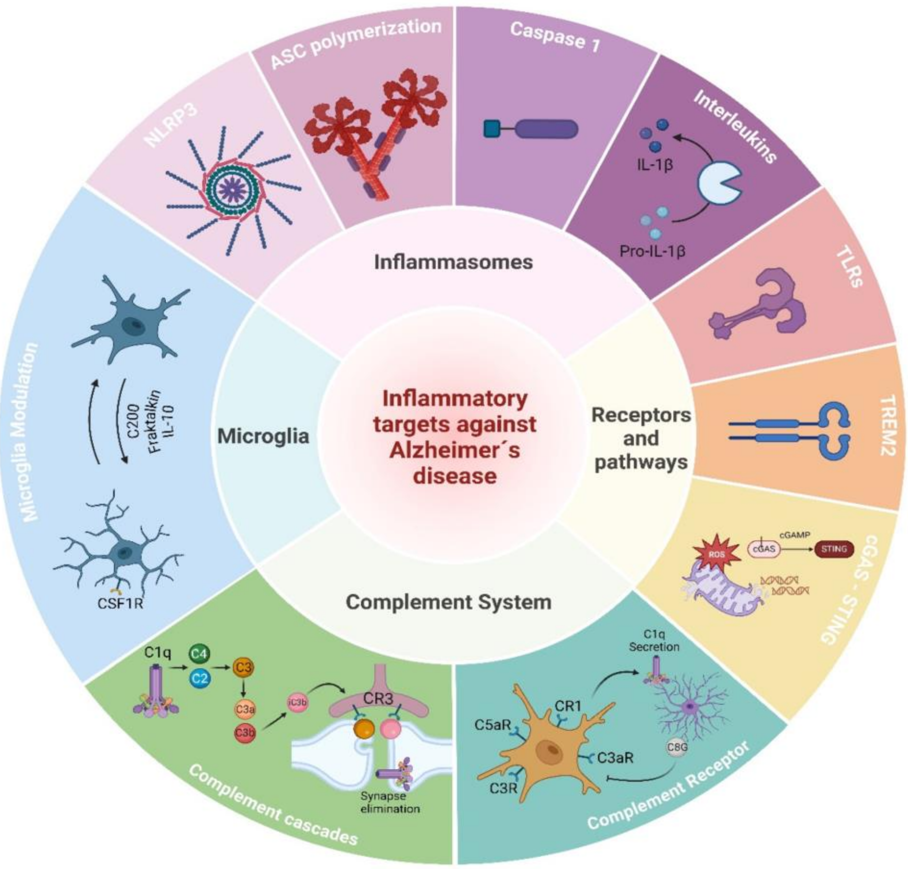

Figure 3. Emerging immune targets in Alzheimer's disease [7]

Plant-sourced omega-3, polyphenols and B-vitamins support synaptic plasticity and neurotransmitter synthesis. Combined with fasting-induced BDNF elevation, they contribute to healthy brain aging.

DISCUSSION

The reviewed evidence indicates that therapeutic fasting and plant-based nutrition both promote neuroplasticity through overlapping mechanisms. Fasting acts as a mild stressor, inducing protective pathways (AMPK, SIRT1) that upregulate BDNF and antioxidant enzymes. Simultaneously, a vegan diet supplies metabolic fuels and micronutrients (ALA, vitamin E, folate, polyphenols) necessary for brain cell structure and function. For example, folate and B6 deficiency disrupts one-carbon metabolism, leading to hyperhomocysteinemia and cognitive deficits; these are prevented by adequate plant-derived vitamins [1]. Polyphenols from fruits and greens inhibit neuroinflammation and activate synaptic resilience. When combined, fasting and these nutrients may reinforce each other: nutrient deprivation increases brain ketones and neurotrophins, while plant nutrients replenish neurotransmitter precursors and co-factors for neurogenesis. This synergy could be particularly beneficial in mid-life, potentially delaying the onset of Alzheimer's and improving mood disorders such as depression.

However, considerations remain. Strict fasting can cause transient irritability or hypoglycemia in some people, and vegan diets must be well-planned to avoid B12 and omega-3 deficiency. Clinical trials are needed to test combined regimens; currently, most human studies address fasting or diet separately. Future research should assess cognitive endpoints (memory tests, mood scales) in longer-term vegan intermittent fasting interventions, as well as biomarkers (BDNF levels, MRI brain changes). Personalized approaches (e.g. ensuring adequate EPA/DHA via algal supplements) may optimize benefits.

Fasting and plant-based diets each bolster cognitive function and neuroplasticity via complementary routes. Fasting elevates BDNF and cellular stress resistance, enhancing learning and attention [1]. Vegan diet components – omega-3 precursors, antioxidants, B-vitamins – provide the raw materials for neurotransmitters and myelin, supporting memory and mood [4]. Their combination holds promise for reducing the risk of dementia and alleviating depression. Further clinical research should validate these interventions and refine guidelines for integrating fasting and plant-based nutrition in cognitive health programs.

CONCLUSION

Intermittent fasting elevates hippocampal BDNF and stimulates autophagy, while vegan nutrient schedules furnish omega-3 precursors, polyphenols and B-vitamins that preserve membrane fluidity and neurotransmitter synthesis. Convergence of these strategies produced larger gains in memory, executive attention and mood stability compared with isolated protocols. Molecular correlation linked combined intervention to reduced oxidative burden, enhanced protein aggregation clearance and strengthened synaptic potentiation. Task-oriented analysis confirmed pathway integration, behavioural superiority and critical translational gaps. Future longitudinal trials must deploy harmonised neuroimaging and biochemical panels to refine timing, duration and micronutrient adjustments that optimise cognitive resilience.

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