

An Update on Preventing and Treating Parkinson's Disease with a Plant-Based Diet



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Abstract

Since our article on the prevention and treatment of Parkinson's disease with a plant-based diet was published, research has increased our knowledge of the pathophysiology of Parkinson's disease, which helps explain why plant-based diets can reduce the risk of Parkinson's disease. A vegan diet may provide protection from Parkinson's disease by boosting Parkin and PINK1 expression in the substantia nigra. Vegan diets of modest protein content may also help to minimize oxidative stress of mitochondrial origin by upregulating mitophagy. Further research has also discovered more evidence for the role of the intestinal microbiome, and therefore diet, in the pathogenesis of the disease. Microbiota-targeted interventions, including probiotic *Clostridium butyricum*, have been recently shown to have favorable effects in Parkinson's disease by regulating the microbiota-gut-brain axis. In addition, a higher level of dietary antioxidant nutrients, common in plant-based diets, may slow the rate of parkinsonian symptom progression in older adults. A UK study found that those with the greatest adherence to a plant-based diet had a 19% decreased risk of Parkinson's disease. In addition to reducing the risk of Parkinson's disease, dietary modifications for diagnosed patients may alleviate non-motor symptoms like constipation, and promoting a healthy diet should become a part of routine care and disease management for PD patients.

Keywords: Antioxidants; Constipation; FGF; Gut-brain axis; Microbiota; Oxidative stress; Parkin; Pathophysiology; PINK1; Vegan

Abbreviations: ATP: Adenosine Triphosphate; FGF: Fibroblast Growth Factors; PD: Parkinson's Disease; SCFA: Short-Chain Fatty Acid

Introduction

Since our article on the prevention and treatment of Parkinson's disease with a plant-based diet [1] was published; research has increased our knowledge of the pathophysiology of Parkinson's disease; which helps explain why plant-based diets can reduce the risk of Parkinson's disease. It has continued to show that a plant-based diet can reduce the risk of Parkinson's disease and be an efficacious adjunct to standard treatments. Further research has also discovered more evidence for the role of the intestinal microbiome; and therefore diet; in the pathogenesis of the disease.

The pathophysiology of Parkinson's disease involves the reduction in function of the dopaminergic neurons. New studies have helped elucidate one of the mechanisms by which their function is damaged. Efficient mitochondrial function is of great importance for the proper function and survival of dopaminergic neurons of the substantia nigra. Owing to their vastly ramified neural connections; these dopaminergic neurons have an extremely high requirement for mitochondrially

generated ATP. A failure of well-coordinated mitophagy and compensatory mitochondrial biogenesis in these neurons during the development of Parkinson's disease results in the accumulation of mitochondria that are dysfunctional; hyper-fragmented; and a major source of oxidative stress [2].

Studies have shown that Fibroblast Growth Factors (FGF) can play a key role in neuroprotection in Parkinson's disease. FGF can provide effective protection against dopaminergic neuron loss [3] Fibroblast growth factor21 (FGF21); a member of the FGF family; plays multiple biological functions including anti-inflammation; anti-oxidative stress; and anti-apoptosis; [4] so FGF21 can provide effective protection against dopaminergic neuron loss [3]. A cross-sectional study found that plasma concentrations of FGF21 tend to be about 3-fold higher in vegans than in omnivores [5].

New research shows that the proteins Parkin and PINK1 are key mediators of mitophagy and mitochondrial biogenesis; and are notably protective in rodent models of Parkinson's disease [2]. Parkin is an E3 ubiquitin ligase that promotes mitophagy

of damaged depolarized mitochondria while also boosting mitochondrial biogenesis; thereby helping to maintain efficient mitochondrial function.

Boosting Parkin expression in the substantia nigra with viral vectors is protective in multiple rodent models of PD [2]. A vegan diet may provide protection from Parkinson's disease by boosting Parkin and PINK1 expression in the substantia nigra [2]. Vegan diets of modest protein content may also help to minimize oxidative stress of mitochondrial origin by upregulating mitophagy [2].

The microbiome-gut-brain axis has gained much attention in recent years and is considered to be a significant driver of Parkinson's disease pathogenesis. We spoke about the role of microbiome dysbiosis in our previous article [1]. Since then; further research has increased knowledge of dysbiosis in Parkinson's disease [6]. A connection between gut microbiota and Parkinson's disease indicates that dysbiosis of the gut microbiota might represent a risk factor for Parkinson's disease. Microbiota-targeted interventions; including probiotic *Clostridium butyricum*; have been recently shown to have favorable effects in Parkinson's disease by regulating the microbiota gut brain axis [7].

Clostridium butyricum has fermentative activity and can consume undigested dietary fibers and generate Short-Chain Fatty Acids (SCFAs); specifically butyrate and acetate. Butyrate is one of the dominant fermentation end products and is produced by *C. butyricum* via the butyrate-kinase pathway [8]. SCFAs produced by microbial organisms in the colon are known to have myriad and important effects on host health; including modulating intestinal immune homeostasis; improving gastrointestinal barrier function; and alleviating inflammation [8].

In a cohort study of 368,934 participants from the UK Biobank; those with the greatest adherence to a plant-based diet had a 19% decreased risk of Parkinson's disease [9]. Those who followed a plant-based diet had a lower risk of metabolic syndrome [10]. Metabolic syndrome and Parkinson's disease share some pathophysiological processes; including insulin resistance; oxidative stress; and chronic inflammation. In recent years; metabolic syndrome has been associated with an increased risk of Parkinson's disease. Researchers also found that some related metabolic syndrome therapies are potential therapeutic strategies to prevent and improve PD [11].

There is increasing recognition of the role of dietary antioxidants in the prevention and treatment of Parkinson's disease [12]. One study showed that a higher level of dietary antioxidant nutrients may slow the rate of parkinsonian symptom progression in older adults [13]. A slower rate of progressive parkinsonian symptoms was observed among those in the highest dietary intake quintiles of total carotenoids; beta carotene; lutein; zeaxanthin; vitamin E and vitamin C from plant-derived foods when compared to those in the lowest quintiles of intake [12].

A plant-based diet also protects against chronic oxidative-stress related diseases. Dietary plants contain various phytochemical families and amounts of antioxidants. Plant antioxidants may contribute to the beneficial health effects of dietary plant foods [14]. On average plant foods provide 11.57 mmol/100gm antioxidant content, while animal foods provide only on average 0.18 mmol/100gm [14].

One study showed that Parkinson's disease patients; on average; consume a lower-quality diet compared to household and community controls. This suggests that dietary modifications may alleviate non-motor symptoms like constipation; and promoting a healthy diet should become a part of routine care and disease management for PD patients [15].

Since Parkinson's disease often occurs later in life; the fact that a plant-based diet can reduce the risk; as well as treat; common comorbidities such as type 2 diabetes; [16] cardiovascular disease; [17] prostate [18] and colon cancer; [19] makes prophylaxis with it all the more valuable. Treating the Parkinson's disease patients with a plant-based diet has no contraindications or adverse reactions. It offers a safe treatment as an adjunct to treatment with standard pharmacotherapy.

Conflict of Interest

The authors state that there are no conflicts of interest.

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