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# The benefits of extra virgin olive oil polyphenols for possible prevention of parkinson's disease: an integrative mini literature review

## Abstract

Olive oil has phenolic compounds, such as hydroxytyrosol, tyrosol e oleuropein. Through this rich composition, olive oil conditions its biological actions to neuroprotection, such reactive oxygen species, antioxidant and anti-inflammatory action, inhibition of lipid peroxidation, restoration of glutathione and anti-apoptotic properties.

**Objective:** Conduct an integrative mini literature review with the beneficial properties of extra virgin olive oil and its polyphenols for possible prevention of Parkinson's disease.

**Method:** To identify potentially relevant studies for the present mini-review, a search of the literature in databases (PubMed, Scopus and Web Of Science) was conducted during April 2021. The term "extra virgin Olive oil" was searched in combination with "Parkinson". The terms were searched in the title, abstract and keyword. No restrictions were applied as to the language or date of publication.

**Results and discussion:** The sample consisted of 6 articles. When listing the articles found, beneficial effects of polyphenols in olive oil were evidenced, against brain oxidative damage caused by some toxins, in addition to triggering an autophagic response and interfering with the cell signaling pathways and mechanisms associated with cell function, survival or death.

**Conclusion:** The beneficial effects of olive oil and its polyphenols in Parkinson's disease have been extensively researched and associated with the modulation of many cell pathways. Its ability to increase the antioxidant system and reduce inflammation has been linked to the protective effect in Parkinson's disease. Polyphenols have antioxidant power in vitro, studies in cell cultures; therefore, further in vivo studies are needed to confirm the protective effects of olive oil and its polyphenols on Parkinson's disease, in order to identify biologically relevant concentrations for therapeutic purposes.

**Keywords:** extra virgin olive oil, parkinson's disease, polyphenols

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**Abbreviations:** HT, hydroxytyrosol; OLE, oleuropein; ROS, reactive oxygen specie; PD, parkinson's disease; TYR, Tyrosol; EVOO, Extra virgin olive oil; 6-OHDA, 6-hydroxydopamine; MAO, Monoamine oxidase; 2, 4-D, 2, 4-Dichlorophenoxyacetic acid; Ache, acetylcholinesterase; α-syn, α-synuclein

## Introduction

Olive oil is characterized as a food rich in phenolic components, it has shown a growing interest in research in the clinical area, due to its wide variety of beneficial effects on human health.[1–3] Such effects are attributed to a multiplicity of biological activities, among which its antioxidant and anti-inflammatory action, anticancer and antimicrobial properties are evident.[1,4–6] Still, in more recent studies, the neuroprotective effects of phenols present in olive oil against progressive neurodegenerative diseases, such as Alzheimer's and Parkinson's disease (PD) - more prone pathologies in older individuals.[1,7,8]

Olive oil has phenolic compounds, divided into categories - simple phenols (such as hydroxytyrosol and tyrosol), secairidoids (such as oleuropein and oleocanthal) and lignans.[1,9,10] Through this rich composition, olive oil conditions its biological actions to neuroprotection, such as the ability to eliminate reactive oxygen species (ROS), antioxidant and anti-inflammatory action, inhibition of lipid peroxidation, restoration of glutathione and antiapoptotic properties.[1,11,12] However, the mechanisms behind these actions have not been fully elucidated, requiring future research to identify the molecular pathways and intracellular targets responsible for the neuroprotective effects of olive oil phenol.[1,13] The present mini review provides an updated suggestion of the beneficial properties of the extra virgin olive oil and its polyphenols for possible prevention of Parkinson's disease.

## Methods

To identify potentially relevant studies for the present mini-review, a search of the literature in databases (PubMed, Scopus and Web Of Science) was conducted during April 2021. The term "extra virgin olive oil" was searched in combination with "parkinson". The terms were searched in the title, abstract and keyword. No restrictions were applied as to the language or date of publication. The research question for this mini review has: "Was the extra virgin olive oil polyphenols benefit in the prevention of Parkinson's disease?"

The articles found in the databases were analyzed according to the title and abstract and selected according to potential eligibility. After the selection, the articles were read in full and analyzed

according to the research question. Results were summarized and the methodologies of each included study were analyzed. From that point on, the writing of the mini review was conducted.

## Results

Of the 44 publications found, 24 publications were in the Scopus database, 11 in PubMed and 9 in Web of Science. Of these, 3 were in duplicate and 9 in triplicate, totaling 26 publications. After reading the articles in full, the sample for this mini review consisted of 6 articles:

Khalatbary et al.[1] The studies composed by this review, reported that olive oil phenols were effective in protecting against the general mechanisms of neurodegenerative diseases, such as elimination of free radicals, anti-inflammatory and anti-apoptotic properties in cell cultures and animal models.

Amel et al.[14] (2016), Olive oil or its fractions represent a possible natural protective agent against risk factors for acute neurotoxicity induced by 2,4-Dichlorophenoxyacetic acid (2,4-D).

Casamenti et al.[15] (2016), Olive oil or its fractions represent a possible natural protective agent against risk factors for acute neurotoxicity induced by 2,4-D.

Angeloni et al.[16] (2017), the main findings of extra virgin olive oils (EVOO) phenols were that they positively regulated the expression of antioxidant enzymes, reduced apoptosis induced by6-hydroxydopamine(6-OHDA), showed a protective effect against dopaminergic cell death, decreased levels of 5-S-cysteinyl-dopamine (Cys-DA) induced by monoamine oxidase (MAO) inhibitors, suggesting that this olive oil phenol could be used to increase the effectiveness of clinical treatment of PD.

Figueiredo-González et al.[17] (2018), Both phenolic extracts rich in EVOOs were able to simultaneously inhibit monoamine oxidases A and monoamine oxidase B, in a dose-dependent manner Gárcia-Moreno et al. (2019) [19] Reports that tyrosol (TYR) is able to significantly reduce the amount of α-syn aggregates in a DP model of C. elegans.

## Discussion

The in vitro study by Figueiredo-González et al.[17] analyzed two EVOOs in order to establish their phenolic composition and their inhibitory capacity of enzymes that are closely linked to PD, the monoamines oxidases: hMAO-A and hMAO-B.[17] The phenolic compounds of EVOOs may be possible resources to act in the inhibition of these enzymes.[18,19] In the article, it was evidenced inhibitory effects dependent on the concentration of polyphenols in the investigated oils, emphasizing that both oils obtained greater inhibitory activity of the enzymes hMAO-A and hMAO-B, being, therefore, a potential food aid in the neuroprotection of PD[13]. Like Amel et al. (2016) observed that supplementation with EVOO - after an initial administration of 2,4-D - increased the activity of the enzyme acetylcholinesterase (AChE) which attenuates the response of the neurodegenerative enzymes hMAO A and hMAO B was significant16. Other people in the research demonstrated the potential of EVOO against oxidative brain damage caused by 2,4-D, in addition to potentiating the restoration of the composition of brain fatty acids, especially DHA, which acts as an antioxidant and brain neuroprotective.[14]

The review conducted by Casamenti and Stefani[15] showed a possible efficacy of hydroxytyrosol (HT) against dopaminergic dysfunction related to dopamine metabolism and, therefore, useful in PD17 therapy, as well as Angeloni et al.[16] who observed HT as a protector against toxins commonly used in Parkinson's research, such as dopamine and 6-OHDA. HT also appeared to increase the effectiveness of the clinical treatment of the disease, decreasing the levels of Cys-DA induced by MAO inhibitors. It also increased intracellular levels of dopamine and its metabolite, when investigated as an inhibitor of catechol-O-methyl transferase (COMT - often used as an adjunct to levodopa therapy in PD). Oleuropein (OLE) reduces the aggregation of amyloid beta (Aβ) and prevents the appearance of toxic oligomers in C. elegans and mice, alleviating functional deficits in terms of paralysis and cognition, respectively,[15] in addition to decreasing cell damage and reducing cell damage. oxidative stress and apoptosis induced by 6-OHDAe in PC12[16] cells. In this regard, olive polyphenols are capable of potentially triggering an autophagic response and interfering with the cell signaling pathways and mechanisms associated with cell function, survival or death[17]. As in the literature review carried out by Khalatbary.[1] where it was also observed that the phenols present in olive oil were effective in protecting against the general mechanisms of neurodegenerative diseases, in cell culture and animal models; and yet, the potential of phenolic compounds in olive oil for preventive and therapeutic use in neurodegenerative diseases has been suggested.

In the study conducted by García-Moreno et al.[19] the effect of TYR on the aggregation of the pre-synaptic protein α-syn (one of the main toxic mechanisms in the pathogenesis of PD) was investigated in a model of DP C. elegans, as well how, its potential to prevent α-syn toxicity, neurodegeneration and oxidative stress in this model of organism was evaluated. As the main findings of the study, it was observed that TYR supplementation decreased the amount of α-syn inclusions, without affecting its expression, delayed dopaminergic neurodegeneration and decreased the level of ROS in the model studied. In conclusion, the study points to the ability of dietary supplementation with TYR to significantly reduce the amount of α-syn aggregates and, especially, the ability to delay the onset of dopaminergic neurodegeneration in vivo - thus indicating TYR as a possible compound nutraceutical for PD. As in the review by Angeloni et al.[15] TYR was shown to be beneficial in experimental conditions for neuroprotection, probably through an Akt[15] signaling pathway.

## Conclusion

The beneficial effects of olive oil and its polyphenols on PD have been extensively researched and associated with the modulation of many different cell pathways. Among the polyphenols, oleuropein, tyrosol and hydroxytyrosol were the most explored. However, as noted in the main findings in the literature, no study has been conducted to explore the effect of olive oil on neutralizing PD - rather, its ability to increase the antioxidant system and reduce inflammation has been associated with its protective effect on PD. Polyphenols have a high antioxidant power in vitro, containing mostly studies in cell cultures; therefore, further in vivo studies are needed to confirm the protective effects of olive oil and its polyphenols on PD, in order to identify biologically relevant concentrations for therapeutic purposes.

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## Conflicts of interest

The authors declare that there is no conflict of interest.

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