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# Prospecting the anti-inflammatory potential and analysis of the neurological interaction and toxicity of compounds present in the fruits *Persea americana* (Avocado), *Mangifera indica* (Mango) and *Hancornia speciosa* (Mangaba)

**Prospecção do potencial anti-inflamatório e análise da interação neurológica e toxicidade de compostos presentes nas frutas *Persea americana* (Abacate), *Mangifera indica* (Manga) e *Hancornia speciosa* (Mangaba)**

**Prospección del potencial antiinflamatorio y análisis de la interacción neurológica y toxicidad de compuestos presentes en los frutos *Persea americana* (Aguacate), *Mangifera indica* (Mango) y *Hancornia speciosa* (Mangaba)**

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**Abstract**
Inflammation is a biological process in response to injuries, such as infections and cellular trauma, that plays a role in eliminating invading pathogens and wound healing. Inflammation in the brain can lead to neurological disorders, highlighting the need for effective treatments. This study aimed to investigate the anti-inflammatory potential and neurological effects of *Persea americana* (avocado), *Mangifera indica* (mango), and *Hancornia speciosa* (mangaba). The systematic literature review revealed anti-inflammatory and neuroprotective properties of these fruits, including blood pressure reduction, improved vasodilation, and analgesic and anticonvulsant effects. The results highlight the therapeutic potential of these tropical fruits in the prevention and treatment of inflammatory and neurological conditions.
**Keywords:** Fruits; Secondary metabolites; Natural products.

**Resumo**

Inflamação é um processo biológico em resposta a lesões, como infecções e traumas celulares, que desempenha papel na eliminação de patógenos invasores e cicatrização de feridas. A inflamação no cérebro pode levar a distúrbios neurológicos, destacando a necessidade de tratamentos eficazes. Este estudo objetivou investigar o potencial anti-inflamatório e os efeitos neurológicos de *Persea americana* (abacate), *Mangifera indica* (manga) e *Hancornia speciosa* (mangaba). A revisão sistemática da literatura revelou propriedades anti-inflamatórias e neuroprotetoras desses frutos, incluindo redução da pressão arterial, melhora da vasodilatação, e efeitos analgésicos e anticonvulsivantes. Os resultados destacam o potencial terapêutico desses frutos tropicais na prevenção e tratamento de condições inflamatórias e neurológicas.

**Palavras-chave:** Frutas; Metabólitos secundários; Produtos naturais.

**Resumen**

La inflamación es un proceso biológico en respuesta a lesiones, como infecciones y traumas celulares, que juega un papel en la eliminación de patógenos invasores y la cicatrización de heridas. La inflamación en el cerebro puede llevar a trastornos neurológicos, subrayando la necesidad de tratamientos efectivos. Este estudio tuvo como objetivo investigar el potencial antiinflamatorio y los efectos neurológicos de *Persea americana* (aguacate), *Mangifera indica* (mango) y *Hancornia speciosa* (mangaba). La revisión sistemática de la literatura reveló propiedades antiinflamatorias y neuroprotectoras de estos frutos, incluyendo la reducción de la presión arterial, la mejora de la vasodilatación y efectos analgésicos y anticonvulsivos. Los resultados destacan el potencial terapéutico de estos frutos tropicales en la prevención y tratamiento de condiciones inflamatorias y neurológicas.

**Palabras clave:** Frutas; Metabolitos secundarios; Productos naturales.

## 1. Introduction

Inflammation is characterized as a biological process in response to injuries, such as infections and traumas suffered by cells or tissues, which is then a response mechanism, responsible for the elimination of invading pathogens, wound healing process and development of new vessels. Inflammation can be developed in practically all parts of the body, including the brain, where astrocytes are the main source of inflammation, neurons have limited regenerative capacity, and the excessive neuronal loss in the CNS caused by inflammation has significant consequences on motor and cognitive function. Since this is a negative factor that contributes to the development of acute and chronic brain disorders, the neurons of the affected brain perform neuroprotective efforts, to clean up cellular debris and regulate the secretion of neurotrophic factors, cytokines and proteases, yet they have negative effects on recovery after an injury, inhibiting pro-inflammatory mediators and cytokines, modulate microglial activation and normalize mitochondrial function can be effective therapeutic strategies to mitigate the progression of neurodegenerative diseases, (Shabab., et al. 2017; Sprenkle, et al., 2017).

Thus, one of the treatment possibilities that can be adopted in the treatment of inflammations is the use of non-steroidal anti-inflammatory drugs (NSAIDs), these anti-inflammatory drugs are classified into two distinct classes: steroidal anti-inflammatory drugs that are called corticosteroids (AIEs) and non-steroidal anti-inflammatory drugs (NSAIDs)2, non-steroidal anti-inflammatory drugs, despite their high commercialization and wide use by the world population have adverse effects (Gonçalves, 2020). Although this is the most used form of treatment, the complications caused by its adverse reactions show the need for new measures to solve the problem, and new approaches are necessary, in this context, the pharmaceutical industry has focused on the use of natural products produced from bioactive compounds, emerging then as a possibility of using herbal medicines produced from medicinal plants, the use of these herbal medicines has been a great ally to reverse several problems, in this way, it has been used as a safe, low-cost, effective treatment and Quality (Feitosa et al., 2016).

Therefore, some nutritional elements produced through fruits may be associated with protection of neurotransmission, neurogenesis, cell survival and control of neuroinflammation. (Motta, 2020), thus, As a possibility of fruits that can be used for this purpose has the avocado (*Persea americana*), an angiosperm belonging to the Lauraceae family and the genus persea, where about 50 species are classified, within the genus persea and subgenus Persia, it includes three botanical varieties: the Guatemalan avocado (American P.var.guatemaltensis), the West Indies (American P.var. americana) and the Mexican (P. Americanovar.

drymifolia) the three varieties have a similar genome and hybridization between them occurs easily.

Therefore, the chemical matrix of avocado has some components, which in addition to the antioxidant and anti-inflammatory action also act on the modulation of cortisol and probably psychosocial stress. This is the case of apigenin, catechins, especially epigallocakine-gallate (EGCG), campferol, lutein/zeaxanthin and ascorbic acid, molecules that have well-established antioxidant and anti-inflammatory action, relevant neuroprotective properties, including attenuation of changes triggered by psychosocial stress that induce chronic neural changes by continuous cortisol Exposure (Motta, 2020).

Avocado has many health benefits already described in the literature, which have been associated with the compounds present in the lipid fraction, such as omega fatty acids, phytosterols, tocopherols and squalene, its compounds and actions vary according to the part of the fruit that is used, such as fruit, leaves, stone, pulp, in this way, it can be used as an emenagogue (fruit), healing (fruit pulp), and to treat infections and inflammations of the skin (leaves), as well as intestinal diseases (leaves), in addition to the pharmaceutical industry it has been widely used in the cosmetic industry in the format of Oil, produced from the seed, used for centuries for the treatment of dry hair, as an ointment to relieve pain and soften the skin of injured areas, and other diseases. The medicinal properties of avocado include the induction of the production of antimicrobial peptides, such as human βdephensin 2 (HBD-2), and the modulation of the pro-inflammatory response induced by the lipopolysaccharide (LPS) favored by the sugars present in the avocado, such as manoheptulose and perseitol (Tabeshpour et al., 2017).

According to the physicochemical, phenolic and bioactivity characteristics of native Mexican avocado genotype oils, it was established that the oils of this variety exhibit physicochemical characteristics superior to the Hass cultivar. Research shows that the oil content of different accesses of native Mexican avocado, and the oil content of the pulp was variable and dependent on the type of access, the main fatty acids being oleic, linoleic and palmitoleic fatty acids, and the peels presented variable levels of anthocyanin with high antioxidant activity (Tabeshpour et al., 2017).

Another possibility of fruit to be used is mango, a tropical fruit belonging to the Anacardiaceae family, which includes several deadly poisonous plants, has aroma and high nutritional value. Much of the mango crop is produced in Asia, it contains different types of carbohydrates based on the stage of maturity and maturity is a rich source of sugars (fructose, glucose, sucrose), while green mango is a source of starch and pectin. During the ripening process, starch is converted into fructose and glucose. The nutritional composition of the mango pulp depends mainly on the type and variety of the mango, the location and the climatic conditions of its production region and the maturity of the fruit. Mango pulp is a good source of elementary minerals that are essential for a variety of biochemical reactions, contains a variety of macro and micronutrients, contains carbohydrates, proteins, amino acids, lipids, organic acids, as well as dietary fiber, is also a good source of micronutrients, including trace elements such as calcium, phosphorus, iron and vitamins C and A.

Mango pulp is known to have a wide variety of bioactive compounds such as carotenoids, phenolic acids, polysaccharides, sterols and alkaloids, and is then widely used by indigenous people as a drug form to treat diarrhea, fever, gastritis and ulcer, its phenolic compounds are categorized into phenolic acids and polyphenols. In recent years, there has been an increase in studies that have explored the ethnopharmacological and pharmacological efficacy of the various bioactive constituents of mango, the evidence found emphasizes the importance of mango by-products in the treatment of various chronic diseases, including diabetes, cancer, asthma, hypertension and bleeding in the lungs and intestine, in which it presents greater efficiency and fewer side effects. Different parts of the mango offer different benefits, such as anti-inflammatory and antioxidant activities. (Lebaka, et al. 2021).

Finally, *Hancornia speciosa* (Mangaba), a fruit belonging to the botanical family, which has more than 5100 species, in which they are distributed in several countries, but mainly in tropical and subtropical regions. It is native to Brazil, found mainly in the Amazon Forest. Named as "mangaba" fruit. Its branches are smooth and reddish, the flowering of *H. speciosa*

occurs from August to November, and the fruits ripen between September and November in the cerrado. They are edible and are a rich source of vitamin C, the sustainable harvest of these fruits by local communities is of paramount economic and social importance (Bastos, 2017.). In its chemical composition it counts on the presence of ethanolic acid from its leaves, a marked presence of phenolic acids and flavonoids, with a focus on the high concentrations of chlorogenic acid, rutin, luteolin and apigenin, and these compounds with a wide spectrum of therapeutic properties known and studied in the treatment of various diseases, including their anti-inflammatory activity was also recognized, for the aqueous extract demonstrated by the reduction of leukocyte migration and inhibition of the production of pro-inflammatory cytokines.

Still talking about its chemical composition, the latex obtained from its trunk was described in the literature for presenting anti-inflammatory activity, this anti-inflammatory activity was reported for the aqueous extract of the fruit in animal models, demonstrated by the reduction of leukocyte migration and inhibition of the production of pro-inflammatory cytokines (Fabiula, 2019). Therefore, the study in question aims to analyze data regarding the anti-inflammatory potential and analysis of the neurological interaction and toxicity of compounds present in the fruits *Persea americana* (Avocado), *Mangifera indica* (Mango) and *Hancornia speciosa* (Mangaba).

## 2. Methodology

The present study is a systematic literature review, carried out during the period from September 2022 to March 2023 from articles published in the last three years (2019-2023) in the PubMed, ScienceDirect and Scielo databases. The selection of articles was made having as inclusion criterion clinical, preclinical studies, open, prospective, retrospective and field studies in English and Portuguese on therapeutic approaches to the anti-inflammatory potential and analysis of the neurological interaction and toxicity of compounds present in the fruits *Persea americana* (Abacate), *Mangifera indica* (Manga) and *Hancornia speciosa* (Mangaba) and exclusion literature reviews, studies published outside the estimated period and in other languages, duplicate or unrelated to the proposed theme. Initially, a consultation was carried out in the Virtual Health Library through the Descriptors in Health Sciences (DeCS) to obtain the descriptors that were relevant to the proposed theme, being selected for the search the descriptors: "*Persea americana*", "*Mangifera indica*" and "*Hancornia speciosa*", "anti-inflammatory", "neurological", "toxicity" and "Plant Extracts", isolated and combined with the descriptors by the boolean operator AND for evaluation of the anti-inflammatory potential and analysis of the neurological interaction and toxicity of the compounds.

In this way they were identified through the searches in the Science Direct databases (n = 11,263) Pubmed (n= 3,452), totaling (n= 14,715), were then selected ( n= 39 ) within the inclusion criteria, being excluded (n=14,676 ) because they did not meet the inclusion criteria, leaving (n= 39) for final analysis, of these were selected (n=8) for the construction of the study.

## 3. Results and Discussion

By analyzing the selected studies it was possible to observe that the largest number of relevant publications, as available in Table 1, was found in the Pubmed and ScienceDirect database, thus having more studies aimed at the therapeutic applicability of anti-inflammatory, within the areas of Pharmacology, Toxicology and Pharmaceutical Sciences, Medicine, Dentistry and Neurosciences. as can be seen in the table below.

**Table 1 -** Synthesis of the studies analyzed and included in the bibliographic research.

| Author and year | Type of study | Plant | Sample | Results |
|---|---|---|---|---|
| MOTTA et al., 2021 | Clinical trial *in vitro* | *Avocado* | Tests MTT e DNA | Avocado oil may have relevant neuroprotective properties. |
| MÁRQUEZ et al., 2021 | Clinical trial *in vivo* | *Avocado* | Hypertensive rats *(n = 40)* | Avocado oil lowers systemic blood pressure and improves vasodilation dependent on the endothelium in the kidneys. |
| MAHMOUD et al., 2021 | Clinical trial | *Avocado* | Rats | Analgesic, anti-inflammatory, antipyretic and anti-hyperglycemic properties. |
| AMOATENG et al., 2018 | Case study | *Avocado* | Plants | Analgesic and anticonvulsant properties. |
| AMOATENG et al., 2018 | Case study | *Mangifera indica* | Plants | Cognitive performance, Neuroprotection, anticonvulsant. |
| LEBAKA et al., 2021 | Case study | *Mangifera indica* | Plants | Antioxidant effects. |
| REIS et al., 2022 | Narrative review | *Hancornia Speciosa* | Plants | Antimicrobial action, glycemic and hypertensive control, and general anti-inflammatory action, and also on the gastrointestinal system |
| DE OLIVEIRA YAMASHITA et al., 2020 | Case study | *Hancornia Speciosa* | Plants | Inhibition of the inflammatory effects of acute pulmonary edema and kidney damage induced by T. serrulatus poisoning. |

Fonte: Prepared by the authors of this article in 2023 from the PubMed and ScienceDirect databases.

The present review evaluated eight studies on the anti-inflammatory and neuroprotective properties of Persea americana (avocado), Mangifera indica (mango), and Hancornia speciosa (mangaba). These fruits are known for their bioactive compounds, which play a significant role in their therapeutic applications. This section discusses the findings of these studies in detail, including bioactive compounds, therapeutic effects, clinical applications, indications, contraindications, and comparisons with other literature.

### 3.1 Persea americana (Avocado)

**Bioactive Compounds and Therapeutic Effects** Avocado is rich in bioactive compounds such as phytosterols, polyunsaturated fatty acids, antioxidants (e.g., apigenin, catechins, epigallocatechin gallate, campferol, lutein/zeaxanthin, and ascorbic acid), and carotenoids. These compounds have been documented to exhibit neuroprotective properties, reduce systemic blood pressure, improve endothelium-dependent vasodilation, and possess analgesic, anti-inflammatory, antipyretic, and anti-hyperglycemic properties.

**Clinical Applications and Indications** The therapeutic applications of avocado are diverse. Avocado oil has been shown to have relevant neuroprotective properties (Motta et al., 2021). Clinical trials on hypertensive rats demonstrated that avocado oil lowers systemic blood pressure and improves vasodilation (Márquez et al., 2021). Additionally, avocado exhibits analgesic and anticonvulsant properties, beneficial in treating pain and seizures (Amoateng et al., 2018).

**Contraindications and Safety** While avocado is generally considered safe, excessive consumption can lead to gastrointestinal issues due to its high fiber content. Individuals allergic to latex may also be allergic to avocado due to cross-reactivity.

**Comparisons with Other Studies** The neuroprotective properties of avocado are supported by other studies, such as Dreher and Davenport (2013), who highlighted the fruit's benefits for cardiovascular health and its potential to reduce the risk of

metabolic syndrome. However, some studies suggest that the high fat content in avocado may not be suitable for individuals with specific dietary restrictions (Lopez-Ledesma et al., 1996).

### 3.2 Mangifera indica (Mango)

**Bioactive Compounds and Therapeutic Effects** Mango is rich in phenolic acids, carotenoids, polyphenols, polysaccharides, sterols, and alkaloids. These compounds contribute to mango's antioxidant, anti-inflammatory, neuroprotective, and cognitive-enhancing properties. Mango pulp is also a good source of vitamins C and A, essential minerals, and dietary fiber.

**Clinical Applications and Indications** Mango has been traditionally used to treat diarrhea, fever, gastritis, and ulcers. Recent studies have shown its efficacy in improving cognitive performance, providing neuroprotection, and possessing anticonvulsant and antioxidant effects (Amoateng et al., 2018; Lebaka et al., 2021). Mango's bioactive compounds are effective in managing chronic diseases such as diabetes, cancer, and hypertension.

**Contraindications and Safety** Mango consumption is generally safe, but overconsumption can lead to gastrointestinal discomfort. People allergic to mango latex may experience allergic reactions.

**Comparisons with Other Studies** Mango's therapeutic potential is corroborated by other studies, such as Ediriweera and Tennekoon (2017), which discussed mango's antioxidant and anti-inflammatory activities. However, some studies argue that the fructose content in mango might not be suitable for individuals with fructose intolerance or diabetes (Amoateng et al., 2018).

### 3.3 Hancornia speciosa (Mangaba)

**Bioactive Compounds and Therapeutic Effects** Mangaba contains phenolic acids (chlorogenic acid), flavonoids (rutin, luteolin, apigenin), and other bioactive compounds like ethanolic acid. These compounds are known for their antimicrobial, anti-inflammatory, and antioxidant activities. Mangaba's latex has been documented for its anti-inflammatory properties, reducing leukocyte migration and inhibiting the production of pro-inflammatory cytokines (Fabiula, 2019).

**Clinical Applications and Indications** Mangaba is used for its antimicrobial action, glycemic and hypertensive control, and gastroprotective effects (Reis et al., 2022). Its anti-inflammatory properties make it beneficial in treating pulmonary edema and kidney damage induced by toxins (De Oliveira Yamashita et al., 2020).

**Contraindications and Safety** Mangaba is generally safe for consumption. However, its latex may cause allergic reactions in some individuals.

**Comparisons with Other Studies** The therapeutic benefits of mangaba are supported by studies like Souza-Moreira et al. (2018), which highlight its anti-inflammatory and antioxidant properties. Some studies, however, question the efficacy of mangaba in high doses due to potential toxicity (Reis et al., 2022).

### 3.4 Comparative Analysis

The studies included in this review demonstrate the potential of avocado, mango, and mangaba in providing therapeutic benefits through their anti-inflammatory and neuroprotective properties. While the selected articles highlight these benefits, it is essential to compare them with other literature to provide a comprehensive understanding.

**Agreement with Selected Studies** The neuroprotective and anti-inflammatory properties of these fruits are widely supported. For example, avocado's benefits for cardiovascular health and neuroprotection are well-documented (Dreher & Davenport, 2013). Mango's antioxidant and anti-inflammatory effects are also supported by studies emphasizing its role in managing chronic diseases (Ediriweera & Tennekoon, 2017). Mangaba's antimicrobial and anti-inflammatory properties are confirmed by research highlighting its therapeutic applications (Souza-Moreira et al., 2018).

**Disagreement with Selected Studies** Some studies argue against the extensive therapeutic use of these fruits due to potential side effects or contraindications. For instance, the high-fat content of avocado may not be suitable for all individuals (Lopez-Ledesma et al., 1996). Similarly, the fructose content in mango might be problematic for people with fructose intolerance or diabetes (Amoateng et al., 2018). The potential toxicity of mangaba in high doses is another concern (Reis et al., 2022).

## 4. Conclusion and Final Considerations

The systematic literature review on the anti-inflammatory potential and analysis of neurological interaction and toxicity of compounds present in the fruits Persea americana (avocado), Mangifera indica (mango), and Hancornia speciosa (mangaba) revealed a wide range of studies highlighting the therapeutic benefits of these plants.

The findings indicate that avocado, besides its well-documented anti-inflammatory properties, also proved to be a relevant neuroprotective agent. In vitro and in vivo studies demonstrated its efficacy in reducing systemic blood pressure, improving endothelium-dependent vasodilation, and possessing analgesic, anti-inflammatory, antipyretic, and anti-hyperglycemic properties. Additionally, avocado showed analgesic and anticonvulsant potential in case studies.

Similarly, mango and mangaba showed promise in various therapeutic aspects. Studies highlighted their antioxidant, neuroprotective, cognitive, and anti-inflammatory effects. Furthermore, mangaba exhibited antimicrobial activity, glycemic and hypertensive control, and gastroprotective action.

These findings suggest that these tropical fruits, commonly available and consumed in various parts of the world, could be valuable resources in the prevention and treatment of inflammatory and neurological conditions. However, it is important to emphasize the need for further clinical and preclinical research to fully elucidate the mechanisms of action of these compounds and their safety in different populations.

In summary, the results of this review emphasize the importance of exploring the therapeutic potential of the fruits Persea americana, Mangifera indica, and Hancornia speciosa as sources of bioactive compounds with anti-inflammatory and neuroprotective activities, paving the way for future research and development of therapeutic interventions based on natural products.

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