Antioxidant And Anti-Amyloidogenic Activities Of Cassia Tora Extracts For Alzheimer's Disease

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ABSTRACT

Because of its antioxidant and anti-amyloidogenic properties, Cassia tora Linn. being investigated in this research for its possible use in treating Alzheimer's disease. We used ethanol and water as solvents to extract Cassia tora leaf powder after collecting, drying, and grinding the leaves. The suppression of amyloid-β (Aβ1-42) aggregation at different doses of the extracts was measured using the Thioflavin T fluorescence test to assess the anti-amyloidogenic activity. A one-way analysis of variance ($p = 0.0023$) confirmed that the extracts of Cassia tora inhibited amyloid aggregation in a dose-dependent manner. These results indicate that Cassia tora has promise as an antioxidant and natural agent with anti-amyloidogenic effects; hence, it might be used to control Alzheimer's disease.

Keywords: Cassia tora, Antioxidant, Alzheimer's, Disease, Anti-amyloidogenic.

I. INTRODUCTION

Cognitive impairment, behavioral irregularities, memory loss, and other symptoms characterize progressive neurodegenerative Alzheimer's disease (AD), which mostly affects the elderly. While the exact reason for Alzheimer's disease remains a mystery, it is often believed that a combination of genetic, environmental, and lifestyle factors causes abnormal protein accumulation in the brain, including amyloid-beta (Aβ) plaques and neurofibrillary tangles of tau protein. These anomalies impede neuronal communication, leading to significant brain atrophy. Currently, there is no cure for Alzheimer's disease; treatments only slow the disease's progression or reduce symptoms. So, there is a growing movement to look at natural product-based alternative therapies for Alzheimer's disease. Some of these pharmacological effects, such as those of the traditional medicinal plant Cassia tora, may have a beneficial effect on Alzheimer's disease by acting as a neuroprotective.

Throughout the tropics and subtropics, you may find Cassia tora and other leguminous Fabaceae plants. Cassia tora has a long history of use in traditional Ayurvedic and Chinese medicine for the treatment of many ailments, including those pertaining to the skin, liver, digestive system, and eyes. The seeds and leaves of the Cassia tora plant contain a variety of bioactive compounds. Some examples of these chemicals include anthraquinones, flavonoids, glycosides, tannins, and polysaccharides. These chemicals may inhibit inflammation, kill germs, and function as antioxidants, among other biological effects. Cassia tora extracts have been in the news a lot lately because of research into neurological illnesses like Alzheimer's and their potential neuroprotective effects. It has been suggested that Cassia tora's antioxidant and anti-inflammatory properties may play a crucial role in mitigating the oxidative stress and neuroinflammation associated with the etiology of Alzheimer's disease.

One of the primary functions linked to Alzheimer's disease is the buildup of amyloid-beta (Aβ) peptides, which produces brain plaques and disrupts synaptic function. Aβ aggregation is believed to cause synaptic disruption, neuronal loss, and cognitive impairment; it is a critical and early stage in the progression of Alzheimer's disease. Therefore, preventing or suppressing Aβ aggregation is an important objective in Alzheimer's disease research. Research on Cassia tora has focused on its potential anti-amyloidogenic effects, namely its ability to inhibit Aβ aggregation and improve the clearance of brain amyloid plaques. Based on initial study, Cassia tora extracts may be able to suppress the aggregation of Aβ peptides, hence reducing their neurotoxic effects. The neuroprotective effects of Cassia tora may be amplified by its powerful antioxidant properties, which it uses to combat amyloidosis. Oxidative stress, which occurs when cells produce too much reactive oxygen species (ROS), is a characteristic of the pathophysiology of Alzheimer's disease (AD). Due to its high oxygen consumption and lipid-rich makeup, the brain is particularly vulnerable to neurodegeneration induced by reactive oxygen species (ROS). Scientific studies have shown that Cassia tora's flavonoids and phenolic acids, which are antioxidant compounds, may protect neurons from oxidative damage by neutralizing free radicals. By lowering oxidative stress, these compounds may help AD patients maintain cognitive function and preserve neurons.

Inflammation is also an important factor in how Alzheimer's disease progresses. Neuroimmune cells in the brain called microglial cells are activated when amyloid plaques and other abnormalities happen in the brains of persons with Alzheimer's disease. While activation of microglia provides some initial protection, the production of mediators and pro-inflammatory cytokines by chronic inflammation ultimately leads to neuronal

damage and accelerates neurodegeneration. It has long been known that Cassia tora has anti-inflammatory properties; however, recent studies have shown that it may also affect neuroinflammation. The bioactive compounds in the plant extracts may reduce inflammation-induced neuronal damage in Alzheimer's disease by inhibiting the generation of pro-inflammatory cytokines and microglial activation, two mechanisms by which the illness manifests. An further fascinating aspect of using Cassia tora in Alzheimer's research is its capacity to alter cholinergic function. The cholinergic system, which produces and releases the neurotransmitter acetylcholine, is an integral component of learning, memory, and overall cognitive function. Cognitive decline and a precipitous decrease in acetylcholine levels are the results of Alzheimer's disease (AD) early symptoms, which include cholinergic neuron degeneration. The present pharmacological treatment for Alzheimer's disease (AD) is acetylcholinesterase inhibitors (AChEIs). These medications enhance cognitive function by raising acetylcholine levels in the brain. Cassia tora's acetylcholinesterase (AChE) inhibitory activity suggests it may improve cholinergic transmission, which might aid cognition and memory in Alzheimer's disease patients. The fact that Cassia tora may enhance cholinergic function and reduce Aβ aggregation makes it an attractive prospect for a multi-target therapy for Alzheimer's disease.

II. REVIEW OF LITERATURE

Tuzimski, Tomasz et al., (2022) Neurodegenerative illnesses, of which Alzheimer's disease is one of the most prevalent, are one of the most significant worldwide public health concerns that our age is now confronted with. This is mostly due to the fact that the older population in the majority of international nations is growing. In light of the increasing prevalence of these disorders, it is of the utmost need to identify and develop novel therapeutic approaches that are capable of both preventing and curing them. As a result of the fact that neurodegenerative illnesses are multifactorial disorders, numerous treatment methods are required for treating them. Of all the neurodegenerative disorders, Alzheimer's is among the most common. An important therapeutic strategy is modulating the concentration of the neurotransmitter acetylcholine at cholinergic synapses.

Chethana, Kolambe Rajappa et al., (2018) To investigate the potential of Caesalpinia crista (C. crista) leaf components for cholinergic and anti-amyloidogenic effects in the treatment of Alzheimer's disease using fractional screening of plant extracts. Methods: Aiming to reduce oxidative stress, cholinergic, and amyloidosis, this research investigated the effect of C. crista extracts in polar and nonpolar solvents. The DPPH total antioxidant test, Ellman's technique for cholinergic assay, and

thioflavin-T fluorescence and transmission electron microscopy for anti-amyloidogenic assay were all used to study the antioxidant activity.

R, Chethana et al., (2017) There is a current tendency toward developing drugs for Alzheimer's disease (AD) from natural sources. Find out which plant might be a substitute while looking for a chemical that could cure Alzheimer's disease. The abundance of Cassia tora in nature and its availability as a weed make it a possible source. To determine its efficacy against AD, Cassia tora is a suitable candidate among the many plants belonging to the Leguminosae family that may have therapeutic properties. Senile plaques and neurofibrillary tangles are the hallmarks of Alzheimer's disease's etiology. Plaques are formed by protobirils, oligomers, and final fibrilar-like structures, all of which are formed by Aβ42. Initial screening of potential natural AD treatments was aided by the peptides' fibrilar-like structure, which was present even under in vitro settings.

Yadav, J.P. (2011). Finding out how effective petroleum ether, benzene, chloroform, methanol, and water extract from C. occidentalis and C. tora leaves were as antioxidants was the goal of this study. Metal chelating, reducing power, β-carotene-linoleic acid, and nitric oxide scavenging were the antioxidant tests that were used. Suppression of free radicals in solvent extracts was dose-dependent. In comparison to the comparable aqueous and methanolic extracts of C. tora, the nitric oxide, β-carotene-linoleic acid, and metal chelating activity assays showed the maximum inhibition of 64.65±0.27%, 50.81±0.22%, and 79.44±0.18% at a concentration of 1mg/ml, respectively. A notable disparity was seen when contrasted with the positive control standards, which included curcumin and ascorbic acid. While the methanolic C. tora leaf extract contained 13.15±0.78% dw GAE, the aqueous C. occidentalis leaf extract exhibited the greatest total phenolic concentration at 21.37±0.33% dw GAE. The findings demonstrate that C. occidentalis has a much higher antioxidant activity when compared to C. tora leaf extracts in vitro.

Yen, Gow-Chin et al., (2000) The antioxidant properties of water extracts (WECT) of Cassia tora L. were investigated at various roast degrees. Compared to alpha-tocopherol (82% inhibition of linoleic acid peroxidation), water extracts of unroasted C. tora L. (WEUCT) had a 94% inhibitory effect at a dosage of 0.2 mg/mL. Roasting the aqueous extracts of C. tora L. for 5 minutes at 175 degrees C reduced linoleic acid peroxidation by 83%, while roasting them at 200 degrees C for 5 minutes reduced it by 82%. Results indicated that either roasting temperature or time increased, WECT's antioxidant activity decreased. In the Fenton reaction-induced liposome

oxidation, WEUCT (IC(50)= 0.41 mg/mL) outperformed alpha-tocopherol (IC(50)= 0.55 mg/mL). There was remarkable antioxidant activity shown by WEUCT in both enzymatic and nonenzymatic microsome oxidative systems. The browning degree and chemiluminescence of the water extracts of roasted C. tora L. were higher than those of the unroasted sample. However, the total polyphenolic compounds in WECT decreased after roasting was finished. Degradation of polyphenolic components and Maillard reaction products may explain why water extracts of roasted C. tora L. have reduced antioxidant activity.

III. MATERIALS AND METHODS

Plant Collection and Extraction

A certified herbal garden provided the leaves of Cassia tora Linn. We used solvents like ethanol and water to extract the leaves after they were dried and powdered into a fine powder. In preparation for further examination, the filtrate was concentrated under decreased pressure and filtered.

In vitro Anti-Amyloidogenic Activity

Cassia tora's ability to prevent the formation of amyloid-β (Aβ) clumps was evaluated using a Thioflavin T (ThT) fluorescence test. The level of amyloid aggregation was measured by recording the fluorescence that resulted from incubating Aβ1-42 peptides with different doses of Cassia tora extract.

Antioxidant Assay

With the use of DPPH and ABTS radical scavenging tests, the antioxidant ability of Cassia tora extracts was assessed. The capacity of the extracts to scavenge free radicals was assessed using these tests.

Statistical Analysis

To determine if there were statistically significant differences between the groups, the experimental data were subjected to one-way analysis of variance (ANOVA) and then post-hoc Tukey testing. For statistical purposes, a p-value below 0.05 was deemed significant.

IV. RESULTS AND DISCUSSION

Table 1: Effect of Cassia tora Extracts on Amyloid-β Aggregation (ThT Assay)

Concentration (µg/mL)	% Inhibition (Ethanolic Extract)	% Inhibition (Aqueous Extract)
25	24.8 ± 2.4	18.7 ± 1.8

50	45.2 ± 3.1	31.9 ± 2.5
100	62.5 ± 4.2	49.7 ± 3.6

The inhibitory effects of ethanolic and aqueous Cassia tora Linn. extracts on amyloid-β aggregation are shown in the table. In comparison to the water-based extract, the ethanolic one shows more potent inhibition at all doses. The ethanolic extract has a dose-dependent impact on amyloid-β aggregation, inhibiting 24.8% at 25 µg/mL and rising to 62.5% at 100 µg/mL. In a similar vein, the inhibition of the aqueous extract is lower, standing at 18.7% at 25 µg/mL and 49.7% at 100 µg/mL.

Table 2: Antioxidant Activity of Cassia tora Extracts

Assay	Ethanolic Extract (IC50 µg/mL)	Aqueous Extract (IC50 µg/mL)
DPPH Radical Scavenging	48.7 ± 2.1	75.8 ± 3.3
ABTS Radical Scavenging	29.6 ± 1.7	54.2 ± 2.8

The DPPH experiment shows that the ethanolic Cassia tora Linn. extract has a much lower IC50 of 48.7 µg/mL compared to the aqueous extract's IC50 of 75.8 µg/mL. This indicates that the ethanolic extract is superior in scavenging radicals, as seen in the table. According to the results of the ABTS experiment, the IC50 values for the two extracts are 54.2 µg/mL for the aqueous extract and 29.6 µg/mL for the ethanolic extract.

Table 3: ANOVA Results for the Effect of Cassia tora Extracts on Amyloid-β Aggregation

Source of Variation	Sum of Squares (SS)	Mean Square (MS)	F-value	P-value
Between Groups	1824.75	608.25	15.82	0.0023**
Within Groups	462.75	38.56		
Total	2287.50			

The table illustrates the results of the analysis of variance (ANOVA) on the impact of Cassia tora Linn. extracts on the aggregation of amyloid-β. A sum of squares (SS) of 1824.75 and a mean square (MS) of 608.25 in the "Between Groups" variation show that the inhibitory effects of various extract concentrations on amyloid-β aggregation are differently significant. This confirms that the concentration of Cassia tora extracts has a substantial effect on the suppression of amyloid-β aggregation, since the F-value of 15.82 and p-value of 0.0023 indicate that these changes are statistically significant ($p < 0.05$). A total of 462.75 SS and 38.56 MS points make up the "Within Groups" variant, which stands for the mistake phrase. The sum of all the squares comes to 2287.50 at the end.

V. CONCLUSION

In light of the complex nature of Alzheimer's disease, Cassia tora has emerged as a potential natural treatment option. As a whole, its neuroprotective actions are the result of its many bioactive components' strong anti-amyloidogenic, antioxidant, anti-inflammatory, and cholinergic-modulating capabilities. Cognitive loss linked with Alzheimer's disease (AD) may be slowed by Cassia tora's ability to suppress amyloid-beta aggregation, reduce oxidative stress, and modulate neuroinflammation. Its multipronged strategy for better brain health is further shown by its capacity to boost neurogenesis and cholinergic function. The potential for creating safe, effective therapies for Alzheimer's disease is being explored as scientists learn more about how Cassia tora works. In light of the critical need for novel therapeutic approaches to address this worldwide health crisis, Cassia tora has the potential to significantly contribute to our knowledge of neurodegenerative diseases and the creation of comprehensive treatment plans that improve the lives of those living with Alzheimer's.

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