

BIOMARKERS (NON-NEUROIMAGING)

Anti-Alzheimer Effects of Vigna Radiata and Vigna Pilosa in Rats Induced with Beta Amyloid

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Abstract

Background: Alzheimer's disease is the commonest kind of dementia. Both intracellular neurofibrillary tangles (NFTs) and extracellular senile plaques, also known as amyloid plaques, are characteristic features of the condition. Both the Vigna radiata and the Vigna pilosa are plants that are used in numerous Ayurvedic formulations that are utilized in the treatment of dementia and ailments that are associated to it.

Method: Purpose of assessing the neuroprotective impact of these plants on an amyloid- β (A β) 1-42 model of Alzheimer's disease in rats, the current study was conducted. This study lasted for a total of twenty-one days. After the recovery time following the injection of A β 1-42 intravenous, beginning on the eighth day, the ethyl acetate extract of Vigna radiata and the ethanolic extract of Vigna pilosa were administered at doses of 200mg/kg and 400mg/kg, respectively. Additionally, the dose of Donepezil was administered at a dose of 3mg/kg once day until the 21st day. Both the radial maze test and the Step-through Passive Avoidance Test were utilized in the cognitive behavioural research that was carried out. Euthanasia was performed on the animals, and the brains were removed and analyzed for antioxidant parameters and levels of brain cytokines. The animals were then returned to their owners. It was determined by histological analysis that the brain tissues were examined.

Result: In both the radial arm maze task and the step through passive avoidance test, the rats' cognitive capabilities were greatly improved as a result of the treatment with the extracts. Additionally, it decreased oxidative stress, which was demonstrated by the decreased levels of lipid peroxide and nitric oxide, in addition to the increased levels of antioxidant enzymes such as catalase, superoxide dismutase, and reduced glutathione. A dose-dependent reduction in the concentration of neuroinflammatory markers was achieved by the treatment, which resulted in a reduction in the severity of neuroinflammation in rats.

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Conclusion: The findings allow for the conclusion that the plants *Vigna radiata* and *Vigna pilosa* have favourable effects in the improvement of cognitive impairment in Alzheimer's disease (AD). These benefits are achieved through the reduction of oxidative stress and neuroinflammation. Amyloid- β , *Vigna radiata*, and *Vigna pilosa*

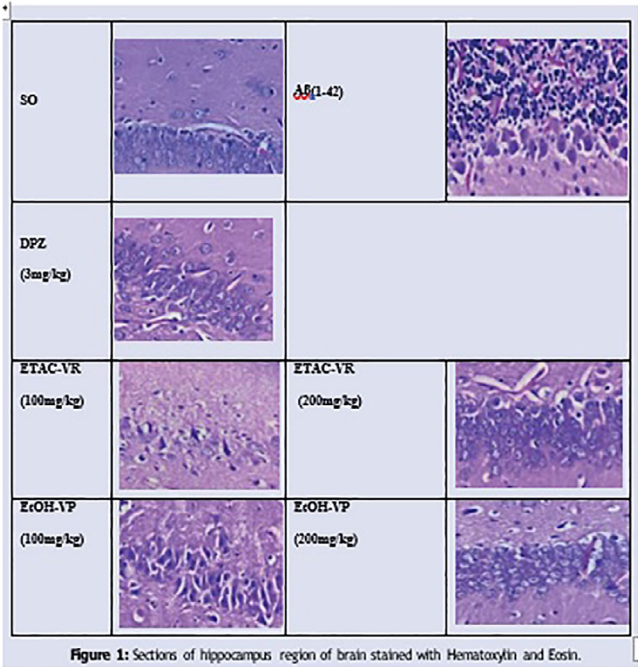


Table 1: Groups and treatments.

Groups	Treatments	No. of animals
I	Sham operated (SO) (ICV-2µl aCSF/site)	6
II	Amyloid-β (Aβ ₁₋₄₂) (ICV- 10µg 2µl aCSF/site)	6
III	Aβ ₁₋₄₂ DPZ (3mg/kg)	6
IV	Aβ ₁₋₄₂ ETAC-VR (100mg/kg)	6
V	Aβ ₁₋₄₂ ETAC-VR (200mg/kg)	6
VI	Aβ ₁₋₄₂ EIOH-VP (100mg/kg)	6
VII	Aβ ₁₋₄₂ EIOH-VP (200mg/kg)	6

Table 2: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on Reference Memory Error (RME) of Radial Arm Maze (RAM) test in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	RME Score
1	SO	1.43±0.42
2	Aβ(1-42)	5.77±0.29***
3	DPZ (3mg/kg)	2.41±0.52***
4	ETAC-VR(100mg/kg)	3.75±0.41*
5	ETAC-VR(200mg/kg)	2.97 ± 0.38**
6	EIOH-VP(100mg/kg)	3.10 ± 0.44**
7	EIOH-VP(200mg/kg)	2.31±0.63***

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated groups respectively. (SO-Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 3: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on Correct Working Memory Error (CWME) of Radial Arm Maze (RAM) test in ICV-Aβ rat model of Alzheimer's disease Correct Working Memory Error (CWME).

S. No	Groups	CWME Score
1	SO	1.67±0.53
2	Aβ(1-42)	6.23±0.31***
3	DPZ (3mg/kg)	2.89±0.47***
4	ETAC-VR (100mg/kg)	3.97±0.53*
5	ETAC-VR (200mg/kg)	3.15 ± 0.27**
6	EIOH-VP (100mg/kg)	3.37 ± 0.21**
7	EIOH-VP (200mg/kg)	2.55±0.87***

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated groups respectively. (SO-Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 4: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on Incorrect Working Memory Error (IWME) of Radial Arm Maze (RAM) test in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	IWME Score
1	SO	2.77±0.73
2	Aβ(1-42)	7.21±0.42***
3	DPZ (3mg/kg)	3.15±0.52***
4	ETAC-VR (100mg/kg)	6.28±0.77
5	ETAC-VR (200mg/kg)	4.27 ± 0.31**
6	EIOH-VP (100mg/kg)	6.72±0.53
7	EIOH-VP (200mg/kg)	4.25 ± 0.17**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 8: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Nitric Oxide (NO) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Nitrate/ Nitrite(µM/g tissue)
1	SO	25.63 ± 1.87
2	Aβ(1-42)	85.56±2.23***
3	DPZ (3mg/kg)	46.87±1.93***
4	ETAC-VR(100mg/kg)	67.26±1.87**
5	ETAC-VR(200mg/kg)	37.28±2.71**
6	EIOH-VP(100mg/kg)	62.57±1.56**
7	EIOH-VP(200mg/kg)	29.17±2.11***

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO-Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 9: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Superoxide dismutase (SOD) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	SOD(U/g tissue)
1	SO	12.81 ± 1.12
2	Aβ(1-42)	2.57 ± 0.87***
3	DPZ (3mg/kg)	7.89 ± 0.73**
4	ETAC-VR(100mg/kg)	6.63±0.77*
5	ETAC-VR(200mg/kg)	8.75±0.53**
6	EIOH-VP(100mg/kg)	7.12±0.93*
7	EIOH-VP(200mg/kg)	9.67±1.13***

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 10: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Catalase (CAT) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Catalase(U/g tissue)
1	SO	8.98±0.79
2	Aβ(1-42)	1.98 ± 0.59***
3	DPZ (3mg/kg)	5.57 ± 0.21**
4	ETAC-VR (100mg/kg)	5.75 ± 0.58**
5	ETAC-VR (200mg/kg)	6.83±0.67**
6	EIOH-VP (100mg/kg)	5.12±0.77*
7	EIOH-VP (200mg/kg)	7.15±0.69**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 11: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Glutathione (GSH) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	GSH(U/g tissue)
1	SO	25.33 ± 1.17
2	Aβ(1-42)	4.47 ± 0.97***
3	DPZ (3mg/kg)	15.45 ± 1.13**
4	ETAC-VR (100mg/kg)	14.22 ± 1.41**
5	ETAC-VR (200mg/kg)	18.73 ± 1.77**
6	EIOH-VP (100mg/kg)	16.14 ± 1.69**
7	EIOH-VP (200mg/kg)	19.87 ± 1.83**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 5: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on Initial latency (IL) period of Passive Avoidance Test (PAT) test in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Initial Latency(Sec)
1	SO	29.56±2.45
2	Aβ(1-42)	52.31±1.77***
3	DPZ (3mg/kg)	34.15±1.97**
4	ETAC-VR(100mg/kg)	42.83±1.59*
5	ETAC-VR(200mg/kg)	35.35±2.14**
6	EIOH-VP(100mg/kg)	40.56±1.58**
7	EIOH-VP(200mg/kg)	36.18±2.17**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 6.1: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on step through latency (STL) period of Passive Avoidance Test (PAT) test in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Step-through Latency(Sec)
1	SO	211.78±11.28
2	Aβ(1-42)	133.54±9.87***
3	DPZ (3mg/kg)	198.56±12.83**
4	ETAC-VR(100mg/kg)	153.47±11.11
5	ETAC-VR(200mg/kg)	185.23±8.69*
6	EIOH-VP(100mg/kg)	147.89±13.57
7	EIOH-VP(200mg/kg)	189.56 ± 12.31*

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 6.2: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on step through latency (STL) period of Passive Avoidance Test (PAT) test in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Malondialdehyde(µMolMDA/g tissue)
1	SO	110.87±9.65
2	Aβ(1-42)	412.33±17.86***
3	DPZ (3mg/kg)	268.98±8.67**
4	ETAC-VR(100mg/kg)	253.21±14.81**
5	ETAC-VR(200mg/kg)	189.26±13.58**
6	EIOH-VP(100mg/kg)	222.14±10.89**
7	EIOH-VP(200mg/kg)	154.78±11.58**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 7: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Lipid Peroxide (LPO) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	Malondialdehyde(µMolMDA/g tissue)
1	SO	110.87±9.65
2	Aβ(1-42)	412.33±17.86***
3	DPZ (3mg/kg)	268.98±8.67**
4	ETAC-VR(100mg/kg)	253.21±14.81**
5	ETAC-VR(200mg/kg)	189.26±13.58**
6	EIOH-VP(100mg/kg)	222.14±10.89**
7	EIOH-VP(200mg/kg)	154.78±11.58**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 12: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain Interleukin-1β (IL-1β) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	IL-1β(pg/ml)
1	SO	123.47±13.18
2	Aβ(1-42)	377.25±12.58***
3	DPZ (3mg/kg)	305.17±14.15**
4	ETAC-VR (100mg/kg)	299.17±13.89**
5	ETAC-VR (200mg/kg)	197.85±13.33**
6	EIOH-VP (100mg/kg)	347.17±12.89
7	EIOH-VP (200mg/kg)	166.87±12.67**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)

Table 13: Effect of ethyl acetate extracts of *Vigna radiata* (ETAC-VR) & *Vigna pilosa* (EIOH-VP) on brain tumor necrosis factor alpha (TNF-α) level in ICV-Aβ rat model of Alzheimer's disease.

S. No	Groups	TNF-α(pg/ml)
1	SO	175.23±11.58
2	Aβ(1-42)	456.71±17.87***
3	DPZ (3mg/kg)	371.83±13.37**
4	ETAC-VR (100mg/kg)	405.87±14.89
5	ETAC-VR (200mg/kg)	296.53±11.72**
6	EIOH-VP (100mg/kg)	399.17±18.13
7	EIOH-VP (200mg/kg)	275.81±10.16**

Values are represented as Mean ± SEM. Superscript***denotes p<0.001; **denotes p<0.01; *denotes p<0.05 vs SO group and ##denotes p<0.001; #denotes p<0.01; #denotes p<0.05 vs Aβ1-42 treated group respectively. (SO- Sham Operated, Aβ-Amyloid beta, DPZ-Donepezil)