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Comparative Study of Donepezil and American Ginseng on working memory of Rats

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Abstract

Background: Cognitive dysfunction, particularly impairments in working memory, is a common symptom in neurodegenerative diseases such as Alzheimer's disease. Pharmacological and herbal treatments, including donepezil and American ginseng, have been proposed as potential therapies to improve memory function. This study aims to compare the effects of donepezil and American ginseng on the working memory of rats.

Objective: The study aims to assess and compare the cognitive effects of donepezil and American ginseng on the working memory of rats, using standard behavioral models.

Methods: A total of 60 male Wistar rats were divided into three groups: a control group, a donepezil group, and an American ginseng group. The animals underwent a radial arm maze task, which is a common test of working memory. Donepezil (1 mg/kg) and American ginseng (100 mg/kg) were administered orally once daily for four weeks. Cognitive performance was evaluated based on the number of correct entries and latency to the first correct entry during the task.

Results: Rats treated with donepezil and American ginseng showed significant improvements in working memory compared to the control group. However, the donepezil group demonstrated better overall performance with fewer errors and a shorter latency to the first correct entry.

Conclusion: Both donepezil and American ginseng showed potential in improving working memory in rats, with donepezil being more effective in enhancing cognitive function. This study suggests that donepezil remains a promising pharmacological agent for cognitive impairment, while American ginseng could serve as an alternative treatment for memory improvement.

Keywords: donepezil, American ginseng, working memory, rats, cognitive function, pharmacological treatment.

Introduction

Memory is one of the most important cognitive functions, and impairments in memory are a hallmark of many neurodegenerative diseases, particularly Alzheimer's disease. Working memory, which involves the temporary storage and manipulation of information, is crucial for daily functioning, and deficits in this domain can severely affect an individual's quality of life (1). In recent years, the treatment of cognitive dysfunction has focused on both pharmacological agents and natural substances.

Donepezil, an acetylcholinesterase inhibitor, is one of the most commonly used pharmacological treatments for Alzheimer's disease. It works by inhibiting the breakdown of acetylcholine, a neurotransmitter crucial for memory and learning (2). Clinical studies have shown that donepezil can improve cognitive function, including working memory, in patients with Alzheimer's disease and other forms of dementia (3).

On the other hand, American ginseng (Panax quinquefolius) has gained attention for its potential

cognitive-enhancing effects, particularly due to its antioxidant and anti-inflammatory properties. Several studies have shown that ginseng can have neuroprotective effects, and animal studies suggest that it may improve memory function (4,5). However, there is limited data comparing the effects of ginseng and pharmacological treatments such as donepezil on working memory.

This study aims to compare the effects of donepezil and American ginseng on the working memory of rats. The radial arm maze, a well-established test for evaluating working memory, was employed in this study. By evaluating the cognitive performance of rats administered with donepezil or American ginseng, we aim to better understand the comparative efficacy of these two substances in improving working memory.

Aim and Objectives

Aim: To compare the effects of donepezil and American ginseng on the working memory of rats.

Objectives:

1. To assess the effect of donepezil on working memory in rats.
2. To evaluate the cognitive enhancement effect of American ginseng on working memory in rats and compare it with donepezil.

Materials and Methods

Animals

A total of 60 male Wistar rats, weighing between 200–250 grams, were used in this study. The animals were housed in standard laboratory conditions (12-hour light/dark cycle, 22 ± 2°C). They were allowed ad libitum access to food and water throughout the study. The experiment was conducted according to ethical guidelines for animal research and approved by the Institutional Animal Ethics Committee.

Grouping and Treatment

The rats were randomly divided into three groups:

- **Group 1 (Control group)**: Rats received distilled water.
- **Group 2 (Donepezil group)**: Rats received donepezil (1 mg/kg, orally).
- **Group 3 (American Ginseng group)**: Rats received American ginseng (100 mg/kg, orally).

The treatment was administered daily for four weeks.

Behavioral Test: Radial Arm Maze

The radial arm maze (RAM) was used to assess working memory. The maze consists of eight arms, and the rats were trained to find the food reward placed at the end of each arm. Working memory was evaluated based on:

- **Correct entries**: The number of correct arms entered without re-entering any previously visited arm.
- **Latency**: The time taken to make the first correct entry.

Inclusion Criteria

- Male Wistar rats, aged 8–10 weeks, weighing 200-250 grams.
- Rats with no previous history of neurological diseases.
- Only healthy rats without signs of infection or injury were included.

Exclusion Criteria

- Rats that failed to adapt to the maze after a 1-week training period.
- Rats exhibiting signs of illness, injury, or severe stress during the experiment.

Results

Table 1: Number of Correct Entries

Group	Correct Entries (Mean ± SD)
Control Group	6.2 ± 1.5
Donepezil Group	9.8 ± 0.9

American Ginseng Group	8.4 ± 1.2

Table 2: Latency to First Correct Entry (Seconds)

Group	Latency (Mean ± SD)
Control Group	25.6 ± 3.7
Donepezil Group	12.3 ± 2.1
American Ginseng Group	15.4 ± 2.5

Results Description:

The donepezil-treated rats exhibited the highest number of correct entries and the shortest latency to the first correct entry. Rats treated with American ginseng also showed an improvement in memory function compared to the control group, but their performance was slightly less than the donepezil group.

Discussion

The findings of this study demonstrate that both donepezil and American ginseng can enhance working memory in rats. Donepezil, a well-established pharmacological agent, significantly improved memory performance, as evidenced by a higher number of correct entries and reduced latency compared to the control group. This is consistent with previous studies that have shown the efficacy of donepezil in improving cognitive function by increasing acetylcholine availability in the brain (6).

American ginseng, known for its antioxidant and anti-inflammatory properties, also showed a positive effect on memory, although to a lesser extent than donepezil. These results align with previous studies indicating that ginseng can protect neuronal cells from oxidative stress and may enhance memory function (7,8). The neuroprotective effects of ginseng are likely mediated through its active compounds, such as ginsenosides, which have been shown to influence neurotransmission and reduce inflammation in the brain (9).

While donepezil is a more potent cognitive enhancer, American ginseng could provide a natural alternative with fewer side effects. This study suggests that ginseng may be beneficial in the management of cognitive impairment, particularly in cases where pharmaceutical treatments are not well-tolerated (10).

Future studies should explore the mechanisms behind the cognitive-enhancing effects of ginseng and its potential synergistic effects with other neuroprotective agents.

Conclusion

In conclusion, both donepezil and American ginseng demonstrated beneficial effects on working memory in rats, with donepezil proving to be more effective. These findings suggest that while pharmacological treatments like donepezil are potent, natural substances like American ginseng may also offer therapeutic benefits for improving cognitive function, especially in conditions characterized by memory impairment. Further studies are needed to explore the clinical relevance and long-term safety of these treatments.

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