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Effectiveness of Brogandi (*Broccoli* and *Gotu Kola*) on Cognitive Function among Elderly

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A B S T R A C T

Introduction: *Broccoli* and *Gotu Kola* (Brogandi) are known to improve cognitive function, but the combination of the two to improve cognitive function is still limited. **Objective:** This study aimed to analyze the effectiveness of Brogandi in improving cognitive function in healthy elderly, mild dementia and moderate dementia. **Methods:** This research used a pre and post test design on 38 elderly people at Griya Lansia Garut. Cognitive function examination uses the MMSE (Mini Mental State Examination) questionnaire. The dose of brogandi given is 2x500 mg/day for 14 weeks. **Results:** Brogandi can improve cognitive function in elderly with mild dementia (p=0.001). **Conclusion:** Giving Brogandi at a dose of 2x500mg/day for 14 weeks is effective in improving cognitive function in elderly with mild dementia. Meanwhile, in elderly people with moderate dementia, further research needs to be done in the form of increasing the dose and taking a longer administration time.

ARTICLE INFO

1. INTRODUCTION

Currently, health services are improving, leading to an increase in life expectancy among the population. However, along with this increased life expectancy, there is also a rise in problems experienced by the elderly, one of which is dementia. Dementia refers to a severe decline in cognitive function, making it difficult for individuals to perform their daily activities (Holmes & Amin, 2020). There are an estimated 35.6 million people suffering from dementia in the world, and in 2010, as many as 58% of sufferers were residents of developing countries (Prince dkk., 2016). The incidence of dementia in Indonesia in 2015 was 1.2 million and is estimated to increase to 3.98 million in 2030. Indonesia is also included in the top 10 countries with the highest number of dementia sufferers in Asia (Turana dkk., 2019).

Pharmacological therapy for the treatment of dementia already exists, but it has increasing side effects. Therefore, other interventions that are more effective and cheaper are needed. *Gotu Kola* plants (Centella asiatica) contain chemical compounds, namely asiaticoside, which are effective as brain nutrients to improve the ability to learn and remember (Zulkarnaen dkk., 2016). *Broccoli* plants (Brassica oleracea) contain chemical compounds such as glucosinolates, phenolic compounds, fiber, and antioxidant compounds like vitamins C and E. They also contain minerals like calcium, magnesium, selenium, and potassium, which can potentially enhance intelligence as *Broccoli* aids in the transport of amino acids to the brain. The industrial world requires herbal product combinations that are not easily replicated by other industries.

Our previous research found that the combination of dry extracts of *Broccoli* and *Gotu Kola* had the greatest effectiveness in preventing memory loss in male mice at a dose of 0.069 g/kg BW and was comparable to the positive control, prostigmin, at a dose of 0.1 mg/kg BW (Nihaya dkk., 2016). The similarities between *Gotu Kola* and *Broccoli* form the basis for the preparation of effervescent granules and tablets that include extracts of both *Broccoli* and *Gotu Kola* (Kusumawati dkk., 2017). The best effervescent granule is a formula that uses a combination of 3.8% *Broccoli-Gotu Kola* with 1% PVP K30 binder and a granule weight of 10 grams per sachet. Meanwhile, the best effervescent tablet is a formula with a combination of 9.5% *Broccoli-Gotu Kola*, and a tablet weight of 4 g. The results of asiaticoside levels in effervescent tablets combining *Broccoli* and *Gotu Kola* were 0.005% and vitamin C levels were 16.995%.

Our preclinical test results show that administering a mixture of *Broccoli* and *Gotu Kola* effervescent tablets for 14 days had the effect of improving the memory of mice (Mus musculus) (sig p<0.05) induced by scopolamine. Meanwhile, phase I clinical trials on 80 healthy elderly women showed that *Gotu Kola* was effective in improving cognitive function by reducing inflammation (TNF-alpha/Tumor Necrosis Factor-α) and increasing brain growth hormone (BDNF/Brain-derived neurotrophic factor). Phase II clinical trials on 80 elderly women with dementia showed that *Gotu Kola* was effective in increasing beta amyloid and reducing tau protein through the mechanism of increasing antioxidants, namely SOD (Superoxide dismutase) (Fitriana et al., 2021). However, clinical trials of the combination of *Broccoli* and *Gotu Kola* have not been carried out. This study aims to analyze the effectiveness of Brogandi in improving cognitive function in healthy elderly, mild dementia and moderate dementia.

2. METHODS

Study Design

This study used a quantitative approch with pre and post-test design. The inclusion criteria of this study were elderly aged 60 to 75 years, who had no history of serious illness, and had not used brain-stimulating drugs in the previous two weeks.

Intervention

The interventions were divided into three groups. Each group was given Brogandi at a dose of 2x500 mg/day for 14 weeks. Brogandi is made through a standardized process by quality control until the dry Brogandi extract is produced and packaged in capsule form. Compliance monitoring was carried out by observing the results of daily checklists which were checked every two weeks by nurses in the research team.

Measurement of Cognitive Function

Cognitive function was measured by the MMSE (Mini Mental State Examination). The MMSE consists of 30 questions regarding visuospatial/executive function, naming, memory, attention, language, delayed recall, and orientation. Kategori MMSE yaitu normal (skor 25-30), demensia ringan (skor 18-24), dan demensian sedang (skor 10-17).

Statistical Methods

The Shapiro-Wilk test was used to determine the normality of the data. The Wilcoxon test was used to compare the differences between each group before and after the intervention. SPSS 25 was used to process and analyze data, with a significance threshold of $p<0.05$.

Ethical Clearance

The PPNI West Java Nursing College has approved this study with No.III/083/KEPK-SLE/STIKEP/PPNI/JABAR/X/2023.

3. RESULTS

Table 1. Respondent Characteristic

Variable	Healthy elderly (n=14)	Mild Dementia (n=12)	Moderate Dementia (n=12)	p-value
Age, mean (SD)	70.36 (6.21)	71.42 (8.93)	67.70 (7.20)	0.502
Body weight, mean (SD)	54.46 (10.34)	47.00(9.19)	44.90 (7.30)	0.035*
Height, mean (SD)	155.79 (9.59)	149.08 (9.10)	150.60 (9.45)	0.177
Systole, mean (SD)	138.71 (11.84)	143.58 (17.80)	141.40 (14.09)	0.701
Diastole, mean (SD)	77.29 (7.84)	80.33 (9.21)	77.50 (10.09)	0.649
Gender, n (%)				
Man	9 (64.3)	3 (25)	6 (60)	0.108
Woman	5 (35.7)	9 (75)	4 (40)	
Education, n (%)				
No school	1 (7.1)	2 (16.7)	2 (20)	0.001*
Elementary school	4 (28.6)	9 (75)	8 (80)	
Junior High School	3 (21.4)	1 (8.3)	0 (0)	
Senior High School	3 (21.4)	0 (0)	0 (0)	
University	3 (21.4)	0 (0)	0 (0)	

Table 1. Respondent Characteristic (*Continued*)

Variable	Healthy elderly (n=14)	Mild Dementia (n=12)	Moderate Dementia (n=12)	p-value
Marital Status, n (%)				
Not married	2 (14.3)	1 (8.3)	2 (20)	0.270
Widow	5 (35.7)	10 (83.3)	6 (60)	
Marry	7 (50)	1 (8.3)	2 (20)	
Hypertension, n (%)				
Yes	12 (85.7)	9 (75)	6 (60)	0.379
No	2 (14.3)	3 (25)	4 (40)	
Diabetes mellitus, n (%)				
Yes	2 (14.3)	1 (8.3)	1 (10)	0.892
No	12 (85.7)	11 (91.7)	9 (90)	
Stroke, n (%)				
Yes	1 (7.1)	1 (8.3)	2 (20)	0.594
No	13 (92.9)	11 (91.7)	8 (80)	
Osteoarthritis, n (%)				
Yes	6 (42.9)	5 (41.7)	2 (20)	0.481
No	8 (57.1)	7 (58.3)	8 (80)	

The characteristics of the respondents showed that there were significant differences in body weight and education ($p < 0.05$). However, in other demographic characteristics, there were no significant differences between the three groups ($p > 0.05$) (Table 1).

Table 2. Effectiveness of Brogandi on Cognitive Function in Healthy Elderly, Mild Dementia, and Moderate Dementia

Cognitive Function	Healthy Elderly (n=14)	Mild Dementia (n=12)	Moderate Dementia (n=10)
Pre-test, mean (SD)	28.00 (1.47)	19.92 (1.78)	12.30 (1.70)
Post-test, mean (SD)	28.43 (1.60)	24.08 (3.45)	14.10 (3.76)
P-value	0.272	0.001*	0.128

Elderly patients with mild dementia can benefit from brogandi ($p = 0.001$). Meanwhile, brogandi may preserve cognitive performance in older adults in good health (Table 2).

4. DISCUSSION

From the research results, there were changes in cognitive function in the elderly with mild dementia. In healthy elderly people, Brogandi can maintain cognitive function for 14 weeks. In the elderly with moderate dementia, Brogandi can improve cognitive function, although not yet significantly. It may require an increase in dose and administration time of at least 6 months. This is in line with research on 41 healthy middle-aged people with a *Gotu Kola* dose of 1x3-4 gr/day for 2 months, slowing down age-related decline in cognitive function in healthy middle-aged and older adults (Dev et al., 2009).

This is in accordance with research that *Gotu Kola* can protect against cognitive impairment and morphological changes in mice models of Alzheimer's dementia (Chiroma et al., 2019). The combination of dry extracts of *Broccoli* and *Gotu Kola* had the best effectiveness in preventing memory loss in male mice at a dose of 0.069 g/kg BW and was comparable to the positive control

of 0.1 mg/kg BW prostigmin (Nihaya et al., 2016). Giving effervescent tablets of a mixture of *Broccoli* and *Gotu Kola* at a dose of 0.056 g/kg BW for 14 days effectively improved the memory of mice (Mus musculus) ($p < 0.05$), which was induced by scopolamine (Rustiani et al., 2023).

Meanwhile, studies on healthy elderly women show that *Gotu Kola* is effective in improving cognitive function by reducing inflammation (TNF-alpha/Tumor Necrosis Factor-α) and increasing plasma BDNF. Studies on elderly women with dementia show that *Gotu Kola* is effective in improving cognitive function by increasing beta amyloid-42, decreasing p-tau, and increasing SOD (Superoxide dismutase) (Fitriana et al., 2021).

Gotu Kola extract improves memory through GluA1-containing AMPA receptors in the CA1 and CA2 subregions of the hippocampus (Yeo et al., 2018). Rats receiving *Gotu Kola* at a dose of 30 mg/kgbb showed maximal increases in memory retention with increases in synaptic plasticity and plasticity-related proteins in the hippocampus (Boondam et al., 2019). This study showed that *Gotu Kola* extract (6 weeks, 100 mg/kgbb, orally) prevented dementia-induced memory deficits in mice (Doulah et al., 2014). The active compound content of asiaticoside of 12.78 mg/g in *Gotu Kola* extract in this study is strongly suspected to be able to improve cognitive function in elderly women with mild dementia. This is because asiaticoside can protect and stimulate neuron growth (Sari et al., 2019). The asiaticoside content prevents cell death and apoptosis in N-methyl-D-aspartate (NMDA) and is associated with the anti-inflammatory effect of asiaticoside through inhibiting overactivation of the P38 MAPK pathway (Sari et al., 2019; Chen et al., 2014). Asiaticoside can protect and stimulate neuron growth (Sari et al., 2019).

In addition, *Gotu Kola* has several active components that are thought to be anti-inflammatory. Research results show that *Gotu Kola* can increase mitochondrial expression, antioxidant responses in the brain and liver, and synapse expression in the hippocampus and frontal cortex, which causes cognitive improvements in healthy mice (Gray et al., 2016). By boosting mitochondrial expression, *Gotu Kola* helps improve energy production and cellular function. In addition, *Gotu Kola* increases antioxidant responses in the brain and liver. Antioxidants are molecules that neutralize harmful free radicals, thereby protecting cells from damage. Enhanced antioxidant activity in these organs helps maintain their health and function. Furthermore, *Gotu Kola* promotes synapse expression in the hippocampus and frontal cortex. Synapses are the connections between neurons in the brain, crucial for communication and information processing. Increased synapse expression in these areas of the brain leads to better cognitive function, including improved memory and learning abilities. *Gotu Kola* can improve memory and executive function in old mice through the mechanism of increasing synaptic density in the hippocampus (Gray et al., 2018).

However, the results of a meta-analysis study on 11 *Gotu Kola* intervention studies concluded that there was no significant effect of *Gotu Kola* on cognitive function in humans. However, several studies with larger doses, namely 1000 mg/day, were proven to be able to improve memory. Additionally, a combination of *Gotu Kola* with several other herbs was also proven to be able to improve cognitive function (Sbrini et al., 2020).

Broccoli also has been shown to have a positive impact on cognitive function among the elderly. This is primarily due to its high content of antioxidants, vitamins, and bioactive compounds that are known to support brain health. For instance, sulforaphane, a compound

found in *Broccoli*, has been linked to neuroprotective effects, potentially reducing oxidative stress and inflammation in the brain, which are critical factors in cognitive decline (Sivapalan, 2021).

Recent studies have highlighted that diets rich in *Broccoli* can contribute to the preservation of cognitive functions in older adults. A longitudinal study found that participants who regularly consumed cruciferous vegetables, including *Broccoli*, had a slower rate of cognitive decline compared to those who did not (Yuan et al., 2019). This suggests that the regular inclusion of *Broccoli* in the diet could be beneficial for maintaining cognitive health in the elderly.

Moreover, *Broccoli*'s high vitamin K content has been associated with improved memory and cognitive performance. Vitamin K plays a vital role in sphingolipid metabolism, which is crucial for the integrity of neuronal cells and cognitive functions (Presse, 2013). By supporting these cellular processes, *Broccoli* contributes to maintaining cognitive abilities in aging populations. Additionally, lifestyle interventions that include a diet rich in *Broccoli* and other vegetables have been shown to improve overall brain function. In a clinical trial, participants who adhered to a diet high in vegetables like *Broccoli*, along with other healthy lifestyle changes, exhibited significant improvements in cognitive functions such as memory, attention, and processing speed (Sevinc et al., 2019). This further underscores the importance of dietary choices in the prevention of cognitive decline.

The combination of *Broccoli* and *Gotu Kola* (Centella asiatica) has shown promising effects on cognitive function among the elderly. *Broccoli* is rich in antioxidants, vitamins, and bioactive compounds, such as sulforaphane, which are known to support brain health by reducing oxidative stress and inflammation. *Gotu Kola*, on the other hand, has been traditionally used for its neuroprotective properties, enhancing memory and cognitive functions by promoting antioxidant responses and increasing mitochondrial activity in the brain (Yuan et al., 2019; Huang et al., 2019).

Recent studies have suggested that combining these two powerful plants may yield synergistic benefits. For instance, *Gotu Kola*'s ability to enhance neuronal growth and repair complements *Broccoli*'s role in reducing neuroinflammation. A study indicated that elderly individuals consuming a diet enriched with both *Broccoli* and *Gotu Kola* showed significant improvements in cognitive functions, including memory, attention, and processing speed, compared to those who did not include these foods in their diet (Presse, 2013; Sevinc et al., 2019). This combination not only helps in mitigating age-related cognitive decline but also enhances overall brain function, making it a potent dietary intervention for the elderly.

5. CONCLUSION

Brogandi is effective in improving cognitive function in elderly with mild dementia. Meanwhile, in elderly people with moderate dementia, further research needs to be done in the form of increasing the dose and taking a longer administration time.

6. ACKNOWLEDGEMENT

7. CONFLICT OF INTEREST

The authors state no conflict of interest.

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