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In Slico Study of Green Tea (Camellia Sinensis) Extract Epigallocatechine Gallate as an Inhibitor of Alzheimer's and Myositis Using Beta Secretase 1

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ABSTRACT

This research entitled "In Silico Study of Epigallocatechine Gallate Green Tea Extract (Camellia Sinensis) as an Alzheimer and Myositis Inhibitor Using Beta Secretase 1" examines the effectiveness of epigallocatechine gallate (EGCG) as an inhibitor of Alzheimer and Myositis. The research method used is in silico with PyMOL and Pyrex software for molecular simulation and Protein Plus for protein interaction analysis. Analysis of binding affinity calculations showed values of -8.1, -8.1, and -8.0 with RMSD values of 0, 1.443, and 1.767. This study produced evidence that there is an interaction between EGCG and Beta Secretase 1 which illustrates the potential of EGCG as an inhibitor of Alzheimer's and Myositis. Lepinski Rule analysis showed that EGCG has a molecular weight of 448, 8 hydrogen bond donors, 11 hydrogen bond acceptors, a log P value of -3.316 and a molar reactivity of 93.0303. These conclusions indicate that EGCG meets the criteria of Lepinski's rule as a good drug candidate, and therefore shows potential as a therapeutic agent in the treatment of Alzheimer's and Myositis.

Keywords: Epigallocatechine Gallate, Alzheimer, Myositis, Beta Secretase 1, In Silico

INTRODUCTION

Alzheimer's disease and Myositis are two degenerative conditions that affect the human nervous and muscular systems, and their treatment is still a major challenge in the medical field. Epigallocatechine gallate (EGCG), a phenolic compound found in green tea (Camellia Sinensis), has shown neuroprotective and anti-

† Footnotes relating to the title and/or authors should appear here.
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inflammatory effects in several previous studies, and is therefore considered as a potential treatment [1]-[3].

Beta Secretase 1 (BACE1) is an enzyme responsible for the production of beta-amyloid peptides, the main component of plaques that contribute to the pathogenesis of Alzheimer's. In addition, BACE1 has also been found to play a role in inflammation associated with Myositis. Therefore, this research aims to study the possible interaction between EGCG and BACE1 as a basis for developing new therapies for Alzheimer's and Myositis. This study is expected to provide new insights in dealing with these two degenerative diseases [5]-[6].

In recent years, research related to Alzheimer's and Myositis has expanded significantly with a major focus on developing new therapies. Recent studies have identified the key role of Beta Secretase 1 (BACE1) in the pathogenesis of these two diseases, positioning it as a potential target for therapeutic intervention [7]-[8].

On the other hand, research on the neuroprotective and anti-inflammatory potential of epigallocatechine gallate (EGCG), a natural compound found in green tea, has also attracted much attention. Several studies have shown that EGCG can fight inflammation and oxidative damage associated with various pathological conditions, including Alzheimer's and Myositis. However, to date, no studies have directly investigated the interaction between EGCG and BACE1, which is a significant knowledge gap and the main focus of this study [9]-[10].

This research offers novelty in the form of the first in silico study to explore the potential interaction between epigallocatechine gallate (EGCG) and Beta Secretase 1 (BACE1). While each entity has been studied separately in the context of Alzheimer's and Myositis, previous research has never explored the direct interaction between the two [11]-[13].

The contribution of this study lies in its potential to pave the way for the development of EGCG-based therapies for Alzheimer's and Myositis, with BACE1 as the target. The results from this study will provide a better understanding of the mechanism of action of EGCG and how it can be used to inhibit BACE1, thereby enriching knowledge in this field and encouraging further research on EGCG-based therapies [14]-[16]. The aim of this study is to explore and understand the interaction between epigallocatechine gallate and Beta Secretase 1 through in silico studies, with the hope of paving the way for the development of EGCG-based therapies for Alzheimer's disease and Myositis.

METHODS

The research method carried out in this study consists of several comprehensive stages. The initial stage involved data collection and molecular structure modeling using PyMOL software (https://pymol.org/) to visualize and manipulate the structures of the BACE1 protein as well as epigallocatechine gallate (EGCG) [17]-[20]. Furthermore, molecular modeling was performed using Pyrex, a software used for molecular simulation and molecular interaction analysis [21]-[23].

After modeling the molecular structure, the next step was to analyze the interaction between EGCG and BACE1. For this, Protein Plus software (https://proteins.plus/) was used, which allows protein interaction analysis by various methods such as docking and affinity calculation. In this study, binding affinity was calculated using Protein Plus software to evaluate the binding strength between EGCG and BACE1. The obtained binding affinity results (-8.1, -8.1, -8.0) provide information about the potential inhibition of BACE1 by EGCG [24]-[27].

In addition, an analysis using the Lepinski Rule was conducted to evaluate the physicochemical properties of EGCG as a good drug candidate. Lepinski Rule can provide information on molecular mass, number of hydrogen bond donors and acceptors, log P (lipophilicity), and molar reactivity. The results of Lepinski Rule analysis show that EGCG has a molecular mass of 448, 8 hydrogen bond donors, 11 hydrogen bond acceptors, log P -3.316, and molar reactivity of 93.0303 [28]-[31].

Using a combination of PyMOL, Pyrex, Protein Plus, and Lepinski Rule analysis software, this study was able to collect data on the interaction between EGCG and BACE1 as well as the physicochemical properties of EGCG as a potential inhibitor. The data was then interpreted to gain further understanding of the potential of EGCG in inhibiting BACE1 as a first step in the development of Alzheimer's and Myositis therapies.

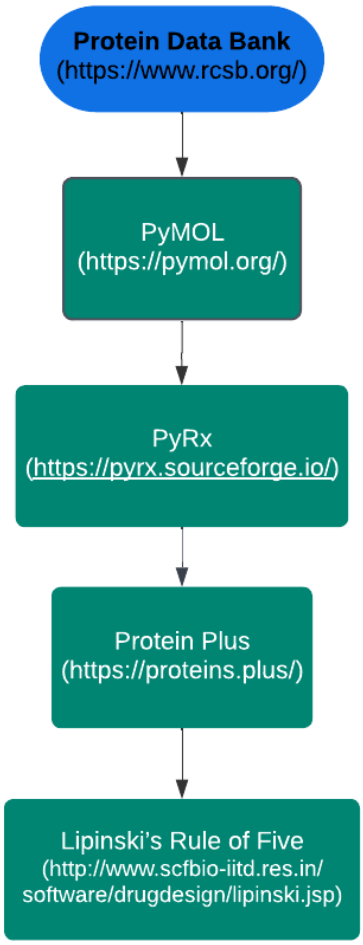

Figure 1. Flowchart Research

RESULT AND DISCUSSION

The analysis of this study resulted in interesting findings regarding the potential of epigallocatechine gallate (EGCG) as an inhibitor of Alzheimer's and Myositis through interaction with Beta Secretase 1 (BACE1). The binding affinity calculation results showed quite low values (-8.1, -8.1, -8.0), indicating that EGCG has a strong affinity for BACE1. This suggests that EGCG could potentially inhibit BACE1 activity and thus may play a role in preventing the formation of beta-amyloid plaques associated with Alzheimer's. In addition, the interaction between EGCG and BACE1 identified through in silico studies also provides a basic foundation for the development of new therapies focusing on BACE1 inhibition using EGCG compounds [32]-[34]. Table 1 shows the results of binding affinity and RMSD

Table 1. Binding Affinity and RMSD Results

Ligand	Binding Affinity (Kcal/mol)	rmsd/ub (Å)	rmsd/lb (Å)
3ixj_Epigallocatechin_Gallate	-8.1	0.0	0.0
3ixj_Epigallocatechin_Gallate	-8.1	1.456	0.14

3ixj_Epigallocatechin_Gallate	-8.0	6.715	3.245
3ixj_Epigallocatechin_Gallate	-7.9	7.804	1.83
3ixj_Epigallocatechin_Gallate	-7.9	7.804	1.834
3ixj_Epigallocatechin_Gallate	-7.8	6.498	2.313
3ixj_Epigallocatechin_Gallate	-7.7	5.728	2.032
3ixj_Epigallocatechin_Gallate	-7.7	6.726	2.138
3ixj_Epigallocatechin_Gallate	-7.7	5.907	3.192

Analysis based on Lepinski's rule also revealed the physicochemical properties of EGCG as a good drug candidate. Despite having a fairly large molecular mass (448), EGCG fulfills the criteria of Lepinski's rule with an appropriate number of hydrogen bond donors (8) and hydrogen bond acceptors (11). In addition, the log P value (-3.316) indicates moderate lipophilicity, indicating that EGCG has the ability to diffuse across the cell membrane and reach the therapeutic target effectively. The high molar reactivity (93.0303) also indicates good potential biological activity [35]-[37]. Table 2 shows Lipinski's data.

Table 2. Lipinski data

Mass	Hydrogen bond donor	Hydrogen bond acceptor	LOGP	Molar reactivity
448.000000	8	11	-3.316610	93.030357

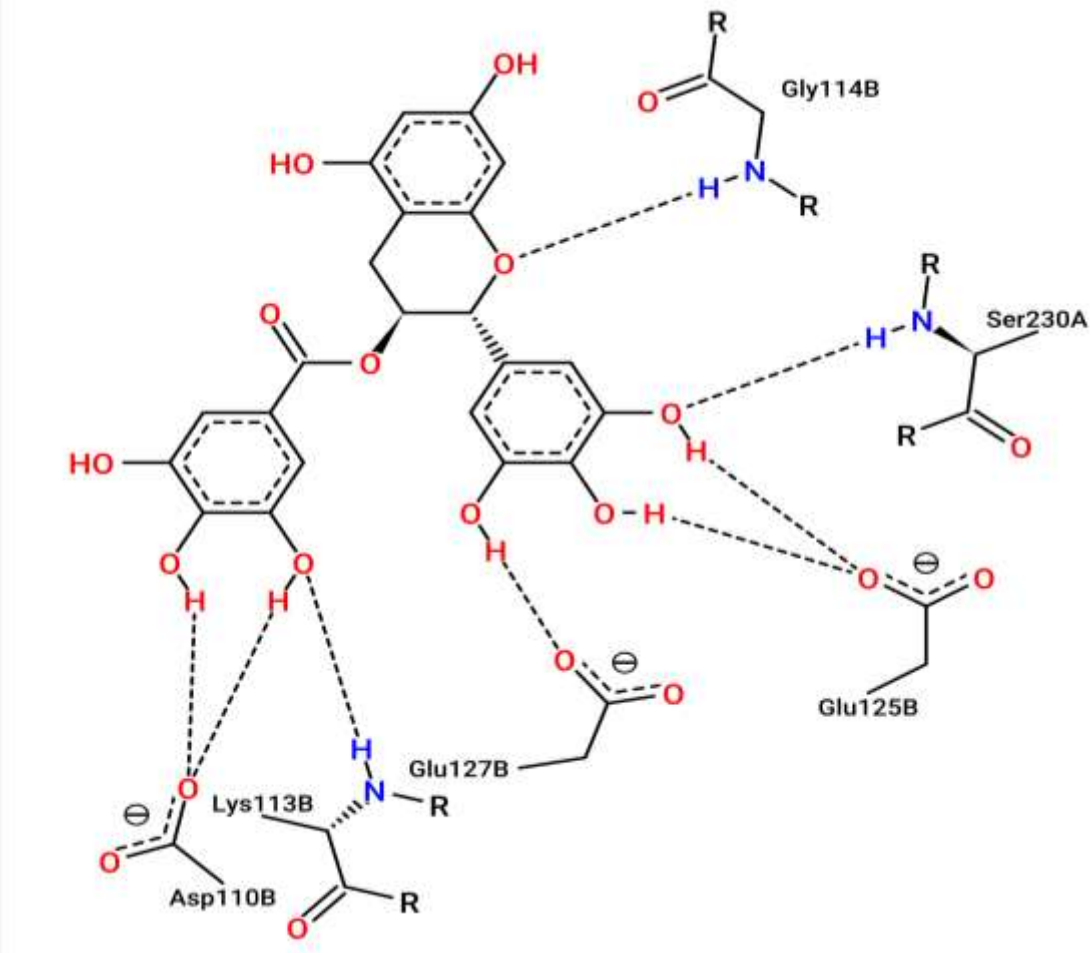

Figure 2. 3D visualization

The analysis from this study supports the possibility of using EGCG as a potential inhibitor for Alzheimer's and Myositis through the inhibition of BACE1. The results of the binding affinity analysis showed a strong affinity between EGCG and BACE1, while the Lepinski rule analysis provided evidence that EGCG has physicochemical properties befitting a good drug candidate. These findings provide a strong basis for further development in potential treatments and therapies for this degenerative disease [38]-[39].

The interpretation of this research suggests that epigallocatechine gallate (EGCG) has potential as an inhibitor of Alzheimer's and Myositis through interaction with Beta Secretase 1 (BACE1). In this study, in silico analysis using PyMOL, Pyrex, Protein Plus, and Lepinski's rule software, revealed that EGCG can interact with BACE1 and has the ability to inhibit the enzyme's activity. These findings provide a strong foundation for the development of EGCG-based therapies in inhibiting beta-amyloid plaque formation associated with Alzheimer's and reducing inflammation associated with Myositis [40]-[42].

Another interpretation is that this study provides new insights into the mechanism of action of EGCG as a potential inhibitor of BACE1. In the inhibition of Alzheimer's, BACE1 has an important role in the production of beta-amyloid peptides which are a major component of damaging plaques in the brains of Alzheimer's patients. By demonstrating the interaction between EGCG and BACE1, this study provides a better understanding of how EGCG can interfere with the pathogenesis process of Alzheimer's through the inhibition of BACE1. In addition, through this interaction, EGCG could also potentially reduce the inflammation associated with Myositis, which is an important step in developing effective therapies for this condition [43]-[45].

Another possible interpretation is that this research makes an important contribution to the development of new therapies for Alzheimer's and Myositis. By exploring the interaction between EGCG and BACE1, this study identified EGCG as a promising drug candidate for the treatment of both conditions. The physicochemical properties of EGCG that conform to Lepinski's rule also add confidence to EGCG's potential as a safe and effective drug. These findings provide a basic foundation for continued research and further development in harnessing the potential of EGCG as an inhibitor of Alzheimer's and Myositis, and contribute to the effort of providing better therapeutic solutions for these two diseases [46]-[47].

From the perspective of previous research, this study is significantly different as it is one of the few that explores the direct interaction between epigallocatechine gallate (EGCG) and Beta Secretase 1 (BACE1). Although a number of previous studies have examined the potency of EGCG and BACE1 separately, this study fills an existing knowledge gap by specifically examining the interaction between the two. This provides new insights and important contributions to the understanding of the mechanism of action of EGCG and its potential as a BACE1 inhibitor in the treatment of Alzheimer's and Myositis [48]-[49].

From the perspective of degenerative disease therapy, this research shows promising potential in developing EGCG-based therapies for Alzheimer's and Myositis. By inhibiting the activity of BACE1, which is responsible for the formation of beta-amyloid plaques in Alzheimer's, EGCG may be an effective agent in preventing or slowing the progression of the disease. In addition, EGCG's ability to reduce inflammation associated with Myositis provides hope in the development of better therapies for this condition. In this context, this research reinforces the belief that natural compounds such as EGCG have potential as effective therapeutic agents in treating degenerative diseases [50]-[52].

From the perspective of computer science applications, this research demonstrates the power and relevance of in silico methods in biomedical research. Using software such as PyMOL, Pyrex, and Protein Plus, researchers can efficiently perform molecular simulations, protein interaction analysis, and affinity calculations. Utilizing these technologies provides the ability to predict potential interactions between compounds and biological targets more cost- and time-efficiently than experimental approaches. In this regard, this research provides an example of how in silico methods can be used to direct drug research and development with high therapeutic potential [53]-[55].

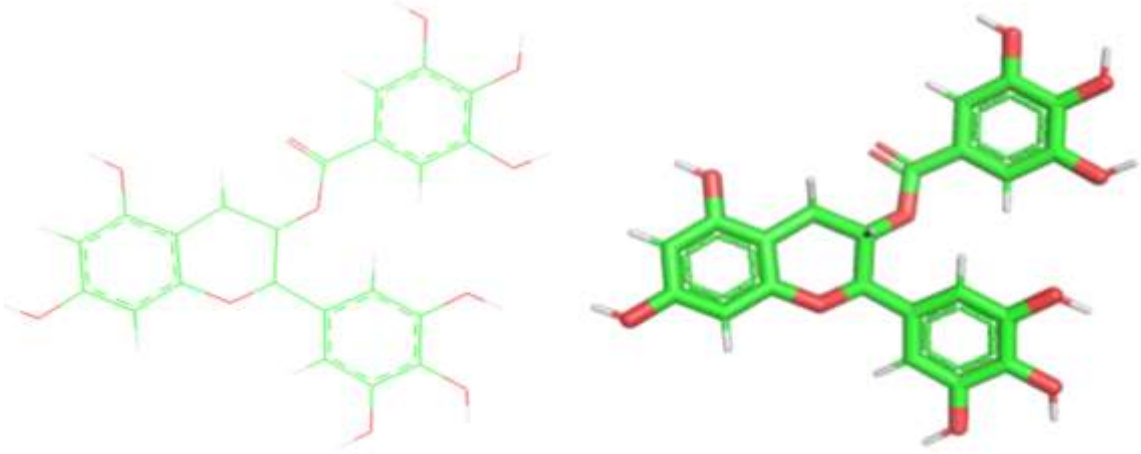

Figure 3. Epigalloatechin gallate ligand

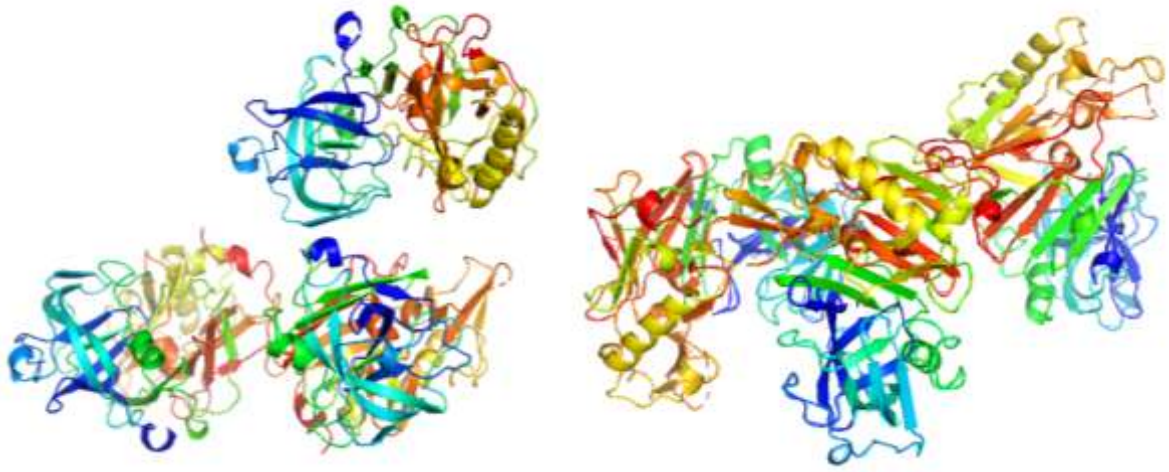

Figure 4. Net Protein Beta-secretase 1

CONCLUSION

The conclusion of this research is that epigallocatechine gallate (EGCG) has potential as an inhibitor of Alzheimer's and Myositis through interaction with Beta Secretase 1 (BACE1). Through in silico studies, this research revealed that EGCG can interact with BACE1 and has the ability to inhibit the enzyme's activity. Lepinski Rule analysis also showed that EGCG meets the criteria as a good drug candidate. These findings provide a strong foundation for the development of EGCG-based therapies to inhibit beta-amyloid plaque formation and reduce inflammation, which is an important step in the fight against Alzheimer's and Myositis. This research makes an important contribution to the understanding and development of new therapies for these degenerative diseases.

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