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Effects of a Cocktail Supplement of Ginkgo Biloba and Acai Extract on Cognitive Symptoms of Parkinson's Disease

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Abstract

Parkinson's Disease (PD) is a neurodegenerative disorder characterized by motor and non-motor symptoms, including cognitive impairment. Current treatments often involve synthetic drugs with significant side effects and potential for dependency. This study investigates the effects of a natural supplement combination of Ginkgo Biloba and Acai Extract on cognitive symptoms in a 77-year-old male with PD. The participant underwent a three-month supplementation regimen, with cognitive function assessed using the Montreal Cognitive Assessment (MoCA) test before and after the intervention. The results indicated an improvement in cognitive scores, suggesting that the combination of Ginkgo Biloba and Acai Extract may offer a promising alternative or adjunct to conventional PD treatments. This study highlights the potential of natural supplements in managing PD symptoms and calls for further research with larger sample sizes to confirm these findings. Human data was performed in accordance with the Declaration of Helsinki by the Roxbury District IRB Board (IRB Number: IRB00011767).

Keywords

Parkinson's Disease (PD), Cognitive Function, Ginkgo Biloba, Acai Extract, Neurodegenerative Disorders, Natural Supplements, Cognitive Symptoms, Montreal Cognitive Assessment (MoCA), Dopaminergic Neurons, Antioxidants, Neuroprotection, Non-Motor Symptoms, Oxidative Stress, Polyphenols

1. Introduction

The Diagnostic and Statistical Manual of Mental Disorders categorizes Parkin-

son's Disease (PD) as a neurodegenerative disease that affects the nervous system, causing unintended and uncontrollable movement [1]. Its symptoms present physically and psychologically. These symptoms range from impaired motor movement to worsened cognitive function [2]. The symptoms progress and can present themselves at any time. PD is considered the second most prevalent neurodegenerative disease in the US, affecting many in the age group of 60 and older [3]. Degenerative nerve diseases affect many daily activities needed to function in life, such as balance, movement, talking and even breathing. They result from the progressive loss of neurons, or brain cells. Parkinson's disease specifically is the "loss of neuromelanin-containing dopaminergic neurons within the substantia nigra pars compacta (SNpc) and the presence of fibrillary cytoplasmic inclusions, known as Lewy bodies. As dopaminergic nigral neurons project to the striatum, the loss of these cells reduces striatal dopamine (DA)" [3]. This serious deficit of dopamine results in devastating symptoms. The motor symptoms include akinesia, freezing, hypokinesia, and hypomimia. The nonmotor symptoms include addictions, anxiety, apathy, dementia, depression, drooling, fatigue, personality changes, slowed cognitive processes, and thermal dysregulation [3]. Parkinson's disease accelerates degeneration.

2. Cognitive Function and Current Treatments

2.1. Cognitive Function and Its Importance

Cognitive functioning (CF) is a crucial factor needed to assess one's mental status as it is needed to make key decisions and actions to get through the day. The mental functions including perception, attention, memory, decision-making, and deciphering spoken and written language are all included in cognition. In both social and everyday activities, cognitive function is needed. Memory, attention, executive functioning, and processing speed are among the cognitive abilities that may deteriorate as we age [4]. To examine cognitive impairment, a comprehensive examination is needed, which includes a two-step process through a screening. After cognitive impairment is diagnosed, it is essential to periodically reevaluate or monitor cognitive and overall functioning in order to track the development or reversal of impairment, particularly in response to treatment.

2.2. Current Treatments in Parkinson's Disease

The most common treatment for Parkinson's disease is Levodopa. This drug is an agonist that represents synthetic dopamine [5]. A group called the Parkinson's Study Group [6], explains how this treatment entails levodopa weakening the effects of motor fluctuations which involve the trembling and any abnormal movements that develop. The group consisting of multiple professors and doctors from medical schools, such as the Mount Sinai School of Medicine, explains that the brain's substantia nigra, ventral tegmental region, and hypothalamus all manufacture the neurotransmitter dopamine. Numerous nervous system illnesses have been linked to dopamine system dysfunction. Dopamine malfunc-

tion caused by oxidative stress, a cause of PD, plays a part in both health and disease. This treatment works in the way that the small intestine absorbs levodopa, which then moves through the blood to the brain where it is changed into dopamine. Carbidopa, a medication that helps to avoid or lessen the levodopa's serious symptoms, is administered simultaneously [6]. Carbidopa-Levodopa has the potential to be very helpful for those with Parkinson's disease and can significantly enhance their quality of life. However, it has been used as a last option by certain PD patients. Carbidopa-Levodopa is used more frequently than any other medication for Parkinson's therapy but there is much hesitation to use it because of its dependency and symptoms [6]. Each Parkinson's patient must make their own decision regarding taking carbidopa-levodopa, taking into account any potential advantages, hazards, and available alternatives. Wen Yu Hsu from the Graduate Institute of Clinical Medical Science at China Medical University [7] describes another treatment for Parkinson's disease using dopaminergic medicines such as Memantine and acetylcholinesterase inhibitors. Since PD affects cognitive function, patients with PD were found to have improved language function after taking dopaminergic medicines, however the effectiveness of these drugs and how their receptor modulators improve cognition is still debatable. Many limitations are present in the treatment methods, a large one being addiction, which could cause more ongoing problems in addition to the symptoms present in those with PD [7].

3. Natural Supplements

In contrast to the use of synthetic drugs, numerous studies have shown that "natural polyphenols, such as epigallocatechin, quercetin, baicalein, resveratrol, luteolin, curcumin, Pueraria, genistein, and hyperoxides naringin, have neuroprotective effects against the death of dopaminergic neurons" [8]. These consist of vitamins and antioxidants found in many plants, fruits and berries, but have not been studied extensively [9]. Their molecular intervention in the process of dopaminergic neuronal death is also not clearly understood.

3.1. Euterpe Oleracea Explained

The palm tree species known as açai (Euterpe oleracea Mart.) is native to the region of South America bordering the Amazon River. The indigenous populations of Central and South America have relied on them for a very long time as a vital source of nourishment. "Polyunsaturated and monounsaturated fatty acids (11.1% and 60.2%)" and 19 health-promoting amino acids make up the majority of the açai berry's polyphenolic composition, according to a contemporary scientific study [10]. These berries are one of the most potent antioxidant berries to be discovered in recent investigations and have a group of polyphenols (plant-based substances) known as anthocyanins. These substances offer a wide range of health advantages, such as lowering the risk of cardiovascular disease, improved glucose tolerance and lipid profiles, enhancing ocular function, and

minimizing cellular oxidative DNA damage. They also prevent the growth of cancer cells and trigger apoptosis in certain cancer cell lines [10].

3.2. Ginkgo Biloba's Potential

A standardized G. biloba leaf extract, another polyphenol, has been employed as an antioxidant and a neuroprotective drug to treat a number of conditions such cerebrovascular insufficiency, degenerative dementia, and neurosensory abnormalities. Since it slows the loss of dopamine levels and stops degeneration of the nigrostriatal pathway, it may be used to treat PD, according to recent research in mouse PD models [11]. Ginkgo Biloba possesses neuro-protective and antioxidant actions; as a result, it may be more effective alternative treatments for PD with fewer adverse effects.

3.3. Polyphenol's Link to Neurodegenerative Diseases

A study run by the International Journal of Molecular Science states that "The neuroprotective effect of polyphenols has been linked to their free radical scavenging and anti-inflammatory properties, both in cellular and animal models. They are able to reduce neurotoxicity by interacting with protein aggregates such as α-synuclein" [12]. Based on this information, polyphenols, which include forms like types of spices or fruits/berries, have promising roles in easing neurodegeneration. According to several studies, polyphenols like curcumin can prevent the rate-limiting enzyme involved in dopamine synthesis, tyrosine hydroxylase, from declining in PD patients. Another polyphenol with the ability to correct PD's faulty mitochondrial electron transport is quercetin. This is crucial knowledge because a polyphenol's ability to mend the transport can increase the rate at which neurons fire, potentially leading to improved cognition and faster reaction times [12]. However, extensive research on multiple polyphenols in neurodegenerative diseases, specifically PD, isn't commonly studied. Christine R. Swanson, from the Preclinical Parkinson's Research Program at the Wisconsin National Primate Research Center [3], reviews the current findings on the risks and neurological factors and their effect on PD. Her findings suggest that the factors that increase the severity and the likelihood of PD are aging, environmental factors, head trauma, and comorbidities. A key component of her article is that she studies how diet has an influence on slowing the progression of the disease. For example, she states how, "Dramatic positive results have been seen in aged rodents that consume as little as a 2% blueberry extract supplemented diet (96, 98). In a rodent model of stroke, blueberry supplementation ameliorates cellular damage (96), and blueberries have been shown to increase neurogenesis in the aged rat brain (86)" [3]. Although many natural treatments are uncommon in the conversations associated with PD, this mention of berries is crucial because it shows how a non-expensive, non-invasive additive has the potential to help a pervasive disease.

Jana Trebatická, Zdeňka Ďuračková from the Faculty of Medicine (2015),

support Swanson's work. Their research shows how treatment for neurodegenerative diseases and disorders has become very high in cost and with many side effects. Therefore, they believe in the importance of increased research efforts in this field; prevention and treatment based on the improvement of life-style factors including diet [13].

A study done by researchers Maryam N. Alnasser, Ian Mellor, and Wayne Carter from the Department of Biological Sciences [14] was intended to investigate the utilization of nutraceuticals and dietary supplements for Alzheimer's disease. They found that, "The acai berry aqueous extract significantly inhibited AChE activity in a concentration-dependent manner" and that the acai extracts "displayed useful radical scavenging and antioxidant activities" [14]. They also state that other independent studies have reported the "high antioxidant capacity of the acai berry...displays useful neuroprotective activity, and it can prevent rotenone-induced oxidative damage" [14]. This is the key for Parkinson's research because a key cause of PD progression is oxidative stress, and acai extract providing relief can be beneficial in easing its various presenting symptoms. Their research, however, concludes that it requires many animal and human studies to truly prove any significant effects. These statements are supported by the findings of researcher Guo S of the State Key Laboratory of Brain and Cognitive Science [15], in which he investigated the importance of inhibition of specific neurotransmitters and enzymes in patients with neurodegenerative diseases, using polyphenols. He found that there was an effect and the polyphenol protected dopaminergic neurons and inhibited the excesses of neurotransmitters like NO and aCHe [15]. But again, this was all done in animal in vitro studies, therefore full effects cannot be determined. Ana Faria, from the Biochemistry Department at the University of Portugal (2014), marks the importance of animal studies not showing the full picture. She states how research methods that the studies above use and reference have data that is inaccurate because the testing that they provide is primarily on animal origin models for the extensive effects and permeability of the blood brain barrier. She further supports her point by saying that "...species differences in flavonoid absorption and metabolism and differences in the structure and function of the BBB make the extrapolation of animal results to humans an impossible task" [16].

Combination treatments for PD have not been explored enough or experimented with extensively. Neurologist Wallace Stevens [17] remarks on the idea of combining two separate treatments or aids to see if the combinations have a stronger effect together than apart. However, his data is very limited since there are few medicinal treatments to combine. Many researchers have been reluctant to try this, but Stevens succeeded in running a double-blind study. His results showed that the test group had higher MoCA scores. This means that there was some improvement in cognitive function in the experimental group. He explains the reason for why this could have worked by stating "...a combination of therapies may be related to the fact that butylphthalide, oxiracetam, and Ginkgo bilo-

ba extract can improve microcirculation in the brain, improve the use of glucose and oxygen in brain tissue, promote synthesis of triphosadenine and energy metabolism in brain cells, resist oxidative stress, protect nerve cells, and strengthen learning and memory, among other functions" [17]. Although his sample size was very small, this is a breakthrough for future treatment experiment opportunities. His sample consisted of 60 - 81-year-old participants, which is one of the most affected age groups for PD. The need for a non-toxic, non-invasive treatment for this more elderly group is high, as their motility is already limited without their symptoms.

3.4. Gap and Research Question

Although there are many current treatments being explored in clinical trials and drugs are available to treat symptoms of PD, there remains a gap in studying the effects of non-invasive, minimal symptomatic treatment options. There are many limitations regarding the current treatments, such as how they are costly and come with symptoms that could cause more harm than good. There remains a need for a treatment that is easily accessible and that uses natural products which minimize side effects. Ginkgo biloba and acai extract have been researched separately in studies regarding neurodegenerative diseases, not necessarily PD. However, it is important to address that studies combining them together have not been performed. In this study, the aim is to test the effects of a combination of ginkgo biloba and acai extract on a 77-year-old Caucasian Eastern European male suffering from PD. It is hypothesized that this combination will improve cognitive function over the span of three months.

4. Method

4.1. Participants

A 77-year-old Caucasian Eastern European man was the only participant in this study. This allowed the researcher to focus all of their attention and resources on just one person, allowing them to establish a clear causal relationship between the supplements and cognitive function. This method also allowed them to study the effects of the supplements ethically because the patient was under medical supervision by a licensed physician. The doctor agreed to provide full supervision and approval of dosages. This patient was invited to participate in the study because of a close connection he had with the supervising doctor.

4.2. Materials

The materials used to collect the data on changes in cognition in this study was a Montreal Cognitive Assessment (MoCA) exam. This examination was chosen because it is the most common type of test that checks cognition in patients with neurodegenerative diseases such as Parkinson's [18]. Additionally, it was the primary choice of cognitive assessment by Dr. Wenfei Zhu, a research associate at Arizona State University [19], who carried out a successful study similar to

this one. It has provided the most accurate data in prior studies done by other researchers and needs to be administered by a certified individual. MedlinePlus [20] shows how the most common types of screenings are the MoCA test, which is a 10 - 15-minute test that includes memorizing a short list of words, identifying a picture of an animal, and copying a drawing of a shape or object [20]. It is a simple test to take and administer. In order to assess the patient with a MoCA examination, the researcher needed to pass a MoCA certification test and receive a badge allowing them to access all proper MoCA test materials. With the certification, the test provided valid results since a medical professional assessed and examined the scores after they administered it, evaluating any changes in cognitive performance. It was an ethical test which provided no physical or emotional harm to the individual, and they could stop at any time. Another material used was the supplement in capsule form of ginkgo biloba of 120 mg per capsule. According to Bruce Diamond, a member of the Psychiatric Clinic of North America, the recommended dietary dosage of ginkgo biloba should range between 80 - 720 mg a day, however the studies he reviewed say that patients took either 240 mg twice daily of the gingko biloba or an equivalent amount of the placebo, and another study took 240 mg once a day [21]. Both studies are on neurodegenerative diseases and ginkgo bilobas effect on cognition and memory and there seems to be a trend of the starting dosage being about 240 mg a day. To support this dosage, both studies state that the scores improved by 2.4 - 2.5 points on the MoCA exam for the experimental group while the group receiving the placebo had little to no change [22]. This dosage is said to have effects in multiple studies, increasing cognitive scores, and is the basic dosage on most vitamin bottles containing ginkgo biloba. The other supplement being used is Acai Extract, of 500 mg per two capsules. This is on the lower end of the dosage of Acai Extract which is usually between 250 to 2500 mg a day [10]. He performed a study testing the supplements effectiveness and concluded with his results that this extract is most effective at low dosages, which is why 500 mg was the decided dosage for this study.

4.3. Procedure

As the goal of the research was to examine if there was an increase in cognitive functioning after administering the combination of these supplements to an individual with PD, an experimental approach was selected as the best fit method for this study, as there is no other method that could test for cause and effect. The steps to this experiment involved starting with researching and determining the starting or average dosage of both acai extract and ginkgo biloba, using any recommendations provided by the medical professional supervising the patient. The independent variables in this experiment are the supplements. These were operationally defined as capsules equal to 500 mg total of acai extract and capsules equal to 240 mg total of ginkgo biloba, taken once a day, one after the other at 12 pm (IST). The dependent variable was the change in cognition. This was

operationally defined as an increase in the MoCA cognitive score when compared to the MoCA cognitive score prior to starting the supplements. A significant change means the change should exceed 1.73 points [23]. The participant, after being explained what this experiment would involve, was assessed using a MoCA examination to establish a baseline score, which showed the cognitive score prior to starting both supplements. Since the participant's main chosen language was Russian, it was explained in Russian, and all testing material provided was in Russian as well. The patient took both supplements (capsules) at 12 pm (IST) daily. The MoCA test will be used to measure cognitive scores every 45 days in a three-month period. Three copies of the MoCA examination test were obtained in Russian, and once a version was used, it wasn't used again. It was given three times in total; the first for the baseline or pre-test, the second for a midway check, and the third as the post-test.

4.4. Data Analysis

The data collected was analyzed using a pretest-posttest design. This analysis method was chosen because of its multitude of advantages for tests involving multiple data points like the MoCA examination. The textbook, *Introduction to Research in Education*, focused on how this strategy is useful in refocusing the data provided while giving a point of comparison from beginning to end since it provides a measure of participant knowledge or behavior prior to the introduction of the independent variable [6]. The pretest-posttest design provided an accurate measurement of change that can be obtained by evaluating actual knowledge or existing abilities rather than just impressions of progress [24]. The pretest-posttest design looks for a proof that change has occurred over the time elapsed during the experiment. The researcher would be able to clearly evaluate any effects that the major variables (ginkgo biloba and acai extract) had on cognitive performance by determining if there is a 1.73-point increase in the patient's before and after MoCA score.

5. Results

As aforementioned, the data collected consisted of three tests. In the first test which established a baseline (MoCA Version 7.1), the patient obtained a MoCA score of 19 points, in the second examination (MoCA Version 7.2) a MoCA score of 22 points, and in the third and final examination (MoCA Version 7.3) a final MoCA score of 23 points (refer to Chart 1). When the answers per assessment were reviewed, no additional points needed to be added since the patient's education was more than twelve years of age, resulting in a final four-point difference between the initial 19 point score and the final 23 point score. The researcher's hypothesis was that a combination of both supplements, acai extract and ginkgo biloba, would increase the MoCA cognitive score. As the difference in points is greater than 1.73 points, a number mentioned earlier as the minimum to establish a significant change, the researcher rejects the null hypothesis.

However, upon referring to a Decision Tree Chart for (see Figure 1), evaluations of the initial MoCA score placed the patient in the "pathological category" and the patient remained in this category despite receiving higher scores throughout the study. In a more thorough analysis of the question categories of the MoCA assessment, the most difference was seen in the baseline, midpoint, and final exams in the questions testing *alternate trail making*, *memory*, and *attention*, specifically the *forward digit span* where the patient needed to repeat the digits in the sequence said exactly how the examiner said them, and *serials 7*, where the patient needed to correctly count by subtracting seven using a mental calculation from a given number. These questions received more points, meaning more correct responses, in the final test compared to the baseline. For example, four out of six points were given during the baseline for the attention section and six out of six points were given during the final exam. Another major difference between the scores was in the questions testing *verbal fluency*, which instructed the patient to name as many words within 60 seconds as they can think of, starting with a specific given letter. In the 7.1 version (Refer to Figure 1), this letter was Л (English L), version 7.2 (Figure 2) had the letter с (English S) and version 7.3 (Figure 3, Figure 4) had the letter б (English B). Although the patient never acquired the points for this question throughout any of the three tests since he failed to meet the required minimum of 11 different words within the time given, the number of words did increase, as he named five words in the first test, nine in the second, and eight in the third. All responses indicated a significant increase between the baseline and midpoint exams but seemed to plateau between the midpoint and final exams.

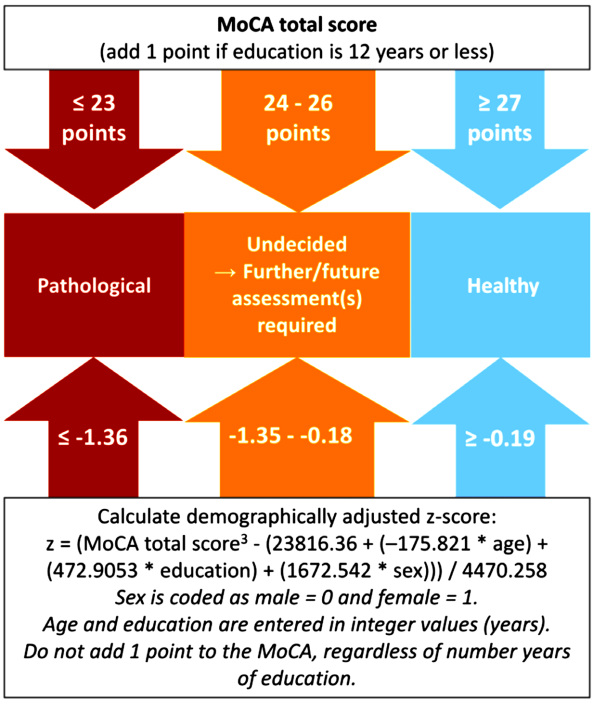

Figure 1. Decision tree chart (Thomann *et al*, 2020).

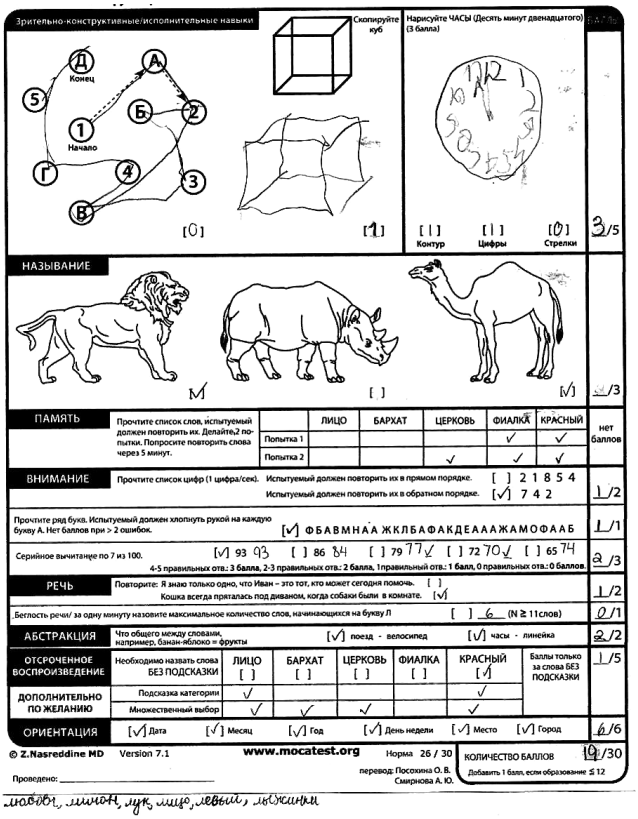

Figure 2. MoCA 7.1 (baseline test).

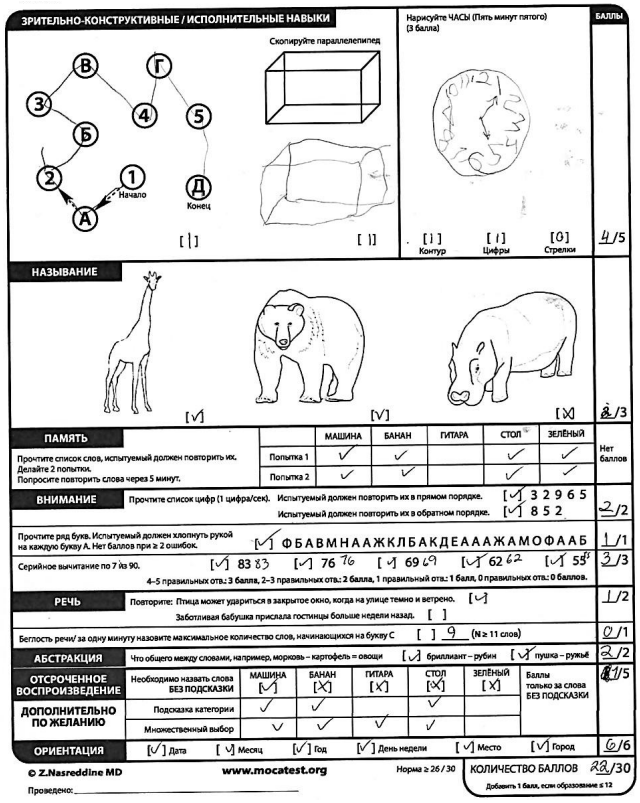

Figure 3. MoCA 7.2 (midpoint test).

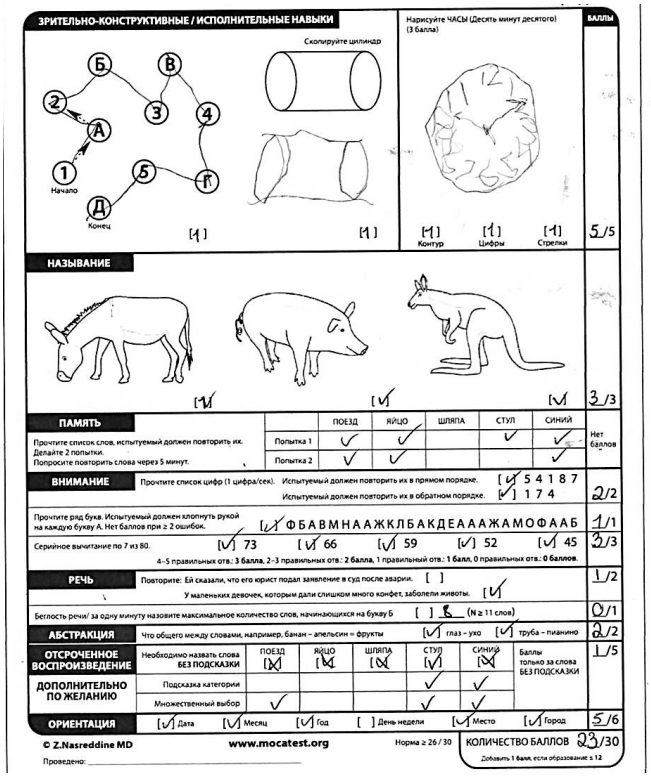

Figure 4. MoCA 7.3 (final test).

6. Discussion

The final MoCA score was determined to be twenty-three points, an increase of four points from the baseline score of nineteen points, suggesting that the combination of the supplements ginkgo biloba and acai extract significantly improved the cognitive MoCA scores of the patient. The supplements are shown to have a strong effect when used together, and based on these results, can be applied as a treatment for Parkinson's disease. The four-point increase shows that this cocktail of two treatments, or supplements, works.

6.1. Analysis of Effectiveness of Supplement from Data Gathered

As aforementioned, the increase in the MoCA score is likely due to the three-month period of supplementation in the patient. It has been proposed that combinations of treatments or supplements are useful and needed because, together, they can improve the brain's microcirculation, and use of glucose and oxygen, promote energy metabolism, and resistance to oxidative stress, and strengthen learning and memory [17]. However, the results of this study go against the results of Dr. Wallace Stephen's study on cocktail therapies regarding patients with Dementia. Although Dementia and Parkinson's are different diseases, both are neurodegenerative and progressive diseases, sharing some similarities in presenting symptoms. His results on the effects and significance of administering the combination of the treatments butylphthalide, oxiracetam, and ginkgo biloba extract showed no statistical differences in cognitive scores. The

same cognitive exam was used, the MoCA, and patients that received the experimental treatment had higher MoCA scores, just not a large enough change to meet the minimum significant difference [17]. He states that his results needed a longer observation to verify its accuracy, but the results obtained in this study refute this because a short period of time (three months) showed a significant change in this patient. A surprising detail in the data collected shows that there was a three-point increase between the baseline score of 19 and the midpoint score of 22, but only a one point increase between the same 45-day span given between the midpoint and the final exam. The plateau exhibited in this study can mean that in Stephen's study, the increase was present but could've plateaued as well. The plateau in this study could mean that the patient adjusted to the dosage and developed a tolerance, suggesting that the dosage needs to be increased and monitored in the timing of administration. In addition, the mentioned Alnasser's study on the use of acai extract as a preliminary treatment for Alzheimer's diseases showed that acai extract inhibited other chemical substances [14], which could support why the change slowed through the progression of this experiment. In support of this finding, studies concerning mixing medical treatments for diseases have shown significant results concerning the cocktail they produce. For example, a study on phage cocktails for pneumonia showed that the cocktail was more effective in reducing bacterial mutations that increase the chances of pneumonia occurring when compared to the individual treatments [15]. Another study testing the effect of a combination of coenzyme Q10 and antioxidants to treat symptoms of patients with Sanfilippo disease showed significant results; it helped restore cellular functions that were damaged as a result of the disease [25]. This further supports the use of cocktails of treatments and shows that the combination of the supplements is indeed more effective than the treatments used apart. The researcher's results show an indication of tolerance towards the supplements due to the MoCA score increase plateauing. Like all chemicals ingested over time, the brain likely developed a tolerance to the supplement combo. Neuroadaptation, or tolerance, is a common occurrence in treatment studies and could explain the results of this study. Tolerance in other studies that experimented with combinations of treatments has happened before, such as the study on a cocktail therapy for a life threatening condition (KMP) in infants. Although the study yielded significant results from their combination of VCR and sirolimus, tolerance was exhibited [26]. Tolerance in this study prevented a large change in cognition from the second to third assessment. The patient's MoCA score was not sufficient enough to take him out of the pathological category. Though tolerance is a valid explanation, the results could also imply that his condition has worsened within the last three months. Parkinson's is a progressive disease [3] which means that not showing a major improvement from the second to third test can be due to his state worsening within that time. Whether the plateau is for reasons of tolerance or progressive deterioration, the findings suggest that the dosage of the acai extract and ginkgo biloba combination may need to be increased with usage [26].

6.2. Limitations and Confounding Factors of Methods and Results

Pertaining to the procedure, there were many limitations that can interfere with the results of this data collected. These included a learning effect from the MoCA test being used, despite a different version being used each time. The versions were 7.1, 7.2 and 7.3, which all included the same type of questions, just with different examples used. There was also a shortage of time to explore if the supplementation had any effects. To continue with, an ideal study to record any data on changes in cognition would have involved an increased sample size. Having several patients diagnosed with Parkinson's on the supplements could have provided more accurate results and would have given the researcher the opportunity to have a control group which would be administered a placebo. This would serve as a comparison to see if there are genuine effects or changes. The participants would likely also be of different genders and ethnicities which could provide more external validity. However, this method could not be chosen because the researcher didn't have access to other individuals who suffer from Parkinson's disease. Additionally, due to the time constraints it would not be feasible to test each patient, nor are the funds available to provide sufficient amounts of supplements to multiple participants. They would also need additional doctors responsible for each individual patient and agree to the supervision of their patient. The current method allowed the researcher to devote all of their time and resources to one individual and follow the ethical guidelines of informed consent, debriefing, protection from physical and mental harm, and confidentiality.

Regarding results, a few variables limited the validity of the results. One limitation was that the researcher was present on the video calls as the supervising doctor administered the exams, which could have caused the patient to be distracted or caused a change in his responses to the questions out of fear of disappointing the researcher, who is a blood relative. A major limitation of the results was that the data was based on the responses of one patient. A larger sample would be more ideal since the impact of any specific genetic or environmental issues affecting individual patients would be minimized. Testing only one subject significantly hurts the generalizability of the results. For instance, although the time of day that the exam was administered was controlled for, the patient's mood could have differed between the three exams, impacting his responses, which would have been neutralized with a larger sample size. In addition, the larger sample would have provided an opportunity to establish a control group with a placebo to strengthen the validity of the effects. The patient knew he was being tested with the expectation of improvement, which could have lent itself to the placebo effect. Another limitation of the results was that there was not an attainable way to measure if one supplement worked and if the other did not, or if one supplement inhibited the other's desirable effects. This limited the results of this study because the effectiveness was solely based on the patient taking the supplements together every day. The four-point difference in the MoCA score

can only be stated as the effect of taking ginkgo biloba and acai extract together, with no feasible way of isolating one's effectiveness over the others.

7. Conclusions

This study investigated the effects of a supplement containing Ginkgo Biloba and Acai Extract on cognitive symptoms in a patient with Parkinson's Disease (PD). The results indicated a notable improvement in cognitive function, as evidenced by increased Montreal Cognitive Assessment (MoCA) scores. These findings suggest that this natural supplement combination may offer cognitive benefits for PD patients.

Given the limitations of this case study, including the single participant and short duration, further research with larger, more diverse populations and extended follow-up periods is necessary to confirm these preliminary results. Future studies should also explore the biochemical and neurological mechanisms behind the observed cognitive improvements. If validated [27], this natural supplement regimen could be integrated into current treatment protocols, potentially providing a safer and more holistic approach to managing cognitive symptoms in PD.

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Conflicts of Interest

The researcher declares there are no conflicts of interest regarding the publication of this study.

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