The Effects of an Over-the-Counter Nootropic on Indices of Cognitive Performance

Direct Original Research

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Abstract

Background: This study aimed to assess the effects of an over-the-counter nootropic supplement, TruBrain, on various indices of cognitive and physical performance.

Methods: A total of 63 healthy young participants (23 males and 40 females) were randomly assigned to either a TruBrain (n=29) or a placebo group (n=34). Mood (i.e., Profile of Mood States [POMS]), memory (i.e., MemTrax), sustained vigilance (i.e., Psychomotor Vigilance Task [PVT]), and handgrip strength were assessed before and after consuming TruBrain or a placebo. Post-testing was conducted 60 minutes after consuming the TruBrain or placebo.

Results: No significant main effects of group were observed for any mood outcomes ($p \geq 0.05$). Memtrax Accuracy demonstrated a borderline significant time effect ($p = 0.050$), whereas vigor, reaction time, false starts, and handgrip strength were not significantly affected by time ($p \geq 0.060$). Significant group × time interactions were observed for reaction time ($p = 0.003$, $d = 0.904$), accuracy ($p = 0.005$, $d = -0.845$) and handgrip strength ($p = 0.003$, $d = 0.909$). Reaction time increased in the TruBrain group but decreased in the placebo group. Accuracy decreased in the TruBrain group, while it improved in the placebo group. Handgrip strength increased in the TruBrain group and decreased in the placebo group.

Conclusions: Despite improvements in handgrip strength, acute ingestion of TruBrain did not improve cognitive performance, reaction time, or accuracy. Nootropic supplements may not uniformly enhance cognitive function, highlighting the need for further research to better understand their efficacy and mechanisms of action.

Keywords: cognition, supplements, brain

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Introduction

Nootropic supplements (i.e., cognitive enhancers) purportedly enhance cognitive performance, focus, and well-being by interfering with the metabolic activity of the neuronal cells of the central nervous system (CNS). These substances usually consist of natural and herbal components and are noted to improve cognitive efficacy by boosting glucose and oxygen supply to the brain and preventing neurotoxicity that damages neural tissue, thereby promoting neuronal protein and nucleic acid production. Because of their natural elements, they tend to be tolerated very well in the majority of patients with cognitive impairments or without, and side effects are very limited and mild[1]. By penetrating the blood-brain barrier and used for more than 2 or 3 weeks, consistent positive results have been observed in enhancing cognitive performance, and it has since gained attention for treating mental and memory dysfunction, or for enhancing performance in university students.

TruBrain is an over-the-counter (OTC) nootropic supplement that is supposed to enhance cognitive function. Despite these claims, there is little evidence to support this. The active ingredients (lion's mane, chaga, reishi, and cordyceps extracts) have natural or herbal origins, and while they show potential cognitive benefits and physical performance, to our knowledge, no studies have investigated this specific combination. Therefore, the focus lies on the individual ingredients. Research on lion's mane (Hericium Erinaceus) focused on cognitive functioning in humans and compared acute to chronic effects, which found improved cognitive processing and reduced stress trends in a placebo-controlled trial[2]. After 60 minutes post-ingestion, participants performed quicker on the Stroop task, an assessment to measure cognitive flexibility and performance by naming the ink color of a word rather than the word's actual meaning. After a single dose of 1.8 g of lion's mane, reaction times improved from 737.70 msecs to 688.05 msecs. After 28 days of consistent dosing, subjective stress also decreased. Based on the Stress Visual Analog Scale scores, the treatment group reported significantly lower scores than the placebo group, with a mean of 33.02 compared to the placebo group's mean of 42.53. Though seeing acute results in speed, the combined factors of speed and accuracy, as cognitive constructs, must be further explored. Lion's Mane also is seen to improve working memory and reaction time[3], with bioactive compounds like Erinacines showing potential cognitive benefits[4].

Cordyceps supplementation may improve physical performance in healthy older adults[5]. In a 12-week study by Chen et al., noninvasive gas exchange analysis on participants during exercise tasks meant to increase exhaustion over time was used to measure fatigue and endurance. 12 weeks after the baseline measurements, results showed the metabolic threshold to increase by 10.5%, and the ventilatory threshold by 8.5%. This may show possible enhancement of aerobic functioning crucial to continuing exercise and movement. These combined threshold increases suggest that cordyceps may benefit by helping reduce fatigue and further improving physical performance.

Conversely, chaga has not been tested in humans, but animal studies show possible anti-fatigue effects, both physically and mentally[6,7]. Inonotus obliquus polysaccharide (IOP), the main ingredient in the chaga mushroom, was shown to increase swimming time in mice while also increasing the glycogen content of liver and muscle with no toxic effects on the organs[6]. An additional study by Zhang et al. showed similar results, with climbing duration and swimming time increasing by 108.7% after 30 days, and a delayed onset of physical depletion by decreasing blood lactic acid[7]. IOP was associated with reduced lactate dehydrogenase levels, which correlated with reduced cell and muscular damage resulting from extreme exercise. It was also seen to reduce mental fatigue by decreasing brain serotonin (5-HT) concentrations, which are linked to central fatigue.

A review conducted by Nkodo analyzing 25 studies, including reishi, lion's mane, and cordyceps, reported positive effects on cognitive impairment[8]. These studies involved 3 human trials and 22 animal studies, of which all of the animal studies showed significant positive results, and 2 of the 3 human trials revealed cognitive benefits[8]. Thus, the purpose of this investigation was to assess the acute effects of TruBrain supplementation (i.e., a combination of various nootropic ingredients) on various indices of cognitive and physical performance and cognitive functioning. Lion's mane, as well as each of the other components in the supplement, is a bioactive ingredient. Previous research involving lion's mane has depicted acute observations as soon as 60 minutes post consumption, as ingredients like this are known to be absorbed quickly and begin affecting the body as soon as 1 hour after ingestion[2]. Because this supplement is commonly taken with expectations of acute, prompt results, a 60-minute parameter was chosen to assess the initial stage of the elements consumed and whether the use of this enhancer truly benefits in the circumstances in which it is taken.

Scientific Methods

Participants

A total of 63 participants (23 males and 40 females) between the ages of 20 and 22 years were recruited from the local university for this single-blind, crossover design (Table 1). All participants were healthy, with no known medical conditions that could influence the study's outcomes. Participants were randomly assigned to receive either TruBrain (n=29) or a placebo (n=34). Both groups drank V8 Splash Diet Berry Blend Flavored Beverage. TruBrain was mixed into the experiment group to mask the flavor, and the placebo group drank only V8. The university's institutional review board approved the study protocol, and all participants provided informed consent before enrollment. Participants were randomly assigned to receive either TruBrain (n=29) or a placebo (n=34). The study protocol was approved by the university's institutional review board, and all participants provided informed consent before enrollment.

Protocol

Baseline assessments included body composition analysis (InBody 270) and subjects' exercise training history. Baseline assessments included body composition analysis (InBody 270) and subjects' exercise training history. Overall, the test took 90 minutes. Participants restricted all caffeine intake and exercise for 24 hours before the study was performed. Before consuming the treatment (TruBrain – see Figure 1, trubrain.com) or placebo, mood was assessed using the Profile of Mood States (POMS), memory via MemTrax, and sustained attention using the Psychomotor Vigilance Task (PVT). Physical performance was assessed through a handgrip strength test. All assessments were performed in order, with no time between tests. Sixty minutes after consuming TruBrain or the placebo, each assessment was repeated.

Serving Size 1 Scoop (6g)	Servings per Container 30
Amount per Serving	**% Daily Value***
Calories 20	
Total Fat 0.5g	0%
Sodium 10mg	0%
Total Carbohydrates 4g	0%
Dietary Fiber 1g	0%
Sugars 0g	
Protein 1g	
Potassium 110mg	2%
Iron 1mg	5%
Adaptogens	
Organic Lion's Mane Extract 200mg	†
Organic Chaga Extract 200mg	†
Organic Reishi Extract 200mg	†
Organic Cordyceps Extract 200mg	†

Other Ingredients: Organic cacao, organic spices, organic black tea powder, himalayan pink salt.

* Percent Daily Value based on a 2,000 calorie diet
† Daily Value not established

Figure 1. TruBrain supplement facts panel.

Body Composition

The InBody 270 estimates body composition by sending a low-level electrical current through the body and measuring the impedance or resistance encountered by the current as it travels through different tissues[10]. Subjects were instructed to stand barefoot on the device's platform, ensuring their feet were in contact with the electrodes. They then held the unit's handles, ensuring their thumbs and fingers maintained direct contact with the electrodes. Participants remained still for approximately 30 seconds, keeping their elbows fully extended and their shoulders abducted to a ~30-degree angle.

Cognitive Assessments

The Profile of Mood States (POMS) assesses mood states and emotions. The POMS scale generates scores across six main categories: Tension, Depression, Anger, Fatigue, Confusion, and Vigor. Participants self-reported answers for questions in the assessment to evaluate mood changes throughout the study. Each item is rated by the participant on a scale from 1-4, and higher values or scores represent increased expression of the correlating mood state[11]. The MemTrax test involves presenting a series of images to participants on a screen, one at a time, at a relatively fast pace. Participants are then asked to identify whether they have seen each image before during the test, and they indicate their recognition by pressing a button or clicking. The images are randomized, with some being repeated at different intervals. The test aims to evaluate the individual's ability to recognize repeated images accurately and quickly, which requires both memory recall and attentional focus. Accuracy (i.e., correctly identifying an image) and reaction time are assessed.

In the PVT, participants respond to a visual stimulus that appears at random intervals. The stimulus's unpredictable timing is designed to prevent participants from anticipating when they need to respond, thus effectively measuring their sustained attention throughout the task. In studies with nootropic substances, psychomotor vigilance is seen to improve after ingestion, and the following metrics were assessed: reaction time and false starts (i.e., when participants press the response button before the visual stimulus appears)[12,13]. The PVT was administered on a laptop. The total time for each PVT was two minutes. Each subject performed three two-minute tests, and the mean of the three tests was used.

These assessments were ideal in swiftly measuring cognitive parameters to reflect the state of performance and functioning with the implementation of the nootropic supplement, or a placebo. Changes and deviations in results are indications of possible involvement in cognitive functioning.

Strength Assessment

The handgrip strength test involves the participant using a handgrip dynamometer to squeeze with maximum effort, thereby measuring the force generated by the forearm muscles. In this regard, the participant holds the dynamometer in one hand, maintaining an upright posture, with the elbow at a 90-degree angle. The participant is instructed to squeeze the dynamometer as hard as possible, typically for a few seconds. Maximum strength was recorded.

Statistical Analysis

All data are presented as the mean and standard deviation. Individual data points are shown in each figure. Data were analyzed using a 2 X 2 mixed ANOVA through GraphPad.

Results

The physical characteristics of the research participants are shown in Table 1. A series of 2 × 2 mixed ANOVAs was conducted to examine the effects of group (TruBrain vs. placebo) and time (pre vs. post) on mood, vigilance, and performance outcomes. There were no significant main effects of group for any mood outcome ($p \geq 0.05$). Significant main effects of time were observed for TMDS ($p < 0.001$), anger ($p = 0.001$), confusion ($p = 0.001$), depression ($p < 0.001$), fatigue ($p = <0.001$), tension ($p = 0.013$), and PVT reaction time in milliseconds ($p = 0.032$), indicating overall pre-to-post changes across both groups. The time effect for accuracy was significant ($p = 0.050$), whereas vigor ($p = 0.060$), reaction time ($p = 0.555$), false starts ($p = 0.482$), and handgrip strength ($p = 0.085$) did not show significant overall time effects (Table 2).

Significant group × time interactions were found for reaction time ($p = 0.003$, $d = 0.904$), accuracy ($p = 0.005$, $d = -0.845$), and handgrip strength ($p = 0.003$, $d = 0.909$). For reaction time, the TruBrain group increased from 0.77 ± 0.11 to 0.81 ± 0.10, whereas the placebo group decreased from 0.77 ± 0.11 to 0.74 ± 0.09. For accuracy, the TruBrain group decreased from 96.69 ± 3.79 to 94.03 ± 4.65, whereas the placebo group increased from 96.48 ± 2.89 to 97.33 ± 2.39.

No significant interactions were observed for TMDS ($p = 0.204$), anger ($p = 0.180$), confusion ($p = 0.591$), depression ($p = 0.905$), fatigue ($p = 0.154$), tension ($p = 0.152$), vigor ($p = 0.649$), PVT reaction time in milliseconds ($p = 0.496$), or false starts ($p = 0.197$) (Table 3). For handgrip strength, the TruBrain group improved from 41.81 ± 11.96 kg to 44.68 ± 12.95 kg, while the placebo group declined from 41.45 ± 10.48 kg to 40.20 ± 9.48 kg (Table 4).

Table 1. Physical characteristics.

	TruBrain	Placebo
Age years	21±1	21±2
Height centimeters	170.3±9.1	168.8±8.6
Body mass kilograms	73.8±14.0	70.2±12.0
Percent body fat	26.2±11.5	25.0±9.0
Years of training	5.2±3.9	6.2±4.9
Hr/wk aerobic training	4.8±5.7	6.1±5.6
Hr/wk resistance training	3.4±1.8	3.7±2.6
Other exercises per week	0.8±1.2	1.2±2.2
Daily caffeine intake (mg)	112±147	85±98

Data are presented as the mean ± standard deviation. N=29 for TruBrain (12 male, 17 female). N=34 for placebo (11 male, 23 female). There were no significant differences between the groups (p>0.05). Legend: Hr – hours; mg – milligrams; wk – week.

Table 2. Mood outcomes from pre to post measures.

Outcome	TruBrain Pre (M ± SD)	TruBrain Post (M ± SD)	Δ	Placebo Pre (M ± SD)	Placebo Post (M ± SD)	Δ	Δ Difference	Interaction p	Cohen's d
TMDS	17.4 ± 27.4	10.1 ± 26.8	-7.2	15.9 ± 22.0	11.90 ± 19.92	-4.1	-3.19	0.204	-0.369
Anger	6.3 ± 9.1	4.76 ± 9.1	-1.5	4.1 ± 4.7	3.43 ± 4.61	-0.6	-0.9	0.18	-0.39
Confusion	6.1 ± 4.4	4.97 ± 3.9	-1.2	6.1 ± 3.6	5.24 ± 3.37	-0.9	-0.32	0.591	-0.155
Depression	4.7 ± 6.7	3.24 ± 6.3	-1.5	5.6 ± 6.8	4.10 ± 6.68	-1.5	0.08	0.905	0.034
Fatigue	6.0 ± 4.7	4.03 ± 4.3	-1.9	5.6 ± 4.5	4.62 ± 3.69	-1.0	-0.93	0.154	-0.415
Tension	8.5 ± 6.5	6.17 ± 5.1	-2.3	6.8 ± 5.6	6.33 ± 4.87	-0.5	-1.75	0.152	-0.417
Vigor	14.1 ± 5.6	13.0 ± 6.8	-1.0	12.3 ± 5.0	11.67 ± 5.43	-0.62	-0.42	0.649	-0.131

Data are presented as the mean ± standard deviation. There were no significant differences between the groups' delta scores (p>0.05).

Table 3. Physical and cognitive changes from pre to post measurements.

Outcome	TruBrain Pre (M ± SD)	TruBrain Post (M ± SD)	Δ	Placebo Pre (M ± SD)	Placebo Post (M ± SD)	Δ	Δ Difference	Interaction p	Cohen's d
Reaction Time	0.8 ± 0.1	0.8 ± 0.1	0.04	0.8 ± 0.1	0.7 ± 0.1	-0.04	0.07	0.003*	0.904
Accuracy	96.7 ± 3.8	94.0 ± 4.7	-2.7	96.5 ± 2.9	97.3 ± 2.4	0.9	-3.51	0.005*	-0.845
PVT (ms)	353.3 ± 52.0	342.6 ± 46.7	-10.7	334.7 ± 52.4	329.3 ± 52.7	-5.3	-5.37	0.496	-0.199
False Starts	0.17 ± 0.5	0.07 ± 0.3	-0.1	0.05 ± 0.2	0.10 ± 0.3	0.1	-0.15	0.197	-0.381

Data are presented as the mean ± standard deviation. There were significant differences in reaction time (p>0.03) and accuracy (p = .05) for the memtrax (i.e., the placebo group performed better)

Table 4. Isometric muscular strength from pre to post measures.

Outcome	TruBrain Pre (M ± SD)	TruBrain Post (M ± SD)	Δ	Placebo Pre (M ± SD)	Placebo Post (M ± SD)	Δ	Δ Difference	Interaction p	Cohen's d
Handgrip (kg)	41.8 ± 12	44.7 ± 13.0	2.9	41.5 ± 10.5	40.2 ± 9.5	-1.3	4.1	0.003	0.909

Data are presented as the mean ± standard deviation. There was a significant difference (p>0.003) in the handgrip strength test (i.e., the TruBrain group performed better).

Discussion

The findings from the present study indicate that this product may offer benefits vis-à-vis cognitive function. However, there may be a tradeoff between perceptions of fatigue (i.e., the treatment demonstrated less self-reported fatigue) and memory accuracy (i.e., the treatment demonstrated significantly less accuracy). Although there is evidence to suggest that the primary active ingredients (i.e., lion's mane extract, chaga extract, reishi extract, and cordyceps extract) might have potential cognitive benefits, it should be noted that there are currently no studies that have examined this specific combination of ingredients. Thus, in this discussion, we focus on the effects of each ingredient individually while highlighting the need for research on their combined effects.

Recent research has explored the potential cognitive and cognitive health benefits of lion's mane extract (i.e., Hericium erinaceus). In a double-blind, placebo-controlled pilot study, healthy adults aged 18-45 were given either a placebo or 1.8 g of lion's mane daily for both acute (single dose) and chronic (28-day) supplementation periods[2]. Results showed a significant increase in performance speed on the Stroop task after a single dose, indicating enhanced cognitive processing. Although not statistically significant, there was a trend toward reduced subjective stress after 28 days of supplementation ($p = 0.051$). Work by La Monica et al.[3] suggests that lion's mane extract improved working memory and reaction time two hours post-ingestion. According to Opanuga and Hossain[4], one of the main bioactive compounds, Erinacines, exhibits potential cognitive benefits.

Findings from Saitsu[14] suggest that the cognitive benefits of lion's mane require long-term use. Their 12-week study on healthy adults over 50 showed significant cognitive improvements, particularly measured by the Mini-Mental State Examination (MMSE). In contrast, the acute testing in our study, conducted with younger participants aged 20-22, may not have captured the full potential of Lion's Mane, as younger adults typically exhibit less baseline cognitive decline. This age difference could explain our study's absence of immediate cognitive benefits. Nevertheless, further clinical trials are necessary to better understand the long-term cognitive effects of lion's mane extract[4].

To our knowledge, there are no studies on the effects of chaga on humans. However, some investigations have found that the chaga mushroom can exert anti-fatigue effects in animal model studies. For instance, Xiuhong[6] employed a swimming-to-exhaustion expericognitive model to evaluate the anti-fatigue activities of chaga on mice, where results indicated that the swimming time to exhaustion in the treated groups was significantly longer than in the untreated mice. Moreover, they found a significantly higher glycogen content in the chaga-treated groups than in the control group in a dose-dependent manner.

Further research by Zhang[7] investigated the antifatigue potential of polysaccharide fractions (PIO-1) extracted from chaga. In their forced swimming test, PIO-1 treatment (50 mg/kg) improved physical endurance by increasing swimming and climbing duration while reducing immobility time. Additionally, metabolic markers of fatigue, such as blood lactic acid (BLA), blood urea nitrogen (BUN), and lactic dehydrogenase (LDH), were significantly reduced in PIO-1-treated mice. Notably, PIO-1 also decreased brain serotonin (5-HT) levels, a neurotransmitter associated with fatigue, indicating potential cognitive fatigue reduction[7]. These findings suggest that chaga may enhance both physical and cognitive endurance through mechanisms involving improved energy metabolism and modulation of fatigue-related neurotransmitters. However, given the lack of human studies, further research on chronic chaga supplementation is essential to verify its effectiveness in fatigue management across populations.

Nkodo's[8] systematic review of seven studies on reishi mushroom highlighted potential cognitive benefits, though no human studies have assessed its effects in healthy individuals. While Ganoderma lucidum (reishi) is not widely studied in healthy populations, recent animal research suggests promising nootropic properties[15]. In rodents, reishi at 150 and 300 mg/kg doses enhanced learning and memory while reducing acetylcholinesterase (AChE) activity, thereby supporting memory by increasing acetylcholine levels[15].

Since our study focused on acute outcomes in healthy young adults, it is possible that the full cognitive benefits of reishi, especially those associated with neuroprotection and long-term supplementation, were not detectable. Most existing research suggests that reishi's effects are more pronounced under chronic use or in individuals experiencing cognitive decline. Further studies are necessary to determine whether prolonged reishi supplementation offers measurable cognitive benefits in healthy adults and whether its effects are synergistic when combined with other active nootropic ingredients.

One potential explanation for the observed divergence between physical and cognitive outcomes is that acute nootropic supplementation may differentially influence central nervous system (CNS) arousal and executive control processes. Specifically, the increase in handgrip strength alongside declines in reaction time and accuracy suggests that the supplement may have enhanced generalized CNS activation or motor drive while simultaneously impairing higher-order cognitive control. This aligns with the concept that heightened arousal can facilitate simple or force-based tasks, but may be detrimental to tasks requiring sustained attention, inhibitory control, and precision. Mednick showed the impact that caffeine had on motor learning compared to a placebo, noting that caffeine significantly impaired motor learning[16]. Consistent with this interpretation, prior research by Diamond has demonstrated that acute increases in arousal, such as those induced by caffeine, can impair cognitive performance, particularly learning and memory, when

arousal exceeds optimal levels[17]. In this context, the findings may reflect a shift along the arousal-performance curve, whereby participants exceeded an optimal level of cognitive arousal, resulting in diminished performance on vigilance-based tasks.

The data collected in this study is reflective of the well-established Yerkes-Dodson law, which posits an inverted-U relationship between arousal and performance[18]. While moderate arousal enhances performance, excessive stimulation may lead to overactivation, characterized by increased impulsivity, reduced attentional stability, and impaired accuracy[17]. Participants in the treatment group may have experienced subtle overstimulation manifesting as jitteriness, overfocus on speed at the expense of accuracy, or reduced inhibitory control, ultimately contributing to slower reaction times and decreased MemTrax accuracy. Notably, the absence of improvement in vigilance metrics (e.g., PVT outcomes) further supports the notion that the supplement did not enhance sustained attention under the acute conditions tested.

Cordyceps extracts, particularly from species such as cordyceps militaris and cordyceps sinensis, show significant promise in enhancing cognitive function, primarily through their potent antioxidant and anti-inflammatory properties. Research has identified various bioactive compounds within cordyceps, such as cordycepin and polysaccharides, which are essential in reducing oxidative stress and modulating inflammatory responses—two factors that are closely linked to neurodegenerative diseases like Alzheimer's and Parkinson's[19]. These compounds combat reactive oxygen species (ROS), which are detrimental to neuronal health when present in excess. Studies using animal models have demonstrated that cordyceps extract administration reduces hippocampal neuronal cell death and markers of inflammation, thereby supporting cognitive functions related to memory and learning[20].

Furthermore, cordyceps has been shown to support cognitive health by enhancing synaptic plasticity, promoting neurogenesis, and stimulating dopamine production—all essential processes for sustaining brain function and mitigating age-related cognitive decline[20,21]. These effects have been observed in animal models where Cordyceps extract improved memory and cognitive performance in tests like the Morris water maze, and this enhancement was attributed to a reduction in oxidative and inflammatory markers. Despite these promising outcomes in vitro and animal studies, further clinical trials are necessary to confirm cordyceps' long-term efficacy and safety as a human neuroprotective agent[19].

Limitations of this study include the use of a convenience sample of college students, resulting in a relatively narrow age range that may limit the generalizability of findings to broader or older populations. Although participants were instructed to refrain from caffeine intake and exercise prior to testing, adherence to these guidelines was not objectively monitored and therefore cannot be fully verified. Additionally, this study examined the effects of an acute intervention; it was not designed to assess long-term cognitive changes, neuroprotective effects, or age-related cognitive decline. Cognitive parameters and means of testing did not assess certain brain characteristics such as brainwaves or stimulation. Some dietary and nutritional variables may play a role in the cognitive performance observed differed in results[13], and should be restricted or controlled more specifically. Additionally, the time of day or timing of circadian rhythm was not accounted for, which may influence the absorbance and presence of the ingredients ingested[13,22], and environment conditions should be accounted for.

Conclusions

While the individual ingredients in TruBrain show promising cognitive and physical benefits, the effects of their combined use remain largely unknown. The discrepancy between reduced fatigue and decreased cognitive accuracy suggests that these ingredients may affect physical and cognitive outcomes differently. Future research should explore how these effects interact over extended use and contribute to cognitive enhancement and alteration or health of neuronal tissue. Observation within different age demographics should also be considered, focusing on whether the combined supplement can synergistically support cognitive resilience and physical endurance.

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