A Randomized, Double-Blind, Placebo-Controlled Evaluation of Coffea Arabica Seed Extract for Cognitive and Mood Impacts in Healthy Adults

Original Research

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Abstract

Introduction: NeuroRush™ is a dietary ingredient comprised of the seed extract of the Coffea arabica. It is rich in polyphenols and chlorogenic acid (CGA). CGAs are linked to positive health impacts and are believed to support cognitive function. This study aimed to determine if a dietary supplement made of Coffee arabica seed extract would affect cognitive function and mood states in healthy adults.

Methods: In a randomized, double-blind, placebo-controlled crossover trial, 19 healthy adults consumed either NeuroRush™ (150 mg coffee seed extract) or placebo (150 mg of maltodextrin). Participants completed cognitive tests (Go/No-Go, Stroop, and N-Back), subjective mood assessments, and safety monitoring at baseline and 1-, 2-, and 3 hours post-ingestion.

Results: Significant main effects of time were observed for cognitive performance across tasks, including improvements in Stroop total score ($p = 0.016$), Stroop reaction time ($p = 0.013$), and N-Back correct responses ($p = 0.010$). The NeuroRush™ group exhibited enhanced N-Back accuracy ($p = 0.008$, $d = 0.85$) and a trend toward faster overall Go reaction times. Self-reported well-being was significantly greater in the NeuroRush™ group at 3 hours compared to placebo ($p = 0.047$, $d = 0.64$).

Conclusions: Acute ingestion of NeuroRush™ may mildly enhance cognitive performance, particularly working memory and processing efficiency, and improve well-being in healthy adults. NeuroRush™ was well-tolerated and was safe within the confines of the study design. Longer-term research is warranted to determine if the enhanced cognitive impacts and mood states remain over time.

Key Words: chlorogenic acid, polyphenols, cognition, mood, coffee

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Introduction

Coffea arabica, a species of coffee plant, is used to produce one of the most popular coffees in the world.[1] Regular consumption of coffee is associated with reduced risk of type 2 diabetes, longer lifespan, improved mood and cognitive function.[2] Caffeine is an alkaloid present in all coffee species but found in lower amounts in the *Coffea arabica* or green coffee bean species. Although caffeine is known to improve cognitive function and mood, *Coffea arabica* contains other bioactive compounds that add to its beneficial properties. Bioactive compounds present in *Coffea arabica* include chlorogenic acids, phenolic acids, and flavonoids.[3] Chlorogenic acids (CGA) are attributed with the most health-

promoting properties found in *Coffea arabica*. The types of CGAs present in *Coffea arabica* include caffeoylquinic acids (CQAs), caffeoylquinic acids (diCQAs), and feruloyl quinic acids (FQAs). Studies report involving *Coffea arabica* report a lower incidence of type-2 diabetes, cardiovascular disease, neurodegenerative diseases, and improved glucose and lipid metabolism, which are likely related to the anti-inflammatory and antioxidant activities of CGA.[3-6]

Chronic CGA consumption improves cognitive function in healthy adults and those with mild cognitive impairment.[7,8] CGA's beneficial effect on cognitive function may be related to several factors. First, CGA crosses the blood-brain barrier, allowing it to exert effects directly in the brain. CGA and its metabolites offer protective effects in the brain due to their ability to lower the production of reactive oxygen species (ROS) (antioxidant effects). Rodent models show that CGA suppresses lipid peroxidation (antioxidant function) and attenuates mitochondrial dysfunction.[9] CGA modulates inflammation by increasing the production of anti-inflammatory cytokines (i.e., IL-4 and IL-13) while simultaneously decreasing the production of inflammatory cytokines (i.e., TNF-α and IL-2).[9] Increased neuroinflammation is linked to cognitive decline, psychiatric disorders, and damage to neurons. Additionally, CGA is thought to promote the growth and development of neurons via increased expression of brain-derived neurotrophic factor (BDNF) and nerve growth factor (NGF).[10,11]

Given the well-established benefits of coffee and its constituents, numerous dietary products and beverages incorporating caffeine are available. However, many products contain mixed ingredients beyond caffeine alone, and as such, the impact of the effects of a multigradient caffeine-containing product is not always well defined. For example, some individuals are caffeine sensitive, and higher doses of caffeine (i.e., >200 – 400mg) may increase feelings of and perception of anxiety [12-15]. Unlike other caffeine-containing supplements, NeuroRush™, is formulated from coffee seed extract, with a high concentration of chlorogenic acid (~53%), other polyphenols, and a minute amount of caffeine (<5%). This formulation is distinct in its low caffeine content, which minimizes the risk of caffeine-related side effects. The unique combination of CGA and polyphenols may synergistically affect cognitive function and overall mood. The primary objective of this study was to examine the effects of a novel coffee seed extract-containing supplement, NeuroRush™, on cognitive function and subjective mood states. This study used validated tests targeting inhibitory control, working memory, and attention to assess cognitive function. The Stroop, N-Back, and Go/No-Go tests are widely used, validated tools suited for detecting short-term cognitive changes.[16-18] Safety outcomes included monitoring of heart rate and blood pressure. The authors hypothesized that the *Coffee arabica* seed extract would positively impact cognition and mood states in healthy adults.

Methods

Experimental Protocol

This study followed a randomized, double-blinded, crossover placebo-controlled design. Subjects reported to the clinical site on three separate visits with a minimum 1-week washout between testing visits (i.e., visits 2 and 3). A Latin square design was used to counterbalance treatment order and control for potential order effects in this randomized crossover study. All participants underwent an informed consent process in accordance with the Declaration of Helsinki and an approved IRB protocol submitted to the institutional review board of Advarra (IRB#00000971). The study was executed by the contract research company, Center for Applied Health Sciences, Canfield, OH.

During the initial visit (screening), subjects underwent assessments that included medical and health history, vitals [blood pressure (BP) and heart rate (HR)], anthropometrics (height, weight, body mass index), and 24-hour dietary recalls. Routine safety blood work was conducted, including a complete blood count (CBC), comprehensive metabolic panel (CMP), and lipid panel. The cognitive battery tests (Go/No-go, N-Back, and Stroop) were administered to familiarize subjects with the testing protocol. At each testing visit, subjects consumed either the active supplement or the placebo. They completed the following protocol: vitals, visual analog scales (VAS) for vitality, energy, well-being, vigor, and mood, and cognitive battery (Go/No-go, N-back, and Stroop), at 0 (pre-ingestion), 1-, 2-, and 3-hours post-consumption. Subjects were instructed to maintain their activities of daily living, abstain from caffeine, alcohol, and physical activity for 24 hours, and fast for 10 hours before both testing visits.

Subjects

Subjects were recruited from the local community (Canfield, OH). Nineteen healthy adult males and females with a mean age of 27.8 ± 8.8 years entered the study. Participants consumed a placebo (150 mg maltodextrin) and NeuroRush™ (150 mg Coffee [Coffea arabica] Fruit Extract) on separate testing visits. The dietary supplement was provided by Aura Scientific, Wilmington, DE. The placebo and the active supplement were identical in size, shape, and color.

Study Product
The study evaluated NeuroRush™ 150 mg (Aura Scientific LLC, Wilmington DE) and placebo (maltodextrin) at an equal dose. Both the placebo and supplement were identical in size, shape, and color. The dose (150 mg) was based on internal data provided by the study sponsor, including unpublished pilot data.

Stroop test
The Stroop test is a validated tool for measuring attention and cognitive inhibition.[17] The Stroop test requires individuals to read color words printed in a different color ink (for example, the word "green" could be printed in blue) and select the color of the ink they see instead of reading the word they see (therefore, within the example, the answer would be blue).[19] This challenge requires participants to perform a less automated task (i.e., naming the ink color) while inhibiting interference from a more automated task (i.e., reading the word).[19] All the participants in the study were assessed using the congruent standard condition of the Stroop test for two minutes at each attempt/repetition. The outcome variables associated with the Stroop test were total score, accuracy, and average time per score, which were all calculated and provided by the testing application (Andrew Novak Stroop Test for Research App).

N Back test
The N-Back task evaluates working memory, attention, and decision-making.[16] This study utilized the protocol outline in a previous study.[18] During the N-Back test, a sequence of stimuli was presented on the screen, and subjects were instructed to identify when the current stimulus matched the one presented earlier in the sequence. In the 1-back version, subjects compare the current stimulus to the immediately preceding one, serving as a short-term memory and cognitive control test. Stimuli cards featuring colored shapes were presented for 1500 ms with 500 ms intervals between each interval. Subjects were instructed to respond as quickly as possible. Key outcome measures included total score, accuracy (calculated as the percentage of correct responses and the number of correct responses out of total attempts), and reaction time. These outcomes were recorded by the Luminosity stimulus presentation software (lumosity.com/app/v4/games/speed-match-overdrive-web).

Go/No-Go test
The Go/No-Go test is a measure of response inhibition.[17] This study utilized the protocol outline in a previous study.[18] The test is comprised of a rapid, continuous stream of visual stimuli, requiring the subject to make a binary decision on each. Specifically, subjects were instructed to respond as quickly as possible with a 'Go' when a stimulus appeared (an orange square) or to withhold their response when a 'No-Go' stimulus appeared (a blue square). There was a higher number of Go stimuli (~81%) compared to No Go (~19%) in order to increase difficulty by creating a habitual motor response. Stimuli were presented for 1000 ms with a 500 ms interval in-between. There was a total of 53 trials. Primary outcome measures included accuracy (percentage of correct responses and correct inhibitions) and reaction time. These outcomes were recorded by the Testable stimulus presentation software (https://www.testable.org/experiment/12553/787858/start).

Visual Analog Scale (VAS): Mood
To assess subjective ratings of vitality, well-being, vigor, energy, and overall mood, subjects were instructed to place a vertical mark on a 10cm horizontal line between the lowest/worst possible and highest/best possible to indicate how they felt. They completed this assessment at all time points.

Anthropometrics
Body weight was measured using a Seca 767TM Medical Scale (Chino, CA). Body composition was assessed with a multi-frequency bioelectrical impedance device (InBody 570 Cerrito, CA) to determine each subject's physical characteristics. Following the directions for the InBody570 measurement, subjects stood on the device's platform barefoot with the soles of their feet on the electrodes. They then grasped the unit's handles with their thumb and fingers to maintain direct contact with the electrodes. Subjects stood still for ~1 minute while maintaining their elbows fully extended and their shoulder joint abducted to about a 30-degree angle.

Statistical Analysis
All calculations and analyses were performed using GraphPad Prism. Mixed factorial ANOVAs assessed the effects of treatment, time, and treatment × time on cognitive performance, subjective VAS ratings, and vital signs. Post-hoc Tukey and Sidak tests were used to examine pairwise differences between time points and treatments. Paired t-tests

compared body mass between conditions. For cognitive tests conducted twice per time point, the mean score was used for analysis. Area under the curve (AUC) was calculated via the trapezoidal method for cognitive and VAS outcomes, with paired t-tests used to compare AUC values between treatments. Change scores for cognitive and VAS measures were analyzed using mixed factorial ANOVAs. The significance level was set at $p \leq 0.05$ and p-values > 0.05 but ≤ 0.10 were accepted as a statistical trend. In addition, effect sizes using Cohen's d (d) or rank-biserial correlation (r) (for non-parametric tests) were calculated to evaluate the magnitude of the observed effect between treatments (NeuroRush™ vs. Placebo) or time (0-hour-pre-ingestion, 1-, 2-, 3-hour post-ingestion). For reference, a small effect size is considered ≥0.2, a medium effect is ≥0.5, and a large effect is ≥0.8 for d. For r, a small effect size is considered ≥0.1-0.3, a medium effect is ≥0.3-0.5, and a large effect is ≥0.5.

Results

Stroop

There was a significant main effect of time for both Stroop Total Score ($p = 0.016$) and Stroop Time per Score ($p = 0.013$), and a trend toward a main effect of time was observed for Stroop Accuracy ($p = 0.089$) (table 1). Post hoc analysis revealed a significant decrease in Stroop Time per Score from 0hr to 2hr ($p = 0.047$, $d = 0.68$ "medium effect") and a trend from 0hr to 1hr ($p = 0.064$, $d = 0.62$ "medium effect"), suggesting a quicker response time following NeuroRush™. No other Stroop-related outcomes showed significant or trending effects.

N-back

Significant main effects of time were observed for N-Back correct responses ($p = 0.010$), N-Back attempts ($p < 0.001$), and N-Back time per score ($p = 0.002$). Post hoc analysis revealed a significant increase in correct responses at 1hr ($p = 0.008$, $d = 0.85$ "large effect") and a trend at 3-hours ($p = 0.091$, $d = 0.58$ "medium effect"), in the NeuroRush™ group, suggesting enhanced accuracy (table 1).

A significant increase in attempted responses was observed at 1hr ($p = 0.001$, $d = 1.03$ "large effect") and 3-hours ($p = 0.013$, $d = 0.80$ "large effect"), with a trend at 2-hours ($p = 0.078$, $d = 0.60$ "medium effect") in the NeuroRush™ group. Additionally, a significant improvement in time per score at 1-hour ($p = 0.020$, $d = 0.75$ "medium effect") and trends at 2-hours ($p = 0.083$, $d = 0.59$ "medium effect") and 3-hours ($p = 0.057$, $d = 0.63$ "medium effect") was observed, indicating enhanced processing efficiency within the NeuroRush™ group.

In the placebo group, a significant increase in attempted responses was observed at 3-hours($p = 0.035$, $d = 0.69$), with trends at 2-hours ($p = 0.100$, $d = 0.57$) and from 1-hour to 3-hours ($p = 0.086$, $d = 0.59$), suggesting a possible practice effect.

There was a trend towards significance in the change scores of N-Back scores ($p = 0.099$), N-Back correct responses ($p = .070$), N-Back attempts ($p = 0.055$), and N-Back accuracy ($p = 0.089$). Post hoc analysis revealed a significant difference in N-Back accuracy change scores between 1-hour and 3-hours post-ingestion ($p = 0.047$, $d = 0.59$ "medium effect"), with greater improvements observed at the 1-hour mark. This pattern suggests a short-term enhancement in accuracy following treatment. No other significant or trending effects were observed for N-Back outcomes.

Go/No-Go

A significant main effect of time was observed for No-Go reaction time ($p = 0.046$). There was a trend toward a difference in the overall response (AUC) for Go reaction time ($p = 0.080$, $r = 0.46$ "medium effect") (table 1), suggesting that subjects in the NeuroRush™ group exhibited faster reaction times over the post-ingestion period compared to those in the placebo group. No other significant or trend-level effects were observed for the Go/No-Go measures.

VAS – Well Being

A significant main effect of time was observed for self-reported energy ($p = 0.012$) with similar post hoc observations in the NeuroRush™ and placebo group (table 2). A significant interaction was found for well-being ($p = 0.029$). At 3-hours, subjects in the NeuroRush™ group reported greater well-being than placebo group subjects ($p = 0.047$, $d = 0.64$ "medium effect"). Within the NeuroRush™ group, well-being at 3-hours was significantly greater than at 2-hours ($p = 0.047$, $d = 0.66$ "medium effect"). It showed a trend toward improvement compared to 1-hour ($p = 0.092$, $d = 0.58$ "medium effect"), suggesting a time-dependent increase in well-being. Delta score for well-being indicated a significant interaction ($p=0.008$) over time in the treatment group. Post hoc analysis suggests NeuroRush™ led to increased feelings of well-being ($p=0.074$, $d=0.56$) between baseline and 3-hours, while the placebo group had a

reduction in well-being. A trend for an interaction was observed for vigor (p = 0.096) and mood (p=0.069). Post hoc analysis showed a trend towards a poorer mood at 3-hours as compared to 2-hours (p = 0.068, d = 0.61) and less vigor (p=0.066, d=0.55) at 3-hours compared to 1 hour in the placebo group. No other significant or trending effects were observed for subjective mood outcomes.

Blood Pressure

There was a significant interaction observed for systolic blood pressure (SBP) (p = 0.010), along with a trend for a main effect of time (p = 0.057), indicating differences both between and within treatment groups over time. Post hoc analysis showed SBP was significantly higher (p = 0.044, d = 0.65) in the placebo group compared to NeuroRush™at 1-hour. Within the NeuroRush™ group, SBP was significantly lower at 1-hour compared to both 0-hour r (p = 0.029, d = 0.71) and 3-hours (p < 0.001, d = 1.09), and lower at 2-hours compared to 3-hours (p = 0.037, d = 0.68).

There was a significant interaction (p = 0.041) and a significant main effect of time (p = 0.010) for diastolic blood pressure (DBP) in both groups. Within the NeuroRush™ group DBP was significantly increased at 3-hours compared to 0hr (p = 0.011, d = 0.82), 1-hour (p = 0.023, d = 0.74), and 2-hours (p = 0.022, d = 0.74).

Heart Rate

A significant main effect of time was found for heart rate (HR) (p < 0.001) in both groups. Post hoc analysis showed HR was significantly higher at all post-ingestion time points compared to 0hr in both groups. In the placebo group, HR increased at 1-hour (p < 0.001, d = 1.57), 2-hours (p < 0.001, d = 1.23), and 3-hours (p < 0.001, d = 1.59). In the NeuroRush™ group, similar increases were observed at 1-hour (p < 0.001, d = 1.15), 2-hours (p = 0.014, d = 0.79), and 3-hours (p < 0.001, d = 1.11).

Table 1. Cognitive Tests

Variable	Treatment	0 min	60 min	120 min	180 min	AUC
Go correct (%)	PL	99.9 ± 0.2	99.9 ± 0.2	99.8 ± 0.5	99.8 ± 0.4	180 ± 0.54
	NR	100 ± 0.0	99.9 ± 0.3	99.7 ± 0.9	99.8 ± 0.4	180 ± 0.75
Go reaction time (ms)	PL	347 ± 38	346 ± 41	349 ± 43	343 ± 34	62388 ± 6944#
	NR	336 ± 39	337 ± 32	342 ± 42	339 ± 39	60990 ± 6534
NoGo correct (%)	PL	93.2 ± 8.4	90.1 ± 10.8	90.3 ± 9.1	91.8 ± 8.7	164 ± 16.0
	NR	93.5 ± 11.6	90.2 ± 11.0	90.9 ± 10.8	90.8 ± 10.1	164 ± 17.8
NoGo reaction time (ms)	PL	952 ± 62	930 ± 80	932 ± 68	943 ± 65	168585 ± 11918
	NR	955 ± 83	931 ± 80	936 ± 77	936 ± 74	168713 ± 12848
Stroop-Total Score (#)	PL	122.8 ± 18.9	125.6 ± 16.7	125.2 ± 16.8	124.7 ± 16.9	22471 ± 2945
	NR	118.6 ± 18.4	123.1 ± 16.5#	124.0 ± 20.0	125.7 ± 18.2#	22157 ± 3183
Stroop-Accuracy (%)	PL	98.8 ± 1.7	98.2 ± 1.8	98.3 ± 2.1	98.2 ± 1.6	17702 ± 297
	NR	98.8 ± 1.2	98.5 ± 1.8	98.5 ± 1.1	98.4 ± 1.7	17739 ± 248
Stroop-Time per Score (s)	PL	1.004 ± 0.170	0.979 ± 0.167	0.979 ± 0.156	0.984 ± 0.160	173 ± 22.2
	NR	1.039 ± 0.182	0.994 ± 0.152#	0.959 ± 0.126*	0.979 ± 0.165	175 ± 21.7
N-Back score (au)	PL	20006 ± 5373	19866 ± 5470	20683 ± 5021	20468 ± 5009	3647179 ± 918262

	NR	19082 ± 5662	20413 ± 5176	19663 ± 5637	20027 ± 5537	3577816 ± 951330
N-Back correct (#)	PL	111.2 ± 22.4	112.0 ± 20.7	114.2 ± 18.6	114.7 ± 19.2	20355 ± 3563
	NR	108.3 ± 22.5	113.2 ± 20.3*	110.8 ± 20.9	112.8 ± 21.4#	20075 ± 3723
N-Back attempted (#)	PL	116.9 ± 24.1	118.6 ± 22.1	120.3 ± 20.3#	121.4 ± 20.8*β	21484 ± 3864
	NR	114.2 ± 23.8	118.8 ± 21.6*	117.2 ± 21.7#	119.8 ± 22.6*	21182 ± 3952
N-Back Accuracy (%)	PL	94.9 ± 3.1	94.1 ± 4.3	94.7 ± 4.5	94.2 ± 4.5	17000 ± 723
	NR	94.4 ± 4.6	95.0 ± 3.4	94.0 ± 4.6	93.5 ± 3.6	16976 ± 673
N-Back Average Time per Score (ms)	PL	805.9 ± 206.8	783.9 ± 168.4	766.7 ± 137.3	752.4 ± 140.7	139787 ± 28180
	NR	828.6 ± 205.0	779.7 ± 154.8*	792.8 ± 156.9#	774.6 ± 155.7#	142444 ± 29145

Data are Means ± SD. * Indicates significantly different vs. 0 min (p≤0.05). # Indicates a trend vs. 0 min (p≤0.10).

Table 2. Visual Analog Scale: Mood.

Variable	Treatment	0 min	60 min	120 min	180 min	AUC
Vitality (cm)	PL	6.2 ± 2.0	6.1 ± 2.2	6.2 ± 2.2	6.1 ± 2.0	1107 ± 364
	NR	5.9 ± 2.3	6.3 ± 2.4	6.5 ± 2.2	6.6 ± 2.0	1146 ± 388
Energy (cm)	PL	5.5 ± 2.1	6.3 ± 1.9#	6.1 ± 2.3	6.0 ± 1.9	1085 ± 355
	NR	5.7 ± 2.2	6.3 ± 1.8#	6.5 ± 1.8	6.6 ± 1.5	1138 ± 296
Well-being (cm)	PL	7.6 ± 1.1	7.4 ± 1.3	7.2 ± 1.6	7.0 ± 1.7	1318 ± 242
	NR	7.4 ± 1.6	7.5 ± 1.4	7.5 ± 1.3	7.9 ± 1.1 £ ¿ +	1358 ± 226
Vigor (cm)	PL	6.1 ± 2.2	6.3 ± 2.2	6.2 ± 2.2	5.9 ± 2.2	1110 ± 377
	NR	6.1 ± 2.3	6.5 ± 2.2	6.8 ± 2.2	6.9 ± 2.1	1191 ± 382

Data are Means ± SD. # Indicates a trend vs. 0 min (p≤0.10). £ Indicates statistically significant difference vs. 120 min (p≤0.05). ¿ Indicates a trend vs. 60 min (p≤0.10). + Indicates statistically significant difference vs. PL (p≤0.05).

Discussion

The present study investigated the effects of 150 mg of NeuroRush™ on cognitive performance and subjective ratings of mood in healthy adults. The present study observed subtle improvements in cognitive performance and self-reported feelings of well-being. A more robust study of duration is warranted to determine if the results are acute or can be maintained over time.

The study results found that both groups improved Stroop performance over time, as reflected by higher total scores and faster reaction times. Within-group analysis in this study revealed a trend towards significance in reaction time following consumption of NeuroRush™. Alharbi et al.[12] reported improvements in reaction times on the Stroop test following the consumption of *Coffea Arabica* but not after the consumption of *Coffea Robusta*. The authors theorize that this difference is due to higher concentrations of CGA found in *Coffea Arabica*. Saitou et al.[10] examined the effects of 16 weeks of CGA consumption on cognitive function. Contrary to our findings, no improvements were reported on

the Stroop test; However, other cognitive tests used reported increases in reaction time and executive function. The differences may be related to the different dosing strategies (daily before bed) and cognitive assessments used. The acute consumption of NeuroRush™ may produce subtle benefits in cognitive speed in conditions requiring inhibition and attentional control as detected by the Stroop test.

Camfield et al.[20] reported faster reaction times on the N-back test at 40 minutes after consuming decaffeinated coffee containing CGA. Additionally, a trend toward accuracy was reported, but there were no differences between placebo and CGA decaf coffee. Similarly, this study found a significant increase in correct responses at 1-hour and a nearly significant increase 3-hours post consumption in the NeuroRush™ group. The large effect size at both time points (1-hour d = 0.85; 3-hours d = 0.58) indicates a short-term benefit of NeuroRush. Combined with the improvements observed in time per score at 1-hour, it appears NeuroRush™ increases processing speed and efficiency, while maintaining "correctness" as detected by the neurocognitive testing employed in this study. The placebo and NeuroRush™ groups had faster reaction times on the No-Go test over time. Notably, there was a trend toward between-group difference in overall response (AUC) for Go reaction time following consumption of NeuroRush™ group. The medium effect size suggests modest improvements in reaction time compared to the placebo group. Pasman et al.[21] reported faster reaction times in the Go-No Go test following caffeine ingestion. The absence of broader effects, particularly in No-Go accuracy or errors, suggests that while NeuroRush™ may facilitate quicker responses, it does not necessarily enhance inhibitory control or accuracy. Performance changes on the N-back and No-Go tests suggest NeuroRush™ enhances cognitive performance, specifically in working memory tasks (N-Back) and reaction times. More research is needed to determine if this effect differs from caffeine alone.

The similar improvements in both groups in various cognitive performance outcomes are likely related to the practice effect.[22] The changes in cognitive performance in this study suggest NeuroRush™ has the potential to acutely improve cognitive performance in tasks requiring sustained attention and working memory. We theorize that the acute dose of NeuroRush™ used in this study may not be sufficient to detect more significant cognitive benefits.

Self-reported energy significantly increased in both groups, suggesting a potential expectancy effect or influence of study procedures independent of treatment. Following the consumption of NeuroRush™, there was a significant improvement in self-reported well-being at 3-hours compared to placebo. Within-group comparisons found high ratings of well-being at 3-hours compared to 2-hours and a trend toward significance at 1-hour. The increase in self-reported well-being at later times shows the potential for NeuroRush™ to enhance specific dimensions of mood. Croplay et al.[23] reported increased feelings of alternates following the consumption of decaffeinated coffee with CGA. However, comparison with their results is limited due to the different mood assessments utilized. Camfield et al.[20] used a Caffeine Research VAS and Bond-Lader VAS to assess self-reported mood feelings. Subjects reported feeling more alert and less negative feelings (tiredness, jitteriness, and headaches) after consuming CGA decaf coffee. These reductions in negative feelings align with the enhanced sense of well-being observed in our findings. It is important to interpret these results cautiously, given the exploratory nature of the study and the use of a general VAS scale rather than domain-specific mood assessments. The absence of significant effects on other mood domains highlight the need for more comprehensive and validated mood assessment tools in future research.

The NeuroRush™ group experienced significantly lower HR at baseline than all other time points. SBP was lower 1-hour relative to both baseline and 3 hours. DBP was significantly increased at the 3-hour point compared to all other time points. CGA has been shown to lower blood pressure.[24,25] Changes in blood pressure at earlier time points may be related to the initial effects of CGA. HR at baseline was significantly lower than all other time points in the placebo group. Changes in the placebo group may be related to the "placebo" effect or perceived mental stress of being a research participant.[6] Importantly, all HR and blood pressure values remained within clinically normal ranges, and no participant experienced hypotension or tachycardia. The placebo group reported one mild adverse advent, a headache. There were no changes in body mass. These findings suggest that acute consumption of NeuroRush™ is safe and well-tolerated in healthy adults, with no clinically meaningful alterations in cardiovascular parameters.

The limitations of this study include that it was a single-dose testing (acute) and not a chronic-use outcomes study. Future studies should examine different dosing strategies (i.e., chronic dosing and higher doses) to understand the effects of NeuroRush™ better. The use of a crossover design is generally thought to minimize confounding variables; however, it may affect the ability to detect the benefits of NeuroRush™ on tasks that are susceptible to practice effects.

Conclusions

The results of this pilot study suggest that acute ingestion of NeuroRush™, a coffee seed extract containing chlorogenic acids (CGA), may potentially have acute, positive impacts on cognitive function and aspects of mood. These results should be interpreted with caution given the small sample size and acute study design. Further research with larger samples and longitudinal designs is warranted to validate and expand upon these exploratory findings. state deserving of further research and development.

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