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File: ■ Cocoa (*Theobroma cacao*, Malvaceae)
■ Cognition
■ Cardiovascular Health

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RE: Cocoa Consumption Lessens Mental Fatigue and Improves Aspects of Cognitive Performance

Masse LA, Ried K, Pase M, et al. The acute and sub-chronic effects of cocoa flavanols on mood, cognitive and cardiovascular health in young healthy adults: a randomized, controlled trial. *Front Pharmacol.* May 2015;6:93. doi: 10.3389/fphar.2015.00093.

The consumption of flavanol-rich foods has been associated with improved learning, memory, and overall cognitive performance. In particular, cocoa (*Theobroma cacao*, Malvaceae) and cocoa-containing products, which contain various forms of beneficial flavonoids, have been studied by researchers seeking to understand the cognitive-enhancing potential of high-flavanol cocoa. The goal of this randomized, controlled, double-blind, clinical trial was to assess both the acute and subchronic effects of cocoa supplementation on mood and mental fatigue, cognitive performance, and cardiovascular function in young, healthy adults.

Subjects aged 18-40 years living in Melbourne, Victoria, Australia, were recruited using magazine and social media advertisements, phone calls, and emails. Inclusion criteria included the following: no diagnosed cardiovascular or cognitive impairment, bleeding disorders, or gastrointestinal disorders; no clinically significant pulmonary, cardiovascular, psychiatric, or neurological conditions in the previous 12 months; not taking illicit drugs, cognitive-enhancing medications, herbal supplements, antidepressants, antipsychotics, or anticoagulants; not pregnant or lactating; not color blind; and able to speak English.

Forty subjects were randomly assigned, 20 in each group, to receive 1 of the following interventions: active cocoa tablets (containing 3058 mg cocoa seed extract standardized to contain 250 mg catechin polyphenols and 5.56 mg caffeine) or placebo (tablets containing inert cellulose powder and identical in appearance, size, texture, and color to the cocoa tablets). Swisse Wellness Pty. Ltd. (Melbourne, Victoria, Australia) provided both the cocoa and placebo tablets. The subjects took 1 tablet daily for 30 days.

The primary outcomes were cognitive performance (as measured by the Swinburne University Computerized Cognitive Assessment Battery [SUCCAB]) and mood, mental

fatigue, and stress (as measured by the Cognitive Demand Battery [CDB]). Cardiovascular markers, including blood pressure and cerebral blood flow, were used as secondary outcomes.

The subjects underwent 3 testing sessions—a baseline assessment, an acute assessment 2 to 3.5 hours after tablet ingestion on the same day, and a subchronic assessment 4 weeks after the initial testing. The subjects abstained from caffeine the night before each testing session and fasted, except for water, during each of the testing days.

At each testing session, the subjects completed 8 computer-based SUCCAB tasks to assess cognitive performance. Those tasks included simple reaction time, choice reaction time, immediate recognition, congruent Stroop color word, incongruent Stroop color word, spatial working memory, contextual memory, and delayed recognition. The subjects were challenged mentally to further evaluate cognitive function using the CDB, which included 2 serial subtraction tasks, the Bakan Rapid Visual Information Processing Task, and a mental fatigue visual analog scale. The subjects completed three 10-minute cycles of the CDB.

Of the 40 subjects who began the study, 38 (19 from each group) returned for the subchronic assessment at 30 days. Reasons for the 2 subjects not returning were not given.

Assessing the acute effects of the interventions, the authors report no significant between-group differences in accuracy or reaction time for any SUCCAB task.

While there was no significant difference between the groups in mental fatigue at baseline, subjects in the cocoa group reported being significantly less mentally fatigued than subjects in the placebo group at the acute assessment after treatment and before the CDB ($P=0.02$). Both groups reported being more mentally fatigued after completing the CDB compared with earlier time points, with subjects in the placebo group feeling more mentally fatigued than those in the cocoa group.

Significant between-group differences were found for the Serial Sevens task, where subjects counted backwards by sevens on a keyboard as quickly and as accurately as possible for 2 minutes. During the first cycle of the CDB at the acute time point, when covarying for baseline, subjects in the cocoa group provided significantly more correct answers than those in the placebo group ($P=0.02$). No significant between-group differences were observed during cycles 2 and 3 of the CDB.

Looking at the subchronic data, the authors report no significant between-group differences in accuracy or reaction time for any SUCCAB task when covarying for baseline data. After cycle 3 of the CDB at the subchronic assessment, subjects in the placebo group reported feeling significantly less stressed than those in the cocoa group ($P=0.03$). Subjects in the cocoa group did not report any significant changes in stress levels during the study; however, compared with baseline, those in the placebo group reported significantly lower levels of stress after completing the CDB during the subchronic assessment ($P=0.003$).

Compared with baseline data, no significant differences in task performance were observed for either group during the 3 cycles of the CDB at the subchronic assessment.

Additionally, no significant effects were observed in either group for any of the cardiovascular measures at the acute time point or after 30 days during the subchronic assessment, when covarying for baseline data.

An earlier study reported beneficial CDB effects throughout 6 cycles of the CDB with cocoa supplementation.¹ But, differences in study design, including an assessment that began 1.5 hours after consuming cocoa and the use of a much higher dose of cocoa flavanols, could account for the difference in outcomes. In the current study, epicatechin levels may have been too low and/or diminished by time of assessment.

The authors conclude that a 250-mg dose of cocoa flavanols decreased mental fatigue and improved minor aspects of cognitive performance acutely but not subchronically during a highly demanding task. The study did have several limitations, including lack of time for practice testing, short study period, a dose that may have been too low, and a placebo that did not contain the same amount of caffeine as the treatment. In future studies, these should be taken into consideration and higher doses of cocoa should be used for a longer duration to determine its effects on cognitive, mood, and cardiovascular markers.

—*Shari Henson*

Reference

¹Scholey AB, French SJ, Morris PJ, Kennedy DO, Milne AL, Haskell CF. Consumption of cocoa flavanols results in acute improvements in mood and cognitive performance during sustained mental effort. *J Psychopharmacol.* 2010;24(10):1505-1514.

Referenced article can be accessed at <http://journal.frontiersin.org/article/10.3389/fphar.2015.00093/full>.

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