

ACUITY

SPORTS DRINK | SCIENCE SERIES

The Cognitive Stack:

L-Theanine, Vitamin B6, and Vitamin B12

How Three Nutrients Work Together to Sharpen Your Mind

A SCIENTIFIC WHITE PAPER

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The Cognitive Stack: A Brief Overview

Mental performance doesn't live in a vacuum. The ability to focus, think clearly, manage stress, and sustain attention is the product of underlying brain chemistry — chemistry that depends on specific, well-studied nutrients. Acuity was formulated around three of those nutrients: L-theanine, Vitamin B6, and Vitamin B12.

This white paper reviews the scientific literature on each ingredient individually and as a combined stack — explaining the mechanisms, the evidence, and why this specific combination supports both acute mental performance and long-term brain health. Our goal is transparency: you deserve to know exactly what's in your drink, why it's there, and what the science actually says.

31	200 mg	2 yrs
Randomized trials reviewed in the 2026 L-theanine meta-analysis	Standard clinical dose of L-theanine studied	Supplementation period showing B-vitamin neuroprotection in MCI

SECTION 1

The Brain-Performance Connection

Cognitive performance is physical performance. Whether you're an athlete reading a defense, an executive making high-stakes decisions, or a student absorbing new information under pressure — your brain is working against a biological clock. Fatigue, stress, and poor focus aren't character flaws. They're the result of depleted neurotransmitters, disrupted signaling, and an overworked nervous system.

The most effective interventions for cognitive performance don't force the brain into an unnatural state — they support the chemical systems the brain already runs on. That means supplying the raw materials for neurotransmitter synthesis, protecting the structural integrity of

neurons, and modulating the brain's excitatory-inhibitory balance so that focus and calm can coexist.

L-theanine, Vitamin B6, and Vitamin B12 each address one of these layers — and together, they cover the full picture.

SECTION 2

L-Theanine: Calm Focus Without Sedation

What It Is

L-theanine is a naturally occurring amino acid found almost exclusively in green tea leaves (*Camellia sinensis*). It is responsible for the uniquely calm-alert mental state that tea drinkers have described for thousands of years — a state that coffee, with its caffeine alone, cannot reliably produce. Modern neuroscience has explained why.

How It Works in the Brain

L-theanine crosses the blood-brain barrier within 30 to 60 minutes of consumption and interacts with the brain's signaling systems through four well-documented mechanisms:

Alpha Wave Induction	L-theanine measurably increases alpha-frequency brain wave activity — the same electrical signature seen during alert meditation and deep, relaxed focus. This shift occurs without sedation or drowsiness, distinguishing it from anxiolytics and sleep aids.
Glutamate Modulation	L-theanine is structurally similar to glutamate, the brain's primary excitatory neurotransmitter. It partially occupies glutamate receptors without activating them, effectively turning down neural over-excitation — the mechanism behind stress-related cognitive interference.
GABA Enhancement	The compound increases GABA, the brain's main inhibitory neurotransmitter. GABA quiets overactive neural circuits the way a volume knob works — reducing noise without cutting signal.
Mood Neurotransmitt	L-theanine modestly elevates both dopamine and serotonin, contributing to the calm, positive mental state users report. These effects are subtle but consistent

What the Research Shows

The evidence base for L-theanine is substantial and growing. A 2026 systematic review and meta-analysis published in *Molecular Psychiatry* — the most comprehensive to date — analyzed 31 randomized controlled trials. Key findings included:

- A robust short-term improvement in attention in healthy adults, with significantly improved choice reaction time (standardized mean difference = 0.51).
- A significant reduction in depressive symptoms following a single dose in healthy individuals (SMD = 0.69), with minimal variability across trials.
- A strong safety profile across all studies — no serious adverse events and dropout rates comparable to placebo.
- The effects are primarily acute. L-theanine works in the short window after consumption, making it well-suited for a performance drink taken before cognitive or physical demands.

Clinical Dose Note: Studies consistently use 200 mg of L-theanine — the dose found effective across the majority of positive trials. A standard cup of green tea contains only 5 to 85 mg depending on preparation, meaning meaningful doses require a concentrated supplement or functional drink.

SECTION 3

Vitamin B6: The Neurotransmitter Architect

What It Is

Vitamin B6 — primarily in its active form, pyridoxal 5'-phosphate (PLP) — is one of the most critical coenzymes in brain biochemistry. The brain maintains B6 concentrations roughly 100 times higher than blood levels, a fact that underscores how essential it is to normal neurological function. Without sufficient B6, the enzymatic pathways that build the brain's most important neurotransmitters simply cannot operate at full capacity.

Core Functions in Brain Chemistry

Neurotransmitter Synthesis	B6 catalyzes the conversion of tryptophan to serotonin, DOPA to dopamine, and glutamate to GABA. It is the rate-limiting enzyme cofactor in all of these pathways — which means that even mild B6 insufficiency can reduce the brain's production of the very neurotransmitters that govern mood, focus, and stress response.
Homocysteine Control	B6 works alongside B12 and folate to metabolize homocysteine, a toxic amino acid byproduct that — when elevated — correlates significantly with poor memory, reduced learning capacity, and increased long-term dementia risk.
Myelin Support	B6 contributes to myelin formation, the insulating sheath around nerve fibers that enables fast, accurate signal transmission throughout the brain and nervous system.
Blood-Brain Barrier Integrity	Research suggests B6 supports the structural integrity of the blood-brain barrier, helping regulate what enters and exits brain tissue.

What the Research Shows

The Linus Pauling Institute at Oregon State University notes that B6 deficiency reliably produces irritability, depression, and confusion, and that the brain's extraordinary dependence on B6 concentration explains why neurological effects appear early in deficiency states.

In supplementation trials, B6 at 20 mg/day demonstrated improved long-term memory in one key study. More robustly, B6 combined with B12 and folate over two years stabilized executive function in patients with mild cognitive impairment — particularly in those with elevated baseline homocysteine. The takeaway is consistent: B6 is foundational infrastructure for brain chemistry. It doesn't spike performance acutely — it ensures the underlying systems are built and running properly.

SECTION 4

Vitamin B12: The Neuroprotector

What It Is

Vitamin B12 (cobalamin) is essential for the health and maintenance of the nervous system. Unlike B6, B12 deficiency doesn't produce subtle signs — it produces serious, sometimes irreversible neurological damage. The hallmarks of deficiency include concentration problems, memory loss, disorientation, and dementia. B12 is one of the few nutrients where deficiency is both common (particularly in athletes, vegans, older adults, and people under chronic stress) and directly measurable in cognitive function.

Core Functions in Brain Health

Myelin Maintenance	B12 is critical to the production and repair of myelin — the protective sheath around nerve fibers. Without adequate B12, myelin degrades, signal conduction slows, and the cognitive consequences range from brain fog to severe neuropathy.
Homocysteine Metabolism	Working in concert with B6 and folate, B12 converts homocysteine back into methionine. The B6/B12/folate trio can reduce circulating homocysteine by roughly 25 to 33% — a meaningful reduction given homocysteine's established role in brain atrophy and cognitive decline.
Gray Matter Protection	A landmark clinical trial found that B vitamin supplementation protected against gray matter atrophy in patients with mild cognitive impairment and elevated homocysteine — a structural neuroprotective effect that goes beyond functional performance.
Energy Metabolism	B12 supports mitochondrial energy production in neurons, contributing to sustained mental energy without the peaks and crashes associated with stimulants.

What the Research Shows

A 2025 longitudinal study published in *Alzheimer's & Dementia* found that higher B12 levels from mid-to-late life are associated with significantly slower rates of cognitive decline — one of the strongest long-term associations in the B vitamin literature. A separate 2023 randomized trial demonstrated that B12 supplementation improves cognitive function in middle-aged and elderly patients with cognitive impairment.

An important nuance: like B6, B12 is more clearly a protector than an acute enhancer in healthy individuals with adequate levels. Its value is in preventing the erosion of cognitive capacity over

time — and in athletes and high-performers who burn through B vitamins faster due to physical and mental stress, that protection is especially relevant.

Athletes and B12: Physical training, metabolic demands, and chronic stress all increase B12 turnover. Studies suggest athletes and high-output individuals may have elevated B12 requirements relative to sedentary populations — making supplementation particularly meaningful in a sports nutrition context.

The Combined Stack: Why These Three Work Together

The power of this combination lies in the fact that each ingredient works through a different mechanism, targeting a different timescale and different layer of brain function. There is no redundancy — only complementarity.

Ingredient	Primary Role	Timescale	Key Mechanism
L-Theanine	Calm, focused alertness	Acute (30-60 min)	Alpha waves, GABA, glutamate modulation
Vitamin B6	Neurotransmitter production	Long-range (days to weeks)	Enzymatic cofactor for serotonin, dopamine, GABA
Vitamin B12	Structural neuroprotection	Long-range (months to years)	Myelin maintenance, homocysteine metabolism

The Layered Model of Cognitive Support

Think of the three ingredients as operating on three distinct layers simultaneously:

Layer 1 — Acute State (L-Theanine). Within an hour of drinking Acuity, L-theanine shifts your brain into an alpha-wave dominant state. The background noise of stress and distraction quiets. Attention sharpens. This isn't sedation — it's the calm that precedes peak performance. It's the same state skilled athletes describe before competition: fully present, not over-aroused.

Layer 2 — Chemical Infrastructure (B6). On an ongoing basis, B6 ensures that your brain has the enzymatic machinery to manufacture serotonin, dopamine, and GABA in adequate supply. L-theanine can modulate these systems acutely, but it's B6 that determines whether the neurotransmitter pool is full in the first place. Without it, the raw materials run thin — and no amount of acute modulation compensates for a depleted system.

Layer 3 — Structural Integrity (B12). At the deepest level, B12 protects the physical wiring of the brain. Myelin intact means signals travel fast and accurately. Homocysteine controlled

means the brain isn't quietly accumulating metabolic damage. This is the foundation everything else is built on — and it's the layer most people neglect until the damage is done.

Evidence for the B6 + L-Theanine Combination

Direct evidence for this specific combination exists. A 2022 pilot study published on PubMed examined L-theanine combined with Vitamin B6 and found the pairing beneficial for managing anxiety-related cognitive symptoms — specifically leveraging B6's neurotransmitter synthesis role alongside L-theanine's acute modulating effects. The researchers' rationale maps precisely to the layered model above: B6 builds the system; L-theanine tunes it in real time.

Mind Lab Pro, one of the most research-referenced nootropic formulations, also combines L-theanine with B6 and B12, describing the pairing as: "complementary support for a positive, balanced mental state — raising alpha brainwaves for immediate mood support and optimizing brain chemical synthesis for long-range emotional balance."

SECTION 6

An Honest Assessment of the Evidence

We believe that credibility is earned by being direct about what science shows and what it doesn't. So here is a clear-eyed summary:

What the evidence supports strongly	What needs more research
• L-theanine's acute attention and reaction time benefits in healthy adults • L-theanine's ability to induce alpha brain wave activity • B6 and B12 deficiency causing meaningful cognitive impairment • B6+B12+folate combination protecting against gray matter atrophy in MCI • Higher B12 levels associated with slower	• L-theanine's chronic cognitive benefits in healthy adults (weaker evidence) • B6 and B12 as cognitive enhancers in already-healthy, non-deficient individuals • Large-scale RCTs specifically testing L-theanine + B6 + B12 as a three-way stack • Dose-response curves for athletic populations specifically

cognitive decline over time	
• The complementary, non-overlapping mechanisms of the three-ingredient stack	

The honest story for Acuity is this: the combination of L-theanine, B6, and B12 is mechanistically well-justified, has early direct evidence, and supports brain health across multiple timeframes. It is not a magic bullet — no single drink is. But it is one of the most credibly designed cognitive stacks in the functional beverage space, grounded in actual nutritional science rather than marketing language.

CONCLUSION

What Acuity Is Built On

Acuity's formulation starts with a simple premise: if you want to perform mentally, your brain needs the right environment to do it. Not stimulation — support. Not a spike — a foundation.

L-theanine creates the mental state: calm, alert, focused — the cognitive mode where your best thinking happens. Vitamin B6 maintains the chemical infrastructure that produces the neurotransmitters behind motivation, mood, and mental steadiness. Vitamin B12 protects the structural wiring that lets every signal in your brain travel fast and clean.

Together, they address what performance actually requires: a brain that's present in the moment, chemically equipped for sustained output, and protected against the slow erosion that stress and high cognitive demand can cause over time.

That is the science behind Acuity. And it's why we put these three ingredients in every packet.

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