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B MAX+ as a Multi-Botanical Cognitive and Adaptogenic Nutraceutical: Evidence for Memory, Learning, Stress Modulation and Neuroprotection

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Abstract:

Background: Multi-botanical cognitive supplements combine several standardised plant extracts on the rationale that constituents acting on complementary pathways may support memory, attention, stress adaptation and antioxidant defence jointly rather than singly. B MAX+ is one such nutraceutical, providing 510 mg of declared botanical extract per daily serving from nine species long used in Ayurvedic and other traditions.

Scope: This narrative review sets out the composition of B MAX+, the pharmacopoeial standing and mechanisms of each constituent, and the literature available for each as a single ingredient. Declared doses are compared with single-botanical-trial doses, and claim wording appropriate for a nutraceutical is discussed.

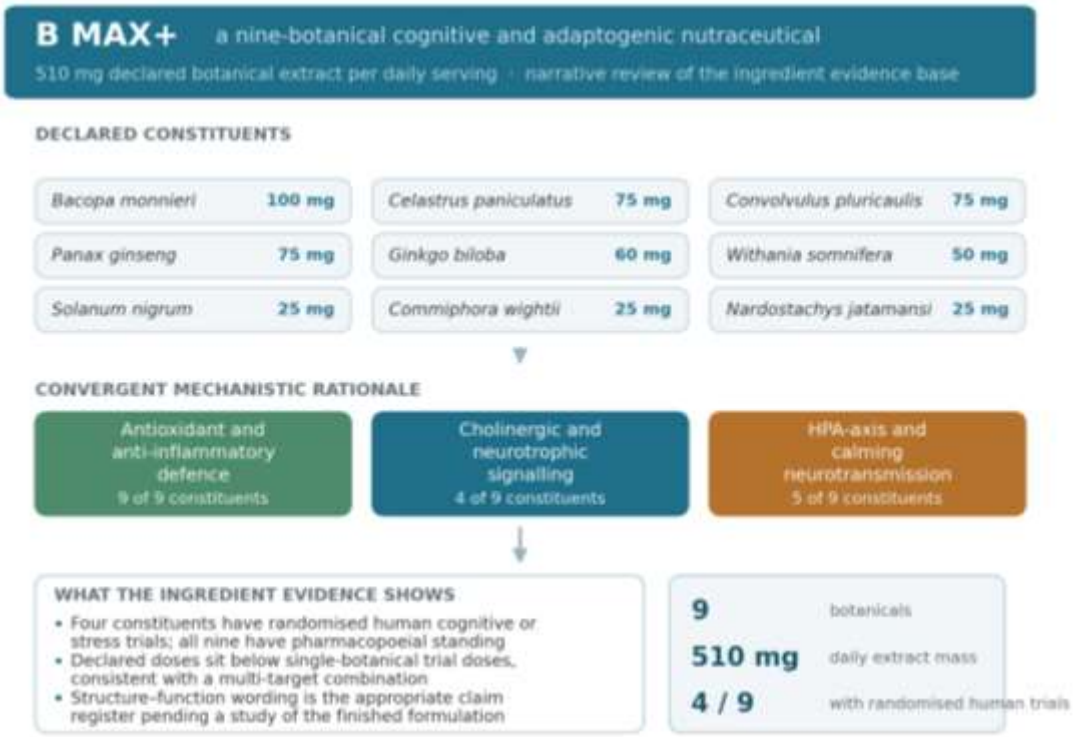
Findings: All nine constituents carry pharmacopoeial or regulatory monographs and preclinical evidence relevant to cognition, stress adaptation or neuroprotection. Four — *Bacopa monnieri*, *Panax ginseng*, *Ginkgo biloba* and *Withania somnifera* — have randomised controlled trials with cognitive or stress endpoints and meta-analyses. The constituents converge on six reported mechanistic domains, including cholinergic signalling, antioxidant defence, hypothalamic–pituitary–adrenal axis modulation and neurotrophic signalling. Declared doses of the four trial-supported constituents sit below trial doses by factors of 1.3–5.3 (*P. ginseng*), 2–4 (*G. biloba*), 3–6 (*B. monnieri*) and 4.8–12 (*W. somnifera*). Tolerability is good at the doses studied. No clinical study of the finished B MAX+ formulation has been published.

Conclusion: B MAX+ rests on a coherent traditional, pharmacopoeial and mechanistic rationale and on an ingredient-level literature substantial for four of nine constituents. Structure–function wording matches the current evidence. Declaration of drug-to-extract ratios, extraction solvents and marker-compound specifications, followed by a randomised placebo-controlled study of the finished formulation, would establish an evidence base for the product itself.

Keywords: cognitive nutraceutical; multi-botanical formulation; adaptogen; dose alignment; extract standardisation; structure–function claims

Abbreviations: ALT, alanine aminotransferase; API, Ayurvedic Pharmacopoeia of India; AST, aspartate aminotransferase; BDNF, brain-derived neurotrophic factor; CANTAB, Cambridge Neuropsychological

Test Automated Battery; CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora; CREB, cAMP response element-binding protein; CTRI, Clinical Trials Registry – India; DER, drug-to-extract ratio; EFSA, European Food Safety Authority; EMA, European Medicines Agency; FSSAI, Food Safety and Standards Authority of India; FXR, farnesoid X receptor; GABA, gamma-aminobutyric acid; HPA, hypothalamic–pituitary–adrenal; IUCN, International Union for Conservation of Nature; NF-κB, nuclear factor kappa B; RCT, randomised controlled trial; TLR4, Toll-like receptor 4; WHO, World Health Organization.



Graphical abstract. *Composition of B MAX+, the mechanistic domains reported for its nine declared constituents, and the nature of the ingredient-level evidence available for them. No clinical study of the finished formulation has been published; nothing in this figure represents a claim for the product.*

1. Introduction

Interest in dietary approaches to cognitive well-being has grown steadily as populations age and as cognitively demanding work becomes the norm across a wider age range. Botanical preparations occupy a distinctive place in this field. Several have been used continuously for centuries within codified medical systems, which gives them a documented traditional indication, an established plant part and preparation, and — for many — a pharmacopoeial monograph specifying identity and quality parameters. A number have since been studied in randomised controlled trials, so that a modern clinical literature sits alongside the classical one.

Products that combine several such botanicals in a single serving are common in the nutraceutical sector, and the rationale for combining them is pharmacological rather than merely commercial. Cognitive performance, subjective mental clarity and the capacity to cope with everyday stress are not governed by any single pathway. Cholinergic transmission, synaptic plasticity, oxidative and inflammatory tone in nervous tissue, cerebral microcirculation, hypothalamic–pituitary–adrenal (HPA) axis reactivity and sleep quality all contribute, and they interact. A formulation that engages several of these domains at moderate intensity is a different pharmacological proposition from a single botanical taken at the maximum studied dose, and the literature on synergy and network pharmacology in phytomedicine addresses exactly this distinction[1,2].

B MAX+ is a nine-botanical cognitive and adaptogenic nutraceutical manufactured by Biotex Life Solutions Pvt. Ltd. (Hyderabad, India), providing 510 mg of declared botanical extract per daily serving.

The constituents are *Bacopa monnieri* (leaf), *Celastrus paniculatus* (seed), *Convolvulus pluricaulis* (whole plant), *Panax ginseng* (root), *Ginkgo biloba* (leaf), *Withania somnifera* (root), *Solanum nigrum* (whole plant), *Commiphora wightii* (oleo-gum-resin) and *Nardostachys jatamansi* (stem). The product is positioned for memory and concentration, cognitive performance and learning, stress and everyday anxiety support, neuroprotection and brain vitality, and mental clarity and alertness.

This review has three purposes. The first is descriptive: to set out, constituent by constituent, what the traditional record, the pharmacopoeial monographs and the modern literature actually contain, so that the formulation rationale can be examined on its merits. The second is comparative: to place the declared doses alongside the doses used in single-botanical clinical trials, and to discuss what that comparison does and does not tell us about a combination product. The third is practical: to identify the claim wording appropriate to a nutraceutical under current Indian, European and United States frameworks, and to set out the studies that would most efficiently strengthen the evidence base for the finished product.

Comprehensive single-ingredient reviews already exist for *Bacopa monnieri*[3–6], *Withania somnifera*[7–10], *Ginkgo biloba*[11–13] and *Panax ginseng*[14–16]. This review does not duplicate them. Its contribution is to assemble the ingredient-level evidence around one specific commercial formulation, to make the dose and preparation comparison explicit rather than implicit, and to frame the result in the register appropriate to a food supplement.

A note on terminology is warranted at the outset. B MAX+ is marketed as a nutraceutical — a food supplement regulated in India under the Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Uses, Food for Special Medical Purpose, Functional Food and Novel Food) Regulations, 2016[17,18] — and is discussed on that basis throughout, with the classification question itself taken up in Section 8.1. It is not a medicinal product, is not intended to diagnose, treat, cure or prevent any disease, and the claims discussed here are structure–function claims about the support of normal physiological function in healthy adults. Throughout this review, statements about what a botanical "supports" should be read in that sense.

2. Scope and Methods

2.1 Review design

This is a narrative review. It was not registered, no formal protocol was prepared, and no PRISMA flow diagram accompanies it. The design was chosen deliberately: the question addressed — what evidence exists across nine botanicals spanning classical pharmacopoeial texts, preclinical pharmacology, randomised trials and regulatory monographs — spans literature types that a single systematic search strategy handles poorly. The trade-off is that the review is less reproducible than a systematic review would be, and this is stated among the limitations in Section 11.

2.2 Literature search

Literature was identified through PubMed and Google Scholar, supplemented by the Ayurvedic Pharmacopoeia of India[19,20], European Medicines Agency (EMA) herbal monographs[21,22], World Health Organisation monographs, and regulatory texts from the Food Safety and Standards Authority of India (FSSAI)[17,18,23], the European Commission[24,25] and the United States Food and Drug Administration[26]. Search terms combined the botanical name of each constituent with *cognition*, *memory*, *learning*, *attention*, *neuroprotection*, *stress*, *anxiety*, *adaptogen*, *randomised controlled trial*, *systematic review* and *meta-analysis*. No date restriction was applied. Additional sources were identified by citation chasing. Searching was conducted between January and July 2026.

2.3 How the evidence was organised

Sources were grouped into seven categories, which are used consistently in Section 5 and summarised graphically in Figure 3:

1. **Finished-product evidence** — clinical studies of B MAX+ itself.
2. **Randomised human evidence for a single constituent** — controlled trials with cognitive, mood or stress endpoints.

3. **Other human evidence** — uncontrolled, open-label, non-cognitive or combination-formula studies.
4. **Preclinical evidence** — in vivo and in vitro pharmacology.
5. **Pharmacopoeial and regulatory standing** — monographs specifying identity, plant part, quality parameters and, where applicable, posology.
6. **Analytical and authentication evidence** — chromatographic fingerprinting, DNA-based identification and adulteration detection.
7. **Safety and interaction evidence** — trial adverse-event data, case reports, pharmacovigilance and interaction studies.

Levels of evidence were considered in the sense of the Oxford Centre for Evidence-Based Medicine framework[27], adapted for a nutrition context. Systematic reviews, meta-analyses and randomised trials carry the weight for statements about human effect. Trial sponsorship was noted where it is material. Much of the strongest single-ingredient evidence in this field was generated on named proprietary extracts by, or with the support of, the companies that market them — this applies to the *Ginkgo biloba* EGb 761 literature, to several of the ashwagandha trials conducted on proprietary root extracts, and to the standardised *Bacopa monnieri* preparations used in the Australian and Indian trial programmes. Such trials are not thereby unreliable, and they are frequently the best-designed studies available, but the pattern is relevant when reading effect sizes and should be weighed by the reader alongside the present authors' own disclosed affiliation. Preclinical work is reported as mechanistic rationale and is not treated as evidence of a clinical effect. Two sources encountered during searching have been formally retracted and are cited only as retraction records, never as evidence[28–31].

2.4 How doses were compared

For each constituent with human trial data, the declared B MAX+ dose was placed alongside the daily dose range used in trials reporting positive cognitive, mood or stress outcomes for that botanical. Ratios are expressed as the trial dose divided by the label dose (for example, a 3–6× ratio means trials used three to six times the label amount). Where only animal data exist, doses are noted but not converted into ratios, because interspecies dose translation by body-surface-area scaling[32,33] carries assumptions that do not support a quantitative claim about a finished consumer product. The comparison is presented in Figure 4 and Table 2, and its interpretation for a combination product is discussed in Section 6.1.

2.5 What this review does not do

No formal risk-of-bias instrument was applied to individual trials, and no GRADE assessment of certainty was performed. Numerical results are reported as they appear in the source record. Where a figure could not be confirmed against the source, it is not reproduced here.

3. Composition, Traditional Context and Pharmacopoeial Standing

B MAX+ is supplied as a finished oral formulation delivering 510 mg of declared botanical extract per daily serving. The product as marketed is shown in Figure 1.

Fig 1: B MAX+ as marketed: the finished nine-botanical formulation providing 510 mg of declared botanical extract per daily serving.

Table 1 sets out the declared composition together with the botanical binomial, family, plant part and the traditional and pharmacopoeial context of each constituent.

Table 1: Declared composition of B MAX+ with botanical identity and pharmacopoeial context

Constituent	Accepted binomial	Family	Part	mg	Traditional and pharmacopoeial context
Brahmi	*Bacopa monnieri* (L.) Wettst.	Plantaginaceae	Leaf (herb)	100	Classical *medhya rasayana* (intellect-promoting) drug; Ayurvedic Pharmacopoeia of India monograph; extensive modern clinical literature
Jyotishmati	*Celastrus paniculatus* Willd.	Celastraceae	Seed	75	Classical *medhya* drug; seed oil used for memory and mental fatigue; Ayurvedic Pharmacopoeia of India monograph[20]
Shankhpushpi	*Convolvulus pluricaulis* Choisy	Convolvulaceae	Whole plant	75	Classical *medhya rasayana* and nervine tonic; Ayurvedic Pharmacopoeia of India monograph[20]; the accepted source species for Shankhpushpi in the API
Ginseng	*Panax ginseng* C.A. Mey.	Araliaceae	Root	75	Principal East Asian adaptogen; European Union herbal monograph for temporary fatigue and weakness[21]; WHO monograph
Ginkgo	*Ginkgo biloba* L.	Ginkgoaceae	Leaf	60	European Union herbal monograph, well-established use for age-related cognitive impairment at defined extract specifications[22]
Ashwagandha	*Withania somnifera* (L.) Dunal	Solanaceae	Root	50	Principal Ayurvedic *rasayana* adaptogen; Ayurvedic Pharmacopoeia of India monograph; WHO monograph; substantial modern trial literature
Makoi	*Solanum nigrum* L.	Solanaceae	Whole plant	25	Classical Ayurvedic drug used for hepatic and inflammatory conditions; documented antioxidant pharmacology[34]
Guggul	*Commiphora wightii* (Arn.) Bhandari	Burseraceae	Oleo-gum-resin	25	Classical *rasayana* and lipid-regulating drug; Ayurvedic Pharmacopoeia of India monograph; modern human data principally in lipid and inflammatory indications
Jatamansi	*Nardostachys jatamansi* (D. Don) DC.	Caprifoliaceae (Valerianoideae)	Stem	25	Classical *medhya* and calming drug; Ayurvedic Pharmacopoeia of India monograph[19]
Total				**510**	

Two points of nomenclature are stated here for clarity.

Shankhpushpi. Shankhpushpi refers to *Convolvulus pluricaulis* Choisy, the source species adopted for Shankhpushpi in the Ayurvedic Pharmacopoeia of India (API)[20] and supported by pharmacognostic and

comparative pharmacological studies of the drug[35–37]. This is the constituent in B MAX+. The identification matters for evidence transfer, because the pharmacological studies most relevant to cognition — on synaptic plasticity[38], on scopolamine-induced amnesia[39,40] and on neuroinflammation-associated behaviour[41] — were conducted on *Convolvulus pluricaulis*. Species-specific analytical methods, including ITS-guided multiplex PCR, are available for confirming identity in commercial material[42].

Jatamansi plant part. The Jatamansi plant part is the stem. It is the part declared in B MAX+, the part specified in the Ayurvedic Pharmacopoeia of India monograph[19] and the part used throughout the pharmacological literature[43–45], in which it is described as the subterranean stem.

The nine constituents divide naturally into three groups based on the kinds of evidence available for them, and this grouping is used throughout the review. *Bacopa monnieri*, *Panax ginseng*, *Ginkgo biloba* and *Withania somnifera* have randomised human trials with cognitive or stress endpoints and systematic reviews or meta-analyses synthesising them. *Celastrus paniculatus*, *Convolvulus pluricaulis* and *Nardostachys jatamansi* are classical *medhya* drugs with pharmacopoeial monographs and a substantial preclinical literature but without randomised single-agent cognitive trials. *Solanum nigrum* and *Commiphora wightii* contribute principally antioxidant, anti-inflammatory and metabolic activity, with human data in non-cognitive indications.

4. Convergent Mechanistic Rationale

The pharmacological argument for a multi-botanical cognitive formulation is that its constituents act on several pathways that jointly determine cognitive comfort, rather than on one pathway at high intensity. One caution should be stated before the mapping that follows. Botanicals are selected for cognitive formulations precisely because they already appear in the cholinergic, antioxidant, adaptogenic and neurotrophic literatures, so a map of this kind is close to guaranteed for any set of popular nootropic botanicals. The mapping below is therefore a post-hoc description of what the constituents are reported to do, not a demonstration that this particular combination was assembled to cover the domains, and not a comparison against alternative formulations that were not chosen. Figure 2 maps the nine B MAX+ constituents onto the mechanistic domains reported for them and onto the structure–function areas those domains support. Six domains account for essentially the whole map.

4.1 Cholinergic and synaptic signalling

Acetylcholine contributes to attention and to the encoding of new information, and cholinergic facilitation is one of several mechanistic routes to memory support — glutamatergic, NMDA-receptor-dependent long-term potentiation is generally regarded as more central to encoding itself, with cholinergic systems more closely tied to attentional gating. *Bacopa monnieri* extracts modulate cholinergic transmission and synaptic function in preclinical models[6], and *Celastrus paniculatus* seed preparations reverse scopolamine-induced navigational memory deficits in rats — an effect specifically attributed to cholinergic mechanisms[46] — and enhance hippocampal synaptic plasticity[47]. *Convolvulus pluricaulis* attenuates scopolamine-induced amnesia and the associated increases in tau and amyloid markers[39], with bioactive coumarins identified among the responsible constituents[40]. Ginsenosides likewise modulate cholinergic and glutamatergic signalling relevant to working memory[16].

4.2 Antioxidant and anti-inflammatory defence

Every constituent in the formulation has documented antioxidant activity, and this is the domain in which the combination is most fully populated. *Celastrus paniculatus* seed extract raises antioxidant defences in brain tissue, which has been proposed as a mechanism of its cognitive effect[48], and its seed oil attenuates nuclear factor kappa B (NF-κB)-mediated neuroinflammation and preserves synaptic plasticity in a metabolic model[49,50]. *Ginkgo biloba* leaf extract has an extensively characterised antioxidant and membrane-protective profile[13]. *Withania somnifera* withanolides attenuate amyloid-induced neurodegeneration in vivo[51]. *Solanum nigrum* contributes a well-documented antioxidant phytochemistry[34]; *Solanum* vegetables improve memory index and redox status in a *Drosophila melanogaster* model of memory impairment[52], and the steroidal glycoalkaloid solasonine has been reported to attenuate cerebral ischaemia–reperfusion injury through suppression of Toll-like receptor 4 (TLR4)/MyD88/NF-κB signalling[53]. *Convolvulus pluricaulis* is protective against neuroinflammation-associated behavioural change[41].

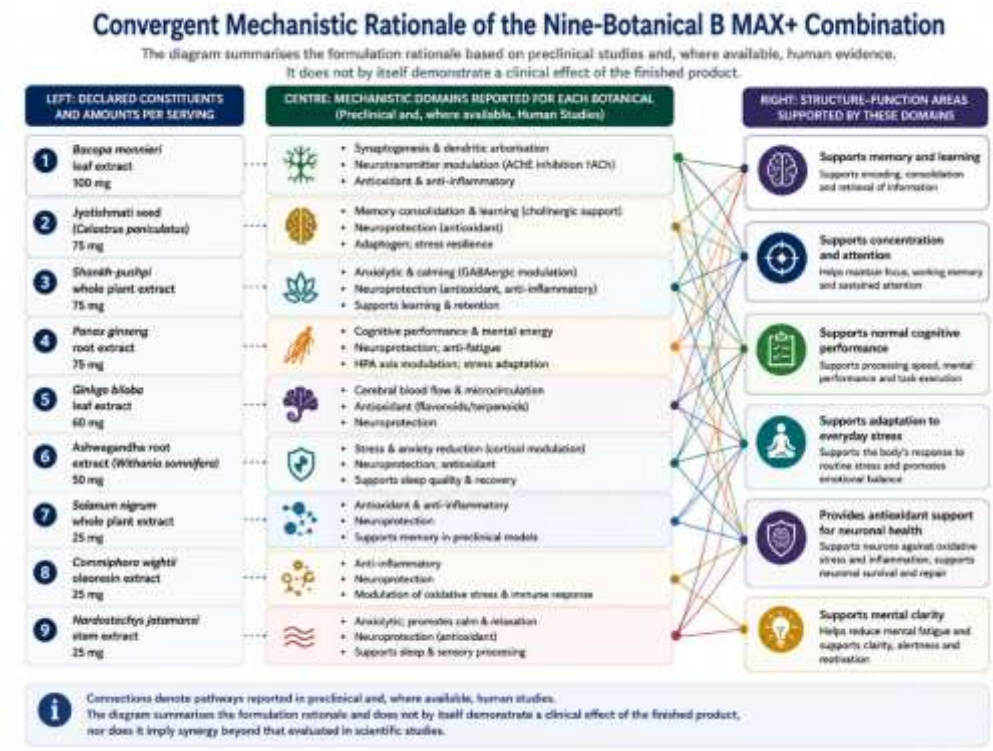


Fig 2: Convergent mechanistic rationale of the nine-botanical B MAX+ combination. Left: declared constituents and amounts. Centre: mechanistic domains reported for each botanical. Right: structure–function areas those domains support. Connections denote pathways reported in preclinical and, where available, human studies. See Section 4 on the post-hoc character of this mapping.

4.3 HPA-axis and stress-response modulation

Adaptogenic activity — the moderation of the physiological stress response rather than sedation — is the mechanism behind the stress and everyday-anxiety positioning. *Withania somnifera* is the best-studied adaptogen in this formulation, with randomised trials reporting reductions in perceived stress and in serum cortisol in adults under chronic stress[54–56]. *Panax ginseng* has a long adaptogenic tradition and an EU herbal monograph for temporary fatigue and weakness[21]. *Celastrus paniculatus* is neuroprotective against chronic stress-induced cognitive impairment in rodents[57], and *Nardostachys jatamansi* prevents chronic restraint stress-induced learning deficits[44].

4.4 Cerebral microcirculation and endothelial function

Ginkgo biloba leaf extract acts in part through effects on microcirculation, blood rheology and endothelial function, and these are integral to its regulatory profile in age-related cognitive impairment[13,22]. *Panax ginseng* contributes vascular effects that have been characterised in systematic reviews of blood-pressure outcomes[58], and guggulsterone from *Commiphora wightii* has documented effects on lipid handling and vascular inflammation through nuclear-receptor signalling[59,60].

4.5 Calming neurotransmission and sleep quality

Restorative sleep and a settled affective state are preconditions for daytime cognitive performance, and three constituents act here. *Nardostachys jatamansi* has anxiolytic activity mediated through the gamma-aminobutyric acid (GABA)–benzodiazepine channel complex[61], inhibits monoamine oxidase and modulates GABA[62], and the stem has documented central depressant activity[45], with valeranone identified as a pharmacodynamically active sesquiterpene[63]. *Withania somnifera* shows direct GABAergic activity at mammalian ionotropic receptors[64], and randomised trials report improvements in sleep quality in adults with and without insomnia[65,66]; a systematic review and meta-analysis supports a beneficial effect on sleep[7]. *Convolvulus pluricaulis* has documented antidepressant-like and CNS-modulating activity in standard rodent paradigms[67].

4.6 Neurotrophic signalling and neurite outgrowth

Sustained cognitive benefit from a botanical is generally attributed to trophic rather than transmitter effects. *Bacopa monnieri* reduces amyloid burden in transgenic models[68]; *Withania somnifera* withanoside IV and its metabolite sominone attenuate amyloid-induced neurodegeneration and promote neurite regeneration[51]; Z-guggulsterone from *Commiphora wightii* improves scopolamine-induced memory impairment through enhancement of brain-derived neurotrophic factor (BDNF) signalling[69] and produces antidepressant-like effects through the same pathway[70]; and *Celastrus paniculatus* preserves synaptic plasticity under inflammatory stress[47,49,50].

The point of Figure 2 is not that each constituent contributes a large effect in each domain. It is that the domains are jointly covered, and that such coverage — rather than the dose of any single botanical — is the stated rationale for a combination of this kind. Whether coverage was the organising principle behind this particular selection of nine botanicals, and whether it confers any advantage over a different selection, are separate questions that the mapping cannot answer. Whether joint coverage at these doses produces a measurable effect in humans is an empirical question about the finished product, and one that only a study of the finished product can answer.

5. Constituent-by-Constituent Evidence

Figure 3 summarises, for each constituent, which categories of evidence are populated. The subsections below give the substance behind that map.

Fig 3: Evidence map for the nine declared B MAX+ constituents. Filled circles denote a substantial body of evidence, half-filled circles limited or indirect evidence, and open circles evidence not identified in the reviewed source set. Categories describe the evidence available for each botanical as a single ingredient, not the finished product.

5.1 Bacopa monnieri (leaf)

Bacopa monnieri is the most extensively studied botanical in the formulation and the classical *medhya rasayana* with the strongest modern support. Two meta-analyses of randomised controlled trials have examined its cognitive effects. Kongkeaw and colleagues pooled trials in healthy adults and reported improvement in speed of attention and in Trail-Making Test performance[3]. The reported effect size for Trail-Making Part B appears in the source abstract as −17.9 ms, 95% CI −24.24 to −11.56. That unit is very likely a typographical error for seconds in the published record; it is reproduced here as printed. Pase and colleagues, in a systematic review of nine trials, concluded that *Bacopa monnieri* has the potential to improve cognition, particularly delayed free recall of verbal learning[4]. A further systematic review addressed child and adolescent populations[71], and a network comparison examined *Bacopa monnieri* alongside *Ginkgo biloba*[72].

The individual randomised trials that underpin these syntheses are consistent in design. Stough and colleagues used 300 mg/day of a standardised extract for 12 weeks in healthy adults and reported improved speed of information processing, learning rate and memory consolidation[73]. Roodenrys and colleagues used 300 mg/day for 12 weeks and reported a significant effect on retention of new information[74]. Calabrese and colleagues studied 300 mg/day for 12 weeks in older adults, with improvement in delayed recall and in Stroop performance[75]. Morgan and Stevens used 300 mg/day for 12 weeks in adults over 55 and reported improved delayed word recall[76]. Peth-Nui and colleagues studied 300 and 600 mg/day over 12 weeks with attention and cognitive processing endpoints[77]. Raghav and colleagues used 250 mg twice daily in age-associated memory impairment[78]. More recent work includes trials on cognition, stress and fatigue in healthy adults[79] and comparative work against donepezil in mild cognitive impairment[80]. Acute-dosing studies have also been reported[81,82], alongside work in other adult populations[83]. Not every trial has been positive: Sathyanarayanan and colleagues reported findings that qualified earlier conclusions in healthy volunteers[84].

Two features of this literature are relevant to formulation. First, the effective dose in essentially all positive trials is 300–600 mg/day of a standardised extract, most commonly 300 mg. Second, the extracts used are chemically defined — trials typically specify bacoside content, and safety studies have been conducted on named standardised preparations[85,86]. Tolerability is good, with mild and transient gastrointestinal effects the most frequently reported events in a phase I evaluation of a standardised preparation in healthy volunteers[85]; a supporting repeat-dose toxicology study of a standardised extract has been conducted in rats[86].

The B MAX+ declared dose is 100 mg. This is one-third of the most common trial dose and one-sixth of the highest. Section 6 discusses what follows from that for a combination product.

5.2 Celastrus paniculatus (seed)

Jyotishmati is a classical *medhya* drug with an Ayurvedic Pharmacopoeia of India monograph for the seed[20], and its preclinical cognitive literature is coherent. Gattu and colleagues showed reversal of scopolamine-induced navigational memory deficits with seed extract in rats, attributed to cholinergic mechanisms[46]. Kumar and Gupta demonstrated antioxidant activity in brain tissue as a plausible cognitive mechanism[48]. Bhagya and colleagues reported neuroprotection against chronic stress-induced cognitive impairment[57]. Thongon and colleagues reported enhancement of memory and hippocampal synaptic plasticity with seed extract[47]. Faldu and colleagues reported amelioration of NF-κB-mediated neuroinflammation with preservation of synaptic plasticity[49], with a subsequent correction to the published article[50]. Chahuan and colleagues examined seed oil in a chronic unpredictable stress model, both alone and in combination with fluoxetine[87]. A comprehensive phytochemical and pharmacological review is available[88].

Human data are limited. A comparative clinical evaluation of a *Celastrus paniculatus* capsule against sertraline has been registered as a protocol, with results not yet published[89]; human work on this botanical is therefore at an early stage. There is therefore no randomised single-agent human cognitive trial from which a clinical dose could be derived, and the 75 mg declared amount rests on the pharmacopoeial and traditional record rather than on a trial-derived posology.

On safety, the preclinical record includes an antispermatogenic effect of seed extract in male rats, described by the authors as reversible on withdrawal[90], and hepatic and reproductive signals have been noted in reviews of the genus[88]. These are animal findings at experimental doses; they do not establish a hazard at the amount present in a food supplement, but they are a reason for the conservative use guidance in Section 9 and for a liver-function endpoint in any future clinical study.

5.3 Convolvulus pluricaulis (whole plant)

Shankhpushpi, *Convolvulus pluricaulis* Choisy, is one of the principal *medhya rasayana* drugs of Ayurveda and carries an Ayurvedic Pharmacopoeia of India monograph[20]. Its modern pharmacology is directly relevant to the formulation's positioning. Das and colleagues showed that *Convolvulus pluricaulis* extract modulates synaptic plasticity in rat hippocampus[38]. Bihaqi and colleagues reported attenuation of scopolamine-induced increases in tau and amyloid precursor protein expression[39]. Malik and colleagues

identified bioactive coumarins responsible for attenuating scopolamine-induced amnesia[40]. Dhingra and Valecha demonstrated antidepressant-like activity in the forced-swim and tail-suspension tests[67], and Gupta and Fernandes reported protection against neuroinflammation-associated depressive behaviour[41]. Comparative pharmacological work across the four candidate Shankhpushpi species confirms that *Convolvulus pluricaulis* carries the nootropic, anxiolytic and CNS-modulating profile[36,37], and a recent review consolidates its role in neurological indications[91].

Human data exist principally for compound Ayurvedic preparations containing Shankhpushpi rather than for the single botanical: a clinical study of Bhāvita Śaṇkhapuṣpī tablets reported nootropic effect[92], and a study in post-hysterectomy menopausal symptoms has been published[93]. These are supportive of traditional use but do not provide a single-agent trial dose.

One interaction is well documented and important. Dandekar and colleagues demonstrated that a Shankhpushpi preparation reduced plasma phenytoin levels and diminished its antiepileptic effect[94]. This is a specific, clinically meaningful interaction and is reflected in the use guidance in Section 9.2. A rodent study has additionally reported inhibition of triiodothyronine production in levothyroxine-treated mice by *Convolvulus pluricaulis* root extract[95]; although the plant part and species preparation differ from the whole-plant extract used here, it is a further reason for clinician consultation by users on thyroid medication.

5.4 Panax ginseng (root)

Panax ginseng has both a substantial clinical literature and formal regulatory standing: the European Medicines Agency has adopted a European Union herbal monograph for *Panax ginseng* radix for temporary symptoms of fatigue and weakness[21].

The cognitive evidence is mixed in a way worth stating plainly. A Cochrane review of ginseng for cognition concluded that the available evidence did not support a firm conclusion in the populations studied[14]. Subsequent meta-analyses have been more favourable: Zeng and colleagues reported positive effects on cognitive function[15], and Kim and colleagues reported changes in Mini-Mental State Examination scores in a meta-analysis of trials in cognitively impaired populations[96]. Individual acute-dosing trials by Kennedy and colleagues showed dose-dependent changes in cognitive performance and mood[97], and Reay and colleagues reported improvements in working memory and subjective calmness[98] and cognitive performance in conjunction with reductions in blood glucose[99,100]. Park and colleagues reported cognition-enhancing effects in Korean volunteers[101]. Neale and colleagues benchmarked ginseng and *Bacopa* against conventional comparators[102]. Beyond cognition, randomised trials have examined *Panax ginseng* in cancer-related fatigue[103], and related work has been conducted with *Panax quinquefolius*[104,105]. A mechanistic review of ginsenoside effects on cognition is available[16].

The trial doses that generated these findings span roughly 100–400 mg/day of standardised extract, the acute cognitive studies clustering at 200–400 mg. The B MAX+ declared amount, 75 mg, is closest of the four trial-supported constituents to the lower bound of the studied range.

Safety is favourable at the doses studied. Systematic reviews of blood-pressure[58] and glycaemic[106] outcomes have not identified adverse signals of concern in healthy adults. One frequently repeated caution requires correction: the well-known interaction reducing warfarin effect was demonstrated with *Panax quinquefolius*, American ginseng[107], whereas a controlled study of *Panax ginseng* with warfarin did not show the same effect[108]. Anticoagulant users should still be advised to consult their clinician, but the two species should not be conflated.

5.5 Ginkgo biloba (leaf)

Ginkgo biloba leaf extract has the most developed regulatory profile of any constituent in the formulation. The EMA monograph recognises well-established use for the improvement of age-associated cognitive impairment and quality of life in mild dementia, and does so for a specific extract specification: a dry extract with a drug-to-extract ratio of 35–67:1, extracted with acetone–water, containing 22–27% flavone glycosides and 5–7% terpene lactones, with ginkgolic acids below 5 ppm, at 120–240 mg/day[22].

The clinical literature is correspondingly large. A Cochrane review by Wieland and colleagues assessed *Ginkgo biloba* for cognitive impairment and dementia[11], updating the earlier review by Birks and Grimley Evans, which concluded that the evidence of benefit was inconsistent and unreliable[109]. Gauthier and Schlaefke's meta-analysis of EGb 761 in dementia reported efficacy and good tolerability[12]. Large prevention trials — GEM[110,111] and GuidAge[112] — did not show prevention of dementia in older adults, and Le Bars and colleagues' earlier trial in dementia was positive[113]. In healthy adults, the picture is different again: Canter and Ernst[114] and Laws and colleagues[115] concluded in systematic reviews and meta-analyses that *Ginkgo biloba* is not a cognitive enhancer in healthy individuals, and Solomon and colleagues' randomised trial in healthy older adults was null[116]. Kennedy and colleagues did report dose-dependent acute cognitive effects in healthy young adults[117], and a comparative network analysis has examined *Bacopa* and *Ginkgo* alongside one another and includes a 60–<240 mg stratum among the doses evaluated[72].

The honest summary is that *Ginkgo biloba*'s strongest evidence is for age-associated cognitive impairment with a defined extract at 120–240 mg/day, that trials in healthy adults have generally not shown enhancement, and that the B MAX+ declared amount of 60 mg sits below the monograph range. Where *Ginkgo biloba* contributes most credibly in this formulation is through its microcirculatory and antioxidant pharmacology[13], as one of several convergent inputs rather than as a stand-alone cognitive agent.

On safety, bleeding risk has been examined systematically: Bent and colleagues reviewed spontaneous bleeding case reports[118], and Kellermann and Kloft's systematic review and meta-analysis of standardised extract did not confirm an increased bleeding risk at therapeutic doses[119]. A case of seizure precipitation has been reported[120], and rodent carcinogenicity data at high gavage doses exist[121]. The practical guidance that follows — caution with anticoagulants and antiplatelet agents, and with a seizure history — is in Section 9.

5.6 Withania somnifera (root)

Ashwagandha is the constituent with the most rapidly growing modern trial literature, and it supports the formulation's stress and sleep positioning rather than its memory positioning.

Four systematic reviews and meta-analyses cover the ground. Cheah and colleagues found a beneficial effect on sleep, most pronounced in adults with insomnia at doses of 600 mg/day or more for eight weeks or longer[7]. Akhgarjand and colleagues examined anxiety and stress management[8]. Alsanie and colleagues reviewed effects on mental health in adults[9]. Zhu and colleagues examined cognitive and physical function[10].

The individual trials are consistent in dose. Chandrasekhar and colleagues used 600 mg/day of a high-concentration root extract for 60 days and reported reduced perceived stress and serum cortisol[54]. Salve and colleagues studied 250 and 600 mg/day with adaptogenic and anxiolytic endpoints[55]. Lopresti and colleagues used 240 mg/day and reported stress-relieving effects with hormonal correlates[56]. Langade and colleagues studied 600 mg/day for sleep in insomnia[65], Kelgane and colleagues 600 mg/day in the elderly for sleep and well-being[66], and Choudhary and colleagues 600 mg/day for memory and cognitive function in adults with mild cognitive impairment[122]. An adjunctive study in bipolar disorder used a standardised extract[123], and a trial in subclinical hypothyroidism used 600 mg/day[124].

Mechanistically, direct GABAergic activity at mammalian ionotropic receptors has been demonstrated[64], and withanoside IV and sominone attenuate amyloid-induced neurodegeneration and promote neurite regeneration[51].

Two safety matters must be stated. First, hepatotoxicity: a case series from Iceland and the United States Drug-Induced Liver Injury Network described ashwagandha-associated liver injury[125], with a further causality-assessed case report[126] and a LiverTox entry[127]. These are idiosyncratic reactions, uncommon in absolute terms and generally reported at doses of 450–1,350 mg/day of concentrated extract, but they are the reason liver-function monitoring belongs in any clinical study of a formulation containing ashwagandha, and the reason for the guidance in Section 9. Second, the United States National Institutes of Health Office of Dietary Supplements advises against use in pregnancy[128].

The declared amount of 50 mg is well below the 240–600 mg/day used in the trial literature; it is also well below the doses at which the reported hepatic events occurred.

5.7 *Solanum nigrum* (whole plant)

Makoi is a classical Ayurvedic drug whose modern pharmacology is principally antioxidant, anti-inflammatory and hepatoprotective. Wang and colleagues provide a comprehensive review of traditional uses, phytochemistry and pharmacology[34]. Neuropharmacological activity of the fruit has been described[129]. In an invertebrate model, *Solanum* vegetables improved memory index and redox status with effects on relevant enzyme expression[52], and in rodent work, solasonine attenuated cerebral ischaemia–reperfusion injury through suppression of TLR4/MyD88/NF-κB signalling[53]. There are no randomised human cognitive trials of *Solanum nigrum*, and its contribution to this formulation is best described as antioxidant support rather than as a nootropic in its own right.

The relevant quality consideration is glycoalkaloid content. Solanaceous species accumulate steroidal glycoalkaloids, and the toxicology of the family is well characterised[130]; acute interstitial nephritis has been reported following ingestion of *Solanum nigrum* plant material[131], and *Solanum nigrum* berries contaminating a frozen vegetable product have been the subject of a public-health risk assessment[132]. Both concern consumption of raw or unprocessed plant material rather than a characterised extract at supplement dose, and neither establishes a hazard at 25 mg of a specified extract; they establish that glycoalkaloid content is the parameter to control. The European Food Safety Authority has published a risk assessment of glycoalkaloids in food and feed that provides the reference framework[133]. The appropriate response is specification rather than avoidance: a defined upper limit for total glycoalkaloids in the *Solanum nigrum* extract, verified batch by batch, addresses this fully, and is recommended in Section 10.3.

5.8 *Commiphora wightii* (oleo-gum-resin)

Guggul is a classical *rasayana* whose modern human evidence lies chiefly in lipid metabolism. Szapary and colleagues conducted a randomised controlled trial of guggulipid in hypercholesterolaemia[134], and Nohr and colleagues conducted a further randomised study[135]. The relevance to a cognitive formulation is indirect but not negligible: guggulsterone is a nuclear-receptor ligand — a farnesoid X receptor (FXR) antagonist[59] that activates multiple nuclear receptors[60] — with anti-inflammatory and lipid-regulating consequences, and the cerebrovascular relevance of lipid and inflammatory tone is well established.

More directly, Z-guggulsterone improves scopolamine-induced memory impairment through enhancement of BDNF signalling[69] and produces antidepressant-like effects through the same pathway[70], and gugulipid has documented lipid-lowering and related central effects in rodent work[136]. There are no randomised human cognitive trials.

Safety and interaction considerations are specific and manageable. Dalvi and colleagues showed that gugulipid affects the bioavailability of diltiazem and propranolol[137], which is a pharmacokinetic interaction to respect. Thyroid-stimulating action of Z-guggulsterone has been described[138], relevant to those on thyroid medication. Toxicity studies of a gum guggul extract formulation have been conducted by the United States National Toxicology Program[139]. One frequently repeated attribution should be corrected: the case of acute hepatitis attributed in some secondary sources to guggul was in fact caused by a red yeast rice product containing monacolin K[140], and it is not evidence of guggul hepatotoxicity.

Commiphora wightii is assessed as Critically Endangered (A2cd) on the IUCN Red List[141]. It is not currently listed on the CITES appendices; a proposal to include it in Appendix II was considered at the twentieth meeting of the Conference of the Parties in 2025 and was not adopted[142]. Regardless of listing status, the conservation assessment makes documented, cultivated or sustainably managed sourcing the appropriate standard for this ingredient, and this is addressed in Section 10.4.

5.9 Nardostachys jatamansi (stem)

Jatamansi is the calming constituent of the formulation, and its pharmacology is consistent on that point. Razack and colleagues demonstrated anxiolytic action through the GABA–benzodiazepine channel complex[61]. Dhingra and Goyal identified MAO inhibition and GABA modulation as probable mechanisms of antidepressant-like activity[62]. Panara and colleagues documented central nervous system depressant activity of the stem[45], and Rücker and colleagues isolated valeranone and characterised its pharmacodynamic activity[63]. Joshi and Parle reported improvement in learning and memory in mice[43], and Karkada and colleagues showed prevention of chronic restraint stress-induced learning deficits[44].

Human data exist in non-cognitive indications: a randomised controlled study in essential hypertension[143] and a comparative clinical study against *Valeriana wallichii*[144]. A study reporting BDNF–TrkB effects in a ketamine model of schizophrenia-like behaviour has been retracted[30,31] and is not relied upon anywhere in this review.

Two practical points. *Nardostachys jatamansi* is assessed as Critically Endangered and is listed in CITES Appendix II (as *Nardostachys grandiflora*), with the listing covering underground parts[145]; documented legal and sustainable sourcing is therefore not optional for this ingredient, and is addressed in Section 10.4. Second, given the GABAergic and central depressant pharmacology, additive sedation with alcohol, benzodiazepines or other CNS depressants is a reasonable expectation and appears in the use guidance.

6. Dose and Preparation Considerations

6.1 How to read a dose comparison for a combination product

Figure 4 and Table 2 place the declared amount of each constituent alongside the daily dose range used in positive single-botanical trials. For the four constituents with such trials, the declared amounts are lower — by approximately 1.3–5.3× for *Panax ginseng*, 2–4× for *Ginkgo biloba*, 3–6× for *Bacopa monnieri* and 4.8–12× for *Withania somnifera*.

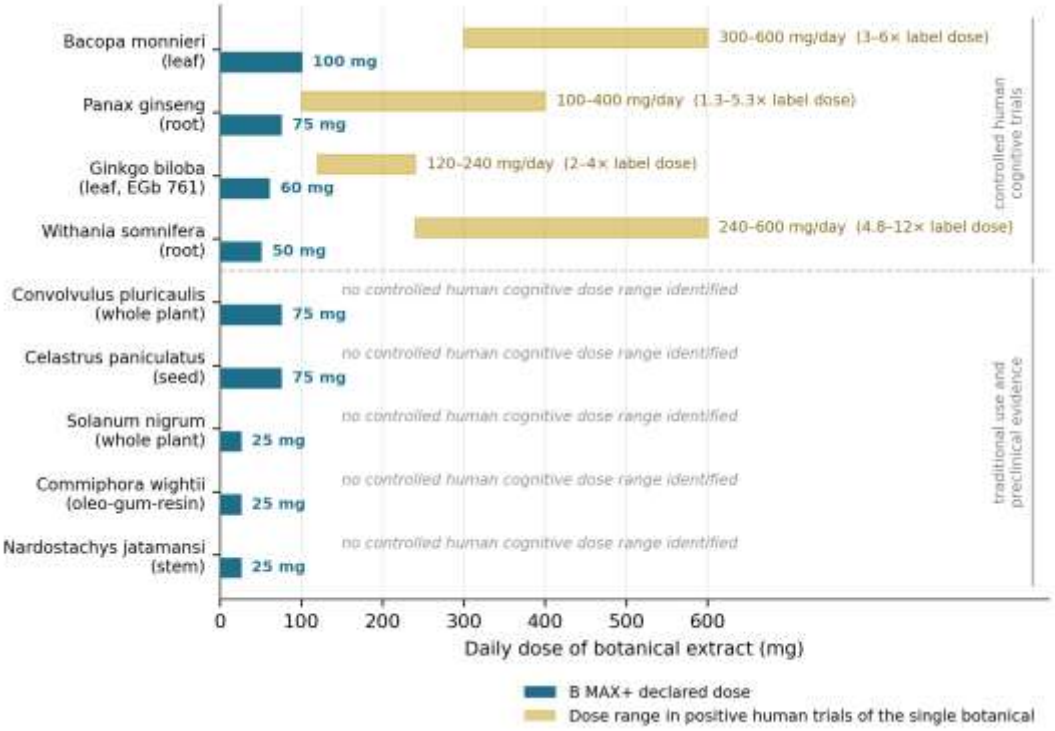


Fig 4: Dose alignment between B MAX+ declared doses (teal) and the daily dose ranges used in positive single-botanical human trials (ochre). Ratios in parentheses express the trial dose as a multiple of the declared label dose. The five constituents below the dashed line are supported by traditional use, pharmacopoeial monographs and preclinical data, and no controlled human cognitive dose range was identified for them.

Table 2: Declared dose, single-botanical trial dose range and evidence status

Constituent	mg/day	Trial dose range (mg/day)	Trial ÷ label	Basis for the declared amount
Bacopa monnieri	100	300–600[3,4,73–78]	3–6×	Traditional and pharmacopoeial use; contributory dose in a combination

Celastrus paniculatus	75	No single-agent human cognitive RCT	—	Ayurvedic Pharmacopoeia of India monograph; preclinical pharmacology
Convolvulus pluricaulis	75	No single-agent human cognitive RCT	—	Ayurvedic Pharmacopoeia of India monograph; preclinical pharmacology
Panax ginseng	75	100–400[14,15,96–99,101,102]	1.3–5.3×	Traditional use; EU monograph indication; contributory dose
Ginkgo biloba	60	120–240 (EGb 761 specification)[22]	2–4×	EU monograph botanical; contributory antioxidant and microcirculatory input
Withania somnifera	50	240–600[7–10,54–56,65,66,122]	4.8–12×	Traditional and pharmacopoeial use; contributory adaptogenic input
Solanum nigrum	25	No human cognitive RCT	—	Traditional use; antioxidant contribution
Commiphora wightii	25	No human cognitive RCT	—	Traditional use; nuclear-receptor and BDNF-related pharmacology
Nardostachys jatamansi	25	No human cognitive RCT	—	Ayurvedic Pharmacopoeia of India monograph; GABAergic and calming pharmacology

Interpreting this table requires care in both directions, and both errors are common in the literature on combination supplements.

The first error is to treat a fraction of a trial dose as pharmacologically equivalent to the trial dose. It is not. A trial establishing that 300 mg/day of a standardised *Bacopa monnieri* extract improves delayed recall over 12 weeks does not establish that 100 mg/day does so, and this review does not make that inference anywhere.

The second error is to treat a lower dose in a combination as necessarily inert. That inference is equally unsupported. Combination formulations are not designed as reduced-dose monotherapy; they are designed on the expectation that constituents acting on complementary and partly overlapping pathways contribute jointly. The phytomedicine literature on synergy and network pharmacology addresses precisely this — the observation that multi-constituent preparations can produce effects not predictable from the dose–response curve of any single component, through additive action at a shared endpoint, action at different points in the same pathway, and pharmacokinetic interactions that alter exposure[1,2]. Formulation practice in the wider supplement sector follows this logic routinely; multi-ingredient products commonly deliver each component below its stand-alone trial dose[146,147].

The honest position lies between the two errors. The declared doses are consistent with a multi-target combination design and are well supported by traditional and pharmacopoeial use. They are not doses at which any individual constituent has been shown in trials to produce a cognitive effect on its own. Which of these framings describes B MAX+ in practice is a question that a randomised, placebo-controlled trial of the finished product would answer directly.

6.2 Extract characterisation

Independent of dose, the parameter that determines what a given milligram amount of a botanical extract actually delivers is its characterisation. Three specifications matter.

The **drug-to-extract ratio (DER)** states how much dried plant material yielded one part of extract. A 100 mg dose of a 20:1 extract derives from 2 g of crude drug; the same 100 mg of a 2:1 extract derives from 200 mg. The two are not interchangeable, and the dose comparison in Table 2 is necessarily made on declared extract mass because DER is not currently declared.

The **extraction solvent** determines which constituent classes are carried into the extract. Bacosides, ginsenosides, withanolides, flavone glycosides and terpene lactones partition differently between water,

ethanol–water mixtures and acetone–water, and a change of solvent produces a chemically different preparation from the same plant material.

The **marker-compound specification** states the content of the constituents held to be responsible for, or at least indicative of, activity: bacosides for *Bacopa monnieri*, ginsenosides for *Panax ginseng*, withanolides for *Withania somnifera*, flavone glycosides and terpene lactones for *Ginkgo biloba*.

The *Ginkgo biloba* monograph is the clearest illustration of why these three specifications matter more than the milligram figure: the EMA's well-established-use entry applies to a preparation defined by DER 35–67:1, acetone–water extraction, 22–27% flavone glycosides, 5–7% terpene lactones and ginkgolic acids below 5 ppm[22]. A 60 mg dose of a preparation meeting that specification and a 60 mg dose of an uncharacterised leaf extract are different products.

The framework for judging equivalence between herbal preparations is well established in the regulatory literature on herbal medicinal products, and requires the same plant material, comparable extraction and comparable chemical specification before evidence generated with one preparation is applied to another. None of the nine B MAX+ constituents currently declares DER, extraction solvent or marker content. Adding these three items to the specification is the single most valuable change that could be made to the product documentation: it costs little, it is fully within the manufacturer's control, and it converts the ingredient-level literature from background context into a defensible basis for the formulation. It is the single most valuable step available to the manufacturer at present.

6.3 Oral bioavailability of the marker constituents

Declared extract mass sets an upper bound on what can reach the circulation; it does not describe what does. For three of the four trial-supported constituents, the marker compounds are poorly and variably absorbed, and this bears directly on the dose question posed in Section 6.1.

Ginsenosides are the clearest case. The protopanaxadiol and protopanaxatriol glycosides are large, polar molecules with low intrinsic permeability, and their pharmacological activity depends substantially on deglycosylation by gut microbiota to secondary metabolites such as compound K. Because that conversion varies between individuals according to the composition of the intestinal flora, systemic exposure from an identical oral dose differs several-fold between subjects. Bacosides are likewise glycosidic, of high molecular weight, and poorly permeable, which is one reason the *Bacopa monnieri* trial literature uses sustained 12-week dosing rather than acute administration to demonstrate effect. Withanolides are more lipophilic and better absorbed, but are subject to first-pass metabolism. *Ginkgo biloba* is the exception: the terpene lactones of the EGb 761 specification are well absorbed with reasonably predictable pharmacokinetics, which is part of why that preparation has a well-established-use monograph at all[22].

Two consequences follow for B MAX+. First, the dose ratios in Table 2 are ratios of administered extract mass, not of systemic exposure, and the true exposure gap could be either wider or narrower than the mass ratio implies. Second, formulation variables that are not currently declared — particle size, excipient composition, the presence or absence of a bioavailability enhancer[148] — may matter as much as the milligram figure. Measuring marker-compound exposure from the finished product, rather than inferring it, would resolve this directly, and on the evidence set out here such a pharmacokinetic study is arguably more informative per unit of cost than a dose-ranging one.

7. Evidence on Multi-Botanical Cognitive Formulations

7.1 What combination trials show

The most directly relevant published combination trial is that of Nathan and colleagues, who studied a combined extract of *Ginkgo biloba* and *Bacopa monnieri* in 85 healthy participants over 4 weeks and found no significant effect on cognitive performance relative to placebo[149]. The combination used 120 mg of *Ginkgo biloba* and 300 mg of *Bacopa monnieri*, both at or near single-agent trial doses. That makes the null result informative: combining two well-supported botanicals, each at a dose shown to be active alone, did not produce a detectable effect. Trial duration and an unimpaired population, in which ceiling effects on cognitive testing are a real constraint, are plausible contributors, but they are not the only reading. The

Bacopa monnieri trials that reported benefit generally ran for 12 weeks[73–77]; 4 weeks may be too short for a botanical whose effects are attributed to trophic rather than transmitter mechanisms.

The straightforward reading is that this trial is evidence against, not merely silent on, the proposition that combining well-supported cognitive botanicals produces an additive benefit detectable over placebo. It is a single trial with a defined duration and population, and it does not settle the question; but it should not be set aside as a design artefact, and the joint-coverage rationale set out in Section 4 has to be held alongside it rather than in place of it.

Other combination work exists. Multi-ingredient formulations have been studied for attention outcomes[150], and Indian compound preparations containing several *medhya* botanicals have been evaluated in cognitive and behavioural indications[151,152] and in senile dementia[152]. These are supportive of the general approach but are studies of other formulations, not of B MAX+, and their results cannot be transferred to it.

7.2 What this means for the design of B MAX+

Two design lessons follow directly. The first concerns duration: any study of B MAX+ should run for at least 12 weeks, consistent with the *Bacopa monnieri* and *Withania somnifera* literature, rather than the 4 weeks that produced the null combination result. The second concerns population: healthy young adults with intact cognition provide little room for measurable improvement, whereas adults in middle age with subjective memory complaints — the population in which several positive single-agent trials were conducted[75,76,122] — offer both greater sensitivity and closer correspondence to the product's actual users.

7.3 Bioavailability considerations

Ayurvedic formulation practice has long used bioavailability enhancers, and the pharmacological basis for this has been examined in the light of modern pharmacokinetics[148]. B MAX+ does not currently declare such an excipient. Whether the constituents of the formulation influence one another's absorption is unknown and is a legitimate subject for a pharmacokinetic sub-study, particularly given the documented effect of gugulipid on the bioavailability of co-administered drugs[137].

8. Claim Framing for a Nutraceutical

8.1 Regulatory context

In India, B MAX+ falls under the FSSAI Health Supplements and Nutraceuticals Regulations, 2016[17,18], with claims governed by the Food Safety and Standards (Advertising and Claims) Regulations, 2018[23]. The 2018 regulations require that claims be truthful, unambiguous, not misleading, and substantiated by evidence appropriate to the claim made; they prohibit claims that a food prevents, treats or cures a disease.

One classification question should be acknowledged rather than assumed away. All nine constituents are monographed classical Ayurvedic drugs, and several carry traditional indications that are therapeutic rather than merely supportive — *Commiphora wightii* is a lipid-regulating drug with modern human trials in hypercholesterolaemia, and *Withania somnifera* and *Bacopa monnieri* are *rasayana* drugs with formal therapeutic standing in the Ayurvedic system. A fixed combination of nine such drugs could in principle be regulated as an Ayurvedic proprietary medicine under the Drugs and Cosmetics Act, administered through the Ministry of AYUSH, rather than as a nutraceutical under FSSAI. Which route applies turns on the composition, the dose relative to the pharmacopoeial dose of the crude drug, and the claims made. The claim wording recommended in Table 3 is written to sit clearly within the food-supplement register; a manufacturer should nonetheless confirm the classification with its regulatory adviser rather than treat the FSSAI route as automatic.

In the European Union, Regulation (EU) No 432/2012 establishes the list of permitted health claims other than those referring to disease-risk reduction and children's development[24]. No botanical cognitive claim currently appears on that list: claims for botanicals remain in the "on hold" category pending resolution of the European Commission's approach to botanical health claims[25]. A product of this kind sold in the EU would therefore not be able to make an authorised cognitive health claim in the current state of the register.

In the United States, structure–function claims for dietary supplements are permitted under 21 CFR §101.93, subject to notification, substantiation and the accompanying disclaimer that the statement has not been evaluated by the FDA and that the product is not intended to diagnose, treat, cure or prevent any disease[26].

8.2 Claim wording matched to the evidence

Table 3 sets out, for each of the five positioning statements, the constituents that carry the supporting evidence, the nature of that evidence, and a recommended wording appropriate to a nutraceutical.

Table 3: Positioning statements, supporting evidence and recommended claim wording

Positioning statement	Constituents carrying the evidence	Nature of the supporting evidence	Recommended wording
Enhances memory and concentration	*Bacopa monnieri*; *Panax ginseng*; supporting mechanistic input from *Celastrus paniculatus*, *Convolvulus pluricaulis*	Meta-analyses and RCTs of the single botanicals at higher doses[3,4,15,73–78,96–98]; pharmacopoeial *medhya* standing and preclinical pharmacology for the others	"Formulated with traditional *medhya* botanicals to support memory and concentration"
Supports cognitive performance and learning	*Bacopa monnieri*; *Panax ginseng*; *Celastrus paniculatus*	RCT evidence for learning rate and information processing at higher doses[73,74]; preclinical synaptic-plasticity data[38,47]	"Supports learning and normal cognitive performance"
Helps manage stress and everyday anxiety	*Withania somnifera*; *Panax ginseng*; *Nardostachys jatamansi*; *Convolvulus pluricaulis*	Meta-analyses and RCTs of ashwagandha for perceived stress and cortisol at higher doses[7–10,54–56]; EU monograph indication for ginseng[21]; GABAergic pharmacology [61,62]	"Contains adaptogenic botanicals traditionally used to support the body's response to everyday stress"
Promotes neuroprotection and brain vitality	All nine, principally *Ginkgo biloba*, *Withania somnifera*, *Celastrus paniculatus*, *Solanum nigrum*	Antioxidant, anti-inflammatory and neurotrophic pharmacology, largely preclinical[13,48,49,51–53,68,69]	"Provides antioxidant support for nervous tissue" — avoid "neuroprotection", which reads as a disease claim
Boosts mental clarity and alertness	*Panax ginseng*; *Ginkgo biloba*	Acute-dosing human studies at higher doses[97,98,117]; microcirculatory pharmacology[13]	"Supports mental alertness and clarity"

One qualification applies to the middle column of Table 3. Where a constituent is listed as contributing to a claim based on preclinical work alone — *Celastrus paniculatus* and *Convolvulus pluricaulis* for memory and learning, *Solanum nigrum* for antioxidant support — that contribution is mechanistic and traditional, not evidential in the sense a claim-substantiation dossier requires. Animal behavioural pharmacology does not substantiate a claim about human cognitive support under the FSSAI 2018 regulations, and the recommended wording in the final column is framed accordingly, around traditional use and formulation composition rather than around a demonstrated effect. The constituents carrying substantiating human evidence for the cognitive and stress claims are *Bacopa monnieri*, *Panax ginseng*, *Ginkgo biloba* and *Withania somnifera*, and only at doses above those declared.

Two wording principles follow from the current evidence. First, verbs of support ("supports", "helps maintain", "contributes to") are the appropriate register; verbs of improvement ("improves",

"enhances", "boosts") assert a measured change and should follow rather than precede a study of the finished product. Second, "neuroprotection" should be avoided in consumer-facing material: whatever its accuracy as a description of the pharmacology, it reads as a claim to prevent neurological disease and is not permissible for a food supplement in any of the three jurisdictions discussed. "Antioxidant support for nervous tissue" conveys the same underlying science within the permitted register.

9. Safety, Tolerability and Use Guidance

9.1 General tolerability

Across the constituent literature, tolerability at the doses studied is good. The most frequently reported events in *Bacopa monnieri* trials are mild and transient gastrointestinal symptoms; a dedicated phase I safety evaluation of a standardised preparation has been conducted in healthy volunteers[85], supported by repeat-dose toxicology in rats[86]. *Panax ginseng* trials have not shown adverse signals of concern in healthy adults[58,106]. *Withania somnifera* trials report good tolerability at 240–600 mg/day[54–56,65,66]. *Ginkgo biloba* is well tolerated in dementia trials at 120–240 mg/day[12]. The declared amounts in B MAX+ are below the doses at which these safety data were generated, which is a favourable rather than an unfavourable position from a tolerability standpoint.

Table 4 summarises the constituent-specific considerations.

Table 4: Constituent-specific safety considerations and practical guidance

Constituent	Consideration	Evidence base	Practical guidance
Bacopa monnieri	Mild gastrointestinal effects; cholinergic activity	Phase I human safety study[85]; rat toxicology[86]	Take with food if gastrointestinal discomfort occurs
Celastrus paniculatus	Reversible antispermatogenic effect and hepatic signals in animals at experimental doses	Rodent studies[88,90]	Include liver-function monitoring in clinical studies; not recommended in pregnancy
Convolvulus pluricaulis	Reduces plasma phenytoin levels; thyroid-hormone signal in a rodent study	Human interaction study[94]; rodent study[95]	Not to be used with phenytoin or related antiepileptics without clinician supervision; clinician consultation for thyroid-medication users
Panax ginseng	Interaction with warfarin demonstrated for *P. quinquefolius*, not for *P. ginseng*	Controlled studies[107,108]	Advise clinician consultation for anticoagulant users; do not conflate the two species
Ginkgo biloba	Bleeding case reports; systematic review did not confirm increased risk at therapeutic doses; single seizure case report	Case reports and systematic review[118,119]; single case report[120]	Caution with anticoagulants and antiplatelet agents; caution with a seizure history; discontinue before elective surgery
Withania somnifera	Idiosyncratic hepatotoxicity reported at 450–1,350 mg/day of concentrated extract; advised against in pregnancy	Case series and pharmacovigilance[125–128]	Avoid in pregnancy; discontinue and seek advice if jaundice, dark urine or right upper-quadrant pain occurs; liver-function endpoints in clinical studies
Solanum nigrum	Steroidal glycoalkaloid content; one report of acute	Toxicological review[130]; case report[131]; EFSA risk	Specify and verify a total glycoalkaloid limit per batch

	interstitial nephritis	assessment[133]	
Commiphora wightii	Alters bioavailability of diltiazem and propranolol; thyroid-stimulating activity of Z-guggulsterone	Human pharmacokinetic study[137]; preclinical study[138]	Advise clinician consultation for users on cardiovascular or thyroid medication
Nardostachys jatamansi	GABAergic and central depressant pharmacology	Preclinical pharmacology[45,61,62]	Avoid combining with alcohol or sedatives; caution before driving until individual response is known

9.2 Interactions and medication review

The interaction profile of B MAX+ is defined and manageable, and it points to a single practical recommendation: a medication review before starting the product. The specific classes warranting clinician consultation are antiepileptics, particularly phenytoin[94]; anticoagulants and antiplatelet agents[118,119]; sedatives, hypnotics and alcohol[45,61]; cardiovascular agents metabolised by pathways affected by guggul, including diltiazem and propranolol[137]; and thyroid medication[138]. The safety of the nine-constituent combination has not itself been studied, and combination safety should not be assumed from constituent data alone — this is a further reason for a study of the finished formulation.

9.3 Populations warranting caution

Based on the constituent literature, B MAX+ is not recommended during pregnancy or lactation[128], for children and adolescents in the absence of paediatric data, for individuals with active liver disease, or for individuals scheduled for surgery within two weeks. Two constituents, *Withania somnifera* and *Solanum nigrum*, belong to the Solanaceae, so individuals with known nightshade sensitivity should exercise the same caution they would with other foods of that family. Individuals on any prescription medication should consult a healthcare professional before use. These are ordinary, proportionate precautions for a botanical supplement and are consistent with the guidance carried by comparable products.

10. Quality, Authentication and Standardisation

10.1 Botanical authentication

Authentication is the confirmation, by morphological, microscopic, chemical or molecular means, that the material in the product is the declared species. It matters commercially as well as scientifically: DNA metabarcoding studies of Ayurvedic herbal products have detected undeclared species[153], and heavy-metal surveys of Ayurvedic medicines sold in retail and online channels have found contamination in a proportion of products[154,155]. The sector's credibility on this point is unevenly earned, which makes verifiable authentication a differentiator rather than a formality.

For B MAX+ the botanical identities are settled — *Convolvulus pluricaulis* for Shankhpushpi[20] and the stem for *Nardostachys jatamansi*[19], as set out in Section 3 — and species-specific molecular methods are available for the constituent where confusion is most likely[42]. Documenting authentication of each incoming batch, by pharmacopoeial identity tests and, for *Convolvulus pluricaulis*, by a species-specific molecular method, converts a settled identity into a demonstrable one.

The scope of this section should be stated plainly: it sets out the authentication, standardisation and contaminant-control parameters that a product of this composition should meet. It does not document the manufacturer's current practice, batch records, certificates of analysis or certification status, none of which are presented here. Readers should not infer from the recommendations below either that these controls are in place or that they are absent.

10.2 Chemical standardisation

As set out in Section 6.2, declaring DER, extraction solvent and marker-compound content for each of the nine extracts is the single highest-value addition to the product specification. For the four constituents with trial literature, the markers are well established and the analytical methods are routine: bacosides,

ginsenosides, withanolides, and flavone glycosides with terpene lactones. Analytical methods for *Ginkgo biloba* in particular are highly developed, including chromatographic and spectral fingerprinting for adulteration detection, and the same methodological approach applies across the other constituents.

10.3 Contaminant control

Three contaminant classes warrant defined limits and batch verification: heavy metals, given the documented history in the wider sector[154,155]; pesticide residues and microbial counts, per pharmacopoeial general requirements; and total steroidal glycoalkaloids in the *Solanum nigrum* extract, with the EFSA assessment providing the reference framework[133].

10.4 Sustainable sourcing

Two constituents carry conservation obligations. *Nardostachys jatamansi* is assessed as Critically Endangered and is listed in CITES Appendix II (as *Nardostachys grandiflora*), with the listing covering underground parts[145]; legal-origin documentation and CITES-compliant sourcing are mandatory, not discretionary. *Commiphora wightii* is assessed as Critically Endangered (A2cd)[141] and, while not currently CITES-listed[142], is subject to significant wild-population pressure. Cultivated or certified sustainably managed sources, with documented chain of custody, are the appropriate standard for both. Establishing and publishing this documentation is straightforward, is increasingly expected by regulators and retailers, and strengthens rather than constrains the product's position.

11. Limitations

This review is narrative rather than systematic. No protocol was registered, no PRISMA flow diagram was prepared, and the search was not designed to be exhaustive. Selection bias cannot be excluded, and a systematic review of any single constituent would provide a more reliable estimate of effect for that constituent than the synthesis offered here.

No formal risk-of-bias assessment was applied to individual trials, and no GRADE evaluation of certainty was performed. Consequently, statements in this review about the strength of evidence for a constituent are qualitative.

The most consequential limitation is the absence of finished-product evidence. Every efficacy-relevant statement in this review concerns a single botanical studied on its own, generally at a higher dose than the formulation delivers and, in a preparation, whose chemical specification differs from, or is not known to match, that of the corresponding B MAX+ extract. The review therefore describes the evidence available for the constituents; it does not establish an effect of B MAX+.

Related to this, the absence of DER, extraction solvent and marker-compound declarations means that the dose comparison in Section 6 is made on declared extract mass alone. Extract mass is a weaker basis for comparison than characterised extract content, and the comparison should be revisited once drug-to-extract ratios, extraction solvents and marker-compound specifications are declared.

Finally, the safety of the nine-constituent combination has not been studied as a combination. The constituent-level safety data are reassuring at the doses concerned, but combination safety is an assumption rather than a finding.

12. Conclusion

B MAX+ combines nine botanicals with documented traditional use, pharmacopoeial or regulatory standing, and a preclinical pharmacology that converges on a small set of mechanisms relevant to memory, learning, stress adaptation, cerebral perfusion and antioxidant defence of nervous tissue. Four of the nine — *Bacopa monnieri*, *Panax ginseng*, *Ginkgo biloba* and *Withania somnifera* — have randomised human trials and meta-analytic syntheses behind them. The botanical identities are settled: Shankhpushpi in this formulation is *Convolvulus pluricaulis* Choisy, the source species recognised in the Ayurvedic Pharmacopoeia of India, and the Jatamansi ingredient is the stem, the plant part specified in the Ayurvedic Pharmacopoeia of India monograph.

The declared amounts sit below the doses used in single-botanical trials. Lower constituent doses are characteristic of many multi-ingredient formulations; however, their combined efficacy cannot be

inferred from single-ingredient evidence and requires direct evaluation of the finished product. Structure–function wording —supporting memory and concentration, supporting learning and normal cognitive performance, supporting the body's response to everyday stress, providing antioxidant support for nervous tissue, and supporting mental alertness — is the register that matches both the current evidence and the product's status as a nutraceutical.

Tolerability across the constituent literature is good at the doses studied, and the interaction profile is specific and manageable, resting principally on a medication review before use for those taking antiepileptics, anticoagulants, sedatives, certain cardiovascular agents or thyroid medication.

Two steps would materially strengthen the position of the product. The first is documentary and immediate: declaring drug-to-extract ratio, extraction solvent and marker-compound content for each extract, together with batch authentication, contaminant limits and sustainable-sourcing documentation. The second is a randomised, placebo-controlled study of the finished formulation over 12 weeks in adults with subjective memory complaints. Together these would convert a well-reasoned formulation with a strong ingredient literature into a product with an evidence base of its own.

Declarations

Author contributions. All authors contributed to the conception of the review, the identification and appraisal of sources, and the drafting and revision of the manuscript. All authors approved the final version.

Conflict of interest. All three authors are employees of Biotex Life Solutions Pvt. Ltd., which manufactures B MAX+. The authors have endeavoured to represent the evidence accurately, including where it is limited; readers should take the affiliation into account in weighing the review's conclusions.

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Data availability. No new data were generated. All sources are listed in the reference list. The B MAX+ composition was provided by the manufacturer.

Ethics approval. Not applicable; this review involved no human or animal participants.

Use of AI-assisted tools. AI-assisted tools were used for literature organisation, reference management and language editing. All content was verified by the authors against primary sources, and the authors take full responsibility for the manuscript.

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