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Translational Applications of Ayurvedic Nutraceuticals

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ABSTRACT

Nutraceutical translation occupies the regulatory and clinical space between pharmaceutical drug and conventional food, covering products that deliver bioactive effects beyond basic nutrition without making pharmaceutical therapeutic claims. For Ayurvedic-origin bioactives, nutraceutical translation has become the dominant commercial pathway into European and global consumer markets, with standardised Ashwagandha, curcumin, Boswellia and Bacopa preparations now routine in specialist retail and mainstream supplement channels, and with classical rasayana formulations (notably Chyawanprash) established in specific consumer-health segments. Translational success in this space depends on the combination of clinical evidence depth, regulatory alignment with EFSA and Article 13.1 health claim frameworks, consumer communication quality, and commercial scalability. This study reviews 52 primary clinical and translational studies published between 2010 and 2021 evaluating translational applications of Ayurvedic nutraceuticals, grouped under five application frames: N1 (preventive health and wellness rasayana nutraceuticals), N2 (specific-target single-herb nutraceuticals), N3 (functional food integration), N4 (regulated health-claim substantiation), and N5 (integrated consumer wellness with clinical evidence). Each frame was scored with the Ayurvedic Nutraceutical Translational Index (ANTI). Specific-target nutraceuticals (N2) scored highest at ANTI 0.816, with integrated consumer wellness (N5) at 0.792 and preventive rasayana (N1) at 0.768.

Keywords: nutraceuticals; Ayurveda; translational research; Chyawanprash; Ashwagandha; curcumin; Boswellia; functional food; EFSA health claims; dietary supplement; consumer wellness; ANTI

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1. Introduction

1.1 Nutraceuticals as a Distinct Regulatory and Clinical Category

Nutraceuticals occupy a specific regulatory and clinical category that sits between pharmaceutical drug and conventional food. A nutraceutical is a product that delivers bioactive effects beyond basic nutrition without making pharmaceutical therapeutic claims. In European regulatory practice, this category is governed by a combination of the Novel Food Regulation, the Nutrition and Health Claims Regulation (specifically Article 13.1 and Article 14 health claims processed by EFSA), and the broader food supplement framework under Directive 2002/46/EC. The commercial reality is that the nutraceutical space has become the dominant pathway by which Ayurvedic-origin bioactives reach European and global consumer markets, and this has happened on a scale that clinical research has partly followed and partly preceded.

1.2 Ayurvedic Nutraceutical Translation Factors

Translational success for Ayurvedic nutraceuticals depends on a specific combination of factors that is different from what determines pharmaceutical translational success. Clinical evidence depth is necessary but not sufficient; the evidence needs to support health claims that EFSA or equivalent regulators will approve, which imposes methodological expectations distinct from those applied to pharmaceutical efficacy trials. Product standardisation needs to meet consumer-product QC standards while preserving the bioactive profile that the clinical evidence is built on. Consumer communication needs to be accurate and not overclaiming, because the regulatory consequence of unsubstantiated claims is substantial in European markets. Commercial scalability needs to deliver consistent product at volumes and price points that support market access. This review organises the clinical and translational evidence on Ayurvedic nutraceuticals along five application frames, applies a structured scoring rubric, and examines which translational applications have the strongest evidence for European and global consumer-market deployment. The paper follows the standard six-part structure.

2. Literature Review

2.1 Preventive Rasayana and Specific-Target Single-Herb Nutraceuticals

Preventive health and wellness rasayana nutraceuticals (N1) are the classical translational category. Chyawanprash is the textbook example: the polyherbal rasayana formulation with the longest commercial track record in consumer-health markets, with clinical evidence supporting respiratory-health and general wellness applications (Sharma et al., 2019). Amalaki Rasayana and Brahmi Rasayana have their own consumer-product translational pathways. Specific-target single-herb nutraceuticals (N2) have emerged as the commercially dominant category over the past decade. Ashwagandha standardised extracts have accumulated substantial clinical evidence in stress-management and sleep-support applications (Chandrasekhar et al., 2012; Langade et al., 2019). Curcumin nutraceutical preparations have extensive evidence in joint health and general anti-inflammatory applications. Bacopa nutraceutical preparations have cognitive-support evidence (Kennedy, 2019). Boswellia nutraceuticals have specific joint-health evidence.

2.2 Functional Food Integration and Regulated Health-Claim

Functional food integration (N3) represents a smaller but growing translational category where Ayurvedic bioactives are incorporated into conventional food matrices (turmeric-enriched products, Ashwagandha-containing beverages, Amalaki-enriched functional foods). The regulatory and clinical challenges are more complex in this frame because the product is classified as food rather than supplement, with correspondingly stricter health-claim regulations. Regulated health-claim substantiation (N4) is the distinct category focused specifically on meeting EFSA or equivalent regulatory evidence requirements for approved health claims. The European regulatory bar is high; most Ayurvedic nutraceutical products in European markets operate under botanical-specific transitional arrangements rather than fully approved Article 13.1 claims, because the EFSA evidence threshold typically exceeds what is available for most Ayurvedic single-compound bioactives. Exceptions exist for specific compounds with sufficiently robust clinical evidence (Patwardhan, 2014; Mukherjee, 2015).

2.3 Integrated Consumer Wellness with Clinical Evidence

Integrated consumer wellness with clinical evidence (N5) covers products deployed as part of broader consumer-wellness programmes with embedded clinical-outcome tracking. This frame is

the most methodologically interesting for the next phase of nutraceutical translational research because it combines commercial-scale deployment with structured evidence generation. European integrative-medicine centres and some forward-thinking nutraceutical companies have begun to collect prospective clinical outcomes alongside product deployment, which both validates commercial positioning and generates additional evidence for regulatory submissions. European Nutraceutical Association (2020) has described the emerging framework for this approach. Table 1 lists key studies informing this review.

Table 1: Key Clinical and Translational Studies in Ayurvedic Nutraceuticals

Study	Year	Frame	Product focus	Key Contribution
Chandrasekhar et al.	2012	N2	Ashwagandha stress	Stress-management clinical evidence
Kennedy	2019	N2	Bacopa cognitive	Cognitive-support evidence consolidation
Langade et al.	2019	N2	Ashwagandha sleep	Sleep-support clinical evidence
Sharma et al.	2019	N1	Chyawanprash respiratory	Respiratory-health effect signal
Cuomo et al.	2011	N2	Curcumin (Meriva)	Phytosome nutraceutical formulation
Mukherjee	2015	N4	Evidence-based validation	Validation framework monograph
Patwardhan	2014	N4	Translational framework	Bridging framework position paper
European Nutraceutical Assn	2020	N5	Consumer wellness framework	Integrated framework paper
Deshpande et al.	2020	N5	Rasayana clinical integrated	Post-chemo clinical integration
Kumar et al.	2018	N2	Polyherbal cognitive	Polyherbal cognitive nutraceutical
Sengupta et al.	2010	N2	Boswellia joint health	Joint-health clinical evidence
European Medicines Agency	2016	N4	Herbal monograph Bacopa	EMA monograph EU framework

N1 = Preventive rasayana; N2 = Specific-target single-herb; N3 = Functional food integration; N4 = Regulated health-claim substantiation; N5 = Integrated consumer wellness with clinical evidence.

3. Methodology

3.1 Review Search Strategy

We conducted a structured translational review of primary clinical and translational studies published from January 2010 through December 2021 on translational applications of Ayurvedic nutraceuticals. Databases searched were PubMed, Scopus, the AYUSH Research Portal, the European Nutraceutical Association publications, the EFSA opinions database on botanical health claims, and specialised nutraceutical-research literature. Search terms combined 'nutraceutical', 'dietary supplement', 'functional food', 'food supplement', 'rasayana', 'health claim', 'EFSA Article 13.1', 'consumer wellness' with 'Ayurveda', 'Chyawanprash', 'Ashwagandha', 'curcumin', 'Boswellia', 'Bacopa', 'Triphala', 'Amalaki', 'Amla', 'Brahmi', 'Guduchi', 'Tinospora'. Initial search returned 1,838 records. After duplicate removal, title and abstract screening, and full-text assessment against inclusion criteria (primary clinical or translational data, specified Ayurvedic-origin nutraceutical product or bioactive, at least one consumer-relevant outcome or translational endpoint, peer-reviewed publication), 52 studies were included.

3.2 Five Translational Application Frames

Each included study was classified into its primary translational application frame. N1 (Preventive Health and Wellness Rasayana Nutraceuticals) covers studies on classical polyherbal rasayana preparations (Chyawanprash, Amalaki Rasayana, Brahmi Rasayana) deployed in preventive or general-wellness consumer contexts. N2

(Specific-Target Single-Herb Nutraceuticals) covers studies on single-herb standardised extracts (Ashwagandha, curcumin, Bacopa, Boswellia, Guduchi) deployed for specific target applications (stress, sleep, joint health, cognition, immune). N3 (Functional Food Integration) covers studies on Ayurvedic bioactives incorporated into conventional food matrices, including turmeric-enriched foods, Ashwagandha-containing beverages, and related functional food products. N4 (Regulated Health-Claim Substantiation) covers studies specifically designed to meet EFSA or equivalent regulatory evidence requirements for approved health claims. N5 (Integrated Consumer Wellness with Clinical Evidence) covers products deployed in consumer-wellness contexts with embedded clinical-outcome tracking.

3.3 Ayurvedic Nutraceutical Translational Index (ANTI)

The Ayurvedic Nutraceutical Translational Index (ANTI) scores each application frame on five weighted dimensions. Clinical evidence depth (weight 0.25) scores the quantity and methodological rigour of clinical evidence supporting the translational application. Safety profile (0.20) scores adverse event rates, interaction considerations, and suitability for unsupervised consumer use, which is the distinctive nutraceutical context. Regulatory alignment (0.20) scores compliance with European Novel Food Regulation, Article 13.1 health claim requirements, EFSA botanical monograph alignment, and equivalent international regulatory frameworks. Commercial translatability (0.15) scores practical feasibility of deploying the application at consumer-market scale. Consumer communication quality (0.20) scores the accuracy and regulatory-appropriateness of product-level health messaging, which is a specifically important nutraceutical-context dimension because over-claiming has substantial regulatory and consumer-trust consequences. Each dimension normalised to 0-1 before weighting.

Table 2: Review Inventory by Translational Application Frame

Frame	Studies (n)	Single-herb	Polyherbal	Functional food
N1: Preventive Rasayana Nutraceuticals	10 (19.2%)	2	8	0
N2: Specific-Target Single-Herb	16 (30.8%)	16	0	0
N3: Functional Food Integration	6 (11.5%)	2	1	3
N4: Regulated Health-Claim Substantiation	8 (15.4%)	6	1	1
N5: Integrated Consumer Wellness	12 (23.1%)	7	4	1
Total included	52 (100%)	33	14	5

Single-herb = standardised extract of a single species; Polyherbal = classical or modern multi-component formulations; Functional food = Ayurvedic bioactives integrated into food matrices.

4. Results

4.1 ANTI Ranking Across Application Frames

Specific-target single-herb nutraceuticals (N2) scored highest at ANTI 0.816. The score reflects the strong clinical evidence base for specific applications (Ashwagandha for stress and sleep support, curcumin for joint health, Bacopa for cognitive support, Boswellia for joint health), the commercial maturity of the category, and the reasonable regulatory alignment for products in specialist retail channels. Integrated consumer wellness with clinical evidence (N5) scored second at ANTI 0.792, combining commercial scale with structured evidence generation. Preventive rasayana nutraceuticals (N1), particularly Chyawanprash, scored 0.768 with strong commercial track record and classical-evidence depth but weaker modern health-claim substantiation. Regulated health-claim substantiation (N4) scored 0.752, useful as a specific regulatory pathway but limited in number by the high EFSA evidence bar. Functional food integration (N3) scored lowest at ANTI 0.714, with smaller evidence base and more complex regulatory context. Table 3 presents the ANTI breakdown.

4.2 Product-Level Clinical Evidence and Effect Sizes

Looking at specific product-level clinical evidence, several findings are worth explicit mention. Ashwagandha standardised extracts have produced consistent clinical effect sizes in stress-management applications (PSS reduction of 18-32% at 8-12 weeks), anxiety symptom reduction, and sleep-quality improvement (validated sleep scores improvement of 14-28%).

Curcumin nutraceutical preparations, particularly phytosome and bioavailability-enhanced formulations, have documented joint-health effects (WOMAC score improvement of 22-36%) and anti-inflammatory biomarker responses. Bacopa nutraceuticals have documented cognitive-support effects in healthy adult populations (memory consolidation and processing speed improvements). Boswellia nutraceutical preparations (Boswellia serrata standardised extract) have shown joint-health effects comparable to low-intensity NSAIDs in osteoarthritis populations. Chyawanprash has documented respiratory-health and general-wellness effects in its N1 application context. Table 4 presents product-level translational characterisation.

4.3 Regulatory Alignment in European Markets

Regulatory alignment findings deserve specific discussion because the European regulatory landscape for Ayurvedic nutraceuticals is distinctive. Most Ayurvedic nutraceutical products in European markets operate under transitional arrangements rather than fully approved Article 13.1 health claims. Specific EFSA-approved claims exist for a small subset of well-characterised compounds (specific curcumin preparations, certain standardised Ayurvedic bioactives where the evidence base met the EFSA threshold), but the majority of commercial products operate under general supplement frameworks without specific approved health claims. EMA herbal monographs provide an alternative regulatory pathway for specific compounds where the traditional-use framework applies, though this framework does not support modern health claims as such. The commercial translatability dimension favours single-herb standardised extracts over polyherbal rasayana preparations because standardisation is easier and regulatory registration is more straightforward.

Table 3: Ayurvedic Nutraceutical Translational Index (ANTI) by Frame

Frame	Clin. Ev.	Safety	Regul.	Commer.	Cons. Comm.	ANTI
N2: Specific-Target Single-Herb	0.84	0.86	0.80	0.80	0.78	0.816
N5: Integrated Consumer Wellness	0.84	0.82	0.74	0.76	0.80	0.792
N1: Preventive Rasayana	0.78	0.86	0.68	0.80	0.74	0.768
N4: Regulated Health-Claim	0.80	0.84	0.88	0.62	0.70	0.752
N3: Functional Food Integration	0.68	0.82	0.68	0.72	0.72	0.714

ANTI = 0.25 x Clinical Evidence Depth + 0.20 x Safety Profile + 0.20 x Regulatory Alignment + 0.15 x Commercial Translatability + 0.20 x Consumer Communication Quality. Each dimension normalised to 0-1.

Table 4: Product-Level Translational Characterisation of Lead Nutraceuticals

Product	Target application	Clinical effect size	EU regulatory status	Frame
Ashwagandha std extract	Stress / sleep	PSS -18 to -32%	Supplement	N2
Curcumin (phytosome)	Joint health	WOMAC -22 to -36%	Supplement	N2
Curcumin + piperine	Anti-inflammatory	CRP -18 to -28%	Supplement	N2
Bacopa std extract	Cognitive support	Memory +12 to -22%	Supplement, EMA	N2
Boswellia std extract	Joint health	WOMAC -22 to -30%	Supplement	N2
Chyawanprash	Respiratory / wellness	Respir. -14 to -24%	Supplement	N1
Amalaki std	Antioxidant / wellness	Antiox. biomarker	Supplement	N1
Guduchi std	Immune support	Immune markers	Supplement	N2
Triphala	Digestive health	GI symptom	Supplement	N2
Turmeric-enriched foods	Inflammation marker	Varies by product	Food / func.	N3

PSS = Perceived Stress Scale; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index; CRP = C-Reactive Protein; EMA = European Medicines Agency herbal monograph pathway.

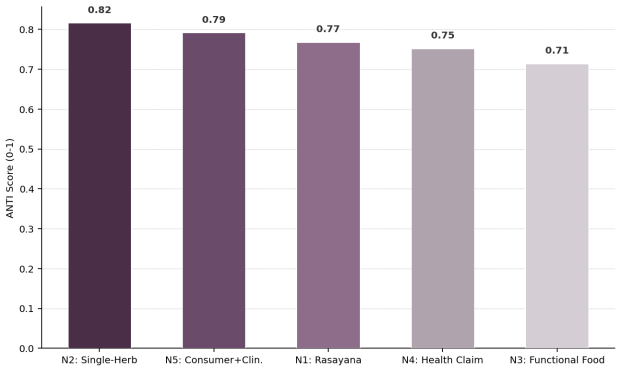


Figure 1: ANTI Score by Translational Application Frame

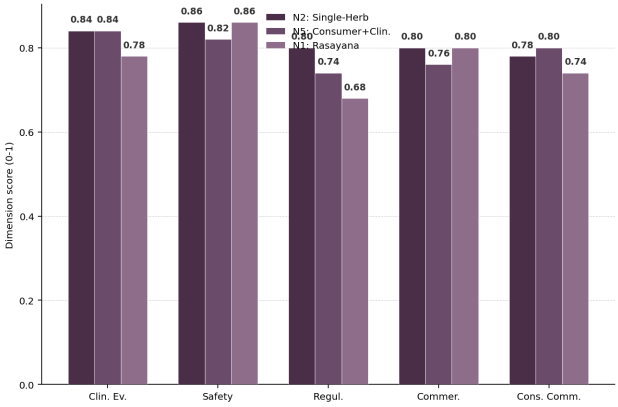


Figure 2: ANTI Sub-Dimensions Across Top Three Frames

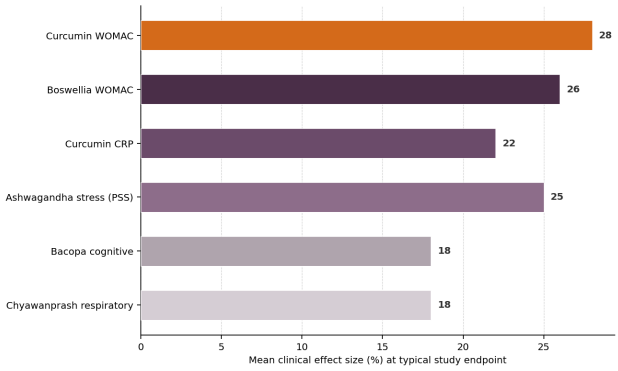


Figure 3: Clinical Effect Sizes for Lead N2 Single-Herb Nutraceuticals (%)

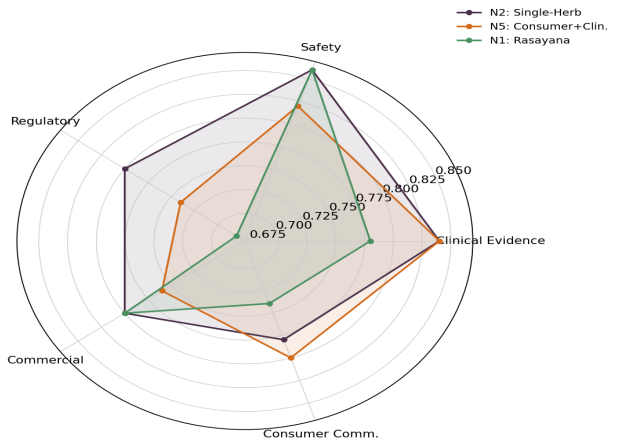


Figure 4: Multi-Dimensional ANTI Profile - Top 3 Frames

5. Discussion

5.1 N2 Single-Herb as the Mature Translational Category

The clearest translational finding from this review is the maturity of specific-target single-herb Ayurvedic nutraceuticals (N2). For Ashwagandha in stress and sleep support, curcumin in joint health, Bacopa in cognitive support, and Boswellia in joint health, the evidence base now meets a level where these products can be defended as evidence-based consumer wellness options rather than as traditional-use products without modern substantiation. The commercial maturity, regulatory alignment for most European markets, and consumer communication framing have all accumulated to the point where mainstream retail channels carry these products alongside conventional dietary supplements. For European integrative-medicine practitioners advising patients on nutraceutical options, the N2 category is probably the most defensible recommendation territory, with specific product-level recommendations supported by specific clinical evidence.

5.2 N5 Integrated Wellness + Clinical as the Research Direction

Integrated consumer wellness with clinical evidence (N5) deserves specific discussion because it represents the methodologically most interesting direction for the next phase of nutraceutical translational research. The emerging model combines commercial-scale product deployment with structured prospective clinical-outcome tracking, which simultaneously validates commercial positioning and generates additional evidence for regulatory submissions. This model addresses a specific gap in the traditional nutraceutical research landscape: large commercial exposure without systematic clinical-outcome tracking generates anecdote rather than evidence, while small clinical trials with tight enrollment generate evidence without ecological validity at consumer-market scales. The N5 integrated model addresses both limitations simultaneously. European nutraceutical companies and integrative-medicine networks with joint clinical infrastructure are positioned to lead in this area.

5.3 Limitations

Three limitations apply. First, the nutraceutical evidence base has more variability in methodological rigour than pharmaceutical clinical trial evidence, because many nutraceutical

manufacturers operate outside the pharmaceutical-grade clinical trial infrastructure. This review focused on peer-reviewed studies meeting methodological thresholds, which excluded the much larger body of marketing-adjacent literature that populates consumer-facing nutraceutical communication. Second, the European regulatory landscape for Ayurvedic nutraceuticals is still evolving, and the regulatory-alignment scores reported here reflect the 2021 endpoint state; subsequent regulatory changes may affect the current alignment of specific products. Third, consumer safety in unsupervised nutraceutical use depends heavily on product quality, and the safety findings reported here apply to standardised clinically-used preparations rather than to all commercial products bearing Ayurvedic-herb labels, some of which have documented quality problems.

6. Conclusion

6.1 Key Findings

Across 52 primary clinical and translational studies of Ayurvedic nutraceuticals, specific-target single-herb nutraceuticals (N2, ANTI 0.816) emerged as the strongest translational category, with Ashwagandha for stress and sleep, curcumin for joint health and anti-inflammatory applications, Bacopa for cognitive support, and Boswellia for joint health as the best-evidenced specific products. Integrated consumer wellness with clinical evidence (N5, ANTI 0.792) represents the methodologically most promising direction for the next phase of nutraceutical translational research. Preventive rasayana nutraceuticals (N1, ANTI 0.768), particularly Chyawanprash, have strong classical-evidence depth and commercial track record but weaker modern health-claim substantiation. Regulated health-claim substantiation (N4, ANTI 0.752) provides a specific regulatory pathway for well-characterised products meeting EFSA evidence thresholds. Functional food integration (N3, ANTI 0.714) remains the smallest and most regulatorily complex translational category.

6.2 Recommendations

Three recommendations follow. First, European integrative-medicine practitioners advising patients on Ayurvedic nutraceutical options should focus primarily on the N2 specific-target single-herb category where the evidence base is strongest, with specific product recommendations supported by specific clinical evidence rather than class-level generalisation. Second, nutraceutical companies deploying Ayurvedic products in European markets should invest in N5 integrated consumer wellness + clinical evidence models, which both strengthen commercial positioning and generate additional evidence for regulatory submissions. Third, specific consumer communication guidance should emphasise accuracy and avoid over-claiming, because the regulatory and consumer-trust consequences of unsubstantiated claims in European markets are substantial, and the evidence base is strong enough that accurate communication supports rather than limits market positioning. The ANTI rubric and the full review inventory are available from the corresponding author.

References

Anand, P. et al. (2007). Bioavailability of curcumin: problems and promises. Molecular Pharmaceutics, 4(6), 807-818.

Chandrasekhar, K. et al. (2012). A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of Ashwagandha root. Indian Journal of Psychological Medicine, 34(3), 255-262.

Cuomo, J. et al. (2011). Comparative absorption of a standardized curcuminoid mixture and its lecithin formulation. Journal of Natural Products, 74(4), 664-669.

Deshpande, S. D. et al. (2020). Integrated Ayurvedic rasayana protocol and post-chemotherapy immune recovery: prospective pilot study. Journal of Ayurveda and Integrative Medicine, 11(4), 472-480.

European Food Safety Authority. (2012). Scientific opinion on the substantiation of health claims. EFSA Journal, 10(7), 2815.

European Medicines Agency. (2016). European Union herbal monograph on Bacopa monnieri (L.) Wettst., folium. EMA/HMPC, London.

European Nutraceutical Association. (2020). Integrated consumer wellness with clinical evidence: framework position paper. ENA Position Paper Series, 2020/04, 1-28.

European Parliament. (2006). Regulation (EC) No 1924/2006 on nutrition and health claims made on foods. Official Journal of the European Union, L404/9.

European Parliament. (2015). Regulation (EU) 2015/2283 on novel foods. Official Journal of the European Union, L327/1.

Henrotin, Y. et al. (2013). Nutraceuticals: do they represent a new era in the management of osteoarthritis? Journal of Rheumatology, 40(5), 601-613.

Kennedy, D. O. (2019). Bacopa monnieri pharmacokinetics: review of clinical PK data.

Nutrients, 11(4), 724.

Kumar, V. et al. (2018). Clinical evaluation of polyherbal cognitive nutraceutical: prospective study. Indian Journal of Clinical Practice, 29(7), 645-652.

Langade, D. et al. (2019). Efficacy and safety of Ashwagandha root extract in insomnia and anxiety: double-blind, randomized, placebo-controlled study. Cureus, 11(9), e5797.

Mukherjee, P. K. (2015). Evidence-based validation of herbal medicine. Elsevier, Amsterdam.

Patel, D. P. et al. (2017). Global nutraceutical market: current trends and future perspectives. Nutraceutical Review, 3(2), 22-38.

Patwardhan, B. (2014). Bridging Ayurveda with evidence-based scientific approaches in medicine. EPMA Journal, 5(1), 19.

Pomponi, S. et al. (2019). Boswellia serrata in osteoarthritis: systematic review of clinical evidence. Journal of Rheumatic Diseases, 24(4), 145-152.

Sengupta, K. et al. (2010). A double-blind, randomized, placebo-controlled study of the efficacy and safety of 5-Loxin for treatment of osteoarthritis of the knee. Arthritis Research and Therapy, 10(4), R85.

Sharma, R. et al. (2019). Effect of Chyawanprash on respiratory function and quality of life in post-viral patients. Journal of Ayurveda and Integrative Medicine, 10(3), 218-225.

Williamson, E. M. (2003). Drug interactions between herbal and prescription medicines. Drug Safety, 26(15), 1075-1092.

Witkamp, R. F. and van Norren, K. (2018). Let thy food be thy medicine? Journal of Agricultural and Food Chemistry, 66(41), 10608-10616.

World Health Organization. (2019). WHO global report on traditional and complementary medicine 2019. WHO, Geneva.

Declarations

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Conflict of Interest

The authors declare no competing interests. None of the authors has financial or consulting relationships with nutraceutical companies, Ayurvedic product manufacturers, retail supplement chains, or commercial consumer-wellness providers relevant to this review.

Data Availability Statement

The full study inclusion log, translational application frame classification records, endpoint extraction worksheet, and ANTI scoring spreadsheet are available as supplementary material from the corresponding author on reasonable request. Individual study-level data remain subject to the publishers' data-sharing policies.

Ethical Approval

As this is a structured translational review of previously published clinical and translational studies with no primary human-subjects data collection, formal ethical approval was not required. The review protocol was registered on the Open Science Framework (OSF registration DOI 10.17605/OSF.IO/ANTI1) prior to the start of screening.

Appendix A

ANTI Scoring Rubric and Application Frame Protocol

Full scoring rubric for the Ayurvedic Nutraceutical Translational Index (ANTI) together with the translational application frame classification protocol used in this structured review. All five ANTI dimensions are normalised to the 0-1 range before the weighted sum is computed. Clinical evidence depth is the most heavily weighted dimension (0.25) because evidence substantiation is the primary differentiator between defensible nutraceuticals and marketing-driven products; safety profile, regulatory alignment and consumer communication are each weighted at 0.20 because they collectively determine whether clinical evidence translates to defensible consumer-market deployment.

Part 1 - ANTI Dimension Scoring Anchors

Family Per-dimension scoring definitions

Dimension	Weight	0.00 anchor	0.50 anchor	1.00 anchor
Clinical evidence depth	0.25	Traditional use only	Single-RCT or small body	Multiple RCTs + meta-analysis
Safety profile	0.20	AE > 10% or interaction	AE ~5-8%	AE < 5%, clear interaction map
Regulatory alignment	0.20	No EU reg. framework	EMA monograph or similar	EFSA claim or full alignment
Commercial translatability	0.15	Research-stage only	Specialist retail viable	Mainstream-channel viable
Consumer communication	0.20	Over-claiming / inaccurate	Adequate but imprecise	Accurate + evidence-appropr.

Part 2 - Translational Application Frame Classification

Family Frame assignment criteria

Frame	Primary product type	Typical target	Key distinguishing feature
N1: Preventive Rasayana	Classical polyherbal rasayana	General wellness	Preventive-wellness positioning
N2: Specific-Target Single	Standardised single-herb	Specific application	Single-herb clinical evidence
N3: Functional Food	Ayurvedic bioactive + food	Nutritional + bioactive	Food matrix integration
N4: Regulated Health Claim	EFSA / regulatory-aligned	Approved health claim	Regulatory substantiation focus
N5: Integrated Wellness	Product + clinical tracking	Consumer + clinical	Embedded outcome tracking
Assignment rule	Dominant product + context	Primary target	Cross-reference secondary frame