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NVTIA™ Standardized Tri-Extract System (Milk Thistle–Artichoke–Dandelion Root) for Bile-Secretion-Oriented Hepatic Support: Botanical Standardization, Mechanistic Rationale, and Evidence Synthesis

Jabar Yassine *, Gregg L. Semenza, Emilio Cortez

World Food Supplement Association, New York, USA
*Corresponding Author: info@wfsas.org

ABSTRACT

Background: Multi-botanical liver-support formulations are increasingly positioned around bile flow, oxidative stress control, and hepatocyte protection, yet the scientific value of such products depends on whether botanical standardization, dose–response behavior, and external evidence converge. Methods: We evaluated the NVTIA tri-extract formulation-series dataset together with a targeted search of PubMed, PMC, and regulatory monographs through March 2026 to identify clinical, mechanistic, and preclinical evidence relevant to milk thistle, artichoke, and dandelion root. Results: Within the formulation series, marker-standardized extracts exceeded predefined quality thresholds (silymarin 83.5%, cynarin 3.2%, total flavonoids 4.8%). Increasing milk thistle from 20 to 50 parts was associated with monotonic improvement in oxidative-stress endpoints, with MDA reductions from 51.27% to 68.17%, SOD increases from 98.62% to 141.53%, and GSH-Px increases from 112.35% to 162.48%. Increasing dandelion root from 15 to 45 parts was associated with 4 h bile-flow increases from 52.78% to 86.11%, ALT reductions from 62.35% to 81.26%, and MDA reductions from 53.47% to 66.78%. In the public literature, a 2024 meta-analysis of nine clinical trials reported significant reductions in ALT and AST with silymarin in MASLD, while a separate 2024 meta-analysis of 26 randomized trials found improvement in liver injury and steatosis outcomes. Two meta-analyses of artichoke supplementation reported significant reductions in ALT and AST, and a placebo-controlled NAFLD trial found improvements in liver enzymes, bilirubin, and sonographic parameters. A placebo-controlled crossover study also documented a marked short-term increase in bile secretion after standardized artichoke extract. By contrast, dandelion-root evidence remained predominantly preclinical. Conclusion: The NVTIA tri-extract framework shows internal dose–response coherence and aligns most strongly with the external evidence base when milk thistle is interpreted as the hepatocyte-protective anchor, artichoke as the bile-oriented functional driver, and dandelion root as an antioxidant and adjunctive biliary-support component. The current literature supports biological plausibility and formulation rationale, while definitive human efficacy for the full tri-extract system still requires prospective clinical validation.

KEYWORDS

Coffee fresh fruit skin; Coffee fresh fruit skin flower cake; Technology optimization

1. INTRODUCTION

Botanical liver-support products are often marketed through broad claims that do not distinguish between mechanistic plausibility, dose-dependent formulation behavior, and externally reproducible human evidence. We approached the NVTIA tri-extract system from a stricter perspective: whether a milk thistle–artichoke–dandelion root combination can be defended not merely as a traditional

botanical blend, but as a standardized, bile-secretion-oriented formulation with coherent preclinical gradients and support from published human literature. Our central premise is that a multi-target liver-support formula becomes scientifically stronger when three conditions are met simultaneously: the raw materials are chemically standardized, the formulation-series data exhibit directional dose–response behavior, and the broader literature supports the functional roles assigned to each botanical.

Milk thistle is most frequently linked to hepatocyte protection, antioxidant defense, and membrane-stabilizing effects; artichoke is more consistently associated with choleretic and bile-flow-related actions; and dandelion root is commonly discussed in connection with oxidative-stress attenuation and bile-oriented digestive support. Rather than treating these activities as interchangeable, we examined whether they can be integrated into a more disciplined tri-extract framework in which each botanical occupies a differentiated role. We therefore combined the formulation-series data with published clinical and preclinical literature and interpreted the full evidence base as one bile-secretion-oriented hepatic-support model.

2. EVIDENCE ACQUISITION AND ANALYTICAL FRAMEWORK

We conducted a targeted narrative evidence synthesis using PubMed, PubMed Central, and selected regulatory monographs through March 2026. Search emphasis was placed on randomized trials, systematic reviews, meta-analyses, and mechanistic or preclinical studies relevant to milk thistle (silymarin), artichoke leaf extract (cynarin-rich preparations), and dandelion root (Taraxacum officinale) in relation to bile secretion, liver enzymes, oxidative stress, steatosis, and hepatoprotection. We then aligned the public evidence with the NVTIA formulation-series dataset, which includes marker-standardization data and dose-gradient observations for milk thistle and dandelion root while holding the companion botanicals constant. Because the available evidence spans clinical, preclinical, and formulation-level sources, our goal was not to force statistical pooling across all datasets, but to evaluate coherence across evidence layers.

3. COMPOSITION, STANDARDIZATION, AND QUALITY CONTROL

The NVTIA system uses three standardized botanical extracts: milk thistle extract, artichoke extract, and dandelion root solid extract. The quality-control architecture is based on marker thresholds rather than undifferentiated plant powders, which is important for reproducibility. In the exemplar batch, measured levels exceeded threshold specifications for all three markers, supporting the view that the formulation is built on chemically qualified inputs rather than generic botanical labeling.

Table 1. Marker standardization within the NVTIA tri-extract system

Marker compound	Measured (%)	Threshold (≥%)
Silymarin (milk thistle)	83.5	80.0
Cynarin (artichoke)	3.2	2.5
Total flavonoids (dandelion root)	4.8	4.0

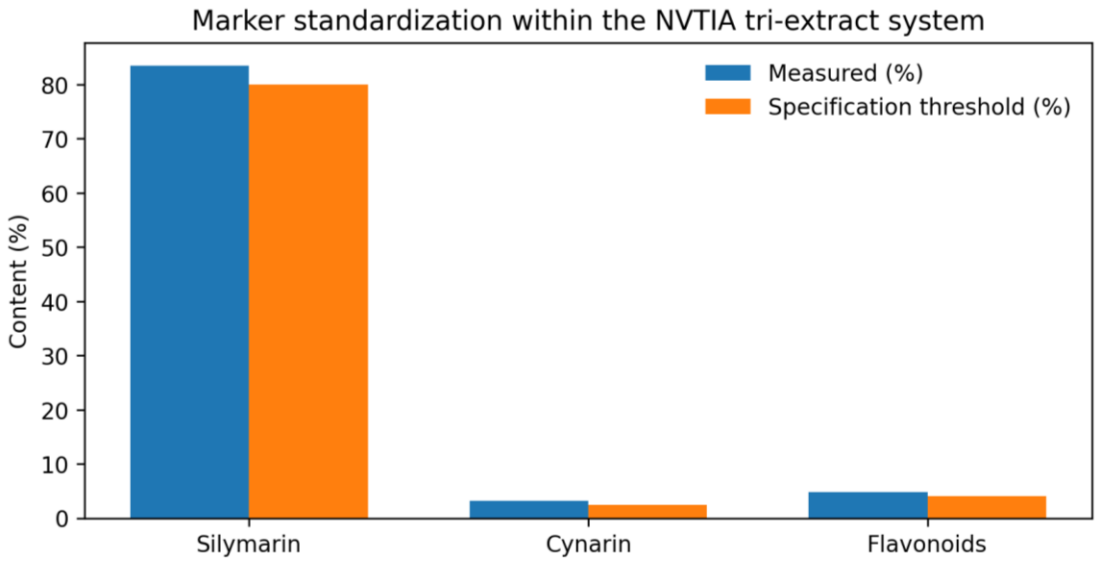

Figure 1. Marker standardization within the NVTIA tri-extract system

4. PUBLICLY AVAILABLE CLINICAL AND MECHANISTIC EVIDENCE

The external literature provides the strongest clinical support for milk thistle and artichoke. For silymarin, Malik et al. reported in a 2024 meta-analysis of nine clinical trials that treatment significantly reduced ALT (MD -17.12 U/L) and AST (MD -12.56 U/L), alongside triglyceride improvement. Li et al. included 26 randomized controlled trials involving 2,375 patients and found significant improvements in liver injury markers and hepatic steatosis outcomes. However, the 2025 Cochrane review concluded that the benefits and harms of silymarin in adults with MASLD remain uncertain, with some liver-enzyme improvements observed but evidence graded low or very low. This combination of positive signal and cautious certainty assessment suggests that milk thistle remains biologically credible, but not definitively settled, in human liver-support use.

Artichoke shows a particularly useful profile for a bile-oriented liver-support framework. Moradi et al. synthesized eight clinical trials and found significant reductions in AST and ALT, especially in non-alcoholic fatty liver disease. Amini et al. likewise reported significant pooled reductions in ALT (Hedges' g -1.08) and AST (Hedges' g -1.02) across randomized trials. In a double-blind placebo-controlled NAFLD trial, Panahi et al. randomized 100 patients and observed improvements in ALT, AST, bilirubin, APRI, hepatic vein flow, portal vein diameter, and liver size after artichoke leaf extract 600 mg/day for two months, with no side effects reported in completers. Earlier, Kirchhoff et al. demonstrated a measurable choleretic effect in healthy volunteers, with bile secretion increasing by 127.3% at 30 minutes and 151.5% at 60 minutes after standardized artichoke extract administration. These findings are highly relevant because they align artichoke not only with enzyme reduction but also with a direct bile-secretion signal.

By contrast, dandelion root currently has a predominantly preclinical evidence base. A 2025 review concluded that dandelion shows promising hepatoprotective effects in animal models, especially through antioxidant and anti-inflammatory pathways, but emphasized the need for clinical trials. In a rat acute-on-chronic liver failure model, Pfingstgraf et al. found that dandelion root extract reduced AST, ALT, ALP, GGT, bilirubin, and multiple oxidative-stress markers. Accordingly, dandelion can be positioned as a biologically plausible support component, but not yet as a clinically mature anchor ingredient.

Table 2. Summary of publicly available clinical and mechanistic evidence

Evidence source	Design / population	Key quantitative findings	Interpretation
Silymarin meta-analysis [3]	9 clinical trials in MASLD	ALT -17.12 U/L; AST -12.56 U/L; TG -22.60	Supports biochemical improvement
Silymarin meta-analysis [2]	26 RCTs, n=2375	Improved ALT/AST, steatosis OR 3.25 (1.80-5.87)	Broadest pooled evidence base
Cochrane review [4]	17 RCTs, n=2069	ALT MD -7.21 U/L vs placebo; certainty low/very low	Benefit signal with uncertainty
Artichoke meta-analysis [6]	7 RCTs	ALT Hedges' g -1.08; AST -1.02	Consistent liver-enzyme reduction
Artichoke NAFLD trial [7]	100 randomized, 90 completed	ALT/AST, bilirubin, APRI and ultrasound indices improved; no side effects in completers	Clinically relevant bile-oriented signal
Artichoke choleresis trial [8]	Randomized crossover, n=20	Bile secretion +127.3% at 30 min; +151.5% at 60 min	Direct support for choleretic action
Dandelion review/preclinical [9, 10]	Narrative review + rat ACLF model	Reduced AST, ALT, ALP, GGT, bilirubin and oxidative-stress markers	Biologically plausible but clinically immature
Combination biliary study [11]	Open prospective study, 65 adults	Sludge disappearance 32.4% vs 8.7% control; total disappearance/reduction 64.86%	Supports feasibility of bile-oriented multi-botanical design

5. INTERNAL FORMULATION-SERIES DOSE-RESPONSE EVIDENCE

The internal formulation-series dataset adds an important layer of evidence because it does not merely state that the three botanicals are combined; it shows that specific component gradients are associated with directional functional change. When milk thistle increased from 20 to 50 parts while artichoke and dandelion remained fixed, oxidative-stress endpoints improved monotonically. MDA reduction rose from 51.27% to 68.17%, SOD increase from 98.62% to 141.53%, and GSH-Px increase from 112.35% to 162.48%. This pattern strengthens the interpretation that milk thistle is not an ornamental ingredient in the system, but a major driver of hepatocellular antioxidant recovery.

Table 3. Milk thistle dose-gradient and antioxidant-related outcomes in the liver-injury model

Embodiment	Milk thistle (parts)	Artichoke (parts)	Dandelion root (parts)	MDA decrease (%)	SOD increase (%)	GSH-Px increase (%)
Embodiment 1	20	45	25	51.27	98.62	112.35
Embodiment 2	40	45	25	63.89	128.74	148.62
Embodiment 3	50	45	25	68.17	141.53	162.48

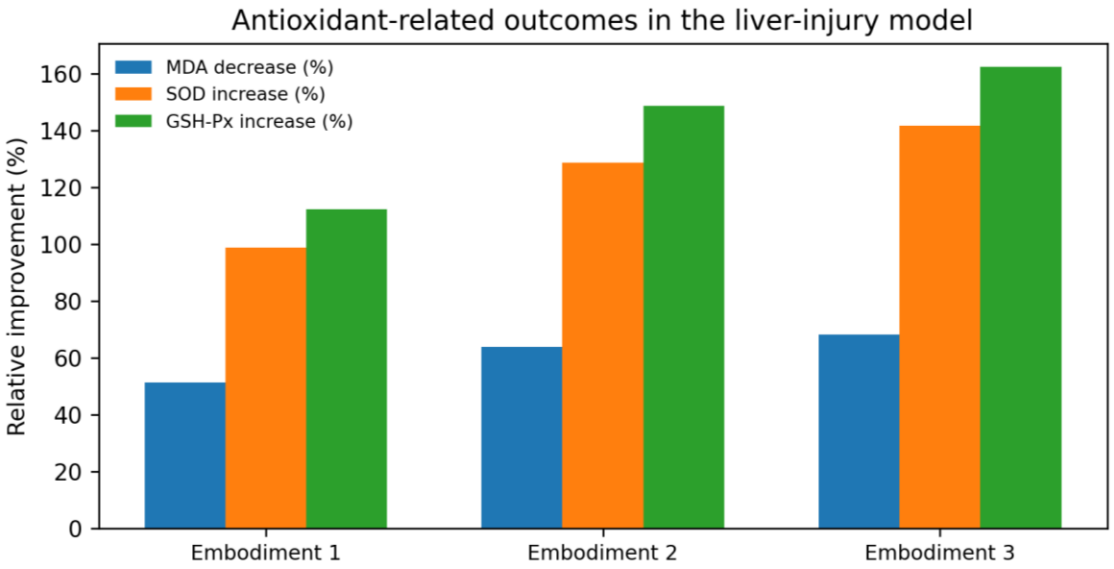

Figure 2. Antioxidant-related outcomes in the liver-injury model

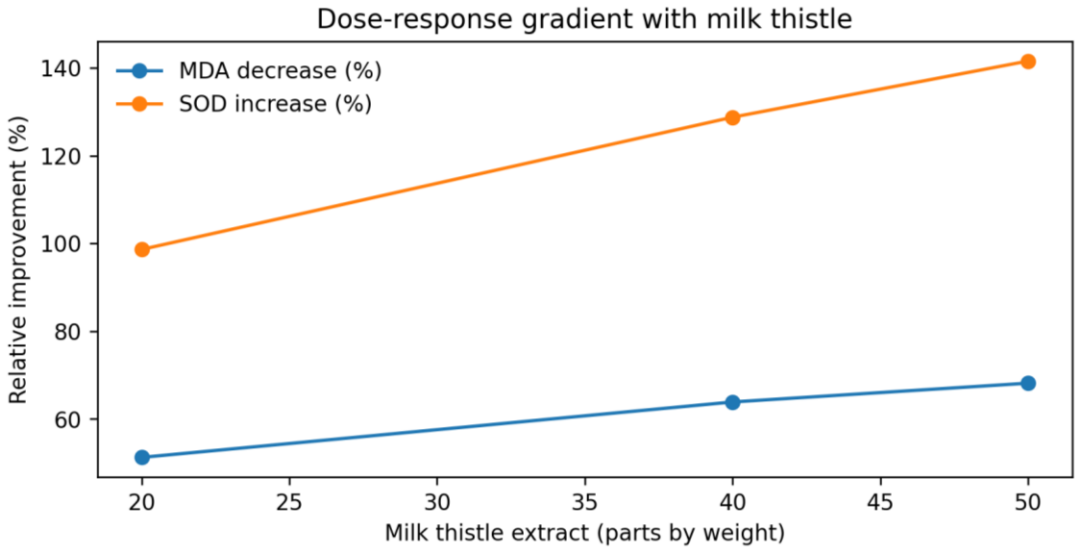

Figure 3. Dose-response gradient with milk thistle

A similarly coherent gradient appeared when dandelion root increased from 15 to 45 parts while milk thistle and artichoke remained fixed. Four-hour bile flow rose from 52.78% to 86.11%, ALT reduction from 62.35% to 81.26%, and MDA reduction from 53.47% to 66.78%. Because artichoke remained constant across this series, the results suggest that dandelion contributes more than generic antioxidant support and may reinforce the bile-oriented functional profile of the overall system. Taken together, the two gradients indicate that NVTIA is best interpreted as a coordinated formulation rather than a simple mixture of three familiar botanicals.

Table 4. Dandelion root dose-gradient and bile-secretion-related outcomes

Embodiment	Milk thistle (parts)	Artichoke (parts)	Dandelion root (parts)	4 h bile flow increase (%)	ALT decrease (%)	MDA decrease (%)
Embodiment 4	30	45	15	52.78	62.35	53.47
Embodiment 5	30	45	35	78.47	76.84	62.38
Embodiment 6	30	45	45	86.11	81.26	66.78

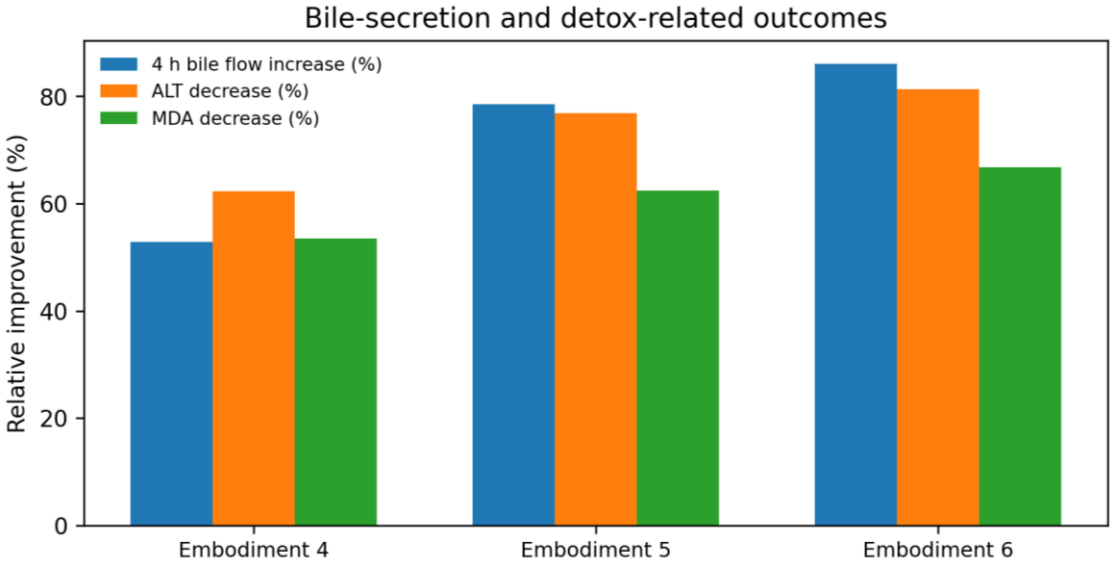

Figure 4. Bile-secretion and detox-related outcomes

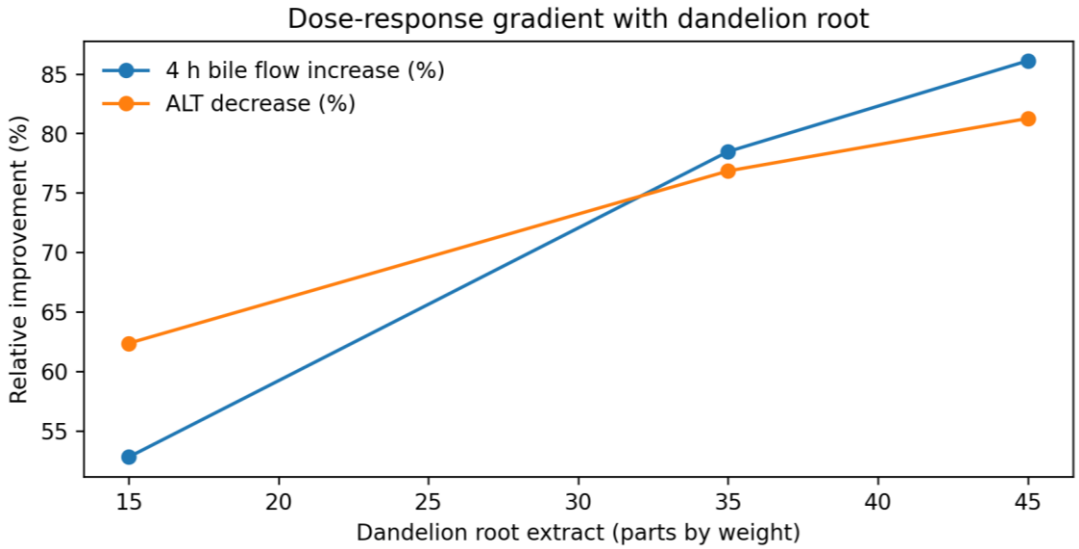

Figure 5. Dose-response gradient with dandelion root

6. INTEGRATED MECHANISTIC INTERPRETATION

The strongest scientific interpretation of the NVTIA system is therefore hierarchical rather than symmetrical. Milk thistle appears to provide the most established hepatocyte-protective and liver-enzyme-related literature support, artichoke contributes the clearest bile-secretion and choleretic justification, and dandelion root broadens oxidative-stress control while potentially amplifying biliary and detox-oriented behavior. This division of roles is preferable to claiming that all three ingredients do the same thing. The evidence is more coherent when the formula is described as a standardized tri-extract network with differentiated functions and overlapping support at the level of oxidative stress, bile handling, and biochemical liver indices.

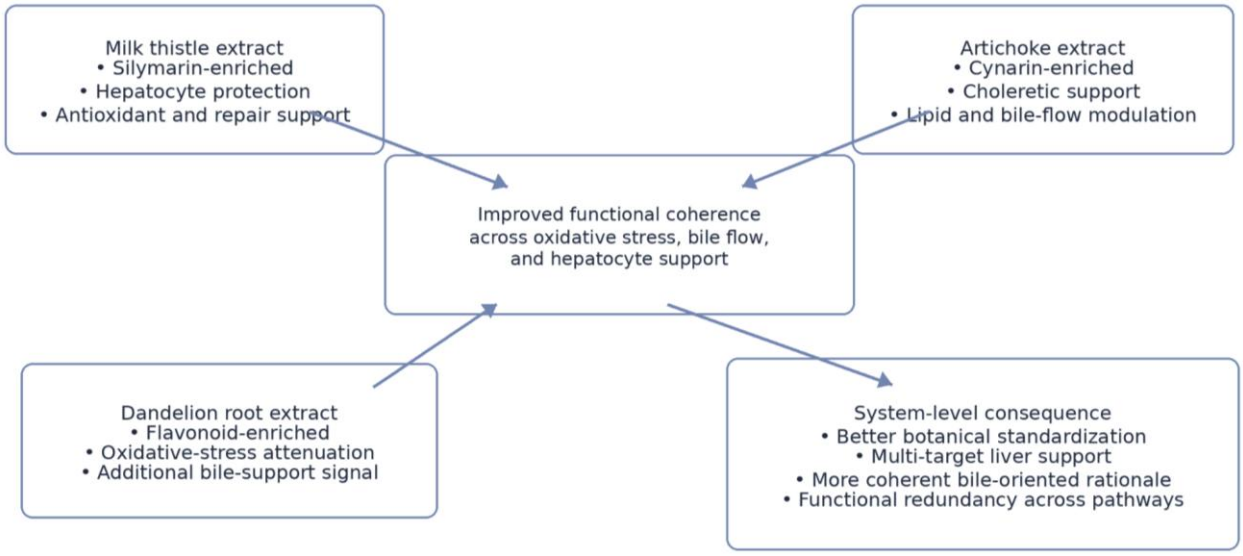

Figure 6. Conceptual model of the NVTIA tri-extract functional network

At the same time, the current public evidence does not justify overstating the maturity of the full tri-extract combination. Human evidence is strongest for milk thistle and artichoke individually, modest for combination strategies in biliary settings, and still insufficient for dandelion root as a clinically validated liver intervention. A recent prospective open study using a milk thistle–artichoke–green tea combination in biliary sludge reported disappearance of sludge in 32.4% of treated patients versus 8.7% in controls after three months, with a total 64.86% rate of disappearance or reduction, suggesting that multi-botanical bile-oriented strategies can be clinically tractable. Even so, the exact NVTIA tri-extract configuration still requires its own prospective verification, ideally through randomized trials with liver enzymes, bilirubin, imaging, symptom burden, and tolerability endpoints.

7. CONCLUSIONS

In summary, the NVTIA standardized tri-extract system is supported by three mutually reinforcing layers of evidence: chemical standardization of the botanical inputs, internally coherent formulation-series dose gradients, and a public evidence base that most strongly supports milk thistle for hepatocyte protection and artichoke for bile-oriented liver support. Dandelion root remains a credible adjunctive component whose role is presently better substantiated by preclinical than clinical data. Framed in this way, the NVTIA system represents a plausible and scientifically defensible bile-secretion-oriented hepatic-support strategy with clear priorities for future clinical validation.

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