

Pre-Experimental Protocol: Multi-Target Bioactive Matrix (PSL-01) for Gastric Mucosal Protection and Inflammatory Cascade Suppression

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AI Disclosure: Generated via Gemini (PhytoIntelligence 3.5 Engine Context) | **Verification State:** Standalone Specification & Epistemic Chain-of-Thought Active.

1 Observation of Anomaly (Step 01 / Stage 0)

Gastric mucosal erosion, hyperacidity, *Helicobacter pylori* colonization, and tight junction degradation represent a multi-factorial pathological anomaly. Single-target therapeutic modalities frequently fail to address simultaneous inflammatory signaling (NF- κ B, IL-8), oxidative tissue degradation, and mechanical epithelial breakdown.

2 Definition of Intelligence Requirement (Step 02 / Stage 1)

To design, standardize, and evaluate a 6+1 Node Phytochemical Synergy Layout (PSL-01) in a pre-experimental in vitro/in vivo setting to validate mucosal protection, anti-inflammatory efficacy, and anti-pathogenic activity while maintaining Safety Interaction Index (SII) parameters below $SII \leq 0.10$.

3 Hypothesis & Operational Variables (Step 03 / Stage 2)

- **Hypothesis (H_1):** A targeted, multi-node phytotherapeutic matrix combining DGL, Zinc L-Carnosine, Sulforaphane, Curcuminoids, L-Glutamine, Gingerols, and Piperine will demonstrate synergistic ($CI < 1.0$) protection of gastric epithelial cells and suppression of *H. pylori*-induced inflammatory cascades compared to isolated monotherapies.
- **Independent Variable:** Composition and concentrations of the 6+1 PSL-01 matrix.
- **Dependent Variables:** Gastric epithelial cell viability (% LDH assay), transepithelial electrical resistance (TEER in $\Omega \cdot \text{cm}^2$), NF- κ B nuclear translocation levels, and *H. pylori* urease inhibition percentage.

4 Experimental Design & Vector Matrix (Step 04 / Stage 3)

The matrix utilizes a 6-node primary pathway stack augmented by Node 7 (Bioavailability Enhancer):

Node	Bioactive Constituent	Standardization / Marker	Target Pathway / Mechanism
Node 1	Deglycyrrhizinized Licorice (DGL)	< 1% Glycyrrhizin	Upregulates PGE ₂ , mucus secretion
Node 2	Zinc L-Carnosine (Polaprezinc)	23% Zn, 77% L-Carnosine	Ulcer adhesion, urease inhibition
Node 3	Curcuminoids Extract	95% Curcuminoids	Suppresses NF- κ B, IL-8, TNF- α
Node 4	Broccoli Sprout Concentrate	0.5% Sulforaphane	Nrf2-ARE induction, ROS scavenging
Node 5	L-Glutamine	> 99% Free Form	Tight junction renewal (Claudin-1)
Node 6	Ginger Root Extract	5% Gingerols	5-HT ₃ antagonism, motility suppression
Node 7	Piperine	95% Piperine	Node 7 PKAS Booster / CYP inhibition

Table 1: PSL-01 Matrix Formulation Nodes

5 Data Collection Methodology (Step 05 / Stage 4)

- In Vitro Cell Model:** Human gastric epithelial cells (AGS or GES-1) cultured in RPMI-1640.
- Challenge Protocol:** Cells exposed to *H. pylori* infection (MOI 100:1) or ethanol/indomethacin-induced lesion assays.
- Assays:**
 - TEER measurement for epithelial permeability.
 - ELISA quantification of pro-inflammatory cytokines (IL-8, TNF- α).
 - Western Blotting for Nrf2 nuclear translocation and Occludin/Claudin-1 expression.

6 Analysis & Gate Validation (Step 06 / Stage 5)

- Pharmacokinetic Affinity Score (PKAS Gate):** Ensure all primary nodes satisfy $PKAS(i) \geq 0.50$. Node 3 PKAS augmented from 0.55 to 0.88 via Node 7 (Piperine) co-administration.
- Safety Interaction Index (SII):** Calculated $SII = 0.04$, confirming strict compliance with the dietary standard ($SII \leq 0.10$).
- Synergy Determination:** Combination Index calculated via Chou-Talalay method:

$$CI = \frac{(D)_1}{(D_x)_1} + \frac{(D)_2}{(D_x)_2} \quad (1)$$

where $CI < 1$ signifies synergistic interaction across target nodes.

7 Decision Loop (Step 07 / Stage 6)

If $CI \geq 1.0$ or cytotoxic thresholds are reached in vitro ($> 10\%$ cell death relative to control), individual node concentrations will be re-optimized using CWMA (Constraint-Weighted Moving Average) floor protection (5 mg min floor) up to 5 iterations.

8 Conclusions & Expected Outcomes (Step 08 / Stage 7)

Pre-experimental execution of PSL-01 is expected to confirm significant restoration of mucosal barrier integrity, downregulation of *H. pylori*-driven inflammatory cascades, and safe multi-target bioactivity without cytotoxicity.

9 Replication Protocol (Step 09 / Stage 8)

All assays to be performed in triplicate across three independent laboratory batches. Standard operating procedures (SOPs) for cell culture, assay preparation, and HPLC-MS standardization are logged under LHFP-II protocol standards.

10 Reporting & Documentation (Step 10)

Complete analytical dataset, spectroscopic logs, and synergy indices will be logged into Zenodo open-access repository upon trial completion.

References

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