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Review Paper

Formulation and Therapeutic Potential of Polyherbal Effervescent Tablets Containing *Glycyrrhiza glabra* for the Management of Gastrointestinal Disorders: A Comprehensive Review

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ABSTRACT

Gastrointestinal disorders are among the most frequently encountered chronic health conditions worldwide and are characterized by symptoms including dyspepsia, acid reflux, constipation, bloating, mucosal irritation, and impaired gastric motility. Conventional pharmacotherapy provides symptomatic relief but often fails to address oxidative stress, inflammation, and mucosal barrier dysfunction associated with chronic gastrointestinal pathology (1,2). Increasing interest has therefore been directed toward herbal therapeutics with multi-targeted mechanisms of action. Among medicinal plants used in digestive disorders, *Glycyrrhiza glabra* (liquorice) has demonstrated significant gastroprotective, anti-ulcer, anti-inflammatory, antioxidant, and mucosal regenerative properties (3–5). Additional supportive herbs such as *Embllica officinalis* (amla), *Zingiber officinale* (ginger), *Foeniculum vulgare* (fennel), *Cuminum cyminum* (jeera), and *Mentha piperita* (pudina) contribute antioxidant, prokinetic, carminative, and antispasmodic activities (6–9). Incorporation of these botanical extracts into effervescent dosage forms enhances dissolution, improves palatability, and ensures rapid gastric dispersion (10). This review focuses primarily on liquorice as the principal therapeutic component while discussing its phytochemistry, laboratory-scale extraction methods, mechanisms of gastrointestinal action, and synergistic integration with other herbal ingredients in polyherbal effervescent formulations.

INTRODUCTION

Digestive disorders significantly impair quality of life and frequently require long-term therapeutic management. Conditions such as gastritis, acid

peptic disorders, constipation, and functional dyspepsia involve complex mechanisms including excess gastric acid secretion, mucosal damage, oxidative stress, inflammatory mediator release,

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and altered gastrointestinal motility (1,2). Although proton pump inhibitors, H₂ blockers, and laxatives are widely prescribed, prolonged therapy has been associated with adverse effects and incomplete mucosal protection (2).

Herbal medicines provide a rational alternative due to their ability to act on multiple pathophysiological pathways simultaneously. Among these, *Glycyrrhiza glabra* has been extensively investigated for gastrointestinal cytoprotection. Its active constituents enhance mucus secretion, stimulate prostaglandin synthesis, inhibit inflammatory cytokines, reduce acid output, and promote epithelial regeneration (3–5). These properties position liquorice as a central therapeutic agent in digestive formulations. Complementary herbs including *Embolica officinalis*, *Zingiber officinale*, *Foeniculum vulgare*, *Cuminum cyminum*, and *Mentha piperita* provide supportive antioxidant, motility-enhancing, carminative, and smooth muscle relaxant actions (6–9,11). When combined into an effervescent drug delivery system, these extracts rapidly disperse in aqueous medium, enhancing mucosal contact and therapeutic onset (10).

Extraction method of *Glycyrrhiza glabra* from Liquorice roots

Liquorice roots are shade dried, pulverized, and passed through a 40-mesh sieve. For laboratory-scale hydroalcoholic extraction, 100 g of coarse powder is subjected to Soxhlet extraction using 70% ethanol for 6–8 hours at controlled temperature (60–70°C). The extract is filtered and concentrated under reduced pressure using a rotary evaporator. The semi-solid mass is dried in a vacuum oven below 50°C and stored in airtight containers. Alternatively, aqueous extraction may be performed by macerating powdered roots in distilled water for 24–48 hours followed by filtration and concentration. Hydroalcoholic extraction is generally preferred due to improved recovery of glycyrrhizin and flavonoids (5,12).

Phytoconstituents of *Glycyrrhiza glabra*

The pharmacological activity of liquorice is attributed to diverse bioactive compounds.

Table 1: Major Phytoconstituents of *Glycyrrhiza glabra* and Gastrointestinal Relevance

Phytoconstituent	Chemical Class	Gastrointestinal Activity	Reference
Glycyrrhizin	Triterpenoid saponin	Anti-ulcer, mucus stimulation, cytoprotection	(3,5)
18 β -Glycyrrhetic acid	Triterpenoid	Acid inhibition, epithelial healing	(5,12)
Liquiritigenin	Flavonoid	Antioxidant, anti-inflammatory	(15)
Isoliquiritigenin	Chalcone	Reduces oxidative gastric damage	(16)
Glabridin	Isoflavan	Antioxidant, anti-H. pylori	(17)
Licochalcone A	Chalcone	Anti-inflammatory, mucosal protection	(18)
Liquiritin	Flavonoid glycoside	Cytoprotective	(15)

Polysaccharides	Carbohydrate polymers	Mucosal soothing, immunomodulatory	(19)
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Effects of Liquorice in Gastrointestinal Disorders

Liquorice exerts cytoprotective effects through stimulation of mucus secretion and enhancement of prostaglandin synthesis, thereby strengthening gastric mucosal defense (3,13). Experimental studies demonstrate significant reduction in ulcer

index following administration of liquorice extract (14). Anti-inflammatory properties are mediated through inhibition of cytokine production and reduction of oxidative stress (21). Deglycyrrhizinated liquorice preparations have shown clinical benefit in functional dyspepsia while minimizing mineralocorticoid-related side effects (22).

Table 2: Experimental and Clinical Evidence of Liquorice in GI Disorders

Study Model	Observed Effect	Mechanism	Reference
Ethanol-induced ulcer (animal)	Reduced ulcer index	Increased mucus secretion	(14)
NSAID-induced ulcer	Cytoprotection	Prostaglandin stimulation	(3)
Dyspepsia clinical study	Symptom improvement	Anti-inflammatory effect	(22)
H. pylori model	Antimicrobial activity	Glabridin action	(17)
Oxidative gastric injury	Reduced lipid peroxidation	Antioxidant flavonoids	(5)

Effects of Polyherbal Ingredients on Gastrointestinal Passage

The supportive herbs included in the formulation influence gastric emptying, intestinal motility, and mucosal comfort.

Table 3: Effects of Herbal Ingredients on Gastrointestinal Passage

Herb	Botanical Name	Effect on GI Passage	Mechanism	Reference
Liquorice	<i>Glycyrrhiza glabra</i>	Enhances mucosal integrity	Mucus stimulation	(3–5)
Amla	<i>Emblica officinalis</i>	Protects gastric mucosa	Antioxidant activity	(6)
Ginger	<i>Zingiber officinale</i>	Improves gastric emptying	Prokinetic action	(7)
Fennel	<i>Foeniculum vulgare</i>	Reduces bloating	Carminative, antispasmodic	(8)

Jeera	<i>Cuminum cyminum</i>	Stimulates digestion	Digestive enzyme stimulation	(9)
Pudina	<i>Mentha piperita</i>	Relaxes smooth muscle	Calcium channel modulation	(11)

Rationale for Selecting Effervescent Tablets or Granules

Effervescent tablets or granules were selected to enhance the therapeutic performance of the proposed polyherbal gastrointestinal formulation. Gastrointestinal disorders such as gastritis, dyspepsia, and acid peptic disease involve mucosal irritation, oxidative stress, inflammation, and altered motility (1,2). Effervescent systems rapidly disintegrate in water, ensuring immediate dispersion of active constituents and faster onset of action compared to conventional solid tablets (10). Pre-dissolved administration improves mucosal contact, which is particularly beneficial for cytoprotective agents such as Glycyrrhiza glabra, known to stimulate mucus secretion, enhance prostaglandin synthesis, and reduce inflammatory damage (3,13,14). In addition, effervescent delivery improves palatability and compliance, especially when administering herbal extracts with strong taste profiles (10). Rapid availability of antioxidant and anti-inflammatory phytoconstituents such as glycyrrhizin, flavonoids, and chalcones may contribute to improved mucosal protection and reduction of oxidative injury (3,5,19). Thus, effervescent technology complements the pharmacological actions required for effective gastrointestinal management.

Reasons for Limited Development of Similar Effervescent Polyherbal Formulations

Despite strong evidence supporting the anti-ulcer and cytoprotective effects of liquorice (3–5,14), effervescent polyherbal gastrointestinal products

remain uncommon. One major limitation is formulation complexity. Effervescent systems are highly moisture sensitive and require controlled manufacturing conditions and protective packaging to maintain stability (10). Herbal extracts contain multiple phytoconstituents whose stability may vary under acidic effervescent conditions (19). Standardization also presents challenges, as therapeutic efficacy depends on consistent glycyrrhizin content and extract quality (3,12). Although deglycyrrhized liquorice has shown clinical benefit in functional dyspepsia (22), incorporation into stable effervescent systems requires careful compatibility and stability evaluation. These pharmaceutical constraints likely explain the limited commercialization of such formulations.

Comparison with Marketed Gastrointestinal Formulations

Conventional gastrointestinal therapies such as proton pump inhibitors and H₂ blockers provide acid suppression but may not fully address oxidative stress or mucosal repair mechanisms (2). In contrast, Glycyrrhiza glabra demonstrates significant ulcer reduction and cytoprotection through mucus enhancement and anti-inflammatory activity (3,14). Its flavonoids also exhibit antioxidant and anti-Helicobacter pylori effects (5,16,17). Supportive herbs further enhance therapeutic breadth. Phyllanthus emblica provides antioxidant gastroprotection (4,6), Zingiber officinale improves gastric motility (7), Foeniculum vulgare relieves bloating (8), Cuminum cyminum stimulates digestion (9), and Mentha piperita exerts antispasmodic effects (11).



Unlike synthetic effervescent antacids that mainly neutralize acid, the proposed polyherbal effervescent formulation offers rapid dispersion (1,3,5,10) combined with multi-targeted mucosal protection, antioxidant support, and motility regulation.

Effervescent Drug Delivery: Advantages and Limitations

Advantages	Limitations
Rapid disintegration	Moisture sensitive
Faster onset of action	Requires moisture-proof packaging
Improved palatability	Higher production cost
Better compliance	Sodium load due to bicarbonate
Suitable for dysphagia	Bulkier tablets
Reduced gastric irritation	Stability challenges

Effervescent formulations allow pre-dissolved administration, increasing surface area contact with gastric mucosa and accelerating therapeutic onset (1)

CONCLUSION

Polyherbal effervescent formulations centered on *Glycyrrhiza glabra* represent a scientifically supported and pharmaceutically advantageous approach for gastrointestinal management. Liquorice remains the primary therapeutic agent due to its strong cytoprotective, anti-ulcer, and anti-inflammatory properties, while supportive herbs enhance motility and digestive comfort. Effervescent technology further optimizes delivery and patient compliance. Future research should focus on controlled clinical trials and standardized extract optimization.

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