



A REVIEW ON CHAMOMILE AND FENNEL SEEDS-BASED ELIXIRS FOR RAPID NEUTRALIZATION OF GASTRIC ACID

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ABSTRACT

Gastric hyperacidity and gastroesophageal reflux disease (GERD) represent significant global healthcare burdens, often necessitating long-term pharmacological intervention. While proton pump inhibitors (PPIs) and mineral antacids are the standard of care, their limitations—including rebound acid hypersecretion and systemic side effects—have prompted a re-evaluation of botanical alternatives. This review examines the pharmacological potential of elixirs derived from *Matricaria chamomilla* (German Chamomile) and *Foeniculum vulgare* (Fennel seeds) for the rapid neutralization of gastric acid. These botanicals provide a dual-action therapeutic profile: direct chemical buffering of hydrochloric acid and biological modulation of the gastric secretory apparatus. *M. chamomilla* contributes a rich array of flavonoids (apigenin, quercetin) and

essential oils (bisabol, chamazulene) that exert potent anti-inflammatory and spasmolytic effects. Simultaneously, *F. vulgare* provides prokinetic benefits through anethole and fenchone, specifically accelerating the clearance of acidic refluxate by stimulating antral contractions while relaxing the gastric fundus. Evidence from standardized formulations, such as STW 5, demonstrates an acid-neutralizing capacity (ANC) comparable to commercial mineral antacids, with the added benefit of inhibiting secondary hyperacidity and enhancing mucosal barrier function via the regulation of prostaglandin E₂ and the STAT1 pathway. This

review synthesizes current phytochemical, in vitro, and clinical data to establish a comprehensive framework for the utilization of chamomile-fennel elixirs as rapid-acting, multifaceted gastroprotective agents.

- **KEYWORDS:** *Matricaria chamomilla*,
- *Foeniculum vulgare*,
- Gastric Acid Neutralization,
- Phytotherapy,
- Acid Neutralizing Capacity (ANC),
- Gastroprotective Elixirs, STW 5, Functional Dyspepsia.

1. INTRODUCTION

The human gastric environment is characterized by a finely tuned balance between aggressive factors, primarily hydrochloric acid (HCl) and pepsin, and defensive factors, such as the bicarbonate-rich mucus layer and the epithelial barrier. When this equilibrium is disrupted, the resulting hyperacidity leads to a spectrum of upper gastrointestinal disorders, including functional dyspepsia, erosive gastritis, and gastroesophageal reflux disease (GERD).

The standard pharmacological approach relies on neutralizing existing acid via mineral salts or suppressing its production through H_2 -receptor antagonists and proton pump inhibitors (PPIs). However, long-term PPI use is increasingly associated with adverse effects, including micronutrient malabsorption, altered gut microbiome, and "rebound acid hypersecretion" upon discontinuation. Botanical elixirs based on *Matricaria chamomilla* (Chamomile) and *Foeniculum vulgare* (Fennel) offer a compelling alternative. These plants have been used for thousands of years in Greece, Rome, and ancient Egypt to treat stomach problems. Unlike solid dosage forms, liquid elixirs facilitate swift chemical interaction with luminal H^+ ions, meeting the requirement for "rapid neutralization" while providing broader biological regulation of gastric motility and mucosal integrity.

2. Phytochemical Profiling of *Matricaria chamomilla*

The efficacy of *M. chamomilla* is a function of its chemical complexity, containing over 120 identified constituents. These are primarily categorized into volatile essential oils (1–2% of the flower) and non-volatile phenolic extracts.

2.1 Essential Oil Constituents

The volatile oil is dominated by sesquiterpenes, which provide the primary spasmolytic and anti-inflammatory activities.

- **alpha-Bisabol:** Found to reduce the amount of the proteolytic enzyme pepsin secreted by the stomach without causing drastic changes in baseline acid volume.
- **Chamazulene:** Formed from matricin during extraction, this compound provides potent antiseptic and anti-inflammatory effects. Chamazulene (26.11%) and α -bisabolol oxide A (up to 44.5%) are key markers of therapeutic quality.

2.2 Phenolic Diversity

The rapid neutralization of acid is largely supported by the hydrophilic phenolic components. In hydroethanolic extracts (70:30 ethanol/water), flavonoids account for approximately 42.91% of the content, while phenolic acids represent 33.39%.

- **Apigenin:** Recognized as the most pharmacologically active constituent targeting inflammation. It acts as a digestive relaxant and alleviates nervous excitability.
- **Quercetin and Luteolin:** These flavonoids neutralize free radicals and inhibit digestive enzymes, protecting cells from oxidative stress associated with hyperacidity.
- **Chlorogenic Acid:** Abundant (up to 14.79% in some extracts), this phenolic acid contributes to the chemical buffering capacity of the elixir.

3. Phytochemical Profiling of *Foeniculum vulgare*

Foeniculum vulgare (Fennel) complements chamomile by providing a distinct set of aromatic compounds and minerals that influence both gastric pH and motility.

3.1 Volatile Phenylpropanoids

GC-MS analysis of fennel seed extracts identifies up to 57 distinct phytoconstituents.

- **Trans-anethole:** The dominant compound (31.49% to 68%), known to restore delayed gastric emptying and improve gastric accommodation.
- **Fenchone (11.68%) and Estragole:** These contribute to the plant's carminative properties, reducing gas build-up and upward pressure on the lower esophageal sphincter (LES).

3.2 Mineral and Nutrient Buffering Profile

Fennel seeds are high plant sources of essential minerals that function as direct chemical buffers.

- **Potassium (852 mg/100g) and Calcium (588 mg/100g):** These minerals participate in acid-base reactions to neutralize HCl . Calcium specifically improves esophageal peristalsis and acid clearance.
- **Magnesium (406 mg/100g):** Contributes to the buffering capacity and helps relax gastric smooth muscle.

4. Mechanisms of Gastric Acid Neutralization and Regulation

4.1 In Vitro Acid Neutralizing Capacity (ANC)

ANC measures the amount of acid a specific dose of a substance can neutralize. In vitro studies using simulated gastric fluid (pH 1.2) demonstrate that household botanical remedies can achieve significant neutralization.

- **Synergy:** Polyherbal formulations containing fennel demonstrate superior ANC compared to individual extracts, maintaining higher pH levels (between 3.5 and 5.0) upon incremental acid addition.
- **Kinetics:** While synthetic antacids like sodium bicarbonate can reach near-neutral pH within seconds, botanical elixirs provide a more gradual and sustained rise in pH, often peaking between 15 and 30 minutes.

4.2 Biological Suppression of Acid Secretion

Botanical elixirs actively modulate cellular acid production, a feature lacking in simple chemical antacids. The herbal preparation STW 5 (Iberogast), which contains both chamomile and fennel, has been shown to.

- **Reduce Acid Output:** Dose-dependently lower acid secretion from parietal cells.
- **Increase Mucin Secretion:** Enhance the protective mucus layer.
- **Prostaglandin Regulation:** Increase PGE release, which inhibits acid secretion and enhances mucosal blood flow.

4.3 Inhibition of Secondary Hyperacidity

A critical advantage of chamomile-fennel elixirs is their ability to inhibit "secondary hyperacidity" or the rebound effect. STW 5 was found to be as effective as the commercial antacid magaldrate in acid neutralization but significantly more effective in preventing the rebound acid spike often seen after standard antacid use.

5. Impact on Gastric Motility and Reflux Dynamics

5.1 Region-Specific Motility of Fennel

Fennel elixirs exert a unique, region-specific effect on the stomach.

- **Proximal Stomach (Fundus and Corpus):** Fennel induces significant relaxation, likely by inhibiting store-operated Ca^{2+} channels. This improves gastric accommodation and reduces reflux pressure.
- **Distal Stomach (Antrum):** Fennel acts as a prokinetic agent, increasing the amplitude of contractions to accelerate gastric emptying.

5.2 Spasmolytic Effects of Chamomile

Chamomile provides a generalized relaxant effect on the GI tract, specifically alleviating esophageal spasms associated with GERD-related discomfort. This spasmolytic action is mediated through K^+ channel activation and weak Ca^{2+} channel antagonism.

6. Mucosal Protection and Barrier Function

6.1 STAT1 Pathway and Barrier Integrity

Fennel seed extract has been shown to improve gastrointestinal barrier function by downregulating the STAT1 activation pathway. By reducing levels of phosphorylated STAT1 (pSTAT1), the extract strengthens epithelial tight junctions, preventing acid "back-diffusion" into sensitive tissues.

6.2 Anti-inflammatory Synergy

Chamomile flavonoids and essential oils penetrate deep into the mucosa to inhibit PGE_2 release and attenuate COX-2 enzyme activity without affecting COX-1 . This provides a localized anti-inflammatory effect comparable to some conventional medications but with fewer side effects.

7. Clinical Evidence and Human Trials

Standardized formulations like STW 5 provide the most robust evidence

- **Functional Dyspepsia:** Randomized clinical trials comparing STW 5 with prokinetic drugs like cisapride show comparable or superior symptom relief for dysmotility-type dyspepsia.
- **Symptom Onset:** Observational trials indicate that patients experience symptom improvement within 15–30 minutes after an STW 5 dose.

- **GERD Management:** Modern studies using impedance and wireless pH monitoring show that botanical blends reduce reflux episodes and enhance gastric motility.

8. Safety, Toxicology, and Interactions

8.1 Allergic Sensitivity

Chamomile belongs to the Asteraceae family. Individuals allergic to ragweed, chrysanthemums, or marigolds should avoid these elixirs, as they may experience reactions ranging from dermatitis to anaphylaxis.

8.2 Herb-Drug Interactions

- **Warfarin and Anticoagulants:** Both chamomile and fennel may interact with blood thinners, potentially increasing bleeding risk.
- **Cyclosporine:** Chamomile may affect immune response or medication levels in transplant patients.
- **Oral Contraceptives:** Preliminary studies suggest chamomile may decrease the efficacy of hormonal birth control.

8.3 Pregnancy and Dosage

Fennel intake as tea is recommended at 3 to 5 grams per day for no more than 7 days. High quantities of chamomile may have teratogenic effects or disrupt the menstrual cycle, and its use is generally advised against during pregnancy.

9. CONCLUSION

Elixirs based on *Matricaria chamomilla* and *Foeniculum vulgare* represent a multifaceted therapeutic approach to gastric hyperacidity. By combining the direct chemical buffering of fennel's minerals with the biological acid suppression and spasmolytic effects of chamomile's flavonoids, these preparations provide rapid relief while fostering long-term mucosal resilience. Their ability to manage gastric motility—specifically relaxing the fundus while stimulating the antrum—addresses the underlying causes of acid reflux more comprehensively than standard mineral antacids. Future research should focus on optimizing extraction methods, such as natural deep eutectic solvents (NADES), to enhance the bioavailability of these potent phytochemicals.

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