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DEVELOPMENT AND EVALUATION OF A CASSIA TORA-BASED HERBAL ANTACID SUSPENSION

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ABSTRACT

Background: Synthetic antacids are frequently used to manage gastric hyperacidity; however, their potential for long-term adverse effects has catalyzed significant interest in developing safer herbal-based therapeutic alternatives. *Cassia tora*, traditionally used for gastrointestinal disorders, contains gastroprotective flavonoids, anthraquinones, and tannins. **Methodology:** To develop and evaluate a *Cassia tora*-based herbal antacid suspension, assessing its physicochemical stability, microbial safety, phytochemical profile, and acid-neutralizing capacity against a marketed antacid. A methanolic *Cassia tora* extract was formulated into a suspension with aluminium hydroxide, magnesium hydroxide, and magnesium trisilicate, using controlled flocculation and a structured vehicle. The evaluations included physicochemical properties (pH, viscosity, redispersibility), microbial safety, phytochemical screening, and a 90-day accelerated stability study (ICH guidelines). The acid-neutralizing capacity (ANC) was determined via back titration and compared to that of the marketed antacid and the control. **Results and Discussion:** The suspension demonstrated acceptable stability over 90 days, with minimal changes in pH (8.86→8.82) and viscosity (1780→1738 cP), and retained easy redispersibility. The microbial counts remained within the pharmacopeial limits. Phytochemical screening confirmed the presence of flavonoids, tannins, and saponins. The ANC was 1.68 mEq, comparable to that of a marketed antacid (2.15 mEq) and significantly superior to that of the control (0.02 mEq). **Conclusion:** A stable, efficacious *Cassia tora*-based herbal antacid suspension was successfully developed, exhibiting physicochemical stability, microbial safety, and an ANC comparable to that of commercial formulations. This supports its potential as a natural adjunct, though further in vivo and clinical studies are needed to confirm therapeutic applicability.

INTRODUCTION

Antacids are among the most commonly used therapeutic agents for managing conditions associated with excessive gastric acidity, such as hyperacidity, gastritis, acid reflux, and peptic ulcers [1, 2]. Antacids primarily function by neutralizing excess stomach acid, thereby alleviating pain, discomfort, and related symptoms. Most antacid formulations consist of basic

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compounds, such as magnesium hydroxide, aluminum hydroxide, calcium carbonate, and sodium bicarbonate [3]. These agents chemically react with gastric acid to produce water and various salts, increasing the gastric pH. Acid-related disorders constitute a significant global health burden, with gastroesophageal reflux disease (GERD) affecting approximately 14% of the global population. Although proton pump inhibitors (PPIs) and H2 receptor antagonists are frequently prescribed for these conditions, antacids offer more immediate symptomatic relief owing to their direct acid-neutralizing action, making them particularly valuable for the acute management of symptoms [4-7]. Although synthetic antacids act rapidly and are widely available, their long-term use is frequently associated with adverse effects, such as constipation, diarrhea, electrolyte imbalances, and renal complications [8]. Furthermore, the rising cost of conventional antacid therapy, coupled with increasing consumer concerns regarding the safety of chemical drugs, has shifted attention toward natural and herbal alternatives.

Herbal products are increasingly recognized as safe and cost-effective alternatives to conventional chemical drugs. They offer several advantages, including biocompatibility, a lower incidence of adverse effects, affordability, and widespread availability, particularly in developing countries where traditional medical systems are well-established [9]. The use of plants to treat gastrointestinal (GIT) disorders has been practiced for centuries and is well documented in various traditional medical systems, including Ayurveda, Unani, and Traditional Chinese Medicine. Among the diverse array of medicinal plants with gastroprotective properties, *Cassia tora* stands out for its longstanding use in Indian traditional medicine, particularly as an anti-diarrheal agent [10,11]. *Cassia tora,* commonly known as sickle senna, coffee pod, or Chakramarda in the Ayurvedic tradition, is an annual herbaceous plant in the family Fabaceae. It is widely distributed throughout the tropical and subtropical regions of Asia, particularly in India. *Cassia tora* is a climatically adaptable species capable of thriving along roadsides, in wastelands, and in cultivated fields. Nearly all parts of the plant, including the seeds, leaves, and roots, possess medicinal value [12-15]. Phytochemical analyses of *Cassia tora* have identified various bioactive constituents, including flavonoids, anthraquinones, glycosides, saponins, tannins, and other phenolic compounds [16]. These constituents are responsible for the plant's diverse pharmacological activities. Notably, *Cassia tora* has attracted particular attention for its antiulcer and antioxidant properties [17,18]. The antiulcer activity of *Cassia tora* is primarily attributed to its ability to enhance mucosal defense mechanisms and scavenge free radicals, thereby protecting the gastric mucosa from acid-induced injuries [19,20]. Additionally, the antioxidant activity of *Cassia tora* is attributed to its ability to neutralize reactive oxygen species (ROS), thereby helping prevent peptic ulcers and other gastric pathologies. Its anti-inflammatory properties synergistically reduce gastric mucosal irritation [21,22]. The scientific evaluation of antacid formulations involves assessing several parameters, including acid-neutralizing capacity (ANC), pH, buffering capacity, and dissolution profile, all of which contribute to their overall therapeutic efficacy. These standardized evaluation methods are essential for developing evidence-based herbal alternatives to synthetic antacids [23,24]. Furthermore, commercially available antacid formulations are mostly based on synthetic compounds. In contrast, only a few contain herbal ingredients and often lack adequate standardization, insufficient evaluation of physical and chemical parameters, and scientific validation [25,26]. Despite the extensive traditional use and well-documented pharmacological benefits of *Cassia tora,* the development of standardized herbal antacid formulations remains limited [27,28]. Therefore, this study aimed to develop an effective herbal suspension of *Cassia tora* extract as a natural alternative to synthetic antacids. In this study, the formulated Cassia tora suspension was systematically characterized for key physicochemical parameters, including pH, viscosity, sedimentation volume, redispersibility, and microbial stability, and was subjected to phytochemical screening to confirm the presence of bioactive constituents such as flavonoids, tannins, and saponins. The acid-neutralizing capacity was quantitatively assessed and compared with that of a marketed standard antacid, and accelerated stability studies were conducted in accordance with ICH guidelines for 90 days to evaluate its long-term stability and suitability as a natural alternative to conventional antacids. This study establishes a foundation for the development of standardized herbal antacids and their therapeutic integration into sustainable gastrointestinal pharmacotherapy.

MATERIALS AND METHODS

Chemicals and Reagents

Magnesium trisilicate hydrate (Extra Pure, Loba Chemie, Mumbai, India; CAS No.: 39365-87-2), magnesium oxide (Light/Heavy, Extra Pure, Loba Chemie, Mumbai, India; CAS No.: 1309-48-4), and sodium lauryl sulphate (0.004 M solution,

Loba Chemie, Mumbai, India; HSN: 2920.9000) were obtained from Loba Chemie. All solvents used, including methanol, chloroform, and petroleum ether (60–80 °C), were of analytical grade and procured from standard laboratory suppliers. Fresh distilled water was prepared in the laboratory before use. All other chemicals and excipients used were of analytical grade.

Plant Material Collection and Preparation

Cassia tora leaves were collected from different agroclimatic zones of Madhya Pradesh, India, and authenticated at Maharshi Dayanand University, Rohtak (No. MDU/DB/PU/2025-133). Following collection, the leaves were thoroughly washed under running tap water to remove any adhering debris, then shade-dried at ambient temperature (252 °C) for 7 days until a consistent weight was reached. Shade drying was used to prevent heat-sensitive constituents from degrading. Once dried, the leaves were pulverized into a coarse powder using a mechanical grinder and stored in airtight containers at 4 °C to preserve their chemical integrity before extraction [18].

Extraction of Plant Material

The leaves of *Cassia tora* were collected, cleaned, shade-dried for seven days, and powdered to a fine consistency. Two approaches, namely sequential maceration and the Soxhlet technique, were employed for the extraction of *Cassia tora* [29,30]. Sequential maceration was performed to obtain extracts across a range of polarities for preliminary phytochemical screening, and Soxhlet extraction with methanol was performed to prepare the extract used for suspension formulation. For maceration, approximately 100 g of powdered material was successively extracted with chloroform (non-polar), methanol (semi-polar), and distilled water (polar) for 72 h at room temperature with intermittent shaking. After each step, the solvent was filtered through Whatman No. 1 paper and concentrated under reduced pressure at 45 °C in a rotary evaporator. The crude extracts were collected in airtight amber containers and stored at 4 °C until analysis [31-33].

Soxhlet extraction was chosen for formulation owing to its efficiency and reproducibility. Approximately 100 g of powdered leaves were first defatted with petroleum ether (80 °C) for 6-8 h, and the residue was then subjected to continuous hot percolation with methanol for 16-18 h. The methanolic extract was concentrated under reduced pressure at 45 °C to remove the solvent, yielding a crude extract, which was stored in amber containers at 4 °C until incorporation into the herbal antacid suspension [34,35].

Formulation of Herbal Antacid Suspension

The dried methanolic extract of *Cassia tora*, along with conventional antacid bases (aluminum hydroxide, magnesium hydroxide, and magnesium trisilicate), was dispersed in a small volume of distilled water and stirred continuously. The detailed quantitative composition of the final formulated suspension is presented in Table 1. To prevent the formation of compact sediments, controlled flocculation was induced by adding surfactants, such as sodium lauryl sulfate and polysorbate 80, at low concentration. This adjustment of the surface charge facilitated the formation of soft, loose aggregates (flocs) that settled slowly and could be easily redispersed, thereby ensuring uniformity. Simultaneously, a structured vehicle was prepared by hydrating xanthan gum and sodium alginate in warm distilled water under constant agitation. These natural polysaccharides increase viscosity, slow sedimentation, and provide pseudoplastic flow, so that the suspension remains thick at rest yet becomes pourable when shaken. The flocculated suspension was gradually introduced into the structured vehicle with continuous mixing to achieve a homogeneous mixture. Preservatives (methyl paraben & propyl paraben) & stabilizers, such as sodium benzoate, were incorporated to ensure microbial safety and chemical stability. Finally, the suspension volume was adjusted with distilled water, the pH was standardized to the antacid range (8.0-9.0), and the preparation was transferred to amber-colored bottles and stored at low temperature until further evaluation.

Table 1: Composition used in the preparation of *Cassia tora* herbal antacid suspension.

Active Ingredients	Quantity (per 100 mL)	Function
C. tora Methanolic Ext.	5.0 g	Herbal Active
Aluminum Hydroxide	4.0 g	Antacid/Neutralizer
Magnesium Hydroxide	4.0 g	Antacid/Neutralizer
Magnesium Trisilicate	4.0 g	Antacid /Adsorbent
Excipients		
Sodium Lauryl Sulfate	0.1 g	Wetting Agent
Polysorbate 80 (Tween 80)	0.5 mL	Flocculating Agent
Xanthan Gum	0.5 g	Viscosity Modifier
Sodium Alginate	1.0 g	Suspending Agent
Methyl Paraben	0.18 g	Preservative
Propyl Paraben	0.02 g	Preservative
Sodium Benzoate	0.1 g	Stabilizer
Peppermint Oil	q.s.	Flavoring Agent
Aspartame / Sucrose	q.s.	Sweetener
Distilled Water	qs.-100mL	Vehicle

PHYSICAL EVALUATION OF THE HERBAL ANTACID SUSPENSION

Organoleptic properties

The formulated suspension was visually examined for color, odor, homogeneity, and particulate matter, and any evidence of phase separation or microbial contamination was carefully assessed [36].

pH measurement

The pH of the formulation was determined using a calibrated digital pH meter. The meter was calibrated with buffer solutions of pH 4.0, 7.0, and 9.0 before use. Approximately 10 mL of the suspension was transferred to a beaker, and the electrode was immersed until a stable value was recorded.

Weight per mL (Density)

The density was measured using a calibrated pycnometer. The empty pycnometer was weighed, filled with distilled water, and weighed again to establish a reference weight. After drying, the pycnometer was filled with the suspension, and its weight was measured again. The weight per mL was calculated as the weight of the filled sample divided by its volume (mL).

Viscosity

The viscosity was measured using a Brookfield viscometer (Spindle No. 2) at 50 rpm, with the temperature maintained at 252 °C. To ensure accuracy, each measurement was performed in triplicate, and the average values were recorded to represent the formulation's rheological properties.

Redispersibility

To assess redispersibility, the suspension was left undisturbed, then the graduated cylinder was gently inverted at 180 °. The number of inversions required to achieve uniform redispersion of the sediment was recorded, serving as an indicator of the formulation's physical stability and ease of reconstitution.

Sedimentation volume

A 50 mL aliquot of the suspension was transferred into a 100 mL graduated cylinder and maintained undisturbed at room temperature for 24 h. The final sediment volume (Vu) was measured, and the sedimentation volume ratio (F) was calculated as follows:

$$F = \frac{Vu}{Vo}$$

where Vo is the original suspension volume, and Vu is the final sediment volume.

CHEMICAL EVALUATION

Phytochemical screening

Preliminary phytochemical analysis of the *Cassia tora* leaf extracts (chloroform, methanol, and aqueous) was performed using standard qualitative tests. Alkaloids were identified using Dragendorff's and Mayer's reagents, flavonoids using the Shinoda test, saponins using the foam test, tannins and phenolics using ferric chloride solution, and glycosides, steroids, and terpenoids using established chemical assays [18].

Quantitative estimation of total phenolics and flavonoids

The total phenolic content (TPC) was evaluated using the Folin–Ciocalteu method. Methanolic extract aliquots were reacted with the Folin–Ciocalteu reagent and sodium carbonate, and the absorbance was measured at 765 nm using a UV-Visible spectrophotometer. A standard curve was created using gallic acid, and the results were expressed as mg gallic acid equivalent (GAE)/gram extract. The total flavonoid content (TFC) was determined using an aluminum chloride colorimetric assay. The extract was combined with an aluminum chloride reagent, and the absorbance was recorded at 415 nm. Quercetin was used as the reference standard, and the values were expressed as mg quercetin equivalent (QE)/g extract [29].

Antacid activity (acid-neutralizing power)

The acid-neutralizing capacity (ANC) of the formulated suspension was evaluated using a standardized back-titration method. A specific volume of the suspension was treated with an excess of 0.1 N HCl and incubated at 37 °C to mimic gastric conditions. The unneutralized acid was quantified by back titration with 0.1 N NaOH using phenolphthalein as the pH indicator. The ANC was expressed as milliequivalents (mEq) of acid neutralized per mL of suspension. A commercially available antacid suspension (Digene®, Abbott India Ltd.) was used as a reference for comparing the acid-neutralizing capacity. The results for the *Cassia tora* suspension were directly compared with those of a marketed reference antacid and a distilled water control [37,38].

Stability testing

Stability studies were conducted in accordance with ICH guidelines under accelerated conditions (40 ± 2 °C/ 75% RH) for 90 days. Samples were withdrawn at 0, 15, 30, 60, and 90 days to evaluate the organoleptic properties, pH, viscosity, sedimentation volume, and redispersibility. Chemical stability was assessed by repeating the acid-neutralizing- power assays and phytochemical profiling at each time point.

Statistical analysis

All experiments were performed in triplicate (n = 3), and results are expressed as Mean ± Standard Deviation (SD). Stability parameters were analyzed using one-way ANOVA followed by Tukey's post-hoc test. Acid-neutralizing capacity comparisons were evaluated using Student's t-test. Statistical analysis was performed using GraphPad Prism (Version 8.0), and significance was set at $p < 0.05$ [39,40].

RESULTS AND DISCUSSION

Extraction Yield

Sequential maceration of *Cassia tora* leaves with chloroform, methanol, and water produced crude extracts of varying polarities. Among these, the methanolic fraction yielded visibly higher amounts than the chloroform & water fractions, consistent with its broad solubility profile for secondary metabolites such as phenolics, flavonoids & glycosides. Soxhlet extraction with methanol, performed after petroleum ether defatting, yielded a concentrated dark brown- extract that was used for suspension formulation. Sequential maceration of *C. tora* leaves with chloroform, methanol, and water produced extracts of varying polarities. The percentage yields obtained were 2.45% w/w (chloroform), 10.24% w/w (methanol), and 8.12% w/w (aqueous). Soxhlet extraction with methanol, performed after petroleum ether defatting, yielded a concentrated dark-brown extract containing 14.82% w/w. The higher recovery observed with methanol indicates its suitability for extracting phenolic and flavonoid constituents. The extract used for formulation was standardized based on this yield to ensure batch reproducibility. A qualitative assessment confirmed that methanol was the most efficient solvent system for the recovery of phytoconstituents, which aligns with previous reports on Cassia species.

Formulation of Herbal Antacid Suspension

The methanolic extract of *C. tora* was successfully formulated with aluminum hydroxide, magnesium hydroxide & magnesium trisilicate into a stable suspension using a combination of controlled flocculation and structured vehicle strategies. The prepared suspension appeared brown, smooth, without phase separation & had acceptable pourability (Figure 1).

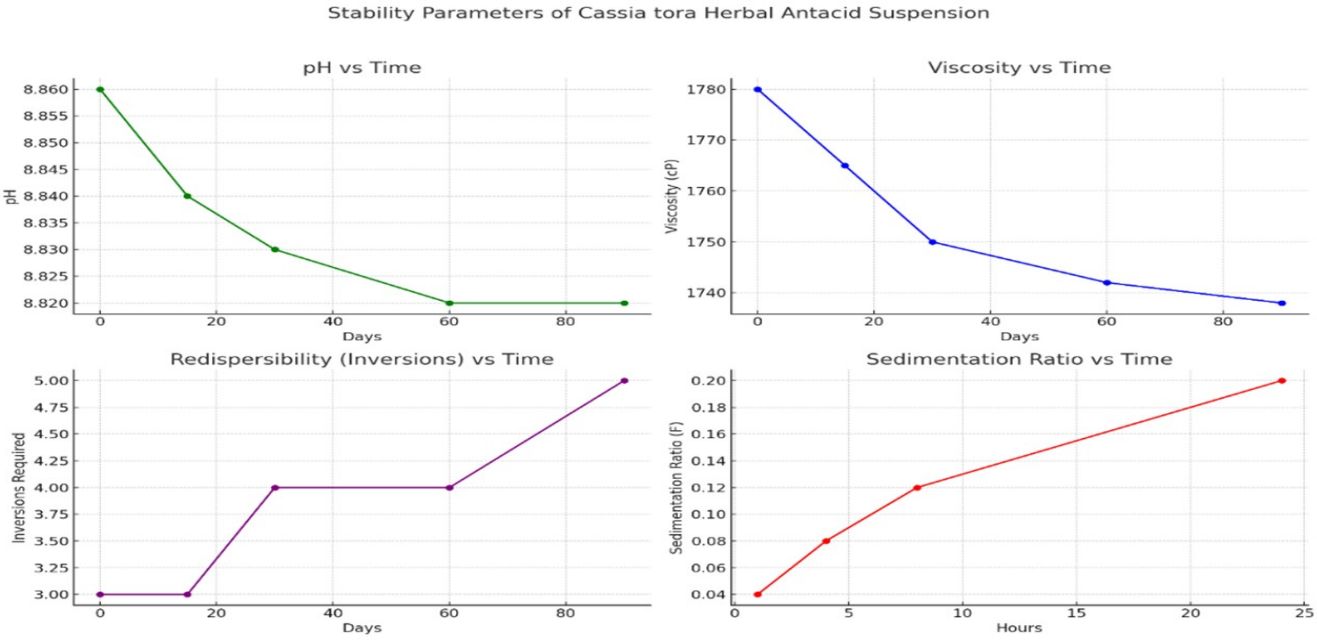

Figure 1: Evaluation of physical parameters, including pH, viscosity, redispersibility, and sedimentation rate of the formulated suspension over storage time.

Physical Evaluation of the Suspension

The formulated suspension remained organoleptically acceptable throughout the accelerated storage period, retaining a brown, smooth appearance, a mild herbal odor, and a slightly bitter taste, with no evidence of phase separation or particulate agglomeration (Table 2). Furthermore, the pH declined minimally from 8.86 at day 0 to 8.82 at day 90, while the viscosity decreased slightly from 1780 to 1738 cP over the study period. The weight per ml was 1.08 g/mL (water: 1.00 g/mL) & the sedimentation volume increased modestly from 20 to 22 mL over 90 days. The suspension remained readily redispersible, requiring only 3–5 gentle inversions to achieve a uniform

suspension. Microbial counts remained within acceptable limits, with the total bacterial count declining from 40 to 35 CFU/mL, and the total fungal count remained nil throughout the study (Table 3). All parameters remained within the acceptable pharmacopeial limits during accelerated storage.

Table 2: Organoleptic evaluation of *the Cassia tora* herbal antacid suspension.

Organoleptic Properties	
Parameter	**Observation/Value**
Appearance	Brown, smooth
Odor	Mild herbal
Taste	Slightly bitter
Phase Separation	Absent
Particulate Agglomeration	Absent

Table 3: Stability profile under accelerated storage (40 °C, 75% RH).

Parameter*	Day 0	Day 15	Day 30	Day 60	Day 90
pH	8.86	8.84	8.83	8.82	8.82
Viscosity (cP)	1780	1765	1750	1742	1738
Sedimentation (mL)	20	21	21	22	22
Redispersibility (Inversions)	3	3	4	4	5
TBC (CFU/mL)	40	38	36	34	35
TFC (CFU/mL)	Nil	Nil	Nil	Nil	Nil

**All parameters remained within the acceptable pharmacopeial limits during accelerated storage.*

Chemical Evaluation of Extracts and Suspension

Phytochemical screening of *Cassia tora* revealed diverse phytoconstituents in its chloroform, methanolic, and aqueous extracts, each exhibiting distinct profiles of bioactive compounds. The methanolic extract showed strong positive results for flavonoids, saponins, and tannins (Table 4).

Table 4: Phytochemical profile of *Cassia tora* extracts

Compound class	Chloroform	Methanol	Aqueous
Alkaloids	+	++	+
Flavonoids	+	+++	++
Saponins	–	++	+++
Tannins	–	++	+
Glycosides	+	+	–
Steroids	++	+	–
Terpenoids	–	+	+

Quantitative estimation of the methanolic extract revealed a Total Phenolic Content (TPC) of 42.15 ± 1.24 mg GAE/g extract and a Total Flavonoid Content (TFC) of 73.4 ± 1.12 mg QE/g extract (mean ± SD, n = 3). These findings establish a reproducible phytochemical baseline for the formulation and support its gastroprotective and antioxidant potential (Table 5).

Acid-neutralizing capacity

The *Cassia tora* suspension neutralized 1.68 mEq of HCl, while the marketed standard antacid neutralized 2.15 mEq and the control (distilled water) only 0.02 mEq (Table 6 and Figure 1). These results demonstrate that although slightly lower than the marketed standard, the *Cassia tora* formulation achieved a comparable acid-neutralizing- effect and was markedly superior to the control. Additionally, the stability, physical appearance, pH, viscosity, and acid-neutralizing power of the formulated suspension varied minimally over 90 days and remained within pharmacopeial ranges.

Table 5: Quantitative phytochemical analysis of methanolic extract

Parameter	Method	Result (Mean ± SD, n=3)
Total Phenolic Content	Folin–Ciocalteu	42.15 ± 1.24 mg GAE/g
Total Flavonoid Content	$AlCl_3$ colorimetric assay	73.4 ± 1.12 mg QE/g

Table 6: Acid-neutralizing capacity of *Cassia tora* methanolic suspensions

Sample	NaOH consumed (mL)	Acid neutralized (mEq)
	16.8	1.68
Standard antacid	21.5	2.15
Control (water)	0.2	0.02

Statistical Analysis

ANOVA revealed no significant ($p > 0.05$) differences in pH, viscosity, or sedimentation across storage times. Student's t-test confirmed that the acid-neutralizing capacity of the suspension was significantly higher than that of the control ($p< 0.05$) but not significantly different from that of the standard preparation ($p> 0.05$). Statistical analysis indicated no significant difference between the *Cassia tora* suspension and the marketed standard in acid-neutralizing capacity ($p > 0.05$), while both were significantly greater than the control ($p < 0.05$).

DISCUSSION

The present study successfully developed a stable herbal suspension from the methanolic extract of *Cassia tora*, a plant traditionally used to treat gastrointestinal disorders. Methanol was identified as the most efficient solvent for extraction, yielding a rich profile of flavonoids, tannins, and saponins. These phyto-constituents are widely associated with antioxidant, mucoprotective, and gastroprotective activities, providing a strong rationale for their integration into antacid formulations

[41]. The formulation design incorporated aluminum hydroxide, magnesium hydroxide, and magnesium trisilicate as conventional bases, supported by a structured vehicle system to ensure physical stability. The vehicle was specifically formulated using Xanthan Gum (0.5% w/v, Food Grade, 200 mesh) and Sodium Alginate (1.0% w/v, Medium Viscosity Grade), which synergistically imparted the desired pseudoplastic flow behavior. This rheological profile ensures that the suspension remains thick at rest to prevent rapid settling but thins upon shaking for easy pouring. To further prevent caking, the controlled flocculation achieved in this suspension was critically dependent on the precise surfactant concentrations employed. Sodium lauryl sulfate (0.1% w/v) and Polysorbate 80 (0.5% v/v) were utilized to modify the surface charge of the suspended particles, promoting the formation of loose, easily redispersible flocs rather than a compact cake. In this study, the "controlled" nature of the flocculation is scientifically validated by established principles of suspension stability. According to the DLVO theory of colloid stability, the sedimentation volume reaches its maximum value. It remains relatively constant within a certain range of zeta potential, where it changes from low positive to low negative potential.

Furthermore, the observed sedimentation volume ratio ($F \approx 1.0$) and the ease of redispersion (requiring only 3–5 inversions even after 90 days) serve as practical indicators of a stable flocculated system. These physical stability parameters demonstrated that controlled coagulation can be achieved using mixtures of ionic/non-ionic surfactants, producing sterically stabilized systems. Overall, the absence of a compact cake or rigid sediment, combined with the rapid restoration of uniformity upon minimal agitation, confirms that the chosen surfactant concentrations effectively balanced inter-particulate forces, preventing irreversible aggregation and ensuring dose uniformity throughout the shelf-life.

sAt baseline, the suspension exhibited desirable characteristics, including a smooth texture, a brown appearance, and a mild herbal odor. Although a slightly bitter taste persisted due to the high concentration of *Cassia tora* extract, the inclusion of Peppermint oil as a flavoring agent and aspartame/sucrose as sweeteners significantly improved palatability. This masking strategy is essential to ensure patient compliance, as acceptance of oral liquid dosage forms is highly dependent on taste masking, particularly for bitter herbal actives.

Physicochemical studies under accelerated ICH conditions (40 °C/75% RH for 90 days) revealed a negligible decline in pH from 8.86 to 8.82, indicating preserved buffering capacity. The viscosity decreased slightly from 1780 to 1738 cP, yet the suspension remained readily pourable, while the sedimentation volume increased modestly from 20 to 22 mL without compromising redispersibility. These modest changes fell well within pharmacopeial limits. Moreover, microbial analysis validated the formulation's safety: bacterial counts decreased from 40 to 35 CFU/mL over the study period, and fungal growth was consistently absent. This reduction in microbial load is likely attributable to the synergistic antimicrobial action of the added preservatives (methyl paraben and propyl paraben) and the inherent antibacterial properties of the *Cassia tora* extract itself, which contains anthraquinones and flavonoids known to inhibit bacterial proliferation. Regarding efficacy, acid-neutralizing studies revealed that the *Cassia tora* suspension neutralized 1.68 mEq of HCl, compared to 2.15 mEq for the marketed reference. This observed approx. 22% difference is attributed to the incorporation of the herbal extract, which displaces a portion of the volume otherwise occupied by high-density synthetic neutralizers. However, this difference is not anticipated to necessitate a clinical dosage adjustment. Unlike the marketed product, which relies exclusively on rapid chemical neutralization, the developed formulation employs a hybrid therapeutic mechanism. The synthetic bases effectively elevate gastric pH, while the *Cassia tora* extract contributes complementary gastroprotective and antioxidant properties mediated by flavonoids and tannins. Thus, the extract likely potentiates anti-ulcer efficacy not by significantly altering stoichiometric ANC but by providing biological protection against acid-induced mucosal injury. Overall, this study demonstrates that *Cassia tora* can be developed into a standardized herbal antacid suspension with acceptable physicochemical stability and microbial safety. The methanolic extract was characterized by a defined extraction yield (14.82% w/w) and quantified phytochemical markers (TPC: 42.15 ± 1.24 mg GAE/g; TFC: 73.4 ± 1.12 mg QE/g), ensuring batch-to-batch reproducibility. It is acknowledged that *in vitro* ANC alone does not fully predict *in vivo* mucosal protection. While established models, such as ethanol-induced gastric ulcers in rats, provide critical data on cytoprotection, the primary objective of this study was first to establish a stable, standardized pharmaceutical formulation. Developing a reproducible dosage form with consistent physicochemical properties is a prerequisite for

reliable *in vivo* assessment. Consequently, the standardized phytochemical profile and stability data generated here provide the necessary quality-control foundation for subsequent in vivo studies, which are currently planned to evaluate the formulation's gastroprotective potential.

SAFETY CONSIDERATIONS & CONTRAINDICATIONS

The *Cassia tora*-based herbal antacid suspension offers a natural alternative for managing hyperacidity; certain safety considerations have been drawn to the attention of the researchers because it contains anthraquinone glycosides, which exhibit laxative and gastrointestinal irritant properties at elevated doses, and are contraindicated in patients with intestinal obstruction, spastic colon, or severe inflammatory bowel conditions.

CONCLUSION

The methanolic extract of *Cassia tora* was formulated into an herbal suspension that exhibited favorable physicochemical stability, microbial safety, and acid-neutralizing capacity comparable to that of a marketed antacid. Accelerated stability testing over 90 days, in accordance with ICH guidelines, demonstrated minimal variations in pH, viscosity, sedimentation, and redispersibility, underscoring the robustness of the formulation. Phytochemical analysis confirmed the presence of flavonoids, tannins, and saponins, which may synergistically enhance the observed gastroprotective effects. Collectively, these findings support the use of *Cassia tora* as a promising natural adjunct to conventional antacids. The extract was standardized based on the extraction yield and quantitative measurements of phenolic and flavonoid content, ensuring reproducible therapeutic quality. Future studies should include in vivo antiulcer models and clinical validation to further establish its translational applicability.

FINANCIAL ASSISTANCE

NIL

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTION

Shivani and Charit Kumar have equal contributions to conceptualization, review, methodology, investigation, writing-original draft. Rakesh Redhu contributed to Data curation and methodology. Karan Jangra contributed to Data curation. Amit Lather contributed to Methodology, writing, review and editing, and supervision resources. All authors have read and agreed to the published version of this manuscript.

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