RESEARCH PAPER

PHARMACEUTICAL QUALITY ASSESSMENT AND COMPARATIVE PHYSICOCHEMICAL EVALUATION OF COMMERCIAL HERBAL ANTACID SUSPENSIONS

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Abstract

Background: People are using antacid suspensions more and more to help with too much acid and stomach problems because they come from natural things, are safe to use, and can help protect the stomach. We do not know much about how well these herbal antacid suspensions are made and how long they last. **Methods:** We looked at five antacid suspensions that people can buy to see how well they are made. We checked the packaging and labels, how acidic or basic they're how thick they are, how well they flow, how much they settle, how well they mix again with water and how much they cost compared to what they do. We used tests to compare these things. Statistical comparisons were performed using one-way ANOVA followed by Tukey's post hoc test. **Results**: All of the herbal antacid suspensions we looked at were good at neutralising acid and were okay to use. They were different in how thick they were, how they flowed and how much they settled. One of them, Sample C, was very good at not settling. Was a good value for the money. Samples D and E were liked the most by people because they tasted and felt good. Most of the antacid suspensions followed the rules for labelling set by the World Health Organisation and the Central Drugs Standard Control Organisation, but some of them did not have all the information they should have. **Conclusion:** The results of this study support using antacid suspensions that have been tested scientifically to help with stomach problems. Herbal antacid suspensions are an option for people with stomach problems because they are natural and can help protect the stomach.

Keywords: Herbal antacids; Integrative medicine; Hyperacidity; Suspension stability; Quality assessment; Consumer acceptability.

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Introduction

Hyperacidity overview

Hyperacidity is a stomach problem. It happens when the stomach produces too much acid. This can cause heartburn, acid reflux and indigestion. You might also feel pain in your stomach, feel bloated, get nauseous or feel uncomfortable in your stomach. Things like eating certain foods, being stressed, smoking, drinking alcohol, eating irregular meals and taking certain painkillers for a long time can make hyperacidity worse. When stomach acid gets out of balance, it can hurt the stomach lining. If hyperacidity is not treated, it can lead to problems. These include gastroesophageal reflux disease, stomach inflammation, stomach ulcers and ulcers in the intestine. Hyperacidity can cause a lot of discomfort. Needs to be taken care of. Stomach acid problems can be serious if not addressed. Hyperacidity symptoms should not be ignored [1-3]. The usual way to manage hyperacidity is to use things like antacids, proton pump inhibitors and H_2-receptor antagonists. These hyperacidity treatments help reduce the acid in your stomach or make it less strong. This gives people some relief from their symptoms. Hyperacidity management with these treatments is pretty common. Hyperacidity is a problem that can be helped with these kinds of treatments [4]. Using antacids for a long time can be bad for you. Synthetic antacids can cause problems like your stomach getting upset. You might get constipation or diarrhoea. Synthetic antacids can also mess with the balance of things in your body. Sometimes synthetic antacids can even make your stomach acid worse, which is called acid rebound. Synthetic antacids are supposed to help with stomach acid. Using synthetic antacids for too long can have the opposite effect [5]. Therefore, people are getting more interested in finding safer and better alternative treatments for acid-related stomach problems. These alternative therapies are being

considered for managing acid reflux and other gastrointestinal disorders. The goal is to find treatments that work well and do not have side effects. Acid-related gastrointestinal disorders are a concern for many people. They are looking for ways to manage their symptoms. Safer and effective treatments are what they need. Alternative therapies might just be the answer [6-8].

1.2 Herbal antacid importance

Herbal antacids are really popular now because they are natural and safer than the antacids we buy. People like Herbal antacids because they have fewer side effects and can help us feel better. Herbal antacids use plants and things in plants to help prevent and treat different health problems. The Herbal antacid is a choice for people who want to try something new and natural. Herbal antacids are used to help with lots of health issues, and people trust them because they come from plants [9-11]. Polyherbal antacid formulations contain medicinal herbs. They are commonly used in medicine like Ayurveda to help with acidity, indigestion and stomach irritation. These formulations work well because they have many helpful plant compounds like flavonoids, tannins, alkaloids, glycosides and phenolic compounds. The combination of these compounds provides relief from acidity, indigestion, gastric irritation and dyspepsia. Polyherbal antacid formulations are often used for managing acidity, and they also help with indigestion. They are a choice for people looking for natural remedies for stomach problems. Polyherbal antacid formulations have benefits due to their multiple medicinal herbs [12-14].

Medicinal plants including *Glycyrrhiza glabra*, *Emblica officinalis*, *Foeniculum vulgare*, *Mentha* species, and *Tinospora cordifolia* possess gastroprotective, antioxidant, anti-inflammatory, and mild acid-neutralising properties that contribute to their therapeutic efficacy [15-19]. Unlike conventional antacids that largely neutralise stomach acid, herbal antacid formulations may also boost mucosal protection, improve digestion, reduce oxidative stress, and support overall gastrointestinal health [20,21]. Owing to their natural origin, affordability, and patient acceptability, herbal antacids are increasingly being used worldwide as alternative remedies for acid-related disorders [22,23].

1.3 Need for pharmaceutical quality assessment

The increasing commercial availability and widespread use of herbal antacid suspensions necessitate systematic pharmaceutical quality assessment to ensure their safety, efficacy, and consistency. The therapeutic effectiveness of herbal formulations largely depends on the quality of raw materials, manufacturing processes, formulation stability, and concentration of active phytoconstituents. Variations in herbal composition, processing methods, storage conditions, and excipients may significantly influence the physicochemical characteristics and performance of the final product [24-27].

Quality control evaluation of herbal medicinal products includes assessment of physicochemical parameters, stability characteristics, organoleptic properties, labelling compliance, and regulatory standards. Proper standardisation and quality assurance are crucial for minimising batch-to-batch variability and ensuring reproducible therapeutic outcomes. In addition, contamination with microorganisms, heavy metals, pesticides, or adulterants may compromise product safety and efficacy. Therefore, implementation of Good Manufacturing Practices (GMP), validated analytical methods, authentication of herbal ingredients, and post-market surveillance are important components of pharmaceutical quality assurance [28-32].

Comprehensive pharmaceutical evaluation also helps identify formulation defects related to sedimentation, viscosity, redispersibility, and physical instability, which can impact patient compliance and dosage uniformity. Hence, comparative assessment of marketed herbal antacid suspensions is necessary to establish their pharmaceutical quality, regulatory compliance, and overall acceptability [33-36].

1.4 Suspension stability importance

A pharmaceutical suspension is a coarse dispersion in which the internal phase is dispersed uniformly throughout the external phase. The internal phase consists of insoluble solid particles of a specific size range dispersed throughout a suspending vehicle with the aid of one or more suspending agents. The external phase is generally aqueous for oral preparations, although organic or oily vehicles may be used for certain non-oral formulations [37-39].

The physical stability of a suspension is a critical quality attribute that influences its therapeutic effectiveness, appearance, patient acceptability, and shelf life. Instability phenomena such as sedimentation, caking, crystal growth, phase separation, and changes in viscosity may adversely affect dose uniformity and product performance [40-42]. Therefore, evaluation of physicochemical parameters including density, pH, viscosity, sedimentation volume, flow rate, redispersibility, and specific gravity is essential for assessing the quality and stability of suspension formulations [43-45].

Evaluation of these physicochemical properties provides important information regarding the stability, elegance, and pharmaceutical acceptability of herbal antacid suspensions. Such assessments help identify formulation-related issues and ensure that the product maintains its intended quality throughout storage and use [46-48].

1.5 Rationale of the Study

Although numerous herbal antacid suspensions are commercially available, limited scientific data are available regarding their comparative pharmaceutical quality and physicochemical characteristics. Most marketed products claim therapeutic benefits based primarily on traditional use rather than standardised pharmaceutical evaluation. Therefore, systematic comparative analysis of these formulations is necessary to determine their quality, stability, organoleptic properties, and compliance with pharmaceutical standards [49-52].

The present study aims to provide a comprehensive pharmaceutical quality assessment and comparative physicochemical evaluation of commercially available herbal antacid suspensions using physicochemical, organoleptic, and regulatory parameters. The findings of this study may contribute to quality standardisation, formulation improvement, and rational selection of effective herbal antacid products for the management of hyperacidity and related gastrointestinal disorders [53-54].

2. MATERIALS AND METHODS

2.1 Physicochemical Evaluation

2.1.1 Visual Inspection and Packaging Analysis

The marketed herbal antacid suspensions were subjected to visual inspection and packaging analysis to evaluate their pharmaceutical appearance, labelling quality, and packaging compliance. A modified checklist suitable for liquid oral formulations was prepared based on standard pharmaceutical evaluation parameters. Each product was examined for packaging integrity, labelling accuracy, batch information, manufacturing and expiry dates, dosage instructions, storage conditions, manufacturer details, and declaration of active ingredients. Additional information, including country of manufacture, pack volume, and maximum retail price (MRP), was also recorded. The evaluation was performed to assess product authenticity, completeness of labelling information, and compliance with regulatory requirements [33-35, 51-54].

2.1.2 Determination of pH and Density

The pH of each marketed herbal antacid suspension was determined using a calibrated digital pH meter. Before analysis, the suspensions were thoroughly shaken to ensure uniformity. About 10 ml of each sample was transferred into a clean beaker, and the pH was measured at room temperature. Measurements were performed in triplicate, and the mean values were recorded.

The relative density of the suspensions was determined using a pycnometer method. The weight of a fixed volume of suspension was compared with the weight of an equal volume of distilled water at room temperature. All determinations were carried out in triplicate. Evaluation of pH and density was performed to assess alkalinity, physical consistency, and formulation uniformity of the suspensions [36-40].

2.1.3 Determination of Viscosity and Flow Rate

Viscosity and flow rate studies were carried out to evaluate the pourability and physical stability of the marketed suspensions. The viscosity of each formulation was measured using a digital rotational viscometer at 30 rpm using an appropriate spindle. Approximately 100 ml of thoroughly mixed suspension was used for analysis, and measurements were conducted at room temperature in triplicate.

Flow rate was determined by measuring the time required for 10 ml of suspension to flow through a 10 ml pipette. The flow behaviour of the formulations was evaluated to determine ease of administration and resistance to sedimentation [40-46].

2.1.4 Determination of Sedimentation Volume

Sedimentation volume studies were conducted to evaluate the physical stability of the suspensions during storage. Approximately 50 ml of each thoroughly shaken suspension was transferred into separate 50 ml graduated cylinders and stored undisturbed at room temperature for 12 days.

Sediment volume was recorded hourly for the first 7 hours on day 1 and subsequently on days 2, 3, 4, 5, 6, 7, and 12. All measurements were performed in triplicate. Sedimentation volume (F) was calculated using the following equation:

$$F = Vu / Vo$$

Where:

- **Vu** = Ultimate volume of sediment
- **Vo** = Original volume of suspension

Sedimentation volume versus time graphs were plotted, and sedimentation rates were determined from the slope of the plots. The study was performed to assess suspension stability and resistance to caking [45-48].

2.1.5 Redispersibility Study

Redispersibility studies were performed to evaluate the ease with which settled particles could be uniformly redistributed upon shaking. After completion of sedimentation studies, each measuring cylinder was manually inverted through 180° until a homogeneous suspension was obtained.

The number of inversions required for complete redispersibility was recorded. A suspension requiring a single inversion was considered completely redispersible, while additional inversions indicated reduced redispersibility. The study was carried out qualitatively to assess physical stability and patient convenience during administration [41,46-48].

2.1.6 Determination of Specific Gravity

Specific gravity of the marketed herbal antacid suspensions was determined using a specific gravity bottle at room temperature. The method involved comparing the weight of a known volume of suspension with the weight of an equal volume of distilled water.

Density and specific gravity were calculated using the following equations:

$$Density = W_3 / Vf$$

$$Specific\ Gravity = W_5 / W_4$$

Where:

- **W_3** = Weight of suspension
- **Vf** = Volume of suspension
- **W_5** = Weight of suspension
- **W_4** = Weight of water

The analysis was conducted in triplicate to ensure accuracy and reproducibility [37-40].

2.2 Stability and Consumer Evaluation

2.2.1 Consumer Preference Study

Organoleptic evaluation of the marketed herbal antacid suspensions was carried out to assess patient acceptability and consumer preference. Parameters evaluated included taste, odour, appearance, texture, mouthfeel, and ease of administration.

These sensory characteristics play an important role in patient compliance, particularly for oral liquid dosage forms. Each formulation was comparatively assessed for palatability, smoothness, and overall acceptability [35,47,48].

2.2.2 Labelling and Regulatory Compliance

Labelling compliance of the selected herbal antacid suspensions was evaluated according to the guidelines of the World Health Organisation (WHO) and the Central Drugs Standard Control Organisation (CDSCO).

The following labelling parameters were examined:

Product name, Active ingredients, Excipients, Batch number, Manufacturing date, Expiry date, Dosage instructions, Storage conditions, Warnings and precautions, Manufacturer information, Maximum retail price (MRP).

The evaluation was conducted to determine product authenticity, regulatory compliance, and adequacy of information provided to consumers [26,31,51,54].

2.2.3 Cost–Benefit Analysis

A cost–benefit analysis was performed to determine the economic value of the marketed herbal antacid suspensions. The cost-effectiveness of each product was evaluated by calculating the cost per milliequivalent (mEq) of acid neutralised.

The cost per mEq neutralised was calculated using the following equation:

Cost per mEq neutralised = Product Cost / Total mEq Acid Neutralised

This analysis was conducted to compare the therapeutic value and affordability of the marketed formulations [49,50].

2.2.4 Market and Economic Comparison

Comparative market evaluation of the selected formulations was performed based on pharmaceutical quality, labelling compliance, organoleptic properties, and economic value. Cost-effectiveness was assessed using cost per mEq neutralised, while labelling compliance was verified according to WHO and CDSCO recommendations [26,28,31,32].

Consumer-oriented parameters such as taste, odour, texture, and mouthfeel were also comparatively evaluated to determine patient acceptability and product preference [35,47,48].

3. RESULTS AND DISCUSSION

Table 1 Herbal Antacid Suspension

Sr. No.	Sample No.	Brand Name	Manufactured By
1.	Sample A	Himcocid Suspension	Himalaya Wellness Company
2.	Sample B	Amlapitt Syrup	Om Pharmaceuticals Ltd & Shree Dhootapapeshwar Ltd.
3.	Sample C	Pittank Suspension	Inducare Pharma Pvt. Ltd.
4.	Sample D	Scool SF	Octavis Inc.
5.	Sample E	Digecid Suspension	Fidalgo Healthcare

3.1 Visual Inspection and Packaging Analysis

Visual inspection of the marketed herbal antacid suspensions demonstrated acceptable primary packaging integrity for all samples (A–E). Internal packaging was intact in every formulation, indicating adequate protection against contamination and environmental exposure. However, variations were observed in secondary packaging and labelling compliance. Sample D showed the best overall packaging compliance, while Sample C lacked clear storage condition information and displayed incomplete expiry labelling.

All formulations exhibited uniform physical appearance without visible defects such as cracks, erosion, discolouration, foreign particles, or leakage. Batch number, manufacturing date, expiry date, and active ingredient details were generally available on the internal packaging of all samples. Nevertheless, traceability and labelling information on the external packaging were inconsistent in Samples A, B, C, and E.

Comparative composition analysis revealed substantial variation among formulations. Samples B and D contained complex polyherbal-herbomineral combinations, whereas Samples A and E contained relatively simpler herbo-mineral compositions. Sample C incorporated a syrup base and Shankha Bhasma, suggesting improved palatability and suspension stability. Most products exhibited a shelf life of approximately 36 months, except Sample E, which showed a comparatively shorter shelf life.

Table 2 Visual Inspection of Herbal Antacid Suspensions

Questions	Sample				
	A	B	C	D	E
A. Packaging					
1. Is there external packaging?	*	*	*	+	*
2. Is the external packaging intact?	*	*	*	+	*
3. Is the internal packaging intact?	+	+	+	+	+
4. Does the internal packaging provide clear information on the storage conditions of the medicine?	+	+	-	+	+
B. Identification					
B1. Does the external packaging carry the following information on the outer side?	*	*	*	+	*
5. Name of the active ingredient(s)	*	*	*	+	*
6. The amount of active	*	*	*	+	*
7. The expiry date in an uncoded form	*	*	*	-	*
B2. Does the internal packaging carry the following information on the outer side?	+	+	+	+	+
8. Name of the active ingredient(s)	+	+	+	+	+
9. The amount of active ingredient per dosage unit?	+	+	+	+	+
10. The expiry date in an uncoded form	+	+	-	-	+
C. Traceability?					
C1. Does the external packaging carry the following information on the outer side?	*	*	*	+	*
11. The name and address of the manufacturer or the company/Person responsible for placing the product on the market?	*	*	*	+	*
12. The batch number?	*	*	*	+	*
C2. Does the internal packaging carry the following information on the outer side?	+	+	+	+	+
13. The name and address of the manufacturer or the company/Person responsible for placing the product on the market?	+	+	+	+	+
14. The batch number?	+	+	+	+	+
D. Physical appearance					
15. Do the tablets have the same shape, dimensions, colour, and marks?	*	*	*	*	*
16. Are the tablets free from cracks, erosion, stains, and foreign particles?	*	*	*	*	*

+=Yes, - = No, * = Not applicable

Table 3 Visual Inspection (Composition) of Herbal Antacid Suspensions

Sample	Composition	Batch No.	Mfg Date	Expiry Date	Dosage form
Sample A	Varatika, Dugdhapashana, Mouktika Sukti	252500850	11/25	10/28	Suspension
Sample B	Vasa, Guduchi, Parpata, Nimb, Kiratatikta, Bhrungaraja, Patola, Yashti, Haritaki, Bibhitaka, Amalaki, Shouktik	DP0124096	12/24	11/27	Suspension
Sample C	Aamalaki Emblica officinalis, Shatawari (Asparagus racemosus), Yashtimadhu (Glycyrrhiza glabra, Jatamansi Ela (Nordostachys jatamansi Rz), Elettaria cardamomum Sd, Shankha Bhasma, Generic preparation, Syrup Base	338125	03/25	03/28 (Best before 36 months from manufacturing)	Suspension
Sample D	Adraka, Hareetak, Pudina, Shweta Jeera, Nimbu Ka Ras, Trikatu, Saunf, Ajamoda, Mustaka, Vidanga, Naushadar, Saindhav Lavan, Pipali Mool, Gulab Phool, Karpoora, Bhumi Amla, Amla, Behra, Harad, Karela, Ghee Kesar, Shyam Tulsi, Barbani Tulsi, Van Tulsi, Ram Tulsi, Mugal Tulsi, Elachi, Shatavari, Kaur BHasam, Hing, Jai Graqss, Sorbitol base	OSHAL-517	Dec-2024	Dec-2027	Suspension
Sample E	Varatika, Mukta sukti, VidarikandGiloy, Bhringraj, Mulethi, Balamool, Jeera, Pippali, Saunf, Ajwain, Sodium benzoate	LE5740	Nov-2024	Oct-2026	Suspension

Discussion

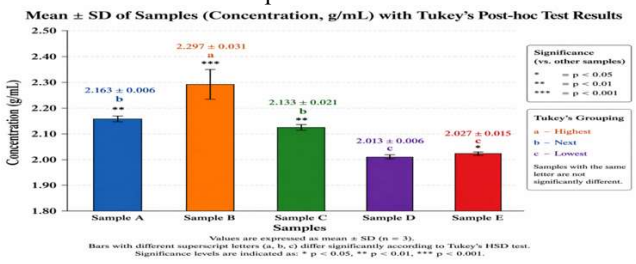
The results indicate satisfactory primary packaging quality and acceptable pharmaceutical appearance among all marketed formulations. Proper internal packaging ensures maintenance of product integrity, stability, and protection during storage. However, inconsistencies observed in external labelling and traceability may affect regulatory compliance and patient safety. Samples containing complex polyherbal compositions (particularly Samples B and D) may provide broader therapeutic activity; however, increased formulation complexity can influence viscosity, sedimentation behaviour, and long-term suspension stability. In contrast, simpler formulations may exhibit improved physicochemical stability and ease of standardisation. The absence of adequate storage information and incomplete expiry labelling in some products highlights the need for improved regulatory adherence and standardised labelling practices. Overall, the marketed suspensions demonstrated pharmaceutically acceptable packaging quality with moderate variation in labelling compliance and formulation composition.

3.2 Determination of Density

Results

The density values of the marketed herbal antacid suspensions ranged from 2.013 ± 0.006 g/ml to 2.297 ± 0.031 g/ml. Sample B showed the highest density, whereas Sample D exhibited the lowest value. One-way ANOVA demonstrated a highly significant difference among formulations ($p < 0.001$). Tukey's HSD test classified the samples into three statistically distinct groups: Sample B, Samples A and C, and Samples D and E.

Figure 1 Histograph of Density of Herbal Antacid Suspensions



Discussion

Differences in density among formulations may be attributed to variations in herbal extract concentration, mineral content, and suspended solid particles. The significantly higher density of Sample B suggests the presence of greater solid content and a more concentrated suspension system. Similar density values observed for Samples A and C and for Samples D and E indicate comparable formulation characteristics.

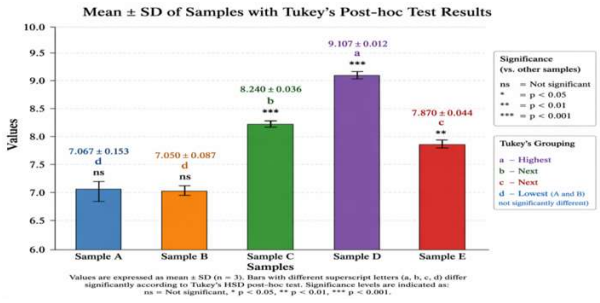
Density is an important parameter affecting sedimentation behaviour, redispersibility, and pourability of suspensions. Higher density formulations may exhibit improved acid-neutralising capacity but can also increase the risk of sedimentation if viscosity is not adequately optimised.

3.3 Determination of pH

Results

The pH values of the formulations ranged from 7.050 ± 0.087 to 9.107 ± 0.012. Sample D exhibited the highest alkalinity, while Samples A and B showed nearly neutral pH values. Statistical analysis revealed significant variation among formulations ($p < 0.001$). Samples A and B did not differ significantly, whereas all other pairwise comparisons showed significant differences.

Figure 2 Histograph of pH of Herbal Antacid Suspensions



Discussion

The alkaline pH observed in all formulations confirms their suitability for acid neutralisation and management of hyperacidity. Sample D demonstrated the highest alkalinity, which may contribute to greater acid-neutralising potential. However, excessively alkaline formulations may affect palatability and gastric tolerance.

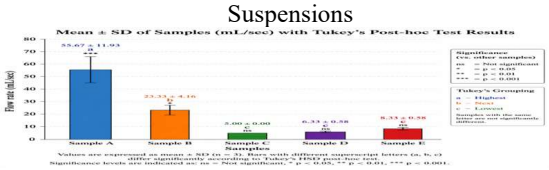
The similarity between Samples A and B suggests comparable buffering characteristics. Variations in pH among formulations are likely related to differences in mineral components, herbal extracts, and excipient composition. Appropriate pH is essential for formulation stability, therapeutic efficacy, and patient acceptability.

3.4 Determination of Flow Rate

Results

Flow rate analysis showed marked variation among formulations. Sample A exhibited the highest flow time, whereas Samples C, D, and E demonstrated significantly lower and statistically comparable values. ANOVA indicated significant differences among formulations ($p < 0.001$).

Figure 3 Histograph of Flow Rate of Herbal Antacid Suspensions



Discussion

Flow rate reflects the pourability and ease of administration of suspension formulations. The significantly higher flow time of Sample A indicates greater resistance to flow, likely due to increased viscosity or higher suspended solid content. In contrast, Samples C, D, and E exhibited better flow properties, suggesting easier administration and improved patient convenience.

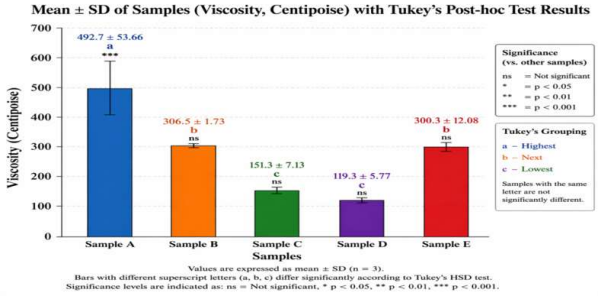
Adequate flow characteristics are essential for uniform dosing and consumer acceptability. Excessively high flow resistance may negatively influence handling and pourability.

3.5 Determination of Viscosity

Results

Viscosity values ranged from 119.3 ± 5.77 cP to 492.7 ± 53.66 cP. Sample A showed significantly higher viscosity compared with all other formulations ($p < 0.001$). Samples B and E formed one statistical group, while Samples C and D demonstrated the lowest viscosity values.

Figure 4 Histograph of Viscosity of Herbal Antacid Suspensions



Discussion

Viscosity plays a critical role in suspension stability by reducing sedimentation and maintaining uniform particle distribution. The markedly higher viscosity of Sample A indicates stronger structural organisation and greater internal resistance to particle settling.

Lower viscosity values observed in Samples C and D may improve pourability but could increase sedimentation tendency during storage. Similar viscosity profiles of Samples B and E suggest comparable rheological behaviour. Overall, formulation composition significantly influenced the rheological properties of the suspensions.

3.6 Sedimentation Volume

Results

Sedimentation volume studies demonstrated a gradual reduction in sedimentation volume over the study period for all formulations. Sample C exhibited the highest

sedimentation volume, whereas Sample E showed the lowest value. A significant difference was observed between Samples C and E ($p < 0.01$), while other pairwise comparisons were statistically non-significant.

Figure 5 Histograph of Sedimentation Volume of Herbal Antacid Suspensions

Discussion

Higher sedimentation volume indicates improved suspension stability and reduced particle aggregation. The superior sedimentation characteristics of Sample C suggest better particle dispersion and resistance to caking. Conversely, the lower sedimentation volume of Sample E indicates relatively greater particle settling during storage.

The absence of significant differences among most formulations suggests acceptable physical stability overall. Sedimentation behaviour is influenced by viscosity, particle size distribution, and the nature of suspending agents used in the formulations.

3.7 Redispersibility Study

Results

Redispersibility evaluation revealed that Sample A required the highest number of inversions for complete redispersibility, while Sample D exhibited the best redispersibility characteristics. Statistical analysis showed significant differences between Sample A and Samples B, C, and D ($p < 0.05$).

Table 4 Redispersibility of Herbal Antacid Suspensions

Sample	Mean ± SD
Sample A	$9.00 \pm 1.00^{a*}$
Sample E	7.00 ± 1.00^{ab}
Sample C	5.67 ± 1.53^{b}
Sample B	5.33 ± 1.53^{b}
Sample D	4.00 ± 1.00^{b}

Discussion

Redispersibility is an important indicator of suspension stability and ease of use. Formulations requiring fewer inversions are considered more pharmaceutically elegant and patient-friendly. The poor redispersibility of Sample A may be associated with its higher viscosity and stronger particle aggregation.

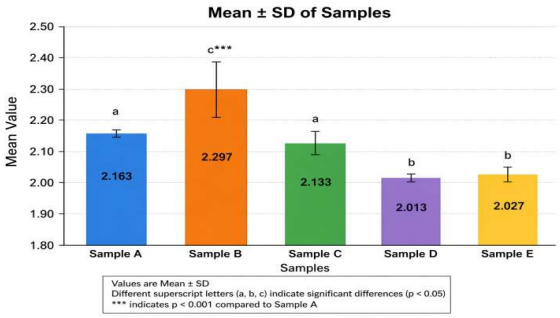
Samples B, C, and D demonstrated satisfactory redispersibility behaviour, indicating acceptable suspension stability without significant caking.

3.8 Specific Gravity

Results

Specific gravity values ranged from 2.013 ± 0.006 to 2.297 ± 0.031. Sample B showed the highest specific gravity, whereas Sample D showed the lowest value. Significant differences were observed among formulations ($p < 0.001$).

Figure 6 Specific gravity of Herbal Antacid Suspensions



Discussion

Specific gravity reflects the concentration of suspended materials and formulation composition. Higher specific gravity in Sample B may be due to increased mineral and solid content. Similar values observed between Samples A and C and between Samples D and E suggest related formulation characteristics. Variations in specific gravity may influence sedimentation behaviour, viscosity, and dosing uniformity.

3.9 Consumer Acceptability Study

Results

Comparative organoleptic evaluation demonstrated that Samples D and E showed the highest consumer acceptability, followed by Sample A. Sample C exhibited the lowest acceptability because of its highly sour odour and mixed taste perception.

Samples D and E showed excellent taste, mint-like odour, and refreshing mouthfeel, whereas Sample B demonstrated moderate acceptability due to slight bitterness. Sample C exhibited poor sensory acceptance despite satisfactory mouthfeel.

Overall ranking based on organoleptic properties was: Sample D > Sample E > Sample A > Sample B > Sample C

Discussion

Organoleptic properties significantly influence patient compliance and market preference of oral liquid formulations. Mint-like odour, balanced sweetness, and refreshing mouthfeel were strongly associated with higher consumer acceptance.

Samples D and E achieved superior acceptability due to effective taste masking and pleasant sensory characteristics. In contrast, the sour odour and inconsistent taste profile of Sample C negatively affected consumer preference.

These findings indicate that sensory optimisation is essential for improving patient adherence and the commercial success of herbal antacid suspensions.

3.10 Cost–Benefit Analysis

Results

Cost-effectiveness analysis demonstrated that Sample C exhibited the lowest cost per mEq neutralised and

therefore the highest economic efficiency. Sample D showed the highest cost per mEq neutralised, indicating lower economic value.

Table 5 Cost Benefit Comparison of Herbal Antacid Suspension Marketed Brands

Sample Code	Cost per Unit (Rs)	Acid Neutralising Capacity (mEq)	Cost per mEq (Rs/mEq)	Economic Efficiency
Sample A	145	5.5	26.36	Good
Sample B	150	5.0	30.00	Moderate
Sample C	130	6.0	21.66	Excellent
Sample D	183	4.0	45.75	Satisfactory
Sample E	126	5.2	24.23	Very Good

Discussion

Economic evaluation revealed considerable variation in cost-effectiveness among marketed formulations. Sample C provided the best therapeutic value relative to cost, whereas Sample D demonstrated comparatively lower economic efficiency despite good organoleptic acceptability.

Cost–benefit analysis is important in determining the affordability and accessibility of herbal antacid formulations for long-term management of hyperacidity.

3.11 Labelling and Regulatory Compliance

Results

Most marketed formulations complied with WHO and CDSCO labelling requirements. All products included active ingredients, batch number, manufacturing date, expiry date, and storage conditions. However, dosage instructions were absent in Samples D and E.

Table 6: Labelling Compliance Comparison Herbal Antacid Suspension Marketed Brands

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Ingredients listed	Yes	Yes	Yes	Yes	Yes
Batch number	Yes	Yes	Yes	Yes	Yes
Mfg. date	Yes	Yes	Yes	Yes	Yes
Expiry date	Yes	Yes	Yes	Yes	Yes
Dosage instructions	Yes	Yes	Yes	No	No
Storage conditions	Yes	Yes	Yes	Yes	Yes
Warning label	Yes	Yes	Yes	Yes	Yes

Discussion

Adequate labelling is essential for safe administration, product traceability, and regulatory compliance. Although overall compliance was satisfactory, missing dosage instructions in some formulations may affect appropriate patient use. Improved standardisation of labelling practices is necessary to ensure consumer safety and adherence to pharmaceutical regulatory guidelines.

4. CONCLUSION

The comparative evaluation of marketed herbal antacid suspensions demonstrated noticeable differences in physical stability, pharmaceutical elegance, suspension quality, and patient acceptability among the selected formulations. Physicochemical studies revealed that all formulations possessed acceptable alkaline pH and satisfactory suspension characteristics; however, variations were observed in viscosity, flow rate, sedimentation behaviour, redispersibility, density, and specific gravity, indicating differences in formulation design and manufacturing quality. Formulations exhibiting optimum viscosity and higher sedimentation volume showed better physical stability and resistance to caking, which are important for maintaining uniformity during storage. Samples with improved redispersibility and appropriate flow properties demonstrated superior suspension quality and ease of administration. In contrast, formulations with excessive viscosity or reduced redispersibility characteristics may negatively influence dose uniformity and patient convenience. Pharmaceutical elegance was strongly associated with organoleptic properties such as taste, odour, mouthfeel, and appearance. Samples D and E exhibited superior pharmaceutical elegance due to their pleasant mint-like odour, balanced sweetness, refreshing mouthfeel, and acceptable consistency, resulting in greater patient preference and compliance. Sample C demonstrated comparatively lower consumer acceptability because of its sour odour and variable taste perception despite acceptable physical stability.

Overall, the study confirms that patient acceptability and therapeutic suitability of herbal antacid suspensions depend not only on acid-neutralising potential but also on physical stability, rheological behaviour, pharmaceutical elegance, and sensory characteristics. Among the evaluated formulations, Samples D and E demonstrated the most balanced combination of suspension stability, pharmaceutical quality, and patient acceptability, indicating their better overall formulation performance and market suitability.

1. Funding

None to declare.

2. Conflict of interest

None to declare.

3. Ethics approval

None to declare.

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