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COMPARATIVE PHYTOCHEMICAL PROFILING AND ANTIOXIDANT POTENTIAL OF *KALANCHOE PINNATA, CURCUMA LONGA,* AND *ALOE BARBADENSIS* IN THE MANAGEMENT OF INFLAMMATION IN EXPERIMENTAL MODELS

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ABSTARCT

The present study investigated the comparative phytochemical profiles, antioxidant potential, and anti-inflammatory effects of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis*. Methanolic extraction yielded 3.11%, 6.12%, and 5.46% crude extracts, respectively. Preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, glycosides, tannins, saponins, and phenolic compounds, with variations across the plants. Quantitative analysis indicated that *Curcuma longa* had the highest total phenolic content (40.65 mg/g gallic acid equivalent), while *Curcuma longa* exhibited the highest total flavonoid content (43.7 mg/g rutin equivalent). Antioxidant activity assessed by DPPH radical scavenging demonstrated concentration-dependent effects, with *Aloe barbadensis* showing the lowest IC_{50} value (23.30 µg/ml) among the extracts. Physicochemical evaluation of formulated suspensions revealed suitable pH (6.3–6.7), viscosity (1385–1510 cps), good redispersibility, and stable sedimentation volumes, with the polyherbal formulation showing superior stability. *In vivo* studies using carrageenan-induced paw edema in rats demonstrated significant anti-inflammatory activity for all extracts, with the polyherbal suspension exhibiting maximal edema inhibition comparable to ibuprofen. The enhanced effects are likely due to synergistic interactions among bioactive phytoconstituents. These findings highlight the potential of these plants, individually and in combination, as natural antioxidants and anti-inflammatory agents, supporting their traditional use and potential therapeutic applications.

KEYWORDS: *Kalanchoe pinnata*, *Curcuma longa*, *Aloe barbadensis*, DPPH assay, Total phenolic content, Total flavonoid content, Anti-inflammatory activity, Polyherbal formulation.

1. INTRODUCTION

Inflammation is a defense response of our body to hazardous stimuli such as allergens and/or injury to the tissues; on the other hand, uncontrolled inflammatory response is the main cause of a vast continuum of disorders including allergies, cardiovascular dysfunctions, metabolic syndrome, cancer, and autoimmune diseases imposing a huge economic burden on individuals and consequently on the society **(Stewart *et al.*, 2021).** There are various medicines for controlling and suppressing inflammatory crisis; steroids, nonsteroid anti-inflammatory drugs, and immunosuppressant are the practical examples of these medications which are associated with adverse effects while in practice our goal is to apply minimum effective dose by the highest efficacy with the least adverse effects **(Kasturi *et al.*, 2019).** Thus, we need to apply natural anti-inflammatory factors within medication therapy to achieve increased pharmacological response and the lowest degree of unwanted side effects. Herbal medicines are promoting

subjects in medicine and, of course, we have to increase our knowledge about them. Complementary, alternative, and traditional medicines are the pivotal source of herbal medication guidance, but surely modern medicine must prove these guidelines through scientific methods before using them in practice **(Ekor, 2014).**

As of right now, inflammation is understood to be a collection of shifting reactions to tissue damage that is mostly brought on by things like hazardous substances, environmental contaminants, trauma, excessive use, or infection. Some of these responses can facilitate wound healing and infection control or pathology, as in many chronic disease states **(Gusev *et al.*, 2022).** Inflammation is a second-line defense against infectious agents. The responses evoked by inflammation are a keystone of pathology. The suffix -itis designates diseases in which inflammation is a major pathogenic factor. The immune system's humoral and cell-mediated reactions are crucial to inflammation. This activity summarizes how inflammation is linked to cardiovascular disease and cancer, two global causes of mortality and morbidity **(Stone W*et al.*, 2024).**

Aloe barbadensis (commonly known as *Aloe vera*) has gained significant attention for its diverse pharmacological properties. It is widely used in traditional and modern medicine for its wound-healing, anti-inflammatory, antimicrobial, and antioxidant activities **(Sánchez *et al.*, 2020).** The plant contains a variety of phytoconstituents, including flavonoids, phenolic compounds, tannins, saponins, vitamins, and polysaccharides, which contribute to its therapeutic effects. Its gel and leaf extracts are particularly valued for their ability to promote skin health and protect against oxidative damage **(Nwozo *et al.*, 2023).**

Kalanchoe pinnata has attracted considerable attention due to its wide range of pharmacological properties. Traditionally, it has been used for the treatment of wounds, infections, inflammation, kidney stones, and various skin disorders **(Dogra *et al.*, 2022).** The plant is rich in diverse phytoconstituents, including flavonoids, phenolic acids, triterpenoids, bufadienolides, and glycosides, which contribute to its antioxidant, anti-inflammatory, antimicrobial, and cytoprotective activities. Despite its extensive traditional use, systematic scientific evaluation of its phytochemical composition and antioxidant potential is essential to validate its therapeutic claims and ensure its effective utilization **(Nwozo *et al.*, 2023).**

Curcuma longa (commonly known as turmeric) has gained considerable scientific and medicinal importance due to its diverse pharmacological properties. The rhizome of *Curcuma longa* is rich in curcuminoids, particularly curcumin, along with essential oils, flavonoids, and other phenolic compounds **(Ibáñez *et al.*, 2020).** These constituents are primarily responsible for its strong antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. Traditionally, turmeric has been widely used in Ayurvedic and other traditional systems of medicine for the treatment of inflammatory conditions, wounds, infections, and metabolic disorders **(Akaberi *et al.*, 2021).**

In this context, the present study aims to perform a comparative phytochemical profiling and evaluate the antioxidant potential of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis*, along with their anti-inflammatory effects in experimental models. The study involves extraction using suitable solvents, qualitative and quantitative phytochemical analysis, in vitro antioxidant evaluation, and in vivo anti-inflammatory assessment. The findings are expected to provide scientific validation for the traditional use of these plants and highlight their potential as natural therapeutic agents for the management of inflammation and oxidative stress–related disorders.

2. MATERIALS AND METHODS

2.1 Chemicals

Glacial Acetic Acid, Nitroprusside, Sodium Hydroxide and Ammonia were procured by Merck. Clorofilt ind. provided the Chloroform, 95% Alcohol, and Conc. HCl. Himedia provided the Magnesium while Fizmerck supplied Conc. H_2SO_4.

2.2 Plant Collection and Authentication

Fresh leaves of *Kalanchoe pinnata* (300 g), *Curcuma longa* (450 g), and *Aloe barbadensis* (350 g) were collected and thoroughly washed to remove impurities. The materials were shade-dried at room temperature for three days, followed by drying in a hot air oven at 45°C until completely dehydrated. The dried plant materials were then stored in airtight glass containers under cool and dry conditions to preserve their phytochemical stability. Botanical authentication was performed by a qualified taxonomist to ensure the identity and purity of the plant samples.

2.3 Soxhlet Extraction Procedure

The bioactive constituents from *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis* were extracted using the Soxhlet continuous hot percolation method. The dried plant materials were powdered, weighed, and placed in a cellulose thimble, followed by extraction at 60°C using a suitable solvent. The process was continued until the solvent in the siphon tube became colorless, indicating complete extraction. The marc was then dried and re-extracted with methanol to ensure maximum recovery of phytoconstituents. The combined extracts were concentrated using a rotary evaporator at 40°C, and the dried extracts were weighed to calculate percentage yield **(López-Bascón, 2020).**

$$\% \text{ Yield} = \frac{\text{Weight of extract}}{\text{Weight of Plant Material used}} \times 100$$

2.4 Quantitative Phytochemical Estimation

2.4.1 Determination of Total Phenolic Content (TPC)

The total phenolic content of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis* extracts was determined using the Folin–Ciocalteu colorimetric method. Briefly, 0.2 mL of each extract was mixed with Folin–Ciocalteu reagent and sodium carbonate solution, and the volume was adjusted to 7 mL with distilled water. The mixture was incubated at room temperature for 2 hours to allow color development, after which absorbance was measured at 760 nm using a UV–visible spectrophotometer. The total phenolic content was quantified using a calibration curve of gallic acid (20–100µg/mL) and expressed as gallic acid equivalents (GAE), based on the intensity of the blue chromophore formed **(Shirazi *et al.*, 2014).**

2.4.2 Determination of Total Flavonoid Content (TFC)

The total flavonoid content of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis* extracts was determined using the aluminium chloride colorimetric method. In this procedure, 0.5mL of each extract was mixed with distilled water and sodium nitrite, followed by the addition of aluminium chloride after 6 minutes. Subsequently, sodium hydroxide was added to develop the color, and the mixture was thoroughly mixed. The absorbance was measured at 510nm using a UV–visible spectrophotometer. Flavonoid content was quantified using a rutin calibration curve (20–100 µg/mL) and expressed as milligrams of rutin equivalent (RE) per gram of dry extract **(Shraim *et al.*,2021).**

2.5 DPPH(2,2-Diphenyl-1-picryl-hydrazyl) Assay

Stock solutions of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis* extracts, along with the reference standard, were prepared at 1 mg/mL in methanol, which efficiently dissolves both the extracts and the DPPH reagent. Working solutions were then prepared by diluting the stock to concentrations of 20, 40, 60, 80, and 100 µg/mL to evaluate dose-dependent antioxidant activity. For the assay, 2 mL of 0.1 mM DPPH solution was mixed with the respective extract or standard. The mixtures were thoroughly vortexed to ensure proper interaction and incubated for 30 minutes at room temperature in the dark to prevent light-induced degradation of DPPH. After incubation, the absorbance was measured at 517 nm using a UV spectrophotometer, with a decrease in absorbance indicating the extent of free radical scavenging by the extracts **(Chrzczanowicz *et al.*, 2008).**

2.6 Preparation of Polyherbal Suspension of Extracts

1. Formulation I – *kalanchoe pinnata* Suspension

The formulation contains 1.0 g of *Kalanchoe pinnata* extract as the active ingredient. The suspending base was prepared by dispersing 2.0 g of sodium CMC in 50 mL of warm distilled water with continuous stirring, followed by hydration for one hour. Excipients including Tween 80 (0.1%), methyl paraben (0.2%), sucrose (10 g), and sorbitol (5 g) were added to enhance stability, wettability, preservation, and palatability. The extract was then incorporated with constant stirring, and the final volume was adjusted to 100 mL with distilled water to obtain a uniform and homogeneous suspension.

2. Formulation II – *curcuma longa* Suspension

The formulation contains 1.0 g of *Curcuma longa* extract as the active herbal ingredient. The suspending base was prepared using 2.0 g of sodium CMC dispersed in warm distilled water, followed by hydration and the addition of Tween 80 (0.1%), methyl paraben (0.2%), sucrose (10 g), and sorbitol (5 g) to enhance stability and palatability. The extract was then gradually incorporated with continuous stirring, and the final volume was adjusted to 100 mL with distilled water to obtain a uniform and homogeneous suspension.

- **Formulation III – *Aloe barbadensis* Suspension**

The formulation contains 1.0 g of *Aloe barbadensis* extract as the active ingredient. The suspending base was prepared by dispersing 2.0 g of sodium CMC in warm distilled water and allowing it to hydrate for one hour. Excipients including Tween 80 (0.1%), methyl paraben (0.2%), sucrose (10g), and sorbitol (5g) were added to enhance stability, wettability, and palatability. The extract was then incorporated with continuous stirring, and the final volume was adjusted to 100mL with distilled water to obtain a uniform and homogeneous suspension.

3. Formulation IV – Polyherbal Suspension (*kalanchoe pinnata* + *curcuma longa* + *Aloe barbadensis*)

The polyherbal formulation contains 1.0 g each of *Kalanchoe pinnata*, *Curcuma longa*, and **Aloe barbadensis** extracts as active ingredients. The suspending base was prepared by dispersing 2.0 g of sodium CMC in warm distilled water and allowing it to hydrate for one hour. Excipients including Tween 80 (0.1%), methyl paraben (0.2%), sucrose (10 g), and sorbitol (5 g) were added to enhance stability, wettability, and palatability. The combined extracts were then incorporated with continuous stirring, and the final volume was adjusted to 100 mL with distilled water to obtain a uniform and stable polyherbal suspension **(Mahajan, 2021).**

Table 1: Composition of Formulation.

Name of Ingredient	Formulation I	Formulation II	Formulation III	Formulation IV
kalanchoe pinnata	1.0g	---	---	1.0 g
curcuma longa	---	1.0g	---	1.0 g
Aloe barbadensis	---	---	1.0g	1.0 g
Tween 80	0.1%	0.1%	0.1%	0.1%
Sodium CMC	2.0 g	2.0 g	2.0 g	2.0 g
Sucrose	10 g	10 g	10 g	10 g
Sorbitol	5.0 g	5.0 g	5.0 g	5.0 g
Methyl parabeen	0.2%	0.2%	0.2%	0.2%

2.7 Quality control parameters of Herbal Suspensions
the methanolic extracts of *Kalanchoe pinnata, Curcuma longa*, and *Aloe barbadensis* were subjected to acute cutaneous toxicity studies to evaluate their safety for dermal use.

2.7.1 PH
The pH of the formulations was measured using a calibrated digital pH meter to ensure accuracy **(Vázquez-Blanco *et al.*, 2018).**

2.7.2 Redispersibility
The herbal suspension was placed between two clean glass slides and subjected to a specified load to form a uniform thin layer. Redispersibility was assessed by measuring the time (in seconds) required for the upper slide to slip off the suspension under the applied weight. A shorter slipping time indicated better redispersibility, reflecting the ease with which the formulation could be uniformly re-dispersed after settling **(Wang *et al.*, 2018).**

2.7.3 Viscosity
The viscosity of the prepared herbal suspension was measured using a Brookfield viscometer to assess its flow properties **(Rukadikar *et al.*, 2024).**

2.7.4 Sedimentation volume
The sedimentation volume was measured to evaluate the physical stability of the suspension. It is the ratio of settled particle volume to total suspension volume, with higher values indicating better stability and reduced risk of caking. Settling was monitored over time to assess long-term stability.

2.8 *In vivo* anti-inflammatory activity (Ezzat *et al.*, 2018).

2.8.1 Animals
Healthy rats were randomly selected from Pinnacle Biomedical Research Institute (PBRI), Bhopal and housed in propylene cages with sterile bedding under 22 ± 2°C, 30.7% humidity, and a 12:12 h light-dark cycle. They were fed standard pellets with water ad libitum and acclimatized for 7 days before experiments. Each experimental group included six rats (n = 6). All procedures were approved by the Institutional Animal Ethics Committee (IAEC) of PBRI, Bhopal.

Animals used
- Strain - *Albino Wistar* rats
- Age - 5-6 weeks
- Sex - either sex
- Body weight - 200±20 g

2.8.2 Experimental setup
Thirty minutes after oral administration of the test extracts or standard drug, 0.1 mL of 1% carrageenan in distilled water was injected into the subplantar region of the right hind paw of all experimental groups. To ensure consistent measurement, a mark was placed at the malleolus of each paw for uniform dipping during subsequent readings. The paw volume was measured using a vernier caliper at 1, 2, and 3 hours post-injection. The actual edema volume at each time point was calculated as the difference between the 1-hour reading and the readings at 2 and 3 hours, providing a quantitative measure of inflammation and the anti-inflammatory effect of the administered extracts or standard drug.

➢ **Experimental design**

Group No.	Treatment
Group I	served as control and treated with carrageenan
Group II	Standard Drug, , Ibuprofen 50 mg/kg
Group III	*Kalanchoe pinnata* suspension ((300 mg/kg p.o))
Group IV	*Curcuma longa* suspension (300 mg/kg p.o)
Group V	*Aloe barbadensis* suspension (300 mg/kg p.o)
Group VI	Polyherbal suspension (*Kalanchoe pinnata*, *Curcuma longa* and *Aloe barbadensis*) (3%)

2.8.3 Carrageenan-Induced paw Edema in Rats
In this study, rats were divided into six groups to evaluate the anti-inflammatory activity of *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis*, individually and in combination. The control group received carrageenan only, while the standard group was treated with Ibuprofen (50 mg/kg, p.o.). Test groups received respective plant suspensions (300 mg/kg), and

the polyherbal group received a combined formulation (3%). Paw edema was measured at 1, 2, and 3 hours using a vernier caliper, and anti-inflammatory activity was assessed by calculating the percentage inhibition of edema compared to the control group **(Mansouri *et al.*, 2015).**

3. RESULT AND DISCUSSION

3.1 Percentage Yield

Table 2: Percentage Yield of crude extracts.

Plant name	Solvent	Theoretical weight	Yield(gm)	% yield
Kalanchoe pinnata	Methanol	300	9.35	3.11
Curcuma longa	Methanol	450	27.58	6.12
Aloe barbadensis	Methanol	350	19.12	5.46

3.2 Preliminary Phytochemical study

Table 3: Phytochemical analysis of extracts of *Kalanchoe pinnata, Curcuma longa* and *Aloe barbadensis.*

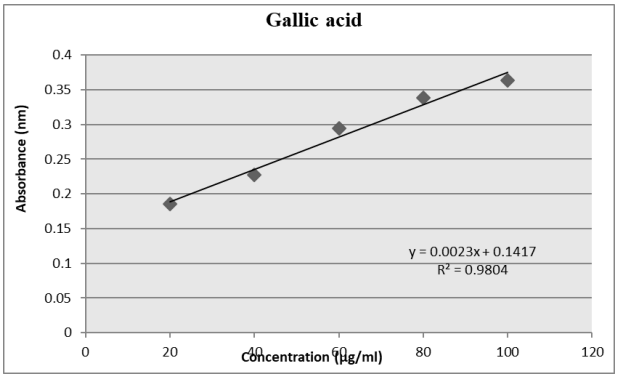
Experiment	Presence or absence of phytochemical test		
	methanolic extract (*Kalanchoe pinnata)*	methanolic extract (*Curcuma longa)*	methanolic extract (*Aloe barbadensis)*
Carbohydrates			
Molish's test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Fehling's test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Benedict's test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Barfoed's test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Glycoside			
Borntrager test	**Present (+ ve)**	**Absent (- ve)**	**Absent (- ve)**
Legal's test	**Present (+ ve)**	**Absent (- ve)**	**Absent (- ve)**
Killer-Killiani test	**Present (+ ve)**	**Absent (- ve)**	**Absent (- ve)**
Alkaloids			
Dragendroff's test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Mayer's reagent test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Wagner's reagent test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Hager's reagent test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Proteins and Amino Acids			
Biuret test	**Present (+ ve)**	**Absent (- ve)**	**Absent (- ve)**
Ninhydrin test	**Present (+ ve)**	**Absent (- ve)**	**Absent (- ve)**
Test for Triterpenoids and Steroids			
Salkowski's test	**Absent (- ve)**	**Present (+ ve)**	**Present (+ ve)**
Libbermann-Burchard's test	**Absent (- ve)**	**Present (+ ve)**	**Present (+ ve)**
Tannin and Phenolic Compounds			
Ferric Chloride test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Saponin			
Foam test	**Absent (- ve)**	**Present (+ ve)**	**Present (+ ve)**
Flavonoids			
Alkaline reagent test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**
Lead Acetate test	**Present (+ ve)**	**Present (+ ve)**	**Present (+ ve)**

3.3 Quantitative Analysis

3.3.1 Total Phenolic content (TPC) estimation

Table 4: Standard table for Gallic acid.

Concentration (µg/ml)	Absorbance (nm)
20	0.186
40	0.227
60	0.294
80	0.338
100	0.364



Graph 1: Represent standard curve of Gallic acid.

3.3.1.1 Total Phenolic Content in extract

Table 5: Total Phenolic Content in *Kalanchoe pinnata* extract.

Absorbance	TPC in mg/gm equivalent of Gallic Acid
0.199	34.15 mg/gm
0.211	
0.221	

Table 6: Total Phenolic Content in *Curcuma longa* extract.

Absorbance	TPC in mg/gm equivalent of Gallic Acid
0.213	40.65 mg/gm
0.222	
0.234	

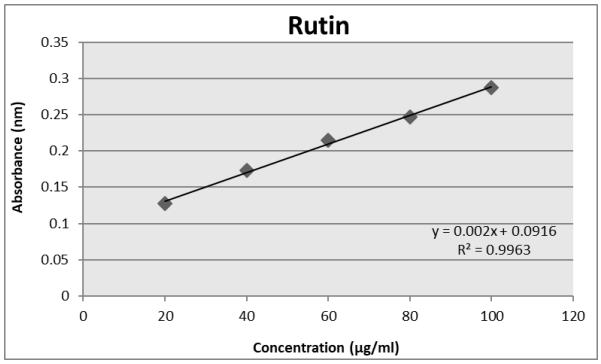
Table 7: Total Phenolic Content in *Aloe barbadensis* extract.

Absorbance	TPC in mg/gm equivalent of Gallic Acid
0.210	39.15 mg/gm
0.220	
0.232	

3.3.2 Total Flavonoids content (TFC) estimation

Table 8: Standard table for Rutin.

Concentration (µg/ml)	Absorbance (nm)
20	0.127
40	0.173
60	0.215
80	0.247
100	0.287



Graph 2: Represent Standard Curve of Rutin.

3.3.2.1 Total Flavonoid Content in extract

Table 9: Total Flavonoid Content in *Kalanchoe pinnata* extract.

Absorbance	TFC in mg/gm equivalent of Rutin
0. 134	28.2 mg/gm
0.143	
0.154	

Table 10: Total Flavonoid Content in *Curcuma longa* extract.

Absorbance	TFC in mg/gm equivalent of Rutin
0. 166	43.7 mg/gm
0.175	
0.184	

Table 11: Total Flavonoid Content in *Aloe barbadensis* extract.

Absorbance	TFC in mg/gm equivalent of Rutin
0.145	31.2 mg/gm
0.155	
0.164	

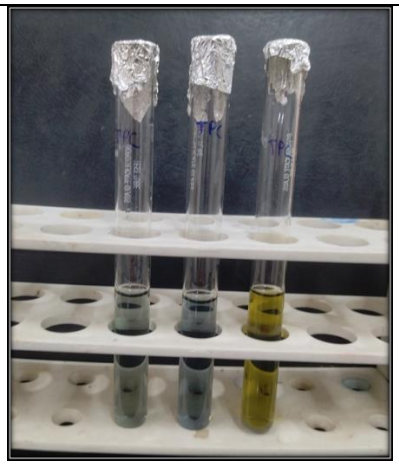


Figure 1: Total Phenolic Content of extract *Kalanchoe pinnata*, *Curcuma longa* and *Aloe barbadensis.*

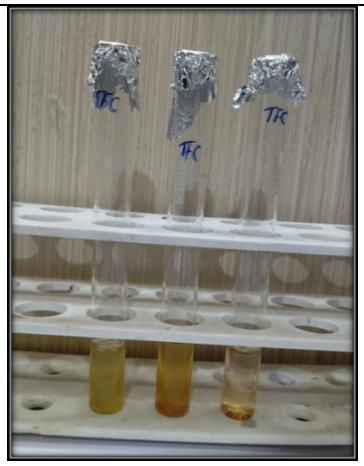
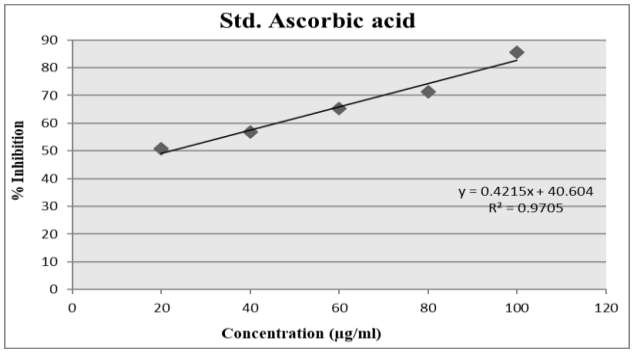


Figure 2: Total Flavonoid Content of extract *Kalanchoe pinnata*, *Curcuma longa* and *Aloe barbadensis.*

3.3.3 DPPH 1, 1- diphenyl-2-picryl hydrazyl Assay

Table 12: DPPH radical scavenging activity of Std. Ascorbic acid.

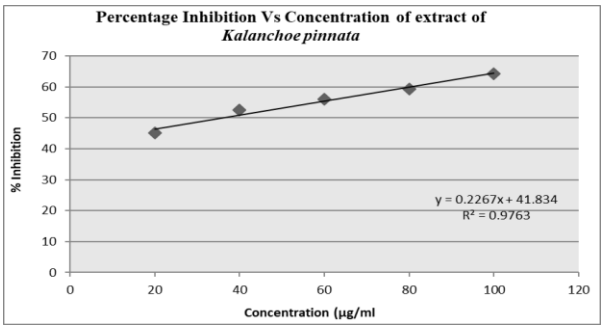
Concentration (µg/ml)	Absorbance	% Inhibition
20	0.489	50.705
40	0.430	56.740
60	0.346	65.191
80	0.286	71.227
100	0.143	85.613
Control	**0.992**	
IC50	**22.31**	



Graph 3: DPPH radical scavenging activity of Std. Ascorbic acid.

Table 13: DPPH radical scavenging activity of methanol extract of *Kalanchoe pinnata.*

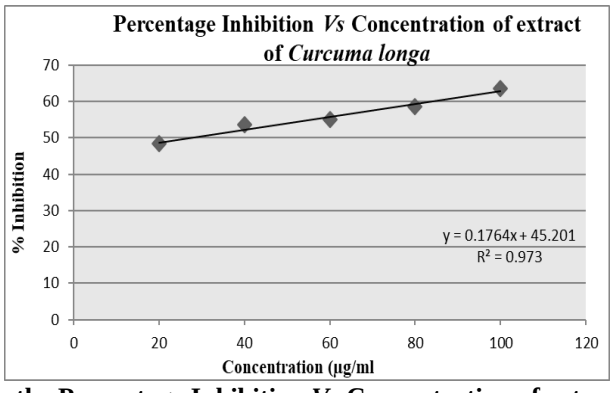
Concentration (µg/ml)	Absorbance	% Inhibition
20	0.545	45.060
40	0.470	52.515
60	0.439	55.947
80	0.402	59.356
100	0.354	64.314
Control	**0.992**	
IC50	**36.13**	



Graph 4: Represents the Percentage Inhibition *Vs* Concentration of extract of *Kalanchoe pinnata.*

Table 14: DPPH radical scavenging activity of methanol extract of *Curcuma longa.*

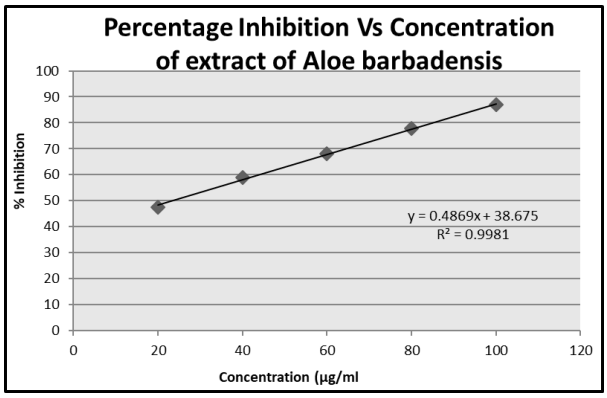
Concentration (µg/ml)	Absorbance	% Inhibition
20	0.520	47.580
40	0.406	59.072
60	0.310	68.075
80	0.220	77.822
100	0.130	86.895
Control		**0.992**
IC50		**27.26**



Graph 5: Represents the Percentage Inhibition *Vs* Concentration of extract of *Curcuma longa.*

Table 15: DPPH radical scavenging activity of methanol extract of *Aloe barbadensis.*

Concentration (µg/ml)	Absorbance	% Inhibition
20	0.508	48.944
40	0.456	54.170
60	0.443	55.477
80	0.404	59.396
100	0.355	64.257
Control	0.995	
IC50	23.30	



Graph 6: Represents the Percentage Inhibition *Vs* Concentration of extract of *Aloe barbadensis.*

3.4 physicochemical parameters of formulated suspensions

3.4.1 Measurement of pH, Viscosity, Redispersibility and Sedimentation volume.

Table 16: pH, Viscosity, Redispersibility and Sedimentation volume test.

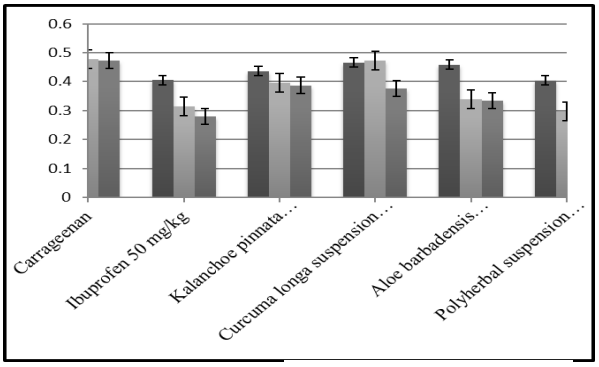
Formulation	pH	Viscosity determination (cps)	Redispersibility	Sedimentation volume
Formulation1	6. 5	1420	Good	0.88
Formulation 2	6.3	1510	Good	0.85
Formulation 3	6.6	1385	Good	0.91
Polyherbal formulation	6.7	1480	Good	0.93

3.5 *In vivo* anti-inflammatory activity

3.5.1 Carrageenan-Induced Edema in Rats

Table 17: Effect of extract *Kalanchoe pinnata, Curcuma longa*, and *Aloe barbadensis* against carrageenan induced paw edema in rats (n=6)

Treatment	1 h	2 h	3 h
Carrageenan	0.508±0.013	0.478±0.016	0.472±0.024
Ibuprofen 50 mg/kg	0.404±0.025	0.298±0.011	0.279±0.017
Kalanchoe pinnata suspension ((300 mg/kg p.o))	0.436±0.23	0.396±0.29	0.387±0.16
Curcuma longa suspension (300 mg/kg p.o)	0.466±0.10	0.472±0.053	0.376±0.026
Aloe barbadensis suspension (300 mg/kg p.o)	0.458±0.014	0.339±0.033	0.334±0.016
Polyherbal suspension (*Kalanchoe pinnata*, *Curcuma longa* and *Aloe barbadensis*) (3%)	0.405±0.014	0.314±0.22	0.286±0.020



Graph 7: **Carrageenan -induced rat paw edema.**

3.6 Images

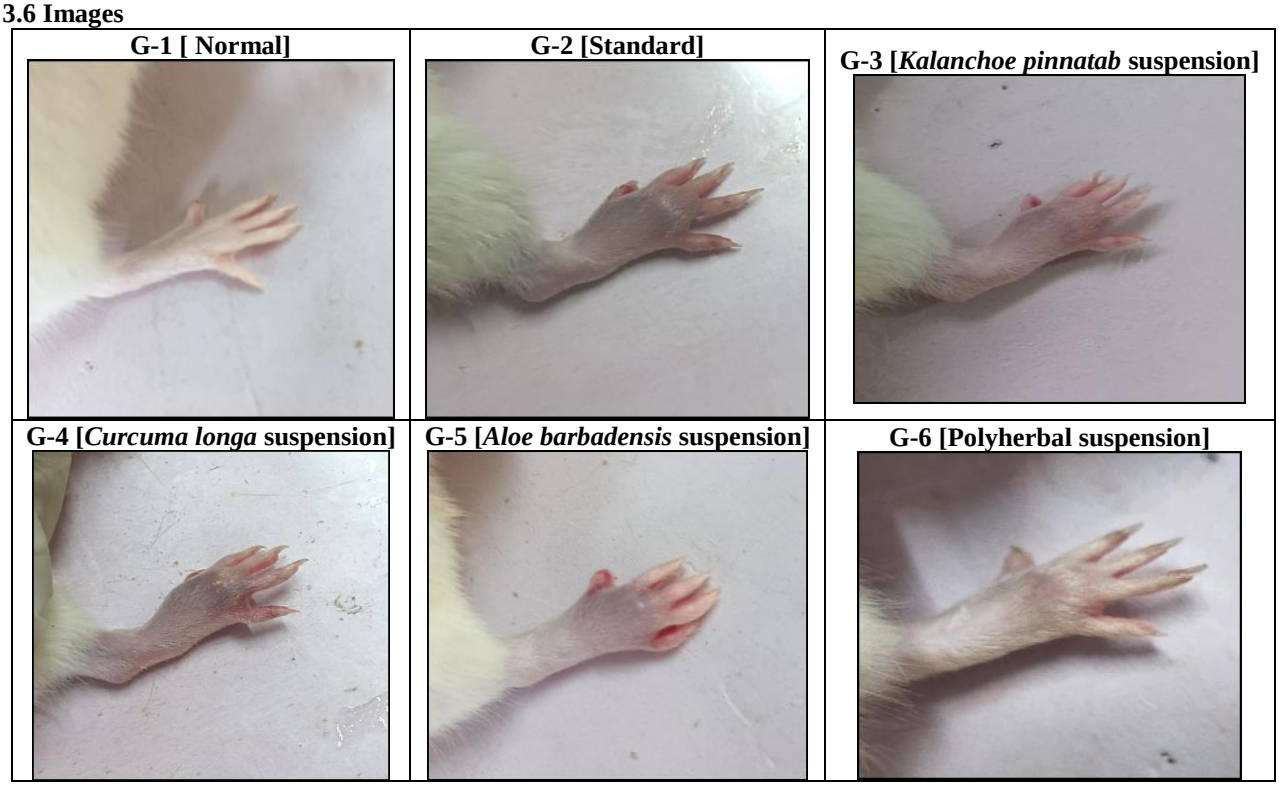


Figure 3: Anti-inflammatory activity of both plant extract in rat.

DISCUSSION

The study highlights that Methanolic extracts of *Curcuma longa*, *Aloe barbadensis*, and *Kalanchoe pinnata* possess significant phytochemical and biological potential. *Curcuma longa* showed the highest extraction yield, phenolic, and flavonoid content, indicating strong antioxidant capacity, while *Aloe barbadensis* exhibited superior radical scavenging activity in the DPPH assay. All extracts demonstrated concentration-dependent antioxidant effects, comparable to Ascorbic acid. The formulated suspensions displayed acceptable physicochemical properties, good stability, and redispersibility, with the polyherbal formulation showing the highest sedimentation volume. In vivo studies revealed that all extracts significantly reduced carrageenan-induced paw edema, with the polyherbal formulation exhibiting maximum anti-inflammatory activity, comparable to Ibuprofen. This enhanced effect is likely due to the synergistic interaction of bioactive constituents, supporting the potential of the polyherbal suspension as an effective natural anti-inflammatory therapy.

4. CONCLUSION

The study demonstrates that *Kalanchoe pinnata*, *Curcuma longa*, and *Aloe barbadensis* are rich in bioactive phytochemicals with notable antioxidant and anti-inflammatory properties. Among them, *Curcuma longa* showed higher phenolic and flavonoid content, contributing to strong anti-inflammatory potential, while *Aloe barbadensis* exhibited superior radical scavenging activity. The polyherbal formulation displayed synergistic effects, enhancing overall anti-inflammatory efficacy and stability. These findings support their traditional use and highlight the potential of the combined formulation as a natural alternative to synthetic anti-inflammatory agents, though further studies are needed to confirm safety and clinical effectiveness.

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