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Research Article

Formulation and Evaluation of Cream Containing Extracts of *Cassia fistula* and *Lavandula bipinnata*: In Vitro and Docking Study of Phytochemicals

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ABSTRACT

This research centers on formulating and assessing a herbal-based cream using methanolic extracts of Cassia fistula and Lavandula bipinnata, well-known for their antimicrobial, antioxidant, and anti-inflammatory properties. The extracts were obtained via Soxhlet extraction and incorporated into an oil-in-water (O/W) cream base. The formulation was evaluated for physicochemical properties such as pH, viscosity, Spreadability, and stability under accelerated conditions. Antimicrobial activity was tested against common skin pathogens, and molecular docking studies were performed to predict the interaction of phytoconstituents with microbial protein targets. The results showed the cream to be stable, safe and effective in combating microbial infections. Hence, the formulated herbal cream presents a promising natural alternative for dermatological applications.

INTRODUCTION

The global rise in demand for herbal cosmetics is attributed to their natural origin, safety profile, and multipurpose efficacy. Herbal creams have emerged as viable alternatives to synthetic products that often pose risks such as skin irritation and environmental toxicity. *Cassia fistula* and *Lavandula bipinnata* are traditionally used in Ayurveda and folk medicine due to their wide range of pharmacological properties, such as antimicrobial, antioxidant, anti- inflammatory, and wound-healing activities.

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Fig no: 1.1 *Cassia fistula*



Fig no: 1.2 *Lavandula bipinnata*

OBJECTIVES

- To authenticate and extract the phytochemicals from *Cassia fistula* and *Lavandula bipinnata*.
- To develop an herbal cream formulation.
- To evaluate its physicochemical properties and antimicrobial activity.
- To study molecular docking of major phytoconstituents.

MATERIALS AND METHODS

Materials

Plant parts of *Cassia fistula* (fruit pulp) and *Lavandula bipinnata* (leaves and flowers) were sourced locally and authenticated. Other ingredients included beeswax, stearic acid, borax, benzyl alcohol, rose water, and acetylglyceride.

Extraction

Methanolic extraction was done using a Soxhlet apparatus. Extracts were filtered, concentrated via rotary evaporation, and stored in airtight containers.

Cream Formulation

Oil-in-water emulsions were prepared using the fusion method. The active extracts were incorporated into the cream base.

Evaluation Parameters

- pH Measurement (Digital pH meter)
- Viscosity (Brookfield viscometer)
- Spreadability (Slip and drag method)
- Stability (Accelerated conditions for 3 months)
- Antimicrobial Activity (Disc diffusion method against C. albicans)
- Molecular Docking (Mole soft software, targets included microbial proteins)

RESULTS AND DISCUSSION

Table no 2.1: Extraction results

Sr. No.	Parameter	*Cassia fistula*	*Lavandula bipinnata*
1	Plant part used	Leaves & pulp	Leaves & flower
2	Solvent used	Methanol: Water (70:30)	Methanol: Water (70:30)
3	Extraction Method	Soxhlet Extraction	Soxhlet Extraction
4	Duration of extraction	6-8 hours	7-8 hours
5	Color of extract	Dark brown	Light green
6	Temperature	60-70º c	60-70ºc
7	Odor	Mild	Strong aromatic
8	Consistency	Thick-sticky semisolid	Oily to semisolid
9	%Yield	10.4%	6.5%
10	Strong conditions	Stored in air tight container at 4ºc	Stored

Extraction of Lavandula oil

- **Yield Calculation**

Yield (%) = (Volume of oil (mL) / Weight of flowers (g)) × 100

Weight of flowers = 500g
Volume of oil extracted = 1.25 mL
Yield = (1.25 / 500) × 100 = 0.25%

Table no 2.2: Oil Extraction

Sample Weight (g)	Oil volume	Yield (%)
500	1.25	0.25%
600	1.8	0.30%
1000	3.5	0.35%

Physical Properties of Extracted Oil

- **Color:** Pale yellow
- **Odor**: Sweet, floral-lavender-like

Table no 2.3: Phytochemical tests of extracts

Sr. No.	Phytochemical Tests	Reagents	Observation	*Cassia fistula*	*Lavandula bipinnata*
1	Alkaloids	Dragendorff's Wagner's Mayers reagent	Orange/ red/ brown ppt	+	+
2	Flavonoids	Alkaline reagent test	Yellow color turns colorless with acid	+	+
3	Tannins	Ferric chloride test	Blue – black color	+	+
4	Saponins	Foam test	Foam	+	-
5	Glycosides	Keller test	Red-brown ring	+	+
6	Phenolic compounds	Ferric chloride test	Bluish – black color	+	+
7	Terpenoids	Salkowski Test	Reddish - brown coloration	+	+
8	Steroids	Liebermann - buchard test	Bluish green ring	+	+
9	Coumarins	UV fluorescence test	Blue/violet fluorescence under UV	-	+
10	Anthraquinones	Borntrager test	Pink/red layer	+	_
11	Essential oils	Sudan III	Orange – Red	_	+

Table no 2.4: Formulation Table of F1 to F5 of herbal cream

Component	Function	1 (F1)	2 (F2)	3 (F3)	4 (F4)	5 (F5)
Lavandula bipinnata Oil	Acts as a hydrating and softening agent	1.0 ml	2.0 ml	3.0 ml	4.0 ml	5.0 ml
Cassia fistula Extract	Provides antibacterial & nourishing effects	2.0 gm	2.5 gm	3.0 gm	3.5 gm	4.0 gm
Isopropyl Myristate	Works as an emulsifying agent	0.5 gm	1.0 gm	1.5 gm	2.0 gm	2.5 gm
Beeswax	Serves as the base substance	2.0 gm	2.5 gm	3.0 gm	3.5 gm	4.0 gm
Stearic Acid	Function as an emulsifier	0.5 ml	1.0 ml	1.5 ml	2.0 ml	2.5 ml
Benzyl Alcohol	Acts as a preservative	2.0 ml	2.2 ml	2.4 ml	2.6 ml	2.8 ml
Borax	Aids in emulsification	1.0 gm	1.5 gm	2.0 gm	2.5 gm	3.0 gm
Acetylglyceride	Stabilizes the emulsion	2.0 ml	2.5 ml	3.0 ml	3.5 ml	4.0 ml
Rose Water	Provides scent	Qs	Qs	Qs	Qs	Qs
Purified Water	Used as a carrier/ liquid base	Qs	Qs	Qs	Qs	Qs

UV visible spectroscopy

UV visible spectroscopy of *Cassia fistula* extract

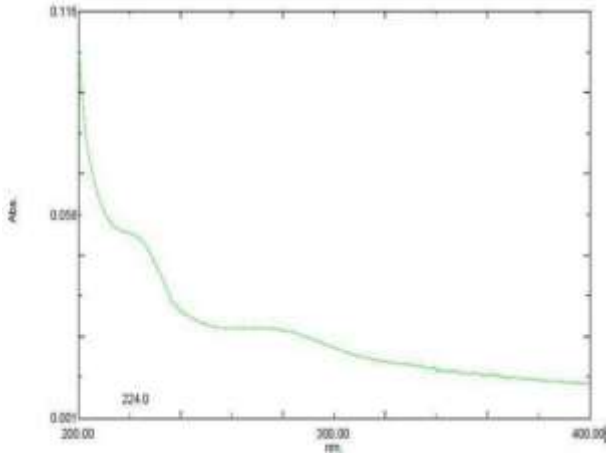


Fig no 2.1: Shows spectra of *Cassia fistula* Linn extract in methanol

Table no 2.5: Absorbance

Sr.No.	Wavelength	Absorbance
1.	224.00	0.051

After scanning, absorption maximum of *Cassia fistula* extract in distilled water was found to be at 224 nm

Calibration Curve of *Cassia fistula* linn Extract in methanol: Solution of *Cassia fistula* Extract in distilled water 2µg/ml was prepared and by suitable dilutions, solutions of concentrations ranging from 2 to 10µg/ml were prepared. A graph of absorbance versus concentration was plotted. It is observed that Beer's and Lambert's law is obeyed.

Table no 2.6: Absorption

Concentration	Absorbance
0	0
2	0.185
4	0.252
6	0.396
8	0.564
10	0.768

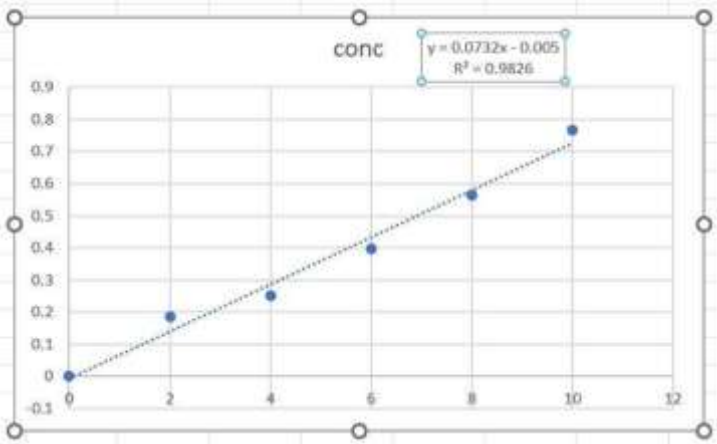


Fig no 2.2: Calibration curve of *Cassia fistula* linn extract in methanol

IR spectra of *Cassia fistula* linn extract

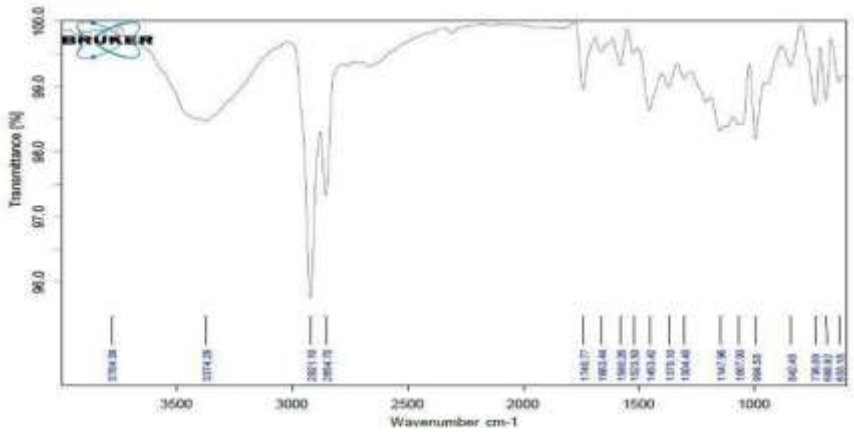


Fig no 2.3: Shows IR spectra of *Cassia fistula* linn extract

Table no 2.7: Interpretation of IR spectra of *Cassia fistula* linn extract

Peak	Value	Functional group
1	994.58	C-O stretching
2	1147.96	C-O stretching
3	1304.40	C=C stretching
4	1453.42	C-O-H bending
5	1580.26	C=O stretching
6	2854.70	C-H stretching
7	3374.29	N-H stretching

Characterization of optimized batch (F3)

FTIR Analysis of Optimized Batch (F3)

IR spectra of *Cassia fistula* linn extract:

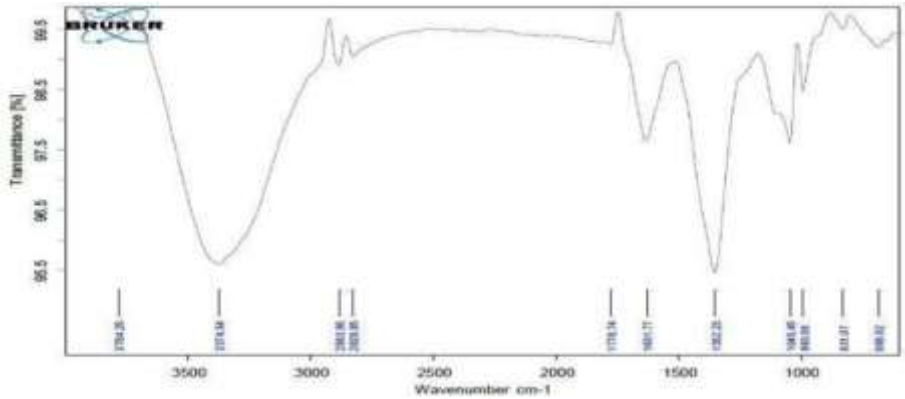


Fig no 2.4: Shows IR spectra of *Cassia fistula* linn extract

Table no 2.8: Interpretation IR spectra of optimized batch (F3) herbal cream

Peak	Value	Functional group
1	993.08	C-O stretching
2	1045.45	C-O stretching
3	1352.23	C=C stretching
4	1631.77	C=O stretching
5	1776.74	C=O stretching
6	2883.95	N-H stretching
7	3374.54	N-H stretching

Table no 2.9: Evaluation tests for cream

Sr. No	Parameter	Method used	Observed results	Acceptance criteria
1	Appearance/ color/ odor	Visual-sensory examination	Smooth, brown cream with pleasant odor	Smooth, uniform, acceptable, natural odor

2	pH	pH meter	5.8	4.5 – 6.5
3	Viscosity	Brookfield viscometer	3368 cps	1000-50,000 cps
4	Spreadability	Slip and drag method	9.1 g.cm/sec	9.0 to 31.02
5	Extrudability	Tube extrusive method	92% cream extruded	>90%easy extrusion
6	Washability	Rinsing with water	Easily washable with water	Easily washable
7	Emulsion type	Test of dye	Oil-in-Water	Usually Oil-in- Water for creams
8	Homogeneity	Glass slide method	Homogenous, no lumps or grittiness	Uniform distribution
9	Stability (1month)	ICH conditions	No change in pH, viscosity or phase separation	Stable, no separation or degradation
10	Phytochemical screening	Qualitative chemical tests	Alkaloids Glycosides Flavonoids Tannins Saponins Terpenoids Phenolic compounds	Presence of active constituents

Table no 2.10: Physiochemical properties

Property	Formulation 1 (F1)	Formulation 2 (F2)	Formulation 3 (F3)	Formulation 4 (F4)	Formulation 5 (F5)
Color	Brown hue	Brown hue	Brown hue	Brown hue	Brown hue
Fragrance	Characteristic scent	Characteristic scent	Characteristic scent	Characteristic scent	Characteristic scent
Texture	Semisolid consistency	Semisolid consistency	Semisolid consistency	Semisolid consistency	Semisolid consistency

Table no 2.11: Phase separation, Irritancy, Washability, after feel, Homogeneity results

Evaluation Parameter	Formulation 1 (F1)	Formulation 2 (F2)	Formulation 3 (F3)	Formulation 4 (F4)	Formulation 5 (F5)
Phase Separation	No evidence observed	No evidence observed	No evidence observed	No evidence observed	No evidence observed
Skin Irritation	Absent	Absent	Absent	Absent	Absent
Ease of Washing	Washable	Washable	Washable	Washable	Washable
Post-application Feel	Softening effect	Softening effect	Softening effect	Softening effect	Softening effect
Uniformity	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous

Table no 2.12: Viscosity

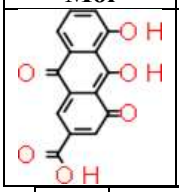
Formulation	10rmp	20rpm
F1	1201centipoise	1247centipoise
F2	1254centipoise	3322centipoises
F3	1277centipoise	3368centipoises
F4	1385centipoise	2013centipoise
F5	1395centipose	2278centipose

Table no 2.13: Spreadability

Formulation code	Spreadability (g,cm/sec)
F1	7.5
F2	6.2
F3	9.1
F4	8.5
F5	8.6

Docking

Table no 2.14: Docking of *Cassia fistula* linn

Mol	L	LX	Name	Score	Natom	Nflex	Hbond	Hphob	Vwint
	#	1	Fragment	-32.84	29	2	-6.406	-3.558	-26.6

Eintl	Dsolv	SolEl	mfScore	RTCNNscore	dTSsc	RecConf	Molecule Name
0	7.7132	8.1206	-68.7163	-27.58221	1.1989	1	1Fragment

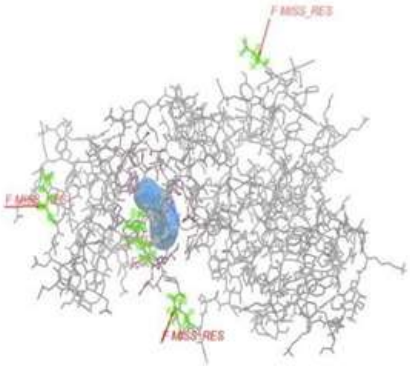
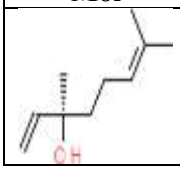


Figure no: 2.5

Table no 2.15: Docking of *Lavandula bipinnata*

Mol	L	LX	Name	Score	Natom	Nflex	Hbond	Hphob	Vwint
	0	1	Fragment	-15.23	29	7	-2.363	-4.868	-20.29

Eintl	Dsolv	SolEl	mfScore	RTCNNscore	dTSsc	RecConf	Molecule Name
1.5849	4.9315	8.2506	-19.2696	-17.21656	0.8737	1	1Fragment

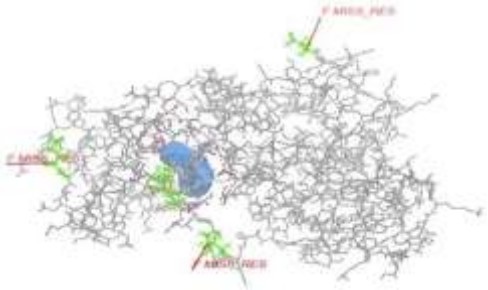


Fig no: 2.6

Table no 2.16: pH

Sample ID	Measurement (Original)	Description
F1	5.6	Sample F1 recorded a value of 5.6
F2	5.7	Sample F2 recorded a value of 5.7
F3	5.8	Sample F3 recorded a value of 5.8

F4	5.4	Sample F4 recorded a value of 5.4
F5	5.5	Sample F5 recorded a value of 5.5

Table no 2.17: Accelerated stability testing

No of Days	Temp (0C)	Formulation code	pH	Homogenisity	Appearance	Spreadability	After feel
0	RT ACC45°C	F3 F3	6.86 5.1	G G	NC NC	G G	E E
5	RT ACC45°C	F3 F3	6.87 5.9	G G	NC NC	G G	E E
10	RT ACC45°C	F3 F3	6.90 5.8	G G	NC NC	G G	E E
15	RT ACC45oC	F3 F3	6.94 5.80	G G	NC NC	G G	E E
20	RT ACC45oC	F3 F3	6.96 5.90	G G	NC NC	G G	E E

Accelerated stability testing

Acc- Accelerated condition, RT- Room Temperature, G- Good, NC-No change, E-Emollient. This study selected best formulation of herbal cream. This result show best physical stability of formulation. The formulation that was taken for further pharmacological evaluation F3.

Table no 2.18: Comparative study of herbal cream & Fluconazole (1%) cream

Parameter	Herbal Cream	Fluconazole Cream (1%)	Control/Base Cream	Statistical Significance
Zone of Inhibition (mm)	18.5 ± 0.6	22.8 ± 0.4	0.0 ± 0.0	Significant
Minimum Inhibitory Concentration (MIC, µg/mL)	125.0 ± 0.0	62.5 ± 0.0	—	—
Minimum Fungicidal Concentration (MFC, µg/mL)	250.0 ± 0.0	125.0 ± 0.0	—	—
Healing Time (Days)	6.5 ± 1.0	5.2 ± 0.8	>10.0	Significant
Skin Irritation Score	0.5 ± 0.1	0.3 ± 0.1	0.0 ± 0.0	Not Significant
Viscosity (cPs)	3368 ± 200	10,500 ± 180	10,000 ± 250	Not Significant
Spreadability (g·cm/sec)	9.1 ± 0.3	7.2 ± 0.2	6.5 ± 0.4	Not Significant
pH of Formulation	5.8 ± 0.2	6.0 ± 0.1	6.2 ± 0.1	Not Significant
Stability (3 Month @ 40°C/ 75%RH)	No change	No change	—	Stable

Table no 2.19: Antimicrobial Test

Control	Standard(1mg/ml)	Test
-	Fluconazole	5mg, 10 mg

Table no 2.20 Zone of inhibition

Parameter	Herbal Cream	Fluconazole	Cream control
Zone of inhibition (mm)	18.5 ± 0.6	22.8 ± 0.4	0
MIC (µg/mL)	125	62.5	-
MFC (µg/mL)	250	125	-
Healing time (Days)	6.5 ± 1.0	62.5 ± 0.0	>10



Fig no 2.7: Antimicrobial Test



Fig no 2.8: Antimicrobial Test

CONCLUSION

The formulated herbal cream containing *Cassia fistula* and *Lavandula bipinnata* extracts demonstrates strong antimicrobial activity, good physicochemical properties, and excellent stability. Molecular docking further supports the pharmacological claims. The herbal extracts were efficiently obtained and underwent preliminary phytochemical analysis, which revealed owing to the presence of essential secondary metabolites such as flavonoids, tannins, alkaloids, and others. phenolic compounds. The results indicated that the cream possessed good consistency, pH within skin-compatible range, excellent Spreadability, homogeneity, and washability. It remained stable over three months under accelerated conditions, showing no signs of phase separation or significant changes in viscosity or pH. Microbial evaluation demonstrated that the formulation was free from harmful pathogens and within acceptable microbial load limits, confirming its microbiological safety. In vitro antimicrobial studies showed significant zones of inhibition against common skin pathogens including Candida albicans supporting the antimicrobial potential of the cream. The formulation stands as a promising natural skincare alternative with therapeutic and cosmetic benefits.

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