

FORMULATION AND EVALUATION OF MULTIPURPOSE HERBAL GEL

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ABSTRACT

Herbal formulations have gained significant importance due to their safety, efficacy, and minimal side effects compared to synthetic products. The present study focuses on the formulation and evaluation of a multipurpose herbal gel intended for topical application on skin and scalp. The gel was developed using extracts of *Musa acuminata* (banana leaves) and *Murraya koenigii* (curry leaves), which are known for their rich content of bioactive compounds such as polyphenols, flavonoids, tannins, and alkaloids. These constituents contribute to antimicrobial, antioxidant, and anti-inflammatory activities.

The prepared formulations were evaluated for various physicochemical parameters including colour, odour, clarity, pH, viscosity, spreadability, washability, gel strength, and homogeneity. Biological activities were assessed through in vitro antimicrobial studies, antioxidant activity using DPPH and FRAP assays, and anti-inflammatory evaluation.

The results suggest that the developed herbal gel possesses significant potential in protecting the skin and scalp from microbial infections, reducing inflammation, and managing oxidative stress. Additionally, it may help in soothing irritation, reducing signs of premature ageing, and maintaining overall skin and hair health.

Keywords: Herbal gel, *Musa acuminata*, *Murraya koenigii*, Carbopol 940, antimicrobial activity, antioxidant activity, physicochemical evaluation.

INTRODUCTION

The increasing demand for herbal-based formulations in pharmaceutical and cosmetic applications has led to a renewed interest in plant-derived bioactive compounds. Herbal products are widely preferred due to their safety, biocompatibility, and reduced incidence of adverse effects compared to synthetic counterparts. Medicinal plants contain a variety of secondary metabolites such as flavonoids, phenolic compounds, tannins, and alkaloids, which are known to exhibit antimicrobial, antioxidant, and anti-inflammatory activities. These properties make them highly suitable for the development of topical formulations intended for skin and scalp care.

Musa acuminata (banana leaves) has been reported to contain significant amounts of polyphenols, flavonoids, and tannins, which contribute to its antimicrobial and antioxidant properties. These phytoconstituents help in protecting the skin from microbial infections and oxidative stress. *Murraya koenigii* (curry leaves), on the other hand, is rich in carbazole alkaloids such as mahanimbine and murrayacine, along with phenolic compounds, which exhibit potent antioxidant and anti-inflammatory activities. The incorporation of these extracts into a gel base may result in a synergistic effect, enhancing the overall therapeutic potential of the formulation. In addition to the gelling agent Carbopol 940, excipients such as glycerin and triethanolamine play a significant role in the formulation. Glycerin acts as a humectant, helping to retain moisture and improve skin hydration, while triethanolamine is used as a neutralizing agent to adjust the pH and facilitate gel formation by Carbopol 940. The

careful selection and optimization of these components are essential to obtain a stable, effective, and aesthetically acceptable formulation.

Despite the widespread availability of synthetic topical preparations, their long-term use may lead to adverse effects such as irritation, dryness, and hypersensitivity reactions. Therefore, there is a growing need to develop safe, effective, and multifunctional herbal formulations that can provide therapeutic benefits with minimal side effects.

Hence, the present study aims to formulate and evaluate a multipurpose herbal gel containing extracts of *Musa acuminata* and *Murraya koenigii* using Carbopol 940 as a gelling agent, and to assess its physicochemical properties and biological activities including antimicrobial, antioxidant, and anti-inflammatory effects.

LIST OF MATERIALS

Table No. 1: List of Materials used for the Preparation of Formulation

Sl.NO	List of Materials	Source
1.	Carbopol 940P	Chemdyes Corporation, Rajkot
2.	Propylene glycol	Isochem Laboratories, Cochin
3.	Glycerine	Fortune Chemicals private limited, Cochin
4.	Sodium benzoate	Spectrum Reagents and Chemical Pvt Ltd, Cochin
5.	Triethanolamine	Spectrum Reagents and Chemical Pvt Ltd, Cochin
6.	Lavender oil	AVA International Private Limited, Noida
7.	Amaranth dye	Friends Dyes and Chemical Agencies Pvt Ltd, Kozhikode
8.	Banana leaves	Aranmula, Pathanamthitta
9.	Curry leaves	Local market, Alappuzha

PREPARATION OF HERBAL EXTRACTS

Extraction of *Musa acuminata* leaves

The banana leaves were dried using the shade drying method and subsequently ground into a fine powder. The maceration method was employed for the extraction of the leaves. The powder was then soaked in 80% acetone with occasional agitation. After 24 hours, the mixture was filtered and the acetone was evaporated to dryness to obtain concentrated extract. The concentrated extract was mixed with a specific volume of glycerin (1:10 ratio) and stirred thoroughly until a homogenous solution was formed. This glycerin-based extract was then stored in a cool, dark place to maintain its stability.



Fig No. 1: Maceration of *Musa acuminata* leaves

Extraction of *Murraya koenigii* leaves

The curry leaves were extracted using the maceration method and subsequently ground into a fine powder. The powder was then soaked in 60% acetone with occasional agitation. After 24 hours, the mixture was filtered and the acetone was evaporated to dryness to obtain concentrated extract. The concentrated extract was mixed with a specific volume of glycerin (1:10 ratio) and stirred thoroughly until a homogenous solution was formed. This glycerin- based extract was then stored in a cool, dark place to maintain its stability.



Fig No. 2: Maceration of *Murraya koenigii* leaves

PREPARATION OF MULTIPURPOSE HERBAL GEL

Multipurpose herbal gel formulations with ten different viscosities and consistencies were prepared by simple gel preparation method using a Carbopol gel base. The Carbopol gel base was preprepared by soaking it overnight in different quantities. A measured quantity of sodium benzoate was dissolved in distilled water, and then the weighed quantities of glycerine and propylene glycol were added into it. Then these solutions are added to Carbopol and the mixture was stirred to get a smooth gel. Then the acetonc extracts of banana leaves and curry leaves were added into the Carbopol gel. The mixture was neutralized by dropwise addition of triethanolamine and was mixed thoroughly. The prepared multipurpose herbal gel was stored at room temperature for further evaluation.

Table No. 2: Formulae used for development of multipurpose herbal gel

Formulation	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Banana leaf extract(ml)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Curry leaves extract(ml)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Carbopol(g)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
Sodium benzoate(g)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Glycerin(ml)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Propylene glycol(ml)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Triethanolamine(ml)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lavender oil(drops)	2	2	2	2	2	2	2	2	2	2
Amaranth dye (drops)	2	2	2	2	2	2	2	2	2	2
Water(ml)	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30	qs to 30

PHYTOCHEMICAL SCREENING

Table No. 3: Phytochemical screening

SL.NO	Phytoconstituent	Observation	Inference	Pictures
1	Flavonoid	A yellow precipitate is formed	Presence of flavonoid	
2	Tannins	A black colour is Formed	Presence of tannins	
3	Alkaloids	A reddish- brown precipitate	Presence of alkaloids	
4	Saponins	Persistent foam for 10 minutes	Presence of saponins	
5	Carbohydrates	A reddish- brown precipitate	Presence of carbohydrates	

RESULTS AND DISCUSSION**PHYSICAL PARAMETERS****Table No. 4: Results of physical parameters of all formulated herbal gels**

Formulations	PHYSICAL APPEARANCE	Homogeneity	pH	Viscosity(cps)	Spreadability (g.cm/sec)
F1	Translucent, less viscous, nongreasy, reddish-brown colour	Good	6.89±0.003	15660±0.001	31.9±0.002
F2	Translucent, less viscous, nongreasy, reddish-brown colour	Good	6.71±0.002	16410±0.003	28.3±0.002
F3	Translucent, less viscous, nongreasy, reddish-brown colour	Good	6.83±0.001	17550±0.001	27.2±0.001
F4	Translucent, less viscous, nongreasy, reddish-brown colour	Good	6.95±0.003	19800±0.002	26.6±0.002
F5	Translucent, less viscous, nongreasy, reddish-brown colour	Good	6.87±0.002	24300±0.005	25.1±0.001
F6	Translucent, ideal viscosity, light weight, reddish-brown colour	Good	6.83±0.001	26700±0.005	24.4±0.002
F7	Translucent, viscous, light weight, reddish-brown colour	Good	6.31±0.001	27200±0.002	23.7±0.002
F8	Less translucent, highly viscous, sticky, reddish-brown colour	Good	6.85±0.001	28500±0.005	22.6±0.002

F9	Less translucent, highly viscous, sticky, reddish-brown colour	Good	6.99±0.002	28670±0.003	22.3±0.001
F10	Opaque, highly viscous, sticky, reddish-brown colour	Good	6.89±0.003	29550±0.001	20.8±0.002

ANTIMICROBIAL ACTIVITY

Antimicrobial activity was evaluated using *S. aureus* against tetracycline as control

Table No. 5: Antimicrobial activity

SL.NO	FORMULATION	ZONE OF INHIBITION (mm)
1	Sample	16.0 mm
2	Control	25.0 mm



Fig No. 3: Antimicrobial activity

ANTIOXIDANT ACTIVITY

The capacity of the product to scavenge the free radical was determined using DPPH assay, adhering to the procedure detailed by Blois and Desmanrachelier. 1,1 diphenyl 2 picryl hydrazyl is a stable free radical, which has violet or purple colour. The plant extract contribute hydrogen atom was assessed by fading of colour in methanol mixture incorporating DPPH. If antioxidant present the DPPH solution, the colour (violet or purple) changes to yellow tones.

Table No. 6: Antioxidant values

S.NO	Concentration(mg)	COD	SOD	%inhibition	Average	IC ₅₀ (mg/ml)
1	50 mg	0.28	0.04	85%	80 ± 5.13	32.76
2		0.28	0.05	82%		
3		0.28	0.07	75%		
1	100 mg	0.28	0.09	67%	67 ± 7.50	
2		0.28	0.07	75%		

3		0.28	0.11	60%		mg/ml
1	150 mg	0.28	0.10	64%	65 ± 1.73	
2		0.28	0.10	64%		
3		0.28	0.09	67%		
In vitro Standard vitamin C						
1	100 mg	0.28	0.04	85%	87 ± 2.30	
2		0.28	0.03	89%		
3		0.28	0.03	89%		



Fig No. 4: Antioxidant activity of multipurpose herbal gel by DPPH Assay

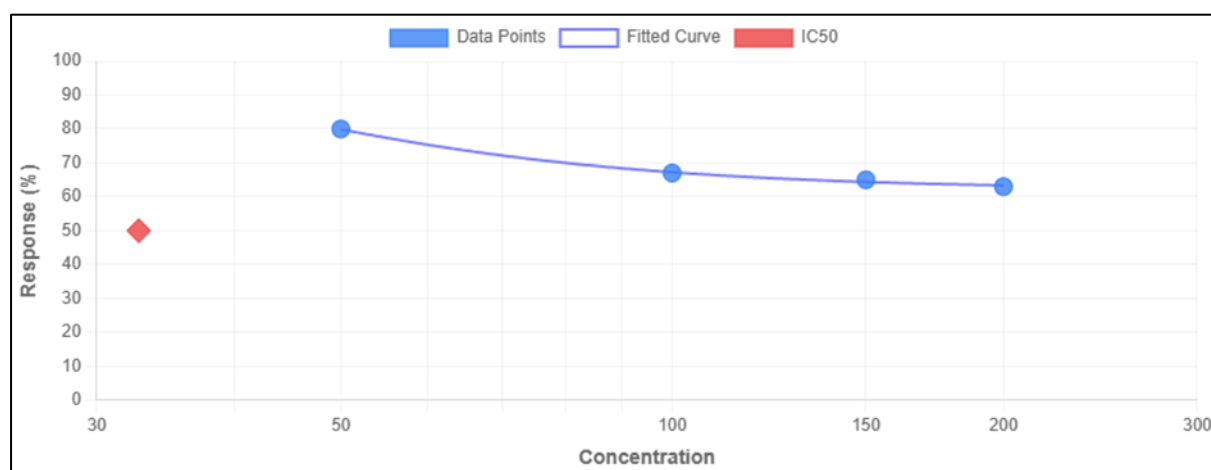


Fig No. 5: Antioxidant activity of multipurpose herbal gel IC₅₀ Value (mg/ml)

IN VITRO ANTI- INFLAMMATORY ACTIVITY

In vitro anti inflammatory activity was determined using egg albumin denaturation method. The main objective of egg albumin denaturation assay is to determine whether certain compound can prevent or reduce denaturation under specific condition. Denaturation alter the protein structure and initial shape of egg white changes. Substance with anti inflammatory property balance out protein structure and prevent denaturation. The procedure involved

is The Multipurpose herbal gel, measuring 0.5 ml was combined with 0.45 ml of fluid arrangement containing 5% bovine egg white to create the response. Starting value id 6.3, the blend's pH was adjusted using 0.1N HCl kept in 37 °C for a period of 20 minutes, then this warmed to 57 °C for 30 minutes. After cooling, the arrangement was allocated into 96-well plates, and absorbance measured at 660 nm. The standard used as Diclofenac sodium.

Table No. 7: Anti-inflammatory Values of multipurpose herbal gel

S.NO	Concentration(mg)	COD	SOD	%inhibition	Average	IC ₅₀ (mg/ml)	
1	50 mg	0.30	0.17	43%	35 ± 6.80	38.45 mg/ml	
2		0.30	0.20	33%			
3		0.30	0.21	30%			
1	100 mg	0.30	0.22	26%	28 ± 4.04		
2		0.30	0.20	33%			
3		0.30	0.22	26%			
1	150 mg	0.30	0.21	30%	29 ± 6.50		
2		0.30	0.23	23%			
3		0.30	0.19	36%			
Standard Diclofenac Sodium							
1	100 mg	0.30	0.07	76%	74 ± 1.73		
2		0.30	0.08	73%			
3		0.30	0.08	73%			



Fig No. 6: Anti-inflammatory activity of Multipurpose herbal gel

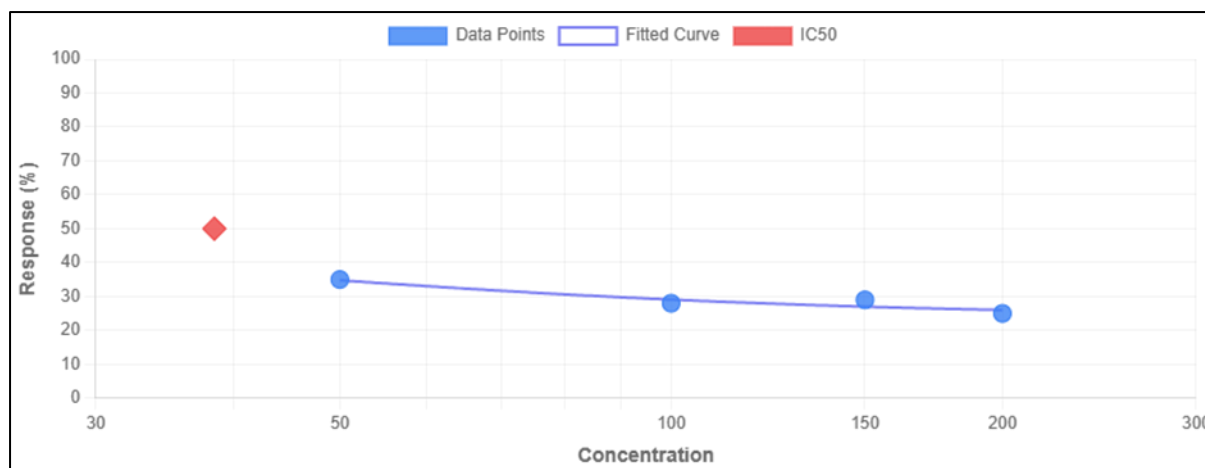


Fig No. 7: Anti-inflammatory activity of Multipurpose herbal gel IC₅₀ value (mg/ml)

CONCLUSION

The Multipurpose Herabl Gel containing Banana leaves (*Musa acuminata*) and Curry leaves (*Murraya koenigii*) was successfully formulated. The extract of Banana leaves and curry leaves was prepared by maceration where Acetone was used as the extraction solvent. The solvent from the herbal extract was evaporated to maximum and the obtained extract was reconstituted with glycerin. The quantity ideal for formulation was determined by various means, such as by performing microbial assay, referring prior study, product aesthetics. A gel base was formulated using suitable excipients and the extract was added in definite quantities. Therefore such 10 formulations (F1-F10) containing varying concentrations of gelling agent i.e; Carbopol 940 was formulated. The formulations differed in physical characteristics such as appearance, pH, viscosity and spreadability.

Out of the 10 formulation, F-6 was identified as the ideal formulation based on its physical characteristics such as appearance, pH, viscosity, spreadability and therapeutic effects such as Antimicrobial activity, Anti-inflammatory activity and Antioxidant activity. Antimicrobial activity was determined as presence and measurement of Zone of Inhibition on agar plate against Tetracycline as control. *In vitro* Egg Albumin Denaturation method using Standard Diclofenac Sodium as control determined the Anti-inflammatory activity of Multipurpose Herbal gel to inhibit albumin denaturation. Antioxidant activity was determined by DPPH and FRAP assay against Standard Vitamin C as control.

The Multipurpose Herbal Gel showed good Antimicrobial activity which contributed to prevent infection and itching caused by microbes on skin and scalp. The Anti-inflammatory activity prevented redness and inflammations. The Antioxidant activity of the formulation prevents premature aging; greying of hair and wrinkling of skin. Therefore, this formulation can be used as a safe alternative for commercial cosmetics containing chemical ingredients as it contains herbal extracts as actives for protecting skin, scalp and hair.

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