

FORMULATION AND EVALUATION OF HERBAL FACE SCRUB

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ABSTRACT

Herbal face scrub is formulated from natural ingredients and herbal extract helps in exfoliating the skin, enhanced skin texture and moisturizing the skin. The aim of this research work was to formulate and evaluate herbal face scrub containing mulberry (*Morus alba*) leaves and red lentils (*Lens culinaris*) for antioxidant, anti-inflammatory and anti-bacterial activity. By using Box-Behnken Design Expert, F₂ was found as the optimized formulation. It was then evaluated for physicochemical properties and antioxidant, anti-inflammatory, anti-bacterial activity. Based on the above parameters, F₂ formulation showed satisfactory results. Anti-bacterial activity was determined by measuring the Zone of inhibition. Antioxidant property was determined by DPPH assay method and the anti-inflammatory property was determined by Egg albumin denaturation method. The study reveals mulberry leaf and red lentils extract show prominent in-vitro activity against *Staphylococcus aureus* and have significant antioxidant and anti-inflammatory properties.

Keywords: *Morus alba*, *Lens culinaris*, *Staphylococcus aureus*, Zone of inhibition, DPPH assay method, Egg albumin denaturation method.

INTRODUCTION

Facial scrubs remove dead cells from the skin and encourage cell turnover by exfoliating it mechanically or chemically. Benefits of using herbal face scrubs include lessening environmental harm and aging-related changes. The phytoconstituents present in *Morus alba* such as flavonoids, phenolic acid, glucosides contribute to its antioxidant and inflammatory action. *Morus alba* with its de-melanising property aid in skin brightening and rejuvenation, while *Lens culinaris* offers mild exfoliation without stripping the skins natural shine and health. In combination provides both brightening and exfoliating potential. pH and spreadability were optimized during optimization using Design Expert Software to guarantee compatibility with skins natural pH and optimum spreadability for exfoliation. In order to create a herbal face scrub that satisfies customer expectations and provides therapeutic advantages, this study combines ancient herbal knowledge with contemporary cosmetic science.

LIST OF MATERIALS

Table No:1: List of materials used for the preparation of the formulation

Sl.No	List of materials	Activity
1	Mulberry leaf extract	Antioxidant, Anti-inflammatory, antimicrobial
2	Red lentils powder	Antioxidant, Natural exfoliant
3	Carbopol 934	Gelling agent
4	Glycerin	Humectant
5	Tween 80	Foaming agent

6	Sodium benzoate	Preservative
7	Rose water	Perfume
8	Triethanolamine	pH adjuster
9	Distilled water	Solvent

EXTRACTION OF MORUS ALBA LEAF

10g of mulberry leaf powder was extracted by using 200 ml methanol in a flask closed with lid. They were left in lab for 5 days and after which the extract was filtered using filter paper of grade-40 and the extract was aliquoted and stored at cool temperature till further use.



Fig No:1: Extract of *Morus alba*

EXTRACTION OF LENS CULINARIS

10g of red lentils was extracted by using 200 ml methanol in a flask closed with a lid. They were left in the lab for 7 days after which the extract was filtered using filter paper of grade-40 and the extract was aliquoted and stored at -20°C till further use.



Fig No:2 Extract of *Lens culinaris*

FORMULATION TABLE

Table No:2: Formulation chart of herbal face scrub

Formulation	Mulberry leaf extract (g)	Red lentils powder (g)	Carbopol 934 (g)	Glycerin (ml)	Tween 80 (ml)	Sodium benzoate (g)	Rose water (ml)	Triethanolamine (ml)	Distilled water (ml)
F ₁	1.20	3.50	0.12	1.50	0.60	0.20	0.60	0.12	12.16
F ₂	0.50	1.50	1.0	1.2	0.40	0.20	0.50	0.10	15.5
F ₃	0.40	1.0	1.0	1.0	0.40	0.20	0.50	0.10	16.3
F ₄	0.60	2.0	0.12	1.20	0.50	0.20	0.50	0.10	14.78
F ₅	0.80	2.50	0.12	1.30	0.50	0.20	0.60	0.10	13.88
F ₆	1.0	3.0	0.12	1.50	0.50	0.20	0.60	0.12	12.56
F ₇	1.50	4.0	0.14	1.60	0.60	0.20	0.70	0.14	11.12

F₈	1.8	4.5	0.14	1.80	0.70	0.20	0.80	0.14	10.02
F₉	2.0	5.0	0.15	2.0	0.80	0.20	0.80	0.15	9.00
F₁₀	2.50	5.50	0.15	2.0	0.80	0.20	1.00	0.15	7.70
F₁₁	2.80	6.0	0.16	2.10	0.90	0.20	1.00	0.16	6.78
F₁₂	3.0	6.50	0.16	2.20	0.90	0.20	1.10	0.16	5.78
F₁₃	3.20	7.0	0.17	2.30	0.90	0.20	1.10	0.17	4.96
F₁₄	3.50	7.50	0.18	2.40	1.00	0.20	1.20	0.18	3.84
F₁₅	3.80	8.0	0.18	2.50	1.00	0.20	1.30	0.18	2.84
F₁₆	4.0	8.50	0.19	2.60	1.10	0.20	1.40	0.19	1.82
F₁₇	4.50	9.0	0.20	2.80	1.20	0.20	1.50	0.20	0.40

EXPERIMENT DESIGN

Optimization is the processing of adjusting variables to achieve the most desirable outcome. It guarantees that a cosmetic product is safe, stable, and pleasant to use in addition to being effective.

BOX-BEHNKEN Design

Box-Behnken design is a statistical experimental design often used for optimization in formulation development, and it can be applied effectively for herbal face scrub. It helps optimize key formulation parameters such pH, spreadability and stability by systematically varying factors like herbal extract concentrations, gelling agent concentration, and excipients.

Table No: 3 Observed values of Responses

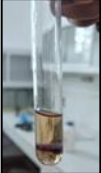
std	Run	Factor 1 A concentration of herbal extract %	Factor 2 B concentration of carbopol %	Factor 3 C concentration of glycerine %
8	1	3	0.8	8
3	2	1	1	6
14	3	2	0.8	6
17	4	2	0.8	6
13	5	2	0.8	6
6	6	3	0.8	4
9	7	2	0.6	4
10	8	2	1	4
2	9	3	0.6	6
15	10	2	0.8	6
12	11	2	1	8
5	12	1	0.8	4
4	13	3	1	6
1	14	1	0.6	6
7	15	1	0.8	8
16	16	2	0.8	6
11	17	2	0.6	8

PHYTOCHEMICAL SCREENING

Table No: 4 Phytochemical screening of mulberry leaves

PHYTOCONSTITUENT	OBSERVATION	INFERENCE
a) Alkaloids	Formation of reddish-brown precipitate	 Indicate the presence of alkaloids in mulberry leaf extract
b) Glycosides	Brown ring was formed at the interface of two liquids	 Confirm Presence of glycosides in mulberry leaf extract
c) Terpenoids	Formation of reddish-brown color at the interface	 Confirm the presence of terpenoid in mulberry leaf extract

Table No: 5 Phytochemical screening of Red lentils

PHYTOCONSTITUENT	OBSERVATION	INFERENCE
a) Carbohydrates	Violet color ring formed at the junction of two liquids	 Confirm the presence of carbohydrate in red lentil extract
b) Tannins	Formation of creamy white precipitate	 Confirm the presence of tannins in red lentils
c) Phenolic acid	Formation of blue green coloration	 Confirm the presence of phenolic acids

RESULT AND DISCUSSIONS

ANOVA for quadratic model – pH

Response 1: pH

Table No: 6 ANOVA of pH

Source	Sum of squares	df	Mean squares	f-value	p-value	
Model	1.86	9	0.2062	1034.80	<0.0001	significant
A-concentration of herbal extract	0.1568	1	0.1568	786.81	<0.0001	
B-concentration of carbopol	0.5460	1	0.5460	2739.85	<0.0001	
C-concentration of glycerine	0.7140	1	0.7140	3582.86	<0.0001	
AB	0.0380	1	0.0380	190.81	<0.0001	
AC	0.1260	1	0.1260	632.38	<0.0001	
BC	0.0625	1	0.0625	313.62	<0.0001	
A ²	0.1778	1	0.1778	892.24	<0.0001	
B ²	0.0000	1	0.0000	0.1902	0.6759	
C ²	0.0256	1	0.0256	128.54	<0.0001	
Residual	0.0014	7	0.0014			
Lack of fit	0.0001	3	0.0001	0.0758	0.9698	Not significant
Pure error	0.0013	4	0.0013			
Core Total	1.86	16				

Table No: 7 Fit statistics of pH

Std dev	0.0141	R²	0.9992
Mean	5.88	Adjusted R²	0.9983
CV%	0.2401	Predicted R²	0.9982
		Adequate precision	121.1077

Table No: 8 Fit summary of pH

source	Sequential p-value	Lack of fit p-value	Adjusted R ²	Predicted R ²	
Linear	0.0002	0.0001	0.7081	0.5514	
2F1	0.0564	0.0002	0.8157	0.6071	
quadratic	<0.0001	0.9698	0.9983	0.9982	suggested
cubic	0.9698		0.9972		Aliased

Table No: 9 Lack of fit test

source	Sum of squares	df	Mean squares	F-value	p-value	
Linear	0.4392	9	0.0488	147.89	0.0001	
2F1	0.2127	6	0.0354	107.41	0.0002	
quadratic	0.0000	3	0.0000	0.0758	0.9698	suggested
cubic	0.0001	0				Aliased
Pure Error	0.0013	4	0.0003			

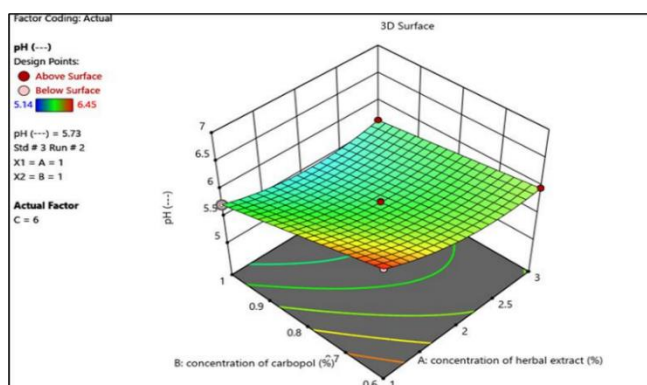


Fig No: 3 3D surface plot for pH

ANOVA for quadratic model - Spreadability

Response 2: Spreadability

Table No:10 ANOVA of Spreadability

Source	Sum of square	df	Mean squares	F-value	p-value	
Model	73.24	9	8.14	8978.37	<0.0001	significant
A concentration of herbal extract	4.20	1	4.20	4639.09	<0.0001	
B concentration of caroapol	3.77	1	3.77	4156.44	<0.0001	
C concentration of glycerine	51.46	1	51.46	56772.83	<0.0001	
AB	0.0100	1	0.0100	11.03	0.0127	
AC	4.00	1	4.00	4412.92	<0.0001	
BC	1.84	1	1.84	2025.56	<0.0001	
A ²	2.89	1	2.89	3186.59	<0.0001	
B ²	3.45	1	3.45	3810.83	<0.0001	
C ²	1.75	1	1.75	1928.02	<0.0001	
Residual	0.0063	7	0.0009			
Lack of fit	0.0000	3	8.333E-06	0.0053	0.9993	Not significant
Pure error	0.0063	4	0.0016			
Core Total	73.25	16				

Table No: 11 Fit statistics of Spreadability

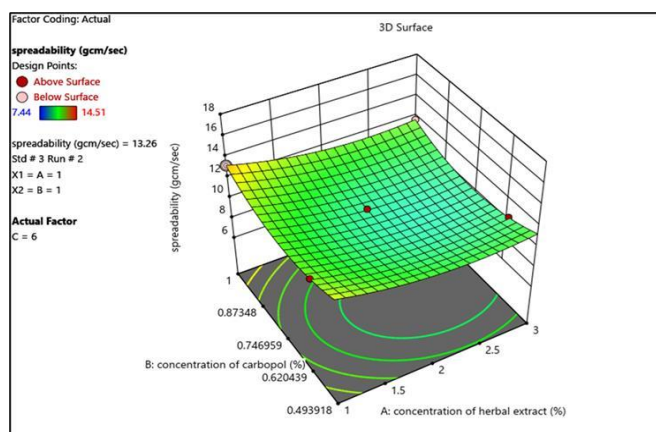
Std.dev	0.0301	R²	0.9999
Mean	10.58	Adjusted R²	0.9998
CV%	0.2846	Predicted R²	0.9999
		Adequate precision	306.2885

Table No: 12 Fit summary of Spreadability

source	Sequential p-value	Lack of fit p-value	Adjusted R ²	Predicted R ²	
Linear	0.0001	0.0001	0.7081	0.5514	
2F1	0.1243	0.0001	0.8157	0.6071	
quadratic	<0.0001	0.9698	0.9983	0.9982	suggested
Cubic	0.9994		0.9972		Aliased

Table No: 13 Lack of Fit of Spreadability

Source	Sum of squares	df	Mean squares	F-value	P-value	
Linear	13.81	9	1.53	971.25	<0.0001	
2FI	7.97	6	1.33	840.21	<0.0001	
quadratic	0.0000	3	8.333E-06	0.0053	0.9994	suggested
Cubic	0.0000	0				Aliased
Pure Error	0.0063	4	0.0016			

**Fig No: 4 3D surface plot for Spreadability****ORGANOLEPTIC EVALUATION****Table No: 14 Organoleptic evaluations**

SL.NO	PARAMETERS	OPTIMIZED FORMULATION
1	State	Semi-solid
2	Colour	Bright yellow
3	Odour	Characteristic
4	Texture	Thick and grainy
5	Homogeneity	Homogenous

**Fig No:5 Formulation of Herbal face scrub**

Table No:15 Evaluation Parameters Data

Parameters	Optimized formulation (F8)	Mean±SD
pH	Good	5.73±0.008
Viscosity	Good	12000±0.8
Spreadability	Good	13.26±0.008
Foamability	Good	35.0±0.04
Grittiness	Good	12.66±0.47

ANTIMICROBIAL ACTIVITY

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

Table No:16 Antimicrobial activity

SL.NO	FORMULATION	ZONE OF INHIBITION (mm)
1	Sample	21.51
2	Control	25.0



Fig No:6 Antimicrobial activity

ANTIOXIDANT ACTIVITY

Antioxidant activity of herbal face scrub was determined by DPPH:

DPPH Assay

The *In-vitro* activity was determined by estimating DPPH (1, 1- Diphenyl 1-2, Picryl-Hydrazyl) free radical scavenging activity of face scrub. The capability of the extracts to counteract free radical was gauged utilizing the DPPH radical scavenging test.

$$\% \text{ Inhibition} = (\text{Absorbance of DPPH blank} - \text{True absorbance}) \times 100 / \text{Absorbance of DPPH blank}.$$

Table No:17 Antioxidant activity

SL.NO	Concentration (mg)	% inhibition	IC ₅₀ value
1	50	75%	150.83 mg/ml
2	100	72%	
3	150	75%	
Standard Ascorbic acid			
1	50	91%	33.733 mg/ml
2	100	87%	
3	150	86%	
4	200	92%	
5	250	84%	

ANTI-INFLAMMATORY ACTIVITY

The in-vitro anti-inflammatory activity was determined by egg albumin denaturation method. The test surveys how well a medicated compound can avoid or diminish the denaturation of egg whites, which makes a difference assess to its anti-inflammatory impacts.

Table No:18 *In vitro* anti-inflammatory activity

SL.NO	Concentration (mg)	% inhibition	IC ₅₀ value
1	50	33	33.71 mg/ml
2	100	28	
3	150	29	
Standard Diclofenac			
1	50	91	121.29 mg/ml
2	100	93	
3	150	85	
4	200	88	
5	250	89	

CONCLUSION

Herbal face scrub was formulated using of *Morus alba* leaves extract and *Lens culinaris* powder for its antioxidant, anti-inflammatory and anti-bacterial action. These scrub, enriched with plant-based ingredients, effectively neutralize free radicals there by reducing oxidative stress and preventing premature aging. The natural antioxidant present in these herbs not only enhance the skin's defense mechanism but also promote healing and rejuvenation. The alcoholic extract of mulberry leaves was prepared. Using this alcoholic extract, red lentils powder and other ingredients, herbal face scrub of various concentrations was prepared. By Box-Behnken design expert, optimized formulation was found to be F₂ and was evaluated by various parameters. The anti-bacterial activity was determined by the Agar well diffusion method. The study reveals that the mulberry leave extract and red lentils show prominent anti-bacterial activity against *Staphylococcus aureus*. Antioxidant activity was determined by DPPH and FRAP assay method which shows prominent antioxidant activity with standard ascorbic acid. Anti-inflammatory property was determined by egg albumin denaturation method which shows prominent anti-inflammatory activity against standard diclofenac. From the above study, it can be concluded that the formulated herbal face scrub is safe to use for skin exfoliation, anti-oxidant, anti-inflammatory and anti-bacterial property. As the product is made from natural ingredients, less amount of chemicals was present.

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