



# FORMULATION AND EVALUATION OF POLYHERBAL FACIAL SCRUB GEL MEDIATED BY BOX BEHNKEN DESIGN

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**Abstract:** Demand for herbal formulations has recently increased as a result of growing public interest in natural products. Herbal cosmeceuticals are more popular at the moment because they don't have any negative side effects. Scrubbing is very important because acne, whiteheads, and blackheads affect a lot of people. The primary goal of the current study was to formulate a face scrub gel using different herbs. Multani mitti, Orange peel, Cinnamon, Aloe vera gel, Rosewater, Neem, and Honey are utilized as active ingredients in this preparation and mixed to form a gel with the help of Carbopol. Along with this sodium lauryl sulfate, Hyaluronic acid, triethanolamine, and methyl para hydroxy benzoate were added to the gel. Design Expert software was used to optimize the formula with 12 trial batches and assistance from Box Behnken Design. The formulated gel passed all necessary characterizations after being tested for several factors, including appearance, pH, viscosity, spreadability, washability, and irritability. As a result, the gel can be administered as a powerful scrub to achieve healthy, radiant skin.

**Keywords:** Box Behnken Design, Face Scrub gel, Multani mitti

## I. INTRODUCTION

Due to the enormous health risks associated with synthetic ingredients, which further exacerbate environmental degradation, the demand for herbal products and cosmetics is rising daily. The idea of cosmetics and beauty traces its roots to prehistoric humankind and civilization.(1)

The largest organ in the body is the skin. It is an important organ that protects other bodily parts. Our skin shields us from germs, helps control body temperature, and allows us to feel touch, heat, and cold. The skin acts as a barrier, shielding everything underneath it from harmful elements including the sun, wind, and pollution. Getting a scrub that exfoliates deeply is crucial for oily skin to balance the skin's oil production and prevent clogged pores.(2) Various herbs have been used for management, cleaning, and beauty purposes since ancient times. The majority of the body, or the skin on the face, is an indicator of one's health.(3) For healthy skin and a pleasing appearance, the skin's surface must be regularly cleansed to get rid of debris, grime, dead skin cells, crusts, makeup, sebum, and other secretions.

Cosmetics are meant to be applied to the human body to clean, beautify, decorate, encourage attractiveness, and change the way the skin looks. Skin cosmetics work on the skin's outermost layers, or epidermis, without altering the skin's natural physiological characteristics. Cosmetics are typically used to prevent and lessen wrinkles, fine lines, and aging, to treat acne, and to regulate the skin's excessive oil production. (4)

Scrubs can be put on the skin directly or with the help of a tiny cosmetic pad. It's recommended to apply the scrub gel gently since this will increase blood flow and oxygen delivery to the skin's surface. Body and facial scrubs are the two types of scrubs that are used on the skin. The amount of sugar and oil that each of these two receives is the only distinction between them. The face scrub is less abrasive and it removes dead skin cells and exfoliates the skin. Scrubs are suitable for treating any type of skin. A face scrub is one of the best remedies for clear and healthy skin. Using a face scrub that also functions as an exfoliant can help remove dead skin cells that build up on the face and clog the pores. Face skin cells renew themselves every two weeks on average. Polyherbal facial scrub with natural active components helps lessen wrinkles, dark circles, acne, and redness. In addition to providing skin-nourishing and calming benefits, these preparations might also aid in improving fairness.(5)

The skin surface needs to be cleaned often to get rid of grime, sebum, and other secretions, dead cells, crusts, and makeup to stay healthy and attractive.(6) Natural exfoliates remove surface skin cells and promote sub-epidermal layer cell growth, which mitigates age-related changes and environmental assault.(7) During the exfoliation process, the oldest, superficial dead skin cells are scraped off the skin's outermost layer. For skin exfoliation, mechanical and chemical methods are available. Mechanical exfoliation is achieved by rubbing abrasive substances against the skin. Frequent exfoliation leaves skin more toned, smoother, and healthier by promoting a natural shedding process. Exfoliating the skin can help with acne vulgaris, wrinkles, and clogged pores. Scrubbing or exfoliating the skin provides a nice massage that eases tension and promotes relaxation.(8)

### 1.1 Ideal Properties of Scrub (9)

- Non-abrasive
- Mildly scented
- Safe and effective for all skin types
- Gentle exfoliates the skin
- Hydrating and efficient.

### 1.2 Benefits of scrubbing skin (10)

- Removes flakes from the skin
- Enhance skin radiance
- Removes Dark spots
- Eliminates dead cells
- For squeaky clean skin
- Enhance skin texture and clarity of complexion.

## II. MATERIALS AND METHODS

### 2.1 Materials

Multani mitti, Neem extract, Honey, Orange peel, Aloe vera gel, Almond oil, Cinnamon, Hyaluronic acid, Carbapol, Triethanolamine, Sodium Lauryl Sulfate, Methylparaben, Rose oil and distilled water. Few ingredients were purchased from the shop and few were procured from the laboratory.

## 2.2 Polyherbal facial Scrub gel formula

**Table 1. Optimized formula(F9)**

SI. No	Ingredient	Quantity (%)	Uses
1.	Multani mitti	1.5	Cleanser
2.	Neem extract	0.5	Skin conditioner, Antiseptic
3.	Honey	2	Antioxidant
4.	Orange peel	1	Antioxidant
5.	Aloe vera gel	2.5	Antiaging
6.	Almond oil	3	Production of new skin cells
7.	Cinnamon	2	Anti-bacterial
8.	Hyaluronic acid	1-2	Moisturizer
9.	Carbopol	2	Gelling agent
10.	Triethanolamine	2	Neutralizer
11.	Sodium Lauryl sulfate	3	Foaming agent
12.	Methylparaben	0.05	Preservative
13.	Rose oil	Q.s	Perfuming agent
14.	Water	Q.s	Vehicle

## 2.3 Procedure

### 2.3.1 Preparation of extract

To make the extract, Multani Miti, Orange peel, Cinnamon, Aloe vera gel, Rosewater, Neem extract, and Honey were mashed and kept in water for 72 hours during the cold maceration process. After being air-dried, this was stored in a desiccator for later use.

### 2.3.2 Preparation of gel

A weighed quantity of methylparaben was dissolved in water. To this Carbopol, was added and vigorously stirred for a few minutes until a gel formed. Add the prepared extract to this and stir for 10 minutes. The aforementioned gel was then supplemented with sodium lauryl sulfate. After that, hyaluronic acid was added. Triethanolamine was gradually added to the gel to adjust the pH. As a last step, a scented agent called rose oil is added.

## 2.4 Design model

**Table 2. Box Behnken Design Model**

		Factor 1	Factor 2	Factor 3	Response 1	Response 2
Std	Run	A: Multani mitti	B: Neem extract	C: Almond oil	pH	Viscosity
		%	%	%		Poise
5	1	1.5	0.75	2	7	1.458
9	2	1.75	0.5	2	6.6	1.298
8	3	2	0.75	3	6.5	1.3685
7	4	1.5	0.75	3	7.1	1.4068
4	5	2	1	2.5	6.8	1.4163
11	6	1.75	0.5	3	7.2	1.3958
3	7	1.5	1	2.5	7.3	1.369
2	8	2	0.5	2.5	6.7	1.3789
1	9	1.5	0.5	3	6.9	1.3589
12	10	1.75	1	3	6.8	1.4015
10	11	1.75	1	2	7.1	1.3898
6	12	2	0.75	2	6.5	1.4236

## 2.5 Effect on Independent Variable on pH

Table 3. ANOVA table for pH

Source	Sum of Squares	df	Mean Square	F-value	p-value	
<b>Model</b>	0.5073	2	0.2536	7.73	0.0111	significant
A-Multani mitti	0.3332	1	0.3332	10.16	0.0111	
BC	0.1023	1	0.1023	3.12	0.1113	
<b>Residual</b>	0.2952	9	0.0328			
<b>Cor Total</b>	0.8025	11				

The **Model F-value** of 7.73 implies the model is significant. There is only a 1.11% chance that an F-value this large could occur due to noise. **P-values** less than 0.0500 indicate model terms are significant. In this case, A is a significant model term. Values greater than 0.1000 indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model.

### Final Equation

$$\text{pH} = +6.86 - 0.2067A - 0.1461BC$$

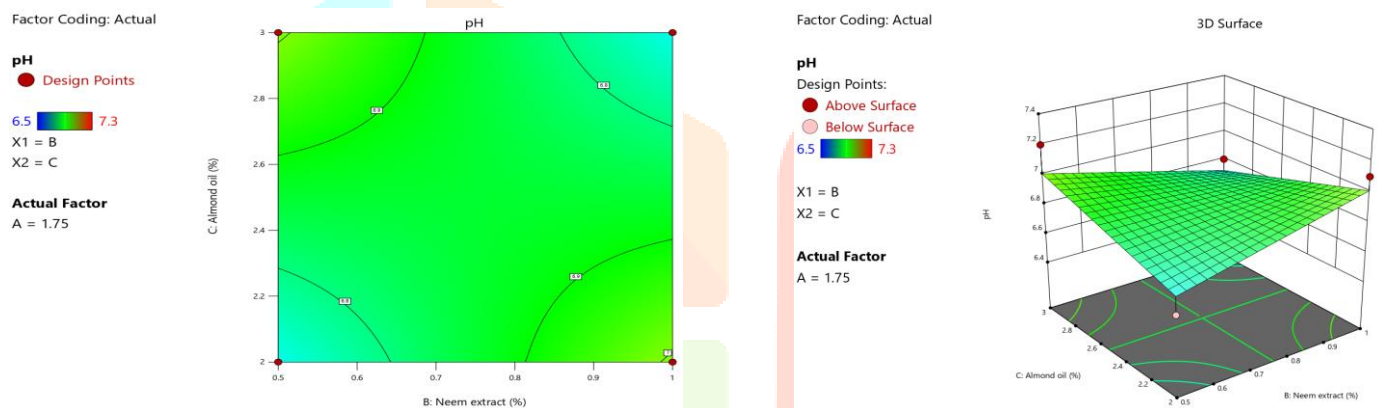


Figure 1. Contour and 3D plot of pH

From the contour and 3D plot, the pH at 6.9(F9) formulation shows an optimized result than others.

## 2.6 Effect on Independent Variable on Viscosity

Table 4. ANOVA table for Viscosity

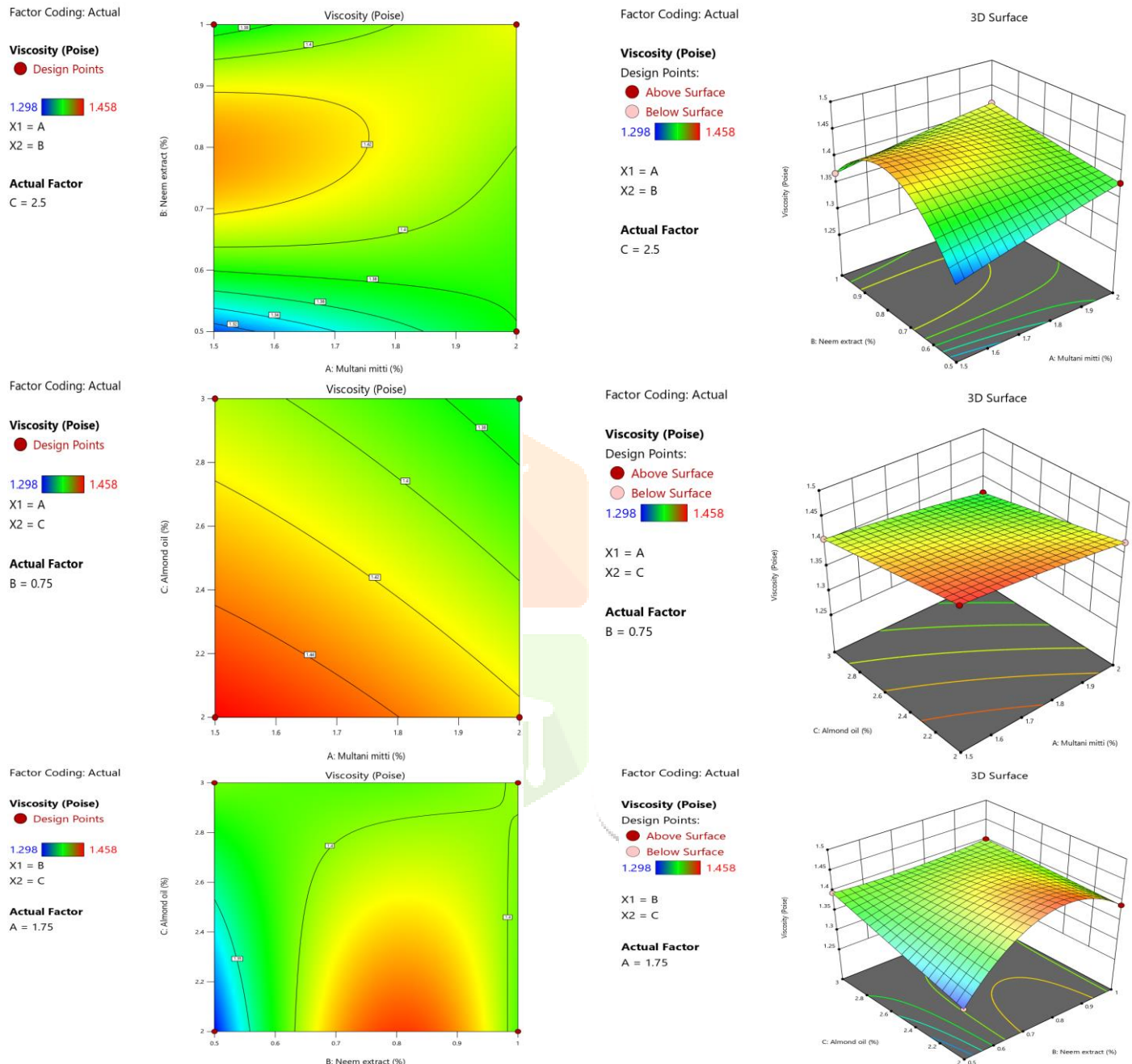
Source	Sum of Squares	df	Mean Square	F-value	p-value	
<b>Model</b>	0.0173	10	0.0017	9.706E+05	0.0008	significant
A-Multani mitti	0.0013	1	0.0013	7.399E+05	0.0007	
B-Neem extract	0.0044	1	0.0044	2.449E+06	0.0004	
C-Almond oil	0.0028	1	0.0028	1.582E+06	0.0005	
AB	0.0001	1	0.0001	60964.90	0.0026	
AC	3.943E-06	1	3.943E-06	2208.12	0.0135	
BC	0.0019	1	0.0019	1.069E+06	0.0006	
A <sup>2</sup>	0.0000	1	0.0000	9108.21	0.0067	
B <sup>2</sup>	0.0039	1	0.0039	2.175E+06	0.0004	
AB <sup>2</sup>	0.0042	1	0.0042	2.325E+06	0.0004	
B <sup>2</sup> C	0.0059	1	0.0059	3.308E+06	0.0004	
<b>Residual</b>	1.786E-09	1	1.786E-09			
<b>Cor Total</b>	0.0173	11				

The **Model F-value** of 970591.29 implies the model is significant. There is only a 0.08% chance that an F-value this large could occur due to noise. **P-values** less than 0.0500 indicate model terms are significant. In this case, A, B, C, AB, AC, BC, A<sup>2</sup>, B<sup>2</sup>, AB<sup>2</sup>, and B<sup>2</sup>C are significant model terms. Values greater than 0.1000

indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model.

### Final equation

$$\text{Viscosity} = +1.42 - 0.01882A + 0.0244B - 0.0266C - 0.0056AB - 0.0010AC - 0.0215BC - 0.0030A^2 - 0.0459B^2 + 0.0475AB^2 + 0.0540B^2C$$



**Figure 2. Contour and 3D plot of Viscosity**

From the contour and 3D plot, the viscosity of **1.3589poisie (F9)** formulation shows an optimized result than others.

### III. EVALUATION OF SCRUB GEL

The prepared gel was evaluated for various parameters. It includes:

#### 3.1 Physical Appearance

The formulated face scrub was examined visually to check for lumps, homogeneity, color, and syneresis.(11)

#### 3.2 Consistency

The consistency of the face scrub gel was evaluated manually.(12)

### 3.3 pH

pH of the prepared scrub formulation was determined by using a digital pH meter.(13)

### 3.4 Extrudability

A tiny quantity of gel was placed in a foldable ointment tube. One end was sealed off while the other remained open. The closed side was given a little pressure. Both the amount of gel extruded and the extrusion time were recorded.(14)

### 3.5 Spread ability of scrub

When it comes to the behavior of the gel that emerges from the tube, spread ability is crucial. It is employed to determine the extent to which the gel can be spread across the skin. A glass slide with a small amount of sample on it was positioned above another slide that had 100 g of weight on it. It was observed and measured how long it took the gel to spread on the slide; it took 4 cm in 60 seconds. The formula used to calculate it was as follows:  $S = m \times l / t$  S= Spread ability m=Weight placed on slide l=Length of the glass slide t= Time taken in seconds.(15)

### 3.6 Washability

This test was conducted directly on the skin, which was prepped and then cleaned with regular water. (16)

### 3.7 Grittiness

The Grittiness of the formulation was checked manually.

### 3.8 Foamability

The foam was measured after a small amount of scrub was shaken with water in a measuring cylinder.

### 3.9 Viscosity

The Brookfield viscometer was used to measure the viscosity of the scrub. The viscosity value was expressed in units of cps.(17)

### 3.10 Irritancy test

The prepared face scrub was applied to the 1 square centimeter area on the left dorsal surface that had been previously marked, and the application time was noted. The skin was then periodically checked for irritation, erythema, and edema (if present).(18)

### 3.11 Patch test

Patch testing is a well-researched technique for identifying hypersensitivity and assessing the likelihood that a particular material will react allergically on a patient's skin. In a patch test, a tiny patch of skin is exposed to diluted chemicals whose particular impact on the skin is to be investigated. In a patch test, the skin's reaction to the formulation is seen in two to three days.(14)

### 3.12 Stability test

By packing the scrub into plastic containers and keeping it in a humidity chamber with a temperature of 45°C and a relative humidity of 75%, the stability of the formulation was examined. For a month, the formulation's stability was monitored.(8)

## IV. RESULTS AND DISCUSSION

### 4.1 pH

**Table 5. Results of pH for F1-F12**

Formulation code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
pH	7	6.6	6.5	7.1	6.8	7.2	7.3	6.7	<b>6.9</b>	6.8	7.1	6.5

Based on Optimization and evaluation F9 formulation Shows a **pH of 6.9** which is considered as the optimized result than other formulations.

## 4.2 Viscosity

Table 6. Results of Viscosity for F1-F12

Formulation code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Viscosity(Poise)	1.458	1.298	1.3685	1.4068	1.4163	1.3958	1.369	1.3789	<b>1.3589</b>	1.4015	1.3898	1.4236

The viscosity of the optimized formulation F9 was found to be **1.3589 poise**

Table 7. Results of Polyherbal facial scrub gel

SI. No.	Parameters	Observation
1.	Color	Pale Brown
2.	Odor	Pleasant
3.	pH	6.9
4.	Consistency	Consistent and semi-solid
5.	Extrudability	Extruded easily
6.	Spreadability	6.5g.cm/sec
7.	Washability	Easily washable
8.	Grittiness	Mild gritty particles
9.	Foamability	120ml foam after 5mins
10.	Viscosity	1.3589 poise
11.	Irritation	No irritation
12.	Patch test	No observed allergic reaction

## 4.3 Irritancy test

Table 8. Results of Irritancy test

SI. No.	Parameters	Observation
1.	Irritation	No irritation signs were observed
2.	Erythema	No redness or inflammation was observed
3.	Edema	No signs of swelling were observed

## 4.4 Stability test

Table 9. Results of Stability test

Parameters	Temperature conditions(45 °C) and 75% RH
Color	Brownish red
Odor	Pleasant
Spreadability	Uniform and no changes observed
pH	7
Viscosity	1.3494 poise

## V. CONCLUSION

The polyherbal scrub gel showed good results and is stable at 45 °C. Based on the results of scrub gel it is found to be satisfactory for use on the skin to promote health and radiance without causing any negative effects. Out of many formulations performed F9 batch showed good results with good viscosity and pH. Further, it provides better spread ability and smoothing action to the skin. So it can be concluded that this scrub gel is very useful for oily type of skin and provides fewer side effects.

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