



## Original Research Article

## A research on formulation and evaluation of herbal anti-acne gel

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## Abstract

**Introduction:** The aim of this study to do A Research on Formulation and Evaluation of Herbal Anti – Acne Gel. Gels have become popular in cosmetics and topical medications because they are non-greasy, easy to apply, and wash off quickly.

**Aim & Objectives:** The aim of this study to do A Research on Formulation and Evaluation of Herbal Anti – Acne Gel.

The Objective is to Reduce inflammation and redness. Inhibit acne-causing bacteria. Provide a safe, natural alternative to synthetic drugs. Topical drug delivery involves applying substances to the skin to treat skin conditions. Gels have become popular in cosmetics and topical medications because they are non-greasy, easy to apply, and wash off quickly.

**Materials and Method:** An herbal anti-acne gel was prepared using extracts of Bay leaf, Manilkara zapota leaves, and Vigna mungo. Polyethylene glycol and triethanolamine were used as emulsifiers. Three formulations (Batch 1, 2, and 3) were made with different extract ratios and tested for pH, spreadability, homogeneity, colour, odour, and consistency.

**Results:** Batch 3 showed the best spreadability and excellent homogeneity compared to other batches.

**Conclusion:** The optimized Batch 3 gel, containing a combination of all three herbal extracts, was most effective and suitable as a natural anti-acne formulation.

**Keywords:** Skin, Acne, Herbal drug, Topical Formulation.

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## 1. Introduction

Skin is the body's largest organ, weighing 16 % of body weight, and covering a surface area of 1.8m<sup>3</sup>. There are three structural skin layers: the epidermis, the dermis and subcutis. The epidermis is the outermost layer acting as the physical and chemical barrier between interior body and external environment. The dermis is the inner layer of the structural support of the skin, beneath which there is a loose connective tissue layer, the subcutis or hypodermis which is a significant component of fat. The pH of the skin is between 4 to 5.6.<sup>1</sup>(Figure 1)

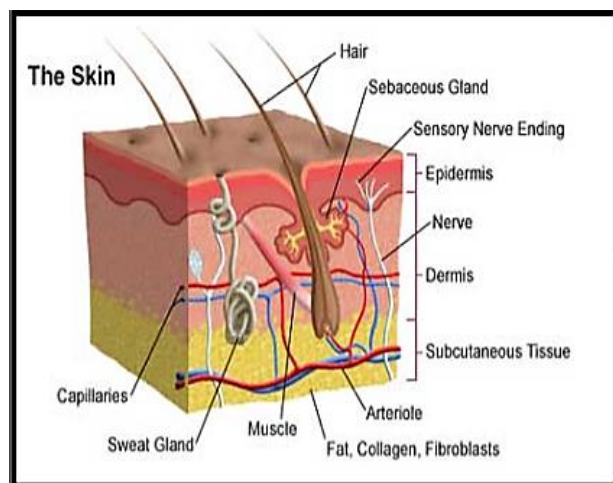
## 1.1. ACNE

Acne, deduced from the Greek word "Akme", means peak or apex, is inheritable or acquired affection of the pilosebaceous units. Acne is the most common complaint set up among

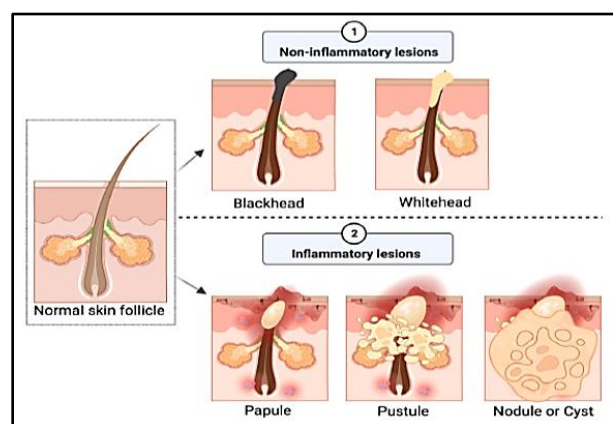
adolescents generally 18- 25 times old. Acne vulgaris, which is a pilosebaceous gland skin complaint which is marked by conformation of seborrhea, comedones, seditious lesions and circumstance of bacteria *Propionibacterium acnes*, *Staphylococcus epidermidis* and *Staphylococcus aureus* in the follicular conduit and sebum stashing It's nearly a universal complaint seen in all races and affects 95 of boys and 83 of girls.<sup>2</sup>

Acne vulgaris is an incredibly common skin condition affecting the pilosebaceous unit, with nearly everyone passing it at least formerly in their continuance.<sup>3</sup>

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**Figure 1:** Anatomy of skin



**Figure 2:** Types of acne



**Figure 3:** Filtration and extract of ingredients



**Figure 4:** Formulation

### 1.2. Types of acne: (Figure 2)

Acne is classified into several forms, including

1. Acne Conglobate.
2. Acne Rosacea.
3. Acne Fulminans.
4. Acne Cosmetica.
5. Acne Excoriate (picker's acne).<sup>4</sup>

### Figure 2 Types of acne

Acne vulgaris is the most common type of acne, making up 99% of all cases. It's characterized by two main kinds of skin lesions: non-inflammatory lesions, which include,

1. **Whiteheads:** These occur when a pore becomes entirely blocked, trapping oil, bacteria, and dead skin cells, leading to a white bump on the skin's surface. They are frequently treated with non-prescription acne remedies.
2. **Blackheads:** These develop when a pore is only partially blocked, allowing the trapped bacteria, oil, and dead skin to gradually reach the skin's surface.<sup>5</sup>
3. **Papules:** When healthy skin reacts to bacteria, too important oil painting oil, and increased androgen exertion, it becomes lit, showing symptoms like swelling, heat, greenness, and pain.
4. **Pustules:** Papules are small, lit bumps that develop when pores get congested with spare oil painting oil painting and dead skin cells. They constantly look like white pustules girdled by red, bothered skin.
5. **Nodules:** Acne nodes are a severe type of seditious acne that arise when pores come blocked with bacteria, redundant oil painting, and dead skin cells.
6. **Cysts:** Cystic acne is a serious form of inflammatory acne that develops under the skin due to blocked pores

filled with a buildup of bacteria, dead skin cells, and oil.<sup>6</sup>

### 1.3. Acne –Causes

The following are some of the threat factors that may impact for developing acne

1. Hormonal shifts, similar as those being during puberty or gestation, can contribute to acne.
2. Certain medicines, like birth control capsules or corticosteroids, may also spark acne.
3. A diet high in reused sugars or carbohydrates, similar as chuck and chips, might increase the liability of acne.
4. Teenagers are particularly susceptible to developing acne during puberty due to significant hormonal oscillations.<sup>7</sup>

### 1.4. GELS

Gels are semi-solid systems where the movement of the liquid is restricted by a network formed either by particles interacting in three dimensions or by large molecules dissolving in the liquid.<sup>8</sup> The specific characteristics of the final product and the type of oil that helps bind the network together determine the gel's structure.<sup>9</sup>

## 2. Topical Drug Delivery System

Applying prescription medications directly to the skin to treat skin conditions is called a topical drug delivery system. Topical gels are semi-solid formulations where a liquid is held within a three-dimensional network of polymers from natural or partially synthetic sources, linked together physically or chemically. Clinical studies suggest that topical gels are a safe and effective way to manage skin diseases, particularly for localized treatment to avoid the side effects of traditional medications.<sup>10</sup>

### 2.1. Advantages

1. Simple and straightforward to use.
2. Allows for further targeted medicine delivery to a particular area.
3. Prevents issues with medicine relations or breakdown in the digestive system.<sup>11</sup>

### 2.2. Disadvantages

1. Some medications don't pass through the skin very well.
2. Drugs with larger particles may not be absorbed easily through the skin's layers.
3. There's a chance of skin allergies occurring.<sup>12</sup>

### 2.3. Anti-acne gel

In recent years, anti-acne gel formulations have become a major focus because they offer a way to effectively treat acne, potentially without the negative side effects often linked to synthetic medications. Researchers have been investigating

different plant extracts and natural components for their acne-fighting abilities, and initial studies on formulations and effectiveness have shown encouraging outcomes. Typically, topical treatments are considered safer, with minor skin reactions being the most frequent side effects.<sup>13</sup>

### 2.4. Need of study

The study of the expression of anti- acne gel is essential for several compelling reasons:

**1. Addressing a common skin condition:** Acne vulgaris is a wide dermatological issue affecting a significant portion of the population, particularly adolescents and immature grown-ups. Effective and accessible treatments like anti- acne gels are vital for managing this condition.

**2. Accommodating treatments to skin types:** Different skin types may respond else to colorful phrasings. Research can concentrate on developing specific gel phrasings acclimated to unctuous, dry, or sensitive skin, maximizing effectiveness and minimizing vexation for each group.

**3. Cost- effectiveness:** Optimizing phrasings can lead to further cost-effective product, making effective treatments more accessible to a wider population.

**4. Meeting market demands:** The demand for effective and well- permitted topical acne treatments is continuously growing. Research in this area drives invention and the development of new and advanced products to meet consumer conditions.

## 3. Materials and Methods

### Drug Profile: (Table 1)

**Table 1:** Ingredients name and their role

Ingredients Name	Role of Ingredients
Manilkara zapota leaves	Antioxidant agent, Anti-inflammatory agent.
Bay leaf	Anti- microbial agent.
Vigna mungo	Hydration, Exfoliation.

### 3.1. Manilkara zapota leaves

1. **Kingdom:** Plantae
2. **Scientific Name:** Manilkara zapota
3. **Family:** Sapotaceae
4. **Species:** Manilkara zapota(L)P. Royen.<sup>14</sup>
5. **Biological Source:** Manilkara zapota (L.) Van Royen, a tropical American evergreen tree, was brought to Egypt in 2002 to be grown for its fruit.

### 3.2. Chemical constituents

The biological effects seen in alcoholic and water-based extracts from Manilkara zapota (L.) Van Royen leaves are likely due to their phenolic compounds, specifically apigenin-7-O- $\alpha$ -L-rhamnoside, myricetin-3-O- $\alpha$ -L-rhamnoside, and caffeic acid. This aligns with existing research indicating that phenolic compounds exhibit significant antioxidant, antidiabetic, and cholesterol-lowering properties.<sup>15</sup> (Figure 3)

### 3.3. *Manilkara zapota* leaves uses

Traditionally, Sapodilla leaves have been used to treat various ailments:

1. **Anti-inflammatory:** Applied externally, the leaves are used to calm skin irritation and minor injuries, with their anti-inflammatory effects potentially reducing redness, swelling, and discomfort from skin issues.
2. **Antimicrobial:** Sapodilla leaves are applied to injuries and skin infections to promote healing and inhibit microbial growth.
3. **Antioxidant:** Being rich in antioxidants, Sapodilla leaves help neutralize dangerous free radicals and lower oxidative stress in the body.
4. **Antidiarrheal:** They are a common remedy for diarrhoea due to their astringent properties, which are thought to lessen intestinal inflammation and ease symptoms.<sup>14</sup>

### 3.4. Bay leaf

1. **Kingdom:** Plantae
2. **Scientific Name:** *Laurus Nobilis*
3. **Family:** Lauraceae
4. **Species:** *Laurus nobilis*.<sup>16</sup>

### 3.5. Biological source

Bay laurel thrives in a wide range of environments across India, Pakistan, Southeast Asia, parts of the Pacific, Australia, the Mediterranean and Southern Europe (including Greece, Portugal, France, Turkey, and Spain), North Africa (Algeria, Morocco), Belgium, Central America, Mexico, the southern United States, and the Canary Islands. For the fastest and most abundant growth, bay laurel prefers damp, sandy soil with plenty of water or humid, coastal climates.

### 3.6. Chemical constituents

Bay leaf extract contains phenolic compounds, giving it antioxidant properties that vary depending on the specific bay leaf species. Nutritionally, one ounce provides approximately 54 calories, 1-1.2 grams of protein, 12-13 grams of carbohydrates, a minimal amount of fat, 1-1.5 milligrams of iron, 51-53 milligrams of calcium, 2000-3000 IU of vitamin A, and 14-15 milligrams of vitamin C, along with a small quantity of potassium. Bay seeds are a good source of dietary fiber. The characteristic spicy aroma of bay leaves comes from significant compounds like eugenol (11%-12%), methyl eugenol (9%-12%), and elemicin (1%-12%).<sup>17</sup> (Figure 3)

### 3.7. Medicinal uses

Bay leaves may also help to:

1. Lessen inflammation and pain.
2. Protect against DNA-damaging chemicals.
3. Fight off microbes.
4. Act as an anticholinergic.<sup>18</sup>

### 3.8. *Vigna mungo*

1. **Kingdom:** Plantae
2. **Scientific Name:** *Vigna mungo* (Linn.) Hepper
3. **Family:** Fabaceae (Leguminosae) Papilionaceous (Leguminosae – Papilionoidea, Fabaceae)
4. **Species:** *V. mungo*<sup>19</sup>

### 3.9. Biological source

Black gram can be grown under low humidity and fertility conditions. Black gram (*Vigna Mungo* L.) is a major important pulse cultivated not only in India, but also in other Asian countries and some corridor of Africa.

### 3.10. Chemical constituents

Phytochemical webbing of different excerpts of *Vigna Mungo* L. seed fleece was carried out according to standard styles for the following chemical composites similar as alkaloids, terpenoids, phenols, tannins, carbohydrates, saponins, flavonoids, proteins and sterols.<sup>20</sup> (Figure 3)

Black grams are also known as urad dal and black dal (kali dal) due to its black colour. These black grams are spherical and perpendicular in shape, their external skin is greyish black, and the inner is delicate white and round.<sup>21</sup>

### 3.11. Medicinal uses

1. **Lightens suntan:** Urad dal is considered a fantastic component for cooling the body down internally. You can make a paste of urad dal and fresh curd to apply on your face and any sun-scourged spots. After letting it sit for 30 twinkles, simply wash it off with cool water.
2. **Fights acne:** Black gram is full of antibacterial parcels, it can help skin regenerate. Putting a paste of urad dal on acne can fade scars and keep your skin clear.<sup>22</sup>

### 3.12. There are many benefits of *Vigna mungo*. These include

1. Help with digestion.
2. Improve skin health.
3. Increase energy levels.<sup>21</sup>

### 3.13. Excipient profile: (Table 2)

**Table 2:** Ingredients name and their role

Ingredients	Role of ingredients
Carbopol	Gelling Agent
Polyethylene Glycol	Humectants PH adjuster, Emulsifier
Triethanolamine	PH adjuster, Emulsifier
Methyl Paraben	Preservatives

### 3.14. Carbopol 940

Carbopol 940, a white, crosslinked polyacrylic acid polymer in powder form, is a highly effective rheology modifier. Its non-drip quality makes it perfect for these kinds of applications.<sup>23</sup> Carbopol 940 is specifically chosen for its wide density range of 40,000 to 60,000 centipoise(cp).<sup>24</sup> Carbopol polymers are basically large, connected networks of acrylic acid chains held together by cross-links.<sup>25</sup>

### 3.15. Topical applications

Because carbomers are gentle, effective, and don't irritate the skin or interfere with how medications work, they're a great choice for water-based topical products. Carbopol polymers are useful for ensuring active drug ingredients stay evenly dispersed in patches that deliver medication through the skin, as well as in gels and creams applied directly to the skin.<sup>26</sup>

### 3.16. Methylparaben

Methylparabens, a type of paraben, are chemical preservatives commonly used by manufacturers to extend the shelf life of their products by preventing the growth of harmful microorganisms. Methylparaben, with the chemical formula C<sub>8</sub>H<sub>8</sub>O<sub>3</sub>, acts as a preservative by inhibiting the growth of pathogens and preventing unwanted chemical changes, thereby protecting both the product and the consumer.

Methylparabens have diverse applications primarily related to preservation, including:

1. Functioning as antifungal agents.
2. Being used as allergenic testing agents.

The most widespread application of methylparaben is as an antimicrobial preservative in cosmetic products.<sup>27</sup>

## 4. Polyethylene Glycol

Polyethylene glycol (PEG), a water-soluble and safe polymer compatible with many active ingredients, is widely used in medicine.<sup>28</sup> Its diverse molecular weights and adjustable properties make it a key ingredient in drug delivery, functioning as both an ointment base and a substance that helps other drugs dissolve.<sup>28</sup> In skin treatments, PEG's moisturizing and softening effects are helpful for psoriasis by enhancing the delivery of corticosteroids and reducing redness and scaling. Beyond its pharmaceutical uses, PEG works as an emulsifier, surfactant, and conditioner in cosmetic products.<sup>30</sup>

### 4.1. Triethanolamine

Triethanolamine (TEA) is a protean chemical generally set up in skin care and ornamental products. It primarily functions as a pH balancer and an emulsifier. TEA is produced through a chemical response involving ethylene oxide and ammonia. In cosmetics specifically, TEA helps

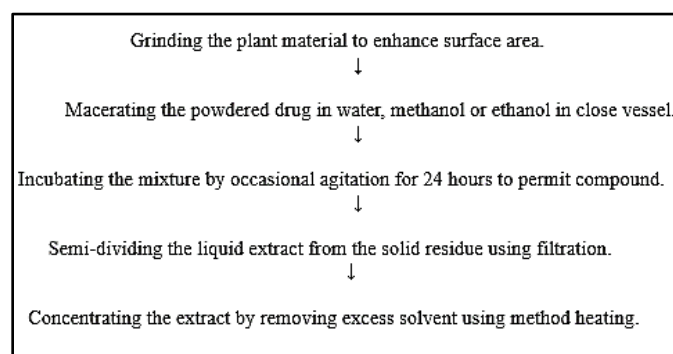
maintain product thickness, improves texture for a softer sense, and enhances spreadability. also, it acts as a buffer, icing the ornamental formula stays at the intended pH position.

## 5. Method of Pre-Formulation

**Table 3:** Equipment and glassware

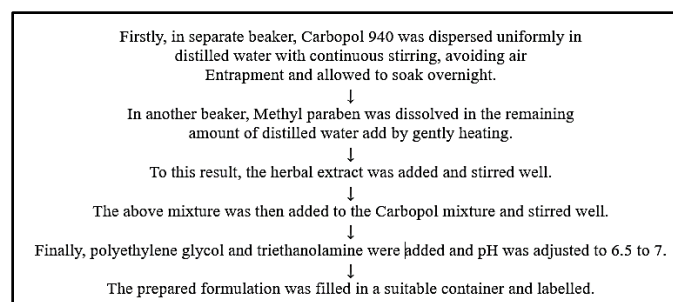
Equipment	Glassware
Weighing Balance	Beaker
PH meter	Measuring Cylinder
Water Bath	Stirrer
	Filter Paper
	Funnel

### Extraction by Maceration



### Filtration and extract

### Formulation of Gel: (Figure 4, Table 4)



**Table 4:** Formulation table of gel

Sr. No	Ingredients Name	Batch 1	Batch 2	Batch 3
1.	Extract of Manilkara zapota leaves	1ml	1.5 ml	2 ml
2.	Extract of Bay leaf	1ml	1.5 ml	2 ml
3.	Extract of Vigna mungo	1 ml	1.5 ml	2 ml
4.	Carbopol 940	1 gm	1 gm	1 gm
5.	Polyethylene glycol	1 ml	1 ml	1 ml
6.	Triethanolamine	1 ml	1 ml	1 ml
7.	Methyl paraben	0.5 gm	0.5 gm	0.5 gm
8.	Distilled Water	q.s	q.s	q.s

### Evaluation test: (Table 5)

1. **Colour:** The colour of the prepared gel was visually assessed against both white and black backgrounds.
2. **Odour:** The product was found to have an Odour through olfactory detection.
3. **Consistency:** The prepared gels were spread onto a transparent glass plate and then visually inspected for any coarse particles.
4. **State:** The state of formulation was ensured by visual inspection.

**Table 5:** Observation table

Parameters	Observation
Odor	Slightly malty odour
Consistency	Good
State	Semi – Solid

#### 5.1. Phase separation

The prepared gels were spread onto a clear glass plate and then visually inspected to check for the presence of aggregates.

#### 5.2. Washability

The formulation was applied to the skin, and then its ease and extent of washability with water were manually assessed.

#### 5.3. Homogeneity

The prepared gels were spread on a clear glass plate and visually inspected to see if any unmixed particles were present.

#### 5.4. pH Determination

To perform the dimension, 1 gm of the gel expression was dissolved in roughly 10 ml of distilled water, stirred to form invariant dissipation and the pH was measured using calibrated pH cadence.

### 6. Spreadability

It indicates the extent of area to which gel readily spreads on application to skin or affected part. The therapeutic potency of formulation also depends upon its spreading value. Spread ability is expressed in terms of time in seconds taken by two slides to slip off from gel which is placed in between the slides under the direction of certain load. Lesser the time taken for the separation of two slides, better the spreadability. It is calculated by using the formula:

$$S = M \cdot L / T$$

Where,

S = Spreadability.

M = Weight tide to upper slide.

L = Length moved on the glass slide.

T = Time taken to separate the slide completely from each other.

### 7. Result

The results of the evaluation are shown in Table No.6.

All the formulations have slightly alkaline pH. Amongst all the formulation batch 3 showed very optimum spreadability. The formulations batch 1, batch 2, shows good homogeneity whereas formulation batch 3 shows excellent homogeneity.

**Table 6:** Result of evaluation test of gel

Formulation Batch	Batch 1	Batch 2	Batch 3
Colour	Brownish red	Brownish red	Dark brownish red
pH	6.55	6.62	6.82
Spreadability	5.8	6.3	6.9
Homogeneity	Good	Good	Excellent
Phase Separation	No	No	No
Washability	Good	Good	Good

### 8. Discussion

Acne vulgaris is a common skin disorder affecting nearly everyone at least once, peaking during adolescence but often persisting into adulthood (20–40 years). It can lead to low self-esteem, social withdrawal, and depression. Herbal medicines are considered safer alternatives to allopathic treatments, which may cause side effects like irritation, allergy, redness, itching, and skin dryness.

The formulations were glossy and translucent. On application to the skin all formulations produced smooth and cooling effect. The gels were brownish red to dark brownish red with specific Odor. All formulations were found homogeneous and easily washable. The pH for all formulations ranged from 6.5-7.1, which may be suitable for topical application without discomfort three different concentrations of bay leaf, manilkara zapota leaves and vigna mungo extracts were used to prepare gel formulations with carbopol 940. An anti-acne study was carried out to show that that herbal gel can heal the acne without severe adverse effect.

### 9. Conclusion

Natural remedies hold significant promise in treating diseases, and the global market is witnessing a surge in demand for herbal formulations. Many believe that herbal medicines offer a safer alternative compared to allopathic drugs. In a particular study, several formulations were carefully optimized by assessing characteristics like physical appearance, washability, pH, spreadability, homogeneity, and phase separation. After evaluation, this study concludes that formulations batch 3 i.e. the gel which contains a combination of bay leaf, Manilkara zapota leaves and vigna mungo extracts was comparatively better than formulations of batch 1 and batch 2.



## 10. Source of Funding

None.

## 11. Conflict of Interest

None.

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