

## **A Review on Use of Natural Retinoid Bakuchiol and Natural Anti-Microbial Agent Tea Tree Oil in Anti Acne Gel Formulation**

PRAVEEN JAVALI R

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501  
[praveenjavalisgk1997@gmail.com](mailto:praveenjavalisgk1997@gmail.com)*

SYED IMRAN

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501  
[syedimran665@gmail.com](mailto:syedimran665@gmail.com)*

PRAVEEN SUTAGUNDI\*

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501*

DEVARAJU. T

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501*

MANASA. P

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501*

G. JEEVITH

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501*

ANNAPURNAMMA. R

*Department of Pharmaceutics (Faculty of Pharmacy), Sri Raghavendra College of Pharmacy  
Chitradurga, Karnataka, India-577501*

### **Abstract**

Acne is prevalent issue among today's youth concerning for good appearance; various synthetic anti acne gel is employed, but they can result in numerous side effects such as that may be controlled by using Herbal anti acne gels. They provide mild or no

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\*Corresponding Author.

adverse effects. Bakuchiol one of the natural retinol and alternative has been exposed to have anti-microbial, antioxidant, and anti-inflammatory qualities. TTO (tea tree oil) exhibit wide range of anti-microbial activity, whereas aloe vera gel serves as natural moisturising agent and soothing agent. Therefore, using Herbal ingredients in the formulation might lower expenses and give enhanced safer activity. This formulation is prepared by coarse dispersion method, cold method, and fusion method. To achieve improved result, the course dispersion method can be used, which will maintain stability for an extended period as it does not segregate.

**Keywords:** Acne Vulgaris (AV), Anti Acne, Bakuchiol, Course dispersion method, Tea tree oil (TTO).

## 1. INTRODUCTION

Acne (Acne Vulgaris), is a long-lasting state of the skin, causes inflammation in the oil glands and hair follicles which affects individual globally (Vasam, Korutla, & Bohara, 2023). Almost everyone has acne vulgaris at some point, which is a dermatological condition marked by inflammation (Ansong et al., 2023). Acne derived from the Greek word "Akme", means peak or apex, refers to genetic or acquired conditions of the pilosebaceous units. Acne is primarily involves of sebaceous gland characterized by pustules and papules, which are solid lesions or puss occurs on the skin (Alburyhi et al., 2024). Since the sebaceous gland acts as a holocrine gland, its secretions are produced once the gland cells fully decompose. Adult acne or AV is becoming more common especially in women who are 25 years old or elder. About 82 to 95% of teenage boys and 79 to 82% of girls get it, while only 3 to 12% of adult men and women are affected (Decker & Graber, 2017.). Recurrently, acne is a frequently occurs and wide spread dermatological condition associated with depression, anxiety, and various psychological outcomes (Sinha et al., 2014).

### 1.1. SKIN

The skin is a complex organ that surrounds the whole body and serves as a barrier between our bodies and the environment. This helps keep water and important minerals inside the body. Stops harmful chemicals from getting in and guard's against harmful microorganisms (Khavkin & Ellis, 2011).

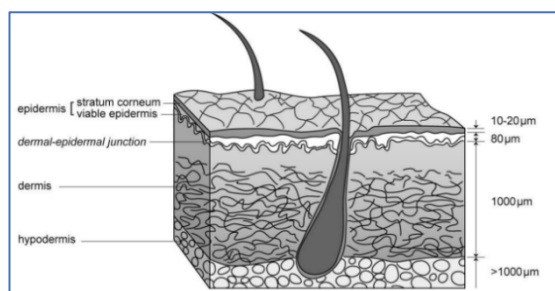


Fig. 1. A view of skin structure and physiology.

The skin also has senses that help detect different types of touch, pain, and heat. It has special glands called sebaceous glands that produce sebum. A mix of fats that help fight bacteria and keep the skin dry in many animals (Riviere, 2010). Skin has 3 major layers: the epidermis, dermis, and hypodermis. The skin's outermost layer is the farthest film or layer and is mostly fabricated of cells that move to the surface of the skin (Geerligs, 2010).

- **Epidermis:** The epidermis consists of several layers and different types of cells that are important for its role.
- **Dermis:** The basement membrane links the dermis and epidermis. The dermis containing two layers of connective tissue, papillary and reticular layers, that blend seamlessly mutually.
- **Hypodermis:** The hypodermis or subcutaneous fascia, is situated below the dermis. (Yousef et al., 2017)

## 1.2. GEL

Gels are semisolid products used on the skin or on mucus membranes that are exposed like inside the mouth gels are made up of two parts that work together in this gels tiny particles called gelators or gellants are spread evenly in liquid or other type of medium this creates a three-dimensional structure that makes gel hold its shape (Ahmed un Nabi, 2016). The USP, which is a standard for medicines describes gels sometimes called jellies, as semisolid mixtures. These can be made either by mixing very small inorganic particles in a liquid or by having larger organic molecules spread throughout the liquid (Rathod & Mehta, 2015). In single phase gels, the large organic molecules are mixed so well with the liquid that there is no clear line between them (Soni, 2018).

### 1.2.1. Characteristics of Gels: (Rathod & Mehta, 2015) (Pazyar, 2012)

- Swelling
- Syneresis
- Ageing
- Structure
- Rheology

### 1.2.2. Properties: (Rathod & Mehta, 2015)

- The gelling agent needs to be safe, not harmful, and unable to interact with other elements of the formulation.
- It should include a good anti-microbial agent.
- The gel should not stick to surface.
- The gel used in the eyes must be free from any harmful agents.

### 1.2.3. Classification of Gels: (Metta, 2023)

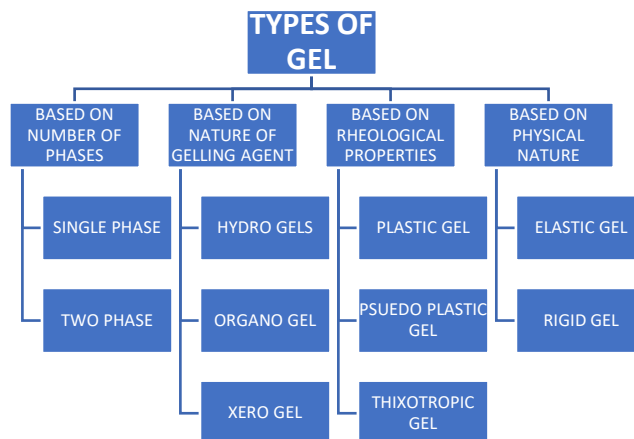


Fig. 2. Classification of Gel.

### 1.3. ANTI ACNE

Anti acne pertains to any product, substance, treatment, or action that assist in preventing, diminishing, or addressing acne. Contemporary acne treatment aims to disrupt the disease-causing process at various stages. Topical treatment involves comedolytic agents as well as different anti-inflammatory medications. Systemic treatment includes antibiotics, zinc, and hormones. Extended overuse of antibiotics has led to increased conflict in bacteria responsible for acne, including Propionic bacterium acnes and Staphylococcus epidermidis.

Table 1. Ingredients for the preparation of anti-acne gel and their role.

Sl. No	Materials	Role
1	Bakuchiol	Anti-inflammatory, anti-acne
2	Tea tree oil	Anti-microbial
3	Carbomer 940	Gel base
4	Propylene glycol	Solvent.
5	Triethanolamine	pH neutralizer
6	Niacinamide	Brightening agent
7	Aloe Vera gel	Humectant
8	Phenoxyethanol	Preservative
9	Ethanol	Solvent
10	Ethyhexylglycerin	pH neutralizer
11	Xanthan Gum	Gelling agent
12	Propanediol	Humectant
13	1,2-Hexanediol	Preservative

#### 1.4. BAKUCHIOL

*Psoralea corylifolia* Linn. seeds were the original source of bakuchiol. (Krishna, 2022) Bakuchiol (Phenol, 4-[1E,3S)-3-ethenyl-3,7-dimethyl-1,6-octadinenyl. Bakuchiol is part of a rare category of terpenoids characterized by an aromatic ring structure derived from phenyl propane unit. (Chaudhuri, 2014) It is a meroterpene that exposed significant antimicrobial, anti- osteoporotic & antitumorigenic other beneficial uses. (Nizam et al., 2023)

##### 1.4.1. Bakuchiol mechanism of actions: (Chaudhuri & Marchio, 2011)

- Fixing the changed the follicles produce keratin
- Reducing activity of the oil glands
- Lowering the number of bacteria in the hair follicles, especially *P. acnes*
- Helping to reduce inflammation.



Fig. 3 (a). Bakuchiol powder.

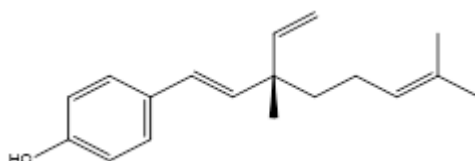


Fig. 3 (b). Chemical structure of Bakuchiol.

#### 1.5. TEA TREE OIL

Melaleuca oil, or tea tree oil, is a pure essential oil that is rich in lipophilic and monoterpene compounds. It is made by steam distilling the leaves of the resident Australian plant *Melaleuca alternifolia* (Hammer, 2014). *Melaleuca alternifolia* also called as Maiden and Betch is an evergreen tree that grows naturally in Australia belonging to the Myrtaceae family. This TTO finds application in pharmaceutical, cosmetics and food sectors because of its antimicrobial, antioxidant, anti-inflammatory, and antineoplastic characteristic (Nascimento et al., 2023). Tea tree oil exhibits extensive antimicrobial activity (Hammer, 2014). Tea tree oil consists of diverse combination of terpenes & associated alcohol (Carson, 1998) Among all the qualities attributed TTO, its antimicrobial activity have generated the most focus, The Assessment TTO's antimicrobial effectiveness has been hindered by its physical characteristics; TTO and its constituent have limited solubility in water (Carson, 2006).

## 2. MECHANISM OF ACTION

Antibiotics that restrict the growth of *Propionibacterium* are often used to treat acne vulgaris, but the rise of antibiotic-resistant strains poses an issue. Tea tree oil has demonstrated a wide range antimicrobial and anti-inflammatory effects in laboratory tests. These impacts have established foundation for its application in acne therapy (Pazyar, 2012).



Fig. 4. TTO.

### 2.1.1. *Advantages of Anti acne Gel*

- Targeted & localized delivery (Fox et al., 2016).
- Higher skin penetration & bioavailability (Barak-Shinar & Draelos, 2017).
- Stable & cost-effective.
- Cosmetically preferred texture.

### 2.1.2. *METHODOLOGY*

Methods used in the Formulation of Anti acne gels (Niyaz et al., 2011).

- Dispersion Method
- Cold Method
- Fusion Method

## 3. COURSE DISPERSION METHOD

**Step 1:** Preparation of Gel phase.

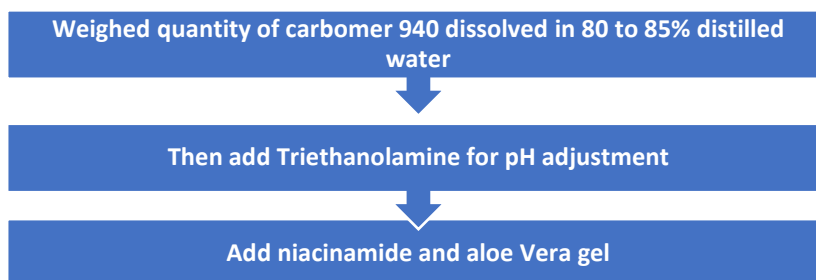


Fig. 5 (a). Preparation of Gel phase.

**Step 2: Preparation of API phase**

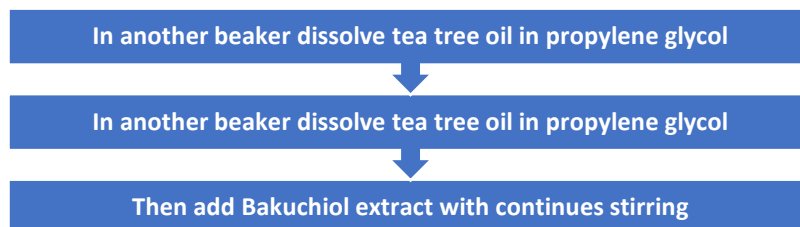


Fig. 5 (b). Preparation of API phase.

**Step 3: Mixing**

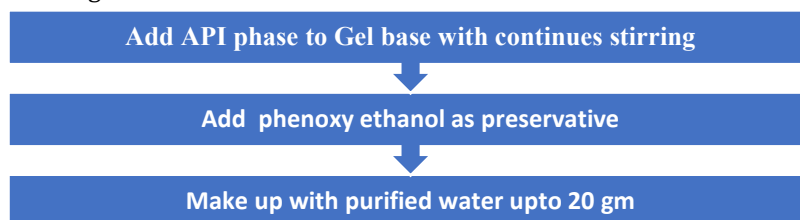


Fig. 5 (c). Mixing.

Fig. 5. Steps involved in preparation of anti-acne gel by course dispersion method (Chandrasekar, 2020).

**4. EVALUATION PARAMETERS:**

**4.1. Physical appearance**

- **Color:** The physical appearance of the formulation was checked visually by looking after the color beside white board.
- **Consistency:** The formulation was tested for its consistency by being applied to the skin.
- **Greasiness:** It was tested by apply on the skin surface.
- **Odor:** The odor was checked by mixing a small amount of gel in water and then sniffing it.

**4.2. pH**

The pH values of the various formulations were determined using a Digital pH Meter (HI 96107). After mixing one gram of gel with one hundred milliliters of purified water, the finished product was allowed to sit for two hours. They measured the pH. The gel formulations are unlikely to cause skin irritation since their pH values were within the typical range of normal skin, which is  $5.9 \pm 0.1$ - $6.36 \pm 0.2$ .

#### **4.3. Spreadability**

The polyherbal dermal gel's spreadability was assessed by examining its slip-drag properties. The method included putting 2 g of the gel formulation on a glass slide and covering it with another slide equipped that as a hooked edge. A heavy object was positioned over the slides to let out trapped air and form a uniform film linking them. overload gel was vigilantly taken off from the ends. The upper slide was then pulled with a energy of 50 grams, and the time essential for the slide to shift a distance of 6cm was recorded. The spreadability (S) was determined using the formula:  $S = M \times L / T$ , M = weight applied to the upper slide (20g); distance moved (6 cm); T = time in seconds it to pull the slides apart.

#### **4.4. Drug Content**

Drug content Procedure was performed under dim lighting. A volume of gel contains 0.5 mg isotretinoin was taken, 10 ml of dichloromethane was poured, mixed awaiting fully gels completely dispersed and then solution is dilute to 100 ml with 5 ml of 0.1 M HCL to 250 ml with ethanol (96%). the absorbance of the solution was recorded at its peak near 356 nm. This measurement was taken using a reference cell filled with an ethanolic hydrochloric acid solution. The amount of C<sub>20</sub>H<sub>28</sub>O<sub>2</sub> in gel was calculated using a value of 1350 for a (1%, 1cm) at the peak around 356nm, measured with a UV visible spectrophotometer, which is a systronic double beam spectrometer.

For the drug content analysis samples were collected from top, middle and bottom parts of the container. The experiment was repeated ten times for each batch. Four samples were taken from the top section and three samples each were taken from the middle and bottom sections. After all the measurements the typical value was used to determine drug content. Novel analytical methods also can be considered such as AQBd for drug content evaluation for further analysis. (Bairagi et al., 2024)

#### **4.5. Stickiness**

It was assessed by applying little amount of gel, then looking to see if it was sticky or not after the product was applied.

#### **4.6. Viscosity**

The formulation's viscosity was assessed with the Digital Brookfield Viscometer using spindle no. 6 at 10 rpm and temperature of 25±1°C. An adequate quantity of gel was poured into a suitable wide mouth container to ensure the spindle could be immersed properly and it was allowed to rest for 30 minutes prior to taking the measurements.

#### **4.7. Washability**

To check how well the formulations can be washed off, gel was applied to the skin. Then, easiness and completeness of rinsing it with distilled water were evaluated, and the results were observed.

## 5. CONCLUSION

The formulated anti-acne gel combining Bakuchiol and Tea Tree Oil represents a good herbal option for the treatment of acne. Bakuchiol, a plant-based substitute to retinoids, offers anti-inflammatory and skin-regenerating properties without causing the irritation that often comes with synthetic retinoids. Tea Tree Oil, a well-known natural antimicrobial agent, effectively targets acne-causing bacteria (*Propionobacteria acnes*) and reduces inflammation. The gel demonstrated good physicochemical properties, stability, and potential antimicrobial activity, making it suitable for topical application. This combination uses both ingredients together in a way that works well together, offering a gentle yet effective solution for managing acne. In the future, this formulation can be further explored for clinical testing, extended into other product types including creams or face washes, and potentially marketed as a safe, natural, and consumer-friendly alternative to conventional acne treatments.

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