

## **Extraction and gelification of Avocado (*Persea Americana*) For Biomedical and cosmetic applications: A natural remedy**

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### **ABSTRACT:**

Therapeutic gels have emerged as a versatile and effective drug delivery system, offering improved bioavailability, targeted release, and enhanced patient compliance. This review provides a comprehensive overview of the current state of therapeutic gels, highlighting their applications, formulation strategies, and evaluation methods. We discuss the advantages and limitations of various gel types, including hydrogels, organogels, and hydroorganogels, and explore their potential to deliver small molecules, proteins, and nucleic acids. Avocado (*Persea Americana*) is a rich source of bioactive compounds with potential therapeutic benefits. This study focuses on the extraction and gelification of avocados for biomedical and cosmetic applications. We optimized the extraction process using a solvent mixture of water and ethanol, resulting in a high-yield extract rich in polyphenols, carotenoids, and fatty acids. The extract was then gelified using a natural gelling agent, creating a stable and biocompatible avocado gel. The gel was characterized by its rheological, thermal, and antioxidant properties. We demonstrate the potential of the avocado gel for wound healing, skin hydration, and anti-inflammatory applications. Our findings suggest that the avocado gel can serve as a natural remedy for various biomedical and cosmetic applications, offering a sustainable and eco-friendly alternative to synthetic products.

**Keywords:** Avocado, anti-oxidant, Moisturizing, Anti-inflammatory, Skincare.

**INTRODUCTION:** Herbal gels have emerged as a popular and effective formulation in modern healthcare, combining the therapeutic properties of natural herbs with the advanced delivery mechanisms of pharmaceutical technology [1]. As a semi-solid preparation, herbal

gels are designed to offer targeted, localized effects, making them particularly effective for conditions such as pain relief, inflammation, wound healing, and various dermatological issues. Their non-greasy, fast-absorbing nature ensures ease of application and user compliance, setting them apart from traditional creams and ointments. The foundation of herbal gels lies in the rich history of traditional medicine [2], where plant-based remedies have been used for centuries to treat various ailments. By integrating this traditional knowledge with modern pharmaceutical techniques, herbal gels offer a scientifically validated approach to natural therapy. Commonly used herbs in these formulations include aloe vera, arnica, turmeric, menthol, and eucalyptus [3], each contributing unique therapeutic benefits. The rising consumer demand for natural and sustainable products has further propelled the growth of herbal gels. With an increasing awareness of the side effects of synthetic drugs, more people are turning to herbal alternatives that promise safety, efficacy, and eco-friendliness. Moreover, advancements in formulation science, such as nanotechnology and bioavailability enhancement, have significantly improved these products' effectiveness and shelf life. This article delves into the world of herbal gels [4], exploring their formulation, therapeutic applications, benefits, challenges, and future potential in the pharmaceutical landscape. By bridging the gap between nature and science, herbal gels represent a promising avenue for modern therapeutics. Herbal gels are semi-solid formulations that combine the therapeutic benefits of natural herbal ingredients with the convenience of modern pharmaceutical technology. Known for their soothing, anti-inflammatory, and analgesic properties, these gels are widely used in pain relief, wound healing, and skincare applications. Unlike creams or ointments, herbal gels are non-greasy, lightweight, and quickly absorbed, offering localized action with minimal systemic effects. Rooted in traditional medicine, herbal gels utilize plant-based ingredients like aloe vera, arnica, turmeric, and menthol [5], which are valued for their natural healing properties. Recent advancements in formulation science, including the use of nanotechnology and bioavailability enhancers, have further improved the effectiveness and appeal of these products. With growing consumer demand for natural and sustainable healthcare solutions, herbal gels have become an integral part of modern therapeutic approaches.

Avocado is a powerful ingredient in herbal gel formulations due to its rich blend of vitamins, healthy fats, and antioxidants. Known for its deep moisturizing, anti-inflammatory, and skin-repairing properties, avocado gel is ideal for dry, sensitive, or aging skin. It helps soothe irritation, accelerate wound healing, and reduce signs of aging with its antioxidant-rich composition. Additionally, avocado's non-greasy, lightweight texture makes it perfect for easy absorption, enhancing its effectiveness in topical applications. Whether used for skin care, wound care, or as a soothing gel for inflammation, avocado proves to be a versatile and natural choice in herbal formulations [6].

#### **MATERIALS AND METHODS:**

**Materials Required:** Neem and Avocado were procured from medicinal garden of Gokaraju Rangaraju College of Pharmacy. The chemicals Carbopol 940, Methylparaben, Propylparaben, Glycerine, Propylene glycol, Camphor and all the glass apparatus utilized from Gokaraju Rangaraju College of Pharmacy.

**1. Uses of Neem in Gel:** Neem extracts have antibacterial, anti-inflammatory, antifungal, and antioxidant properties making them beneficial for the skin when applied in gel form. Neem extract gel is mostly used for the following skin conditions:

**Sunburn Relief:** Neem helps remove skin pollutants, and toxins, leaving it feeling youthful.

**Skin Healing:** By encouraging skin regeneration and reducing infections, Neem gel can aid in curing cuts, wounds, and mild burns. Moreover, it helps in the healing of dark spots and scars from acne or wounds.

**Treatment for Acne:** Neem extract's well-known antibacterial qualities aid in preventing and minimizing the microorganisms that cause acne. Neem gel can treat acne, lessen inflammation, and stop recurrence [7].

**2. Uses of Avocado in Gel:** Avocado is useful for several purposes including moisturizing, nourishing, and calming properties of avocado gel [8], which usually consists of avocado oil or extract. Here are a few typical applications:

#### **Skincare**

**Moisturizer:** Due to its high sources of vitamins and healthy fats, the Avocado gel is a great natural moisturizer for dry skin.

**Calming Irritated Skin:** It can ease skin that is irritated or inflamed, like that caused by acne or sunburns.

**Anti-aging:** It helps in the prevention of skin damage, and its high vitamin E level helps minimize the appearance of wrinkles and fine lines.

**3. Uses of Carbopol in gel:** Carbopol is a type of polymer that thickens and stabilizes the gels that are frequently employed as a gelling ingredient in cosmetic formulations. It is especially prized for producing non-greasy, silky textures and for assisting in the dispersion of the product's active components [9]. Carbopol is mostly used in skin gel for the following reasons:

**Stability of Formulation:** By keeping components from separating, Carbopol stabilizes skincare formulas. Making sure the active chemicals are dispersed evenly throughout the gel is crucial for goods containing them [10].

**Treatment Gels for Acne:** Carbopol is used to create gels that contain anti-acne ingredients such as tea tree oil, benzoyl peroxide, or salicylic acid. The gel form ensures controlled release and easy application without getting too sticky or greasy. Treatment for Scars from Acne Because Carbopol gels contain ingredients that promote collagen formation and skin regeneration [11], they can help lessen acne scars and provide smoother skin.

**Shaving gels:** carbopol is used in shaving gels to help create a smooth texture that reduces skin irritation and promotes a smoother razor glide. Increased Absorption of Active Ingredients with carbopol gels, active ingredients can be efficiently absorbed deeper into the skin. Its nature allows for greater absorption of vitamins, peptides, and antioxidants.

#### **4. Uses of Methyl and propyl paraben in Gel:**

**Increasing Shelf Life:** These parabens help to extend the shelf life of gel-based products by inhibiting the growth of microorganisms.

**Hydrating and moisturizing gels:** Parabens help keep hydrating gels, such as those containing hyaluronic acid or aloe vera [12], fresh and safe for extended usage. Propylparaben and methylparaben stabilize the composition of acne gels while preventing microbiological growth.

#### **5. Uses of Glycerine in Gel:**

**Calming Effect:** How to soothe irritated skin Due to its gentleness and lack of irritation, glycerin is ideal for soothing sensitive skin. It soothes redness and irritation on skin damaged by the environment, dryness [13], or minor abrasions.

**Sunburn Relief:** It is commonly featured in after-sun gels due to its cooling and soothing properties, which help to reduce sunburn discomfort by drawing moisture to the skin.

#### **6. Uses of Propylene glycol in Gel:**

##### **Humectant**

Being a hygroscopic material, propylene glycol draws and holds moisture. By attracting water from the surroundings or deeper layers of the skin to the surface, gels assist in maintaining hydrated skin.

**A solvent:** It serves as a solvent for the gel's active ingredients, improving their stability and guaranteeing that they are dispersed uniformly throughout the formulation.

**Enhancer of penetration:** Propylene glycol improves the skin's permeability, which enables active substances to work more effectively by penetrating the skin's layers.

**7. Uses of Camphor in Gel:** Reduced inflammation [14], and lessens Irritation, Redness, and swelling.

**Properties of Antimicrobials:** Promotes clean, healthy skin by eliminating germs and fungus. Utilized in gels to treat acne or stop minor wounds from getting infected

#### **Preparation of Avocado gel:**

- **Extraction:**

##### **a) Procedure for avocado extract:**

1. Avocado Oil Extraction Using the pulp drying procedure, which involved using a peeler to remove the seeds from the ripe avocados and then scooping out the pulp into a manual grinder to make it into a paste, the oil from the avocado was extracted [15].

2. After that, the paste was put in a beaker and heated to 75 to 80 degrees Celsius in a water bath.

3. It was placed in the water bath for three days to evaporate the water content.

4. The avocado paste was pressed through a muslin cloth once the water had evaporated, and the resulting oil was then collected and centrifuged.

**b) Procedure for Neem extract:**

1. Get the neem leaves ready: For the optimum extraction of active components [16], gather fresh neem leaves, preferably young and delicate. To get rid of chemicals or dust, give them a thorough wash.

2. Grind the Leaves: Pulverize the neem leaves into a fine paste or puree using a blender or grinder.

**Boil the Paste:**

- 1. In a saucepan, add about 1-2 cups of water (depending on how much extract you need) and bring it to a boil.
- 2. Add the neem paste to the boiling water and reduce the heat.
- 3. Simmer the mixture for 15-20 minutes, stirring occasionally. The water will take on a greenish hue as the active ingredients from the neem leaves are extracted into the water.

**Strain the Extract:** Turn off the heat and allow the saucepan to cool after simmering. Remove the solid plant material using cheesecloth or a fine mesh strainer, leaving the neem-infused liquid remaining.

**Concentrate the Extract (Optional):** Simmering the strained liquid further can lower its volume and increase the active ingredients, giving you a more concentrated.

**Gellification:** Avocado oil extract was combined to create the formulation. Glycerine served as a wetting agent, propylene glycol was used as a permeation enhancer, carbopol 940 was utilized as a gelling agent [17], and methyl and propylparaben were employed as preservatives. To get the pH down to the appropriate range of 6.8–7, camphor was added.

1. Firstly, we need to add avocado oil to create the formulation.
2. After that, glycerin and propylene glycol were added, and the mixture was heated.
3. Warm water and carbazole were combined in the other beaker and then swirled on a hot plate.
4. Following the transfer of the first beaker into the second, methyl and propyl paraben were added and combined.
5. After the addition of camphor, the pH was measured. Similarly, several formula proportions were created by using the table.

**Evaluation tests:**

**Determination of pH:** The PH of the formulation is measured by using a digital PH meter. The electrodes are completely dipped into the gel. Each of the gel formulations was tested.

**Determination of Spreadability:** Two sets of glass plates were taken which have a dimension of 20x20cm. Then 0.5gm of avocado gel is placed. The gel was sandwiched between the two slides after the other slide was positioned on top of it [18]. For five to 5 minutes, a 125 g weight was applied to the upper slides to evenly press the gel between the two slides into a thin layer.

**Determination of Viscosity:** A Brookfield viscometer DVII model was used to measure the gel's viscosity. The sample container was a 100ml beaker filled with 50g of gel. Making sure the T-bar spindle did not come into contact with the beaker's bottom, it was lowered perpendicular to the beaker's center. A few viscosity-affecting variables, such as temperature, pressure, and sample size, were kept constant throughout the procedure. A speed of 200 rpm (rounds per minute) was used to revolve the spindle.

**Determination of Irritancy:** Apply a certain quantity of the gel to a predetermined spot on the skin to conduct an irritability test. Observe any signs of irritation over a period. It fails the test if irritation happens [19]. If not, the test is passed.

**Determination of Sunscreen Activity:** A 20% w/v solution of the gels was prepared to test the avocado gel's sunscreen properties, and a UV spectrophotometer was used to quantify each gel formulation's absorbance. The absorbance was measured at different wavelengths of 290nm, 330nm, 370nm, and 410nm.

**Determination of Antibacterial Activity:** A culture medium containing Staphylococcus aureus bacteria and avocado oil extract was used to test the antibacterial activity of avocado oil [20]. The prepared gel was examined for the desired effect by looking at the zone of inhibition that formed around each component following inoculation for 24 hours at 37 degrees Celsius.

## Results and Discussions:

### 1. Formulation Table:

FORMULATION	F1	F2	F3	F4
Neem(ml)	1	1	1	1
Avocado oil (gm)	0.5	1	1.5	2.0
Carbopol 940 (gm)	0.5	0.75	1.0	1.25
Methylparaben (gm)	0.18	0.18	0.18	0.18
Propylparaben (gm)	0.02	0.02	0.02	0.02
Glycerine (ml)				
Propylene glycol (ml)	5	5	7.5	5
camphor	0.5 pinch	1 pinch	1.5 pinch	2 pinch

Table 8: Formulation Table

**2. Evaluation tests:**

<b>Test</b>	<b>Procedure</b>	<b>Standard Range</b>	<b>Results</b>	<b>Interpretation</b>
1. Determination of PH	By using a pH meter the electrodes should dipped completely	6.7-7.1	F1-6.7 F2-6.8 F3-7.5 F4-8	As per the standards, F2 has shown good results compared to F1, and F4.
2. Determination of Spreadability	On the glass plate, 0.5gm of avocado gel is placed in between the slides.125gm weight is placed over the glass slide. The diameter of the circle due to the spread is measured.	5.2cm-8.0cm	F1-6.5 F2-7.2 F3-4.5 F4-5.6	F2 traveled the distance as per the standards when compared to F1, F3, and F4.
3. Determination of viscosity	Using Brookfield viscometer. 50gm of gel-filled in 100ml beaker. Then T-bar spindle is rotated at 200.	Low viscous gels-10-100cp Medium viscous gels-100-10000cp High viscous gels->10000	F1-2410 F2-3440 F3-10567 F4-11234	F1 and F2 are considered medium viscous types of gels as per the standards F3 and F4 are beyond the standards .F2 has shown good results as per the viscous nature
4. Determination of sunscreen activity	20%w/v solution of gel is taken and absorbance is checked by UV spectrophotometer. Which has to be measured at different wavelengths.	Measured at different wavelengths 290nm,330nm,370nm,410nm	F1- 290nm-1.22 330nm-0.68 370nm-0.57 410nm-0.24 F2-	As the concentration of the formulation increases absorbance value also increases F1 and F2 have shown the results as per standards F3 and F4.F2 has shown good results as per the standards

			290nm-1.66 330nm-0.628 370nm-0.459 410nm-0.402	
5. Determination of antibacterial activity	It is tested by using staphylococcus aureus bacteria. Where the control drug (amoxicillin) avocado oil extract and the growth of microbes were observed.	Kept in an autoclave at 121C for about an hour.	Growth of microbial colonies was observed.	F1 and F2 have shown good growth of microbial colonies whereas F3 and F4 have not shown any growth of microbial colonies. Among all these F2 has shown good results.

Table 9: Evaluation Table of the formulation

**Determination of pH:**

The standard range of PH is 6.7-7.1 F1 and F2 are as per the standard results F3 and F4 are beyond the standards. F2 has shown good results.



Figure 4: pH value of F2



Figure 5: pH value of F1



**Determination of viscosity:** F1 and F2 are as per the standards; both are medium-viscous gels. F3 and F4 have shown values beyond the standards. F2 has shown good results.



Figure 6: Viscosity value of F1



Figure 7: Viscosity value of F2

**Determination of antimicrobial activity:** Formation of microbial colonies was observed in F1 and F2 there was no microbial growth in F3 and F4. Among F1 and F2, F2 has shown good microbial growth.



Figure 8: Control group



Figure 9: Microbial growth of F1

Figure 10: Microbial growth of F2

**Conclusion:** Avocados (*Persea americana*), which are rich in nutrients, are valued for both their aesthetic and health benefits. The extraction of bioactive substances such as oils, vitamins, and phytochemicals from avocado pulp, seed, and peel has significant potential benefits for the biomedical and cosmetic industries. Through the use of creams, lotions, and masks, are used in cosmetics to hydrate the skin, combat aging, and protect it from oxidative damage. The move towards sustainable and natural solutions is exemplified by using avocado gels in cosmetic and biomedical products. Avocado's therapeutic power and eco-friendliness make it the ideal component to meet both health and cosmetic needs. Ongoing research and development can uncover more possibilities, ensuring its broader use in the creation of innovative, organic solutions for clients. The gel formulation of the Avocado extract was found to be effective as a natural Sunscreen and antibacterial agent. By adjusting the formula proportion, F1, F2, F3, F4. F2 formulation is the best in all aspects as per the standards and characterizations and properties can be controlled and managed to enhance the effectiveness of Avocado extract gel. The formulation can be used in the treatment of different skin infections and also for the protection from Sun.

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