WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 16, 1885-1914. Research Article ISSN 2277–7105

FORMULATION AND EVALUATION OF POLYHERBAL EMULGEL ENRICHED WITH *DAUCUS CAROTA*, *RUBUS IDAEUS* SEED OIL AND *SOLANUM LYCOPERSICUM* EXTRACT FOR ENHANCED SKIN PROTECTION.

Dr. M. Senthil Raja, A. Chandra*, S. Madhan, S. Nirmalraj, T. V. Sucheendradevi, S. Tamilvanan

B. Pharmacy Final Year Students, Department of Pharmaceutics, P. S. V. College of Pharmaceutical Science and Research, Orappam, Krishnagiri Affilated to The Tamil Nadu Dr. M. G. R. Medical University, Tamil Nadu, 635108.

Article Received on 20 July 2026,
Article Revised on 10 August 2026,
Article Published on 16 August 2026,
https://doi.org/10.5281/zenodo.22055216

***Corresponding Author**
A. Chandra
B. Pharmacy Final Year Students, Department of Pharmaceutics, P. S. V. College of Pharmaceutical Science and Research, Orappam, Krishnagiri Affilated to The Tamil Nadu Dr. M. G. R. Medical University, Tamil Nadu, 635108.

How to cite this Article: Dr. M. Senthil Raja, A. Chandra*, S. Madhan, S. Nirmalraj, T. V. Sucheendradevi, S. Tamilvanan (2026). Formulation And Evaluation Of Polyherbal Emulgel Enriched With Daucus Carota, Rubus Idaeus Seed Oil And Solanum Lycopersicum Extract For Enhanced Skin Protection.. World Journal of Pharmaceutical Research, 15(16), 1885–1914.
This work is licensed under Creative Commons Attribution 4.0 International license.

1. ABSTRACT

The present study aims to formulate and evaluate a polyherbal Emulgel containing *Daucus carota* (Carrot) seed oil, *Rubus idaeus* (Raspberry) seed oil, and *Solanum lycopersicum* (Tomato)extract for topical application. Carrot seed oil is a rich source of carotenoids and antioxidants that help protect the skin from oxidative damage. Essential fatty acids and naturally occurring UV-protective substances found in raspberry seed oil aid in skin nourishment and photoprotection. Lycopene, a potent antioxidant with anti-aging and skin-protective qualities, is abundant in tomato extract. Emulgel has an advantage of both emulsion and gel. Therefore, it has dual release control system. Emulgel system is most significant for delivering the hydrophobic drugs and hence it is used for both cosmetics and therapeutic application. The formulation was prepared using suitable gelling agents, emulsifying agents, and other excipients to obtain a stable and homogeneous product and the various physiochemical parameters were evaluated.

KEYWORDS: Emulgel, Hydrophobic drug, Dual release, Gelling agent, Antioxidants, Lycopene.

2. INTRODUCTION

A topical drug delivery system is a formulation or medication that is applied directly to the skin to either directly treat cutaneous illnesses or obtain the local effect of drug. There are several dosage forms for topical drug delivery including ointment, paste, cream, lotion and gels. Topical medication delivery methods allow a medicine to enter the systemic circulation at a controlled rate by penetrating the epidermal layer to limit the drug's pharmacological or other effects on the skin's surface or deeper layers to treat cutaneous condition. Topical drug delivery system was used for both cosmetic and therapeutic applications. Gel is the most advantageous both in cosmetics and pharmaceutical preparations when compared to other formulations. Delivery of many herbal oils, lipophilic plant constituents and drugs having poor water solubility is insignificant in gel formulations. So, to overcome this limitation an emulsion-based approach is being used. When gels and emulsions are used in combined form the dosage form is referred as Emulgel. An emulsion can be made into an Emulgel by combining it with gelling agents.

The inclusion of naturally occurring bioactive substances such antioxidants, fatty acids, carotenoids, phenolics, and other phytoconstituents is linked to the growing interest in herbal topical preparations. These substances may aid in preserving the health of the skin and shielding it from environmental elements and oxidative stress. Combining various plant-derived substances in one formulation may enhance the product's overall functional potential and offer complementing qualities.

The herbal components were chosen such as *Daucus carota* (carrot) seed oil, *Rubus idaeus* (raspberry) seed oil, *Solanum lycopersicum* (tomato extract). Carotenoids, terpenoids, phenolic compounds, fatty acids, and tocopherols are among the bioactive components found in carrot seed oil, which has been linked to antioxidant and skin-conditioning qualities. Polyunsaturated fatty acids, including linoleic and α-linolenic acid, as well as tocopherols, phytosterols, and other bioactive substances, can be found in raspberry seed oil. These components support its skin-conditioning, hydrating, and antioxidant qualities. Tomato extract contains number of bioactive substances, including as lycopene, β-carotene, lutein, vitamin C, vitamin E, flavonoids, and phenolic compounds. These components are also linked to antioxidant activity and could help shield the skin from oxidative and environmental stress.

The DPPH free-radical scavenging assay is used to evaluate the antioxidant potential, and an in-vitro SPF determination method is used to examine the photoprotective capability. The overall goal of the research is to create a herbal topical formulation that is stable, palatable, and may have skin-protective uses.

3. EMULGEL

Emulgels have emerged as one of the most promising semisolid topical drug delivery methods in recent years. Emulgel have been utilized in both pharmaceutical as well as cosmetic preparations as it has an advantage of both emulsion and gel for topical drug delivery. Although gels offer several benefits, the administration of hydrophobic medications is one of their main drawbacks. In order to overcome this limitation, Emulgel are designed to facilitate the delivery of these hydrophobic medications as well.

Emulgel can be defined as the semisolid dosage form which can be prepared by the incorporation of an emulsion that is either oil in water or water in oil into a gel base using suitable gelling agent. The emulsion permits the addition of lipophilic active substances hence the emulsion (O/W or W/O) is used as a vehicle to delivery various hydrophobic therapeutic moiety, while the gel network improves stability, spread ability, and patient acceptability. Thixotropy, non-greasy, spreadable, easily removable, softening, non-colouring, water-soluble, longer shelf life, biocompatibility, transparency, and pleasing look are the benefits of using Emulgel for dermatological purposes.

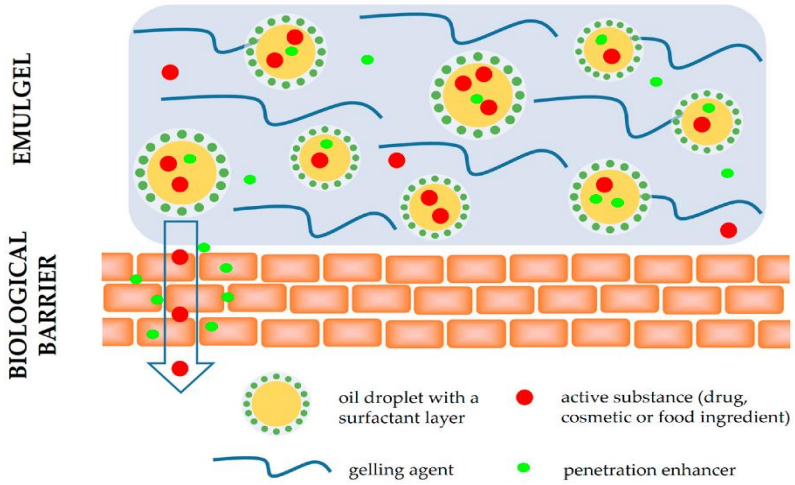


Figure 1: Schematic representation of Emulgel.

3.1 Rationale of Emulgel as a topical drug delivery

Numerous commonly used topical medications, such as lotion, cream, and ointment, have many drawbacks. When application, they are stickiness and greasiness making the patient uncomfortable. Additionally, they have a lower spreading coefficient and require rubbing when applied. They also show the stability problems. The use of transparent gels in pharmaceutical and cosmetic preparations has increased as a result of these drawbacks of the semisolid preparations. The gel is a colloid, typically contains 99% by weight. It is rendered immobile by surface tension between it and a macromolecular network of fibres composed of a trace amount of gelatin. Despite gels' many benefits, the administration of hydrophobic medications remains a significant drawback and most of the herbal extracts and oils were poor aqueous solubility and low skin penetration capacity therefore, an emulsion-based strategy is being employed to get overcome this restriction so that even a hydrophobic therapeutic drug moiety can be effectively incorporated and delivered through gels. Emulgel system is suitable for cosmetics and dermatological applications including antioxidant, antiaging, anti-inflammatory, moisturizing, sunscreen and other skin protective formulations.

3.2. ADVANATAGES OF EMULGEL

- **Incorporation of hydrophobic drugs**

The emulsion phase helps to incorporate poorly water-soluble drugs, oils and herbal extracts which improves the drug stability and release.

- **Better stability**

The gel structure of the Emulgel system improves the physical stability and reduces the problems like phase separation hence it is more stable than other transdermal preparations.

- **Better loading capacity**

The gel network has comparatively better loading capacity when compared to other novel approaches like liposomes and noisome.

- **Production feasibility and low preparation cost**

Emulgel preparation involves simple and short process and does not require any specialized equipment, it uses easily and commonly available excipients and low-cost material, making the production feasible and economical.

❖ **No intensive sonication**

Emulgel can be prepared by simple mixing and homogenization without high energy sonication so, that degradation can be prevented making it suitable for sensitive herbal ingredient.

❖ **Controlled drug release**

The gel network provides sustained release of active ingredients over a longer period, suitable for drugs having shorter half-life.

❖ **Easy application and enhances patient compliance**

It is less greasy, easy to apply and easily spreadable making it more comfortable for patient.

❖ Avoidance of first pass metabolism and gastro- intestinal incompatibility.

❖ Provide site specific delivery by directing active ingredients to the targeted skin area for localized action.

❖ **Suitable for herbal and cosmetic formulations**

Emulgel can effectively carry plant oils, extracts and other bioactive compounds used in skincare products.

3.3. DISADVANTAGES OF EMULGEL

❖ **Instability problems**

Emulgel contains both emulsion and gel system. Phase separation, change in viscosity and altered physical stability during storage resulted from the improper selection of the formulation ingredients.

❖ **Air bubble entrapment during preparation**

Air bubbles may become entrapped during the emulsion and gel base mixing process, which could affect the formulations stability, homogeneity and appearance.

❖ **Skin irritation and allergic reactions**

In susceptible people, some surfactants, preservatives, penetration enhancers or other excipients used in Emulgel may resulted in skin irritation, sensitivity or allergic reactions.

❖ **Limited drug permeation**

Some drugs, particularly with large molecular weights, may exhibit poor skin permeability and limited absorption because of natural barrier function of the skin i.e. stratum corneum.

❖ **Limited only to hydrophobic drugs**

Emulgel are particularly useful for hydrophobic or lipophilic medications, however it might not be suitable for the medications having diverse solubility properties.

❖ **Possibility of microbial contaminations**

Emulgel may be susceptible to microbial growth if appropriate preservatives and production conditions are not maintained since, they contain an aqueous phase.

4. AIM AND OBJECTIVE

4.1. Aim

The aim of the present research work is to formulate and evaluate a polyherbal Emulgel enriched with *Daucus carota* seed oil, *Rubus idaeus* seed oil and *Solanum lycopersicum* extract for potential skin protective, antioxidant and moisturizing properties.

4.2. Objectives

- To design and develop a polyherbal Emulgel containing *Daucus carota* seed oil, *Rubus idaeus* seed oil and *Solanum lycopersicum* extract.
- To choose the appropriate polymers, oils and other components for the formulation of polyherbal Emulgel.
- To prepare a suitable gel base for the formulation of Emulgel using suitable gel base and other excipients.
- To prepare an emulsion phase by combining appropriate quantity of oil and aqueous phase components and extract.
- To incorporate the prepared emulsion into the gel base to form a stable Emulgel.
- To optimize the formulation and evaluate the various physiochemical properties such as appearance, pH, viscosity and spread ability.
- To determine the antioxidant potential of the formulation using an appropriate invitro antioxidant assay.
- To perform the stability studies of the prepared polyherbal Emulgel under suitable storage conditions.
- To investigate the skin suitability of the formulated Emulgel for potential topical cosmetic application.

5. MATERIALS AND METHOD

5.1. COLLECTION AND PROCUREMENT OF MATERIALS

The herbal ingredient selected for the study such as Carrot seed oil (*Daucus carota*) and Raspberry seed oil (*Rubus idaeus*) were procured from the authenticated commercial suppliers.

Fresh, ripe and disease-free tomato (Solanum *lycopersicum*) fruits were collected from a local market, and the collected fruits were washed with water to remove dust and impurities. The fruits were cut into small piece, shade dried and finely powdered and stored in an airtight container at room temperature until further extraction.

The authenticity and quality of the purchased materials were ensured before use and stored under suitable condition for further use.

All other excipients including Carbopol 934, Tween80, liquid paraffin, Propylene glycol, Methyl paraben and Triethanolamine were obtained from the college laboratory. All the chemicals and reagents used were of analytical grade and purified water was used throughout the study.

6. PLANT PROFILE

6.1.*Daucus carota*.L.(Carrot)

Figure 2: Carrot Seed Oil.

Biological source: Carrot seed oil is a fixed or volatile oil obtained from the seeds of *Daucus carota* L. (Carrot) belonging to the family Apiaceae.

Taxonomical classification

- **Kingdom** Plantae
- **Division** Magnliophyta

- **Class** Magnoliopsida
- **Order** Apiales
- **Family** Apiaceae
- **Genus** *Daucus*
- **Species** *Daucus carota* L.

Plant description

- **Habit:** It is an annual or biennial herbaceous plant; erect or branched stem grows up to 30-100cm in height mainly grown for its edible root. In the vegetative stage during first year the plant produce leaves and storage roots, while in the second year it produces flower.
- **Root:** The root is thick, fleshy, conical in shape and are greatly enlarged having good storage ability. Edible portion is the fleshy taproot contains an outer cortex and inner core. Available in different colours includes orange, yellow, purple, red and white due to the presence of pigments.
- **Stem:** The vegetative stem is short, compressed having closely arranges nodes and in the flowering stage it elongates, erect and branched forming inflorescence, flowering stalk and grows up to 60-200cm in tall.
- **Leaves:** The leave are alternate, finely divided, pinnately compound and are rosette at the base of plant, which is triangular to oblong in outline, 2-3 pinnatisect into oblong lanceolate.
- **Flower:** Inflorescence is compound umbel, flowers in the centre of umbel and are epigynous having five small sepals, five petals, five stamens and two carpels and are usually white in colour.
- **Fruit:** Fruit is an oblong-ovoid, dry schizocarp 2-4mm long, outer surface contains fine prickles.

Phytochemical constituents

- *Daucus carota* seeds contains essential oils, carotenoids, flavonoids, phenolic compounds, terpenoids, fatty acids and other phytoconstituents mainly oleic acid, linoleic acid, tocopherols, phytosterols carotol and daucol.

Uses

- Seed oil exhibit antioxidant potential by reducing oxidative stress caused by free radicle, skin conditioning, moisturizing and protective property.

6.2.*Rubus idaeus.* L.

Figure 3: Raspberry Seed Oil.

Biological source: Raspberry seed oil is a fixed oil obtained from the seeds of *Rubus idaeus* L., belonging to the family Rosaceae.

Taxonomical classification

- **Kingdom** - Plantae
- **Division** - Magnoliophyta
- **Class** - Magnoliopsida
- **Order** - Rosales
- **Family** - Rosaceae
- **Genus** - Rubus
- **Species** - Rubus idaeus L.

Plant description

- **Habit:** It is a hardy perennial, deciduous shrub about 1-2m tall with slender, upright to slightly curved or arching stem called canes. It exhibits a bushy growth habit with new shoots growing from the base.
- **Root:** It has a perennial woody root system with several branching lateral roots along the main root axis, grows in a vast network that gives support to the plant.

- **Stem:** It has a perennial root system gives rise to an upright to arching stem (cane like), young shoots are glaucous, weekly to densely loaded with glandular bristle-like hairs and thin prickles and mature stem turn dark, smooth and woody.
- **Leaves:** leaves are alternate, pinnately compound with 3-7 leaflets. The leaflets are blade lanceolate to ovate about 2-10cm long. It has green upper surface and a hairy lower surface with prominent veins. Thin petioles connect the leaf to the stem.
- **Flower:** small, bisexual, white to pale pink colour flowers in cluster(cymes) of 2-5 flowers about 0.6-1cm across, five petals, five sepals and numerous stamens, pistils with style persistent in fruit.
- **Fruits:** A rounded aggregate fruit composed of cluster of small drupes or drupelets attached to a central receptacle, becoming red when mature, edible and juicy. Each drupelets contains small seeds.
- **Seed:** Seeds are small, hard, brownish coloured oval shaped present inside the aggregate fruit contains a rich source of fixed oil.

Phytochemical constituents: Raspberry seed oil contains a rich source of polyunsaturated fatty acids mainly linoleic acid and α-linolenic acid and tocopherols, phytosterols and phenolic compounds.

Uses: Raspberry seed oil exhibit antioxidant, moisturizing, skin conditioning and protective properties and it act as a natural uv-filter.

6.3.*Solanum lycopersicum* L.

Figure 4: Tomato.

Biological source: Tomato is a fleshy edible fruit of Solanum lycopersicum L., belonging to the family Solanaceae.

Taxonomical classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Solanales

Family: Solanaceae

Genus: Solanum

Species: *Solanum lycopersicum* L.

Plant description

Habit: Tomato is an annual herbaceous plant with a soft, branched stem generally grows up to 0.5-2m

Root: It has a well-developed taproot system with numerous lateral roots

Stem: The stem is green, cylindrical, succulent and covered with hairs during early growth and more branched when matured.

Leaves: Leaves are alternate, pinnately compound, dark green and aromatic due to the presence of glandular hairs. Irregularly lobed leaf margin.

Flowers: Flowers are small, yellow, bisexual and arranged in clusters. They posses five fused sepals, five petals and prominent stamens surrounding the pistil.

Fruit: Fruit is fleshy berry that varies from round to slightly flattened in shape. Mature fruits are usually red and contains numerous small seeds embedded in a gelatinous pulp.

Phytochemical constituent

Tomato contains variety of bioactive compounds such as lycopene, β-carotene, lutein, vitamin C, vitamin E, flavonoids, phenolic acids, tocopherols, organic acids and minerals.

Uses

- Exhibits potent antioxidant activity by scavenging free radicals.
- Protect against oxidative stress and uv-induced skin damage.
- Improves skin hydration and elasticity.
- Promote collagen synthesis and delays premature ageing.
- Exhibit mild anti-inflammatory activity.

7.Extraction of *Solanum lycopersicum* (tomato) by Maceration

The dried and finely powdered fruits of *Solanum lycopersicum* were accurately weighed about 25g and transferred into a clean, dry conical flask. Ethanol (250 ml) was added as the extraction solvent and the flask is tightly closed with aluminium foil to prevent solvent evaporation and contamination. The mixture is kept at room temperature for 3-5 days with occasional shaking or stirring to ensure complete extraction of phytoconstituents.

After completion of the maceration period, the mixture was filtered through muslin cloth followed by Whatman no.1 filter paper to separate the extract from the marc(residue). The filtrate was concentrated by evaporating the solvent on water bath maintained at 40-50°C until a thick semisolid extract was obtained. The concentrated tomato extract was transferred to an airtight container and stored under refrigerated condition(2-8°C) until further use in the formulation of the polyherbal Emulgel.

7.1. FORMULATION

Table 1: FORMULATION.

S.NO	INGREDIENTS	QUANTITY FOR F_1	QUANTITY FOR F_2
1	Carrot seed oil	2g	2g
2	Raspberry seed oil	2g	2g
3	Tomato extract	5g	5g
4	Carbopol 940	0.8g	1g
5	Tween 80	2g	2g
6	Liquid paraffin	5g	5g
7	Propylene glycol	5g	5g
8	Methyl paraben	0.18g	0.18g
9	Vanillin	0.05g	0.05g
10	Triethanolamine	Q. s	Q. s
11	Purified water	Q. s to 100g	Q. s to 100g

8. METHOD OF PREPARATION

8.1. Preparation of gel base

- The gel base was prepared by dispersing required quantity of Carbopol 940 in a purified water with constant stirring at moderate speed to obtain a uniform dispersion and it is allowed to hydrate for sufficient time, permitting entrapped air to separate. After the complete swelling of polymer, Triethanolamine was added gradually to adjust the pH to 6-6.5 to neutralize the polymer and to form a clear gel base with suitable consistency.

8.2. Preparation of oil phase

- The oil phase was prepared by mixing measured quantity of Carrot seed oil and Raspberry seed oil in a liquid paraffin and the mixture heated to approximately 70°–80°C with continuous stirring to obtain a uniform solution.

8.3.Preparation of aqueous phase

- The aqueous phase was prepared by dissolving Tween 80 in purified water followed by addition of other water-soluble ingredients, Methyl paraben was dissolved in propylene glycol and then added, and the mixture was heated to approximately 70°–80°C with continuous stirring to obtain a uniform solution.

8.4.Preparation of emulsion

- After heating the oil phase and aqueous phase. The oil phase was slowly added to the aqueous phase with continuous stirring until cooled to room temperature to form a stable emulsion. The mixture was homogenized until a stable and smooth emulsion was formed.

8.5.Incorporation of tomato extract and vanillin

- Dissolve the required quantity of tomato extract in small quantity of propylene glycol and stir until a uniform solution or dispersion is obtained. Dissolve vanillin in small quantity of propylene glycol. Add the tomato extract slowly to the prepared emulsion and then add vanillin solution and continue stirring until a uniform and homogeneous mixture is obtained.

8.6.Preparation of Emulgel

- The prepared emulsion was incorporated gradually into the prepared gel base in a 1: 1 ratio under continuous stirring until a smooth, homogeneous and stable Emulgel was formed. The prepared Emulgel was stored in a suitable container for further evaluation

9. EVALUATION PARAMETERS

9.1. PREFORMULATION STUDY

9.1.1. Identification and characterization of oils

1. Colour

The colour of the oil was observed visually against a white background under natural daylight.

2. Odour

The odour of the oil was evaluated by gently smelling a small quantity of sample at room temperature.

3. Solubility test

The solubility test is performed to determine the solubility characteristics of the selected herbal oils in different solvents such as distilled water, ethanol, chloroform and petroleum ether.

Procedure

- 1ml of oil sample was taken in clean, dry test tube
- To each test tube, 5 mL of a different solvent (distilled water, ethanol, chloroform, and petroleum ether) was added separately.
- The mixture shaken and allowed to stand for 5minutes.
- Observe whether the oil is soluble or insoluble in each solvent

4. Specific gravity

Specific gravity is the ratio of the weight of a given volume of oil to the weight of an equal volume of water at the same temperature.

Procedure

- A clean and dry specific gravity bottle was weighed, and its weight was recorded as $\mathbf{W_1}$.
- The bottle was then filled completely with distilled water, wiped dry from the outside, and weighed again to obtain $\mathbf{W_2}$.
- After removing the water and drying the bottle thoroughly, it was filled with the oil sample and weighed to obtain $\mathbf{W_3}$.
- The same procedure was followed separately for carrot seed oil and raspberry seed oil.

Specific gravity= W3-W1 / W2-W1

Were,

- W_1 = Weight of empty specific gravity bottle (g)
- W_2 = Weight of bottle filled with distilled water (g)
- W_3 = Weight of bottle filled with oil (g)

5. Acid value

A 10g of sample oil was dissolved in an accurately weighed 50ml mixture of equal volumes of alcohol and solvent ether. The flask was connected to a reflux condenser and slowly heated until the sample dissolved completely. Then, few drops of phenolphthalein were added, and the solution was titrated with 0.1N KOH until a persistent pink colour appeared.

Acid value =n×5.61/W

6. Saponification value

2 grams of the oil sample was refluxed with 25ml of 0.5N alcoholic KOH for 30 minutes. To this mixture, 1ml of phenolphthalein was added and it was titrated immediately with 0.5N HCl. Note the reading as a. Repeat the operation, omitting the oil sample being examined and note the reading as b.

Saponification value = (b-a) ×28.05/W

Were,

W = Weight of substance in grams.

a = Volume of titre in ml

b = represents volume of blank in ml.

10. PRELIMINARY PHYTOCHEMICAL SCREENING OF CARROT SEED OIL AND RASPBERRY SEED OIL.

Table 2: PRELIMINARY PHYTOCHEMICAL SCREENING OF CARROT SEED OIL AND RASPBERRY SEED OIL.

S.NO	PHYTOCHEMICAL TEST	OBSERVATION	INFERENCE
1	**TEST FOR ALKALOIDS** **Dragendorff's test**-A small quantity of oil extract dissolved in suitable solvent and dil. HCl was treated with Dragendorff's reagent (Potassium Bismuth iodide) and mix well. **Mayers test**-A small quantity of oil extract dissolved in suitable solvent and dil. HCl was treated with few drops of Mayers reagent (Potassium mercuric iodide) and mix well.	Appearance of an Orangish red or reddish-brown colour precipitate. Formation of a creamy-white precipitate.	Presence of alkaloids. Presence of alkaloids.
2	**TEST FOR FLAVONIDS** **Aluminium chloride test** A small quantity of oil extract was treated with Aluminium chloride solution.	Formation of yellow colour.	Presence of flavonoids

	Lead acetate test A small quantity of oil extract was treated with 10% lead acetate solution	Formation of orange colour	Presence of flavonoids.
3	**TEST FOR TERPENOIDS** **Salkowski test-**About 1ml of oil sample was mixed with 2ml of chloroform and 3ml of Concentrated sulphuric acid was carefully added along the sides of test tube to form a distinct layer, allow to stand for few minutes and observe the colour at the interface.	Formation of reddish-brown colour or reddish colour at the interface of two liquids	Presence of Terpenoids
4	**TEST FOR STEROIDS** **Libermann-Burchard test** About 1ml of oil sample was mixed with 2ml of chloroform and add 1ml of acetic anhydride followed by 2-3 drops of concentrated sulphuric acid. Mix well and allowed to stand for few minutes.	Formation of dark green or bluish green colour	Presence of steroidal compounds
5	**TEST FOR CAROTENOIDS** **Petroleum ether test** A small quantity of oil sample was dissolved in petroleum ether and mix well. **Sulphuric acid test** A small quantity of oil sample was treated with concentrated sulphuric acid and mix well.	Appearance of yellow-orange colour. Appearance of blue to bluish green colour.	Presence of carotenoids. Presence of carotenoids.
6	**TEST FOR PHENOLIC COMPOUNDS** **Ferric chloride test** Oil sample was mixed with equal volume of suitable solvent and then extracted. To 1ml of the extract add few drops of Ferric chloride reagent and mix well.	Appearance of dark green, blue or violet colour.	Presence of phenolic compounds.

11. PRELIMINARY PHYTOCHEMICAL SCREENING OF TOMATO EXTRACT

Table 3: PRELIMINARY PHYTOCHEMICAL SCREENING OF TOMATO EXTRAC.

S.NO	PHYTOCHEMICAL TEST	OBSERVATION	INFERENECE
1	**TEST FOR ALKALOIDS** **Dragendorff's test –** To 2ml of extract, add a few drops of dragendorffs reagent. **Mayers test** – To 2ml of extract add a few drops of Mayers reagent and mix well.	Formation of an orange or reddish brown precipitate Formation of a creamy-white precipitate	Presence of alkaloids Presence of alkaloids
2	**TEST FOR FLAVONOIDS** **Alkaline reagent test –** Add 2ml of 10%NaOH to 2ml of extract followed by dilute HCl.	Yellow colour that disappears after adding acid.	Presence of flavonoids.
3	**TEST FOR PHENOLICS** **Ferric chloride test -** Add 2-3 drops of 5% ferric chloride to the extract.	Appearance of blue, green or dark violet colour	Presence of phenolics compounds.

4	**TEST FOR TANNINS** **Ferric chloride test –** Add a few drops of ferric chloride solution to the extract.	Appearance of blue-black or greenish-black colour	Presence of tannins.
5	**TEST FOR SAPONINS** **Foam test –** Shake 2ml of extract with 5ml of distilled water for 2 minutes.	Formation of persistent froth.	Presence of saponins.
6	**TEST FOR GLYCOSIDES** **Keller-Killiani test –** To the extract add glacial acetic acid containing ferric chloride followed by concentrated sulphuric acid.	Formation of brown ring at the interface	Presence of glycosides.
7	**TEST FOR TERPENOIDS** **Salkowski test –** Mix the extract with chloroform and carefully add concentrated sulphuric acid.	Formation of reddish Brown colour ate the interface.	Presence of terpenoids.

12. Identification test for emulsion

12.1. DYE TEST

Few drops of water-soluble dye (Amaranth dye or Methylene blue) is mixed with the prepared emulsion. A drop of the emulsion is placed on a microscopic slide, covered with a cover slip and examined under a microscope. If the dispersed globules appeared coloured, the emulsion is of water-in-oil(w/o) type. In contrast, if the dispersed globules appear colourless and the dispersed medium coloured, the emulsion is of oil-in-water(o/w) type.

13. EVALUATION OF EMULGEL

13.1. PHYSICAL PROPERTY

The physical property of the prepared Emulgel can be observed for its colour, odour, appearance, texture, consistency, homogeneity, grittiness.

Procedure

- Place 1-2g of prepared Emulgel on a clean white glass plate or slide.
- The colour was examined under white background and observe visually for appearance, homogeneity.
- Smell the gel to evaluate its odour or smell it after diluting with water.
- A small quantity of Emulgel is rubbed between the fingers to assess its texture, uniformity, consistency, grittiness and the presence of coarse particles.

13.2. pH MEASUREMENT

pH is evaluated to assess the skin compatibility and product stability. Standard buffer solution is used to calibrate the pH meter (pH 4,7,9) at room temperature. About 1g of gel was

weighed and dissolved in 10ml of distilled water (1: 10w/v) and stir for 10 minutes to equilibrate and its pH was measured using digital pH meter by immersing the electrode.

13.3. SPREADABILITY

The spread ability of the prepared Emulgel was determined by parallel plate method. About 1g of the Emulgel was placed at the centre of a clean glass slide and covered with another glass slide. A 100g weight was placed on the upper glass slide for 1min to allow uniform spreading of the formulation. After removal of the weight, the spread diameter was measured in two perpendicular directions, horizontal (D_1) and vertical (D_2) using ruler and the average diameter was calculated by using the formula.

Average diameter (D_{avg}) = $D_1 + D_2 / 2$

D_{avg} = Average diameter (cm)

D_1 = Horizontal diameter (cm)

D_2 = Vertical diameter (cm)

A large average diameter indicates good spread ability of the prepared Emulgel suggesting ease of application.

13.4. EXTRUDABILITY

The test is carried out to evaluate the ease of expellation of the formulated Emulgel from the collapsible tube under low pressure. The prepared Emulgel was filled into a clean collapsible tube and pressed gently by hand with uniform hard pressure and the Emulgel coming out from the nozzle was observed. The formulation was evaluated based on the ease and smoothness of extrusion were noted.

13.5. WASHABILITY

The test conducted to determine the ease of removal of formulated Emulgel from the skin surface without leaving any sticky or oily residue. A small quantity of the prepared Emulgel was applied evenly to the skin and then washed with running tap water, the ease of removal was observed visually.

13.6. HOMOGENEITY

The formulated Emulgel was visually inspected to check the homogeneity if no lumps are observed, the formulation is said to be homogeneous.

13.7. GRITTINESS

The test is performed to identify that the Emulgel is free from any coarse or gritty particles and ensures the gel with smooth texture for easy application on the skin. A small quantity of the prepared Emulgel was taken on fingertip and rub gently between the thumb and index finger, check the presence of gritty or coarse particles.

13.8. CONSISTENCY

The test is done to assess the thickness, firmness and uniformity of the gel and helps in stability measures. This will also prevent the issues like leakage, phase separation and poor application. It also provides proper drug delivery from the gel to the skin.

13.9. PHASE SEPERATION

A small of the prepared Emulgel was taken in a clean, transparent glass container and stored at room temperature. The formulation was observed at regular intervals for any signs of phase separation, such as oil separation, creaming, or the formation of separate layers. The formulation is considered to be stable if no phase separation had occurred.

13.10. ANTIOXIDANT ACTIVITY (DPPH ASSAY)

The antioxidant activity of the polyherbal Emulgel was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay. About 3ml of DPPH solution was mixed with various concentration of test solution and HPLC grade methanol to a final volume of 4ml. The test samples are tested in the concentration ranging from 20-100µg/ml, whereas the reference standards are tested in the concentration ranging from 5-100µg/ml. The mixture is incubated at 25°C for 15minutes. Absorbance is measured at 517nm using a semi-automatic analyser and a control reaction is performed without the test sample.

13.11. SPF DETERMINATION (UV SPECTROPHOTOMETRIC METHOD)

Photoprotective topical formulations are becoming more and more crucial since exposure to ultraviolet (UV) radiation can harm skin. Rich in natural antioxidants, the developed polyherbal emulgel with Daucus carota seed oil, raspberry seed oil, and Solanum lycopersicum extract may help shield the skin from UV-induced damage. Consequently, the in vitro UV spectrophotometric (Mansur) method was used to assess the formulation's Sun Protection Factor (SPF).

14. RESULTS AND DISCUSSION

14.1. IDENTIFICATION AND CHARACTERIZATION OF OILS.

Table 4: IDENTIFICATION AND CHARACTERIZATION OF OILS.

S.NO	CHARATERISTICS	CARROT SEED OIL	RASPBERRY SEED OIL
1	Colour	Yellow to orange yellow	Golden yellow
2	Odour	Characteristic aromatic odour	Mild characteristic odour
3	Solubility	Insoluble in water, slightly soluble in ethanol, freely soluble in chloroform and petroleum ether	Insoluble in water, slightly soluble in ethanol, freely soluble in chloroform and petroleum ether
4	Specific gravity	0.91	0.92
5	Acid value	4.0 mg KOH/g	2.0 mg KOH/g
6	Saponification value	187mg KOH/g	190 mg KOH/g

- The colour, Odour, solubility, specific gravity, acid value, and saponification value of carrot and raspberry seed oils were assessed. Table X displays the outcomes.
- Raspberry seed oil was golden yellow with a subtle distinctive smell, and carrot seed oil was yellow to orange yellow with a distinctive aromatic smell.
- Both oils were easily soluble in petroleum ether and chloroform, slightly soluble in ethanol, and insoluble in water. This demonstrates that the solubility characteristics of both oils are comparable. The specific gravity values of 0.91 for carrot seed oil and 0.92 for raspberry seed oil were found to be close to each other.
- Compared to raspberry seed oil, carrot seed oil has a higher acid value. The amount of free fatty acids in an oil is indicated by its acid value. Compared to carrot seed oil (4.0 mg KOH/g), raspberry seed oil's lower acid value (2.0 mg KOH/g) indicates a lower concentration of free fatty acids. The results show that both oils might be used in the Emulgel formulation.
- Carrot and raspberry seed oils had saponification values of 187 and 190 mg KOH/g, respectively. The readings were near to one another, indicating that the qualities of the two oils are comparable. Compared to carrot seed oil, raspberry seed oil has a marginally greater saponification value.

15.PHYTOCHEMICAL SCREENING OF CARROT SEED OIL AND RASPBERRY SEED OIL

The preliminary phytochemical screening of carrot seed oil and raspberry seed oil revealed that they contained terpenoids, phytosterols, carotenoids and trace amount of phenolic compounds. (+ means Present, - means Absent)

Table 5: PHYTOCHEMICAL SCREENING OF CARROT SEED OIL AND RASPBERRY SEED OIL.

S.NO	PHYTOCHEMICAL	TEST	RESULT	
			CARROT SEED OIL	RASPBERRY SEED OIL
1	ALKALOIDS	Dradendorff's Test	_	_
		Mayer's Test	_	_
2	FLAVONOIDS	Aluminium chloride Test	_	_
		Lead acetate Test	_	_
3	TERPENOIDS	Salkowski Test	+	+
4	STEROIDS	Libermann Burchard Test	+	+
5	CAROTENOIDS	Petroleum ether Test	+	+
		Sulphuric acid Test	+	+
6	PHENOLIC COMPOUNDS	Ferric chloride test	+	+

16. PHYTOCHEMICAL SCREENING OF TOMATO EXTRACT

Table 6: PHYTOCHEMICAL SCREENING OF TOMATO EXTRACT.

S.NO	PHYTOCHEMICAL	TEST	RESULT
1	ALKALOIDS	Dragendorff's Test	+
		Mayer's Test	+
2	FLAVONOIDS	Alkaline reagent Test	+
3	PHENOLICS	Ferric chloride Test	+
4	TANNINS	Ferric chloride Test	+
5	SAPONINS	Foam Test	+
6	GLYCOSIDES	Keller Killani Test	+
7	TERPENOIDS	Salkowski Test	+

The ethanolic extract of *Solanum lycopersicum* (Tomato) extract shows the presence of alkaloids, flavonoids, phenolic compounds, tannins, saponins, glycosides and terpenoids.

17. IDENTIFICATIFICATION TEST OF EMULSION

17.1. DYE TEST

Table 7: IDENTIFICATIFICATION TEST OF EMULSION.

EVALUATION TEST	OBSERVATION	INFERENCE
Dye test	Methylene blue dispersed uniformly throughout the formulation	Oil in Water emulsion(O/W) confirmed.

18. EVALUATION OF EMULGEL

Table 8: EVALUATION OF EMULGEL.

S.NO	EVALUATION PARAMETERS	RESULT	
		F_1	F_2
1	Colour	Light orange colour	Light orange colour
2	Odour	Pleasant odour	Pleasant odour
3	P^H Measurement	5.8	5.9
4	Spread ability	7.2 g.cm/s	6.8g.cm/s
5	Extrudability	Good	Good
6	Washability	Easily washable with water	Easily washable with water
7	Homogeneity	Homogeneous, no lumps or aggregates	Homogeneous, no lumps or aggregates
8	Grittiness	Absence of grittiness	Absence of grittiness
9	Consistency	Good semi solid consistency	Good, slightly higher consistency
10	Phase separation	No phase separation observed	No phase separation observed

The physical and formulation properties of the developed formulations F_1 and F_2, which contained 0.8% and 1.0% Carbopol 940, respectively, were assessed. Both formulas had a pleasant smell and a light orange colour. Both formulations were found to be within a suitable range for topical administration, with pH values of 5.8 for F_1 and 5.9 for F_2. The spreadability of F_1 was 7.2 g.cm/s, while F_2's spreadability was significantly lower because of the higher concentration of Carbopol 940. The Emulgel viscosity and consistency were raised by the higher polymer concentration, which decreased its spreadability. Both formulations demonstrated high homogeneity without lumps or aggregates, good extrudability, and ease of water washing. There was no phase separation and grittiness in both F_1 and F_2 formulation.

19. DPPH RADICAL SCAVENGING (ANTIOXIDANT) ASSAY

The DPPH (2,2-diphenyl-1-picrylhydrazyl) assay is widely used method for evaluating the antioxidant activity of various substances, including plant extracts, foods and pharmaceuticals. The assay is based on the ability of antioxidant to scavenge the stable radical DPPH.

Principle

The DPPH free radical scavenging assay measures the ability of antioxidants to donate hydrogen atoms or electrons to the stable, purple coloured radical and converting it into

yellow coloured compound or causing the purple colour to fade when measured at 517nm and the decrease in absorbance is proportional to the antioxidant activity.

Materials Required

- DPPH (2,2-diphenyl-1-picrylhydrazyl)
- Methanol (analytical grade)
- Sample extract (Emulgel extract)
- Standard: Ascorbic acid
- UV-Visible spectrophotometer
- Micropipettes and test tubes

Procedure

Preparation of Emulgel Extract

One gram of the Emulgel was accurately weighed and mixed with 10 mL of methanol. The mixture was vortexed for 2–3 minutes and sonicated for 15–20 minutes to extract the antioxidant constituents. The extract was filtered through Whatman No. 1 filter paper, and the clear filtrate was used as the stock solution for the DPPH assay.

Preparation of DPPH Solution

A 0.1 mM DPPH solution was freshly prepared by dissolving 3.94 mg of DPPH in 100 mL of methanol. The solution was protected from light using aluminium foil until use.

DPPH Assay

- Different concentrations of the Emulgel extract (20, 40, 60, 80, and 100 µg/mL) were prepared by appropriate dilution of the stock solution with methanol.
- For each concentration, 1 mL of the diluted sample was transferred into a test tube, followed by the addition of 3 mL of freshly prepared 0.1 mM DPPH solution.
- The control solution consisted of 1 mL of methanol mixed with 3 mL of DPPH solution was prepared.
- Ascorbic acid at identical concentrations was employed as the reference standard.
- The reaction mixtures were mixed thoroughly and incubated in the dark at room temperature for 30 minutes to allow the radical scavenging reaction to occur.
- After incubation, the absorbance of each reaction mixture was determined at 517 nm using a UV–Visible spectrophotometer.

Formula

$$\% \text{ Inhibition} = \frac{A_C - A_S}{A_C} \times 100$$

Were,

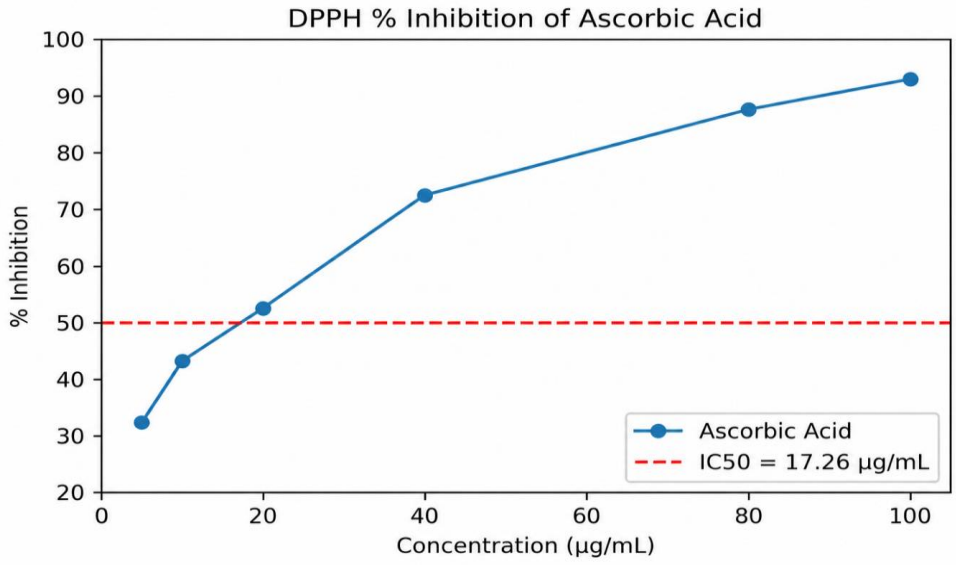
$\mathbf{A_c}$ = Absorbance of control (DPPH solution only), $\mathbf{A_s}$ = Absorbance of sample

RESULT

Table 8: RESULT FOR DPPH ASSAY.

Sample	Concentration (µg/mL)	Absorbance at 517nm	% Radical scavenging	IC_{50} µg/mL
ASCORBIC ACID	5	0.542	32.33	17.26 µg/mL
	10	0.454	43.22	
	20	0.380	52.56	
	40	0.220	72.53	
	80	0.099	87.64	
	100	0.056	93.00	

Control Absorbance = 0.801

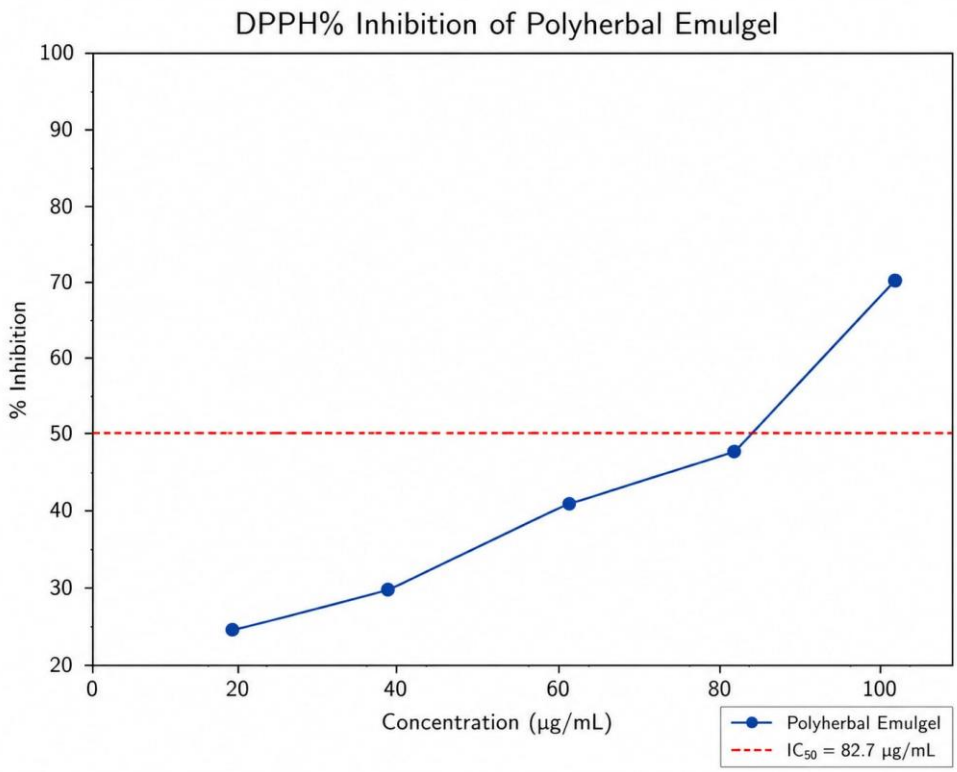


20. RESULT

Table 9: DPPH % INHIBITION OF ASCORBIC ACID.

Sample	Concentration (µg/mL)	Absorbance at 517nm	% Radical scavenging	IC_{50} µg/mL
EMULGEL	20	0.690	13.86	82.7 µg/mL
	40	0.630	21.10	
	60	0.520	35.08	
	80	0.425	46.94	
	100	0.244	69.54	

Control Absorbance = 0.801



21. CONCLUSION FOR DPPH RADICAL SCAVENGING (ANTIOXIDANT) ASSAY

The Polyherbal Emulgel demonstrated antioxidant activity in the DPPH assay, with an IC_{50} value of 82.7µg/mL. This indicates that the Polyherbal Emulgel has a moderate ability to neutralize free radicals. The percentage inhibition of Polyherbal Emulgel increased with concentration, reaching 69.54% at 100µg/mL. These results suggest that while the Emulgel possess antioxidant properties, it is less effective than Ascorbic acid, which showed high antioxidant activity with an IC_{50} value of 17.26 µg/mL.

22. IN VITRO SPF (SUN PROTECTION FACTOR) DETERMINATION

Principle

The SPF (Sun Protection Factor) of the formulated polyherbal Emulgel can be determined by in vitro method (UV Spectrophotometric method). The absorbance of the formulation was recorded in the UVB region between 290 and 320 nm and the SPF was calculated using the Mansur equation from the absorbance reading. The obtained SPF value was used to assess the potential photoprotective property of the developed Emulgel.

Materials Required

- Sample extract (Polyherbal Emulgel)
- Solvent – Ethanol

- UV-Visible spectrophotometer
- Micropipettes and test tubes
- Volumetric flask

Procedure

Accurately weigh 100gm of prepared polyherbal Emulgel, transferred into a 10ml volumetric flask and thoroughly dissolved with ethanol. Sonicate the sample for approximately 5 minutes to obtain a clear and uniform solution and filter to remove any undissolved material. Using ethanol as the blank, measure the absorbance of the prepared sample using a UV–Visible spectrophotometer at 290–320 nm, at 5 nm intervals.

Mansur equation

$$SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$$

where:

- **CF** = correction factor = 10
- **EE(λ)** = erythemal effect spectrum
- **I(λ)** = solar intensity spectrum
- **Abs(λ)** = absorbance of the sample at each wavelength

Relation of λ and EE×I[10]

Table 10: RELATION OF Λ AND EE×I[10]

WAVELENGTH (nm)	EE×I
290	0.0510
295	0.0817
300	0.2874
305	0.3278
310	0.1864
315	0.0839
320	0.0180

Result

Table 11: RESULT.

S.No	Wavelength(nm)	Absorbance(λ)	EE×I	EE×I×Abs
1	290	0.46	0.0510	0.002364
2	295	0.62	0.0817	0.05654
3	300	0.97	0.2874	0.278778
4	305	1.09	0.3278	0.357302
5	310	0.85	0.1864	0.15844

6	315	0.58	0.0839	0.048662
7	320	0.32	0.0180	0.00576

Using Mansur equation,

SPF = 10 × 0.907846

SPF = 9.08

23. CONCLUSION FOR IN VITRO SPF (SUN PROTECTION FACTOR) DETERMINATION

The in vitro sun protection factor (SPF) of the polyherbal Emulgel was determined by the UV spectrophotometric method using the Mansur equation. The calculated SPF value of the formulation was 19.2, indicating moderate photoprotective activity. The moderate SPF observed for the polyherbal Emulgel may be attributed to the synergistic effect of carrot seed oil, raspberry seed oil, and tomato extract.

CONCLUSION

The present study was successfully carried out to formulate and evaluate a polyherbal Emulgel containing *Daucus carota* seed oil, *Rubus idaeus* seed oil, and *Solanum lycopersicum* extract for potential topical skin-protective applications. The preliminary phytochemical screening verified the presence of several bioactive compounds that may contribute to the formulation's antioxidant and protective qualities, and the chosen herbal ingredients demonstrated appropriate physicochemical features.

A pleasant smell, smooth texture, good homogeneity, appropriate consistency, good extrudability, and ease of washing were among the acceptable physical properties of the developed F1 and F2 formulations. The pH values of 5.8 and 5.9 suggested that topical administration was appropriate. Phase separation and grittiness were not apparent in any formulation, which demonstrated high stability. The consistency and spread ability of the formulations were impacted by the variation in Carbopol 940 concentration, with F1 exhibiting superior spread ability compared to F2.

Free radical scavenging activity increased in a concentration-dependent manner according to the antioxidant activity measured by the DPPH assay. The polyherbal Emulgel demonstrated an IC_{50} value of 82.7 µg/mL, showing antioxidant potential, although the activity was lower than that of the ascorbic acid standard. The in-vitro SPF assessment also indicated photoprotective efficacy of the formulation.

Overall, the findings indicate that tomato extract, carrot seed oil, and raspberry seed oil may be effectively added to an Emulgel system and may offer combined antioxidant, moisturizing, and skin-protective advantages. As a result, the created polyherbal Emulgel is a herbal topical formulation that shows promise. Additional research is needed to verify its safety, effectiveness, and suitability for future development, including long-term stability tests, skin irritation studies, and in vivo investigations.

24. REFERENCES

1. Benson HAE. Transdermal drug delivery: penetration enhancement techniques. *Curr Drug Deliv, 20*05; 2(1): 23-33.
2. Singh Malik D, Mital N, Kaur G. Topical drug delivery systems: A patent review. Expert OpinTher Pat, 2016; 26(2): 213-28.
3. Tadros TF, 'Future developments in cosmetic formulations', International Journal Cosmetic Sciences, 1992; 14(3): 93- 111.
4. Ajazuddin; Alexander A; Qureshi A, et al. Recent expansions in an emergent novel drug delivery technology: Emulgel. *J Control Release, 20*13; 171(2): 122-132. doi:10.1016/j.jconrel.2013.06.030.
5. Khullar R, Kumar D, Seth N, Saini S. Formulation and evaluation of mefenamic acid Emulgel for topical delivery. *Saudi Pharm J, 20*12; 20(1): 63-67. doi:10.1016/j.jsps.2011.08.001.
6. Varma VNSK, Maheshwari PV, Navya M, Reddy SC, Shivakumar HG, Gowda DV. Calcipotriol delivery into the skin as emulgel for effective permeation. *Saudi Pharm J, 20*14; 22(6): 591-599. doi:10.1016/j.jsps.2014.02.007.
7. Choudhury H, Gorain B, Pandey M, et al. Recent update on nanoemulgel as topical drug delivery system. *J Pharm Sci, 20*17; 106(7): 1736-1751. doi:10.1016/j.xphs.2017.03.002.
8. Prajapati ST, Patel CG, Patel CN. Formulation and evaluation of topical emulgel containing diclofenac sodium. *Int J PharmTech Res, 20*11; 3(1): 54-61.
9. Sanjay, Jain BD, Padsalg A, Patel K, Mokale V, 'Formulation, development and evaluation of Fluconazole gel in various polymer bases', Asian J Pharm, 2007; 1: 63-68.
10. Sinha A, Garg U, Nagaich U, Chaudhary A, Pandey M, Jain N. Emulgels: a promising topical drug delivery system for arthritis management and care. *Drug Dev Ind Pharm, 20*24; 29(1): 25-39. doi:10.1080/10837450.2023.2289170.

11. Rajni, Shah K, Dewangan HK. Delivery of nano-emulgel carrier: optimization, evaluation and in vivo anti-inflammation estimations for osteoarthritis. *Ther Deliv, 202*4; 15(3): 181-192. doi:10.4155/tde-2023-0109.
12. Kumbhar PR, Desai H, Desai VM, Priya S, Rana V, Singhvi G. Versatility of emulgel in topical drug delivery transforming its expedition from bench to bedside. *Expert Opin Drug Deliv, 202*5; 22(1): 55-68. doi:10.1080/17425247.2024.2439457.
13. Dalal S, Nair AB, Kadian V, Bhattacharyya MS, Jacob S, Aldhubiab B, et al. Development, characterization and in vitro evaluation of clobetasol propionate emulgel for topical delivery in dermatological inflammatory disorders. *3 Biotech, 202*6; 16(7): 258. doi:10.1007/s13205-026-04856-2.
14. Panwar AS, et al. Emulgels: Promising Carrier Systems for Food Ingredients and Drugs. Pharmaceutics, 2023.
15. Nair AB, et al. (2023).Emulgels: Promising Carrier Systems for Food Ingredients and Drugs.
16. Mocanu A, et al. (2024).Development, Optimization, and Evaluation of New Gel Formulations with Cyclodextrin Complexes and Volatile Oils with Antimicrobial Activity.
17. Shebaby WN, Daher CF, El-Sibai M, et al. Wild carrot (Daucus carota ssp. carota) oil: chemical composition and antioxidant activity. *Food Chem, 201*5; 176: 267-273.
18. Prusty B, Hotta SK, Bhuyan JR, Behera C. Targeting oxidative stress with carrot seed extracts: a phytochemical and in vitro antioxidant study. *Int J Indigenous Herbs Drugs, 202*5; 10(2).
19. Teng H, Chen L, Huang Q, Wang J, Lin Q, Liu M, et al. Ultrasonic-assisted extraction of raspberry seed oil and evaluation of its physicochemical properties, fatty acid compositions and antioxidant activities. *PLoS One, 201*6; 11(4): e0153457.
20. Rao AV, Agarwal S. Role of antioxidant lycopene in cancer and heart disease. *J Am Coll Nutr, 200*0; 19(5): 563-569.
21. Ascenso A, Pinho S, Eleutério C, et al. Lycopene from tomatoes: vesicular nanocarrier formulations for dermal delivery. Journal of Agricultural and Food Chemistry, 2013; 61(30): 7284–7293.DOI:10.1021/jf401368w
22. Anwar MUA, et al. An approach to enhanced stability: Formulation and characterization of Solanum lycopersicum-derived lycopene based topical emulgel. Saudi Pharmaceutical Journal, 2019; 27(2): 247–257.DOI:10.1016/j.jsps.2018.07.005.
23. Trease GE, Evans WC. *Trease and Evans Pharmacognosy*. 16th ed. Edinburgh: Saunders Elsevier; 2009.

24. Brand-Williams W, Cuvelier ME, Berset C. Use of a free radical method to evaluate antioxidant activity. *LWT Food Sci Technol, 19*95; 28(1): 25-30.
25. Kedare SB, Singh RP. Genesis and development of DPPH method of antioxidant assay. Journal of Food Science and Technology, 2011.
26. Mansuri R, Diwan A, Kumar H, Dangwal K, Yadav D. Potential of natural compounds as sunscreen agents. Pharmacogn Rev, 2021; 15(29): 47-56. doi:10.5530/phrev.2021.15.5.
27. Ritmaleni, Juson, Zulkarnain AK, Indaryanti AE, Fatmawati A. The effect of variation concentration of tetrahydrohexagamavunon-5 (THHGV-5) in emulgel preparation on acute dermal irritation effect and sun protecting factor (SPF) value. *Int J App Pharm, 20*23; 15(6): 282-287. doi:10.22159/ijap.2023v15i6.47741
28. Mansur JS, Breder MNR, Mansur MCA, Azulay RD.Determination of Sun Protection Factor by Spectrophotometry.Anais Brasileiros de Dermatologia, 1986; 61: 121–124
29. Sayre RM, Agin PP, LeVee GJ, Marlowe E.A Comparison of In Vivo and In Vitro Testing of Sunscreening Formulas.Photochemistry and Photobiology, 1979; 29(3): 559–566.