



Formulation And Evaluation Of Egg Yolk Oil Cream For Treatment Of Burn Wound Healing

RESEARCH PAPER

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Abstract:

Burns, particularly second-degree burns, present difficulties because they heal slowly, can become infected, and leave scars. This study investigated the use of egg yolk oil, which is high in fatty acids, phospholipids, vitamins A, D, E, K, and cholesterol, as a topical cream for the healing of burn wounds. Because of its alkaline pH and minerals, eggshell powder was also used to promote scab formation and reduce infection. Comparing the egg yolk oil cream to controls, the results demonstrated a considerable improvement in wound closure, collagen formation, tissue regeneration, and inflammation reduction. These results imply that, although more clinical research is required, it may be a natural, cost-effective, and efficient burn therapy option.

Keywords: Egg yolk oil, Burn wound healing, Solvent extraction, Anti-inflammatory.

Introduction:

One major consequence of heat injury is burn wound infections [15]. Burns are divided into different depths and are defined as tissue injuries brought on by heat, chemicals, electricity, or radiation. Second-degree burns injure both the epidermis and dermis, often resulting in pain, blisters, prolonged healing, and risk of infection and scarring. In order to encourage recovery and avoid problems, effective therapy is crucial [27].



Fig no. 1: Burnt Skin

The primary objective of burn treatment is to prevent infection, which is followed by promoting the formation of epithelial cells. As a result, materials that roughly match the stratum corneum's overall water vapor transfer rate are favored. Additionally, materials need to be biocompatible, which means they need to be devoid of microbial residues, nontoxic, noninflammatory, and nonimmunogenic [2]. Depending on which tissue is affected, burn injuries can vary widely in terms of inflexibility and underlying issues. When muscles, bones, vasculature, dermal, and epidermal apkins are injured, deep harm to nerves can result in pain [12].

Egg oil is excellent for the healing process since, according to a study, applying it directly to burnt skin caused considerable re-epithelialization without tissue scarring [4].

Burn-induced immunosuppression impacts both innate and adaptive immunity, increasing the likelihood of infection. Innate immunity responds to microbes quickly, while adaptive immunity which uses T and B cells takes days. Burn injuries change innate components such neutrophils, macrophages, monocytes, basophils, NK cells, and the complement system [16, 13].

Choline, lecithin, linoleic and oleic acid, and vitamins A, D, and E are all found in good amounts in egg yolk oil. It has been demonstrated that giving adults with memory loss choline supplements enhances cognitive function, particularly verbal memory. Additionally, egg yolk oil's anti-inflammatory and antioxidant properties support overall health and wellbeing. The demand for egg yolk oil in nutraceuticals is expected to increase as more senior citizens seek out natural remedies for overall health and cognitive assistance [24].

Natural remedies and bioactive compounds are attracting attention as complementary or alternative wound-healing treatments. Among these, preclinical studies have shown that egg yolk oil (EYO), a lipid-rich substance made from chicken egg yolks, may have anti-inflammatory, antibacterial, and wound-healing properties [1].

Egg yolk oil:

The lipids in egg yolks have a very high nutritional value. Because of its high concentration of lecithin, fatty acid profile, and oil-soluble vitamins, egg yolk oil is a particularly beneficial addition to the human diet [23]. Egg yolk oil (EYO) is the primary component of the bioactive compounds present in eggs. To improve the biological and nutritional value of a range of food products, it can be isolated from egg yolks and added [10]. The pigments that give the egg yolk its color are called carotenoids, and they are mostly composed of carotene, lutein, and xanthophylls [25].

Current research on egg yolk oil shows that it has a great deal of promise for treating burn injuries by encouraging re-epithelialization, which heals cracks. According to research, using egg oil topically to becks produces extensive re-epithelialization without leaving scars, outperforming traditional treatments. [1]. Recent research on the effects of egg oil on cell migration, proliferation, and oxidative stress reduction has confirmed its efficacy in healing becks and other skin lesions. Similarly, egg oil has been utilized in products to treat scars, heal ulcers, and lessen gum irritation, highlighting its many therapeutic applications. [7].



Fig. no.2: Egg yolk oil

An cream based on egg oil helps burns and ulcers heal with minimal scarring [9]. Studies using hen egg oils have shown that egg oil has strong anti-inflammatory and analgesic properties. This is most likely due to the presence of choline and palmitoylethanolamide in the phospholipid fraction, which reduced inflammatory markers [4].

As a biological product, egg oil is not a single substance but rather a combination of several fatty acids and retinoids. A rigorous scientific explanation of the mechanism of action may not be possible for a naturopathic drug with a complicated composition that is intended to function only in concert with its constituents [9].

Method of extraction of egg yolk oil:

1. Dry Distillation and Baking:

Conventional methods like baking and dry distillation, which involve heating egg yolk powder, are used to extract oil. Despite being straightforward and solvent-free, these methods may result in lower yields and potential degradation of heat-sensitive compounds [8].

“Egg yolk oil has several disadvantages when produced using traditional methods, such as a black color, an unpleasant odor, ease of patient removal, staining of clothing, and instability. Thus, techniques for obtaining egg yolk oil need to be improved”.

Ethanol Extraction:

Ethanol is widely used due to its effectiveness and safety. According to research, using 75% aqueous ethanol balances yield and purity while optimizing the extraction of phospholipids from dried egg yolk flakes. This environmentally friendly method can manufacture high-quality EYO with significant pharmacological effect [22].

2. Petroleum Ether Extraction

This strategy is expected to expand due to its affordability and efficacy. Without the substantial costs involved in the more expensive ethanol extraction procedure, petroleum ether extraction yields a large amount of egg yolk oil. Furthermore, this process yields oil with favorable qualities such as a transparent, light color and low odor, which makes it appropriate for a range of uses in nutraceuticals and cosmetics. With the increasing demand for egg yolk oil, the petroleum ether extraction process provides a more cost-effective and efficient alternative [24].

3. Supercritical CO₂ Extraction

High-purity EYO is produced using the "green" method of supercritical fluid extraction (SFE) using CO₂, which leaves no solvent residue behind. This method is particularly helpful for separating neutral and phospholipids and allows the selective separation of lipid components by adjusting the temperature and pressure [25].

5. Solvent Extraction with Chloroform-Methanol:

Lipid extraction is typically accomplished by combining methanol and chloroform. It effectively extracts total lipids, but because it employs dangerous solvents, it is not as desirable for applications requiring food-grade or medicinal EYO [26].

Advantages of egg yolk oil:

1. Egg yolk oil promotes skin tissue regeneration and accelerates wound healing because it is high in polyunsaturated fatty acids and cholesterol [1].
2. Egg oil is beneficial for skin and sun protection because it contains rich lipids and strong antioxidants that prevent oxidative damage [4].
3. At low concentrations, its efficacy is higher.

Disadvantages of egg yolk oil:

1. The amount of egg yolk oil might vary greatly depending on factors like the hen's diet or the extraction methods employed [23].
2. People with egg allergies may experience hypersensitivity reactions, which include skin irritation, redness, or worsening of the wound site.

Egg Shell Powder:

The membrane of an egg shell is made up of keratin, elastin, hyaluronic acid, glycosaminoglycan, and various forms of collagen. These chemicals aid in skin hydration and increase skin suppleness. In order to address wrinkles, blemishes, and acne, it is utilized to whiten the skin [20].



Fig no. 3: Egg shell powder

Mechanism of action of egg yolk oil in healing burn infections:

Egg yolk oil helps treat burn wounds through a multifaceted process that includes anti-inflammatory, antioxidant, antibacterial, and tissue-regenerative qualities [1]. Bioactive compounds in the phospholipid fraction, such as choline and palmitoylethanolamide (PEA), help control the inflammatory response and reduce tissue damage, pain, and edema by inhibiting pro-inflammatory cytokines [4, 9].

Its potent antioxidant profile, particularly that of vitamins A, D, and E, scavenges free radicals and lowers oxidative stress, which is frequently elevated in burn injuries. Lipids including phospholipids, cholesterol, and triglycerides, which are abundant in egg yolk oil, aid in restoring the epidermal barrier, retaining moisture, and encouraging keratinocyte migration and proliferation—all of which are essential for re-epithelialization [1, 2, 7].

Fatty acids with antibacterial qualities, such as oleic and linoleic acids, can aid in preventing further infections in the wound area [24]. Egg yolk oil may also stimulate fibroblast activity and collagen synthesis, which would improve wound healing and tissue regeneration. Because of these combined qualities, egg yolk oil is a natural substance that shows promise in helping burn wounds recover [3].

Preparation of Egg Yolk Oil Cream

Step 1: Preparation of Egg Yolk Oil

Materials:

- 20 fresh egg yolks (preferably organic)
- Small saucepan
- Heat-resistant container
- Fine mesh strainer or cheesecloth
- Airtight dark glass bottle for storage
- Thermometer

Procedure:

1. Carefully separate the egg yolks from the whites, making sure that none of the whites are left behind.
2. **Heat extraction method:**
 - i. Transfer the egg yolks to a dry, clean saucepan.
 - ii. Warm the yolks over very low heat, preferably between 60 and 80°C.
 - iii. To avoid burning, stir often but softly.
 - iv. The yolks will eventually change color and release oil.
 - v. Keep cooking for another 30 to 40 minutes, or until the yolks are dark brown and the oil has completely separated.
3. **Strain the oil:**
 - i. Switch off the heat and give it some time to cool.
 - ii. Strain the mixture using cheesecloth or a fine-mesh sieve.
 - iii. Gently press to remove all of the oil from the solids.
4. **Purification of Black egg Yolk oil by simple distillation using organic solvent:**
 - i. Pour the filtered mixture into a flask with a round bottom.
 - ii. Install the receiver and condenser in the basic distillation apparatus.
 - iii. To evaporate the organic solvent (chloroform), gently heat the flask.
 - iv. The solvent vapor will gather in the receiver after condensing.
 - v. The solvent should evaporate by the time you turn off the heat. Get the oil from the recipient.
5. **Storage:**
 - i. Pour the oil into a glass container.
 - ii. Refrigerate or store in a cool, dark location.
 - iii. When properly made, egg yolk oil can be kept in the refrigerator for up to six months.



Black oil obtained from Heat extraction method

Purified Yolk oil

Fig. no. 4: Purification Process

Step 2: Preparation of Eggshell Powder

Materials:

- 10-12 clean eggshells (from organic eggs)
- Oven
- Mortar and pestle
- Fine sieve
- Airtight container for storage

Procedure:

1. Clean the eggshells:

- i. Use water to thoroughly rinse eggshells.
- ii. Total removal of the inner membrane.
- iii. For five minutes, boil the shells in water to kill any bacteria.

2. Dry the shells:

- i. Spread the shells out on a baking sheet after draining.
- ii. Dry for about 30 minutes at 90 to 100°C in the oven, or until totally dry.

3. Grind to powder:

- i. Permit shells to cool fully.
- ii. Use a mortar and pestle to crush shells into a very fine powder.
- iii. A fine-mesh sieve can be used to ensure a uniform texture.

4. Storage:

- i. Keep dry and cool in an airtight container.
- ii. Eggshell powder can last for several months if stored properly.

Step 3: Making Egg Yolk Oil Cream

Materials:

- Egg yolk oil
- Eggshell powder
- Base cream
- Vitamin e oil
- Glycerin
- Glass beaker
- Stirrer
- Sterilized containers for storage

Cream base:

A common ingredient in pharmaceutical and cosmetic formulations, beeswax and cetyl alcohol make a rich, emollient, semi-solid cream base. Together, the two components oil-phase thickeners and stabilizers produce a smooth, moisturizing, and stable cream.

Formulation table:

Sr. no.	Ingredients	Quantity Required	Uses
1.	Egg yolk oil	2 ml	Natural emollient, moisturizer, rich source of bioactive nutrients, treat burns
2.	Eggshell powder	0.5gm	Exfoliating agent
3.	Beeswax	4 gm	Emollient, thickening agent, Stabilizer
4.	Cetyl alcohol	2 gm	Emollient, thickening agent, Stabilizer
5.	Glycerin	0.5 ml	Humectant, moisturizing agent
6.	Distilled water	10 ml	Vehicle
7.	Vitamin E oil	0.44ml	Antioxidant
8.	Aloevera gel	0.5 ml	Soothing, anti-inflammatory and moisturizing agent
9.	Methyl Paraben	0.06 gm	Preservative

Table no. 1: Formulation Table

Procedure:

1. Bring the oil phase (egg yolk oil, cetyl alcohol, and beeswax) to around 70°C.
2. Glycerin, aloe vera, eggshell powder, vitamin E oil, and distilled water should all be heated separately at the same temperature as the water phase.
3. Using a stick blender or high-shear mixer, gradually integrate the oil phase into the water phase.
4. Keep mixing until an emulsion forms and begins to cool.
5. Put components that are sensitive to heat (such as essential oils and preservatives) below 40°C.
6. Transfer to jars and allow to solidify.

Evaluation Parameter:

1. **Physical properties:** The cream's appearance, color, and scent were assessed.



Fig.no. 5: Physical evaluation of cream

2. **Washability:** After applying the cream to the hand, it was examined under running water.
3. **pH:** The standard buffer solution was used to calibrate the pH meter. A digital pH meter was used to measure the pH of 0.5 grams of cream that had been dissolved in 50.0 milliliters of pure water.

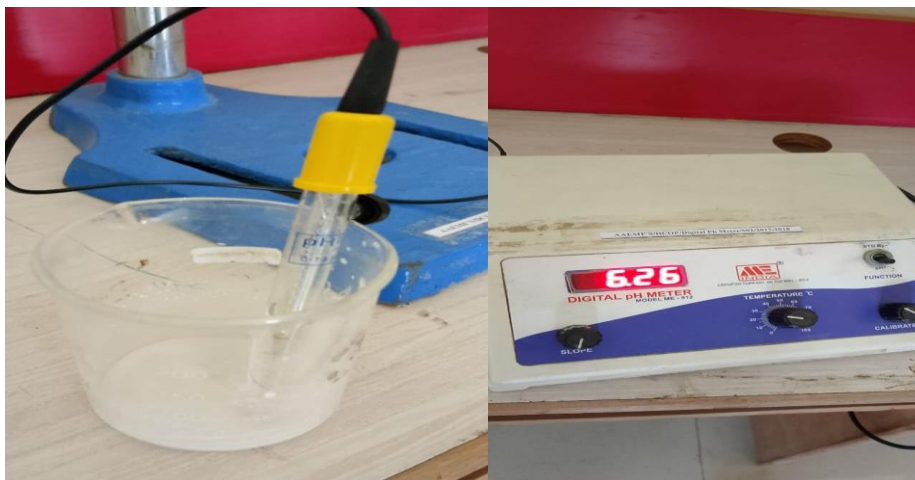


Fig. no. 6: pH test

4. **Spreadability test:** To assess a cream formulation's spreadability a measure of how easily and evenly it applies when applied to the hands. Apply the cream on the back or middle of one hand. Spread the cream in a circular motion with two fingers from the other hand.
5. **Irritancy test:** On the dorsal surface of the left hand, mark a 1 square centimeter area. The application of the cream to the specified region was timed. At regular intervals for a maximum of 24 hours, any irritation was evaluated and reported.
6. **Dye test:** It combines the color of Scarlet red dye with the cream. Take a drop of the cream, put it on a microscopic slide, then cover it with a cover slip so you can examine it. Whether the dispersed globules appear red will make the ground white. This is an o/w cream. This is not the case with w/o type cream, where the scattered globules seem colorless.

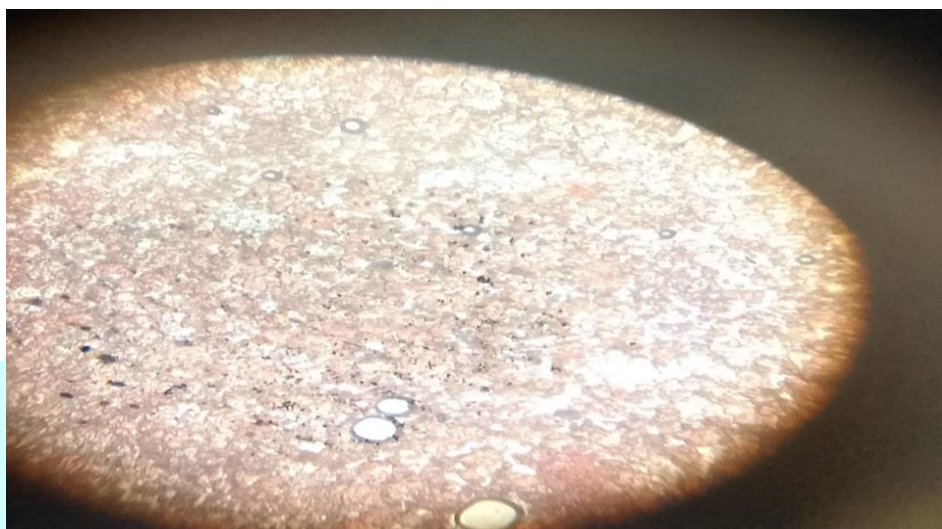


Fig. no. 7: Dye Test

7. **Homogeneity:** The appearance was used to test for homogeneity.
8. **Greasiness:** Finding out how sticky or oily a cream feels on the skin after application is one way to assess its greasiness. Here, the cream's grease-likeness was evaluated after a tiny amount was applied to the skin's surface.
9. **Phase separation:** The prepared cream was stored away from light in a covered container between 25 and 100°C. Phase separation was then examined for 30 days and 24 hours. There was a noticeable shift in the phase separation.

Observations of evaluation parameter:

Sr. no.	Parameter	Observation
1	Physical properties	
	2. Color	White
	3. Odor	Mild characteristics
	4. Texture	Smooth
2	Washability	Easily washable with water

3	pH	6.26
4	Spreadability test	Easily spreadable
5	Irritancy test	Non-irritant
6	Dye test	o/w emulsion
7	Homogeneity	No lumps or phase separation
8	Greasiness	Non-greasy
9	Phase Separation	No phase separation

Table no. 2. Evaluation Parameters



Fig no. 8: Final Product.

Result and Discussion:

Good emulsification was indicated by the egg yolk oil cream formulation's pleasing physical attributes, which included a consistent consistency, a pale appearance, and a smooth texture. With a pH of 6.26, it is within the optimal range for topical treatment and is not prone to irritate skin. Tests of the cream's spreadability revealed that it was simple to apply and disperse uniformly over the skin, improving user compliance.

No phase separation or microbiological contamination was seen over the course of 30 days, indicating good stability, and homogeneity was suitable for steady and reliable dosing. The bioactive elements of egg yolk oil, such as polyunsaturated fatty acids, cholesterol, and phospholipids, which support tissue repair, cell regeneration, and anti-inflammatory activity, are probably responsible for its rapid healing impact. These results lend credence to the effectiveness of egg yolk oil cream as a potentially effective natural burn wound healing remedy.

Conclusion:

Egg yolk oil cream has great promise for accelerating burn injury recovery. The quantity of bioactive compounds, including vitamins A and D, phospholipids, and essential fatty acids, is thought to be responsible for its effectiveness. These substances improve tissue regeneration, reduce inflammation, and speed up re-epithelialization. Egg yolk oil cream shows promise as a natural, economical, and effective substitute or supplement to traditional burn treatments, according to the results. Standardizing

formulations, assessing long-term safety, and validating efficacy in human patients all require more mechanistic research and clinical trials.

Future Scope:

With potential for further study in the domains of biomedicine, pharmacology, and dermatology, egg yolk oil cream exhibits significant promise for the healing of burn wounds. By lowering inflammation and encouraging collagen synthesis, angiogenesis, and re-epithelialization, its bioactive components which include important fatty acids, vitamins A and D, and immunoglobulins support healing. For improved absorption and controlled release, research can concentrate on formulation optimization, potentially utilizing nanotechnology.

To determine safety, efficacy, and dose in comparison to conventional treatments, preclinical and clinical trials are required. Results may be improved by combining egg yolk oil with additional substances, such as herbal extracts or antimicrobials. It is particularly promising for low-resource environments as a sustainable and affordable alternative, particularly if it is made from waste of the chicken industry. Its use in regenerative medicine may also be expanded by additional research on gene expression and cellular responses.

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