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Formulation of Organic Facial Scrub from Egg Shell Membrane

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ABSTRACT

The main objective of this study was to create an organic scrub using eggshell membrane as a natural exfoliator. In order for both men and women to live happy and confident lives, cosmetics have grown to be an essential component of daily living. Observing the variety of synthetic exfoliants found in body scrubs in the market gave rise to the thought of combining natural exfoliants into the formulation. Because egg shell membrane has special moisturizing and antioxidant qualities, a scrub using it was created. A suitable scrub base was created by using varying concentration of egg shell membrane, and the resulting scrub was assessed on several suitable parameters. Due to the high level of hen egg consumption worldwide, there is a significant amount of waste egg material available, especially egg shell (ES) and egg shell membrane (ESM). It is never easy to dispose of ES and ESM, especially for the officials in charge of the food, bakery, and poultry divisions. Eggshell membrane contains collagen which is also one of the main element of the skin's extracellular matrix, which are proteins that are crucial for skin elasticity and firmness, preserving the integrity of the skin barrier to stop moisture loss. Antioxidant qualities of collagen allow it to counteract free radicals. Skin aging, including wrinkles, fine lines, and loss of firmness, can result from a decrease in collagen levels brought on by aging, UV exposure, or environmental stresses. Egg shell membrane scrub was created and subsequently assessed according to a number of criteria. When compared to other scrubs, the combination exhibits better moisturizing and antioxidant qualities.

Keywords: Organic Scrub, Egg Shell Membrane (ESM), Natural Exfoliator, Collagen, Skin Elasticity & Firmness, Skin Aging.

1. Introduction

Due to growing environmental issues & its awareness and all the possible health risks associated with artificial substances, the cosmetics industry has seen a standard change in recent years toward organic and sustainable goods. Skin care products are pharmaceutical formulations meant to come into contact with the body's numerous exterior regions in order to exhibit advantageous topical effects and offer defence against aging skin disorders (Riberio *et al*., 2015). Isolated attention has been noticed in reformulation of face scrubs using biodegradable and non-toxic components. Facial scrubs are exfoliating agents that are used to exfoliate dead skin cells and promote skin regeneration. A naturally occurring biowaste material with notable bioactive qualities, the eggshell membrane (ESM), is an organic component with high potential that is still neglected in this field.

Eggshells are usually thrown away and are commonly considered kitchen trash which adds to the environmental load. However, the eggshell membrane—the inner lining of the eggshell—has recently drawn scientific interest, due to its complex biological makeup. ESM's semipermeable membrane is made up of proteins like collagen (types-I, V, and X), elastin, keratin, and glycosaminoglycans (GAGs). These proteins are responsible for preserving the integrity and elasticity of the skin (Sakai *et al*., 2018). These biomolecules' presence highlights the product's potential as a useful component in dermatological applications, especially exfoliants.

Facial scrubs promotes a clearer and smoother complexion by scraping off the outer layer of dead skin cells. Micro-beads are synthetic polymer particles often used in traditional scrubs. These micro-beads pose serious environmental risks, even with their effectiveness, especially to marine life (Eriksen *et al*., 2013). Consequently, there is an urgent need to replace such materials with biodegradable alternatives. The powdered form of ESM, owing to its fibrous and slightly chafing texture, makes it an excellent by-product for physical exfoliation, while simultaneously delivering beneficial proteins and nutrients to the skin. Through the prevention of skin disorders such as rosacea, eczema, and acne, skincare promotes skin health and reduces discomfort (Surber *et al*., 2018).

The principles of circular economy and zero-waste initiatives promotes the use of eggshell membrane in cosmetic formulations by reusing an otherwise discarded material. Annually from the food processing industry more than 250,000 metric tons of eggshell waste are produced throughout the world. (Kingori, 2011). Majority of this waste ends up in the dumping ground where it poses management challenges. By sanctioning ESM for cosmetic use, its environmental footprint can be reduced while also adding value to bio-waste. Moreover, the amalgamation of skin-compatible and natural components into skincare formulations depicts growing consumer preferences for beauty products that are clean, which exclude harsh & toxic chemicals, parabens, and synthetic fragrances (Euromonitor International, 2022).

Many research studies shows that ESM can promote skin regeneration and healing which are huge dermatological benefits. According to Ruff *et al*. in 2012, hydrolyzed ESM has been associated with improved skin elasticity and reduced wrinkle depth when used as a dietary supplement. These findings provide a rationale for studying topical applications for an exfoliant, where direct application on the skin is expected to yield visible effects. Furthermore, the antioxidant activity of ESM contributes to neutralizing free radicals, which are known to accelerate skin aging (Park *et al*., 2015).

2. Review of Literature

There are many studies that investigate the potential of **apricot** kernels, walnut shells, rice husks, and more recently, fruit seeds as natural exfoliants (Rajauria & Abu-Ghannam, 2013). Although these alternatives are effective, they are derived from edible parts of plants, raising serious concerns over diversion of food resource. ESM being a non-edible by-product, makes its utilization advantageous in cosmetics both economically and ethically.

Collagen and elastin are well-established components in anti-aging skincare which are the functional characters of ESM, offering tensile strength and elasticity to the skin (Gelse *et al*., 2003). Additionally, hyaluronic acid is a constituent of ESM, which has impressive capacity to retain moisture, enhancing to skin plumpness and contributing to skin hydration (Jiang *et al*., 2014). Skin hydration is crucial for preserving its suppleness, elasticity, and general health. Water is vital for the skin's proper operation, especially for the stratum corneum, the skin's outermost layer (Verdier *et al*., 2007). These properties are suggesting that ESM may also provide mechanical exfoliation over bioactive skincare benefits, making it a dual-action ingredient.

From a formulation standpoint, fine powdered ESM can also be merged with other organic components such as aloe vera, honey, green tea extract, and essential oils to produce a systematic organic facial scrub. These additives enhances the fragrance and texture of the facial scrub and also complement the antioxidant and antimicrobial profile of the final product. Aloe vera, for instance, is known for its soothing and anti-inflammatory effects, while honey possesses antibacterial properties that help prevent acne (Surjushe *et al*., 2008).

Despite its promise, the use of ESM in topical formulations such as facial scrubs is still an unexplored area of research, with very limited products currently on the market. To establish and improve its viability, a deep research into its exfoliating efficiency, skin compatibility, and consumer acceptability is crucial. Studies prove that application of ESM is even suitable on sensitive skin types as it has suitable biocompatibility and low cytotoxicity (Mikami *et al*., 2012).

3. Material and Methodology

This process involved the following steps:

Egg shells were collected of species Gallus gallus domesticus from a nearby food vendor and discarded by them following their usage. The egg shell was dissolved using 35% HCl. Principle: In this reaction, water (H2O), carbon dioxide (CO2), and calcium chloride (CaCl2) are produced when calcium carbonate and hydrochloric acid combine. When an acid combines with a carbonate substance, carbon dioxide is released as a gas, which causes the fizzing or bubbling that is frequently noticed. The resulting calcium chloride dissolves into the solution since it is soluble in water.

CaCO3 (s) + 2HCl (aq) -> CaCl2 (aq) + CO2 (g) + H2O (l)

It was stored in the 35% HCl solution for a whole day. In order to neutralize it, 35% NaOH was applied once the entire egg shell had dissolved. After the membrane of the egg shell was neutralized, it was taken out of the solution and preserved for subsequent drying. It was placed in the sunlight for three days to ensure adequate drying. By removing moisture from the eggshell, sun drying reduces the likelihood of bacterial growth and survival. Since bacteria need moisture to survive, the conditions that support bacterial development are adversely affected when the eggshell membrane dries out. The DNA of bacteria, viruses, and other microbes is harmed by UV light, which lowers their viability. Later, the egg shell membrane was turned into a paste by crusting it in a mortar and pestle. Later on, this compound was utilized to make scrubs.

Formulation of scrub:

The formulation of the scrub involved the following procedures:

Scrub was made with the following percentage concentration.

75% Natural egg membrane concentrate, 18 % granulated egg shell powder, 0.3 % almond oil, 0.4% glycerine, water as solvent.

For 100 gm = 75gm Egg membrane concentrate+18 gm shell powder + 33 ml almond oil + 310 ml glycerine and water as solvent

Calcium Carbonate ($CaCO_3$) is a common mineral compound that has various applications in skincare products. It is primarily used as an abrasive agent in exfoliating products and as a bulking agent in formulations.

Further tests were conducted to determine whether the scrub extraction included collagen.

Qualitative Analysis of Collagen:

A test using the biuret reagent was performed to determine whether collagen was present.

1. Test tubes were taken and measured out equal volumes of the 1ml scrub extract solution into the test tubes.
2. Perform the Biuret Test: Added an equal volume of 1 ml biuret reagent to each test tube containing the collagen solution.
3. Incubation: Allowed the test tubes to stand at room temperature for about 5-10 minutes. During this time, a colour change may occur if proteins, including collagen, are present.
4. Observation: After the incubation period, observed the colour change in the test tubes. A positive result shown by a violet or purple colour.

Collagen can help skin stay more hydrated when applied topically or consumed because it forms a barrier on the skin's surface to stop water loss (Schunck *et al.*, 2015). Collagen peptides also help the skin produce more hyaluronic acid and other moisturizing molecules, which improves the skin's capacity to hold onto moisture and preserve a healthy barrier function (Proksch *et al.*, 2014; Zague *et al.*, 2018).

Karl Fischer Titration Method:

To determine the extract's moisture content, a Karl Fischer titration was performed, and the moisture content was compared to that of five different market scrubs.

1. Karl Fischer Reagent is made up of 0.5-1.0 grams of iodine (I_2), 5 mL of methanol (CH_3OH) and 5 mL of sulphur dioxide (SO_2) solution.
2. Weighed accurately about 100.0 mgs Di-sodium tartrate 2-hydrate. (Di-sodium tartrate 2- hydrate is a stable compound for almost all the conditions that prevail in the laboratories.).
3. Using this reading Karl Fischer reagent factor was calculated. To determine the extract's moisture content, a Karl Fischer titration was performed, and the moisture content was compared to that of five different market scrubs.

Table 1. Physical parameters of scrub

Antioxidant Test DPPH Assay:

1. DPPH reagent (2, 2-Diphenyl-1-picrylhydrazyl) -Added 0.1g of DPPH powder in 100 ml solution.
2. Preparation of reaction mixture: Mixed equal volumes of the DPPH solution and the test sample or standard solution in a test tube. 1 ml test solution mixed with ml DPPH solution.
3. Incubation of reaction mixture: Incubated the reaction mixture in the dark at room temperature for a specific period of 30 minutes to allow the antioxidant compounds in the samples to react with the DPPH radical.
4. Measurement of Absorbance: After the incubation period, measured the absorbance of the reaction mixture at the appropriate wavelength 520 nm using colorimeter.

Table 2. Moisture content of samples

pH Test:

The scrub extract's pH was tested by following procedure.

1. A homogeneous, well-mixed solution was utilized for the pH test.
2. pH meter was calibrated using the 7 pH buffer available in the kit.
3. Gave the pH reading some time to settle.Once the pH reading steadied, noted the value that the pH meter showed.

4. Observation and Result

Sr. No.	Test Parameters	Observations
1	Colour	Whitish
2	Odour	Characteristic
3	Consistency	Good
4	Grittiness	Few Gritty
5	Washability	Easily Washable
6	Spreadability	7.5 gm cm/sec

Sr. No.	Sample	Wt. of Sample in gm	KF consumption	% moisture
1	Sample A	0.5	53.49	55.63
2	Sample B	0.5	57.98	60.30
3	Sample C	0.5	55.86	58.10
4	Sample D	0.5	62.84	65.36
5	Sample E	0.5	57.80	60.12
6	Scrub Extract	0.5	70.76	73.60

Obtained extracted scrub solution (ml)	Concentration (mg/ml)	Absorbance	Inhibition%
control	0	0.29	00
1	2	0.26	**10.34**
2	4	0.25	**13.79**
3	6	0.24	**17.24**

Table 3. Inhibition Percentage by DPPH Assay

Inhibition% = (Absorbance of control – Absorbance of sample) / Absorbance of control × 100

Calculation (1) = 0.29 – 0.26 / 0.29 × 100 = 10.34 %

Calculation (2) = 0.29 -0.25 / 0.29 × 100 = 13.79 %

Calculation (3) = 0.29- 0.24/ 0.29 ×100 = 17.24%

The evaluation of the face scrub was done, and the following results were observed

1. Colour: Visual inspection revealed that the face scrub was light brown in colour
2. Consistency: The consistency of face scrub was found to be semi-solid and smooth by visual examination.
3. Washability: This test was carried out directly on the skin. After applying the preparation and rinsing the skin with ordinary water, the skin was found to be clear and clean.
4. Grittiness: Few gritty particles were found in the face scrub.
5. Spreadability: It is used to determine the extent of the gel's ability to spread on the skin. A glass slide with 100 g of weight was placed above a small amount of sample that had been deposited on the slide. A small quantity of sample was placed on a glass slide and another slide was placed above them; 100 g of weight was placed on the slide. The amount of time it took the gel to spread out on the slide was measured and determined to be 3 cm in 40 seconds.

It was calculated by using following formula: $S = m \times l/t$

Whereas, S = Spreadability, m = Weight placed on slide, l = Length of glass slide, t = Time taken in seconds

Calculation: S = 100g × 3/ 40 = 7.5 gm cm/ sec

5. Conclusion

In conclusion, the formulation of an eggshell membrane scrub represents a promising opportunity to harness the beneficial properties of ESM for skincare applications. Through rigorous evaluation of efficacy, safety, and consumer acceptance, this work aims to contribute to the development of innovative and sustainable skincare formulations that meet the evolving needs of consumers in the beauty industry. Further research and development in this area has the potential to drive advancements in natural skincare ingredients and enhance the overall efficacy and sustainability of skincare products. Therefore, the scrub's formulation may prove helpful in the future for scrub preparations and skin care applications.

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