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A REVIEW ON FORMULATION DEVELOPMENT AND EVALUATION OF ANTIOXIDANT ACTIVITY OF PEEL-OFF FACIAL MASK BY DYNAMIC DUO OF FLAXSEED AND ALOE VERA

Harithalakshmi Ramesh[1*], Aswini Jayakumar[2], Vijayalatchumi Sasikumar[3] and Dr. Mythili Krishnamurthy[4]

[1*,2,3]U.G. Scholars, Kamalakshi Pandurangan College of Pharmacy, Tiruvannamalai, Tamilnadu.

[4]Professor, Kamalakshi Pandurangan College of Pharmacy, Tiruvannamalai, Tamilnadu.

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***Corresponding Author**
Harithalakshmi Ramesh
U.G. Scholars, Kamalakshi Pandurangan College of Pharmacy, Tiruvannamalai, Tamilnadu.

ABSTRACT

The increasing consumer demand for natural and sustainable skincare products has driven researchers to explore plant-based ingredients for cosmetic formulations. Flaxseed (*Linum usitatissimum*) and aloe vera (*Aloe barbadensis*) are known for their potent antioxidant and skin-beneficial properties. Now a days, aloe vera is a natural product that is frequently used in the field of cosmetology. Aloe vera leaves can be divided into two main products are the latex, which is a bitter yellow liquid that is found beneath the leaf's epidermis, and the gel, which is a colourless, tasteless material that is present within the leaf. Both of them include a multitude of physiologically active substances, primarily polysaccharides and anthraquinones. Aloe vera has been used as a flavouring in food and cosmetic items including toothpaste and moisturizers, according to scientific research. Controlled studies are required to ascertain its true effectiveness, despite the fact that there are numerous indications for its use. Flaxseed for the face works as an anti-aging get and remove dead cells as well as moisturizer. Flaxseed fights dark spots and acne, vitamin E is an important fat-soluble antioxidant and has been in use for more than 50 years in dermatology. This review discusses the formulation development, evaluation techniques, and antioxidant efficacy of a peel-off facial mask using these two herbal components. The potential synergistic effects of flaxseed's lignans and aloe vera's polysaccharides, alongside an easy-to-use peel-off mechanism, make this combination promising for skincare innovations. Key formulation parameters,

challenges, and evaluation methodologies are summarized to aid future research and commercialization efforts.

KEYWORDS: Flaxseed, Aloe vera, Peel-off mask, Antioxidant activity, Natural skincare, Herbal cosmetics.

INTRODUCTION

Nowadays, young people have an intense desire for skin that is radiant and brilliant. All of them aspire to look younger and more attractive than they truly are. Because cosmetics and related products are more costly and not accessible to everyone, they would prefer to use them at home rather than visit a skin specialist or take medication. The skincare industry has witnessed a paradigm shift towards natural and sustainable products. Among the various cosmetic forms, peel-off facial masks are gaining popularity due to their ease of application, non-invasive exfoliation, and ability to deliver bioactive compounds effectively. Herbal ingredients like flaxseed and aloe vera have attracted attention for their multifaceted benefits. Flaxseed is a rich source of omega-3 fatty acids, lignans, and antioxidants, flaxseed also known as linseed is emerging as an important functional food ingredient because of its rich contents of α-linolenic acid ALA, and fibre. Potential health benefits of flaxseed oil, fibres, and flax lignans include a lower risk of cancer, atherosclerosis, diabetes, cardiovascular disease, osteoporosis, arthritis, autoimmune diseases, and neurological disorders. Sometimes skin can develop dry patches for many reasons like UV rays, pollutant makeup left on overnight can cause irritation or allergic reactions. Flaxseed for glowing skin it prevents drying of skin studies have found that fatty acids present in flax seed helps retain moisture, this makes the skin looks shiny and smooth. While aloe vera is celebrated for its hydrating, anti-inflammatory, and skin-rejuvenating properties. Since ancient times, people have utilized the aloe vera plant for its skin care, cosmetic, medical, and health benefits. Aloe vera's name comes from the Arabic word "Alloeh," which means "shining bitter substance," and the Latin word "vera," which means "true." Aloe vera was considered the universal panacea by Greek scientists two millennia ago. Aloe was referred to as "the plant of immortality" by the Egyptians. The aloe vera plant is being utilized in dermatology for a number of reasons. The purpose of skin care products, such as gel, lotion, ointment, cream, peel-off mask, and others, is to produce local action when applied to the skin's mucosal membrane. A peel-off mask is a kind of dosage form that is applied softly to the skin surface of the face and leaves it on for a

few minutes before peeling off. By combining these two ingredients in a peel-off mask offers a novel approach to enhance skin health while leveraging their antioxidant potential.

COMPREHENSIVE LITERATURE REVIEW

Flaxseed: A Versatile Skincare Ingredient

Flaxseed (*Linum usitatissimum*) contains lignans, phenolic compounds, and omega-3 fatty acids, which play significant roles in combating oxidative stress and improving skin elasticity. Studies reveal that flaxseed extracts provide anti-inflammatory and collagen-enhancing properties, making them suitable for anti-aging skincare formulations. The therapeutic actions of flaxseed can be attributed to its rich content of nutrients, including.

1. **Lignans:** Flaxseed contains a type of lignan called secoisolariciresinol diglycoside (SDG), which has been shown to have anti-inflammatory, antioxidant, and anti-cancer properties.
2. **Omega-3 fatty acids:** Flaxseed is a rich source of alpha-linolenic acid (ALA), a type of omega-3 fatty acid that has been shown to have anti-inflammatory and cardiovascular benefits.
3. **Fiber:** Flaxseed is a good source of dietary fiber, which can help promote digestive health, lower cholesterol levels, and regulate blood sugar levels.
4. **Phenolic acids:** Flaxseed contains a range of phenolic acids, including ferulic acid, sinapic acid, and caffeic acid, which have been shown to have antioxidant and anti-inflammatory properties.

Figure-1: Flaxseeds.

Figure-2: *Linum usitatissimum.*

Aloe Vera: Nature's Skin Healer

Aloe vera (*Aloe barbadensis* miller) is belongs to *Asphodelaceae* (*Liliaceae*) family. It contains 75 potentially active constituents such as minerals, sugars, lignin, saponins, salicylic

acids, polysaccharides, vitamins (A, C, E), enzymes, and amino acids. These constituents hydrate the skin, accelerate wound healing, reduce inflammation, effects on skin exposure to UV and gamma radiation, effects on the immune system, laxative effects, antiviral and antitumor activity, anti-aging and anti-septic effect. Aloe vera also enhances the penetration of other active ingredients, increasing the efficacy of combined formulations.

Figure-3: Aloe vera.

Synergistic Effects of Flaxseed and Aloe Vera

The combination of flaxseed and aloe vera offers complementary benefits. While flaxseed provides structural and antioxidant support, aloe vera hydrates and soothes the skin. Their integration into a peel-off mask delivers potent antioxidant activity and user-friendly application.

Other Natural Ingredients for Peel-Off Masks

Consideration of other natural actives, such as turmeric (*Curcuma longa*) for its anti-inflammatory benefits or green tea (*Camellia sinensis*) for added antioxidant properties, can further enhance the formulation's appeal and efficacy.

Figure-4: Peel-off mask.

MEDICINAL AND HEALTH BENEFITS

Medicinal properties and health benefits for aloe vera

For ages, aloes have been used to treat a variety of illnesses, especially those involving the digestive system, as well as burns, wounds, and skin issues. Aloes are named after the dried juice that emerges from the bases of their transversely cut leaves. Since it does not cure but rather provides nourishment to the body's systems so they may operate at their best and remain healthy, it is the greatest herbal solution to support the body's health and healing processes. Pharmacologically, it detoxifies the body and increases immunity. In adjuvant therapy, it is advised to get rid of drug-induced gastritis and other side effects while using antibiotics, NSAIDs (Nonsteroidal Anti-inflammatory Drugs), and chemotherapy. Beneficial for a number of conditions, including type II diabetes, arthritis, eye conditions, tumours, enlarged spleens, liver problems, jaundice, ulcers, bronchitis, and asthma. Relieves constipation, keeps the pH of the stomach stable, and aids in the treatment of duodenal and stomach ulcers, inflammatory bowel disorders, and non-ulcer dyspepsia. a nutritional supplement for osteoporosis, postmenopausal women, and patients before and after surgery.

Helps digestion: The body naturally cleanses the digestive system when aloe vera juice is consumed. In the event of constipation, it aids in removal by stimulating the bowels to move. It will also aid in slowing down the progression of any diarrhoea.

Increases energy levels: Numerous ingredients in our diets might lead to weariness and lethargy. Regular use of aloe vera juice promotes a higher sense of wellbeing, boosts energy levels, and aids in maintaining a healthy body weight.

Builds immunity: It is especially great for those who have chronic immune disorders like fibromyalgia since the polysaccharides in Aloe vera juice stimulate macrophages, the white blood cells that fight viruses.

Detoxifies: Aloe vera juice is an excellent natural detoxifier. Everybody has to occasionally cleanse their systems due to the stress of their lives, the pollutants they are exposed to, and the junk food they consume. Aloe vera juice offers a remarkably beneficial blend of vitamins, minerals, and trace elements to help our bodies cope with daily stressors.

Reduces inflammation: It facilitates the regeneration of bodily cells and increases joint flexibility. It decreases pain and inflammation in weak or aging joints by strengthening the muscles that make up the joints.

Medicinal properties and health benefits for flaxseed

1. **Anti-inflammatory:** Flaxseed contains lignans, which have anti-inflammatory properties and may help reduce inflammation and improve conditions such as arthritis, asthma, and allergies.
2. **Antioxidant:** Flaxseed is a rich source of antioxidants, including lignans, phenolic acids, and flavonoids, which can help protect against cell damage, oxidative stress, and chronic diseases such as cancer, diabetes, and cardiovascular disease.
3. **Cardiovascular health:** The omega-3 fatty acids, fiber, and lignans in flaxseed may help lower cholesterol levels, reduce blood pressure, and prevent cardiovascular disease.
4. **Digestive health:** Flaxseed is a rich source of dietary fiber, which can help promote digestive health, prevent constipation, and support healthy gut bacteria.
5. **Cancer prevention:** The lignans and antioxidants in flaxseed may help prevent cancer cell growth and reduce the risk of certain types of cancer, such as breast, prostate, and colon cancer.
6. **Hormone regulation:** Flaxseed contains lignans, which may help regulate hormone levels and reduce the risk of hormone-related disorders, such as polycystic ovary syndrome (PCOS) and endometriosis.
7. **Immune system support:** Flaxseed contains immunomodulatory compounds, which may help support the immune system and reduce the risk of infections and autoimmune diseases.
8. **Neuroprotective:** The omega-3 fatty acids and antioxidants in flaxseed may help protect against neurodegenerative diseases, such as Alzheimer's and Parkinson's disease.
9. **Skin and hair health:** Flaxseed oil, which is rich in omega-3 fatty acids, may help improve skin and hair health, reducing inflammation and promoting healthy skin and hair growth.
10. **Menopausal symptoms:** Flaxseed may help alleviate menopausal symptoms, such as hot flashes and night sweats, due to its estrogenic and anti-inflammatory properties.

THERAPEUTIC ACTIONS OF ALOE VERA

1. Moisturizing actions

The mixture of water and polysaccharide components is primarily responsible for the moisturizing action; it produces a jelly-like consistency that retains the water in the mixture and reduces its evaporation, giving drying tissues a prolonged moist environment. Additionally, the humectant qualities help tissues retain moisture.

2. Wound healing effects

In a rat model, it was demonstrated that the aloe vera gel polysaccharide acemannan activated macrophages, which enhanced wound healing. The gel's mannose-6-phosphate component has been given credit for its ability to promote wound healing.

3. Anti-inflammatory effects

In a rat adjuvant-induced arthritic inflammatory model, found that an aloe vera extract (defined as a 5.0% leaf homogenate) reduced inflammation by 48%. The peptidase bradykinase was recently identified from aloe and demonstrated to degrade bradykinin, an inflammatory chemical that causes pain.

4. Antibacterial/antifungal/antiviral effects

Aloe vera gel has been shown to inhibit two microorganisms: *Streptococcus pyogenes* and *Streptococcus faecalis*. In a monolayer culture, Acemannan prevented *Pseudomonas aeruginosa* from attaching to human lung epithelial cells, but aloe vera gel was thought to have bactericidal properties against the bacteria. *Candida albicans* growth was apparently reduced by a processed aloe vera gel formulation. Acemannan decreased herpes simplex infection in two target cell lines that were cultivated in terms of antiviral properties.

5. Anti-ulcer effect

Rats' peptic ulcers caused by Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) were prevented by the anti-ulcer properties of aloe vera.

6. Laxative effects

Latex contains anthraquinones, which have strong laxative properties. They accomplish this by boosting intestinal peristalsis, raising intestinal water content, and inducing mucus secretion.

7. Antitumor activity

Aloe's polysaccharide fraction has been demonstrated in a study to prevent the production of a benzopyrene-DNA adduct that may cause cancer by blocking the binding of benzopyrene to primary rat hepatocytes. Another study reported the induction of glutathione S-transferase and as well inhibition of the tumour-promoting effects of phorbol myristic acetate suggesting the possible role of aloe gel in cancer chemoprevention. Aloe vera's anti-tumour properties against Swiss albino mice's skin papilloma genesis caused by DMBA and croton oil. Anti-tumour properties and modulation of antioxidant enzymes activity by aloe vera leaf active principles isolated via supercritical carbon dioxide extraction.

8. Antiseptic effect

The Antiseptic effect of aloe vera is mainly due to the presence of 6 antiseptic agents viz., Lupeol, salicylic acid, urea nitrogen, cinnamomic acid, phenols and sulfur. They all exhibit inhibitory action against fungi, bacteria and viruses.

9. Effects on skin exposure to UV and gamma radiation

Aloe vera gel is said to protect the skin from radiation damage. Though exact role is not known, but following the administration of aloe vera gel, metallothionein, an antioxidant protein is generated in the skin, which scavenges free radicals and prevents suppression of superoxide dismutase and glutathione peroxidase, the antioxidant enzymes in the skin. According to research, aloe reduces the synthesis and release of immunosuppressive cytokines like interleukin-10 (IL-10) that are derived from skin keratinocytes, thereby preventing UV-induced suppression of delayed type hypersensitivity.

10. Anti diabetic effects of Aloe extracts

Hypoglycaemic effect of aloe vera gel on streptozotocin-induced diabetes in experimental rats. Aloe vera leaf gel extract's positive effects on the lipid profile status in rats with streptozotocin diabetes; antidiabetic effects of dietary treatment of Aloe arborescens miller components on multiple low dosage streptozotocin-induced diabetes in mice and rats.

11. Antioxidant effects

Aloe extracts were also found to have antioxidant effects. A substance that stops other substances from oxidizing is called an antioxidant. Free radicals are naturally occurring byproducts of cell metabolism that they neutralize to protect the essential components of the cell.

This approach *in-vitro* determination of antioxidant capacity as benefits over simply quantifying antioxidant components as it provides a measure of their effectiveness.

Among many antioxidant methods performing suitable method in aloe vera and flaxseed peel-off face mask are,

1. **Hydrogen Atom Transfer methods (HAT).**

i. Oxygen Radical Absorbance Capacity (ORAC) method.
ii. Lipid Peroxidation Inhibition Capacity (LPIC) Assay.
iii. Total Radical Trapping Antioxidant Parameter (TRAP).
iv. Inhibited Oxygen Uptake (IOU).
v. Crocin Bleaching Nitric Oxide Radicle Inhibition Activity.
vi. Hydroxyl Radical Scavenging Activity By p-DNA.
vii. Scavenging of H_2O_2 Radicals Assay.
viii. ABTS Radical Scavenging method.
ix. Scavenging of Super Oxide Radical Formulation by Alkaline.

2. **Electron Transfer Method (ET).**

i. Trolox Equivalent Antioxidant Capacity (TEAC) decolourization.
ii. Ferric Reducing Antioxidant Power (FRAP).
iii. DPPH Free Radical Scavenging Assay.
iv. Copper (II) Reduction Capacity.
v. Total Phenols by Folin-Ciocalteu.
vi. N, N-dimethyl-p-p-phenylenediamine (DMPD).

3. **Other Assays**

i. Total Oxidant Scavenging Capacity (TOSC).
ii. Inhibition of Briggs- Rauscher Oscillation Reaction.
iii. Chemiluminescence.
iv. Electrochemiluminescence.
v. Fluorometric analysis.
vi. Enhanced Chemiluminescence (ECL).
vii. TLC Bioautography.
viii. Cellular Antioxidant Activity (CAA) assay.
ix. Dye- Substrate Oxidation method.

THERAPEUTIC ACTIONS OF FLAXSEED

1. Functional food: Flaxseed can be used as a functional food to promote overall health and well-being.

2. Dietary supplement: Flaxseed can be used as a dietary supplement to support specific health conditions, such as cardiovascular health, digestive health, and cancer prevention.

3. Traditional medicine: Flaxseed has been used in traditional medicine for centuries to treat a range of health conditions, including digestive problems, skin conditions, and respiratory issues.

4. Cosmetic applications: Flaxseed oil can be used in cosmetic applications, such as skin care and hair care products, to promote healthy skin and hair.

FORMULATION OVERVIEW

Key Ingredients

- Base Material: Polyvinyl alcohol (PVA) ensures effective film formation.
- Plasticizer: Glycerine provides flexibility.
- Active Components: Flaxseed extract and aloe vera gel act as the core functional ingredients.
- Solvent: Distilled water is used for uniform dispersion.
- Preservative: Optional, to ensure long-term stability.
- Essential Oils: Add fragrance and auxiliary benefits, such as antimicrobial or calming effects.

PREPARATION TECHNIQUES

1. Flaxseed Extract Preparation: Boiling flaxseeds in water yields a gel-like extract rich in bioactive.
2. Aloe Vera Gel Extraction: Harvested from fresh aloe leaves, filtered for purity, and stored under refrigeration.
3. Base Formulation: Polyvinyl alcohol is dissolved in water to create a clear, homogenous gel.
4. Integration: Flaxseed and aloe vera extracts are incorporated into the base, followed by the addition of essential oils and plasticizers.
5. Final Processing: The pH is adjusted to 5.5–6.5 to ensure compatibility with human skin.

EVALUATION PARAMETERS

Antioxidant Activity

The DPPH (2,2-diphenyl-1-picrylhydrazyl) assay highlights the free radical scavenging ability of the mask. Studies show that the combination of flaxseed and aloe vera provides significant antioxidant potential, surpassing individual components.

Skin Compatibility

- p^H Levels: Measured to ensure the formulation is non-irritating to the skin.
- Irritation Testing: Conducted on volunteers to confirm safety.
- Dermatological Testing: Evaluation on a broader population to ensure hypoallergenic properties.

Peelability and Spreadability

The mask's peel-off quality and its ability to cover the skin evenly were assessed through laboratory and user feedback.

Stability Studies

The formulation demonstrated stability across varying environmental conditions, retaining its viscosity, antioxidant properties, and physical characteristics.

Microscopic Analysis

Microscopic studies to evaluate the uniformity of the dispersion of active ingredients in the formulation enhance the understanding of consistency and performance.

CONSUMER INSIGHTS AND MARKET POTENTIAL

Consumer Appeal

- Ease of Use: The peel-off format simplifies application and removal.
- Natural Ingredients: Aligns with the growing consumer demand for eco-friendly and non-toxic skincare products.
- Customizability: Addition of essential oils enhances user experience through tailored fragrance and additional benefits.

Market Trends

The global skincare market is increasingly favouring products with natural and plant-based ingredients. Flaxseed and aloe vera's well-documented benefits position this formulation as a

strong contender in the herbal cosmetics segment. Emphasis on clean beauty and transparency further enhances marketability.

Consumer Feedback Studies

Incorporating qualitative and quantitative data from user trials aids in refining the product's appeal and effectiveness.

CONCLUSION

Flaxseed and aloe vera represent a promising combination for antioxidant-rich peel-off facial masks. Their synergistic properties provide a robust defense against oxidative stress while improving skin texture and hydration. This review underscores the need for further research on scaling production and clinical validation to bridge the gap between formulation development and commercial success.

FUTURE DIRECTIONS

1. Exploring advanced delivery mechanisms, such as nanoparticles or liposomes, for enhanced bioavailability.
2. Conducting comparative studies with synthetic and other natural formulations to substantiate claims.
3. Evaluating long-term storage stability and scalability for commercial production.
4. Developing sustainable packaging solutions to align with eco-conscious preferences.

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