International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

The Science of Flaxseed in Skincare: A Review on Its Moisturizing and Hydrating Benefits

Sakshi S. Raut[1], Sumit Nerkar[1], and Bhavana P. Raut[1]
[1]*School of Pharmacy,G H Raisoni University, Saikheda, Teh- Saunsar, Dist.-Pandhurna, Madhya Pradesh, India-480337.*

Date of Submission: 01-05-2025 Date of Acceptance: 10-05-2025

ABSTRACT: As a fibre crop people know flaxseed because it delivers important nutrients such as phytoestrogens in the form of lignans alongside omega-3 fats, PUFA along with ALA. The natural ingredient has developed into multiple industrial applications because it now serves many functions throughout haircare, skincare, pharmaceuticals, health items and cosmetics. Flaxseed demonstrates extensive commercial value through its bioactive compounds and nutritional aspects which establishes it as an essential all-purpose agricultural product. The natural gelling qualities of flaxseed mucilage provide pharmaceuticals as well as herbal cosmetics and foods with stability properties because they serve as effective stabilizers and structure enhancers and water-preservers. The scientific evidence shows that flaxseed demonstrates help for anti-aging effects as well as antioxidative and anticancer therapy potential together with its capacity to treat heart conditions through cholesterol reduction and improved blood pressure control.

KEYWORDS: Flaxseed, Mucilage, Omega-3 fatty acid, Lignans.

I. INTRODUCTION

1.1 BACKGROUND ON FLAXSEED IN SKINCARE:

Several century's people have been using flaxseed (Linum usitatissimum) as a nutrition and medical compound, its recent use in dermatology and cosmeceuticals gained popularity only several years ago. Flaxseed is traditionally used as food supplement, based on its very high omega3 fatty acids and lignans and antioxidants with promoting the general health and skin healthy[1]. The moisturizing benefits and anti-inflammatory properties and protection affording against oxidative damage of skin seem to have made flaxseed similarly apparent in modern topical skincare formulations[2].

Increasing usage of flaxseed based natural and herbal skincare products in the market has been risen using flaxseed derived ingredients in different dermal products such as moisturizers as well as serums and facial creams and nanoemulsions and ageing products[3]. Studies have shown that flaxseed elevates the barrier usefulness and moisture retention and improve elasticity to keep moisture and so remains important in the hydrating cosmetics formulations [4].

1.2 BIOACTIVE COMPOUNDS AND THEIR SKIN BENEFITS:

The composition of rich bio active is offered from flaxseed which is credited for its skincare repercussion due to reducing the skin cell damage.

i) Omega-3 Fatty Acids (ALA - Alpha-Linolenic Acid):

Skin moisture balance maintenance and restrained dryness and irritation [5].It increases skin's elasticity and hydration[6].

ii) Lignans and Antioxidants:

It has age prevention properties (i.e., antioxidize and turn down of oxidative stress and inflammation)[7]. Combats free radicals, interferes with the premature aging and collagen breakdown[8].

iii) Flaxseed Mucilage and Polysaccharides:

They are natural humectants that retain moisture and help proliferate hydration retention [9].They exhibit skin soothing properties and hence are ideal for sensitive and dry skin products[10].

iv) Flaxseed Oil and Essential Nutrients:

It includes vitamins A and E that help in facilitating the skin cell regeneration and repair[1]. They have anti-inflammatory properties, drop the

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

redness and inflammation, especially in acne skin [11].

1.3 HYDRATION AND MOISTURIZATION ROLE OF FLAXSEED IN SKIN BARRIER PROTECTION:

Flaxseed, one of the major skin care advantages, is the fact that how it can keep skin moist and hydrate, scientific studies point out that flaxseed mucilage and polysaccharides act like hyaluronic acid retaining moisture in the layers of the skin[9].Several studies have shown that flaxseed products possess on water retention capabilities.Gel and cream made of flaxseed mucilage in fact strongly increase water retention and dehydration [12]. Thus, it is adapted for sensitive and dry skin[4].

Nanoemulsion gels with flaxseed oil offer convalescent skin permeation and longer-lasting this removes the hydration effects compared to conventional creams [11].Herbal preparations of flaxseed mixed with other natural ingredients for example, several manufacturers have found that when applied, aloe vera (among other ingredients) actually increases skin hydrated levels for up to 8-10 hours [3].Flaxseed based skincare products render them the best skin oil to suffer from dry skin all year round, boosts elasticity, and maintains a good barrier to moisture [5].

1.4 FLAXSEED IN HERBAL AND COSMECEUTICAL FORMULATIONS:

Other dermatological and cosmetic products where flaxseed has also been found are moisturizers, creams, and serums to herbal masks and nanoemulsions. Its utility in some studies have been done in modernist skincare formulas. Face masks and gels containing flaxseed have been declared to aid skin hydration andwhen used with other bioactive ingredients, hibiscus, castor oil, and vitamin E, it gives texture[13].

Petition of flaxseed extract to microemulgel formulas has been successfully enhancedand delivering and absorbing its bioactive ingredients for increased hydration as well as anti-agingbenefits[9].Flaxseed oil as a component of lyotropic liquid crystals (LCCs) have already been proven by clinical studies,remarkable enhancement of trans-epidermal water loss (TEWL), supervene on in improved skin barrier function and hydration [5].

1.5 FLAXSEED IN PHARMACEUTICAL EXCIPIENT:

The ingredients that help shape a medicine into its ready form, be it a tablet or a syrup etc. and ensure that it functions as it should, are the excipient. First, flaxseed contains natural sugars (polysaccharides), which swell well in any given body conditions. It is polysaccharide containing so that it has good water holding and swelling properties[14]. These are hydrophilic polysaccharides; they have the ability to absorb and bear water forming gel type consistency. Therefore, it can be used as a bio-adhesive and binder for a drug formulation for its sustained or controlled release. Although flaxseed polysaccharides are used in stabilizers in pharmaceutical formulations, their ability to interact with water and oils makes them useful.

FIG: 1 USES OF FLAXSEED

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

i) Flaxseed as an Encapsulating Agent:

This mucilage, proteins and lipids of flaxseed give film forming, emulsifying and gelation properties and can be used as an encapsulating agent. In food, pharmaceutical and cosmetic applications, active compounds are protected, stabilized and allows them to be released in a controlled manner by using spray drying, emulsion-based encapsulation, ionic gelation or freeze drying[14].

ii) Flaxseed as a Gelling Agent:

The mucilage in flaxseed is a natural gelling agent, and when hydrated, it acts as what would be a natural gelling agent. It serves as a good stabilizer, texture prop and water retainer in formulations. It improves hydration, protection of bioactivity, controlled release, and is biodegradable and safe to be used in food (thickener, vegan version of gelatine), pharmaceuticals (drug delivery, wound healing) and cosmetics (moisturizers, face masks)[14].

iii) Flaxseed as an Emulsifier and Stabilizer:

Flaxseed acts as a natural emulsifier and stabilizer due to its rich content of mucilage, proteins, and polysaccharides, which enhance emulsion stability and viscosity. As an emulsifier, it helps blend oil and water by reducing surface tension, making it valuable in food products like dressings and dairy alternatives, as well as in pharmaceuticals and cosmetics. Its stabilizing properties prevent phase separation by increasing viscosity and forming a protective layer around dispersed droplets, improving texture, consistency, and shelf life. Widely used in plant-based foods, drug formulations, and skincare products, flaxseed offers a natural, biodegradable, and safe alternative to synthetic stabilizers[14].

iv) Flaxseed as a Penetration & Enhancer:

Its bioactive compounds such as omega 3 fatty acids, lignans, mucilage, as natural penetration enhancer improve the permeability of active ingredients through biological membranes. It is its lipid content, which aids in disrupting the stratum corneum, in enhancing transdermal drug delivery and absorption in skincare formulations. The polysaccharides and mucilage in flaxseed have a hydrating affect and make the skin more receptive of active compounds. Flaxseed is used as a biodegradable, safe and plant-based penetration enhancer for enhanced bioavailability in the pharmaceuticals, cosmetics and nutraceuticals[14].

v) Flaxseed as a Structure Forming:

Proteins, polysaccharides and mucilage in flaxseed are responsible for its natural structure forming ability when it is produced in quantity and acts as a natural structure forming agent due to its high content of mucilage, proteins and polysaccharides. The mucilage forms a three-dimensional network, which contributes to food, pharmaceutical and cosmetic formulations. Flaxseed based hydrogelshave great applications in drug delivery due to their controlled release and stability, as well as in the skincare due to their texture and moisture retention. Due to its biopolymer nature, it is an eco-friendly biodegradable film, encapsulation and stabilizing formulation[14].

vi) Flaxseed as a Binding Agent:

Mucilage, polysaccharides and proteins, mainly flaxseed, act as a natural binding agent to robust adhesion and cohesiveness. The mucilage binds its ingredients to form a viscous gel that can be used to hold ingredients together in pharmaceutical tablets and food products as well as cosmetic formulations.

As a plant-based alternative to egg and synthetic binders in food, and as an enhancer of tablet compression and disintegration control in pharmaceuticals, it is used. Due to its biodegradable, natural, and non-toxic properties, this is an excellent choice in the manufacture of sustainable formulations[14].

vii) Flaxseed as an Anti-Retrogradation:

Its high mucilage and polysaccharide content makes Flaxseed a natural anti retrogradation agent because they inhibit starch recrystallization, retain moisture to prolong shelf life, thus keeping the house apples plasticized.

Flaxseed mucilage interferes with retrogradation of amylose in food applications such as baked goods and starch-based products preventing hardening and maintaining texture over time. This property helps to improve shelf life, softness, and quality of such products as bread, pasta and gluten free formulations. It is safe and effective alternative to synthetic anti-retrogradation agents because of its natural and biodegradable nature[14].

viii) Flaxseed as aSuspending and Super disintegrant:

Suspending - Mucilage and polysaccharides of flaxseed mucilage render flaxseed as a natural suspending agent, enhancing

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

the viscosity and preventing the settling of particles in liquid formulations. Stability and uniformity of spread of the pharmaceutical suspensions, food products and cosmetic emulsions are given.

Flaxseed mucilage is a super disintegrant, which swells rapidly upon water contact, breaking the tablets into smaller pieces, and thereby relieving tablets faster and to allow drug to be released and absorbed faster. Being hydrophilic and show swelling, its biodegradable and plant based makes it a plant based non-toxic synthetic disintegrant alternative with increased efficacy of the oral dosage forms[14].

1.6 PHARMACOLOGICAL ACTIVITIES OF FLAXSEED:

a) Antioxidant: -Lignans, polyphenols, and omega-3 fatty acids in flaxseed is acted as an antioxidant and reduce oxidative stress. However, these compounds are beneficial to the cells, delaying aging, and protecting them from damage and lowering the risk of chronic diseases[15].

b)Anti-inflammatory Activity: - Flax seeds contain a high alpha linolenic acid (ALA) and lignan content that is thought to inhibit pro – inflammatory cytokines, promoting anti – inflammatory conditions such as arthritis, cardiovascular diseases and many more[16].

c)Gut Microbiota: -Flaxseed's dietary fiber and lignans are prebiotics that aid in promoting growth of gut bacteria like Lactobacillus and Bifidobacterium. It improves digestion, immune function and reduces dangerous bacteria.

d)FibrinolyticActivity: - The fact that flaxseed has bioactive peptides and omega 3 fatty acids, which breaks down fibrin clots, aids blood circulation and prevents thrombosis and cardiovascular diseases[14].

e)Anti-Cancer Activity: - Phytoestrogenic, also anti–proliferative, flaxseed lignans with prohibited growth in breast, prostate, and colon tumors. In addition, they promote apoptosis (programmed cell death) to cancerous cells and prevent metastasis[17].

1.7 RESEARCH PROGRESS ON FLAXSEED-BASED FORMULATIONS:

i)Formulation and Evaluation of a Novel Herbal Trio Gel Containing Flaxseed Extract, Carbopol, and Carboxymethyl Cellulose:

Shanmugam et al. (2023) formulated a new herbal gel system built from brown flaxseed extract with CMC and Carbopol for local drug administration purposes. Such surface characteristics evaluation represents the inaugural scientific study for this formulation. Laboratory workers used powder brown flaxseeds to extract bioactive substances from distilled water before they mixed CMC and Carbopol to achieve stable rheological gel properties.

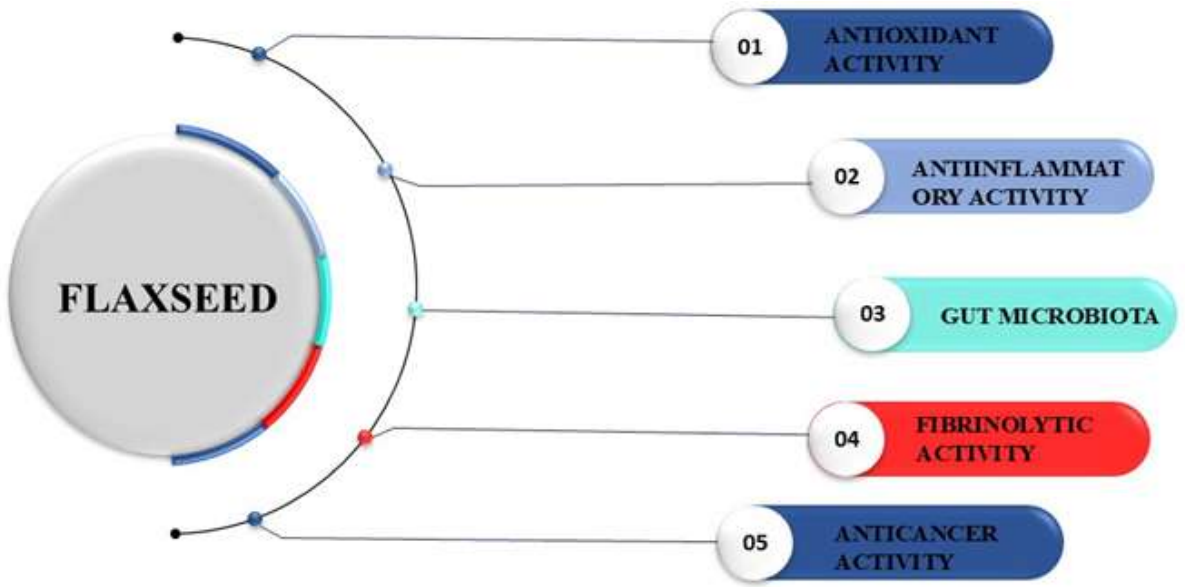

FIG: 2 PHARMACOLOGICAL ACTIVITIES OF FLAXSEED

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

The antimicrobial and anti-inflammatory properties of the prepared gel matched chlorhexidine gel in its ability to combat black-pigmented anaerobes. Brown flaxseed exceeded the anti-inflammatory capacities of gold flaxseed which makes brown flaxseed more suitable for treating periodontal inflammation. The character of flaxseed components including aromatic chemicals and functional groups appeared in the profile through Fourier-transform infrared spectroscopy (FTIR) analysis but additional data about gel surface elements came from scanning electron microscopy (SEM). The research adds to the development of natural therapeutic gels for mouth care and inflammation therapy[1].

ii)Herbal Cosmetics Formulated with Flaxseed, A Comprehensive Study:

The market promotes herbal cosmetics because these products deliver effective results without producing the harmful reactions caused by synthetic cosmetics. The research conducted by Fale et al. (n.d.) demonstrated the use of flaxseed-based herbal cosmetics for skin and hair care which contains fatty acids along with antioxidants and bioactive compounds. The addition of flaxseed to cosmetics proved useful because it provided moisturization and enhanced collagen production and radical-scavenging capabilities which helps prevent aging signs.

The research discussed multiple extraction approaches including supercritical fluid extraction together with hydro-distillation because these methods enable the extraction of beneficial compounds from flaxseed. Modern beauty practices combine with traditional ones through the use of flaxseed in herbal cosmetics that meet rising consumer needs for natural effective skin and hair solutions[2].

iii)Formulation and Evaluation of Hibiscus-Flaxseed Herbal Hair Gel:

Gupta et al. (2024) created and assessed a hair gel from Hibiscus rosa-sinensis and flaxseed to treat typical hair problems that include hair loss and thinning. Flaxseed maintains popularity for its beneficial essential fatty acids and antioxidant content that helps the hair grow stronger while traditional hair-folk treatment with hibiscus targets alopecia alongside thorough hair follicle strengthening.

Research scientists developed five formulation types to determine that H1F4 achieved optimal results regarding pH measurements and colour appearance and stability attributes and viscous properties. The outcome shows that replacing chemical-based hair products with herbal alternatives results in better results than chemicals that commonly harm the scalp while damaging hair[3].

iv)Formulation and Evaluation of an Herbal Hair Mask Containing Flaxseed:

Jujgar et. al. (2024) published a study which evaluated and developed an herbal hair mask comprised of flaxseeds together with curry leaves, aloe vera, hibiscus, amla, multani mitti and bhringraj oil, coconut oil, and castor oil. Many ingredients with antioxidative properties alongside antibacterial and anti-inflammatory abilities were selected because they support holistic treatment for both hair and scalp health.

The creators of the herbal mixture utilized natural oils and preservatives to blend dried and cleaned herbal substances into the mixture. The evaluation showed that the formulation fulfilled both safety requirements and efficacy standards through measurements of pH tests and tests related to washability as well as post-wash hair texture and viscosity and measurements of ocular irritation and patch tests. Studied research demonstrates that affordable herbal haircare alternatives possess no toxicity thus representing an appealing option against synthetic products[13].

v)Preparation and Evaluation of Flaxseed Oil Cream:

Skincare scientists today use flaxseed oil-based formulations because they supply skin with both moisturizing capabilities and therapeutic effects. A flaxseed oil cream for treating dry and cracked skin was formulated by Koli et al. (2022) for winter season use. The product development included an extensive study of skin physical dynamics combined with a comparison between synthetic and natural components.

Flaxseed oil creams show important antioxidant and anti-inflammatory characteristics which make them successful for skincare use. The rising market demand for herbal cosmetics enables flaxseed oil-based creams to provide natural yet secured and effective care in place of synthetic skincare items[4].

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

TABLE NO. 1: -RESEARCH PROGRESS ON FLAXSEED-BASED FORMULATIONS

Study Title	Authors & Year	Key Ingredients	Purpose & Findings
Formulation and Evaluation of a Novel Herbal Trio Gel Containing Flaxseed Extract, Carbopol, and Carboxymethyl Cellulose	Shanmugam et al. (2023)	Brown flaxseed extract, Carbopol, Carboxymethyl Cellulose (CMC)	Creation of a stable antimicrobial anti-inflammatory herbal gel which performed similarly to chlorhexidine. The FTIR spectroscopy aided by SEM microscopy examined the structure of the formulated materials)
Herbal Cosmetics Formulated with Flaxseed, A Comprehensive Study	Fale et al. (n.d.)	Flaxseed extract (rich in fatty acids, antioxidants)	Hydrated skin along with enhanced collagen and reduced aging effects appear as key benefits from using cosmetics based on flaxseed. The extraction process uses hydrodistillation together with supercritical fluid extraction.
Formulation and Evaluation of Hibiscus-Flaxseed Herbal Hair Gel	Gupta et al. (2024)	Hibiscus rosa-sinensis, Flaxseed extract	H1F4 emerged as the solid formulation while other combinations proved unstable. Flaxseed and hibiscus fulfill two vital functions by strengthening hair follicles and blocking hair loss and they also enhance scalp health.
Formulation and Evaluation of a Herbal Hair Mask Containing Flaxseed	Jujgar (2024)	Flaxseed, Curry leaves, Aloe vera, Hibiscus, Amla, Multani mitti, Bhringraj oil, Coconut oil, Castor oil	Creation of a stable antimicrobial anti-inflammatory herbal gel which performed similarly to chlorhexidine. The FTIR spectroscopy aided by SEM microscopy examined the structure of the formulated materials)

II. RESULT & DISCUSSION:

This section presents the major findings from a number of studies on flaxseed-based formulations for applications in skincare as well as pharmaceutical applications. It further discusses how different flaxseed products can be effective, stable, and present some benefits, including their use in hydration, anti-aging, anti-inflammatory properties, as well as pharmaceutical uses.

1]Effectiveness of Flaxseed in Skin Hydration and Moisturization:

Effectiveness of Flaxseed in Skin Hydration and Moisturization If we're talking about skin care products then one of the benefits with weight loss is to retain moisture in skin as well as to give it ultimate human hygiene. Hydrating effects have been studied using various formulations as well including flaxseed mucilage gels, nanoemulsions and oil-based creams.

The results demonstrated that flaxseed-based skincare formulations result in significantly improved skin hydration and these formulations are appropriate for use by sensitive and dry skin. Flaxseed mucilage, because of its high water binding capacity, works the same way as hyaluronic acid in providing deep hydration as well as long lasting moisturization [9].

2]Anti-Aging and Antioxidant Properties:

Anti-Aging and Antioxidant Properties Flaxseed has a high amount of omega 3 fatty acids, lignans, and polyphenols that have anti-aging and antioxidant effect on lessening oxidative stress and slowing down collagen breakdown.

These studies prove that flaxseed-based skincare products can successfully target the signs visible of aging, making them all natural anti-aging products.

3]Anti-Inflammatory and Medicinal Applications:

Anti-inflammatory and medicinal applications although flaxseed possesses anti-inflammatory and antimicrobial uses, the latter can be included in medicinal and therapeutic composition. According to Shanmugam et al. (2023), the usage of brown flaxseed extracts herbal trio gel with Carbopol and CMC had been successful in treating gum inflammation and bacterial infection.

The herbal trio gels were essential as they were medicinal and cosmetic benefits and it is

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 3 May–June 2025, pp: 01-08 www.ijprajournal.com ISSN: 2456-4494

clearly shown that the flaxseed-based formulations can be used to treat oral healthcare and wound healing [1].

4]Role of Flaxseed in Pharmaceutical and Cosmeceutical Formulations:

Role of Flaxseed in Pharmaceutical and Cosmeceutical Formulations Flaxseed is used as a gelling agent, emulsifier, stabilizer as well as a penetration enhancer in all the pharmaceutical and cosmetic formulations throughout.

The role of the multi-functional properties of flaxseed is important in pharmaceuticals and cosmeceuticals. This is very biodegradable, safe ingredient that can be used in eco or sustainable products.

III. CONCLUSION

The most important research done till now among the five studies on flaxseed-based product is the herbal trio gel with brown flaxseed extract, carbopol and carboxy methyl cellulose (CMC) [1]. This is a special study for two reasons, it's not about beauty products per se, it's also partly about medicine. Also, it has proved the gel can treat gum inflammation and fight bacteria, rendering it a potential natural alternative to regular mouth gels like chlorhexidine. This one also looks at health benefits, unlike other studies which mainly tend to only cover hair and skin care.The other strength of this study is that it comprises of the detailed testing. The researchers have the machines like FTIR to find out what helpful ingredients are inside and on the surface of the gel with SEM. These tests showed that the gel is stable, effective and safe for use. Also, the addition of CMC and Carbopol makes the gel thicker, longer lasting and easier to absorb, which makes it appropriate for oral health treatments as well.Other studies describe how flaxseed can aid in dry skin, hair growth and the age process, but don't pay any attention to the medical uses as much as this one. Flaxseed oil related creams, herbal hair masks and hibiscus flaxseed hair gel products are always beautiful and a wonderful self-care investment, but they do not provide help to infections and inflammations like this gel does. This study is most important since it proves health as well as antibacterial benefits. Future treatment can prove better utilizing natural form of treatment with the help of flaxseed. By making this research, flaxseed becomes a big key ingredient in the natural healthcare.

REFERENCES:

[1]. Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai-600077, Tamil Nadu, India, & Shanmugam, R. (2023). Formulation and evaluation of a novel herbal trio gel containing flax seed extract, carbopol and carboxymethyl cellulose. Bioinformation, 19(5), 540–545. https://doi.org/10.6026/97320630019540

[2]. Fale, S. K., Umekar, M. J., Bhoyar, S. K., & Bhoyar, S. K. (n.d.). A COMPREHENSIVE STUDY OF HERBAL COSMETICS PREPARED FROM FLAXSEED.

[3]. Gupta, M., Patel, L., Rohit, D., & Mahida, R. (2024). Formulation And Evaluation Of Hibiscus Flaxseed Herbal Hair Gel. 12(2).

[4]. Miss. Aishwarya S. Koli, Miss Pratiksha D. Narute, Mr. Pramod B. Chikkodi, Mr R. G. Patrakar, & Mr Amol A. Patil. (2022). Preparation and Evaluation of Flaxseed Oil Cream. International Journal of Advanced Research in Science, Communication and Technology, 386–391. https://doi.org/10.48175/IJARSCT-7804

[5]. Vitek, M., & Matjaž, M. G. (2024). Clinical application of hempseed or flaxseed oil-based lyotropic liquid crystals: Evaluation of their impact on skin barrier function. Acta Pharmaceutica, 74(2), 301–313. https://doi.org/10.2478/acph-2024-0014

[6]. Firnanda, D. S., Budiastuti, A., Widodo, A., & Wibowo, D. A. (2020). THE EFFECTS ON FLAXSEED (LINUM USITATISSIMUM) ON THE SEVERITY LEVEL OF ACNE VULGARIS. Jurnal Kedokteran Diponegoro (Diponegoro Medical Journal), 9(4), Article 4. https://doi.org/10.14710/dmj.v9i4.27667

[7]. Yoon, J. H., Jang, W. Y., Park, S. H., Kim, H. G., Shim, Y. Y., Reaney, M. J. T., & Cho, J. Y. (2023). Anti-Melanogenesis Effects of a Cyclic Peptide Derived from Flaxseed via Inhibition of CREB Pathway. International Journal of Molecular Sciences, 24(1), Article 1. https://doi.org/10.3390/ijms24010536

[8]. Spirt, S. D., Stahl, W., Tronnier, H., Sies, H., Bejot, M., Maurette, J.-M., &

Heinrich, U. (2008). Intervention with flaxseed and borage oil supplements modulates skin condition in women. British Journal of Nutrition, 101(3), 440–445. https://doi.org/10.1017/S00071145080203 21

[9]. Tasneem, R., Khan, H. M. S., Rasool, F., Khan, K.-R., Umair, M., Esatbeyoglu, T., & Korma, S. A. (2022). Development of Phytocosmeceutical Microemulgel Containing Flaxseed Extract and Its In Vitro and In Vivo Characterization. Pharmaceutics, 14(8), 1656. https://doi.org/10.3390/pharmaceutics140 81656

[10]. Khalid, M. M., Chadha, M. M., Nath, M. V., Mehta, D. S., Chawla, D. A., Piplani, D. S., Siddheshwar, D. S., & Deshmukh, D. R. (2023). Assessment of organoleptic and physicochemical properties of herbal shampoos: Formulation considerations of fermentation method.

[11]. Ismail, S., Ahmed-Farid, O. A., Metwally, G. F., Mansour, D., & Khattab, A. (2024). Anti-aging effect of mustard and flax seed oils based nanoemulsion gel on aged rat skin through antioxidant and anti-inflammatory activity. Scientific African, 26, e02369. https://doi.org/10.1016/j.sciaf.2024.e0236 9

[12]. Rajju Priya Soni, Mittu Katoch, Kumar, A., Verma Csk, Himachal Pradesh, & Krishi Vishwavidyalya. (2017). Flaxseed-composition and its health benefits. Unpublished. https://doi.org/10.13140/RG.2.2.35208.93 448

[13]. Jujgar, G. S. (2024). Formulation and evaluation of herbal hair mask. Journal of Pharmacognosy and Phytochemistry, 13(3), 86–94. https://doi.org/10.22271/phyto.2024.v13.i 3b.14945

[14]. Rajan, D. S., Ravi, K., Muthuswamy, R., Murugesan, A., Palanisamy, R., Thirumurugan, S., & Subramanian, S. (2024). EXPLORING FLAXSEED IN PHARMACEUTICAL APPLICATION AND THERAPEUTIC POTENTIAL: A COMPREHENSIVE REVIEW. 22(11).

[15]. Nowak, W., & Jeziorek, M. (2023). The Role of Flaxseed in Improving Human Health. Healthcare, 11(3), Article 3. https://doi.org/10.3390/healthcare1103039 5

[16]. There, U., Gour, N., Shrikant, S., Choudhary, V., & Kandasamy, R. (2023). Development of skincare formulations using flaxseed oil and mucilage. Journal of Pharmacognosy and Phytochemistry, 12(2), 33–39. https://doi.org/10.22271/phyto.2023.v12.i 2a.14624

[17]. Li, Y., Zhao, X., Wang, Y., & Qiu, C. (2024). Research Progress and Prospect Analysis of the Application of Flax Lignans. Journal of Natural Fibers, 21(1), 2309909. https://doi.org/10.1080/15440478.2024.23 09909.