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Exploring the properties of omega fatty acid in cosmetics: A comprehensive review

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ABSTRACT:

Omega fatty acids, encompassing omega-3, omega-6, and omega-9, play a pivotal role in cosmetics. Abundantly found in various vegetable oils, these fatty acids offer significant benefits when incorporated into formulations for cosmetic products. They contribute to skin surface fortification, resulting in smoother texture and enhanced healing of the skin barrier, leading to improved moisture retention and increased suppleness. Additionally, these fatty acids demonstrate efficacy in soothing inflamed, delicate, and flushed skin, mitigating the adverse effects of UV radiation, and reducing signs of ageing. Notably, they address issues such as flaky and dehydrated skin. This article provides a comprehensive examination of the importance of omega fatty acid phyto complex derived from vegetable oils within the cosmetics domain. Delving into the distinct characteristics of Omega-3, Omega-6, and Omega-9, this review elucidates their individual impacts on skin and hair health. Moreover, it underscores their versatile applications in various cosmetic products. The review emphasizes current research trends, highlighting the synergistic potential of integrating these fatty acids into nutraceuticals for holistic skincare treatments.

Introduction

Fatty acids, organic compounds composed of carbon, oxygen, and hydrogen, serve as fundamental building blocks of triglycerides, exhibiting a distinctive structure with a hydrophilic carboxyl group and a hydrophobic hydrocarbon chain [1]. Beyond their role in triglycerides, these molecules exert profound effects on skin health, influencing cell membrane flexibility and thereby controlling molecular movement in and out of cells. Approximately one-third of the skin barrier comprises fatty acids, safeguarding against dryness, allergens, irritants, and pathogenic microorganisms [2]. These acids play a pivotal role in the skin's microbiota, influencing conditions like acne, rosacea, psoriasis, and eczema [3]. Fatty acids, fatty acid salts, and their derivatives have extensive use in cosmetic and personal care products for diverse purposes, including cleaning, emulsion stabilization, and altering the surface properties of skin and hair [4].

Omega fatty acids in cosmetics are derived from sources such as fish oil, vegetable oils, and plant oils. Research has indicated that fish oil, which contains high levels of omega-3 polyunsaturated fatty acids (PUFAs) such docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), may offer advantages for the skin [5]. Vegetable oils, including soybean oil, palm/palm kernel oil, sunflower oil, rapeseed oil, and coconut oil, are extensively utilized in cosmetic products as oily foundations and moisturizers. Plant oils that include unsaturated fatty acids, specifically linoleic acid and α-linolenic acid, play a crucial role in skin care by decreasing the occurrence of eczemas and aiding in

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the restoration of the damaged lipid barrier of the epidermis [6]. Omega fatty acids from these sources are included in cosmetic products such as creams, lotions, and emulsions due to their positive impact on the skin [4,7].

As the exploration deepens into the advantages of omega fatty acids for the skin, it becomes evident that essential fatty acid deficiency can compromise the skin barrier's integrity. The topical application of oils containing these fatty acids enhances hydration and barrier function. The potential of incorporating omega fatty acids derived from vegetable oils into cosmetic compositions emerges as a promising avenue for advancing formulations for cosmetic products [6,8,9]. However, despite the growing interest in natural ingredients, a critical challenge surfaces – the lack of thorough scientific research on the effectiveness and ideal utilization of these fatty acids in cosmetics. This knowledge gap hinders the industry's ability to fully harness the potential advantages of omega fatty acids for skin and hair health. This review paper concludes with a call for targeted investigations to address these complexities and unlock the full potential of omega fatty acids in the field of cosmetics.

Types of omega fatty acids

Table 1 provides a concise overview of the fatty acid compositions in various plant-, animal- and algae-based oils, along with their specific cosmetic applications.

Omega-3 fatty acids: EPA and DHA, commonly referred to as "marine omega-3s," are predominantly derived from cold-water fish, including salmon, mackerel, tuna, herring, and sardines. These fatty acids are essential for human health and are considered "conditionally essential" fats, as they can be synthesized from alpha-linoleic acid (ALA). However, due to potential inefficiencies in converting ALA to EPA/DHA, it is recommended to obtain EPA/DHA directly from dietary sources. ALA, the predominant omega-3 fatty acid in Western diets, is found in plant oils (canola, soybean, and flax), nuts (walnuts), chia and flax seeds, green vegetables, and certain animal fats, particularly those from grass-fed animals [10]. ALA, categorized as an essential fat, plays a crucial role in promoting regular human growth and development.

Omega-3 fatty acids have demonstrated potential advantages for the skin in terms of safeguarding and maintaining stability (Figure 1). They have the ability to improve the severity of skin conditions such as photoaging, skin cancer, allergies, dermatitis, cutaneous wounds, and melanogenesis [5]. Omega-3 fatty acids, abundant in fish oil, have been discovered to possess antioxidant and anti-inflammatory properties on human fibroblasts, melanocytes, and keratinocytes [11,12]. Additionally, sardine oil, which is rich in omega-3 fatty acids, has been discovered to stimulate cell growth, shield cells from oxidative stress, and maybe hinder the ageing process of the skin. Additionally, omega-3 fatty acid oil serves to shield the skin against harm caused by UV radiation [13].

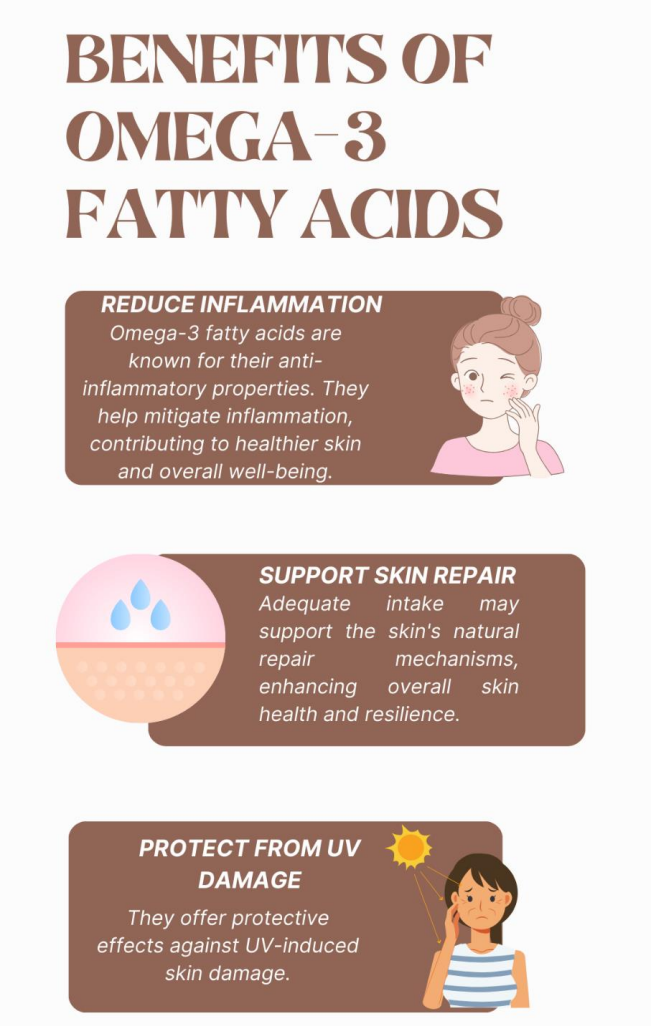

Figure 1: Benefits of omega-3 fatty acid in cosmetics

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Omega-6 fatty acids: Omega-6 fatty acids, classified as essential fatty acids, are vital for human health and cannot be synthesized by the body, necessitating their intake through dietary sources. These PUFAs are essential for brain function, normal growth, and development and play a role in promoting skin and hair growth, preserving bone health, regulating metabolism, and maintaining the reproductive system. Achieving an optimal diet involves a balanced combination of omega-3 and omega-6 fatty acids. While omega-3 fatty acids exhibit anti-inflammatory properties, certain omega-6 fatty acids have pro-inflammatory effects [14].

The use of Omega-6 fatty acids in cosmetic compositions has been discovered to yield advantageous outcomes. These oils, including echium oil, cameline oil, evening primrose oil, and borage oil, may be found in vegetable oils. They are commonly utilized in cosmetic products to achieve an omega-3 to omega-6 ratio ranging from 1 to 5. The presence of fatty acids, namely linoleic acid, is crucial for preserving the lipid composition of the skin and the barrier that controls water permeability [15]. Additionally, they contribute to the regulation of skin irritation, sebum production, and the growth and specialization of cells. Furthermore, conjugated linoleic acid, in both its free and derivatized forms, has been used in cosmetic products due to its therapeutic and nutritional characteristics. Omega-6 fatty acids, which are essential for the body, have been proven to improve the structure and function of cell membranes, preserve and restore the skin's protective barrier, and possess properties that reduce irritation and inflammation.

Omega-9 fatty acids: Oleic acid represents the most common omega-9 fatty acid. While omega-3 and omega-6 fatty acids are classified as polyunsaturated, omega-9 is classified as monounsaturated. Cosmetic formulations and emulsion compositions have been shown to benefit from the inclusion of omega-9 fatty acids, particularly cis-Δ9-octadecenoic acid or its derivative. These formulations offer exceptional comfort during usage, long-lasting stability, and stability in emulsification. Omega 9 fatty acids, which are essential fatty acids, have been proven to improve the structure and function of cell membranes, preserve and restore the skin's protective barrier, and possess properties that reduce irritation and inflammation. Studies have examined vegetable oil blends that include omega-9 fatty acids for their effects on the skin, namely their anti-inflammatory and antioxidant properties, as well as their capacity to promote the growth and movement of fibroblast cells [16].

Table 1: Overview of fatty acids in plant-, animal- and algae-based oils and their cosmetic applications

Fatty acid	Oil	Composition	Application in cosmetics
Plant based			
Omega-3	Canola Oil	Oleic acid (60%), linoleic acid (20%), and ALA (10%)	• Valued for emollient and moisturizing effects. • Soothes dry and irritated skin. • Locks in moisture. • Enhances skin's natural barrier function. • Combats free radicals for a healthy, youthful complexion. • Key ingredient in lip balms, lotions, and creams. • Acts as a binding agent. • Increases the stability of emulsions. • Provides a smooth texture to products.
	Soybean Oil	Linoleic acid (54%), oleic acid (23%), palmitic acid (11%), steric acid (4%)	• Diminishes signs of dullness and wrinkles. • Creates a smoother, more youthful-looking appearance.

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			• Potential to increase collagen levels in the skin. • Anti-inflammatory properties aid in reducing acne and scarring.
	Flax Seed Oil	Palmitic and stearic (9-10%), oleic acid (20%), ALA (more than 70%)	• Essential fatty acids in flaxseed oil smoothen skin's appearance. • Makes the skin super soft. • It can be applied on its own or mixed with a lightweight moisturizer.
	Chia Seed Oil	ω-3 (68%), ω-6 fatty acid (19%)	• Helps maintain a healthy skin membrane. • Protects against ultraviolet (UV) rays. • Reduces fine lines on the skin.
	Walnut Oil	Linoleic acid (60.42-65.77%), oleic acid (13.21-19.94%)	• Since ancient times, known to lighten dark patches. • Helps reduce scars and dark spots. • Promotes an even complexion. • Aids in fading hyperpigmentation. • Contributes to a healthy and radiant appearance of the skin.
	Hemp Seed Oil	Palmitic acid (7%), stearic acid (3%), oleic acid (13%), linoleic acid (55%), ALA (16%)	• Balances skin's sebum production. • Reduces shine, preventing breakouts and acne. • Plays a crucial role in preventing signs of ageing on the skin. • Treats fine lines and wrinkles.
	Perilla Oil	Palmitic acid (6%), stearic acid (16%), oleic acid (14%), ALA (61%)	• Demonstrates excellent antibacterial and anti-inflammatory qualities. • Suitable for problematic skin types. • Provides soothing, repairing, and powerful antioxidant protection for mature and ageing skin. • Offer potent antioxidant activity to prevent free-radical-induced damage and premature ageing.
	Blackcurrant Seed Oil	Palmitic acid (6%), stearic acid (11%), oleic acid (49%), linoleic acid (15%), γ-linolenic acid (GLA; 13%)	• These oils can be included in anti-ageing serums to support skin elasticity and reduce the appearance of fine lines and wrinkles. • The moisturizing properties of blackcurrant seed oil make it a suitable ingredient in hydrating creams. • It is often used in scalp treatments and hair care products. • It can be included in products designed to address sun-damaged skin.
Omega-6	Echium Oil	Oleic acid (18:1 n-9) 16%, Linoleic acid (18:2 n-6) 19%, GLA (18:3 n-6)10%,	• It can be included in eye creams to reduce puffiness and soothe the delicate skin

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		ALA (18:3 n-3) 30%, Stearidonic acid (SDA, 18:4 n-3) 13%	around the eyes. • It may also contribute to minimizing the appearance of dark circles. • It may help reduce redness and inflammation associated with acne.
	Cameline Oil	ALA (18:3) 35–42%, Oleic acid (18:1) 12–27%, Linoleic acid (18:2) 16–25%, Gadoleic acid (20:1) 9–17%, Palmitic acid (16:0) 3–8%, Stearic acid (18:0) 2–3%	• It can be used in moisturizers and lotions to help hydrate and nourish the skin, leaving it soft and supple. • The presence of antioxidants in cameline oil makes it suitable for anti-ageing serums. • It provides moisture and enhances the shine of the hair without leaving a greasy residue.
	Evening Primrose Oil	Palmitic acid (6%), stearic acid (2%), oleic acid (7%), linoleic acid (74%), GLA (9%)	• Soothes and moisturizes the skin. • Enhances skin elasticity. • Promotes a healthy, clear, and rejuvenated complexion. • Enhances radiance of the skin. • Addresses roughness, wrinkles, redness, dryness, and irritation.
	Coconut Oil	Lauric acid (12:0) 49-53%, Myristic acid (14:0) 18-21%, Palmitic acid (16:0) 8-11%, Oleic acid (18:1) 6-7%, Linoleic acid (18:2) 1-2%	• Provides deep hydration to the skin. • Used to gently remove makeup, including waterproof mascara. • Effective for preventing and treating chapped lips. • Soothes skin when applied to sun-exposed skin and helps to alleviate redness and dryness.
	Sunflower Oil	Palmitic acid (4-8%), stearic acid (2-6 %), oleic acid (20-45%), linoleic acid (45-70%)	• Helps remove dead skin cells, promoting a smoother complexion. • Reduces the appearance of wrinkles, potentially due to its moisturizing properties. • It can be used on its own as a moisturizer. • Functions as a cleanser and makeup remover. • Utilized as an active ingredient in various skincare formulations.
	Argan Oil	Oleic acid (42.8%), Linoleic acid (36.8%), Palmitic acid (12.0%), Stearic acid (6.0%), Linolenic acid (less than 0.5%)	• Works to hydrate the skin and soften dry patches. • It can be applied as an oil or in the form of an argan oil-based cream. • Effective for targeting dry areas, such as elbows or around the eyes.
	Amaranth Oil	Linoleic acid (50%), Oleic acid (23%), Palmitic acid (19%), Stearic acid (3%)	• Beneficial for dry, damaged, and sensitive skin. • Beneficial for dry, damaged, and sensitive

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			hair. • Enhances elasticity of both skin and hair. • Improves the overall texture of the skin and hair.
	Palm Oil	Lauric acid (42%), myristic acid (4%), palmitic acid (42%), stearic acid (9%)	• Known for its moisturizing properties. • Used for its texturizing properties in cosmetic formulations. • Used in products for their emollient or foaming properties.
	Safflower Oil	Palmitic acid (6%), stearic acid (16%), oleic acid (21%), linoleic acid (31%), ALA (14%)	• Regular application enhances skin's texture, tone, overall appearance, and quality. • Effectively eliminates whiteheads, blackheads, and acne. • Reduces signs of blemishes. • Prevents future breakouts with continued use.
	Castor Oil	Palmitic acid (2%), palmitoleic acid (2%), stearic acid (5%), oleic acid (7%), ricinoleic acid (80%)	• Useful for treating dry skin by providing hydration. • It may have humectant properties, drawing moisture from the air into the skin.
Omega-9	Marula Oil	Palmitic acid (9–12%), Stearic acid (5.0–8.0%), Arachidonic acid (0.3–0.7%)	• Widely used as an ingredient in skin care products. • Beneficial for oily, acne-prone, dry, and ageing skin. • Effective at keeping hair soft, supple, and moisturized.
	Olive Oil	Palmitic acid (16%), oleic acid (61%), linoleic acid (15%)	• Softens and moisturizes cuticles when applied to nails. • It can be used to create a natural facial mask. • Suitable for those with dryness, inflammation, and itchiness. • Hydrates the skin while addressing skin sensitivities. • Effective for acne-prone skin. • Helps eliminate and prevent acne-causing bacteria from forming.
	Macadamia Oil	Oleic acid (60%), palmitoleic acid (19%), linoleic acid (1-3%), ALA (1-2%)	• Nourishes the skin. • Great at moisturizing. • Beneficial in treating stretch marks. • Helps prevent chapping. • Reduces scars. • Known to smooth and repair dry hair.
	Avocado Oil	Palmitic acid (17%), palmitoleic acid (5%), oleic acid (61%), linoleic acid (11%)	• Aids in skin moisturization • Has anti-inflammatory properties. • Useful in treating sunburn.

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			• Reduces signs of ageing. • Possesses wound-healing properties. • Helpful in coping with eczema and psoriasis. • Improves the health of nails and scalp.
	Plum Oil	Palmitic acid (2%), oleic acid (72%), linoleic acid (20%)	• Due to emollient properties, it softens and smoothes the skin's surface. • Provides a silky feel to the skin. • Enhances overall skin texture. • Benefits hair health. • Used as a conditioning treatment for nourishing and hydrating hair. • Makes hair smoother and more manageable.
	Argan Oil	Palmitic acid (13%), palmitoleic acid (6%), oleic acid (49%), linoleic acid (32%)	• Works to hydrate the skin and soften dry patches. • Effective for dry areas such as elbows or around the eyes.
Animal based			
	Fish Oil	Myristic acid (14:0), palmitic acid (16:0), stearic acid (18:0), behenic acid (22:0), myristoleic acid (14:1ω5), palmitoleic acid (16:1ω7), oleic acid (18:1ω9), eicosenoic acid (20:1ω9), gadoleic acid (20:1ω11), erucic acid (22:1ω9), catoleic acid (22:1ω11), linoleic acid (18:2ω6), ALA (18:3ω3), DHA (22:6ω3), EPA (22:5ω3)	• Useful in cases of hyperpigmentation due to skin trauma. • DHA in fish oil can inhibit melanin production. • It may reduce the risk of UV-induced hyperpigmentation.
	Emu Oil	Linoleic acid (20%), linolenic acid (1-2%)	• Stimulates the skin to reduce the appearance of wrinkles. • Rejuvenates aging or sun-damaged skin.
	Horse Oil	Oleic acid and linoleic acid are 37.7% and 19.7% in HO-I and 32.5% and 15.0% in HO-II	• One of the most common natural moisturizing ingredients in Asian cosmetic products. • Claimed to have antibacterial effects on the skin. • Claimed to have anti-inflammatory effects on the skin. • Claimed to have antipruritic (anti-itch) effects on the skin.
	Shark liver Oil	Squalene, alkylglycerols, omega-3 fatty acids, vitamins A and D	• Boosts cell regeneration. • Aids in eliminating age spots and scars. • Tightens the skin. • Maintains a youthful appearance.
Algae based			
	Spirulina Oil	33.78% of docosanoic acid, hexadecanoic acid,	• Promotes healthy sunscreen protection. • Used to treat skin pigmentation disorders.

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		octadecanoic acid, and hexanedioic acid; 35.82% of Unsaturated Fatty Acids (UFA); 25.21% of palmitic acid (hexadecanoic acid)	
	Seaweed Oil	EPA (5-15%), DHA (2-10%), Arachidonic acid (below 5%), oleic acid (10-30%), palmitic acid (10-20%)	• Regulates natural oil production levels on the face. • Helps control unnecessary oily skin without stripping off natural oils. • Targets and decreases bacteria causing acne breakouts. • Suitable for acne-prone skin.
	Brown Algae Oil	EPA (5-20%), DHA (2-15%), Oleic acid (10-40%), Palmitic acid (10-30%), Stearic acid (<5%), Linoleic acid (1-10%), ALA (<5%), Arachidonic acid (trace amounts to a few percent), Myristic Acid (<5%)	• Offers powerful hydrating and soothing properties. • Certain types can be used to brighten the skin. • Helps reduce hyperpigmentation. • Prevents the appearance of age spots.
	Red Algae Oil	EPA (omega-3, 5-20%), DHA (omega-3, 2-15%), Arachidonic acid (omega-6), oleic acid (omega-9), linoleic acid (omega-6), palmitic acid, stearic acid, and ALA (omega-3).	• Great for dry skin, helping to rejuvenate the complexion. • It may reduce the appearance of fine lines or wrinkles. • Preserves moisture in the skin, making it look more vibrant.
	Nannochloropsis Oil	Palmitic acid (omega-3, 10-15%), DHA (omega-3, 5-10%), oleic acid (omega-9, 15-25%), palmitic acid (10-15%), and myristic acid (1-5%)	• Demonstrates skin protection activity against induced oxidative stress in vitro. • Provides hydration to the skin. • Exhibits potential benefits in preventing skin ageing.
Note: Percentages may vary.			

Applications of omega fatty acids

Omega fatty acids, such as omega-3 and omega-6 PUFAs, have demonstrated diverse advantages for the skin. The presence of these fatty acids can alter the lipid content of cell membranes, influence gene expression, impact cellular metabolism, and affect signal transmission. As a result, they can have beneficial effects on chronic inflammatory and autoimmune skin conditions [17]. Studies have shown that omega-3 fatty acids have the ability to shield against UVR-induced damage to genes, increase the level at which UVR causes redness of the skin, lower the levels of pro-inflammatory and immunosuppressive prostaglandin E2 (PGE2), and safeguard against UVR-induced suppression of the immune system [18]. Research has demonstrated that the use of fatty acids can effectively restore the skin barrier and enhance the healing of the outermost layer of the skin, known as the stratum corneum [19]. In general, omega fatty acids, namely omega-3 PUFAs, provide potential advantages for skin care, such as diminishing inflammation, shielding against skin cancer, and enhancing skin barrier function.

Omega fatty acids, specifically omega-3 PUFAs, have the potential to strengthen the skin surface and promote skin health. The metabolism of dietary omega-3 fatty acids differs in different organs, and in the skin, 12-hydroxyeicosapentaenoic acid (12-HEPE) is the dominant metabolite. Topical application of 12-HEPE has been found to inhibit skin inflammation and neutrophil infiltration [20]. However, elevated levels of omega-3 fatty acids, including DHA, can slow down

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inflammation resolution and impair the quality of healed skin tissue [21]. Fatty acids, including omega fatty acids, play a role in the maintenance of skin function and can affect the skin condition through various mechanisms [2].

Studies have examined the impact of omega-3 fatty acids, particularly EPA and DHA, on the process of repairing and smoothing the skin barrier. Furthermore, research has shown that moisturizers containing fatty acids are superior to moisturizers containing ceramides in terms of enhancing the regeneration of the stratum corneum and mending skin with a compromised barrier [19]. The results indicate that omega-3 fatty acids may play a multifaceted function in the repair of the skin barrier. They have the potential to provide advantages when administered directly to the skin or utilized in skin grafts. However, there may be disadvantages associated with high systemic levels of these fatty acids.

Various oils, such as rose hip, flax, hemp, milk thistle, safflower, and camelina, are evaluated for their fatty acid content and antioxidant activity, with hemp oil identified as particularly promising for cosmetic formulations [22]. The therapeutic effects of omega-3 and omega-6 PUFAs in treating inflammatory skin conditions have been discussed, emphasizing a targeted approach for skin health through nutrition and PUFA-based supplements [14]. Furthermore, the exploration of pteridophytes, a type of land plant, reveals their overlooked potential as a rich source of fatty acids in the cosmetic industry [23]. Lodén (2003) explained the role of emollients and moisturizing creams in skin care, emphasizing their application to maintain skin smoothness and interrupt the cycle of dry skin [24]. Moisturizers, containing active ingredients such as fats and humectants, serve beyond moisturization, influencing skin conditions. The effectiveness of moisturizers is dose-dependent, and their impact on skin conditions may vary.

Ahmad & Ahsan (2020) discussed the incorporation of plant oils containing fatty acids into cosmetic formulations, emphasizing the significance of unsaturated fatty acids in triglycerides for cosmetic purposes [7]. Huber et al. (2020) focussed on chia seeds, which are rich in omega-3 (ω3) polyunsaturated fatty acids [25]. Chia seeds contain ω3 ALA and ω6 linoleic acid, collectively referred to as vitamin F, crucial for maintaining skin health. HYVIA™, a chia seed extract, is explored for its higher levels of vitamin F and its potential benefits in skin hydration and barrier function. The study involves in vitro research on PP2A activity and a clinical trial demonstrating the enhancement of skin hydration with HYVIA™. These studies collectively underscore the importance of fatty acids in skincare, emphasizing their roles in maintaining skin health, hydration, and barrier function.

Research trends and scientific progress

Research has been conducted on nanoformulations of omega fatty acids for their possible application in cosmetics. The use of insoluble, biodegradable nanoparticles in these nanoformulations has demonstrated encouraging results in terms of enhanced effectiveness and prolonged release, resulting in improved bioavailability. Utilizing these nanoformulations in cosmetic products can enhance skin well-being and attractiveness since they have demonstrated efficacy in alleviating irritated and inflamed skin and can assist in managing skin conditions such as atopic dermatitis and psoriasis [7,26]. In addition, fatty acids, such as lauric and oleic acid, have been widely employed in cosmeceutical and pharmaceutical treatments for their emollient and moisturizing properties. The incorporation of these fatty acids into nanostructured lipid carriers can improve their physical stability and boost their efficacy when applied topically. The application of spray drying methods has been utilized to generate lipid-based nanosystems in a powdered state, rendering them potentially appropriate for use as cosmetic components.

Several researchers have investigated the incorporation of omega fatty acids in cosmetics products. Lipid nanosystems, including solid lipid nanoparticles, nanostructured lipid carriers, and lipid nanoparticles, have undergone substantial research for their potential in cosmetics and medicines. Lipid nanosystems can enhance the stability, permeability, and efficacy of these bioactive substances in the specific layer of the skin being targeted [26]. In addition, lipid nanosystems can be integrated into semi-solid bases, such as hydrogels, for the purpose of topical administration. This allows for continuous release of the encapsulated molecules and improves their diffusion. Lipid

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nanosystems, such as liposomes and lipid nanoparticles, have been suggested as vehicles for delivering omega-3 fatty acids and other bioactive substances, such as resveratrol [27]. These lipid nanosystems offer stability and improve the ability of substances to pass through the skin, making them a viable option for treating autoimmune, inflammatory, and malignant skin illnesses. Pharmaceutical formulations including omega-3 fatty acids sourced from fish oil or vegetables, have been created for the purpose of treating skin problems and serving as skincare [28].

In addition, gels containing Omega fatty acid-infused have shown utility within the realm of the cosmetic sector. Oleogels are created by the gelation process of vegetable oils employing low molecular weight gelators such as fatty acids and fatty alcohols. The synergistic impact of combining fatty alcohols and fatty acids in particular weight ratios leads to the development of mixed crystals in oleogels, which enhances their stability and mechanical qualities [29]. In addition, the utilization of lamellar anionic clays as carriers for anti-ageing substances such as ALA enables the stabilization of ALA in hydrogels for cosmetic purposes, hence overcoming its limited solubility [30]. In addition, a gel composition with transparency or semi-transparency has been formulated for cosmetic purposes. This gel has an oil phase, surfactants, an aqueous phase, and polyols. This formulation has notable oil content, stability, and effectiveness in cleaning [31]. Several studies have focused on incorporating different compounds into hydrogels to enhance their stability and efficacy in cosmetic formulations. Another study created a hydrogel particle that incorporates an oil component within a non-crosslinked hydrogel, specifically designed for use in skin cosmetic formulations. In addition, a hydrogel cosmetic formulation was created utilizing natural ingredients such as chitosan, humectants, and herbal extracts. This formulation demonstrated skin whitening, spot lightening, acne treatment, and scar healing benefits [32].

Conclusion

The meticulous examination underscores the pivotal importance of omega fatty acids derived from plant sources, specifically those rich in omega-3, -6, and -9, procured from various vegetable oils within the domain of dermatology and cosmetic formulations. Fatty acids present in oils such as rice bran, sea buckthorn-seaberry, flax, hemp, milk thistle, safflower, cameline, among others, exhibit diverse therapeutic attributes owing to their antioxidant, anti-inflammatory, and moisturizing properties. The incorporation of these oils into cosmetic formulations showcases their efficacy in precisely addressing a spectrum of skin concerns. Noteworthy is rice bran oil, distinguished by its elevated levels of omega-9 and -6 fatty acids, coupled with antioxidants like CoQ10 and γ-orizanol, demonstrating substantial properties for skin regeneration, particularly advantageous for individuals with sensitive skin. Sea buckthorn-seaberry oil, housing omega-7 and other bioactive compounds exhibits significant potential in skin rejuvenation, maintaining purity through advanced extraction techniques and presenting a range of beneficial elements for skin care.

Moreover, the integration of nanoparticle technology facilitates the inclusion of omega-3 into cosmetic products, enhancing skin absorption, hydration, and regenerative capabilities. Research signals the potential of omega fatty acids in managing dermatological conditions such as atopic dermatitis and psoriasis, highlighting their adaptability in skincare formulations. The study underscores the imperative of further research, specifically through clinical and epidemiological investigations, to discern the efficacy and long-term impacts of these fatty acids in dermatological applications. An understanding of their mechanisms, optimal concentrations, and synergistic combinations is paramount to harness their potential in crafting cosmetic solutions that cater to a broad spectrum of skin health requirements.

This comprehensive analysis sheds light on the multifaceted benefits of omega fatty acids derived from vegetable oils, underscoring their substantial potential to revolutionize the landscape of skincare and cosmetics. Nevertheless, the ongoing pursuit of investigation and rigorous scientific scrutiny is imperative to fully exploit their capabilities and pave the way for the development of groundbreaking, efficient, and safe skincare products.

References

[1] Wilkes H., Jarling R. and Schwarzbauer J. 2020. Hydrocarbons and lipids: An introduction to

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(1), 2031-2042 | ISSN:2251-6727

structure, physicochemical properties, and natural occurrence. Hydrocarb Oils Lipids Divers Orig Chem Fate, Springer International Publishing, Cham, 3.

[2] Yang M., Zhou M. and Song L. 2020. A review of fatty acids influencing skin condition. J Cosmet Dermatol, 19, 3199.

[3] Harris-Tryon T.A. and Grice E.A. 2022. Microbiota and maintenance of skin barrier function. Science, 376, 940.

[4] Kelm G.R. and Wickett R.R. 2017. The role of fatty acids in cosmetic technology. Fat Acids, Elsevier, 385.

[5] Huang T.-H., Wang P.-W., Yang S.-C., Chou W.-L. and Fang J.-Y. 2018. Cosmetic and therapeutic applications of fish oil's fatty acids on the skin. Mar Drugs, 16, 256.

[6] Cerone M. and Smith T.K. 2021. A brief journey into the history of and future sources and uses of fatty acids. Front Nutr, 8.

[7] Ahmad A. and Ahsan H. 2020. Lipid-based formulations in cosmeceuticals and biopharmaceuticals. Biomed Dermatology, 4, 12.

[8] Fagionato Masiero J., Barbosa E.J., de Oliveira Macedo L., de Souza A., Nishitani Yukuyama M., Arantes G.J. et al. 2021. Vegetable oils in pharmaceutical and cosmetic lipid-based nanocarriers preparations. Ind Crops Prod, 170, 113838.

[9] Miklavčič M.B., Taous F., Valenčič V., Elghali T., Podgornik M., Strojnik L. et al. 2020. Fatty acid composition of cosmetic argan oil: provenience and authenticity criteria. Molecules, 25, 4080.

[10] Santos H.O., Price J.C. and Bueno A.A. 2020. Beyond fish oil supplementation: The effects of alternative plant sources of omega-3 polyunsaturated fatty acids upon lipid indexes and cardiometabolic biomarkers—An overview. Nutrients, 12, 3159.

[11] Ashfaq W., Rehman K., Siddique M.I. and Khan Q.-A.-A. 2020. Eicosapentaenoic acid and docosahexaenoic acid from fish oil and their role in cancer research. Food Rev Int, 36, 795–814.

[12] AlAmmar W.A., Albeesh F.H., Ibrahim L.M., Algindan Y.Y., Yamani L.Z. and Khattab R.Y. 2021. Effect of omega-3 fatty acids and fish oil supplementation on multiple sclerosis: a systematic review. Nutr Neurosci, 24, 569–79.

[13] Hernandez E.M. 2020. Pharmaceutical and Cosmetic Use of Lipids. Bailey's Ind Oil Fat Prod, Wiley, 28.

[14] Balić A., Vlašić D., Žužul K., Marinović B. and Bukvić Mokos Z. 2020. Omega-3 versus omega-6 polyunsaturated fatty acids in the prevention and treatment of inflammatory skin diseases. Int J Mol Sci, 21, 741.

[15] Simard M., Tremblay A., Morin S., Martin C., Julien P., Fradette J. et al. 2022. α-Linolenic acid and linoleic acid modulate the lipidome and the skin barrier of a tissue-engineered skin model. Acta Biomater, 140, 74.

[16] Guidoni M., de Christo Scherer M.M., Figueira M.M., Schmitt E.F.P., de Almeida L.C., Scherer R. et al. 2019. Fatty acid composition of vegetable oil blend and in vitro effects of pharmacotherapeutical skin care applications. Brazilian J Med Biol Res, 52.

[17] Prokopenko E. V., Orlova S. V., Nikitina E.A., Vodolazkaya A.N., Balashova N. V. and Pigareva Y.A. 2023. The role of omega PUFAs in the complex prevention and treatment of certain skin diseases. Med Alph, 8, 63.

[18] Black H. and Rhodes L. 2016. Potential benefits of omega-3 fatty acids in non-melanoma skin cancer. J Clin Med, 5, 23.

[19] Nip J., Ilarslan H. and Villa A. 2022. 33967 Nourishing fatty acid moisturizers provide superior barrier benefits in ex vivo skin. J Am Acad Dermatol, 87, AB85.

[20] Saika A., Nagatake T., Hirata S., Sawane K., Adachi J., Abe Y. et al. 2021. ω3 fatty acid metabolite, 12-hydroxyeicosapentaenoic acid, alleviates contact hypersensitivity by downregulation of CXCL1 and CXCL2 gene expression in keratinocytes via retinoid X receptor α. FASEB J, 35.

[21] Candreva T., Kühl C.M.C., Burger B., dos Anjos M.B.P., Torsoni M.A., Consonni S.R. et al. 2019. Docosahexaenoic acid slows inflammation resolution and impairs the quality of healed skin tissue. Clin Sci, 133, 2345.

[22] Ionescu N., Ivopol G.C., Neagu M., Popescu M. and Meghea A. 2015. Fatty acids and antioxidant activity in vegetable oils used in cosmetic formulations. UPB Sci Bull Ser B Chem Mater

Sci, 77, 39.

[23] Marimuthu J., Fernández H., Kumar A. and Thangaiah S., (Ed.). 2022. Ferns. Springer Nature Singapore, Singapore.

[24] Loden M. 2003. Role of topical emollients and moisturizers in the treatment of dry skin barrier disorders. Am J Clin Dermatol, 4, 771.

[25] Huber K.L., Fernández J.R., Webb C., Rouzard K., Healy J., Tamura M. et al. 2020. HYVIA™: A novel, topical chia seed extract that improves skin hydration. J Cosmet Dermatol, 19, 2386.

[26] Ahmad J. 2021. Lipid nanoparticles based cosmetics with potential application in alleviating skin disorders. Cosmetics, 8, 84.

[27] Caldas A.R., Catita J., Machado R., Ribeiro A., Cerqueira F., Horta B. et al. 2021. Omega-3- and resveratrol-loaded lipid nanosystems for potential use as topical formulations in autoimmune, inflammatory, and cancerous skin diseases. Pharmaceutics, 13, 1202.

[28] Ijaz M. and Akhtar N. 2020. Fatty acids based α-tocopherol loaded nanostructured lipid carrier gel: In vitro and in vivo evaluation for moisturizing and anti-aging effects. J Cosmet Dermatol, 19, 3067–76.

[29] Fameau A. and Marangoni A.G. 2023. Oleogels based on fatty acids and fatty alcohols. Fat Mimetics Food Appl, Wiley, 132.

[30] Samateh M., Sagiri S.S., Sanni R., Chee C.A., Satapathy S. and John G. 2020. Tuning aesthetic and mechanical properties of oleogels via formulation of enzyme-enabled stereoisomeric molecular gelators. J Agric Food Chem, 68, 13282–90.

[31] Pagano C., Calarco P., Ceccarini M., Beccari T., Ricci M. and Perioli L. 2019. Development and characterization of new topical hydrogels based on alpha lipoic acid—hydrotalcite hybrids. Cosmetics, 6, 35.

[32] Barbosa I.T.F., Oliveira B., Rocha G., Baliza P., Miranda L.F. de, Munhoz Junior A.H. et al. 2023. Characterization of hydrogels containing mandelic acid nanoemulsions and different essential oils. Mater Res, 26.