IJPSR (2025), Volume 16, Issue 2 **(Review Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 03 August 2024; received in revised form, 04 October 2024; accepted, 25 October 2024; published 01 February 2025

MARINE-DERIVED INGREDIENTS AND THEIR POTENTIAL USE IN SKIN-LIGHTENING AND COSMETIC FORMULATIONS

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Keywords:

Antioxidant, Biodiversity, Cosmetology, Heliotherapy, Microalgae, Seaweeds, Thalas-Sotherapy

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ABSTRACT: The advancement and changes in the pharmaceutical and cosmetic industry are governed utilizing the interests of clients for biologically energetic elements obtained naturally in place of synthetic manufacture and resources. One such novel technique within the beauty enterprise is using marine life as a supply of active components like micro and macroalgae, sea corals, marine bacteria, and seaweeds as shown in within the manufacture of skin care products. Marine organisms are discovered in intense conditions or habitats and have evolved with positive beneficial homes that terrestrial organisms lack. Those traits include antioxidant, anti-wrinkling, rehydrating, skin lightening, beautifying, emollient, solar-screening, moisturizing, firming and supplying smooth texture, and shielding the pores and skin. This biodiversity from the oceans has shown amazing results and affected person compliance in the fields of cosmetology and pharmacy. Not only in cosmetics but marine based products obtained from the vast expanse of our oceans, covering 70 percent of the globe, has served as a cradle for human civilization. Thalassotherapy encompasses a diverse range of treatments, including sea bathing, seaweed applications, sand therapy, heliotherapy, and thalassoclimatotherapy. In recent years, scientific research has begun to unravel the underlying mechanisms of thalassotherapy's therapeutic effects. Studies have demonstrated the efficacy of thalassotherapy in improving skin conditions, reducing stress, enhancing respiratory function, and promoting overall well-being. This review aims to provide a succinct overview of the evidence-based clinical applications of thalassotherapy, demonstrating it's potential as a complementary or alternative therapy for various medical conditions.

INTRODUCTION: The largest area of the body is covered by skin which is continuously in contact with the outside environment as well as the internal environment. Therefore, it is very easily susceptible to damage and dangerous reactions or sickness while uncovered to outside elements like dirt, pollutants, ultraviolet radiation, smoking and other risks.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.16(2).377-86

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.16(2).377-86

These motives are also held answerable for extrinsic skin growing older. There also can be genetic elements that affect the pores and skin due to underlying genetic abnormalities and are called intrinsic or chronological elements of skin getting old. If there may be continuous or chronic exposure to the referred variables, the skin of our body starts

losing important components like hyaluronic acid, collagen content, and elastic fibres and that could in turn bring about skin wrinkling, aging, dryness, laxity, loss of elasticity and an unsightly hard texture and look [1].

FIG. 1: SEAWEEDS

FIG. 2: UMBRELLA MACRO ALGAE

Reactive oxygen species or ROS are produced because of cellular oxidation in the body and purpose to harm genetic material, proteins and lipids internally with the aid of changing their levels within the body [2]. Due to this, the lipid content internally is reduced and is the main cause for ultraviolet radiation to penetrate the pores and skin. The skin acts as a considerable barrier by supplying a floor that lets in the triggering movement of selective items in or out of the cellular via a semi permeable membrane [3]. To keep the hydration of tissues and subcutaneous health it additionally serves as a barrier to prevent excessive water loss. It is essential to maintain the integrity and functioning of pores and skin because it acts as a primary defense of the human body and if these residences are impaired may additionally result in a texture of the skin very liable to infections. Within the younger generations, the most normally visible skin problems consist of a dry texture due to much less humidity, desquamation, loss of a smooth texture of the pores and skin and atypical pigmentation.

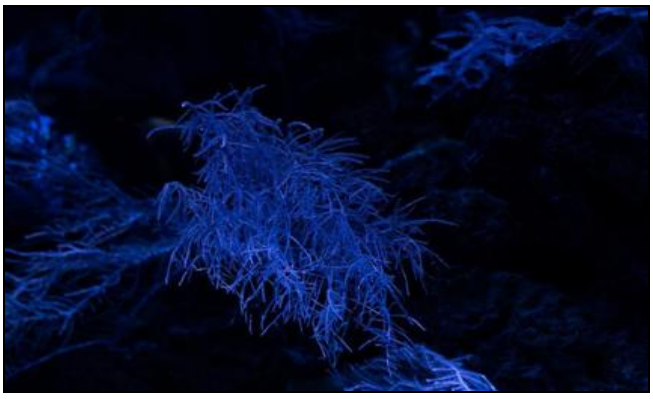

FIG. 3: SEA CORALS

A review of Literature: Ingredients Extracted from Marine life used in Cosmetics with their Potential Action:

Moisturizing: For maintaining the level of hydration in the skin lipids are majorly used which prevent water loss. Ma- rine sources act as a source of polysaccharides; minerals (Zinc, Copper, Selenium); proteins; amino acids; nutrients (A,C,E,D); lipids (rhamnolipids, sophorolipids, mannosyl erythritol, triglycerides, sterols). Trans-epidermal water loss can be avoided or restored by using polyunsaturated fatty acids like arachidonic acid, linolenic acid, and -linolenic acid (18C) [4]. Emulsions maintain the stratum corneum of the skin by per- forming as an emollient and lubricant. Oil in water emulsions have the capacity to maintain water in the layers of the pores and skin. Marine microbes (1) like green algae like *Chlorophyta*; *Cyanobacteria*, *Lam- inaria* and *Nannochloropsis* are rich resources of linolenic acid. Further to them, seaweeds like *Undaria pinnatifida* and microalgae (2) of the genus *Thalassiosira* are rich in amino acids like serine that help keep moisturize the skin.

Marine fish and jellyfish are a supply of proteins like collagen that have excessive skin moisturizing properties when administered in low doses [5]. *Ectothiorhodospira halochloris*, a marine-bacteria that is a source of ecotine, which acts as an osmoprotectant that maintains osmotic strain and assists in tonicity restoring [6]. It is able to be obtained or extracted from different halophilic bacteria, alpha- and gamma- proteobacteria and Actinobacteria which live in intense saline habitat.

Ecotine, after research has shown successful consequences in hydrating pores and skin *via* displaying its capacity to bind with water molecules having a similar motion to glycerol and reducing inflammation and is being researched on further to use as a healing treatment in cases of eczema or atopic dermatitis due to its long-term moisturizing effect. For that reason, those organisms will increase hydration and decrease trans-epidermal loss of water. Ecotine based lotions and emulsions are a brand new and essential method having healing efficacy in sufferers affected by acute and skin infection [7]. Marine based skin moisturizer available in the market includes: Marine algae face moisturizer is a mild day and night time moisturizer, consisting of: Algae, seaweed, Chlorella and Melissa flower water, eucalyptus oil. Used as an anti-aging product [8].

Sun-screening: While we study the anatomy of the skin, it essentially consists of three layers that encompass the epi- dermis, dermis and hypodermis that act as a physicochemical barrier. Photoaging, scientifically termed as Dermatoheliosis is one of the severe situations which occurs when skin is exposed to ultraviolet radiation or exposed to UVA with the wavelength range of 320nm to 400nm and UVB radiations with the wavelength variety of 290nm to 320nm of the sun result in acute or continual harm to the pores and skin texture these may further be categorized as [9]:

1. Short-term or advantageous consequences: Like tanning, abnormal pigmentation, erythema, altered nutrition like vitamin D synthesis.

2. Long term or bad outcomes: Like radiation induced immune system suppression, cancers, pores and skin aging.

To lessen some of these unfavorable outcomes, cosmetics are once more applied to show healing move- ment, provide photoprotection and as a defense system [10]. One such topical system in the cosmeceuti- cal enterprise are sunscreens, commonly synthesized by employing about twenty molecule compunds like carotenoids. They are certain materials extracted from marine life that provide photo-protection, these are scytonemins from *Cyanobacteria*, mycosporines and mycosporine-like amino acids (MAAs), and carotenoids that shield against ultraviolet rays [11]. Mycosporine-like amino acids or MAAs are colourless, intracellu- larly soluble microalgae located in both fresh and marine waters. *Aphanizomenon flosaquae*, is an example [12].

A chromophore manufactured from cyclohexenone or cyclohexenimine makes up MAAs. They are con- nected with imine linkages that result in a combination of tautomers that display resonance and take in UV photons of wavelength of 310–362nm and liberates energy as warmness radiation into the surrounding. Marine sources that produce MAAs consist of: Algae, phytoplankton, microorganism, *cyanobacteria*, and microfungi [13].

Scytonemin, the extracellular overlaying of certain *cyanobacteria* species, consists of scytonemin that can lessens more than 90 percent of UV-A radiation into the cells because of its fantastic absorption in the UVA range [14]. It additionally absorbs inside the UV-B range. Marine-based topical sunscreen available within the market is: natural Le Seaweed Gel Sunscreen, includes seaweeds titanium dioxide and cucumber extracts. Acts as an Antioxidant, offers sun protection and anti-aging of the skin that happens due to degradation of the extracellular matrix of the epidermis. Pigments like carotenoids are energetic additives and have their own anti-aging residences [15].

Carotenoids (8C) are derived from isoprene devices. They incorporate single and double bonds in their structure and feature orange or yellow coloration. Carotenoids include -carotene, liable for destroying reactive oxygen species. One such halotolerant species from the marine supply is the microalga *Dunaliella salina*, is one of the most crucial in pores and skin care cosmetics.

Some other such biologically lively component is Astaxanthin, which indicates anti-growing older due to its anti-oxidation property which is superior to -tocopherol, *Haematococcus pluvialis*, a marine based microorganism is an ample supply of Astaxanthin can be extracted from the dry biomass and is being cultured at the commercial scale [16]. Saproxanthin and myxol are other carotenoids obtained from novel traces of marine microorganisms of their own family

Flavobacteriaceae. However extra investigations and studies are to be accomplished of their use in cosmetics. Bacterial polysaccharides from marine based total microorganism or microalgae also deliver anti-getting old properties. These days, methods are being evolved to extract marine thermoacidophilic bacteria from excessive environments like deep-sea hydrothermal vents.

Polysaccharides have correct absorption, act as emulsifiers, and show thickening and gel-forming capa- bilities [18]. Some already existing commercial molecules like, Deepsane is a polysaccharide from the marine microorganism, *Alteromonas macleodii*, found its use in cosmetics for soothing and lowering infection of sensitive skin towards chemical, mechanical, and ultraviolet radiation attack. moreover, *Pseudoalteromonas*, *Pseudoalteromonas antarctica*, and *Halomonas eurihalina*, which might be considerable in Antarctic wa- ters, are an ample source of polysaccharides, are blended with different polysaccharides to formulate anti- growing older compounds via better collagen I synthesis, this combination complements and keeps, the structural features of the skin. The deep-sea bacterium *Vibrio diabolicus* produces an exo-saccharide much like hyaluronic acid, which can preserve the collagen shape [19].

Because of its tremendous skin repair and regeneration characteristics, collagen from marine fish is regularly employed in cosmeceutical industries. Despite its fish origin, the collagen has a slight fragrance and improved mechanical power. It also has a more absorptive capability than collagen derived from different animal skin and bones. Within famous cosmetics producing product line, hyaluronic acid-based formulations (as shown in the **Fig. 4** are a combination of polysaccharides made with the aid of a microalga [20]. Alguronic acid can enhance elastin synthesis and result in cell renewal. In all likelihood close by is Alguard® PF (Frutarom), a polysaccharide derived from *Porphyridium* species that is suggested for the remedy of skin wrinkling. *Chlorella vulgaris* extract encourages the advent of collagen one of the dermis extracellular matrix macromolecules that decline with age and reasons the emergence of wrinkles, and therefore appears promising effects in the anti-getting old place.

In the skin's extracellular matrix, hyaluronic acid performs a huge role. Anti-aging remedies often consist of retailers that stimulate the manufacturing of hyaluronic acid. Due to this, a product containing an aqueous extract of the *Laminariaceae* family brown alga *Macrocystis pyrifera* is offered for sale [21].

FIG. 4: HYALURONIC ACID BASED MARINE COSMETIC

Syndecan-4, is a vital protein from this. Wrinkles develop on the skin because of the aging process, which additionally causes a decrease in skin thickness and elasticity as well as leads to the curling of elastic fibres. Matrix metalloproteinase (MMP) inhibitors may additionally be useful as anti-aging products [22]. The breakdown of collagen types I, II, and III by using interstitial collagenases, laminin, fibronectin, and proteoglycans by stromelysins, and kind IV and V collagen with the aid of gelatinases are described as they contribute notably to the improvement of wrinkles. The MMP inhibitory effect of marine seaweed species, fish-derived peptides, and from seahorses had been shown to increase collagen production [23]. It's also widely known that the mineral salts in seawater provide health benefits. Minerals which are right for the skin are in particular considerable in seawater and consist of sodium, potassium, magnesium, calcium, sulphates, and chlorides. Sea salts can also be utilized in cosmetics, in particular for skin care.

Deep sea water could be high quality for normal health and especially for skin health, and have an impact on atopic dermatitis or skin infection.

The great deep- sea water resources and the minerals found in seawater are stated to be responsible for the fitness benefits.

Any other marine source, useful to the skin is sea mud (5), it contains an expansion of vitamins and minerals, it's been employed in the improvement of skincare and cosmetic products for their healing consequences on auto-immune sickness like psoriasis and other skin-related situations. Sea mud additionally enhances water retention, balances skin pH, and has anti-aging qualities [24, 25].

Seawater and sea mud, however, have to be strictly regulated since they may include dangerous materials which might be present obviously or as a result of pollutants. It should be noted that the sturdy cationic changeability of sea mud, capable of entrapping heavy metals, has been performed to see if nickel and chrome residues are detected inside their secure limits in order to keep away from any hypersensitivity or detrimental and skin allergic reactions. One such marine based sunscreen in shown in the **Fig. 5.**

FIG. 5: SEA MUD

Skin Whitners: Skin whitening agents are in excessive demand these days. They play a crucial role in presenting whitening results or making the skin appear fairer in instances of abnormal or faulty pigmentation: hypopigmentation or hyperpigmentation [26, 27]. The principle at the back of those beauty merchandise is the synthesis of the pigment melanin that's regulated using the tyrosinase enzyme. For this reason, tyrosinase inhibitors are the first remedies in order to overcome those troubles. Even though some of them (hydroquinones) had unfavorable consequences on human fitness, many herbal chemical substances from marine species have already been used as tyrosinase inhibitors. Presently, research is concentrated on locating novel marine microbes that produce skin-whitening motion [28, 29]. Zeaxanthin seems to be of unique significance amongst them and is available in *Nannochloropsis oculata* extract shows the property of skin lightening, a *Chlorella* extract recommended by famous business lines might likewise lessen skin pigmentation with the aid of more than 10 percent [17].

FIG. 6: MARINE BASED SUNSCREEN AVAILABLE IN THE MARKET

Phlorotannin 7-phloroeckol, which is created from the brown seaweed (7) has been showing properties as a skin-whitening agent because of its anti-tyrosinase activity. As they show skin-whitening effects, marine microorganisms have gained lots of interest in recent times [30]. Methylene chloride, a tyrosinase inhibitor that reduces the pigmentation of human melanocytes, is produced by the marine microorganism *Pseudomonas* [31]. A tyrosinase inhibitor referred to as thalassotalic acid is also produced via the marine bacteria *Thalassotalea* species of bacteria The carotenoids family member, astaxanthin, also has exciting depigmenting competencies by reducing the level of melanin up to 50 percent. The truth is that the majority of skin-whitening elements nevertheless come from terrestrial species creating clean research prospects and scope for marine pores and skin-whitening molecules in cosmetics [32]. A conventional medicinal plant *Pistacia lentiscus* (8), from the Mediterranean place, is located in saline situations. Flavonoids are present in *P. lentiscus* leaves, flavonoids, and phenolic acids along with catechin, -glucogallin, gallic acid, and epicatechin. Gallic acid and epicatechins, catechins are responsible for the strong tyrosinase inhibition ability and are powerful in treating patients with hyperpigmentation [33].

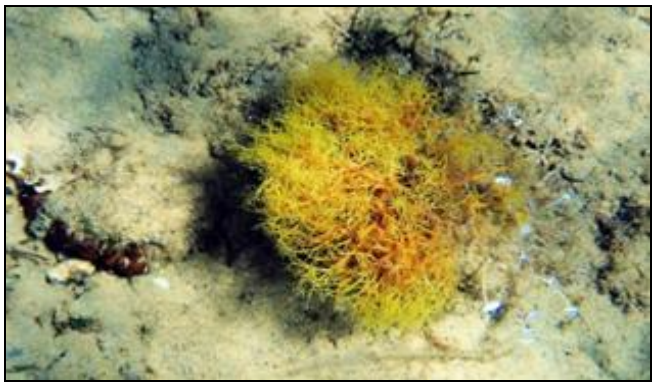

FIG. 7: BROWN SEAWEEDS

FIG. 8: *PISTACIA LENTISCUS*

Marine Excipients utilized in Cosmetic Formulations: Excipients or components are important compounds that offer bulk and stability to the system and are equally vital together with the active pharmaceutical ingredient to offer a successful system or finished product. Synthetic and Semi-synthetic excipients are conventionally applied in pharmaceutical and cos- meceutical sectors so far. Marine-based excipients like antimicrobial preservatives, dyes, vital oils, and antioxidants are a new approach for the same [34].

Anti-oxidants: These are one of the most important substances of cosmetic components or sunscreens because they possess the capacity to scavenge Reactive oxygen species or ROS which can be held liable for dangerous reactions in the pores and skin while uncovered to radiation. Therefore, most pharmaceutical and cosmetic industries use synthetic antioxidants namely butylated hydroxytoluene (BHT), butylated hydroxy anisole (BHA), t-butyl hydroquinone, and propyl gallate to reduce ROS-brought-on oxidation reactions. However, these synthetic antioxidants cause strong skin harm or are dangerous to fitness. we can there- fore switch to herbal marine primarily based antioxidants which consist of carotenoids like xanthophylls, phlorotannins, sulfated polysaccharides, fucosterol, and fucoxanthin derived from algae, yeasts, bacteria, Protista and fishes as skin pleasant alternative [35].

Paracoccus, *Agrobacterium*, a kind of yeast species, from the following genera *Rhodotorula*, *Xantho- phyllomyces* act as antioxidants. Different examples consist of Docosahexaenoic acid (DHA), astaxanthin and -carotene are examples of antioxidants that might be produced by the marine protist Ulkenia and related species like *Thraustochytrids* species. Chlorogenic acid, received from sea fennel (9) exhibits potent antioxidant activity. *Crithmum maritimum* L. (Sea Fennel) grows, the plants can acquire greater or much less CGA. Sand hill flowers commonly incorporate higher concentrations of CGA than the ones developing on cliffs [36]. Collagen and collagen hydrolysate from fish skin and jellyfish *(Rhopilema esculentum)* display their capacity to provide an

effective defense against the damaging outcomes of UV radiation, in particular on the antioxidant device (superoxide dismutase and glutathione peroxidase) [37]. They prevent the skin from getting old via stimulating collagen formation similarly to offer defense against the breakdown of skin lipids. By way of limiting UV-caused irritation, and collagen deterioration, and keeping antioxidant enzymatic systems and collagen peptides have a good potential to prevent pores and skin aging [38].

FIG. 9: SEA FENNEL

Essential Oils: On coasts, the halophyte plant *Crithmum maritimum* L. may be found. *Crithmum mar- itimum* L. has a complicated composition that offers its essential oils and a unique scent that is primarily lemony (from p-cymene) but also barely musty from camphor and sandalwood (from dillapiole).

Thalassotherapy and use of Marine life other than in Cosmetics: Hippocrates, who is a renowned medic from historic Greece along with philosophers like Aristotle, Plato, and Euripides turned into the first to describe the blessings of seawater and thalassotherapy [39].

Thalas- sotherapy is defined as the treatment given to diseased people, the usage of seawater or marine primarily based organisms like microalgae, and algae. It is a new technique on which research continues to be done to develop and make use of this remedy to make the most of it. It is one step ahead of the traditional allopathic and different treatments which have proven to have lesser aspect consequences as all compounds used are natural in the beginning [40]. Thalassotherapy as well as balenotherapy have been used in Italy and France since the nineteenth century for treatments of various diseases including rheumatic diseases and is gaining awareness slowly everywhere around the globe. Biologically active compounds which can be used in thalassotherapy are mentioned in the **Table 1.**

TABLE 1: MARINE ORGANISMS AND THEIR USE IN VARIOUS DISEASES

Organism	Chemical compounds	Used in
Tunicate	Bryostatin 1	Cancer
Sponge	Contignasterol	Asthma
Snail	Conotoxins	Pain
Marine algae	Thallium	Osteoporosis, Joint pain, Rheumatism
Rockweed	Linoleic acid	Anaemia
Brown algae	Iodine, Potash	Used in making of medicines

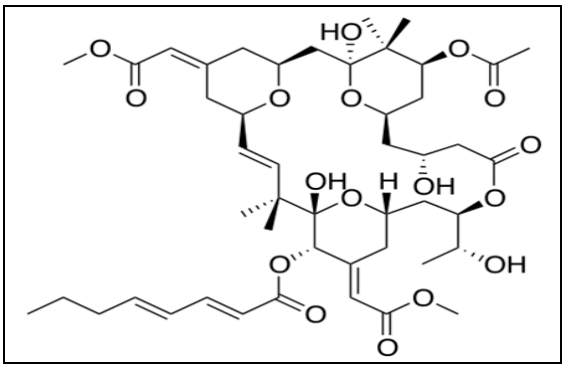

FIG. 10: CHEMICAL STRUCTURE OF BRYOSTATIN 1

Research Gaps: The research gaps in articles regarding marine-based cosmetics and active ingredients that can be identified by analyzing the existing literature and areas where further investigation and exploration are needed are as follows [41]:

Bioactive compounds and mechanisms, Marine organisms produce bioactive compounds that directly interact with the human skin cells, thus more research can be carried out in understanding their mech- anisms of action in detail.

Formulation and evaluation of stability, producing and manufacturing stable cosmetic formulations of marine-based active ingredients can be challenging.

Sustainable sourcing and extraction, marine-based cosmetics being a natural and novel approach have gained a lot of attention but research should be focused on sustainable and environment-friendly ex- traction and sourcing by reducing harmful impacts on the marine ecosystem [42].

Safety and Efficacy, this included the complete analysis of safety as well as the efficacy of the compound that needs comprehensive testing for potential allergens, irritants, or adverse reactions on the skin.

Consumer acceptance and perception, looking into consumer preferences, needs, and willingness to purchase marine-derived cosmetics and guide marketing strategies for product development.

Waste Utilisation, research should be done on how to utilize products from marine-based industries like fisheries and in turn contribute to sustainable development.

DISCUSSION: The discussion in this review article centers around the essential role of our skin, an incredible barrier that protects against harmful elements and maintains the body's hydration balance. The impacts of our environment and genetic factors on skin health underscored the argument for a move from synthetic cosmetics to more natural, marine-based alternatives [43].

Exposure to particular variables can accelerate skin aging, leading to compromised skin components and an increased susceptibility to harmful effects. The article draws attention to the increasing number of younger generation facing skin health issues such as dry texture, abnormal pigmentation, and loss of skin's smooth texture, mainly linked to decreased humidity. This presents a clear argument for the development and use of marine-based cosmetics. With beneficial properties that mimic essential skin components, these products could provide a sustainable solution to help individuals maintain their skin's health.

However, consumer acceptance and perception of these products are vital aspects to consider in their marketing and development. Additionally, it seems imperative to ensure these marine-based industries contribute positively to sustainable development through waste utilization. The use of marine-based cosmetics has gained significant traction in recent years, with a wide array of products incorporating extracts from marine organisms such as algae and shell fish. This shift towards marine-based ingredients in cosmetics is driven by the realization that a single active ingredient is insufficient to meet all the requirements of consumers [43]. Instead, a combination of complex plant-based and marine-based whitening agents is emerging as the dominant trend in the future of skincare. One of the main reasons for the increasing popularity of marine-based cosmetics is the vast potential of the ocean as a source of novel bioactive compounds. Marine plants, algae, microorganisms, and invertebrates like sponges and molluscs are rich resources of bioactive compounds with promising biological and pharmacological ac- tivities. These marine-based ingredients offer a multitude of skin-enhancing benefits, making them highly sought after in the cosmetics industry. From anti-aging properties to moisturizing and brightening effects, marine-based cosmetics have shown promising results in improving skin texture and appearance [44].

In summary, this review suggests that the potential health benefits and environmental sustainability of marine-based cosmetics and pharmaceutical products show potent biomedical effects. Also, utilizing equivalent therapies like thalassotherapy, heliotherapy, balenotherapy that stand in need of further research and development [45].

CONCLUSION: In conclusion, this review has shed light on the role of marine and sea water based organisms that act as natural cosmetics and restore as well as regenerate the lost properties of our skin which not only is it a remarkable barrier that maintains the body's hydration and protects us from harmful elements, but its health is intricately linked to our genetic elements and environmental exposure [46]. It is therefore important to reduce the use of synthetic-based cosmetics and active ingredients and resort to natural and marine- based sources for the same. Chronic or continuous exposure to certain variables can accelerate skin aging and bring about changes such as loss of elasticity, dryness, and wrinkles. This happens because of the depletion of essential skin components like hyaluronic acid, collagen, and elastic fibres [47].

Furthermore, reactive oxygen species or ROS pose another threat as they modify the levels of lipid content, making the skin more susceptible to ultraviolet radiation. Notably, younger generations are presenting with skin issues like dry texture, desquamation, loss of skin's smooth texture, and abnormal pigmentation, mainly due to decreased humidity. Emphasizing the importance of maintaining the integrity and function of our skin to prevent illnesses, this paper underscores the potential benefit of moisturising in maintaining skin health through the use of marine-based macroalgae and microbacteria cosmetics [48–50]. Thalassotherapy is also a natural and novel approach in the pharmaceutical field that's gaining momentum in the current scenario as it holds its potential pharmacological effects in the treatment of various wide spread diseases including inflammation, cancers, asthma and respiratory disorders and various therapeutic effects even for pregnant women [51].

ACKNOWLEDGEMENT: Nil

CONFLICTS OF INTEREST: Nil

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How to cite this article:
Patrawala SA: Marine-derived ingredients and their potential use in skin-lightening and cosmetic formulations. Int J Pharm Sci & Res 2025; 16(2): 377-86. doi: 10.13040/IJPSR.0975-8232.16(2).377-86.