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Review Paper

Polysaccharides in Cosmetics: A review

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ABSTRACT:

One of by far lucrative product categories nowadays is skincare. The evolution of cosmeceutical treatments based on natural ingredients rather than synthetic chemicals has been prompted by consumer demand for skin-friendly products. Due to their multifunctional qualities, polysaccharides, mostly from natural sources, have been extensively employed in the cosmetics industry, skin care, skin diseases, skin related problems, contributing significantly to the study and creation of cosmetics products. Because structure and function are closely related, various extraction and purification techniques may alter the way that polysaccharides are built, therefore, alter their biological activities. Understanding the biology the skin enables the determination of which active components are crucial for maintaining its barrier-forming properties, which are crucial for skin health. Some polysaccharides may also enhance the sensory qualities and formulation stability. In this manner, they serve as intriguing active components for the creation of potent cosmetic formulations for the defence of the skin and preservation of the stability of its construction.

Keywords: natural polysaccharides, skin disorder, cosmetics, pharmaceutical formulation, skin care, skin barrier, cosmeceutical

INTRODUCTION

Skin, which is the body's outermost layer, shields the inside organs from dangers such as shocks, extreme temperatures, UV radiation, chemicals, and other factors. Triple layers of the skin, the epidermis, dermis and fat beneath the skin, listed from the outside in (Benitez et al., 2017).

The epidermis surface, outermost layer of skin, is typically 0.2 millimetres thick. The stratum corneum (SC), basal mobile layer, granular mobile layer, prickle mobile layer are four additional layers that make up the epidermis, starting with the outermost layer (Figure 1). The stratum corneum (SC), or epidermis' outermost layer, serves a variety of purposes, including one of which is to shield internal organs from injury from the environment, including the muscles, nerves, blood arteries, and others. Additionally, it acts as a defence against viral and bacterial invasion. As a result, the stratum corneum is crucial to the organism's survival.

Keratinocytes comprise about 95% of the cells in the epidermis. The amount of time it takes for the epidermis to regenerate is known as epidermal turnover time. In the topmost layer, keratinocytes divide and multiply, mature, and eventually venture outward. The turnover period ranges from 40 to 56 days from basal cell layer cell division to daughter cell dividing and losing epidermal surface cells (Koster et al., 2009; Iizuka et al., 1994). The corneum stratum is composed of around 10 layers of a network that, after losing its core, exfoliates in waves as scurf. Keratin and lipids produced by keratinocytes make up the stratum corneum.

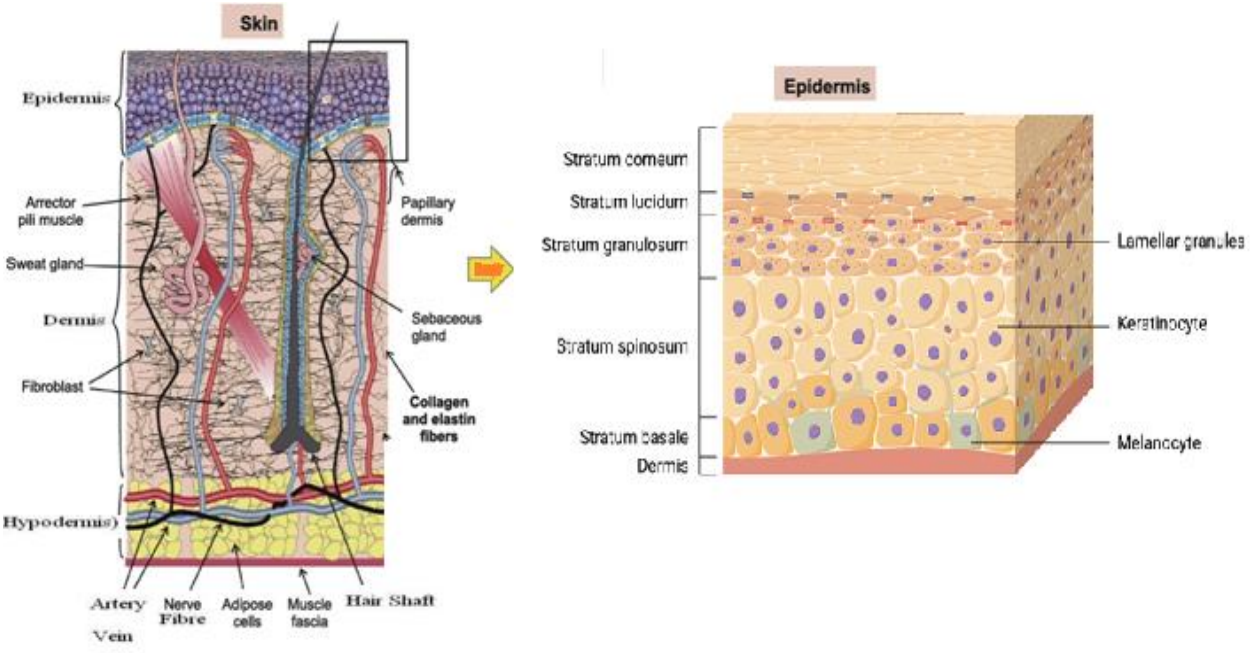

Fig. 1. Skin's structural elements

The epidermis contains Merkel cells, sensory recipient cells; the skin's immunological system is associated to Langerhans cells, and melanocytes, which give black skin its colour (Nkengne et al., 2008; Ichihasi et al., 2011).

Skin performs several purposes. It offers protection against water loss, infections, and several types of stress, including UV, chemical, and thermal radiation. Skin maintains our sense of place, regulates body temperature, enhances metabolic processes, and produces vitamin D through a number of nerve endings. (Yannas et al., 2001).

ANATOMY AND SKIN PHYSIOLOGY

Two mechanisms in the human body guard it from dangerous organisms found in the environment. The body's natural defensive mechanism eliminates germs and microorganisms that have previously assaulted it. The body's exterior defence mechanism stops microbes from entering. The largest exterior defensive system is the skin. Although it protects the outside of the body, skin has additional purposes in addition to acting as a divider. In between inside of the body and the world outside, it acts as a mechanical barrier (Sherwood et al., 2007). According to the ambient factors, bodily temperature ranges from 30 °C to 40 °C (Noble et al., 2009).

ANATOMY OF SKIN

The body's biggest organ is the skin. There are three levels to it. The epidermis is the skin's outermost layer, followed by the middle layer, the deepest layer (Figure 2).

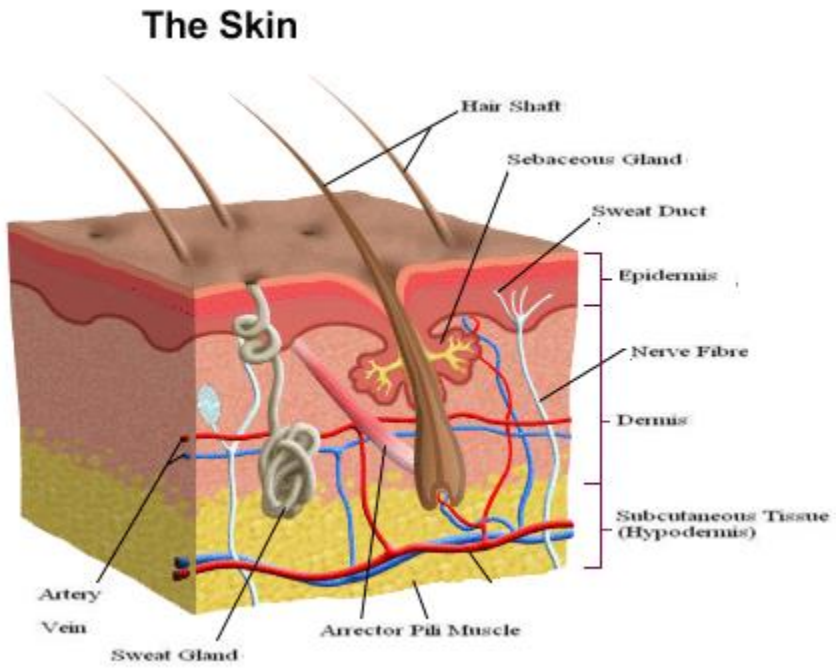

Fig. 2. Skin longitudinal section

Epidermis: Epithelial cells make up the epidermis. These cells may include both live and dead cells. The younger, rapidly dividing the cells at base skin's epidermis push older cells forward. The epidermis receives no direct blood supply of nutrients. It receives its nutrition from a robust circulatory system in the dermis underneath, which enables the necessary chemicals to diffuse there. Epidermal cells are tightly bound together by desmosomes. Cells of keratin congregate & interact by one another in the cytosol as they mature. The protective keratinized layer, a strong and hard layer that surrounds the epidermis, is created by this network of keratin fibroses after the older cells have died. This layer is airtight and waterproof. The majority of chemicals cannot enter or exit the body because of it. In skin conditions, especially burns, the epidermis is damaged, potentially leading to fluid loss as well as a rise in microbial infections susceptibility, both of which can be deadly if left untreated (Mackie et al., 2002).

Five layers make up the epidermis, arranged from the inside out;

- The base layer, Stratum Germinativum, Stratum Spinosum, Stratum Lucidum, Stratum

granulosum, and Stratum Corneum (SC).

Epidermis' outermost layer, or stratum corneum, is 10 to 20 micrometres thick when dry and 40 micrometres thick when moist and swollen (Maghraby et al., 2008).

The SC, stratum corneum is built in "bricks and mortar" fashion. That is concept; the lipid-rich matrix (mortar) within cells is surrounded by Brick-like corneocytes rich in keratin (Gawkrodger et al., 2002).

The stratum corneum is 85% produced by the bricks, the keratinocytes, and 15% is made up of intracellular lipids that are stacked in 15-20 layers. Only 15% of stratum corneum is water, with proteins making about 70% of it (Nino et al., 2010).

Dermis: The dermis, which lies underneath the epidermis, is characterised by an abundance of elastin fibres that give the skin its ability to stretch and an abundance of collagen fibres that give the skin its strength. The dermis and epidermis are nourished by dermal blood vessels. The dermis plays a key role in regulating body temperature. There are nerves that cause pressure and discomfort to be felt (Sherwood et al., 2007). There is 3 to 5 mm of dermis, Blood vessels in addition to elastin fibres. The interfibrillar gel also includes lymphatic cells, sweet glands, salt, water, glycosaminoglycan, and nerves (Maghraby et al., 2008). Dermal cells include the following types:

- Fibroblasts are cells that make collagen.
- Scavenger cells are macrophages.
- Mast cells regulate eosinophil contacts and immune responses (Mackie et al., 2002)

The dermis is crucial for connecting to other skin layers. The epidermis, hair follicles, and skin glands can all develop with integrity depending on changes in dermis metabolism (Noble et al., 2009).

Hypodermis: The skin's deepest layer is known as the hypodermis. It serves as the interface between the skin and the body's deeper tissues, including the muscles and bones (Sherwood et al., 2007). Sebaceous glands, sweat glands, and hair follicles all originate in the dermis despite being covered by the epidermis. Sweat glands pump a fine salt solution onto the top of the skin. Evaporation of this liquid cools the body and controls both body and skin temperature. The body contains sweet glands all around. The degree of heat-producing skeletal muscle activity, the ambient temperature, as well as a number of emotional factors, all affect how many dilutions (sweet) are produced (Sherwood et al., 2007). Sebum is produced by the sebaceous glands. Oily material called sebum penetrates hair follicles and travels through them to the skin's surface. Skin and hair are kept from drying out by sebum's role as a waterproof barrier (Sherwood et al., 2007).

COMMON SKIN DISORDERS

Skin diseases are caused by skin component malfunction or a layer defect in human skin, which in some situations can cause irritation and itching. The majority of the time, specific flaws in enzymes, structural proteins, or lipid metabolism are what cause skin problems (Murphrey et al., 2019; Rawlings et al., 2004). Defects in the stratum corneum can also result in barrier anomalies involving proteins or lipids; they can then result in an increase in transepidermal water loss (Reddy et al., 2019).

Based on how they appear on the outside, three kinds of skin diseases may be distinguished: Acne, Post-Inflammatory Hyperpigmentation (Vitiligo, Melasma, and Eczema), and Eczema, Xerosis, Atopic Dermatitis, and Psoriasis (Kristeen et al., 2019) are conditions of dry skin (Figure 3).

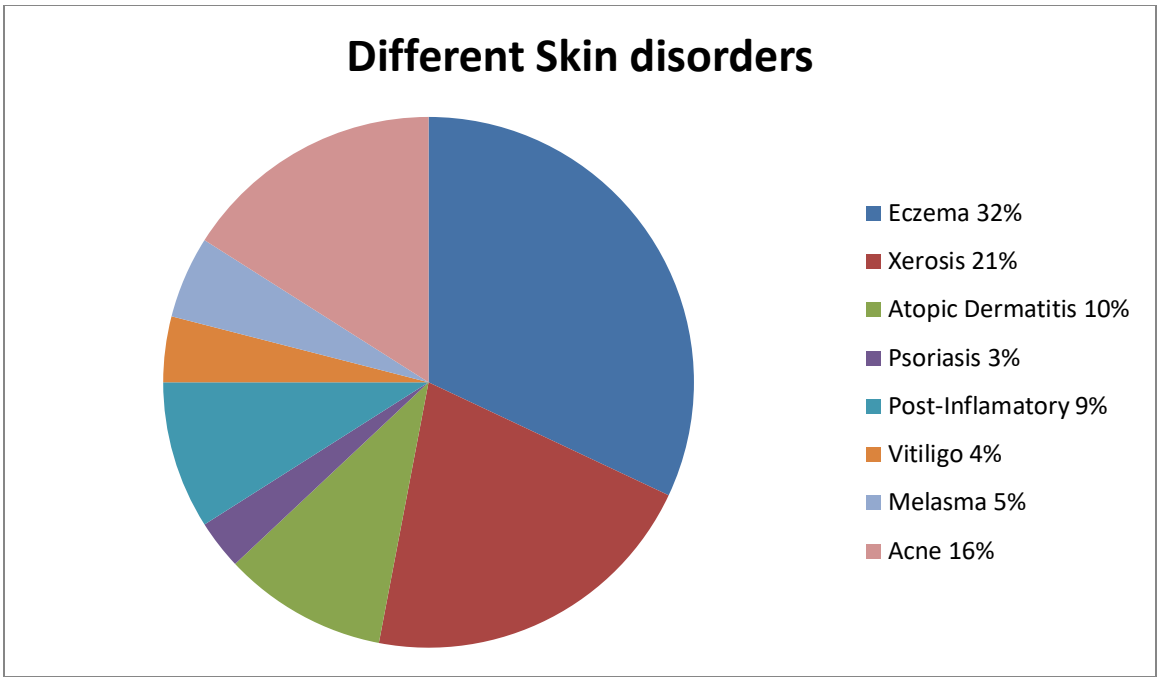

Fig. 3. Different skin disorders

Three major kinds of skin problems have been the topic of a study profile. This trend is based on searches for the terms dry skin, acne skin, and hyperpigmented skin, which are prevalent skin conditions. (Figure 4) shows a correlation between the total numbers of research articles published in each category from 2001 to 2021.

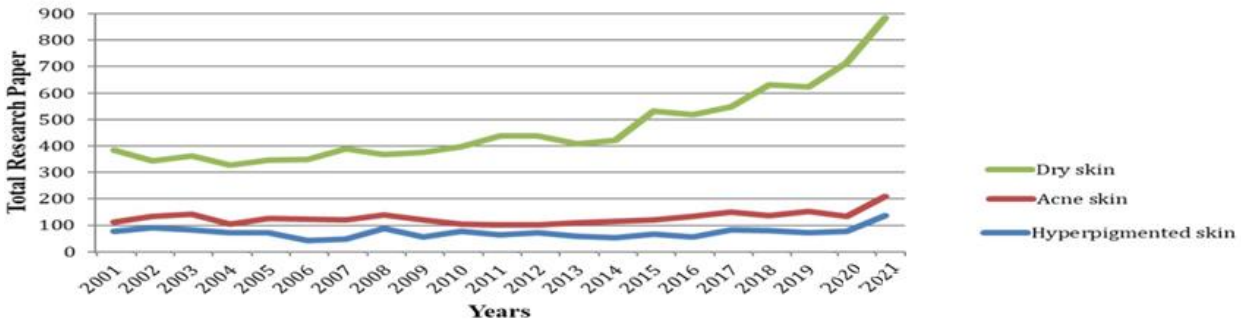

Fig. 4. For 20 years, from 2001 to 2021, researchers have examined the trends in dry skin, acne, and hyperpigmented skin (Fuxench et al., 2018; Dlova et al., 2018).

Human skin problems may be brought on by a variety of essential elements, consisting of environment, the climate, hormones, and DNA. Every aspect may vary from person to person. For instance, atopic dermatitis sufferers may come from atopic families, but some psoriasis sufferers are impacted by immune system flaws that induce fast skin cell turnover (Vashi et al., 2013; Williams et al., 2012).

POLYSACCHARIDES IN SKIN CARE

To cure skin conditions or improve skin health, numerous methods been put to use, including the use of skin care goods and different therapy (Oli et al., 2017). Natural components are generally

recognised, and Natural skin care products are in high demand and growing because consumers feel they are more skin-friendly than other treatments (Kanlayavattanakul et al., 2015). Numerous organic macromolecules, notably Polyphenols, polyesters, polysaccharides, proteins, lipids, etc have been studied by scientists throughout the years (Figure 5). That can shield skin against deterioration (Albuquerque et al., 2022). Natural polysaccharides will get particular focus in this review.

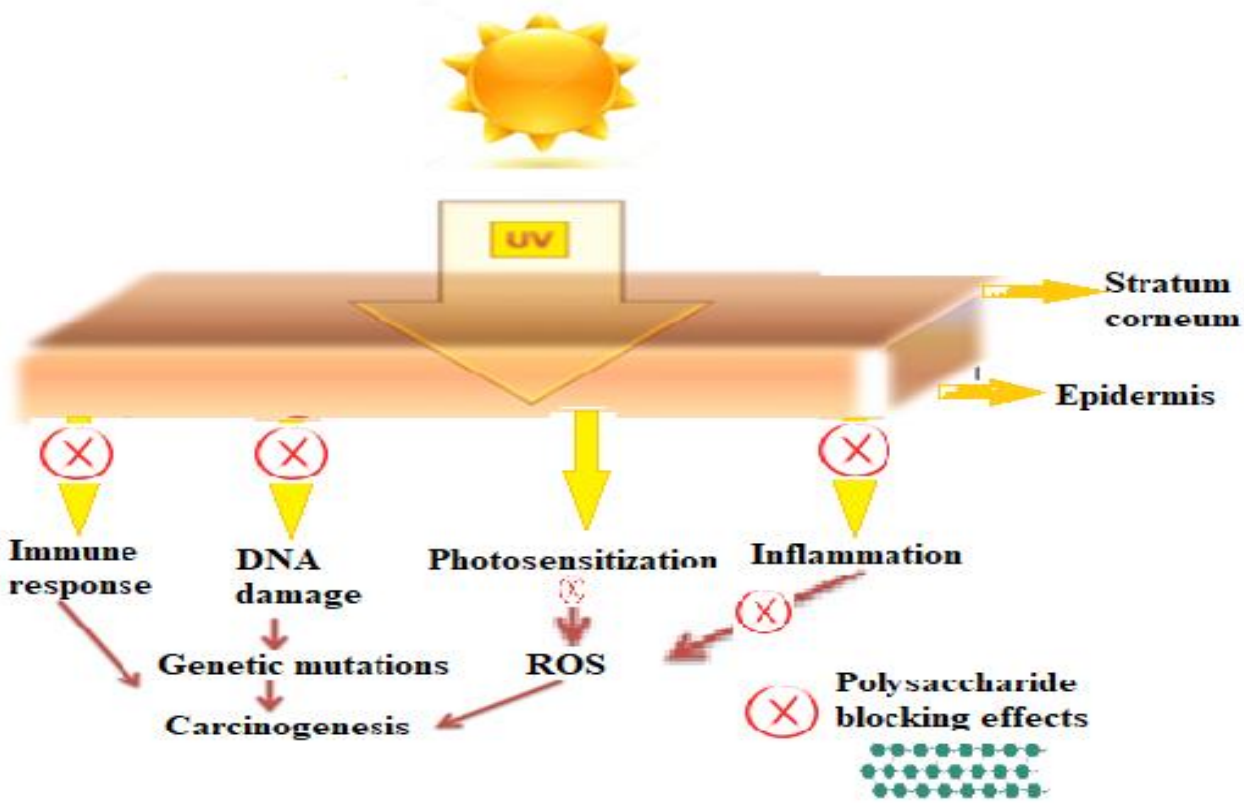

Fig. 5. Picture showing UV-induced skin damage that might lead to skin cancer and polysaccharides that function as skin protectors

Plants, algae, and fungus can all be used to produce naturally occurring polysaccharides through a process of extraction, separation, and purification (Liu et al., 2020). Their distinct structural characteristics, which influence their functional characteristics and wide range of applications, Included in this description are the molecules' molecular weight, and monosaccharide make-up, glycosidic connections, conformations in three dimensions, charge characteristics, the kinds and numbers of groupings (Yuan et al., 2020). Some functional polysaccharides are used as thickeners, film formers, conditioners, emulsifiers, and gelling agents in cosmetics depending on their functionality in formulation technology, which typically relies regarding their physico-chemical characteristics (Kanlayavattanakul et al., 2015). The opposite is true with bioactive polysaccharides; contain properties that help them retain water, absorb water, and have antioxidant, anti-inflammatory, anti-collagenase, anti-melanogenic, and anti-tyrosinase activity (Bedoux et al., 2014). Because of their potent efficacy in moisturising, anti-aging, and whitening, which typically relies on both their biological activity and physicochemical characteristics, low-

cost organic polysaccharide, has recently attracted more attention for skin applications (Bedoux et al., 2014). The brittleness of natural elements, limited effectiveness, also biosecurity issues all need to be addressed before trustworthy natural reagents can be turned into products, which is why they are currently in short supply (Figure 6) (Hu et al., 2020; Tseng et al., 2021).

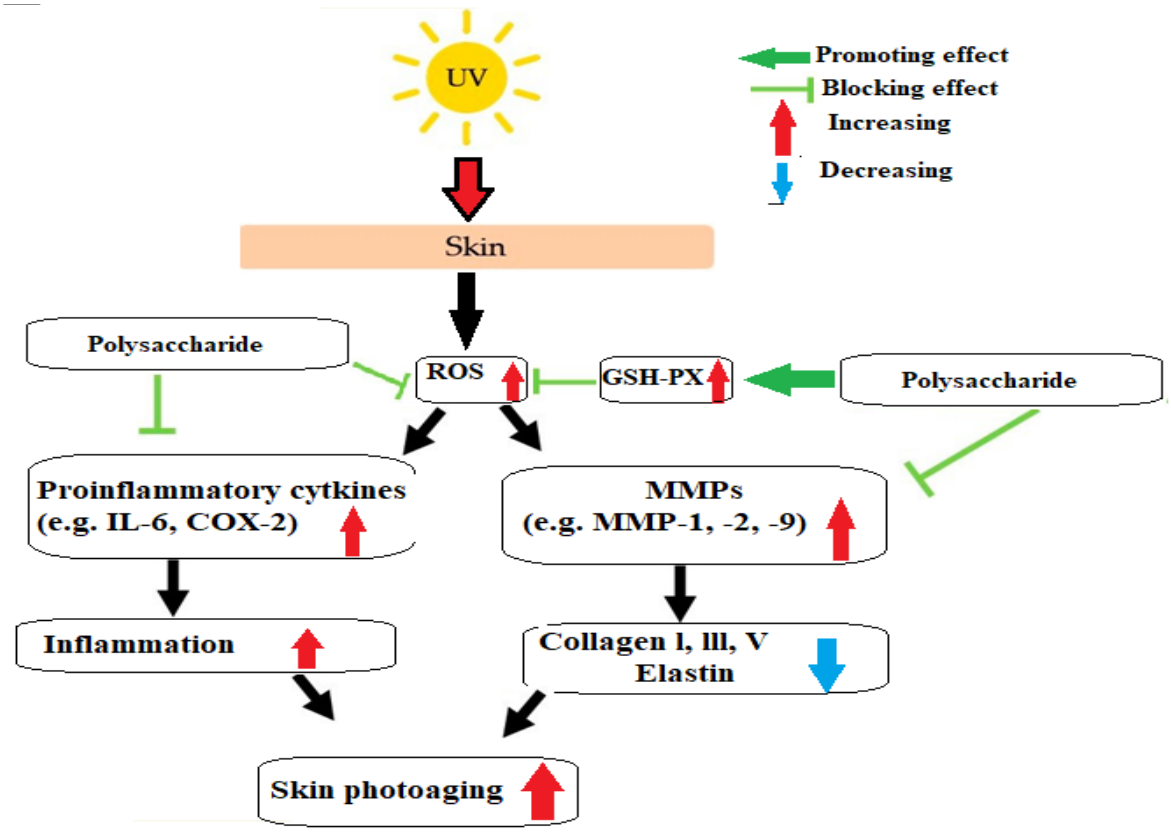

Fig. 6. The illustration of how polysaccharides protect the skin and cause UV-induced skin ageing

Table 1. An overview of the skin-active properties of plant-derived polysaccharides, together with information on how those compounds were prepared and extracted.

Activity	**Methods of extraction and purification**	**Preparation using polysaccharides**	**Ref.**
Wound recovery	• Citrus pectin with low methoxyl amidation produced commercially and FSG acquired by water extraction • Polysaccharide made with 75% ethanol using ethanolic	• Hydrogels made of FSG or LMA • The polysaccharide part of carboxymethyl cellulose and PAP -based composite hydrogel • Polysaccharide from In order to	• Synytsya et al., 2020 • Wang et al., 2020 • El Hosary et al., 2020 • Talodthaisong et al., 2020 • Zhang et al., 2019

	extraction • Polysaccharide produced by 100% ethanol precipitation and hot water extraction. other elements bought commercially • Water extraction and ethanol precipitation • Extracting water, then precipitating alcohol	create hydrogels, Egyptian Avena sativa L. was coupled to PEG, PVP, Carbopol, HEC, HPMC, and NaCMC. • Borax-crosslinked guar gum hydrogels containing silver nanoparticles • Hydrogel derived from the polysaccharide of the orchid Bletilla striata	
Anti-microbiological action	• Precipitation of isopropanol after hot water extraction • Hot water removal • Precipitation of ethanol and hot water extraction	• Daucus carota polysaccharides • Aronia polysaccharides in Crataegus azarolus L. • Annona muricata leaf polysaccharide	• Ghazala et al., 2015 • Rjeibi & jouida et al., 2020 • Byun & kim et al., 2020
Anti-inflammatory and antioxidant effects	• Ethanol precipitation and hot water removal • Precipitation of ethanol after hot water extraction	• The seed of fenugreek (Trigonella foenum-graecum) polysaccharide • Seed polysaccharide from P. anisum	• Ktari et al., 2017 • Ghlissi et al., 2020
Against-cancer impact	• Not mentioned • Not mentioned	• Polysaccharide from goji berries (Lycium barbarum). • L. barbarum polysaccharide	• Cezar et al ., 2019 • Li et al., 2017
Age-defying impact	• Extracting hot water • Water extraction • Not mentioned	• Panax ginseng acidic polysaccharides • Scaphium scaphigerum polysaccharide gel	• Kim et al., 2019 • Barreto et al., 2017 • Neves et al., 2020

		• Topical administration of the isolated L. barbarum polysaccharide portion	

POLYSACCHARIDES IN COSMETICS

Their ability to mimic the properties of natural carbohydrates fraction present in epidermis of skin is greatly influenced by polysaccharides. Polysaccharides are in charge of the body skin's innate capacity they excel in replenishing skin because of their ability to moisturise and retain water. They are also necessary for skin repair and regrowth. (Mihranyan et al., 2012).

Polysaccharides have a unique capacity to adhere to the skin longer and more securely than other materials moisturizer components (Figure 7). In this manner, it may efficiently maintain the skin's hydration longer and better than normal (Ammala et al., 2013; Lupo et al., 2006; Kim et al., 2006; Harris et al., 2011).

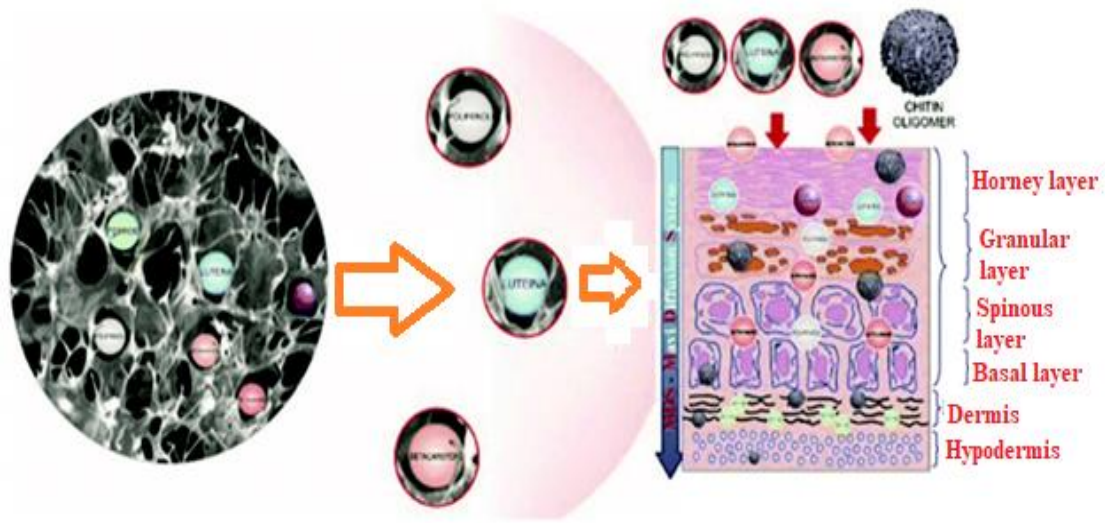

Fig. 7. The potential of polysaccharides to disrupt stratum corneum lamellae organisation increases ability of the entrapped active substances to penetrate skin (Matos et al., 2015; Huang et al., 2010).

Polysaccharides with no distinct flavour and that are insoluble in water include cellulose (glucose chains) and chitin others, such as starch (linear or branched glucose chains), merely swell. For a very long time, polysaccharides have been used in cosmetics, since they are cheap and simple to get owing to their natural origins. There are other more that have not yet been listed, such as alginates, pectins, and xanthan gum. Additionally, the chemical industry has tailored and altered natural compounds, creating refined raw materials with novel properties (Pathakoyi et al., 2017; Jiang et al., 2016).

ROLE OF POLYSACCHARIDE IN VARIOUS SKIN DISORDERS

❖ **Plants polysaccharide with Anti-Acne Activity:** Due to its benefits, including improved tolerant of patients, a lengthy history usage, less adverse effects, and being comparatively low

costly, herbal medications are becoming more and more popular . Additionally, they have offered solid support for the management of a broad range of incurable disorders (Bahmani et al., 2014; Delfan et al., 2014; Mardani et al., 2014; Rafieian-Kopaei et al., 2013). To cure illnesses, these herbs are either utilised by themselves or in conjunction with synthetic medications (Rafieian-Kopaei et al., 2013). More significantly, they may be used with synthetic medications to lessen their negative effects in addition to intake as a preventative or therapy measure (Nasri et al., 2013; Kabiriet al., 2014; Mirhosseini et al., 2014; Nasri et al., 2014; Asadi-Samani et al., 2014; Bahmani et al., 2014; Saki et al., 2014). Without fail, Acne vulgaris is treated using herbal therapies, either alone or in conjunction with other treatments. Acne and other infections disorders are treated using a variety of medicinal herbs that have anti-inflammatory and antibacterial properties. (Baradaran et al., 2013; Amirmohammadi et al., 2014; Rafieian-Kopaei et al., 2013; Bahmani et al., 2014; Rahimian et al., 2018; Rafieian-Kopaei et al., 2014; Bagheri et al., 2013). Common species of these plants are Calendula officinalis, Matricaria recutita, as well as Triticum aestivum (Peck et al., 1979). Following cleanup the skin by taking a steam bath, astringents and other plant-based compounds like tannins are used topically in the form of creams or aqueous infusions. Due to its tannin content and high level of topical safety, Hamamelis virginiana is often used to treat acne. Before periods, acne is treated with vitex agnus-castus. The whole fruit extract reduced premenstrual prolactin levels by increasing progesterone and decreasing oestrogen levels via the dopaminergic mechanism via influencing the amounts of luteinizing and follicle-stimulating hormones in the pituitary gland (Bettoli et al., 2015). For the treatment of acne, Vitex agnus-castus extract should be taken daily in doses of 40 mg, according to German Commission E. Women who are pregnant or breastfeeding shouldn't use this herb. There have been reports of unfavourable side effects include gastrointestinal problems and skin rashes (Bedi et al., 2002; Wuttke et al., 2003). The antibacterial properties of several plants have been investigated to determine their potential as an acne herbal therapy, in addition to the conventional application of herbal remedies for acne (Azimi et al., 2012). Reactive oxygen species are produced together with the release of inflammatory and pro-inflammatory cytokines, reactive oxygen species (ROS). Both stimulated by the anaerobic pathogen P. acnes, which contributes to acne's aetiology (Jain et al., 2003). It's interesting to note that P. acnes development in vitro is not induced by bacterial resistance when licorice (Glycyrrhiza glabra) has an inhibitory impact (Nam et al., 2003).

❖ **Polysaccharide used in treatment of Atopic Dermatitis (AD):** A persistently inflamed skin condition with a high incidence globally is atopic dermatitis (AD). Increasing numbers of research indicates the intestinal microbiota is crucial to the pathophysiology of AD. In a research, It was established that Dendrobium candidum polysaccharides (DCP) have an impact on AD caused by 2,4-Dinitrofluorobenzene (DNFB) in Balb/c mice. They observed that taking DCP orally for two weeks reduced skin damage and symptoms similar to AD, decreased mast cell infiltration, decreased serum total IgE levels, TNF-, IFN-, IL-4, and IL-6 expression was downregulated, while levels of the anti-inflammatory cytokines IL-10 and TNF- were elevated. Intestinal homeostasis out of balance and the makeup of the gut microbiome being restored were credited with the positive effects of DCP. These findings suggested DCP may be a valuable novel microbiota-modulating medication for the treatment of AD (Arana et al., 2021; Cha et al., 2021; Chen et al., 2014; Chen et al., 2020; De Pessemier et al., 2021; Dei-Cas et al., 2020; Dong et al., 2018; Gebrayel et al., 2022; Gong et al., 2020).

❖ **Polysaccharide used in treatment of Vitiligo:** Skin depigmentation illnesses like vitiligo and achromic nevus, which are a major component of pigmentation disorders, are quite frequent and are receiving greater attention right now. Melanocyte dysfunction and loss, which may result from genetics, autoimmune, and oxidative stress, are part of the depigmentation aetiology. Oxidative stress is one of them, but there aren't many therapeutic therapies that can address it. Based on the fact that Cistanche deserticola polysaccharide (CDP) is an efficient antioxidant, its function in the melanocyte was assessed, and additional processes were found. In this work, it was shown that CDP may induce pigmentation in zebrafish and both mouse melanoma B16F10 cells and human epidermal melanocytes (HEMs) were used. Additionally, CDP might activate the MAPK (mitogen-activated protein kinase) the expression of the downstream genes TYR, TRP1, TRP2, and RAB27A as well as the microphthalmia-associated transcription factor (MITF) was enhanced as a result of the signal pathway. Otherwise, we discovered that CDP might lessen the cytotoxicity and apoptosis that H2O2 caused in melanocytes. More proof showed that CDP might boost the antioxidant NRF2/HO1 pathway and scavenge intracellular ROS. In conclusion, CDP may aid to maintain the healthy condition of melanocytes by promoting melanogenesis and protecting them from damage caused by oxidative stress. So, CDP may be a cutting-edge medication for the management of depigmentation disorders (Bleuel et al., 2018; Taieb et al., 2018; Boehncke et al., 2019).

❖ **Polysaccharide used in treatment of Psoriasis:** Traditional wound healing agents like aloe vera are applied to address skin issues. Primary macromolecule of aloe vera, aloe polysaccharide (APS), is involved in its function. 23% of the general population suffers from the immune-mediated chronic inflammatory illness psoriasis. Natural solutions, like Aloe vera, are being considered since the results of traditional psoriasis treatments are ineffective. The effects of APS on psoriasis therapy, as well as the underlying processes, must yet be clarified. The impact of APS on psoriasis was studied using the HaCaT is a human keratinocyte cell line. The tumour necrosis factor (TNF) activated psoriasis model group, the APS (20, 40, and 80 g/ml) pretreatment psoriasis groups, the negative control group, and the five cell groups were generated at random and the negative control group. Using the CCK 8 test, cell viability and proliferation were examined. Interleukin (IL) 8 and IL 12 levels in TNF-incubated culture medium and APS-treated HaCaT cells, respectively, were examined. ELISA and western blotting were used. Additionally, nuclear factor (NF) B inhibitor (IB) and phosphorylated p65 protein expression levels were evaluated using the reverse transcription quantitative polymerase chain reaction and western blotting, respectively. As a function of dosage, APS was shown to drastically lower the rise of HaCaT cell proliferation caused by TNF. Factors that cause inflammation, such as IL 8 and IL 12 have higher expression levels in response to TNF. TNF therapy also induced a rise in the expression of p65's mRNA and protein. Notably, APS therapy was shown to dramatically and dose-dependently reduce the aforementioned symptoms. TNF administration also resulted in a considerable decrease in I-B protein expression levels, which was considerably restored by APS therapy. These findings indicated that APS reduced TNF-induced keratinocyte growth and excessive activation of the NF-B signalling pathway (Ikeda et al., 2008; Chakraborty et al., 2023).

❖ **Polysaccharide used in treatment of Melasma:** A common skin condition known as melasma manifests as brown to gray-brown spots on the face. The majority of individuals develop it on their cheeks, chin, forehead, nasal bridge, and upper lip. Women are more likely

than males to have it. Hot water was used to extract the Cuscuta chinensis polysaccharide (CPS), and mannase was used to enzymatically hydrolyze the C. chinensis polysaccharide (ECPS). In B16F10 melanoma cells, this study examined the antimelanogenic activities of ECPS and CPS. Their ability to reduce ferric iron and their capacity to scavenge DPPH free radicals were used to gauge the in vitro activity of antioxidant. SEC-MALLS-RI was used to calculate the polysaccharide molecular mass distribution. Mannase was used to effectively break down CPS enzymatically, and CPS and ECPS had weighted average molecular weights of 434.6 kDa and 211.7 kDa, respectively. The enzymatically hydrolyzed polysaccharide had greater antimelanogenic activity and an antioxidant impact than the original polysaccharide, according to the results of biological activity testing. By decreasing tyrosinase, MITF, and TRP-1 expression in B16F10 melanoma cells without having any cytotoxic effects, ECPS displayed antimelanogenic action. In conclusion, ECPS have the potential to become a skin-whitening product (Ortonne et al., 2008; Arung et al., 2012).

❖ **Polysaccharide used in treatment of Post-inflammatory:** A frequent acquired cutaneous disease called postinflammatory hyperpigmentation (PIH) develops following skin inflammation or damage. It is persistent, more prevalent, and more severe among those with darker skin. Fatty acids with a short chain (SCFAs), which is metabolites natural polysaccharides, have garnered a lot of interest. They recently shown tremendous promise in reducing systemic inflammatory activity, particularly in inflammatory bowel disease (IBD). Gut microbiota imbalance and epithelial damage are both factors in IBD, a complicated pathological process. Recent research suggests that several pathways may help IBD heal when using natural polysaccharides. Not only might they affect the balance of the intestine's microbiota, but they could also control the quantities of immune cytokines secreted via a variety of routes, including the G-protein-coupled receptor activation and modification by the TLR/MAPK/NF-B signalling pathways. They could also improve gut integrity and control oxidative stress. To demonstrate the connection between polysaccharides and disease recovery, a summary of current studies on the impact of natural polysaccharides on the aetiology of IBD is provided. These polysaccharides may lessen the release of pro-inflammatory cytokines, lessen oxidative stress, ameliorate gut epithelium damage, keep the milieu of the intestines balanced, and eventually minimise the risk of IBD (Ramos et al., 2019; Ng et al., 2017; Kaur et al., 2020; Niu et al., 2021).

POLYSACCHARIDES IN PHARMACEUTICAL FORMULATION

A variety of plant components, including leaves, rhizomes, fruits, pods, grains, seeds, roots, stems, corms, exudates, and so on, include plant polysaccharides, which are by-products of photosynthesis in plants. (Seidi et al., 2018; Shariatinia et al., 2017; Kohsari et al., 2016). Plant polysaccharides provide a number of essential benefits For example, Due to the quantity of plant materials, accessible availability from nature, sustainable and affordable synthesis, biocompatibility, water solubility, and swelling capacity, etc. are all factors that are relevant for application. Many popular pharmaceutical dosage forms, including Liposomes, transdermal formulations, buccal formulations, nasal formulations, microparticles, nanoparticles, ocular formulations, emulsions, gels, tablets, capsules, suspensions, etc., are used to deliver drugs to patients (Figure 8). Research on and use of a variety of plant polysaccharides as excipients for a very long time (Fazli et al., 2016; Germershaus et al., 2015; Shariatinia et al., 2014; Ngwuluka et al., 2014).

Fig. 8. The different Natural polysaccharide uses in medicine.

CONCLUSION

Polysaccharides in nature may provide safer superior functional advantages than a number of synthetic substances when used as components in skincare products. The past several years have seen a growth in knowledge about plant polysaccharide extraction, characterisation, and biological roles. By using various formulations using these macromolecules, including dressings, nanotools, hydrogels, and foams, many polysaccharides produced from plants may also be used to conduct their skincare functions, with effective effects when applied to the skin. Because of their therapeutic, antibacterial, and protective qualities, plant polysaccharides might be thought of as viable sources for cancer, infections, and skin damage prevention and treatment using natural methods. Despite these intriguing uses, the purifying plant polysaccharide production might be a barrier to their widespread commercial adoption in the cosmetics sector. Research on It is also recommended that the potential compositions based on these polysaccharides' shelf lives, as is research on how well they interact with various skin types to identify any potential side effects. Consequently, it is expected that the over time, polysaccharides will able to be employed in formulations for the skin that are relevant to clinical usage with therapeutic, preventative, and even cosmetic goals following proper tests in real time, even on willing human subjects.

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