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Review Article

A REVIEW ON: THERAPEUTIC ACTIVITIES OF SPIRULINA ON SKIN

Tejshri Tambe^{ID*}1, Mayur Bhosale^{ID}1, Pankaj Sonawane^{ID}1, Sonali Shinde^{ID}1¹Department of pharmaceutical chemistry, Pravara rural college of pharmacy, Loni, Ahmednagar, Maharashtra, India.

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ABSTRACT

Spirulina stands out as a sustainable bioactive microalga with health-promoting parcels, and an important active element of natural cosmetics products. Presently, Spirulina has been incorporated in topical skin-care phrasings, similar as a moisturizing, antiwrinkles, antiaging and antiacne agent. Likewise, this microalga is used by ornamental inventors to promote healthy sunscreen protection, to treat skin achromatism conditions and to heal injuries. Utmost of marketable cosmetics claim an outsized range of Spirulina parcels, including antioxidant, revitalizing, demineralizing, moisturizing, guarding alongside sanctification and shining action, both for hair and for skin. In this review, recent ornamental operations of Spirulina are revised, by pressing its capability in perfecting skin appearance and health. Also, the analysis of the Spirulina ornamental standards mooted. Looking at the current emergence of the beauty assiduity, numerous Spirulina extracts and dry cream/ flakes, both the starting element and final Spirulina-rested ornamental products, are available on the request. In this artificial field, Spirulina — substantially Spirulina platensis and Spirulina maxes — is used either as a cream, like in the case of cheaper products, or as a phycocyanin-rich blue Extract, particularly in the luxury request.

INTRODUCTION:

Source-(Arthrosporic platensis (Worsted) Gomont, or *Spirulina platensis*) is a species belonging to the Cyanobacteria class (cyanobacteria) that lives in brackish lakes with alkaline and warm waters (e.g., Lake Texcoco, Lake Cadet.) (1,2). Along with *Spirulina platensis*, another generally used species of spirulina for food supplements is *Spirulina maxes* (3,4). Both species have a long history of use as food and can grow in numerous places worldwide thanks to an astonishing capability to thrive in climatic conditions that are adverse to other algae's growth. The main growing territories of spirulina are the Pacific Ocean near Japan and Hawaii, and large brackish lakes, including Lake Chad in Africa, Lake Klamath in North America, Lake Texcoco in Mexico, and Lake Titicaca in South America.

* Corresponding author.

E-mail address: mayurbhosale2399@gmail.com

Tejshri Tambe.

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Currently, spirulina's world product as a food supplement substantially in special algal granges in outdoor tanks a bioreactor (5).



Figure 1: Source of Spirulina

The United States leads the world's product, followed by Thailand, India, Japan, and China. The nutrient content varies vastly and depends on the product area, the climate, and the water's saltiness in which the algae grow. Harvesting procedures can also impact the content of vitamins, minerals, and Phyto derivatives. Likewise, product processes should always guarantee the absence of heavy essence that can snappily accumulate in the algae (2,5).

Extraction method-Whole Spirulina algae was cleaned, shade

dried, and pulverized to powder in a mechanical grinder. Required quantity of powder sample (40gm) was weighed and transferred to round bottom flask separately. This is treated with methanol(200ml). The flask was heated on sachet apparatus for 120 min. Then the extracts were filtered. The extracts were collected and evaporated to dryness using vacuum distillation units.

Different Extraction process of Spirulina plantaris:

Phycocyanin the active constituents were extracted from the wet mass of Spirulina by using the following methods,

- 1) Homogenize the cells in mortar pestle:- The biomass of Spirulina is homogenized in mortar pestle in the presence of diatomaceous earth.
- 2) Inorganic acid extraction:-The biomass of Spirulina is treated with hydrochloric acid(HCL) with different concentration and left for 24 hours at room temperature.
- 3) Organic acid extraction:-The biomass of Spirulina is treated with acetic acid(1 Molar) at room temperature.
- 4) Water based extraction:-Spirulina plantaris were dried and extracted using distilled water as solvent in a Soxhlet apparatus.
- 5) Ethanolic extraction:-Spirulina platensis dried powder(10gm) was extracted by adding 100 ml of 80% ethanol kept overnight on a rotary shaker at room temperature.

Chemical constituents-

Spirulina species have a significant content of proteins, essential amino acids, vitamins, carotenoids, minerals, essential adipose acids, polysaccharides, glycolipids. (6,7,8),and for this reason, they're generally used as functional foods whose consumption benefits mortal health and improves physical and internal perform. The WHO Refocused out that spirulina is one of the most applicable superfoods on earth, and NASA uses it for space trip, thanks to the wide range of nutrients that a small quantum can give (9). spirulina contains a high position of B vitamins, in particular vitamin B12,and minerals including iron, calcium, zinc, magnesium, manganese, and potassium (10).

Figure 2: Chemical constituent of spirulina

Composition of spirulina

In addition, some essential adipose acids, similar as gamma linolenic acid (GLA) are present. Its Phyto complex is rather rich in colors, including chlorophyll, phycobilin's similar as phycocyanin, and allophycocyanin(6,11,12).it's important to note that spirulina nutrients are readily absorbed by the body and snappily restore Status to physiological situations (11). In particular, the high bioavailability of micronutrients allows their rapid-fire-fire distribution indeed in the nervous system. B vitamins, magnesium, and adipose acids fluently reach the brain through specific carriers plying salutary neuronal goods (10,12).Also, as for other Phyto derivatives(13,14) spirulina Phyto complex can also affect the brain through a first commerce with the intestinal microbiota. In fact, primary in vivo Substantiation presently

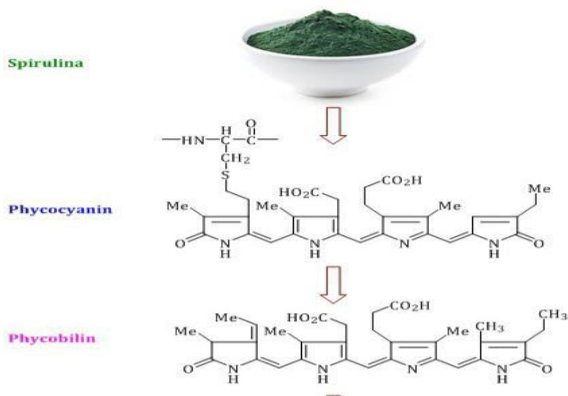


Figure 3: Composition of Spirulina

shows a bidirectional commerce between spirulina and the gut microbiota. On the one hand, the microbiota can biotransform complex into small bioactive moles suitable to reach the blood and play their salutary functions; on the other hand, spirulina seems to modulate the microbiota diversity towards an increase in the relative cornucopia of bacteria(15,16)Arthrosporic platensis hereafter appertained to as 'Spirulina') is uni-cellular microalgae which grows in freshwater, in tar water, as well as in brackish bodies of water. It grows swish in a largely alkaline terrain fop 10-12. Analogous conditions presently live in certain lakes in Sub-Saharan Africa and formerly in Mexico and Central America. Spirulina has been used as a food source for centuries, and is still generally consumed in Chad and girding countries in Africa; in fact, Spirulina has served as the sole source of nutrition in some African communities in times of deficit, during which entire native populations have been eating only Spirulina forever a month at a time. (17)

Current Use-Spirulina has popularly known as a superfood

Effects of spirulina on skin includes



1. Moisturizer
2. Antioxidant
3. Brightening.
4. wound healing
5. Antiacne
6. Antimicrobial



Figure 4: Benefits of Spirulina

1. Moisturizer

Skin aging is a complex process that depends on both an inheritable predilection and external factors, and causes functional and structural skin damage. Water mites play a vital part in maintaining the skin structural mores indeed, water binds the dermal proteins, similar as collagen, and ensures the tissue Consistence. Thus, aged skin is poor of bounded water and has weak hydration networks, which make skin look less and less glow and firm. Generally, UV radiation, pollution, a poor diet and an unhealthy life are the main causes of skin aging, and thus of the loss of humidity together with the drop of skin decreases skin barriers. Presently, the increase in life expectation and the growing interest in an immature appearance have lead the ornamental request to formulate antigen products with moisturizing and wrinkle reduction goods. Considering that beauty companies are also involved in searching sustainable staple and active constituents, the studies on the antiaging goods of algae, like Spirulina, aroused great interest in recent year(18,19)

2. Antioxidant

The antioxidant eventuality of blue multicolored cyanobacteria is of great interest in the cosmesis. Colors can be used as natural colorings in make-up products, like eyeliner and lipstick and as antioxidant agents, which cover against UV radiation.(20) Indeed, Spirulina contains a lot of photosynthetic colors like chlorophyll and especially phycocyanin, which determine a long- lasting green-blue achromatism in ornamental formulas. In 2012Dr.LotanA. (Cnidaria Technology Ltd., Israel) patented some birth sunscreen formulas, which included a mix of algae as active

constituents.(21) The claimed exertion was the synergistic effect of the Contemporaneous use of UV pollutants and algae, which absorb sun, “ convert it in energy source”, cover the skin and ameliorate its appearance. The patent argues that “ the agent primarily responsible for the advanced effect on the skin is the objectification of the algae” and Spirulina was one of the tested algae(Spirulina, Daniela, Hemapodous, Nanocelluloses and Tetrahemes). Still, despite the significance of this statement, an inarguable scientific demonstration is missing. The patent proposed three phrasings containing 10 w/ nonviable complete algae, a topical gel and both W/ O and O/ W mixes. Many times, latterly. Souza teal., further developed a stable and effective sunscreen expression containing an admixture of UV pollutants and antioxidants (using Spirulina between the others). As similar it further encourages experimenters to design further efficient and dependable sunscreens.(22) As an antioxidant, Spirulina may reduce skin hyperpigmentation and cover skin against sun-convincing damages (e.g., photoaging) by inhibiting ROS-convincing damage to the dermis. Both visual and rheological analyses revealed that the sunscreen phrasings were stable during the study period. Thus, the addition of pollutants Tinos orb S, Tinos orb M, Uvinul A Plus and Uvinul T150, along with Spirulina dry excerpt and dimethylmethoxychromanol- loaded solid lipid nanoparticles (DMC- loaded SLN) didn't alter the physical stability of the cream. Similar phrasings were characterized by a pH range between 5.3 and 5.8, suitable for topical operation. DMC- loaded SLN were successfully produced with a high addition rate(roughly 96, after 24 h) and stability (54 days). These phrasings displayed nonnewtonian pseudoplastic Este and, in terms of safety, according to the sensational analyses, they did not irritate the skin.(23)

3. Brightening

Skin hyperpigmentation is an aesthetic issue, which raises a growing concern in the current ornamental request. Presently, decolorizing products are vital in the antigen skin care routine, since they reduce spots and skin dyschromia caused by UV exposure. The pigment genesis begins inside melanocytes, which are a type of cell located between the keratinocytes in the rudimentary subcaste of epidermis. During the mentioned process, tyrosinase plays an important part in controlling the product of melanin and also in coloring hair, skin and eyes. In fact, this multicopper enzyme facilitates the metamorphosis of Tyrosine in Ldihydroxyphenylalanine (L-DOPA), which in turn oxidizes itself and becomes DOPA-quinone. A set of robotic waterfall responses leads to the creation of a color polymer, called melanin, which is

released to the girding keratinocytes (25). Both the abnormal loss and the overproduction of melanin may induce serious esthetical and dermatological skin diseases in humans, similar as Acanthosis nigricans, melasma, Cervical poikiloderma, Lentigines, Periorbital hyperpigmentation, neurodegeneration associated with skin cancer threat and Parkinson's complaint. The most dependable strategy to treat similar pigmentary diseases so far is to use impediments of the tyrosinase.

4.wound healing-

Skin Crack is a dislocation of complete tissue, which leads to a loss in functional and anatomic durability. Environmental conditions, accidents but also skin issues, like blankness and %dermatitis, might be some of the detector factors. Crack mending is, rather, a complex process involving seditious system, conflation of structural proteins, migration and proliferation of both parenchymal and connective tissue, cells. Full recovery is complex and, occasionally, habitual conditions or bacterial infections may further undermine the mending process. In 2011, Spirulina was developed for its effectiveness in crack mending, due to its flavonoids and triterpenoids, which act as tangy and antimicrobial agents (26). The Spirulina crack mending effect of dry Extracts, attained in petroleum ether, chloroform and methanol was tested on rats and covered for 16 days. Specifically, the crack compression — as the chance reduction in crack area — and its check time were controlled. A significant enhancement in the crack mending exertion was noticed with the three extracts .The stylish result was attained in the ointment with Spirulina petroleum ether-based extract at 10 w/ w .In 2013, Gur teal. studied the impact of the crude Spirulina excerpt and the phycocyanin insulated from the crude Spirulina excerpt on societies of mortal keratinocyte, by using in vitro and in vivo models of crack mending (27). They observed that Spirulina excerpt showed the stylish growth stimulation at 33.5 µg/ mL cure of treatment, which declared a cell exertion ranging from 100 to 270 after 72h. Cell viability has also bettered with phycocyanin and it was measured, indeed up to 213. Cell Exertion and proliferation difference between Spirulina excerpt and phycocyanin were noted not to be important ($p>0.05$) at the range of boluses (33.5 –0.0335 µg/ mL) examined. . It was also discovered that 1.25 of C-phycocyanin has a superior effect on the in vivo effectiveness, compared to other specifics with Spirulina extract, on the 7th day. Overall, the proliferation and growth stimulation conditioning of Spirulina excerpt feel to be directly connected to the presence of both phycocyanin and carotenoids, which synergistically contribute to the crack mending and towel

rejuvenescence. A many times latterly, Guneset.al. developed natural skin creams amended with bioactive. platensis excerpt, and studied its crack mending, genotoxic and immunoreactive goods in vitro to estimate the implicit use of Spirulina in biomedical and pharmaceutical sector (28). The in vitro cell culture tests demonstrated that Spirulina extracts showed significant goods on fibroblast cell proliferation and migration. Fibroblast are mesenchymal cells that enable tissue preservation by concealing extracellular matrix, and they're in charge of the inflammation and scar conformation, during the crack mending process. A skin- care cream, which incorporates 1.125 of Spirulina excerpt, presented the biggest proliferative effect on skin cells with an increase of Type 1 collagen immunoreactivity. The micronucleus assay, which shows DNA damage, demonstrated that Spirulina grounded cream had no genotoxic effect on mortal supplemental blood cells. Also, Spirulina platensis also revealed a strong antioxidant property, due to its superoxide dismutase (SOD) exertion with values up to 8.0 U/ mL of SOD in Spirulina excerpt. All these features lead the blue-green microalga to be suitable for biomedical and ornamental operations, particularly for crack dressings as well as sunburns, erythema and photoaging. More lately a Korean exploration platoon absorbed Spirulina in an finagled- tissue, to estimate its crack mending eventuality(29,30). They named nanofibers of polycaprolactone (PCL) as a supporting mater for tissue regeneration.

5.Anti-acne

Acne is an epidermis complaint linked to a sebum hypersecretion in misshaped follicles, which implies inflammation and come dons Conformation. Theanaerobic Cutibacterium acnes (also known as Propionibacterium acnes) plays a part in the inflammation process because it hyper proliferates in these bakeouts lipid terrain and produces reactive oxygen species (ROS) and proinflammatory composites. This cytokine waterfall also induces the follicular wall rupture of sebaceous glands and accordingly variation in the sebum composition. Apneic skins are low in linoleic acid and, thus, their Hedge skin function is compromised. Such a lesion pathway may also help the colonization of several bacteria like the Staphylococcus epidermis (S. epidermis). Indeed, although this Staphylococcus is a commensal skin microbiome bacterium, it was plant in acne as elastance complaint affects several people, substantially during nonage, and it may lead to a lack of the self-confidence, performing in body shame. Since acne- converting bacteria shown side goods and adding resistance towards the synthetic medicines like tetracycline, numerous indispensable approaches have been

explored in the last decades. Among them, the topical operations of ornamental formulas containing botanicals as safer active constituents are the further suitable (31). Presently, the ornamental request is explosively interested in formulating antiacne products with a special focus on natural active constituents, in addition to topical drug (32). With this purpose, in 2018 Nihal et al. developed a topical antiacne expression using Spirulina rich in phycocyanin protein (33). The ultimate protein, as formerly mentioned, is known to be responsible for utmost of the natural Spirulina benefits. The phycocyanin was successfully uprooted from the alga by using sonication and the cold maceration process and also it was purified by the dialysis system. The authors therefore studied its antimicrobial and anti-inflammatory conditioning. In particular, the antioxidant exertion was plant to be dependent on phycocyanin attention in the range between 0.05 and 0.3 mg * mL⁻¹.

6. Antimicrobial-

Spirulina is currently mass-produced as a monoculture in out-of-door civilization systems, with the growing medium used as a crucial input and accounting for a significant portion of the costs associated with the Spirulina output. Spirulina contains other cyanobacteria species and is utilized to produce a wide range of antibacterial compounds, making it a good candidate for biocontrol agents to control pathogenic bacteria and fungi. Spirulina platensis was tested for antibacterial activity against pathogenic bacterial and fungal isolates. The Spirulina platensis extract obtained from the solvent methanol demonstrated the greatest inhibitory zone against the bacterial and fungal isolates. The hexane solvent extraction of Spirulina platensis shows a minimal inhibitory zone against pathogens. When compared to the other Spirulina solvent extracts. Because of its high concentration of bioactive components, Spirulina can inhibit the growth of a variety of microorganisms, including gram-positive and gram-negative bacteria, as well as Candida and Aspergillus spp. Spirulina has a better chance of inhibiting the growth of gram-positive bacteria than gram-negative bacteria. This impact may be due to the intricate structure of gram-negative bacteria's cell wall (external membrane). (34,35)

CONCLUSION

Spirulina has been incorporated in topical skin-care phrasings, similar as a moisturizing, antiwrinkle, antiaging and antiacne agent. Likewise, this microalga is used by ornamental inventors to promote healthy skin, sunscreen protection, to treat skin achromatism conditions and to heal injuries. Utmost of marketable cosmetics claim an All these activities of spirulina including

moisturizing, wound healing, brightening, antioxidant, antiacne and antimicrobial reduces skin ageing and gives healthy skin.

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Author biography

Tejshri Tambe , Student.

Mayur Bhosale , Professor.

Pankaj Sonawane , Student

Sonali Shinde , Student

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