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Formulation And Characterisation Of Herbal Sunscreen

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Abstract: Sunscreen is a topical product designed to protect the skin from the sun's harmful ultraviolet (UV) radiation. It works by either absorbing, reflecting, or scattering UV rays to prevent them from penetrating the skin and causing damage such as sunburn, premature aging, and an increased risk of skin cancer. The incorporation of herbal materials into sunscreen is one of the most effective and natural ways to protect against the sun. The present study integrates the protective properties of these natural ingredients to develop an effective sunscreen product. The flowers of the butterfly pea plant are rich in antioxidants, including flavonoids, polyphenols and anthocyannins. Sunscreen lotion which contains olive oil and herbal ingredients can help to protect the skin from premature aging and damage that may lead to skin cancer.

The observational study of herbal sunscreen lotion showed good spreadability, good consistency, homogeneity, appearance, Ph, ease of removal and no evidence of phase separation. The prepared herbal sunscreen lotion was safe to use for skin .The result of present study attempts to develop sunscreen lotion possessing broad spectrum of anti UV radiation effectiveness with reduce concentration of chemical UV filters from the extracts of bio active products such as Butterfly pea flower (Fabacee) and Aloe Vera (Liliaceae)

Keywords: Herbal sunscreen, SPF (sun protection factor),Skin burn, Aloe Vera gel, Butterfly pea flower, Olive oil, Ultraviolet radiation

I. INTRODUCTION

Cosmetics are defined as "items intended to be rubbed, poured, sprinkled, sprayed, introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, adding to the attractiveness, altering the appearance, or keeping or promoting the skin or hair in good condition"[1]. Cosmetics can include makeup (e.g. foundation, lipstick, eye shadow), skincare products (e.g., moisturizers and Cleansers), fragrances, hair care products and more. These products are often applied topically and come in a wide-range of forms, from creams and powders to liquids and gels. The beauty history now heavily relies on cosmeceuticals, relegating cosmetics to a secondary position.

COSMECEUTICALS

The term "Cosmeceutical" itself was introduced in 1984 by DR ALBERT KLIGMAN to describe an emerging category of skincare products with therapeutic potential. He described these products as topical preparations sold as a cosmetic but with performance characteristics suggestive of pharmaceutical actions. They contain biologically active ingredients purporting to have medical or drug-like benefits. It helps to improve and nourish the skin appearance and known to treat different dermatological conditions. It encompasses cosmetic actives with therapeutic, disease-fighting, or healing properties, thereby serving as a bridge between personal care products and pharmaceuticals.

Cosmeceuticals are the development made within the world of dermatological products and the new beckon in skincare.These topical cosmetic pharmaceutical hybrids intended to enhance the health and beauty of skin[2].

They affects the biological functioning of the skin (medicinal or drug like benefits) depending upon the ingredients present in them.Cosmeceuticals increases the collagen growth in the skin and reduces the harmful effects of free radicals thus maintain the structure of keratin in good condition and making the skin healthier. Like cosmetics, they are destined only for external use on the body but could offer effects beyond simple cosmetic enhancement while falling short of qualification as a drug. In this sense, they blur the line between cosmetic product and pharmaceutical.

Cosmeceuticals are meant to improve appearance by delivering nutrients necessary for healthy skin. They usually claim to reduce wrinkles and to improve tone, texture and radiance of the skin. Cosmeceuticals have now become fastest-growing segment of the natural personal care industry[3]. This include most of the bioactive food components such as milk peptides, certain vitamins and minerals, phytonutrients from herbs, various oils and botanical extracts. Cosmeceuticals market is nowadays more flourished with several botanicals having a history of their use in traditional cultures. More and more cosmeceuticals are being used in cosmetic products due to their less side effects and added advantage of multi functionality. Some common categories of cosmeceutical products are;

- Anti-aging serums
- Sunscreen
- Acne treatments
- Hydrating serums
- Skin brightening creams

- Anti-inflammatory products
- Collagen boosting cream

COSMECEUTICAL TYPES

With the many types of cosmeceutical available, some products emphasize their unique ingredients over others. For example, cosmeceuticals made from botanicals can be organized into sub categories based on their ingredients. Organic cosmeceuticals are made from natural ingredient and do not contain any chemical as active ingredient. Essential oil cosmeceuticals contain oils and extracts from various plant based products. CBD cosmeceuticals contain hemp or its products as active ingredients, which come directly from plants as botanical oils. Other kinds of cosmeceutical sub categories include paraben-free cosmeceuticals and vegan cosmeceuticals.

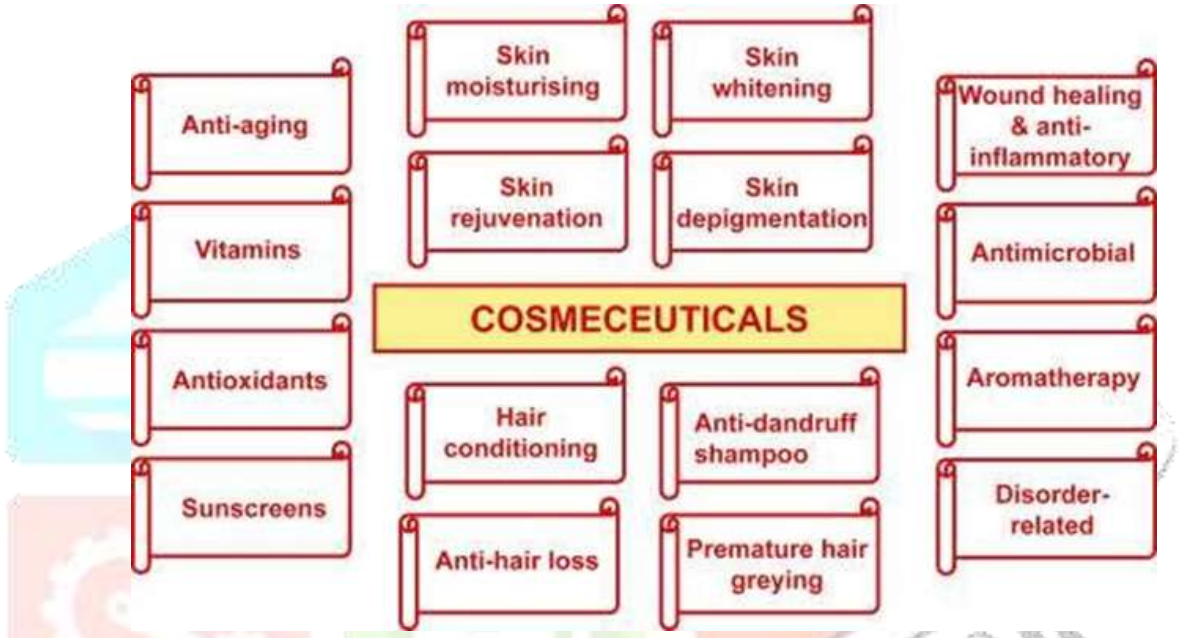


Fig.1 Types of cosmeceuticals

SKIN

The external surface of the body also referred to as the cutaneous membrane. The skin is the body's largest and primary protective organ, covering its entire external surface and serving as a first-order physical barrier against the environment. Its functions include temperature regulation and protection against ultraviolet (UV) light, trauma, pathogens, microorganisms, and toxins. The skin also plays a role in immunologic surveillance, sensory perception, control of insensible fluid loss, and homeostasis in general. The skin is also highly adaptive with different thicknesses and specialized functions in different body sites.

STRUCTURE OF SKIN

The skin is primarily made up of three layers. The upper layer is the epidermis, the layer below the epidermis is the dermis, and the third and deepest layer is the subcutaneous tissue[4].

- The epidermis, the outermost layer of skin, provides a waterproof barrier and contributes to skin tone.

- The dermis, found beneath the epidermis, contains connective tissue, hair follicles, blood vessels, lymphatic vessels, and sweat glands.
- The deeper subcutaneous tissue (hypodermis) is made of fat and connective tissue.

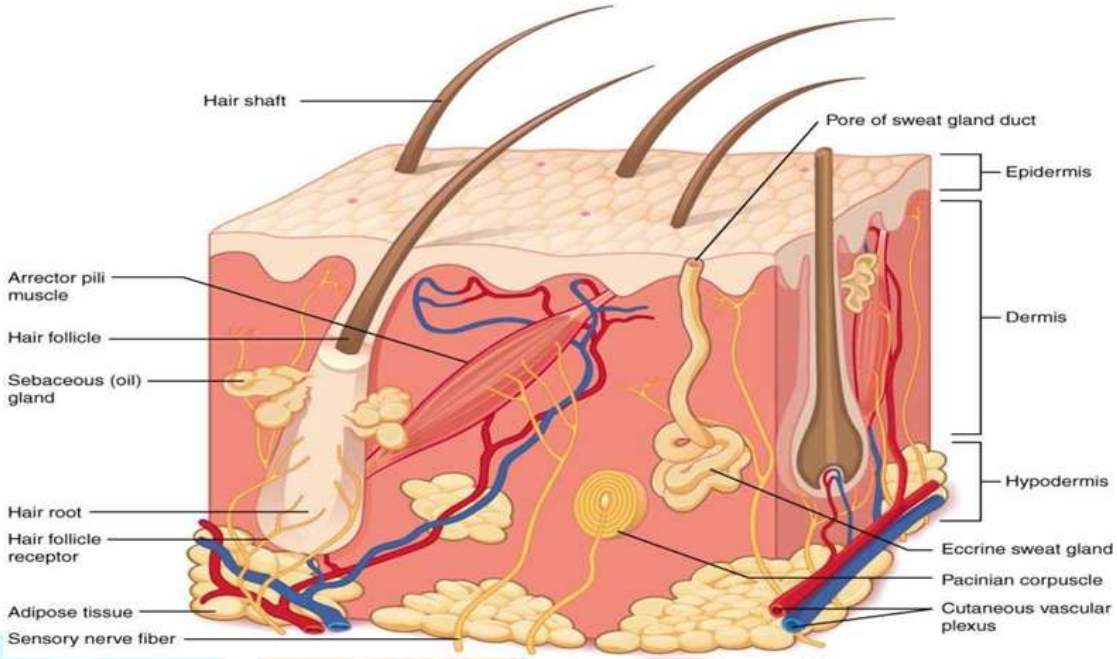


Fig.2 Structure of skin

EPIDERMIS

The layers of the epidermis include the stratum basale (the deepest portion of the epidermis), stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum (the most superficial portion of the epidermis).

Stratum basale

Also known as stratum germinativum, is the deepest layer, separated from the dermis by the basement membrane (basal lamina) and attached to the basement membrane by hemidesmosomes. The cells found in this layer are cuboidal to columnar are mitotically active stem cells that are constantly producing keratinocytes. This layer also contains melanocytes.

Stratum spinosum

8-10 cell layers, also known as the prickle cell layer contains irregular, polyhedral cells with cytoplasmic processes, sometimes called “spines”, that extend outward and contact neighbouring cells by desmosomes and dentritic cells can be found in this layer.

Stratum granulosum

3-5 cell layers, contains diamond shaped cells with keratohyalin granules and lamellar granules. Keratohyalin granules contain keratin precursors that eventually aggregate, cross-link, and form bundles. The lamellar granules contain the glycolipids that get secreted to the surface of the cells and function as a glue, keeping the cells stuck together.

Stratum lucidum

2-3 cell layers, present in thick skin found in the palms and soles, is a thin clear layer consisting of eleidin which is a transformation product of keratohyalin.

Stratum corneum

20-30 cell layers, is the upper most layer, made up of keratin and horny scales made up of dead keratinocytes, known as a nucleated squamous cells. This is the layer which varies most in thickness, especially in callused skin.Within this layer, the dead keratinocytes secrete defensins which are part of our first immune defense.

DERMIS

The dermis serves as connective tissue and protects the body from stress and strain. It also gives the skin strength and elasticity. In addition, its main role is to provide sensation and blood to the skin. The dermis contains hair follicles, blood vessels, and lymphatic vessels. It is home to a number of glands, including sweat glands and sebaceous glands, which produce sebum, an oil that lubricates and waterproofs hair.

HYPODERMIS

The deepest layer of the skin is the subcutaneous tissue, the hypodermis. It is not technically part of the skin, but it helps attach the skin to the bones and muscles and provides nerves and blood supply.

FUNCTIONS OF SKIN

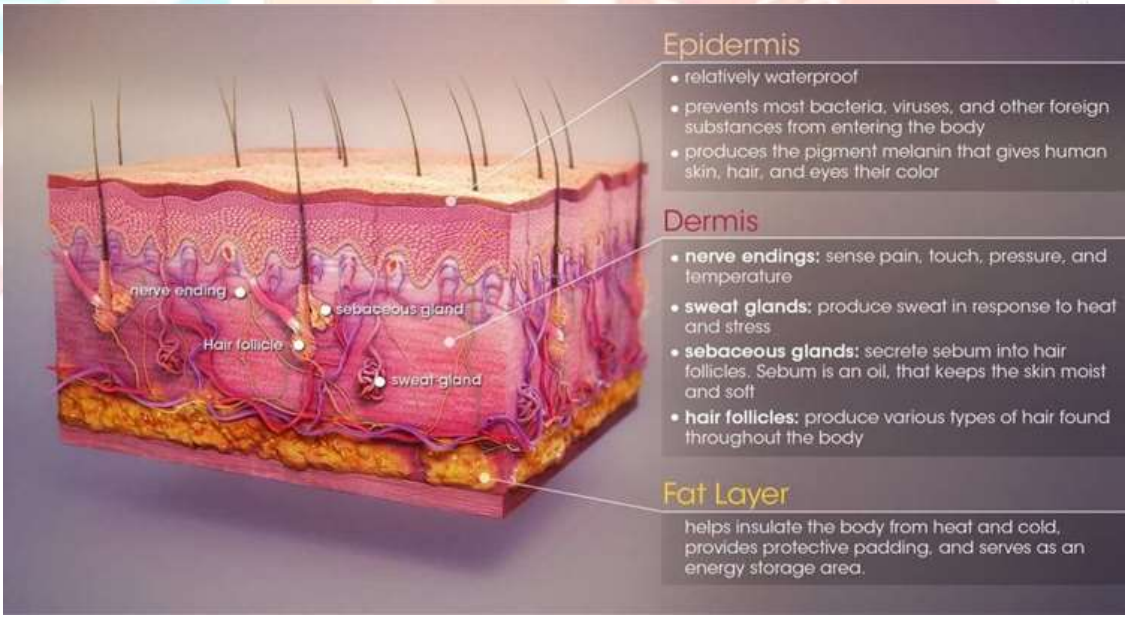


Fig.3 Functions of skin

The functions of the skin include:

- Protection against microorganisms, dehydration, ultraviolet light, and mechanical damage and the skin is the first physical barrier that the human body has against the external environment[5].
- Sensation of pain, temperature, touch, and deep pressure starts with the skin
- Mobility :Skin allows smooth movement of the body
- Endocrine activity: The skin initiates the biochemical processes involved in Vitamin D production, which is essential for calcium absorption and normal bone metabolism.

- Exocrine activity: This occurs by the release of water, urea, and ammonia. Skin secretes products like sebum, sweat, and pheromones and exerts important immunologic functions by secreting bioactive substances such as cytokines.
- Immunity development against pathogens.
- Regulation of Temperature: Skin participates in thermal regulation by conserving or releasing heat and helps maintain the body's water and homeostatic balance.

EFFECT OF SUN RAYS ON SKIN

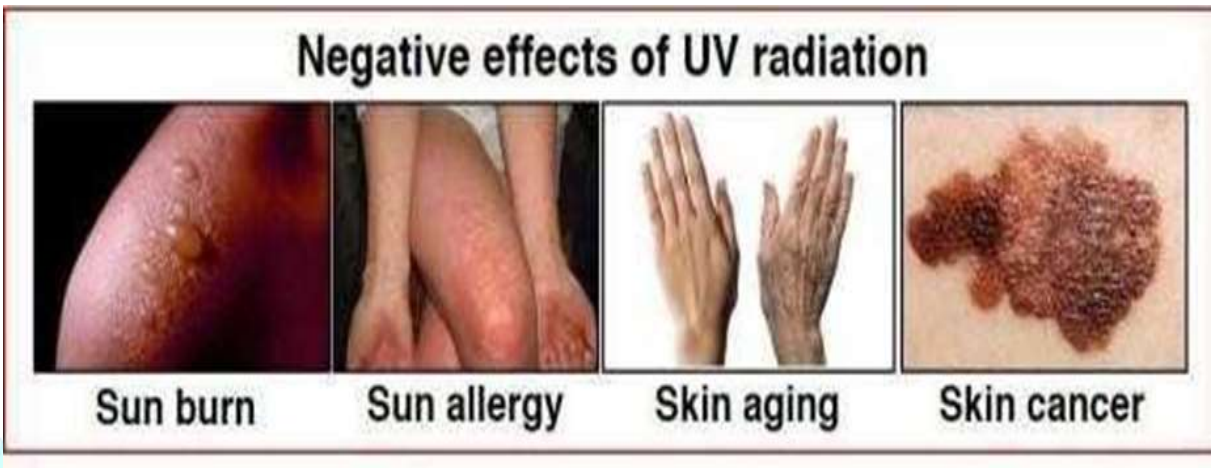


Fig.4 Effect of sun rays on skin

Repeated exposure of the skin to the sun has the potential to cause both short-term and long-term changes in the structure of the skin[6]. In the short term, repeated exposure results in erythema (reddening) of the skin commonly referred to as sunburns . The erythema is followed by activation of melanocytes which increase their rate of melanin production (increased melanization) which darkens the skin appearance otherwise referred to as tanning. Long term effects of repeated exposure include irreversible loss of skin elasticity and may lead to the development of skin cancers, both melanomas and non-melanomas.The extent of skin damage depends on the duration of exposure, seasonal variations in incident sunrays intensity, geographical location, and host-dependent factors including age, skin color, behavioral factors, immune status among others[7].The utilization of sunscreens (also referred to as sunprotectants) for protection against the harmful effects of the sun rays has been increasing over the last few decades

- UV C radiation (100 to 290 nm)
- UV B radiation (290 to 320 nm)
- UV A radiation (320 to 400 nm)

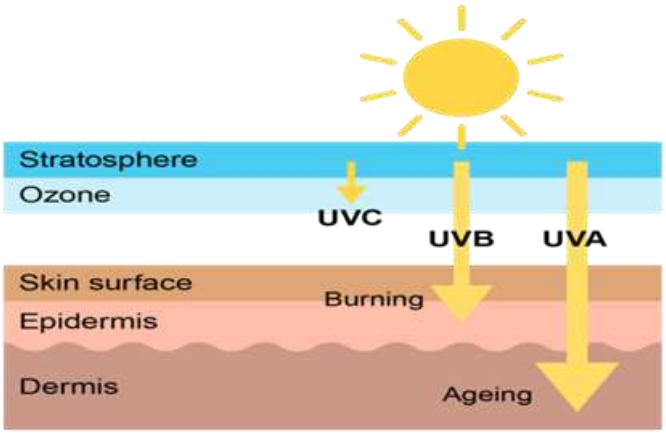


Fig.5 Ultraviolet rays from sun

- UV C radiation has the shortest wavelength and is almost completely absorbed by the ozone layer. As such, it doesn't really affect the skin. However, UV C radiation can be found from such artificial sources as mercury arc lamps and germicidal lamps[8].
- UV B radiation affects the outermost layer of skin (epidermis) and is the primary cause of sunburns. It is most intense between the hours of 10am and 2pm when the sunlight is at its brightest. It is also more intense during the summer months, accounting for around 70 percent of a person's yearly UV B exposure. Because of its wavelength, UV B does not penetrate glass easily[9].
- UV A radiation, by contrast, was once thought to have only a minor effect on the skin. Studies have since shown that UVA is a major contributor to skin damage. UVA penetrates deeper into the skin with an intensity that doesn't fluctuate as much UVB. And, unlike UVB, UVA is not filtered by glass. Several epidemiological studies have provided evidence for the impact of the beneficial and harmful effects of sunlight, especially solar UV exposure on overall human health status[10].

SUNSCREEN

These are formulations that are applied onto the skin surface to protect it from the harmful effects of ultraviolet (UV) light. Ultraviolet filters also referred to as sunscreens, are the elements present in photo-protector formulas that interfere directly with the incident solar radiation through absorption, reflection or dispersion of energy. They are classified into two categories based on their mechanism of action; Chemical or organic sunscreens and mineral-based or inorganic sunscreens.

Classification of sunscreen

Sunscreen are classified as either topical or systemic based on the route of administration topical sunscreen are divided into two classes on their mechanism of protection[11].

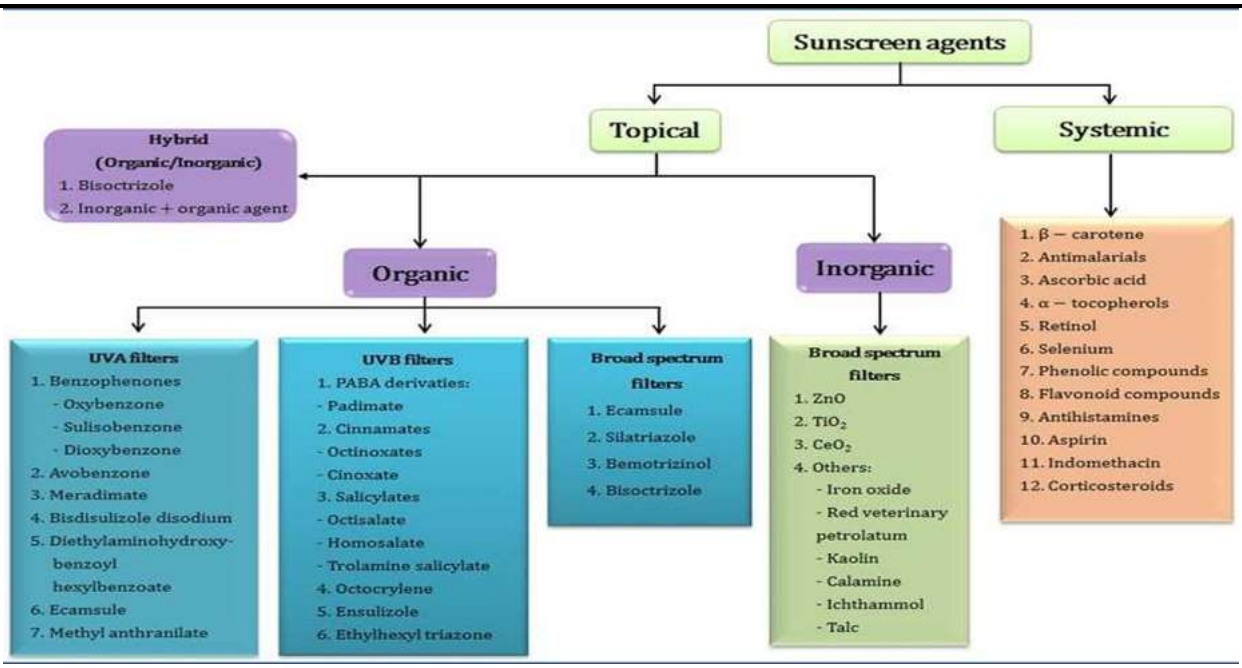


Fig.6 Types of sunscreen

Organic sunscreen

Organic sunscreen works by absorbing and converting UV rays into heat. It is thin and ideal for everyday use allowing for skincare ingredients to be added easily. It contains non mineral active ingredients. Chemical ingredients in this sunscreens absorb UV light and convert it into heat energy that is then released from the skin. Typical examples of chemical sunscreens include octisalate and avobenzone. The organic sunscreens afford better aesthetics upon application and are therefore more widely accepted, however they carry the potential for systemic absorption therefore sensitivity and untoward effects are more common with this group of sunscreens.

Inorganic sunscreen

Inorganic sunscreens also referred to as sunblocks act by reflecting and scattering the UV light thereby protecting the skin. Common examples of mineral sunscreens include titanium dioxide and zinc oxide. Inorganic filters present a minimum potential for allergic sensitization and high photostability and are therefore more appropriate for people with sensitive skin. These are particles that scatter and reflect UV rays back to the environment. They act as physical barriers to indent ultraviolet and UV light .They are considered broad spectrum as they cover the entire ultraviolet spectrum. The Inorganic sunscreen are also referred to as sun block .

HERBAL SUNSCREEN

Fig.7 Herbal Sunscreen

Herbal sunscreen (also known as herbal sun block, suntan lotion) is a lotion, spray or topical product containing herbal ingredients which help to protect from the UV radiations of the sun and hence lowering the risk of skin cancer[12]. Herbal sunscreen is also known herbal sun block.Herbal suntan lotion is a lotion, spray or other topical product that helps protect the skin from the sun's UV radiation and which reduce sunburn and other skin damage[13].

IDEAL PROPERTIES OF HERBAL SUNSCREEN

- Absorb light preferentially over the range of 280 mm-320mm
- Be stable to heat ,light and perspiration
- Be non-toxic and non- irritant
- It should be neutral
- It should be rapid soluble in suitable vehicle

ADVANTAGES OF HERBAL SUNSCREEN

- Easily available[14]
- Do not provoke allergy
- Easy to manufacture
- Cheap in cost
- Effective with small quantity
- No side effect
- No special equipment needed for preparation
- Renewable resources
- Botanical ingredients are easily available
- They are inexpensive
- Ingredients are easily available
- Be neutral
- Be stable to heat
- Easy to manufacture

DISADVANTAGES OF HERBAL SUNSCREEN

- They are difficult to hide odor
- Manufacturing process are time consuming and complicated
- Herbal drug have slow effects as compare to allopathic dosage form it also requires long term therapy
- The SPF might be less than the chemical sunscreen available in the market

GENERAL HERBAL INGREDIENTS USED IN SUNSCREEN

Alo vera

Fig.8 Aloe Vera

Aloe Vera or Aloe barbadensis has been scientifically proven for all forms of burn, be it radiation, thermal, or solar[15]. The leaves of aloe vera are the source of aloe vera gel which is widely used in cosmetics lotion for its moisturizing and revitalizing activity. It has also been demonstrated that it has a prophylactic effect if used before, during, and after these skin damaging events. The polysaccharides, mannose-6- phosphate, and complex anthraquinones all contribute synergistically to the benefits of this material. The natural chemical constituents of Aloe Vera can be categorized in the following main areas: Amino acids, anthraquinones, enzymes, lignin, minerals, mono- and polysaccharides, salicylic acid, saponins, sterols, and vitamins.Aloe Vera is a uniquely effective moisturizer and healing agent for the skin.

BUTTERFLY PEA FLOWER

Fig.9 Butterfly pea flower

Clitoria ternatea or commonly known as Butterfly pea belongs to the family Fabaceae[16] .It is commonly known as butterfly pea, is a perennial plant. The flowers of the butterfly pea plant are rich in antioxidants, including flavonoids, polyphenols, and authocyanins. Antioxidants are necessary for your skin's overall health and elasticity. antioxidants enhance the look and feel of your skin by reducing fine lines. Butterfly pea flowers reduce redness from acne, dryness, and general irritation because of their

capacity to calm irritated skin. When coupled with other nutrients that support the health of the skin, these nourishing qualities are further amplified.

TOMATO

Fig.10 Tomato

Tomato (Solanum lycopersicum) belongs to the family- Solanaceae.Tomatoes are easily available and eaten freely throughout the world .It basically contains carotene lycopene, which is most powerful natural antioxidant[17]. Lycopene has also been shown to improve the skins ability to protect against harmful U.V rays .Tomato also contains various natural antioxidants, vitamin A, C, E, anthocynin, pantothenic acid and cryptoxanthin .Due to presence of these constituents tomato shows strong protection against neurodegenerative diseases, blocks U.V. radiations and reported to be used as a herbal suncreening agent.

PHYLLANTHUS EMBLICA

Fig.11 Phyllanthus emblica

Phyllanthus emblica is mostly used in Thai medicine for treatments of various diseases .The fruits are reputed to contain high amounts of ascorbic acid (vitamin c)[18]. It contains minerals, amino acids, calcium, iron, and carotenes. It also contains a mixture of polyphenols such as phyllemblin, flavonoids, kaempferol. Due topresence of above chemical constituents aqueous extract of phyllanthus emblica

shows free radical scavenging action.It effectively inhibits peroxide free radical production and shows protective action against UV radiation penetration.

LUFFA CYLINDRICA

Fig.12 Luffa cylindrica

It is classified as a type of cucumber. It is also called Vietnamese gourd or Vietnamese luffa. Luffa is a subtropical plant . The fruit contains triterpenoid saponins such as lucyosides A, B, C, D, E, F and ginsenosides. The leaf contains triterpenoid saponins lucyin A, lucosides G, P, N,O,Q, 2-β Hydroxyoleanoic acid, 3-o-β Dglycopyranosyl, maslinic acid, flavonoids such as apigenin and polypeptides such as luffans, luffacylin . It contains various antioxidants which show nourishing action to skin. Its fruit is used in Guinea on tumours and swellings, and the fruit pulp is used in Guinea and Nigeria as emollient. The seeds are credited with tumours and anthelmintic properties. The seed oil is used for treatment of skin problems like erythema, sun burn, and red pigmentation .Triticum vulgare (wheat germ) oil is particularly rich in vitamin E and offers excellent antioxidant promise in topical antiaging formulatins. Also, it nourishes and prevents loss of moisture from the skin.

CUCURBITA PEPO

Fig.13 Cucurbita pepo

Cucurbita pepo (pumpkin) seed oil deserves greater recognition. With a lipid profile containing high levels of linoleic acid (43 – 53%), it contains two classes of antioxidant compounds: Tocopherols and phenolics, which account for 59% of the antioxidant effects. It is especially valued in the healing folklore of Eastern and Central Europe and the Middle East for its nutritious benefits and is used both topically and orally for a range of medical conditions. Due to the strong, rich aroma, it is only used in small proportions in topical formulations.

TURMERIC

Fig.14 Turmeric

Curcumin is a yellow odorless pigment isolated from the rhizome of turmeric (Curcuma longa).Curcumin possesses anti-inflammatory, anti tumoral, and antioxidant properties[19]. It contains many poly phenolic compounds and active ingredients in skin healing.The anti bacterial properties of curcumin helps to kill microbes on the skin which are ker responsible for the infections.Curcuma longa contains 2-9 % curcuminoides which are comprised of curcumin, demethoxycurcumin amnd bis-demethoxycurcumin .

LITERATURE REVIEW

1. Rasheed et al.,(2012)[20]

This study attempts to develop sunscreen lotion possessing broad spectrum of anti-UV radiation effectiveness with reduced concentration of chemical UV filters, from the extracts of bioactive products such as Curcuma longa L. (Zingiberaceae), Aloe Vera (Liliaceae) . The effectiveness of the product was evaluated using Sun Protection Factor (SPF). Curcumin was selected as potential bioactive agents due to their phytochemical compositions possessing considerable content of polyphenolic compounds.

2. Abhishek Purohit et al.,(2023)[21]

The aim of this study was to develop a topical sunscreen formulation based on some fixed oils, in combination with some medical plants. Regular use of sunscreen reduces the development of actinic keratosis, squamous cell carcinoma and melanoma. Sunscreen may be organic or inorganic chemicals.Sunscreen is also known as sun block lotion. The product absorbs or reflects the sun's ultraviolet radiation and protects the skin. The increasing incidence of skin cancers andPhoto-damaging effects caused by ultraviolet radiation has increased the use of screening agents, which have shown beneficial effects in reducing the symptoms. Sunscreen agents should be safe Chemically inert, non-irritating non-toxic, photo stable an able to provide complete protection to the skin against damage from solar radiation.

3. Vigneshwaran. L.V.et al., (2023)[22]

The study's findings suggest that the newly created herbal sunscreen can greatly improve and boost the UV absorption properties of conventional sunscreen formulations. The sun protection efficacy of lotion was evaluated in terms of sun protection factor (SPF) using an in-vitro spectrophotometric technique. The herbal formulation was found to be stable, spreadable, homogeneous, non-greasy, and devoid of any signs of phase separation.

4. Tiwari et al., (2022)[23]

The study aimed to develop herbal sunscreens containing turmeric (strong antiseptic property which protects skin from bacteria caused by excess sweat), coconut oil (used as a sun-block agent and helps to protect skin from sun damage), Aloe Vera (give a cooling effect to the skin and work as skin barrier), lemon (used to protect skin for sunburn) which will be effective for skin and protect skin against harmful sun rays, sunburn, and skin cancer. Prepared herbal sunscreens were evaluated for physicochemical characteristics, SPF, thermal stability, antioxidant activity, in vitro mutagenicity, and stability.

5. Laxmikant Kantilal Banswal et al.,(2023)[24]

The aim of this study was to develop herbal topical sunscreen formulation based on some fixed oils, in combination with some medical plants. This work attempts to formulate and evaluate a cosmetic (Herbal sunscreen) for protection of skin from the natural ingredients which have different properties such as emollient, moisturizer, base, anti-acne, anti sweatning in the ingredients such as Aloe Vera, Butterfly pea flower, Coconut oil, Rose water, Vitamin E Capsule etc.

6. Rozinaparvin Iqbal Patel et al.,(2023)[25]

This research work portrays the formulations & evaluation of topical photo protective, containing antioxidant, anti-malignant, wound healing, antifungal, antiaging, moisturizer, anti-inflammatory,anti proliferative activity, and other photo-protective polyphenols. The present research work renders a stable natural photo protective formulation with antioxidant properties, high SPF, and more indispensable homogenous UVA/UVB protection.

7.Shivraj V. Mane et al.,(2023)[26]

The basic of his study attempts to develop sunscreen lotion, possessing broad spectrum of anti-UV radiation effectiveness with reduced concentration of chemical UV filters, from the extracts of bioactive products such Aloe Vera (Liliaceae), Curcuma longa L. (Zingiberaceae), Green tea(Camellia sinensis), and Carrot Seed oil (Daucuscarota). The effectiveness of the product was identified by using different parameters. Curcumin was selected as potential bioactive agents due to their phytochemical compositions as it has anti-inflammatory and antioxidant properties and Aloe Vera is used as key ingredient in various sunscreen lotions as it has skin protectant action against UV rays and gives soothing and cooling action. The sunscreen lotions were prepared using six different formulations F1, F2 and F3.Evaluation of formulation was also done by physicochemical studies, pH determine,spread ability and viscosity.

8. Mukesh Patel et al.,(2023)[27]

The main goal of our current study was the formulation and development of an herbal sunscreen lotionthat contains more skin-friendly ingredients like aloe Vera, olive oil, turmeric, vitamin E etc. The use of sunscreen lotion has gradually increased over the years as people have become more aware of the harmful effects of UV radiation. Sunscreen lotion is made, and various plant components are extracted. Testing is done using evaluation criteria like pH, spread ability, and feel. The prepared sunscreen lotion has a high SPF rating, good homogeneity, consistency, and appearance, and no signs of phase separation.

9. Saurbh N. Pawale et al.,(2021)[12]

The basic of his study attempts to develop herbal sunscreen among the labeling standards square measure removals of the term "sun block" inclusion of an announcement particularization the importance of sun blocker to stop harmful effects of the sun, three sun protection categories minimum, moderate, high, a brand-new SPF class of 30+ for merchandise with SPF values larger than 30, uniform, and efficient labeling for all sunscreens.

10. Geeta vaman bhople et al.,(2023)[28]

This article gives a detailed review on different types of Ultraviolet radiation. To protect our skin from Ultraviolet radiation sunscreen formulations are used which either absorbs scatters or reflects the radiation. The harmful effects on skin like photo aging, skin cancer, DNA damage are explained. The present review explains the various types of sunscreen formulations and the agents used for the purpose of sun screening. The agents are of two type’s physical and chemical sun screening agents.The physical agents which block the sun light and the chemical agents which absorb the sunlight are listed and explained. To know the efficacy of the formulation sun protection factor calculation is done. The equation used to calculate the Sun Protection Factor value is explained in detail. The ultraviolet

spectroscopic method is employed to calculate the Sun Protection Factor. The proposed method is found to be easy and rapid for the calculation of Sun Protection Factor values in the in vitro studies.

11. Ravindra rohokale et al.,(2023)[29]

This study created a topical herbal sunscreen formulation using a combination of medicinal herbs and some fixed oils. Frequent use of sunscreen prevents melanoma, squamous cell carcinoma, and actinic keratosis from developing. Chemicals in sunscreen can be either organic or inorganic. Sun block lotion is another name for sunscreen. Products that shield skin from UV rays by reflecting or absorbing them. Sunscreen use has increased due to the rising incidence of skin cancer and the photo damaging effects of UV radiation. Which have demonstrated positive results in symptom reduction. Sunscreen ingredients should be completely safe, chemically inert, non-irritating, non-toxic, photo stable, and able to shield the skin from sun harm.

12.Yokesh S Pal et al.,(2023)[30]

The aim of herbal sunscreen lotion is to provide effective sun protection while utilizing natural ingredients derived from plants. The primary goal is to create a sunscreen product that reduces the harmful effects of ultraviolet (UV) radiation on the skin, including sunburn, premature aging, and the risk of skin cancer. The main objective of a herbal sunscreen lotion is to provide a high level of sun protection by blocking or absorbing the UV rays. It should prevent both UVA and UVB radiation from reaching the skin and causing damage. Sunscreen reflects, absorbs and scatters both ultraviolet A and B radiation to provide protection against both types of radiation.Using sunscreen lotion can help to protect the skin from premature aging and damage that may lead to skin cancer. The observational study was herbal sunscreen lotion showed good spread ability, good consistency, homogeneity, appearance, pH, Ease of removal and no evidence of phase separation. The prepared herbal sunscreen lotion was safe to use for skin. The result of present study attempts to develop sunscreen lotion possessing broad spectrum of anti UV radiation effectiveness with reduce concentration of chemical UV filters from the extracts of bioactive products such as a Butterfly pea flowers (Fabaceae) and Aloe Vera (Liliaceae).

13. Rohit Maurya et al.,(2023)[31]

The basis of this study attempts to develop a herbal sunscreen formulation containing aloe Vera, butterfly pea flower, rose water, vit E and coconut oil as main ingredients. Aloe Vera gel helps to block UVA and UVB shafts and maintain skin's natural humidity balance. Butterfly pea flower is known for its antioxidant activity and minimizing fine lines, thereby enhancing skin appearance.

AIM AND OBJECTIVES

AIM:

To Prepare and Evaluate herbal based sunscreen lotion to prevent harmful effects of sun-rays.

OBJECTIVES:

1. To develop sunscreen formulation using herbal ingredients
2. To perform physico chemical characterization
3. To achieve maximum stability of formulation

4. To achieve maximum UV protecting effect

5. To inhibit the transmission of UV radiation into the skin

EXCIPIENT PROFILE

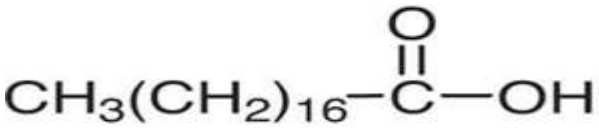
1. Stearic acid

A common excipient used in pharmaceuticals and cosmetic products as an emulsifier, thickener and lubricant[32].

The excipient profile of Stearic acid is as follows:

Chemical name: Octadecanoic acid, Steariphanic acid.

Chemical formula: C18H36O2



Molecular weight: 284.48g/mol

Appearance: White or cream-colored powder

Solubility: Insoluble in water, soluble in ethanol, ether, chloroform and benzene

Melting point: 69.3℃

Boiling point: 361℃

Odor: Odorless

pH: Neutral

Stability: Stable under normal conditions of usage and storage.

Toxicity: Stearic acid is considered safe for use as an excipient in pharmaceuticals and cosmetics when used in accordance with good manufacturing practices. Overall, Stearic acid has a good excipient profile due to its Stability, low toxicity and versatility in variousapplication.

Applications:

1. Cosmetics: Stearic acid is a common ingredient in cosmetic and personal care products such as soaps, lotions, and cream .It acts as an emulsifier, which helps to mix oil and water -based ingredients and also as a thickening agent to give products a creamy texture.

2. Food : Stearic acid is found naturally in many foods such as animal fats, cocoa butter and shea butter.It is also used as a food additive in the production of margarine, shortening and baked goods to improve texture and stability.

3. Pharmaceuticals: Stearic acid is used as a lubricant in the manufacturing of pharmaceuticals and is commonly found in tablets and capsules.

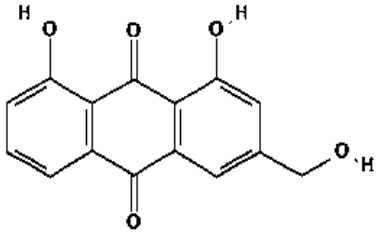
2.Aloe vera

A common excipient used in pharmaceuticals and cosmetic product as a medicinal plant with antioxidant, antibacterial properties.

The excipient profile of aloe Vera is as follows:

Chemical name: Aloe emodin

Chemical formula: C15H10O5



Molecular weight: 267.279

Appearance: Triangular, fleshy leaves with serrated edges

Solubility: The gel has very high water content (99%−99.5%), with the remaining soluble solids making up 0.5%−1%

Boiling point: 442.5±45.0 °C at 760 mmHg

Odor: Pungent, oniony smell

PH: 4.64 ± 0.06

Toxicity: Hypokalemia, Photo toxicity

Applications: Wound healing, Acne, Skin hydration

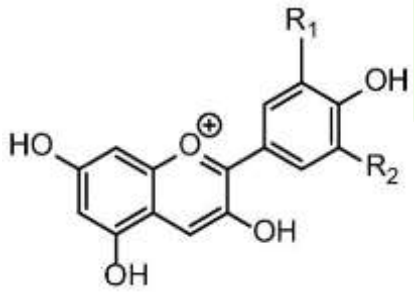
3. Butterfly pea flower

Butterfly pea flower is rich in anthocyanins which are potent anti oxidants that help protect cell from oxidative damage caused by free radicals[33]. They also have anti inflammatory properties and contribute to skin health and UV protection.

The excipient profile of butterfly pea flower is as follows:

Chemical name : anthocyanin

Chemical structure:



Molecular weight: 449.2g/mol

Appearance: This is a large wild flower with one to three showy purple flowers that are up to two inches long. It has the characteristic banner, wing, and keel floral structure of flowers in the Pea family, but the banner is much expanded, concave, and lined with dark lavender markings.

Solubility: Butterfly pea has a blue color due to the anthocyanin pigment; anthocyanin is water soluble because it has an aromatic ring structure that has a polar component.

Boiling point: 208°F

Odor: very little scent

pH: 6.0–8.0

Stability: At 90℃, anthocyanins in butterfly pea extract had the highest stability at the co-pigment ratio of 100:1.

Toxicity: it can cause poisoning when accidentally swallowed. Therefore, using butterfly peas to eat will affect health, especially for young children and people with poor resistance.

Applications : Butterfly pea flower is a common ingredient in many herbal teas, mixed drinks, and cosmetic products. It is rich in antioxidants and may be linked to several health benefits, including increased weight loss, better blood sugar control, and improvements in hair and skin health.

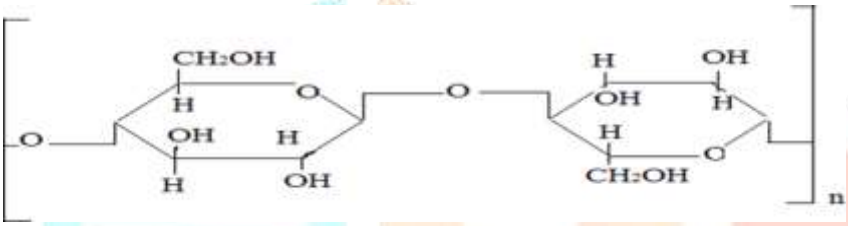
4. HPMC

Hydroxy propyl methyl cellulose is an odorless and tasteless, white to slightly off-white, fibrous or granular, free-flowing powder that is a synthetic modification of the natural polymer, cellulose.

The excipient profile of HPMC is as follows:

Chemical name: hydroxyl propyl methyl cellulose

Chemical formula: C56H108O30



Molecular weight: 86kDa

Melting point: 225-230 ℃

Toxicity :HPMC has no known pharmacological action, no receptor site, is not metabolized in vivo, and is generally considered non-toxic and non-irritating.

Applications: It is extensively used in the food industry as a stabilizer, as an emulsifier, as a protective colloid, and as a thickener.

5. Zinc oxide

Zinc oxide is a largely inert, white compound which is used very widely as a bulking agent or filler, and as a white pigment.

The excipient profile of zinc oxide is as follows:

Chemical name: Oxo zinc

Chemical formula :

$$Zn{=}O$$

Molecularweight: 81.38g/mol

Melting point: 1975 ℃

Appearance: Pure ZnO is a white powder

Toxicity: Exposure to Zinc Oxide can cause “metal fume fever.” This is a flu-like illness with symptoms of metallic taste in mouth, headache, fever and chills, aches, chest tightness and cough.

Applications: ZnO is used as an additive in numerous materials and products including cosmetics, food supplements, rubbers, plastics, ceramics, glass, cement, lubricants, paints, sunscreens, ointments, adhesives, sealants, pigments, foods, batteries, fire retardants, semiconductors, and first-aid tapes.

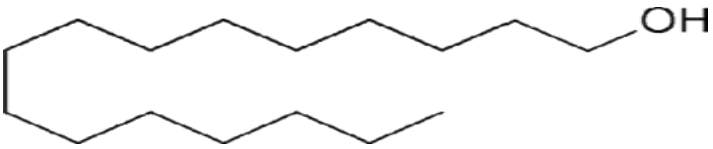
6. Cetostearyl alcohol

A common excipient used in pharmaceuticals and cosmetic products as a thickener and stabilizer[34].

The excipient profile of cetostearyl alcohol is as follows:

Chemical name: palmityl alcohol and 1-hexadecanol

Chemical formula: CH3(CH2)nOH



Molecular Weight: 512.941g/mol

Appearance: Waxy, white mixture

Solubility: Soluble in alcohols and oils and is insoluble in water.

Melting point:50°C

Boiling point: 249°C

Odor: Faint, characteristic sweet

PH: 6.0

Toxicity: Safe and nontoxic for use on skin

Applications: Act as an emulsifier, makes the product thicker or increases its foaming ability.

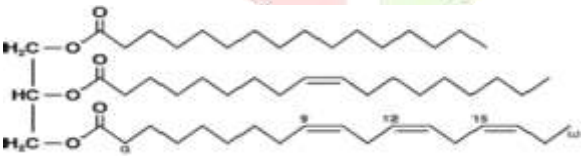
7. Olive oil

Olive oil is a fixed oil obtained by expression of the ripe fruits of Olea europaea Linn. or Indian olive (O. ferruginous), belonging to family Oleaceae. It is used for heart disease, diabetes, and high blood pressure[35].

The excipient profile of olive oil is as follows:

Chemical name: Oleic Acid

Chemical formula: C88H164O10



Appearance: Olive oil varies in color from clear yellow to golden ,some varieties obtained from unripe fruit have a greenish tint.

Solubility: Slightly soluble in ethanol (95%); miscible with ether, chloroform, light petroleum (50–70°C), and carbon disulfide

Melting point: −6.0 °C (21.2 °F)

Boiling point: 299 °C (570 °F)

Odor: Olive oil will have a fruit or vegetable scent

pH: Olive oils have acidity between 0.8% to 2%.

Toxicity: Regular consumption of unprocessed olive oil can increase the risks of lethal diseases like atherosclerosis, obesity, heart attack, stroke, breast cancer, and colon cancer.

Applications: Fatty acids in olive oil seem to decrease cholesterol levels and have anti-inflammatory effects, most commonly use olive oil for heart disease, diabetes, and high blood pressure.

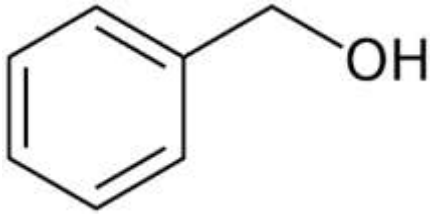
8. Benzyl alcohol

Benzyl alcohol is a mono-aromatic primary alcohol widely used as a solvent and as an intermediate in cosmetic formulations

The excipient profile of benzyl alcohol is as follows:

Chemical name: Phenylmethanol

Chemical formula: C7H8O



Molecular weight: 108.14 g/mol

Appearance: Clear, colorless liquid

Solubility: Moderate solubility in water (4 g/100 mL) and is miscible in alcohols and diethyl ether.

Melting point : −15.2 °C (4.6 °F; 257.9 K)

Boiling point: 205.3 ℃ (401.5 °F; 478.4 K)

Odor: Slightly aromatic

pH: 7.0

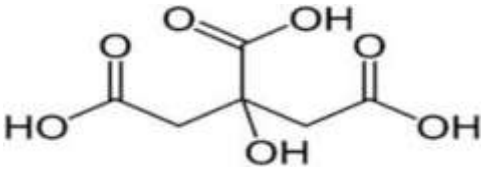
Applications: used as preservative, including paints and coatings, flavour and fragrance, personal care and pharmaceuticals.

9. Citric acid

The excipient profile of citric acid is as follows:

Chemical name: propane-1,2,3-tricarboxylic acid

Chemical formula: C6H8O7



Molecular weight: 192.124 g/mol

Appearance: White crystalline

Solubility: Soluble in Water

Melting point: 153 ℃

Boiling point:175 ℃

Odor: odorless

pH:2.2

Stability: Citric acid solutions remained stable at 4 °C for 28 days

Toxicity: In higher concentrations can cause skin burns

Applications: safe and effective in all types of wound management. It aids in early healing by promoting formation of healthy tissue.

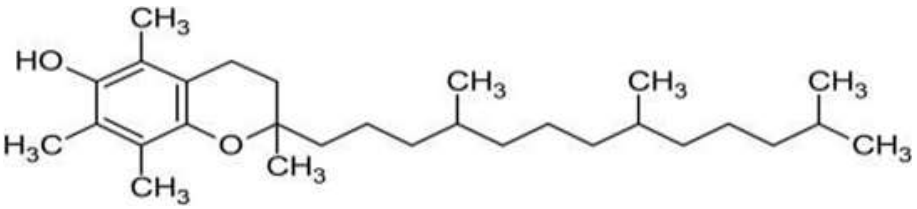
10. Vitamin E

A common excipient used in pharmaceuticals as strong antioxidant, it protects skin from sunburn, sun damage, skin cancers, and aging.

The excipient profile of vitamin E is as follows:

Chemical name: alpha-tocopherol

Chemical formula: C29H50O2



Molecular weight: 430.71 g/mol

Solubility: Very low solubility 20. 9 mg/L in pure water

Melting point: 27.5°.C

Boiling point: 210 ℃

Odor: Raw and strong

Stability: Exhibit stability in nitrogen atmospheres and cool places without light

Toxicity: Increased bleeding risk, especially in patients already on anticoagulation

Applications: Potent antioxidant, Boosts your immune system

11. Glycerin

A common excipient used in pharmaceuticals as humectants and as sweetener in syrups

The excipient profile of glycerin is as follows:

Chemical name: Glycerol

Chemical formula: C3H8O3

Molecular weight: 92.09 g/mol

Appearance: Clear, colorless liquid

Solubility: Very soluble in water

Melting point:18.2 ℃

Odor: Odorless

Stability: Chemically and microbiological stable if kept near ambient temperatures

Toxicity: Low toxicity

Applications: Used as a moisturizer to treat or prevent dry, rough, scaly, itchy skin and minor skin irritation and act as emollient.

MATERIALS AND METHODS

Table 1: Formulation of herbal sunscreen lotion

INGREDIENTS	QUANTITY
ALOE VERA GEL	5gm
BUTTERFLY PEA FLOWER EXTRACT	5ml
OLIVE OIL	2ml
ROSE WATER	3ml
VITAMIN E CAPSULE	1 (400mg)
CETOSTEARYL ALCOHOL	2gm
ZINC OXIDE	1.2gm
STEARIC ACID	4gm
GLYCERINE	4ml
HPMC	4gm
BENZYL ALCOHOL	0.5ml
CITRIC ACID	1.5gm
WATER	q.s

Materials and Reagents:

Butterfly pea flowers and olive oil were purchased online. Cetostearyl alcohol, zinc oxide, stearic acid, glycerin, HPMC, benzyl alcohol and citric acid were provided by the college. Aloevera gel collected from a pure plant. Rose water and vitamin e capsule were purchased from the pharmacy.

Extraction of plant material:

For butterfly pea flower extract, take 3 to 4 flowers in 180ML of hot water for 15 minutes to get the best result. Strain the liquid and discard the flowers. The deep blue water is then ready to be used with sunscreen lotion[30].

Fig.15 Butterfly pea flower extract

Method of Formulation:

Accurate quantities of Cetostearyl alcohol, zinc oxide, stearic acid, glycerine, HPMC and olive oil were weighed and melted in China dish. Accurate quantity of water taken in the beaker and after that1.5 grams of citric acid was added to water & stirred[30]. The water solution was heated up to a temperature 80 °C to 85 °C. After that melted Cetostearyl alcohol, zinc oxide, stearic acid, glycerin, HPMC, olive oil mixture & benzyl alcohol were slowly poured into the water solution a little at a time staring constantly. Stirring was continuous until a smooth & uniform paste was obtained. After that cool that prepared sunscreen. Then weighed the quantity of Aloe Vera gel, butterfly pea flower extract and vitamin-E were added & stirred well until all the ingredients mixed uniformly. Finally rose water was added.

Fig.16 Sunscreen formulation

Table 2: Activity of ingredients in sunscreen lotion

INGREDIENTS	USE
ALOE VERA GEL	SUN PROTECTION, ANTI INFLAMMATORY
BUTTERFLY PEA FLOWER EXTRACT	ANTI OXIDANT
OLIVE OIL	SUN PROTECTION
ROSE WATER	ANTI BACTERIAL
VITAMIN E CAPSULE	ANTI OXIDANT
CETOSTEARYL ALCOHOL	STABILIZER
ZINC OXIDE	UV FILTER
STEARIC ACID	BINDING AGENT
GLYCERINE	HUMECTANT
HPMC	THICKENING AGENT
BENZYL ALCOHOL	PRESERVATIVE
CITRIC ACID	ANTI AGING

PHARMACEUTICAL EVALUATION OF FORMULATED HERBAL SUNSCREEN LOTION

A. Morphological evaluation

It refers to the evaluation of the herbal sunscreen by color, odor, appearance, texture etc. The external characteristics of the formulation were examined.

B. Physicochemical evaluation

The physicochemical parameters were determined including pH, strength.

1. PH Measurement:

1 g of lotion was dispersed in 9 ml of distilled water to determine the pH at 27℃ using the pH meter[36].

Fig.17 Determination of pH using pH meter

2. Spreadability:

1gram of sample is applied between two glass slides and is compressed between two glass slides to uniform thickness by placing 50 gram of weight is placed for 1minute. Weight can be further added. Then diameter of sample between plates is measured[37]. The spread ability test showed that the formulation has good spreadable property.Spreadability is determined by the formula:

$S=d2\times\pi/4$

S–spreading area (mm2) depending on mass,

d–spreading area diameter (mm)

3. Irritancy test

The base in the formulation may cause irritation or allergic reactions. Irritancy ofpreparation is evaluated by patch test[38]. Mark an area [1sq.cm] on left hand dorsal surface, the sample was applied and time was noted. Irritancy, erythema, edema was checked at regular intervals upto 24 hours and reported.

4. Determination of in vitro SPF:

1.0 g of lotion formulation and commercial lotion was weighed, transferred to 100 ml volumetric flask, diluted to volume with ethanol and water (40:60) then ultrasonication for 5 minutes after that filtered through Whatman No. 1 filter paper and collected the filtrate by rejecting the first 10 ml of filtrate. 5.0 ml of aliquot was taken in a 50 ml volumetric flask and diluted to volume with ethanol and water (40:60). The absorbance values of aliquot prepared were determined from 290 nm to 320 nm at 5 nm interval, using ethanol and distilled water (40:60) solution as a blank. The readings were taken and the determinations were made at each point[39]. The obtained absorbance values between 290 and 320 nm were multiplied with the respective EE (λ) values. Their summation was taken and multiplied with the correction factor (10) to obtain the SPF values. Data were expressed as ± standard error mean

Fig.18 UV Visible Spectrophotometer

SPF of a formulation can be calculated using the formula[40]

SPF = CF × EE × I (λ) × abs (λ)

CF = correction factor which is 10

EE = Erythemal effect spectrum

I = Solar intensity spectrum

5. Homogeneity:

The formulations were tested for the homogeneity by visual appearance and by touch.

RESULT AND DISCUSSION

RESULT

The following evaluation parameters were performed to ensure the stability of sunscreen lotion.

1. Morphological Evaluation:

Sunscreen was evaluated for morphological parameters showed in the Table 3.The color of formulation was pale purple. The odor of prepared formulation was pleasant. Texture and smoothness were acceptable as per requirement of cosmetic formulations.

Table No: 3 Results of morphological evaluation

Sl No:	PARAMETERS	OBSERVATIONS
1	Color	Pale purple
2	Odor	Pleasant
3	Appearance	Smooth and fine
4	Texture	Fine
5	Smoothness	Smooth
6	Irritancy test	No irritation

Fig.19 Irritancy test

2. Physicochemical Evaluation:

Sunscreen lotion was evaluated for physicochemical parameters.

Table No 4:Results of physicochemical Evaluation

Sl No.	PARAMETERS	OBSERVATIONS
1	pH	4.6
2	Spreadability	6.15
3	Consistency	Good
4	Washability	Washable

3. Spreadability

1gram of sample is applied between two glass slides and is compressed between two glass slides to uniform thickness by placing 50 gram of weight is placed for 1minutes .Their weight can be further added. Then diameter of sample between plates is measured. The spread ability test showed that the formulation has good spreadable property.

Fig.20 Determination of spreadability

Spreadability is determined by the formula:

$S=d2\times\pi/4$

S–spreading area (mm2) depending on mass,

d–spreading area diameter (mm)

S= (2.8x2.8)x3.14/4

= 24.16/4

=6.15

4. Determination of SPF:

1.0 g of lotionformulation and commercial lotion was weighed, transferred to 100 ml volumetric flask, diluted to volume with ethanol and water (40:60) then ultrasonication for 5 minutes after that filtered through Whatman No. 1 filter paper and collect the filtrate by rejecting the first 10 ml of filtrate. 5.0 ml of aliquot was taken in a 50 ml volumetric flask and diluted to volume with ethanol and water (40:60). The absorbance values of aliquot prepared were determined from 290 nm to 320 nm at 5 nm interval, using ethanol and distilled water (40:60) solution as a blank. The readings were taken and the determinations were made at each point. The obtained absorbance values between 290 and 320 nm were multiplied with the respective EE (λ) values. Their summation was taken and multiplied with the correction factor(10) to obtain the SPF values. Data were expressed as ± standard error mean values.

SPF of a formulation can be calculated using the formula

SPF = CF × EE × I (λ) × abs (λ)

CF = correction factor which is 10

EE = Erythemal effect spectrum

I = Solar intensity spectrum

Table No 5: Determination of SPF

Wavelenghth (nm)	EE × I (λ)	Absorbance (λ)	EE × I (λ) × abs (λ)
290	0.0150	3.100±0.01	0.046
295	0.0817	2.710±0.01	0.219
300	0.2874	2.612±0.02	0.750
305	0.3278	2.314±0.01	0.758
310	0.1864	2.200±0.01	0.410
315	0.0837	1.892±0.02	0.158
320	0.0180	1.601±0.01	0.028
Total :			2.371
SPF :			23.71

SUMMARY AND CONCLUSION

In this study we can understand how cosmeceuticals play a major role in the health industry. Sunscreen is considered to be the most efficient product to reduce the harmful effect of sunrays. In this article, we try to focus on how herbal based sunscreen is beneficial for skin protection. Butterfly pea flower is rich in anthocyanins which are potent anti oxidants that help protect cell from oxidative damage caused by free radicals. They also have anti inflammatory properties and contribute to skin health and UV protection. The prepared formulation of sunscreen lotion shows a SPF of 23.71.

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