"FORMULATION AND DEVELOPMENT OF ALL-IN-ONE ANTIAGING FACE SERUM"

A PROJECT WORK (BP812PW) SUBMITTED TO

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Bachelor of Pharmacy

BY

TRIVEDI RICHA B. (19BPH089)

PATEL RITU J. (19BPH090)

SAHAL VAIBHAV P. (19BPH108)

VYAS VIDHI N. (19BPH114)

PATEL VRUNDA R. (19BPH120)

Semester VIII

UNDER THE GUIDANCE OF

Dr. Niyati S Acharya

INSTITUTE OF PHARMACY
NIRMA UNIVERSITY
SARKHEJ-GANDHINAGAR HIGHWAY
AHMEDABAD-382481
GUJARAT, INDIA

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CERTIFICATE

This is to certify that Project Work (BP812PW) entitled ***"FORMULATION AND DEVELOPMENT OF ALL-IN-ONE ANTIAGING FACE SERUM"*** *is the bonafide work carried out by* ***TRIVEDI RICHA*** *(19BPH089),* ***PATEL RITU (19BPH090), SAHAL VAIBHAV (19BPH108), VYAS VIDHI (19BPH114), PATEL VRUNDA (19BPH120)*** *in* ***B.Pharm*** *semester VIII under my guidance and supervision in the Institute of Pharmacy, Nirma University, Ahmedabad during the academic year 2022-2023. This work is up to my satisfaction.*

Guide:

Dr. Niyati S. Acharya
Ph.D.,
Head of Department of Pharmacognosy,
Institute of Pharmacy,
Nirma University

Dr. Tejal A. Mehta
Ph.D.,
Director (I/C),
Institute of Pharmacy,
Nirma University

Date:29/ 05 / 2023

CERTIFICATE OF SIMILARITY OF WORK

This is to undertake that the B.Pharm. Project work (BP812PW) entitled ***"FORMULATION AND DEVELOPMENT OF ALL-IN-ONE ANTIAGING FACE SERUM"*** *Submitted by* ***TRIVEDI RICHA(19BPH089), PATEL RITU (19BPH090), SAHAL VAIBHAV (19BPH108), VYAS VIDHI (19BPH114),PATEL VRUNDA (19BPH120)*** *B.Pharm. Semester VIII is a bonafide review/research work carried out by us at the Institute of Pharmacy, Nirma University under the guidance of "Dr. Niyati S. Acharya" We are aware about the rules and regulations of Plagiarism policy of Nirma University, Ahmedabad. According to that, the review/research work carried out by us is not reported anywhere as per best of our Knowledge.*

Trivedi Richa (19BPH089),
Patel Ritu (19BPH090)
Sahal Vaibhav (19BPH108)
Vyas Vidhi (19BPH114)
Patel Vrunda (19BPH120)

Institute of Pharmacy
Nirma University
Sarkhej - Gandhinagar Highway
Ahmedabad-382481
Gujarat, India

Guide:
Dr. Niyati S Acharya
Ph.D.,
Head of Department of Pharmacognosy,
Institute of Pharmacy,
Nirma University

Date:29/05/2023

DECLARATION

We, ***TRIVEDI RICHA (19BPH089), PATEL RITU (19BPH090), SAHAL VAIBHAV (19BPH108), VYAS VIDHI (19BPH114), PATEL VRUNDA (19BPH120)*** *students of VIIIth Semester of B.Pharm at Institute of Pharmacy, Nirma University, hereby declare that our project work (BP812PW) entitled* ***"FORMULATION AND DEVELOPMENT OF ALL-IN-ONE ANTIAGING FACE SERUM"*** *is a result of culmination of our sincere efforts. We declare that the submitted project is done solely by us and to the best of our knowledge, no such work is done by any other person for the award of degree or diploma or for any other means. We also declare that all the information was collected from various primary sources (journals, patents, etc.) has been duly acknowledged in this project report.*

Trivedi Richa(19BPH089),
Patel Ritu (19BPH090)
Sahal Vaibhav (19BPH108)
Vyas Vidhi (19BPH114)
Patel Vrunda (19BPH120)

Institute of Pharmacy
Nirma University
Sarkhej - Gandhinagar Highway
Ahmedabad-382481
Gujarat, India

Date:29/05/2023

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ABSTRACT

Face serum is a popular skincare product that can penetrate deeply into the skin's layers to provide effective results. The serum's composition contains skin-friendly penetrators that can supply the skin with necessary ingredients by penetrating 6-7 layers deeper. Vitamin C, Vitamin E, Niacinamide, L-Glutathione, Aloe vera gel and olive oil are key ingredients that are used to create the serum. The facial serum's physical properties, including pH, viscosity, texture, and consistency, were examined, and stability studies showed that the visual appearance and other physical properties of the serum did not change.

The serum has a deep formula with a high concentration of active substances, a non-oily finish, rapid absorption, and the capacity to penetrate deep layers of the skin. It was created to reduce the visibility of fine lines and wrinkles while improving stratum corneum barrier function. Photodamage and UV radiation can cause skin ageing and facial wrinkles, both of which are undesired results. However, there are no proven methods to slow the ageing process of the skin.

Overall, face serum is an effective and appealing product that can provide multiple benefits to the skin, including moisturizing, anti-inflammatory, anti-bacterial, and anti-fungal properties. As the number of people visiting dermatologists for the prevention and treatment of ageing skin continues to rise, face serum has become a popular choice for those looking for an effective and safe anti-ageing solution.

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CHAPTER-1: INTRODUCTION

1.1. Skin aging

The degenerative process of skin aging affects both the skin and the systems that sustain it. Young faces typically have large lips, a sweeping jawline, and full cheeks and temples. The skin starts to change by the middle years of life. Skin aging is a progressive process in which the final skin look is determined by environmental damage added to aging skin. The degenerative process of aging affects many different systems, including bones, cartilage, and dermal compartments that support the skin. There are two distinct aging processes, the term intrinsic or chronological and extrinsic aging. Intrinsic aging is the term used to describe how the body naturally ages over time as a result of internal variables such heredity, cellular metabolism, and hormone changes. This type of aging is often referred to as chronological aging because it is based on the passage of time rather than outside variables like lifestyle choices or sun exposure. Our bodies undergo several changes as we age naturally, including a decline in the synthesis of the proteins elastin and collagen, which give our skin its structure and suppleness. As a result, lines and wrinkles, and sagging skin may appear. Extrinsic aging the other type of aging is brought on by environmental factors.

Intrinsic aging:

All living things experience intrinsic aging, commonly referred to as chronological aging, over the course of their lifetimes. The body's organs, cells, and tissues are impacted by a number of biochemical and genetic processes that cause a steady loss in their integrity and function. The process of intrinsic aging is intricate and multifaceted, and it has distinct effects on various bodily parts. For instance, a decrease in collagen and elastin production is a sign of intrinsic aging in the skin and can cause lines and wrinkles and sagging skin. In the brain, endogenous aging is linked to a loss in memory and cognitive ability. While intrinsic aging is a natural process, a variety of outside influences, including nutrition, exercise, stress, and exposure to environmental contaminants, can have an impact on it. Depending on how they affect the basic functions of the body, these factors can either hasten or slow down the aging process. In conclusion, intrinsic aging is a multifaceted, continuing process that has an impact

on every element of our life. Although aging cannot be completely avoided, there are efforts people may take to slow down the process and keep their health and quality of life as they age.

External Aging

Many external factors influence the skin and result in early signs and symptoms of aging. While excessive exposure to UV rays from the sun is the main cause of premature aging, there are additional components that contribute. As an illustration, other atmospheric elements including air pollution, visible light, and infrared radiation, Smoking, ongoing stress, and excessive alcohol intake all result in older looking skin, and lifestyle decisions can also have a substantial impact on skin aging.

1.2. Factors:

1. Genetics: Our genes have a big impact on how old we get. Some people may age more quickly or more slowly than others due to genetic predispositions.
2. Lifestyle decisions: Some lifestyle decisions, such as smoking, drinking too much alcohol, eating poorly, and not exercising, can hasten the aging process.
3. Environmental factors: Cellular damage and accelerated aging can be brought on by exposure to radiation, pollution, and other environmental pollutants.
4. Chronic stress: Long-term stress can have negative effects on one's physical and emotional well-being, which can hasten aging.
5. Hormonal changes: Age-related hormonal changes, such menopause in women and lower testosterone levels in males, can hasten the aging process.

1.3. Cause of aging

Aging can be brought on by a variety of factors, including metabolic harm, cellular senescence, mortality, and the buildup of toxic and non-toxic waste. Glycation, mitochondrial damage (somatic mitochondrial DNA), and respiratory chain malfunction are examples of metabolic damage. Free radical production from mitochondrial malfunction is a constant process and is a major factor in aging. Distinct aging phenotypes accumulate because of respiratory chain dysfunction. Cell cycle growth arrest that is irreversible and/or irregular cell division are both examples of cellular senescence. Senescent cells never enter the cell cycle again, which causes them to multiply into tumor cells. Senescence is primarily brought on by the upregulation of

the tumor-suppressor genes p53 and p19Arf. Skp2 E3-ubiquitin ligase's role as a protooncogene and its ability to cause cancer are additional causes of senescence. Chronic cell death caused by inflammation includes DNA damage, telomerase shortening, a deteriorating and insufficient antioxidant system, and cellular senescence and death. insufficient autophagy and DNA repair, poor cell cycle regulation, poor proteasome, lysosome, and shock protein function. Advanced glycation end products, cortisol, lipofuscin, atherosclerotic and amyloid plaque, and cortisol are the waste products built up in body tissue and the primary factor in aging.

1.4. Ways to delay aging:

You can take a variety of steps to slow down the aging process of your skin, including:

1. Sun protection: It's important to shield your skin from UV rays from the sun, which can hasten the aging process and damage your skin.
2. Drink plenty of water. Water keeps your skin nourished and prevents dryness and wrinkles.
3. Get enough sleep, as lack of it might hasten the skin's aging process. Aim for seven to nine hours of sleep each night.
4. Maintain a nutritious diet: Eating a diet high in antioxidants, vitamins, and minerals will help you prevent skin damage and promote healthy skin.
5. Use skincare products: Using skincare products with active ingredients like retinoids, vitamin C, and hyaluronic acid can help minimize the signs of aging and improve the texture and tone of the skin.

1.5. Mechanism of Photoaging

The skin and the systems that support it are both affected by the multisystem degenerative process known as photoaging. The percentage of melanocyte density in skin that has received prolonged sun exposure is roughly double that of skin that has not. Erythema is caused by prominent telangiectasias, and fine wrinkles are caused by the corneum layer losing moisture. The clinical signs of photoaging, which affects skin that has been exposed to the sun, include fine and coarse wrinkles, texture, dryness, laxity, telangiectasias, decreased elasticity, and pigmentary changes. On photo-aged skin, both benign and malignant neoplasms are more likely to develop. It is progressive

progress that is mostly influenced by skin pigmentation and sun exposure. Both the epidermis and dermis are impacted by UVB, while UVA also has a sizable impact on the dermis. Long believed to be UVB rays responsible for most human photo lesions, it is now thought that UVA rays play a significant role in photo aging. It is crucial to know that photo aging changes can be brought on by UVA alone because UVB is practically entirely absorbed in the epidermis. In fact, these alterations in photoprotected skin are brought on by few low-dose UVA radiation exposures.

The epidermal swells in response to UV radiation on the skin over time. The epidermis thickness, the stratum corneum becomes acantholic and aphasia and progressive dysplasia with cellular atyoia occur. The lack of polarity results in the irregularity of keratinocytes. The amount of melanocytes varies irregularly in different areas. The epidermis's Langerhans cell population is decreased, which affects the immune system's capacity to recognize antigens and skin cancer cells. A combination of modification to stratum corneum and modifications to the dermal glycosaminoglycans in the dermis declines with aging. Glycosaminoglycans paradoxically grow in photoaged skin compared to skin that is naturally older. However, they are not deposited in the papillary dermis but rather on the abnormal electrostatic material, which may prevent them serving as source of hydration. Basement membrane thickens in photoaged skin. Reduced collagen and precursors of type I and III collagen, deterioration of elastic fibres, which is eventually replaced by an amorphous mass and chronic inflammation with an increase in degranulated mast cells, macrophages and lymphocytes are some of the dermal alterations in photoaged skin. Blood vessels are twisted and dilated. The blood vessels are also inadequately sustained because of the collagen framework's loss, making them susceptible to rupture and causing solar purpura.

1.6. Serum

Serum is a category of skincare product with a high concentration of active ingredients according to cosmetic science. Antioxidants, vitamins, peptides, and hyaluronic acid are among the constituents that can differ based on the type of serum and desired results. Smaller molecules are often used in serum formulations than in moisturizers, allowing them to penetrate the skin more deeply and distribute their active components more efficiently. They are a popular option for folks who wish to address skin conditions

without the weight or greasiness of a regular moisturizer because they are also made to be lightweight and quickly absorbing.[23]

Common serum varieties include:

1. Hyaluronic acid, glycerin, and other humectants are frequently found in hydrating serums, which are intended to increase the skin's level of hydration and moisture.
2. Brightening serums: These serums are designed to lessen the appearance of hyperpigmentation, dark patches, and uneven skin tone. They frequently include niacinamide, vitamin C, or other brighteners.
3. Anti-aging serums: These serums aim to lessen the visibility of wrinkles, fine lines, and other ageing indicators. Peptides, retinol, or other anti-aging chemicals might be present.

Serums can be a potent addition to a skincare regimen, helping to address particular skin issues and enhance the health and appearance of the skin as a whole.[34]

CHAPTER-2: LITERATURE SURVEY

2.1- Skin:

The skin is the body's outermost and most superficial layer. It accounts for 15% to 20% of the body's total mass. The skin is a constantly changing organ made up of numerous specialised cells and structures. The contour of our skin changes with age, which has an impact on how it looks.

Epidermis:

The layer of skin closest to the surface is called the epidermis. It is made up of keratinizing stratified squamous epithelium cells and derives from the ectoderm. It creates a layer of defence across the body's surface that keeps water inside the body and prevents germs from getting in. The palms and soles are thick. The skin's ability to control body temperature is further aided by the epidermis. The epidermis contains four different types of cells.

1) Skin cells, or keratinocytes - As they move, the keratinocytes become more differentiated or mature in following layers and assemble more keratin.

- Cornea Stratum: It is made up of keratinized cells and is the top layer. The keratinized, dead nucleus-containing thin membrane is embedded in a lipid matrix.
- Granular Stratum: The granular cells get their name from the fact that they gather granular structures.
- Spinosum Stratum: The prickly telephone is another name for the stratum spinosum.
- Stratum Germinativum: The only cells (keratinocytes) that may undergo cell division are found in this layer of the epidermis.

2) Melanocytes (cells that create pigment) - These are found in the epidermis' basal layer. The melanin pigment is created by melanocytes. Melanocytes resemble tiny cells. They possess thin cytoplasmic pathways that extend between nearby keratinocytes and serve as.

3) Langerhans cell -The immune system's surveillance function involves the participation of antigen-presenting cells known as Langerhans cells.

4) Dermal tissue cells - It consists of a network of connective tissue such as collage and elastin.

The skin carries out the following tasks:

Anatomical barrier that separates the inside and outside surroundings to stave against sickness and injury. A range of nerve endings that react to touch, pressure, vibration, heat, cold, and tissue injury are referred to as sensations. Reduce cutaneous blood considerably, but limited blood vessels prolong perfusion and heat loss.

A common product used in cosmetology is serum. The origin of the phrase is professional cosmetology. Skincare serum: Cosmetic serum is generally based on water or oil, similar to other creams. A serum or other concentrated solution that deals with aesthetic issues more quickly and effectively than creams because it contains ten times more biologically active ingredients.

2.2- Skin diseases:

- Seborrheic keratoses

  Older persons are more likely to have growths such skin tags, warts, black rough patches (seborrheic keratoses), and other faults. Actinic keratosis is a common disorder that results in rough, reddish spots that very rarely become malignant. Skin cancer is also common and is usually found in areas that are exposed to the sun. Seborrheic keratoses progressively worsen with time. A round, oval, rough, or waxy lump that typically occurs on the face, chest, shoulder, or back is one of the warning signs and symptoms. a flat or slightly elevated scaly growth with the distinctive "pasted on" appearance. From microscopic to over 1 inch (2.5 cm) in size, in a range of numbers, from one growth to numerous growths. little growths gathered together on the face

- Benign melanoma of the skin:

  Many benign tumours in older adults have melanocyte proliferation. One of these lesions is a dysplastic nevus, which histologically has asymmetrical melanocyte nests.

- Unstable Horn:

  A number of neoplasms, including actinic keratosis, warts, Bowen disease, granular cell tumours, Paget disease, sebaceous neoplasms, basal and squamous

cell carcinoma, and seborrheic keratosis, can result in horn-shaped tissue projections known as "cutaneous horn." Rather than being diagnostic, the phrase is descriptive.7 Molluscum contagiosum, a member of the poxvirus group, hardly ever develops a cutaneous horn. The only other infectious cause is leishmaniasis. Skinny horns are taken out with a shave biopsy, and the tissue is then sent for pathological examination.

- Hyperoxic Stress:

  It is believed that cutaneous extracellular matrix alterations brought on by both intrinsic and photoaging depend heavily on reactive oxygen species (ROS). The mitochondrial electron transport chain, proteins localised in peroxisomes and the endoplasmic reticulum (ER), the Fenton reaction, and enzymes like cyclooxygenases, lipoxygenases, xanthine oxidases, and nicotinamide-adenine dinucleotide phosphate (NADPH) oxidases are just a few of the numerous sources from which ROS can be produced. RTK activity on the cell surface is often restricted by receptor protein tyrosine phosphatases (RPTPs), which dephosphorylate RTKs in the absence of ligands. On the other hand, UV light activates cellular chromophores, which causes them to emit ROS and oxidation products. By attaching to cysteine in the catalytic sites, ROS decrease the activity of RPTPs.

- Advanced accumulation of glycation end products:

  During the nonenzymatic process of glycation, when proteins, lipids, or nucleic acids bind covalently to sugar molecules like glucose or fructose, the resulting advanced glycation end (AGE) products are produced, preventing the target molecules from carrying out their typical functions. This is very different from the usual glycosylation that occurs at specific sites with the help of enzymes and is required for target molecules to carry out their tasks. Both intrinsic and extrinsic ageing include glycation. Glycation has a significant impact on the cytoskeleton and long-lived proteins in the dermal matrix, making tissues stiffer and less elastic. Glycated elastin fibres that interact with lysozyme are abnormally aggregated in solar elastosis-affected skin, but not in sun-protected skin.

2.3- Skin care:

The following advice is offered by dermatologists in order to maintain good skin:

Always use sun protection. One of the most crucial things you can do for your skin is to wear sunscreen. Sunscreen shields your skin from the ultraviolet (UV) rays of the sun, which can lead to skin cancer, wrinkles, and other signs of early ageing. Apply a broad-spectrum, water-resistant sunscreen with an SPF of 30 or higher to all exposed skin for the best defence. Apply again every two hours, after swimming or perspiring, or as needed. Use a moisturiser with sunscreen built in to shorten the time you need to spend on your skin care routine. For the best sun protection, sunscreen-containing cosmetics should be reapplied, notwithstanding their practicality.

Don't use a tanning bed. UV radiation from tanning beds causes skin cancer in a manner similar to that of the sun. Actually, just one indoor tanning session can increase your risk of basal cell carcinoma by 29%, squamous cell carcinoma by 67%, and melanoma by 20%. For that golden shine, use self-tanning creams instead. When applied properly, self-tanners offer you a natural-looking tan without giving you streaks, splotches, or orange skin.

Make your Skin-care routine simpler. When it comes to skin care, little is more. Your skin may become irritated if you use too many products, particularly several anti-aging creams. Instead, pay attention to the fundamentals, such a mild cleanser, sunscreen, and moisturizer. Decide on morning and evening skin care routines that are effective for your skin, and follow them.

You can pick the finest skin care products for you and learn how to take care of your skin by understanding your skin type. Knowing and choosing your skin type is essential for providing the best possible care for your skin. Here are some common characteristics of different skin types:

- Sensitive skin: This type of skin is easily irritated and may experience stinging, burning, or redness when using certain products.
- Normal skin: Normal skin has a smooth and even texture and is not overly sensitive or prone to breakouts.
- Dry skin: Dry skin may feel tight or itchy and may have flakiness or rough patches.

- Combination skin: Combination skin has both oily and dry areas, with the T-zone (forehead, nose, and chin) typically being oilier than other areas of the face.
- Oily skin: Oily skin is characterized by a shiny, greasy appearance and may be prone to breakouts and blackheads.

Every patient with a dermatologic condition needs to follow a skin care regimen that includes the proper use of moisturizers and cleansers. As mentioned in this article, the most comprehensive benefits for the restoration of the damaged stratum corneum are provided by moisturizers that contain specific substances, such as occlusives and humectants. When used properly, these products help to rebuild the skin barrier, enhance the cosmetic appearance of the skin, which is a major concern from the patient's perspective, as well as improve skin hydration by lowering transepidermal water loss (TEWL). Patients with dermatological conditions must carefully choose skin cleansers based on the patient's clinical presentation because these products come in a broad variety.

2.4- Face Serum:

Face serum is a light skincare product that is intended to deliver a high concentration of active ingredients deeper into the skin. Targeting certain skin issues including fine lines and wrinkles, dark spots, dullness, and dehydration is the goal of serum formulation.

Since most face serums are water-based, the skin can absorb them quickly. As opposed to moisturizers or toners, they frequently have a higher concentration of active substances. Hyaluronic acid, vitamin C, retinol, niacinamide, and peptides are a few components frequently found in face serums.[9]

Face serums can be used independently or as a component of an all-encompassing skincare regimen. They are often used prior to moisturizing, following cleaning and toning. Serums are intended for daily use.

Targeting the outward indications of ageing, such as fine lines, wrinkles, and age spots, is the goal of an anti-aging face serum. High quantities of active chemicals that are especially made to fight against these ageing indicators can be found in anti-aging serums.[18]

Anti-aging face serums frequently contain the following ingredients:

Retinol: is a kind of vitamin A that improves skin smoothness, encourages cell turnover, and lessens the visibility of fine lines and wrinkles.

Vitamin C: As an antioxidants that helps to lighten skin by shielding it from free radical damage.

Peptides: Chains of amino acids that increase the suppleness of the skin and promote the formation of collagen.

A natural humectant that draws moisture to the skin and fills in fine lines and wrinkles is hyaluronic acid.

Vitamin B3 in the form of niacinamide

Niacinamide: is a type of vitamin B3 that lessens inflammation and makes wrinkles and fine lines seem better.

Before moisturizing, anti-aging face serums are normally administered after cleaning and toning. Depending on the directions for the product, they can be taken once or twice a day. Regular application of an anti-aging serum can help the skin look better overall over time, appearing smoother, firmer, and more young.

2.5- Drugs and Excipients:

As people explore for solutions to look younger, anti-aging face serums have grown in popularity in recent years. Here is a review of the literature on some of the main components in these serums:

Niacinamide:

Niacinamide is a vitamin B3 derivative that has been demonstrated to enhance skin texture, lessen wrinkles, and even out skin tone. It functions by boosting collagen production, a protein that provides skin its suppleness. Additionally, it has been demonstrated that niacinamide enhances the skin's ability to act as a protective barrier, aiding in moisture retention and shielding it from external stresses.

The anti-inflammatory properties of niacinamide are the postulated explanation for its usage in auto-immune vesiculobullous disorders. It blocks cytokines like TNF, IL-1, IL-6, IL-8, and IL-1. Bullous pemphigoid is where niacinamide is used most

extensively. According to one case report, 1.5 g/day of monotherapy is an effective treatment for localised bullous pemphigoid.

Because of its anti-inflammatory, antioxidant, barrier-repair, and protective properties, nicotinamide is a cheap, safe medicine that has positive effects as an adjuvant in many dermatological conditions, according to the available clinical evidence and literature. It has no significant side effects and can be administered orally as well as topically.

L-glutathione:

L-glutathione is an antioxidant that helps protect skin from damage caused by free radicals. It also helps to brighten and even out skin tone, as well as reduced the appearance of fine lines and wrinkles.

We discovered that both topical 2.0% oxidised glutathione and oral glutathione at a dosage of 500 mg/day could lighten skin tone in sun-exposed areas as determined by skin melanin index. In sun-protected areas, no products showed any discernible differences in the lowering of skin melanin index. Additionally, glutathione has been shown to improve UV spots, wrinkles, and skin elasticity. There were a few unfavourable but minor events mentioned.

The existing evidence of glutathione's potential to whiten skin is still unclear because to the poor quality of the included studies and the inconsistent results. However, in exposed skin areas, glutathione may have the tendency to lighten skin tone. Combining L-glutathione with other antioxidants like vitamin C and vitamin E is a common practise.

Vitamin C and Vitamin E:

Vitamin C is a potent antioxidant that aids in defending skin against pollutions and ‘UV radiation' damaging effects. Additionally, it promotes collagen synthesis, which lessens the visibility of wrinkles and fine lines. To increase its potency, vitamin C is frequently combined with additional antioxidants including vitamin E and ferulic acid. Another antioxidant that aids in preventing skin damage from free radicals is vitamin E. Additionally, it aids in hydrating and soothing skin, which lessens the visibility of wrinkles and fine lines. In addition to other antioxidants like vitamin C and ferulic acid, vitamin E is frequently combined with them.

Issues with particular substances. Selecting the ideal product for your skin type and issues can also be aided by speaking with a physician or skincare expert.

Vitamin C may have an impact on trans-epidermal water loss (TEWL) as higher dietary intakes of vitamin C have been linked to a lower incidence of dry skin.Vitamin C supplementation in cell culture models encourages the production of barrier lipids, resulting in the development of a functional stratum corneum with little water leakage.In a human investigation, topical vitamin C usage was associated with decreased skin roughness. However, a different study found that applying vitamin C to the skin increased TEWL. Therefore, it is unclear how vitamin C affects skin dryness.

The combined effects of the vitamins C and E neutralise free radicals. Vitamin C transforms vitamin E from its oxidised condition into the reduced form. It has been shown that 1% alpha-tocopherol and 15% L-ascorbic acid applied topically provide significantly superior protection against the development of sunburn cells than L-ascorbic acid or 1% alpha-tocopherol applied topically alone.

This study demonstrated that an encapsulated serum containing vitamin C, vitamin E, and raspberry leaf cell culture extract can reduce the majority of signs of ageing skin, such as skin darkening, elasticity, radiance, smoothness, scaliness, and wrinkles. Meanwhile, the increased elasticity was inadequate to provide observable lifting effects. Furthermore, the serum was well-tolerated.

Tween 20:

A nonionic surfactant made from sorbitan esterified with 20 ethylene oxide units, tween 20 is also referred to as polysorbate 20. It is frequently utilised in cosmetics as a solubilizer and emulsifier. Tween 20 is a common component in anti-aging face serums because it aids in dispersing oil in water and produces a stable emulsion.

Recent Trends:

Consumers are increasingly seeking for skincare products with natural components, with recent trends in the market focusing on natural and clean beauty. Certain natural ingredients, such as essential oils, which can irritate the skin or trigger allergic reactions, raise some questions about their safety. In order to produce anti-aging face serums, more businesses are resorting to secure and efficient synthetic components, such as Tween 20.

Scenarios from the Past:

Tween 20's safety has previously been questioned, particularly in light of the possibility that it could lead to skin irritation and allergic responses. Tween 20, however, has been established via considerable research to be safe for use in cosmetics and has received global regulatory agency approval.

Olive Oil:

Natural oil called olive oil comes from the olive tree's fruit. It is a common ingredient in anti-aging face serums because of its high concentration of antioxidants, vitamins, and fatty acids. Olive oil is well known for being moisturising, which enables it to hydrate and nourish the skin.

Oleic, linoleic, and palmitic acids are among the many fatty acids found in olive oil, which also contains additional chemicals like squalene, tocopherols, and phenolic compounds. The content of olive oil might vary depending on the kind of olive and the method of extraction.

Recent Trends:

Natural and organic components, such as olive oil, have been the focus of recent trends in the skincare sector. Olive oil is a common ingredient in anti-aging face serums that are widely marketed, with a focus on the moisturising and antioxidant qualities of the oil.

Scenarios from the Past:

In the past, there have been doubts about olive oil's comedogenicity, or its capacity to clog pores and result in acne. Olive oil, however, is a beneficial component in anti-aging face serums because recent study has revealed that it is non-comedogenic and can actually assist to strengthen the skin's barrier function. Furthermore, there have been questions regarding the purity of olive oil used in some products as well as the possibility of pesticide or other chemical contamination.

Tween 20 and olive oil are both common components in anti-aging face serums, to sum up. While there have historically been some worries about their effectiveness and safety, in-depth research has demonstrated that they are both

safe and safe when used properly. It is crucial to select high-quality products with these components in safe and effective quantities, just like with any other substance used in skincare.

PEG and PG:

PEG and PG as emulsifiers and solvents, PEG (polyethylene glycol) and PG (propylene glycol) are both frequently used in skincare products. The fact that they have been connected to skin irritability and allergic reactions in some persons raises some doubts regarding their safety. Additionally, some research have revealed that they might enter the bloodstream and pose health hazards.

Natural and organic compounds, like plant-based antioxidants and botanical extracts, are currently popular antiaging face serum ingredients. Additionally, there is a rising need for customized skincare products, with businesses providing serums based on a person's skin type and skincare issues. As consumers grow increasingly worried about the potential health concerns associated with these compounds, there has been a shift away from harsh chemicals and synthetic ingredients relative to previous trends.

Aloe vera:

The medical properties of aloe vera, a succulent plant, have been used for thousands of years. It is frequently employed as a moisturizer, emollient, and anti-inflammatory in the pharmaceutical sector. Topical formulations, such as gels, creams, and lotions, frequently contain aloe vera.

The dynamic process of wound healing has three phases. The first phase is marked by inflammation, congestion, and leukocyte infiltration. The second stage of proliferation entails the clearance of dead tissue, while the third stage of proliferation comprises the development of fibrous tissue and regenerating epithelium. Aloe vera has been the subject of numerous research, all of which have demonstrated its efficiency in the treatment and healing of skin lesions.

CHAPTER-3: RESEARCH ENVISAGED

3.1. AIM: Formulation and Development of All-in-one Antiaging Face serum

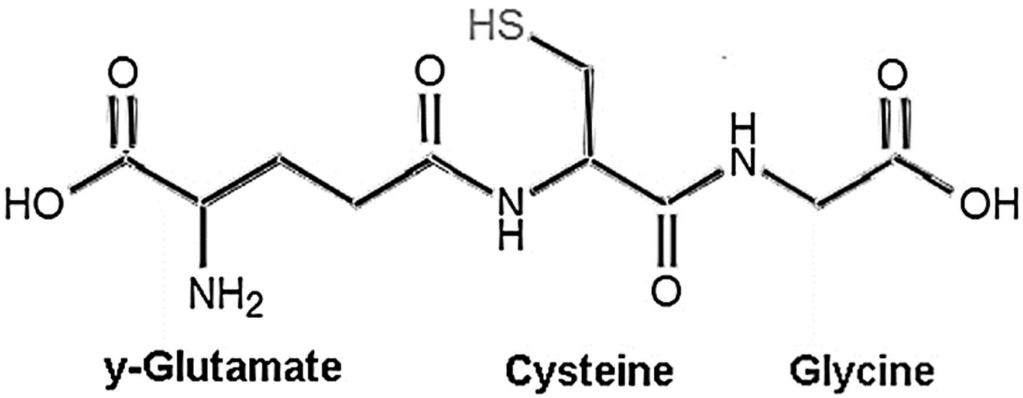
3.2. OBJECTIVES:

- Identify and conduct research on crucial anti-aging components that can be used in the serum's formulation, such as vitamins C and E, niacinamide, and L-glutathione.
- To determine the ideal concentrations of the main anti-aging ingredients for maximum efficacy in order to reduce the appearance of fine lines, wrinkles, and age spots.
- To investigate the compatibility and acceptability of adding other components, including olive oil and aloe vera, for their hydrating, soothing, and nourishing qualities.
- To make sure that the active compounds are properly solubilized and accessible for skin absorption, the proper solvent system and pH range should also be determined.
- Creating a serum with a texture, pH, and viscosity that is suitable for usage on the face and that the user will find pleasing.
- To carry out stability studies to make sure the prepared serum stays stable and functional for a predetermined amount of time while being stored under various conditions.
- To assess the serum's spreadability and residue production in order to guarantee simple application and skin absorption.
- To evaluate the serum's sensory properties, such as its fragrance, color, and texture, in order to make sure that users will find them appealing.

In conclusion, research envisaged for formulating a face serum with multiple vitamins such as Vitamin C, Vitamin E, Niacinamide, and L-Glutathione is a comprehensive process that requires careful consideration of several factors. By carrying out in-depth research, a stable and effective final product can be formulated that ensures safety and efficacy and offers a variety of skin benefits while also satisfying regulatory standards for quality and stability.

4.1. Drug Profile

Active- OPITAC™ L Glutathione



Biological Source- A substance called OPITACTM Glutathione is made when torula yeast (Candida utilis) goes through a natural fermentation process. The FDA has given torula yeast the GRAS designation (Federal regulation code: 172.896).

Chemical Constituent- The simple tripeptide L-Glutathione Reduced (GSH) is made up of glutamic acid, cysteine, and glycine; cysteine can either be in the reduced or oxidised glutathione state. A other name for it is -l-glutamyl-l-cysteinylglycine.

- Molecular Formula: $C_{10}H_{17}N_3O_6S$
- Average mass: 307.323 Da

A glutamate residue, rather of a -carboxyl group, is used to bind cysteine to glutathione, which is then followed by a typical peptide bond linking cysteine and glycine.

Physical state -Solid

Color -White.

Odor -Odourless.

Solubility - Soluble in Water, approximately 20 mg/ml.

PH - 3.5-6.6

Specific Gravity - 1.0276

Uses:-

Glutathione is considered as a master antioxidant can help keep the balance between the oxidant and antioxidant system in the body and prove to be an effective therapy. Glutathione has been considered as one of the best option for the treatment of hyperpigmentation. It plays a significant part in preserving the ideal balance between the oxidised and reduced forms of coenzyme A and other crucial thiols for metabolism. Additionally, it produces reducing equivalents that, with the help of glutathione peroxidase, detoxifying reactive oxygen species like peroxides. It also assists in the detoxification of other xenobiotic substances through the action of glutathione-S-transferase by forming a thioether derivative that can then be excreted. The -glutamyl moiety of glutathione transports amino acids and peptides through the plasma membrane; -glutamyl-transpeptidase catalyses this process.[10]

ANTIAGING- Mitochondrial glutathione is essential for the defence against aging-related free radical damage. An oxidation of mitochondrial glutathione is directly connected to oxidative damage to mitochondrial DNA. In actuality, oxidative harm to proteins, nucleic acids, and lipids is linked to ageing. Aged cells might exhibit poor physiological function as a result of these molecular abnormalities. As a result, taking antioxidant supplements may be a sensible method to protect against age-related performance degradation.[38]

Free radicals play a role in diseases, like atherosclerosis, diabetes, cancer. Gluthione and other antioxidants has role in mechanisms of ageing.

SKIN WHITENING :-In the reduced form, Glutathione is found inside cells and is crucial for a number of physiological processes. By both directly and indirectly inhibiting the tyrosinase enzyme and altering the formation of eumelanin to phaeomelanin, it has the ability to lighten skin.[7]

Tyrosinase is prevented from producing melanin by glutathione, which binds to the enzyme and prevents its activity. This is the pigment that gives the body's skin its colour.

Tyrosinase activity is stopped by glutathione, which also aids in skin lightening. By reducing the body's levels of free radicals, it does this. Tyrosinase is initially produced

by the free radicals. The human body's melanin count is elevated as a result of increased tyrosinase production.

SKIN HEALTH-

Skin health and youth are greatly influenced by glutathione. It has amazing skin-brightening properties, but it also has a reputation for minimising wrinkles and fine lines and enhancing skin suppleness. Glutathione has all these benefits because of its extraordinary capacity to protect the skin.

Being an effective antioxidant, it helps in scavenging free radicals produced as a result of prolonged exposure to ultraviolet radiation and environmental toxins. Free radicals, as was previously said, significantly harm skin cells and hasten the ageing process of the skin, resulting in wrinkles, fine lines, and dark spots. Your skin's ability to retain moisture and act as a barrier is often compromised, which results in loose, sagging, uneven, dull, and dry skin.[37]

It has been demonstrated that glutathione increases the amount of collagen and elastin reserves in our body. This aids in replacing skin cells and lost suppleness. Hyaluronic acid is retained in the body as a result, keeping it moisturised.

All of these elements contribute to smoother, less noticeable fine lines, wrinkles, and skin that appears younger.

Many skin conditions, including acne and hyperpigmentation, are frequently accompanied by inflammation. Due to its anti-inflammatory characteristics, glutathione lowers the concentrations of mediators that are pro-inflammatory. As a result, melasma, post-inflammatory hyperpigmentation, and acne are reduced.[8]

VITAMIN C:-

Source :-

In order to produce ascorbic acid, synthetic vitamin C must first be converted from maize starch using heat, enzyme, acetone, and HCL.

The commercial process for making vitamin C needs multiple chemical stages, Gluconobacter oxydans for bio-oxidation, and conversion of D-sorbitol to L-ascorbic

acid by 2-keto-L-gulonic acid (2KGA) as a critical intermediate. In modern commercial manufacturing procedures, D-sorbitol is converted into the intermediate 2KGA with no the use of any chemical stages through a number of steps using biocatalyst.[21]

Chemical constituent:-

- Name as per IUPAC:- The chemical name for l-threo-Hex-2-enono-1,4-lactone is (R)-3,4-Dihydroxy-5-((S)-1,2-dihydroxyethyl)furan-2(5H)-one.
- CAS No. 50-81-7 and 134-03-2 as salt

Formula - $C_6H_8O_6$

Molar Mass - 176.124 $g \cdot mol^{-1}$

Density - 1.694 g/cm^3

Physical state: Solid

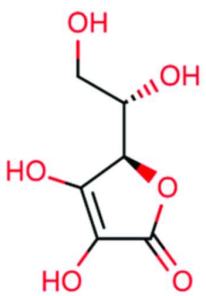
Color -White.

Odor -Odourless.

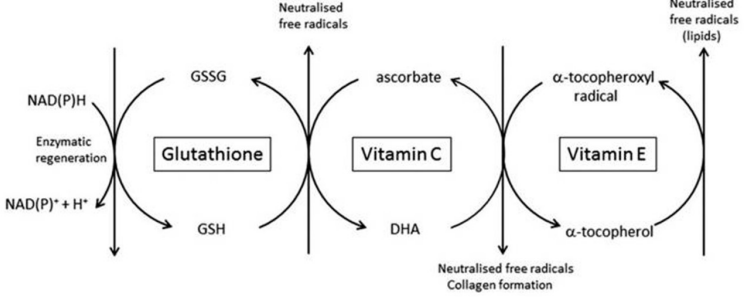
Solubility - Soluble in Water, approximately 0.33gm/ml.

PH - near to 3

Specific Gravity - 1.07



L-ascorbic acid



Uses :-

Photoaging–Both intrinsic ageing and photodamage (photoaging) are characterised by an excessive buildup of oxidative damage to proteins, which can affect the structure of the skin. Vitamin C affects the formation of structural protein collagen in addition to acting as an antioxidant. The hydroxylation of collagen by vitamin C results in extracellular stability and supports the epidermis.[25]

Vitamin C supplementation shows various advantageous effects in preventing photodamage in cell culture models. In particular, vitamin C had been demonstrated to stabilise collagen mRNA, enhancing the synthesis of collagen protein for skin repair. The ability of fibroblasts to proliferate quickly, which declines with age, is also increased by vitamin C. Furthermore, in cultured fibroblasts, vitamin C promotes DNA repair.[33]

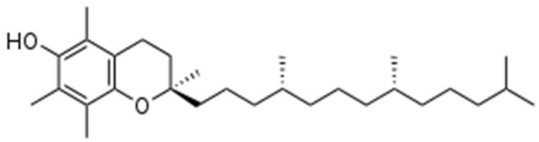
Skin whitening- Additionally, vitamin C has anti-pigmentation properties. Enzyme tyrosinase converts tyrosine into melanin, and by decreasing its activity at tyrosinase-active areas, melanin formation is decreased, stimulates DNA repair in cultured fibroblasts.

Anti aging – The production of collagen depends on vitamin C, which is also believed to have anti-aging benefits. More importantly, it serves as a cofactor for prolyl as well as lysyl hydroxylase, two key enzymes that stabilise in addition to cross-link collagen fibres.[28]

Promoting Differentiation of Keratinocytes-

Vitamin C promotes keratinocytes' late differentiation, combats differentiation-dependent oxidative stress, and preserves the integrity of the entire cuticle, all of which are necessary for the skin barrier's function and the prevention of water loss from the skin.[35]

Vitamin E:-



Alpha, beta, gamma, and delta tocopherol and alpha, beta, gamma, and delta tocotrienol are two of the eight chemical forms of vitamin E that are present in nature and have different degrees of biological activity [1]. The only type of tocopherol acknowledged to satisfy human needs is alpha- (or -) tocopherol.

Eight fat-soluble substances that make up vitamin E comprise of 4 tocopherols and 4 tocotrienols.

Synthesis- By employing iron as a catalyst and hydrogen chloride gas as a reagent, a combination of toluene and 2,3,5-trimethylhydroquinone interacts with isophytol to produce all-rac-alpha-tocopherol. The resulting reaction mixture is filtered before it is extracted using aqueous caustic soda. The toluene is eliminated by evaporation, and vacuum distillation is used to purify the remaining material (all rac-alpha-tocopherol).

Physical state: Solid

Color -White.

Odor -Odourless.

Solubility - Soluble in fat and oil

PH - 7.4

Specific Gravity - 0.947-0958

Molar mass - 430.7

Name as per IUPAC –

(2*R*)-2,5,7,8-tetramethyl-2-[(4*R*,8*R*)-4,8,12-trimethyltridecyl]-3,4-dihydrochromen-6-ol

Molecular Formula - *C29H50O2*

Uses:-

Vitamin E and derivatives work as antioxidants in anti-aging formulations by scavenging free radicals, which are the main causes of skin ageing [65]. In an in vivo investigation, -tocopherol diminished expression lines, wrinkles, and freckles brought on by photoaging.[15]

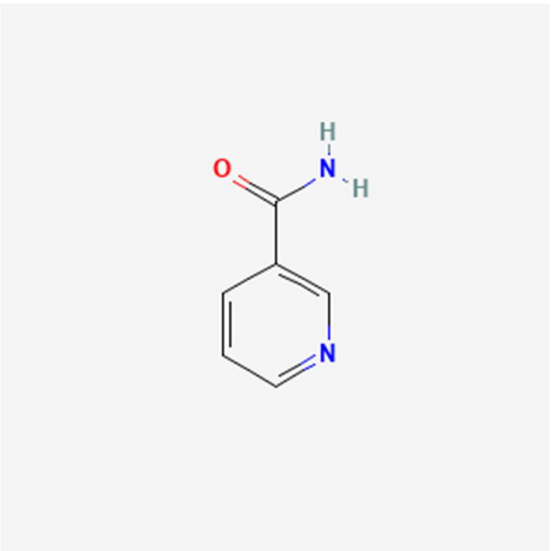
Vitamin E stops the bacterial-induced leaking of serum lipids via follicles and sebaceous glands, reducing inflammation brought on by peroxide irritation.

Vitamin E topical treatment is typically beneficial for enhancing skin's photoprotection. In mouse models, applying -tocopherol acetate before to UV exposure lessens DNA damage, lipid peroxidation, and the other chemical and structural alterations to skin that result from UV exposure.[20]

Niacinamide:-

Molecular Formula - *C6H6N2O*

Molecular Weight - 22.12



IUPAC name- pyridine-3-carboxamide

Synthesis- 3-cyanopyridine, water, and sodium hydroxide are combined in a process that produces crystal seed, crystallisation, and niacinamide after filtration; When the

mother liquor's acid concentration exceeds 30%, nicotinic acid is produced and managed by recovering niacinamide.

Physical state: Solid

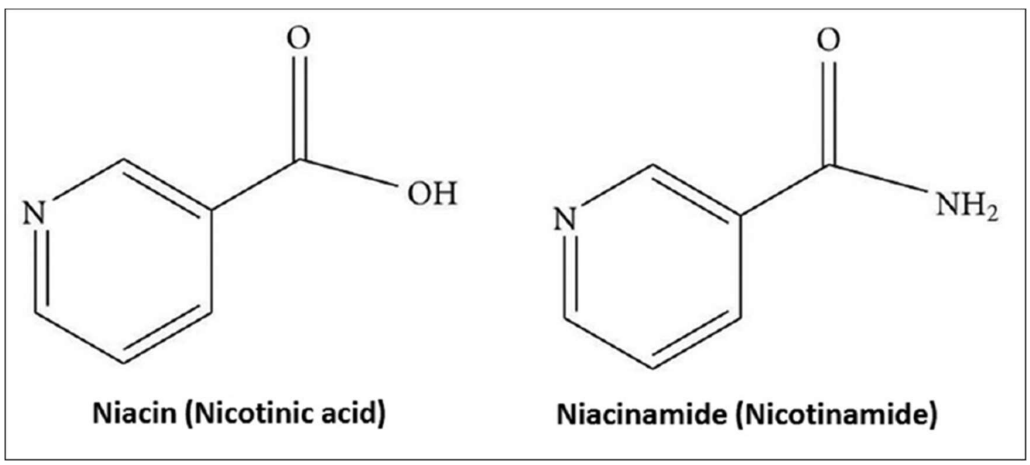
Color -White

Odor -Odourless.

Solubility - Soluble in Water, **17g/L water**

PH - 4.0 – 8.0.

SpecificGravity-1.4



Uses:-

In fibroblast cultures, nicotinamide stimulates the formation of collagen and lowers the elevated dermal glycoaminoglycosides in photodamaged skin.

The generation of the various epidermal proteins keratin, filaggrin, and involucrin is also boosted by niacinamide.The development of cross-linked molecules as a result of protein and sugar glycation gives the skin its yellow colour. Nicotinamide has antiglycation properties and prevents skin sagging because it is a precursor to the antioxidant NADPH.[36]

According to the study, using a topical niacinamide-containing lotion had a variety of positive benefits on the texture, hyperpigmentation, and redness of the skin on the face. Additionally, wrinkles, stiffness (elasticity), and sallowness (yellowing) all saw improvements.[22]

Inhibiting glycation is one possible explanation for the new anti-yellowing observation. When skin ages, an inherent oxidative cross-linking activity called glycation takes place, resulting in the creation of yellow final products between proteins (such dermal collagen) and intrinsic sugar. These goods probably contribute to the sallowness or yellow colour of ageing skin that is visible. Niacinamide may have antiglycation benefits due to its antioxidant qualities since it is a precursor to the intrinsic antioxidants NADH and NADPH.[2][3][4]

Aloe vera:--

Active:-

- **Botanical Name :** *Aloe vera* (L.) Burm.f.
- **Synonyms :** *Aloe barbadensis* Mill., *Aloe vulgaris* Lam
- **Common Name :** Kuwarpathu
- **Plant Family :** ***Liliaceae***
- **Plant Form :** ***Succulents***

Classification:-

Order: *Asparagales*

Family: *Asphodelaceae*

Subfamily: *Asphodeloideae*

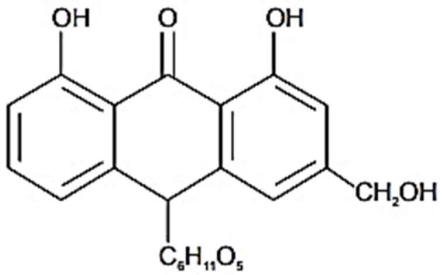
Biological Source:-

Aloe is the dried juice of the Aloe barbadensis Mill plant that is extracted by cutting the leaf bases.[32]

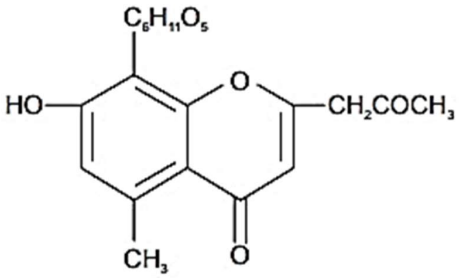
Chemical Constituent:-

As one of the most important constituents of Aloes, the so-called 'crystalline' Aloin is composed of Barbaloin, 1-barboloin and 3-barboloin. The amount of crystalline Aloin in the drug ranges from 10 to 30%. Additionally, there is amor-phous Aloin, resin, emodin, and Aloe-emodin. The glycoside barbaloin is a yellow colored, bitter, water soluble, crystalline compound found in all varieties of barbaloin. Curacao aloe contains isobarbaloin, and Cape aloe contains it in trace amounts, while Socotrine and Zanzibar

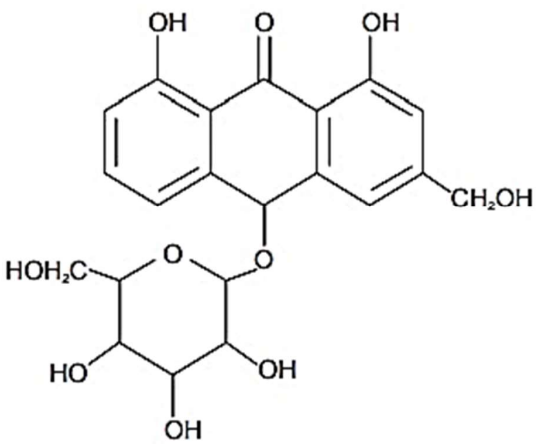
aloe do not. Among the most important components of Socotrine and Zanzibar aloe are Barbaloin and β-Barbaloin.[30]



Barbaloin



Aloesin



Aloin

Description :-

Aloe barbadensis miller is the scientific name for an aloe vera plant. The Asphodelaceae (Liliaceae) family includes perennial, xerophytic, succulent, shrubby, and arborescent plants. It grows most commonly in Africa, Asia, Europe, and America. Also found in India.[31]

Physical state: Liquid

Color -Greenish

Odor -Charactersitic

Solubility - Soluble in Water,

PH - 6

Specific Gravity - 0.997-1.004

Aloe-emodin | C15H10O5

Molecular size- **4 and 7 million Da**

Uses :-

Wound healing- By increasing the amount of collagen in wounds, changing its chemical composition, and promoting collagen cross-linking, aloe vera gel can improve wound healing. Because 99% of this gel contains water, research has shown that it may make the skin more flexible. Additionally, the mucopolysaccharides, amino acids, and zinc in aloe vera can aid in maintaining skin integrity, retaining moisture, reducing erythema, and preventing ulcers. The mucilaginous gel of A. Vera is hypothesised to include mannose-6-phosphate, which is the active ingredient for wound healing.[27]

Anti aging- The mucopolysaccharides in the skin aid in moisture retention. Elastin and collagen fibres are produced more quickly when aloe is present, increasing skin suppleness and minimising wrinkles. Additionally, it possesses cohesive properties that sooth the skin by fusing the flaky epidermal cells on the surface of the skin together. Aloe vera gel gloves moisturise dry skin while increasing skin integrity, minimising the look of fine wrinkles, while decreasing erythema.

It enhances the skin's capacity to retain moisture and aids in the clearance of dead skin cells which generate collagen and elastin fibres, giving the skin more elastic and smoother and reversing the degenerative changes to the skin.[29]

Antioxidant- Ascorbic acid (vitamin C), -tocopherol (vitamin E), carotenoids, flavonoids, and tannins are only a few of the abundant antioxidants found in A. vera. It has even been proposed that antioxidant action may be a key characteristic of plant medications used to treat a variety of ailments. Through the use of its antioxidant components found in the gel, topical administration of A. Saponaria has demonstrated antinociceptive and anti-inflammatory benefits in a sunburn model caused by ultraviolet B.[11]

Anti inflammatory- Ascorbic acid (vitamin C), -tocopherol (vitamin E), carotenoids, flavonoids, and tannins are only a few of the abundant antioxidants found in A. vera. It has even been proposed that antioxidant action may be a key characteristic of plant medications used to treat a variety of ailments. Through the use of its antioxidant

components found in the gel, topical administration of A. saponaria has demonstrated antinociceptive and anti-inflammatory benefits in a sunburn model caused by ultraviolet B.[12]

Olive oil-

Biological source- A fixed oil known as olive oil is produced by pressing the ripe fruits of the Olea europoea Linn., often known as the Indian olive (O. ferruginea), a member of the Oleaceae family.

Chemical Constituents - Mixed glycerides comprising oleic acid (56–85%), palmitic acid (7–20%), linoleic acid (3–20%), stearic acid (1–5%), arachidic acid (0.9%), palmitoleic acid (3%), linolenic acid, eicosenoic acid, gadoleic acid, and lignoceric acid are found in olive oil. Squalene in amounts of 0.7%, phytosterol, while tocopherols about 0.2% make up the minor ingredients. Oleic acid content is higher in olive oil of the Italy-Spain type, while linoleic acid content is higher in oil of the Greece-Tunisia type.

Physical state: Liquid

Color -Greenish- yellowish

Odor -Charactersitic

Specific Gravity - 0.9143,

Uses:-

Olive oil contains squalene, which has moisturising and antioxidant effects and may be utilised to treat atopic dermatitis, psoriasis, acne, and seborrheic dermatitis.

Squalene and vitamins like A, D, K, and E are all abundant in olive oil.These can help to lessen the effects of oxidative stress on the skin, which may speed up skin ageing.

Olive oil also has the ability to counteract the effects of high amounts of adrenaline on the production of extracellular signal-related kinase in ex vivo human skin.

Olive oil prevents the ageing effects caused by stress by reducing MMP-2 expression, ROS production, and ERK 1/2 and c-JUN activation in ex vivo skin samples.

4.2 Excipient Profile

Name:- Propylene glycol

Chemical name And CAS category no-

Molar mass:- 76.09 g/mol

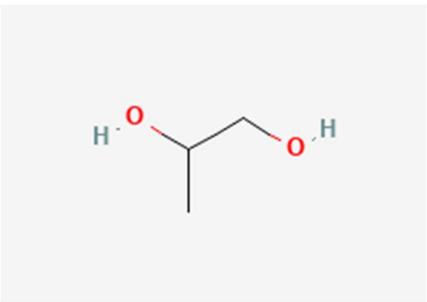
Molecular formula: $C_3H_8O_2$

Density: 1.04 g/cm³

Boiling point: 188.2 °C

Name as per IUPAC: propane-1,2-diol

Cas No: 57-55-6



Boiling point - 188˚C

Density - 1.038 g/cm3 at 20C

Refractive index nD20 = 1.4324

Soluble- water

Viscosity (dynamic) 58.1 mPa s (58.1 cP) at 208˚C.

Function category :-

Humectant, plasticizer, solvent, stabilising agent, antimicrobial preservative, disinfectant, and water-miscible cosolvent.

Application :-

Propylene glycol behaves like a humectant when present at low amounts, attracting moisture to the epidermis. It assists in giving the face a moisturised, dewy appearance when utilised in cosmetic products.

Propylene glycol can improve the distribution of other active substances into the skin due to its binding qualities.

Because of its humectant properties, it is also a helpful component for dry or ageing skin.As the aging occurs, skin loses an element called Natural Moisturising Factor (NMF) and eventually dries out, which emphasises wrinkles and causes flaking and roughness, it aids in the active elements of cosmetics penetrating through the skin, increasing their effectiveness.[24]

Name:-

Ethylenediaminetetraacetic acid is an aminopolycarboxylic acid

Chemical name And CAS category number -

Molar Mass: 292.2438 g/mol

Formula: $C_{10}H_{16}N_2O_8$

Name as per IUPAC: 2,2',2",2'"-(Ethane-1,2-diyldinitrilo)tetraacetic acid

Density: 860 kg/m³

Solubility: Water

Physical state: Solid

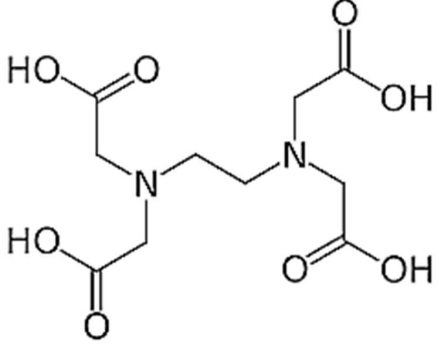
Color - White

Odor - Odourless

Solubility - Soluble in Water

PH - 8

Specific Gravity - 1g/mL



Function category:-

Chelating agent

Application :-

Disodium EDTA guards against unwelcome consistency, pH, odour, and texture changes so that skincare products maintain their integrity.

As a chelator, EDTA works. It "grabs" metal ions that may have an impact on a cosmetic product's stability and/or appearance. In rinse-off products, EDTA is used to combat the hardness of the water.

Name:-

Tween 20

Chemical name And CAS category number :-

CAS - 9005-64-5

Polysorbate 20 is a polysorbate-type nonionic surfactant

Physical Description -

A lemon to amber-coloured oily liquid at 25 °C with a faint characteristic odour

Colour- Lemon- to amber-colored liquid

Odour- Characteristic odor

Solubility- Soluble in water, ethanol, methanol, ethyl acetate and dioxane. Insoluble in mineral oil and petroleum ether

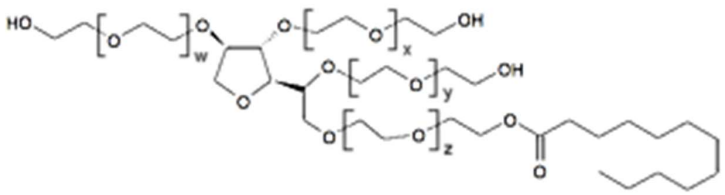
Density- 1.095 g/mL at 25 °C

Index of refraction = 1.468 at 20 °C

Chemical Formula – $C_{58}H_{114}O_{26}$

Molar Mass – 1226 g/mol

Boiling Point - > 100 °C (212 °F; 373 K)



Function category :-

Hydrophilic surfactant

Application :-

It enhances the spreadability of formulations and is also gentle on skin and hair.[1][17]

Name:-

Span 20

Chem name And CAS category number :-

IUPAC name- [2-[(2*R*,3*R*,4*S*)-3,4-dihydroxyoxolan-2-yl]-2-hydroxyethyl] dodecanoate

SORBITAN MONOLAURATE

Molecular formula- C18H34O6

CAS no- 1338-39-2

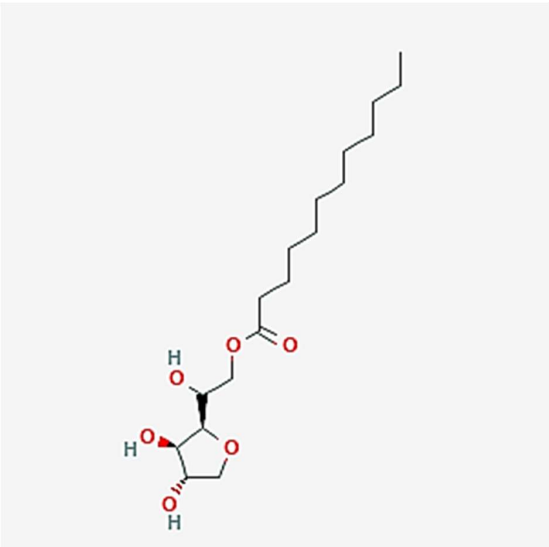
Physical state- Yellow oily liquid

Odour- Characteristic

density-**1.058 g/cm3 (20 °C)**

Boiling point- >100 °C

Solubility - Soluble in ethanol



Function category :-

Emulsifiers/Surfactants

Application :-

As an emulsifier as well as a stabilizer.It enhances the spreadability of formulations and is also gentle on skin and hair.

Name:-

Sodium Hydroxide

Chem name And CAS category number :-

CAS no- 1310-73-2

Molecular Weight - 39.997

Physical state- solid

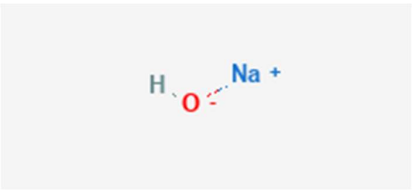
Colour- white

Odour- odorless

Solubility- Very soluble in water.

Density- 2.13 at 68 °F

pH- 12-14



Function category :-

Base

Application :-

Ph adjuster in a formulation

Name:-

Ethanol

Chem name And CAS category number :-

Formula: C_2H_6O

Molar mass: 46.07 g/mol

Boiling point: 78.37 °C

IUPAC ID: ethanol

Density: 789 kg/m³

Melting point: -114.1 °C

Classification: Organic compound

CAS no - 64-17-5

Physical State- Liquid

Colour- Clear

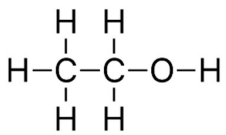
Odour- Alcohol odor

Boiling point- 173.3 °F

Solubility- water soluble, greater than or equal to 100 mg/mL

Density- 0.79 at 68 °F

Viscosity- 1.074 mPa.s at 25 °C



Function categ:ory -

Co solvent

Application -

Ethanol is used as a topical penetration enhancer, so as to increase the transdermal delivery of certain ingredients into the skin.

Name:-

Polyethylene Glycol

Chem name And CAS category number :-

CAS Number - 25322-68-3

Chemical formula - $C_{2n}H_{4n+2}O_{n+1}$

Molar mass - 44.05n + 18.02 *g/mol*

Density - 1.125

Soluble in: Water

It is non-toxic, colorless, inert, odorless, and non-volatile.

Function category:-

They serve as surfactants, penetration enhancers, thickeners, softeners, and moisture-carrying agents.

Application :-

To increase the penetration of the product and its spreadibility.

CHAPTER-5: MATERIAL AND EQUIPMENTS

5.1. Material list required for formulating the face serum

- L- Glutathione
- Vitamin-C
- Vitamin-E
- Niacinamide
- EDTA
- NaOH
- PG
- PEG
- Ethanol
- Aloe Vera
- Distilled Water
- Olive Oil
- Tween-20
- Span-20

5.2 Equipment list required for formulating the face serum

- Precision Balance
- High speed mixer
- Sonicator
- Homogeniser
- Centrifuge
- Brookfied Viscometer
- Colorimeter
- pH meter
- Stability Chamber

CHAPTER-6: EXPERIMENTAL

Formulation and optimization of face serum-

6.1. GENERAL PROCEDURE:-

1) In sufficient quantity of water all the ingredients were added that were water soluble and the sequence and mixing time was varied by one formulation to other till the most efficient one was found.
2) Now in other beaker oil phase or the pg,peg mix was taken as per the formulation and Vitamin E was dissolved in it.
3) Now in the beaker having water the surfactants with varying quantities as per the formulation was added.
4) Then slowly the oily or the pg,peg phase was added with dropwise addition and constant stirring till homogeneous mixture was obtained.
5) If there was any need to set the ph NaOH was added dropwise to set it.
6) Then aloe vera juice was added at last as per the quantity varying as per the formulation and was allowed to stir till a homogeneous mixture was obtained.[16]

6.2. FORMULATION TABLE:-

FOR 50ML FACE SERUM

	F1	F2	F3	F4	F5	F6	F7	F8	F9
L-GLUTATHIONE	01GM	01GM	01GM	01GM	01GM	01GM	01GM	01GM	01GM
VIT-C	05GM	05GM	05GM	05GM	05GM	05GM	05GM	05GM	05GM

VIT-E	0.25GM	0.25GM	0.25GM	0.25GM	0.25GM	0.25GM	0.25GM	0.25GM	0.25GM
NIACINAMIDE	01GM	01GM	01GM	01GM	01GM	01GM	01GM	01GM	01GM
EDTA	-	-	0.1GM	0.1GM	-	-	-	-	-
ALOE VERA	13ML	12ML	5ML	5ML	5ML	5ML	5ML	5ML	5ML
OLIVE OIL	-	-	-	5ML	5ML	3ML	2ML	1.5ML	1ML
OIL	-	-	5ML	-	-	-	-	-	-
PG	2.5ML	1.75ML	-	-	-	2.5ML	2.5ML	2.5ML	2.5ML
PEG	2.5ML	1.75ML	-	-	-	-	-	-	-
SPAN20	-		0.5ML	0.6 ML	0.6 ML	1.5ML	-	-	-
TWEEN 20	0.5 ML	0.4ML	-	0.8ML	0.8ML	1.2ML	2.5ML	2.5ML	2.5ML
NaOH	-	-	qs	qs	-	qs	qs	qs	qs
ETHANOL	-	-	-	-	-	2.5ML	-	-	-
DIST. WATER	qs	qs	qs	qs	qs	qs	qs	qs	qs

Physical Appearance: -

To evaluate the serum formulation sample, it is recommended to visually observe its color, texture and smell.

Additionally, one can assess the texture of the serum by applying a small amount on the skin and feeling for a smooth and homogeneous texture, without any greasy finish. For this a survey was carried out to evaluate the overall physical appearance of the formulated serum among a group of volunteers. This survey includes evaluation of physical properties of the face serum such as texture, feel, oiliness/greasiness to get overall feedback of the serum from a user point of view. The next chapter is a summary of the survey's outcomes.[19]

pH Test:

A Digital pH metre will be used to perform the pH test. The pH value will be recorded after a thorough immersion of the digital pH dipper into the sample of serum formulation. Since the skin has an acidic pH range, the formulation should also have an acidic pH. As a result, the skin serum's pH should be between 4-6.[5]

Homogeneity:

To assess the homogeneity of a face serum formulation, one can examine the consistency and uniformity of the product. This will be verified by applying a little amount of the serum mixture to the clear glass and watching it. The serum should be distributed evenly as a result of the formulation. It may be a sign of poor homogeneity in the composition if there are any observable clumps or separations of the components.

Rheological Study:

The viscosity of the formulation is determined using a Brookfield® viscometer. This tool calculates the viscosity of a fluid by analysing the fluid's resistance to flow. Using a spindle-type model S61ml of serum, the viscosity is assessed at 100 revolutions per minute. Before taking the measurement, the spindle has to be dipped in the serum for around five minutes in a large mouth container. Centipoise (cP) units of viscosity are used to quantify this viscosity while the spindle is rotating at a constant speed.[26]

Spreadability:

The product distributes on the skin and indicates the region to which the serum spreads easily when applied to the skin of the face. The total area of the filter paper (A1) is computed in order to make this determination. Select the test formulation, add a few milliliters to a B-D 5mL syringe, and then drop 20 droplets into the center of the filter paper. Start a stopwatch or timer and set it for counting for about 10 minutes. The liquid will cover the filter paper in a roughly circular pattern during the course of the 10-minute test. After 10 minutes, use scissors to cut precisely along the border between the dry filter paper and soaked part. The saturated filter paper's diameter should be measured. Take many diameter readings around the spread region to get the average diameter if the spread was not a perfect circle. Add this measurement to the A2 scale. It is also known that some serums' bioavailability effectiveness may also be influenced by their spreading potential.

% Spread by Area = (A2/A1)100

Stability Test:

With accelerated stability analysis, which heats the serum formulation to a high temperature, the product's physical and chemical stability is determined. Stability investigations are conducted in accordance with ICH recommendations. For the prepared formulation, a three-month short term accelerated stability study will be conducted. For this, the samples can be kept in storage at temperatures as low as 25 degrees Celsius with a 60% relative humidity. Monthly sampling and analysis of the product samples should be carried out to assess any changes or degradation that may occur over time. Overall, the ICH guidelines should be adhered to, to ensure the product's stability, safety, and high-quality performance.[6][13][14]

Determination of Ascorbic Acid by Titration Method

Reagents: -

- 0.1 mol/l I_2
- 0.2 mol/l H_2SO_4
- Starch indicator at 0.5%
- Ascorbic acid standard solution 40 mol/l
- Sample of ascorbic acid

- **Procedure: -**

Standard -

- Use pipette and add 5 ml aliquot of ascorbic acid standard solution, 2.5 ml of H2SO4, and 100 µl of starch indicator into the glass titration flask.
- Utilize I2 solution to titrate the standard. It is determined that the first enduring remnant of a dark blue-violet tint represents the titration's end point.
- Read the iodine solution's volume (ml) that was utilized in the ascorbic acid standard solution reaction (V standard).

Sample -

- With the help of pipette a 5 ml aliquot of the ascorbic acid sample and perform the titration of the sample as done for the standard.
- Check the iodine solution's volume (ml), which was utilized to react with the ascorbic acid sample (V sample).

Calculation: -

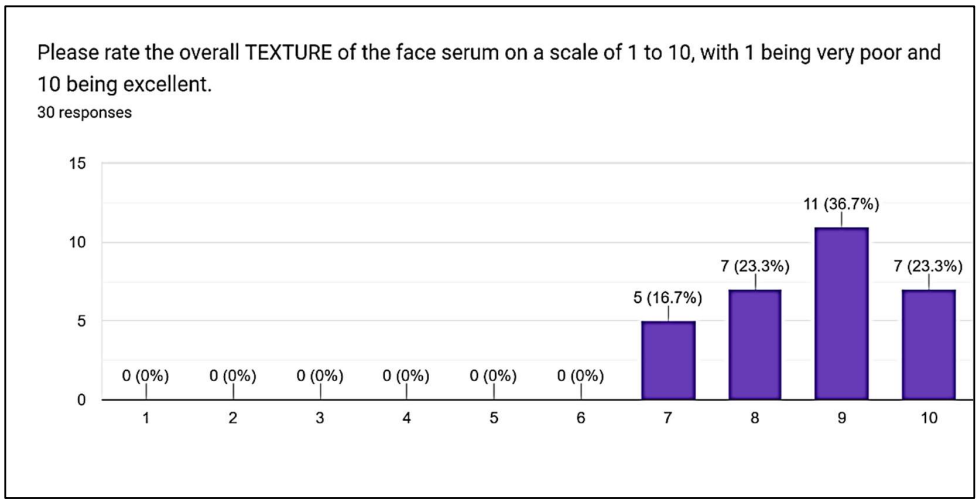
Ascorbic acid (µmol/l) = $Vsample$ / $Vstandard$ × $cstandar$d

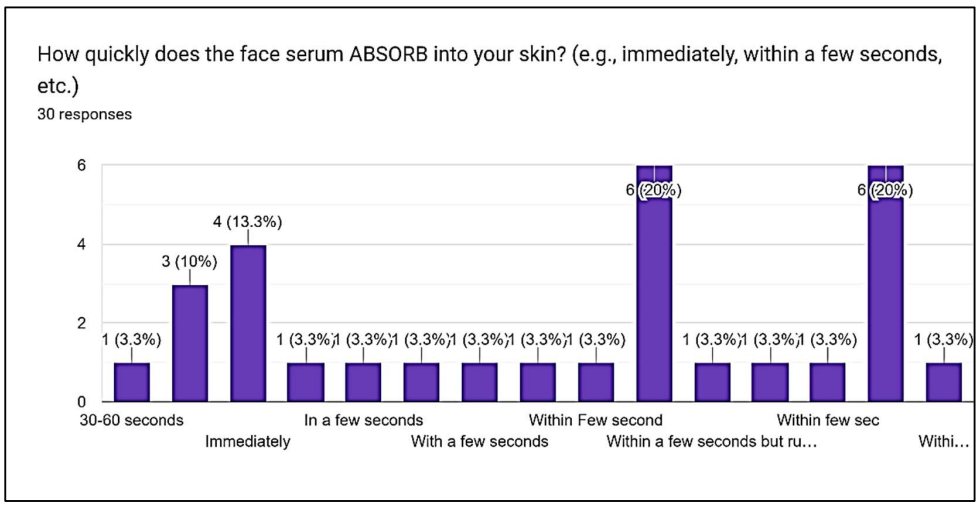
Normal value in serum: 34-114 µmol/l

i. **Physical Appearance:** By observing the color, texture, and scent of the created face serum, physical appearance was assessed.

Color	Greenish turbid appearance
Texture	smooth homogeneous with non-greasy finish.
Smell	Characteristic Odor

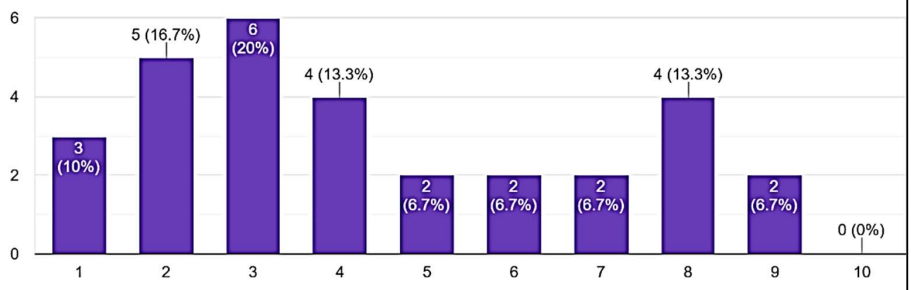
ii. **Physical evaluation survey:** The serum after distribution amongst individuals for application, and their feedback was obtained through a prepared google form. The results of this survey is as follows:





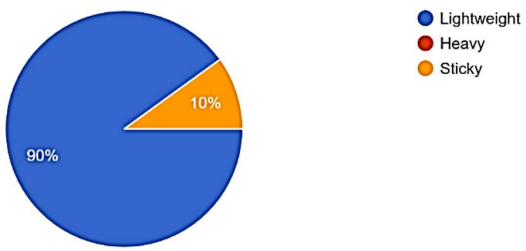
Please rate the level of GREASINESS OR OILINESS of the face serum on a scale of 1 to 10, with 1 being not greasy at all and 10 being very greasy.

30 responses



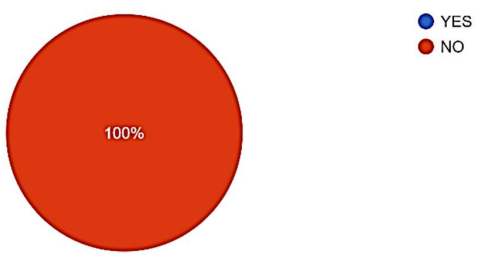
How does the face serum FEEL on your skin?

30 responses



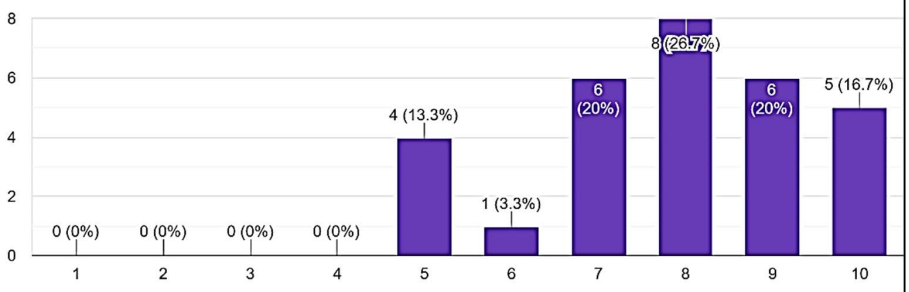
Did you find any DIFFICULTY in applying the serum?

30 responses



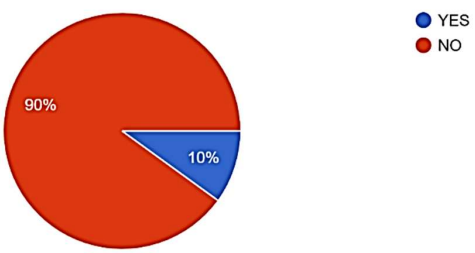
Please rate the overall HYDRATION OR MOISTURIZATION effect of the face serum on your skin on a scale of 1 to 10, with 1 being not hydrating at all and 10 being very hydrating.

30 responses



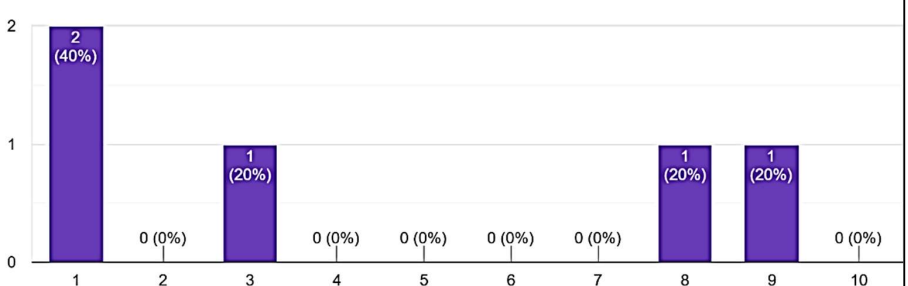
Do you experience any tingling, itching, or DISCOMFORT after applying the face serum?

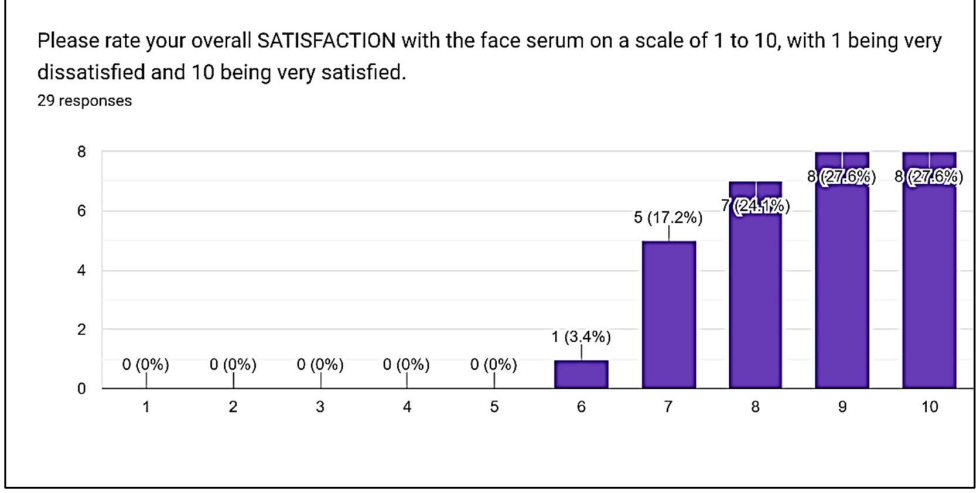
30 responses

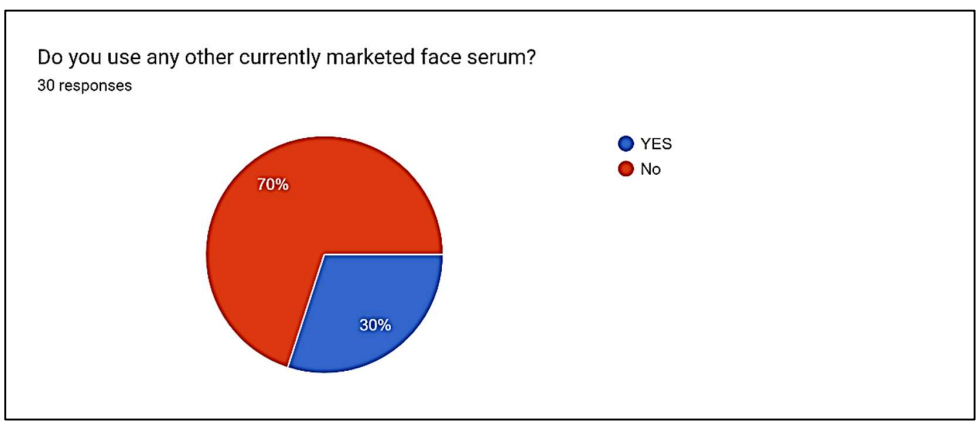


If you answered "Yes" to the previous question, please describe the sensation and its intensity on a scale of 1 to 10, with 1 being very mild and 10 being very severe.

5 responses







iii. **pH Test**: On day 1 the pH of the formulated stable serum with desired consistency was found 4.1 which fall within the range of pH 4 to 6. As mentioned earlier this pH is suitable for face skin formulations.

iv. **Homogeneity**: This was calculated by applying a little amount of the serum blend to the clear glass and then watching it. The formulation created a consistent dispersion of serum, as was demonstrated.

v. **Rheological Study**: Using a spindle type model S61 ml of the serum, the Brookfield® Viscometer measures the viscosity of the formulation at 100 rpm and 13% torque. The serum was placed in a big mouth container with the spindle dipped in it for about 5 minutes before the measurement. The viscosity of the formulation was found to be 8.10 cP (centipoise).

vi. **Spreadability**: When a serum is applied to skin or an afflicted region, its spreadability indicates the size of the area to which it spreads easily.

Total area of filter paper (A1) =78.53 cm square

Apply 20 drops of the serum formulation onto the center of filter paper.

After 10 minutes, Diameter of the saturated portion of filter paper =8.2 cm

Therefore, Area of the saturated portion of filter paper (A2) = 52.81cm square

% Spread by Area = (A2/A1)100

= 67.24% spreadability

Based on the evaluation results, it can be concluded that the formulated serum has a spreadability of 67.24%. This indicates that the serum can spread easily and evenly on the skin, which is an important characteristic for user satisfaction.

Good spreadability ensures that the product can be applied smoothly without any difficulty on the skin, without leaving any residue. This can enhance the user experience and increase the likelihood of continued use of the product, ultimately leading to better results.

vii. **Stability Studies:** - A proper stability study must be performed on a cosmetic product's formulation and development in order to assess its physical and chemical stability and, consequently, its safety. For this we have kept the product in stability chamber at storage conditions of temperatures of 25 degrees Celsius, RH=60%. To date we have withdrawn a sample after 1 week to check if any changes or degradation was observed. There was no change in the serum's color, pH and viscosity. Also, the emulsion didn't break. Accordingly, no physical properties were affected, and no degradation was found. Therefore, we can conclude that the serum formulation was stable after 1 week. Future sampling will be done to continue the short term accelerated stability studies according to ICH guidelines and their results will also be added.

CHAPTER-9: SUMMARY AND CONCLUTION

The study's objective was to create and assess a facial serum comprising several vitamins to provide an anti-aging impact along with a range of advantages for moisturizing and hydrating skin. In the serum aloe vera and olive oil are also used. The formulated serum also contains aloe vera and olive oil, which offer additional benefits. Aloe vera gel has demonstrated effectiveness in treating a variety of skin conditions, including radiation dermatitis, acne, and pimples. It is rich in vitamins and minerals, which help to maintain healthy and fresh-looking skin with good moisturizing capacity and anti-aging effects. Olive oil, on the other hand, has antioxidants that protect against damage caused by UV rays and helps to prevent premature aging.

Stability experiments verified that there was no obvious alteration in the serum's physical characteristics, and it was determined that the pH and viscosity were satisfactory for usage on the skin of the face. Since there was no noticeable deterioration in the emulsion the serum created, the formulation was likewise stable. Furthermore, it was found that the spread ability was good and that there were no residues left behind after application.

Based on the survey conducted to evaluate the physical properties of the prepared serum, it can be concluded that the formulation has potential in the cosmetics market. Further studies could be conducted to investigate the serum's efficacy in providing the intended benefits and its safety for use on the skin. By continuously refining and improving the formulation, a high-quality face serum can be developed that meets the needs and expectations of users.

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