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## Review Article

### A Review on Formulation and Development of Beetroot Facial Scrub

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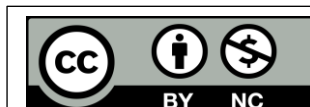
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#### Abstract

Beetroot (*Beta vulgaris*) has gained significant attention in cosmetic and skincare formulations because of its rich antioxidant, vitamin, and mineral composition. Natural facial scrubs prepared from beetroot are increasingly preferred over synthetic exfoliants because of their safety, biodegradability, and skin-nourishing properties. Beetroot contains betalains, phenolic compounds, vitamin C, iron, potassium, and dietary fibers that contribute to antioxidant, anti-inflammatory, moisturizing, and skin-brightening effects. The incorporation of beetroot powder or extract into facial scrub formulations helps remove dead skin cells, improve blood circulation, reduce acne, and enhance skin texture naturally. This review article discusses formulation approaches, ingredients, preparation methods, evaluation parameters, advantages, and future prospects of beetroot facial scrub formulations. Various natural excipients, such as honey, aloe vera, turmeric, walnut shell powder, rice flour, and essential oils, are also highlighted for their synergistic role in improving product stability and efficacy. The review further emphasizes the importance of herbal cosmetics in modern skincare and the growing consumer preference for eco-friendly and chemical-free cosmetic products. Beetroot facial scrub formulations represent a promising area in herbal cosmeceutical research because of their multifunctional benefits and minimal adverse effects.

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## Introduction

The skin is the most penetrating organ of the body and helps protect us from environmental toxins, germs, UV rays, and other chemicals. Having healthy skin shows not just your physical well-being but also significantly adds to your appearance and confidence. Over the years, skin has been exposed to pollution, stress, and an unhealthy lifestyle, overuse of synthetic cosmetic products, and changes in weather conditions. Consequently, skin has suffered from issues such as acne, dry skin, pigmentation, premature aging, blackheads, and dull skin. Cleansing and exfoliating the skin are essential parts of skincare routines for achieving glowing skin. Facial scrubs are cosmetic products designed to remove dead skin cells, excess oil, dirt, and other impurities from the surface of the skin. Regular exfoliation aids in blood circulation and unclogs pores[1]. Moreover, it helps skin cells regenerate and allows better absorption of skincare products, such as creams and lotions. Conventional scrubs sold in the market are loaded with synthetic chemicals, artificial fragrances, parabens, sulfates, microplastics, and harsh abrasive agents that could irritate the skin, cause allergic reactions, dry the skin, and lead to long-term skin damage[2]. As consumers become more aware of the harmful effects of synthetic cosmetics, they are increasingly opting for herbal and natural-based cosmetics, which are considered safer, environmentally friendly, biodegradable, and more compatible with the skin. Cosmetics that use herbal ingredients have beneficial properties, such as antioxidants, moisturizing, antimicrobial, and anti-inflammatory properties, that help nourish the skin[3]. Among cosmetic formulations, beetroot (*Beta vulgaris*) has become popular because of its rich nutrient and phytochemical composition, which aids skin health. Beetroot is a root vegetable grown worldwide, and its medicinal, nutritional, and cosmetic values make it valuable[4].

Beetroots contain essential vitamins, minerals, iron, potassium, folic acid, dietary fiber, and natural plant pigments called betalains, which have strong antioxidant abilities. Antioxidants help eliminate free radicals that damage the skin and cause premature aging due to oxidative stress. The vitamin C found in beetroot stimulates collagen production and improves skin elasticity and brightness. The red pigment in beetroot gives the skin a glow and helps to even out facial complexion. Beetroot also has anti-inflammatory and antimicrobial effects, which reduce acne, irritation, and infection. Because of these

beneficial properties, beetroot has found its way into several herbal cosmetic formulations, such as lip balms, face packs, creams, lotions, soaps, and facial scrubs. Beetroot facial scrub is an herbal exfoliating preparation that is made using beetroot powder or extract along with other exfoliating agents[2]. The formulation aims to deep clean the skin, scrub away dead skin cells, enhance blood circulation, provide nourishment to the skin, and moisturize the skin without any harmful side effects. Countless natural ingredients can be combined with beetroot facial scrub to improve its texture, increase its stability, spreadability, and fragrance, and provide skin benefits[5]. These ingredients mainly include aloe vera gel, honey, rice flour, walnut shell powder, rose water, and essential oils. The rising demand for herbal cosmetics and sustainable skincare products has motivated researchers and the cosmetic industry to formulate and develop a natural face scrub using a plant-based product. Thus, the current review article focuses on the formulation and development of beetroot facial scrub. Further, it will shed light on its phytochemical profile, cosmetic uses, preparation style, evaluation parameters, merits, demerits, and future perspectives with reference to herbal cosmetics and skincare formulations[6].

## Beetroot: Botanical Overview

The term 'beetroot' is derived from the scientific name *Beta vulgaris*. It is a biennial herbaceous plant belonging to a family Chenopodiaceae. This family is now included under Amaranthaceae. It is a cultivated root vegetable that is widely grown around the world for its nutritional, medicinal, and commercial value. Beetroot is also called red beet, garden beet, table beet, or simply beet. The edible taproot of the plant is dark red to purple, owing to the natural pigments known as betalains. These pigments provide beautiful colors and have important anti-oxidants and therapeutic properties. Beetroot is thought to have originated in the Mediterranean region. Initially, beetroot was primarily grown for its leaves; however, the use of the root became widespread later. Over the years, beetroot cultivation spread to Europe, Asia, and many other parts of the world because of its climatic adaptability and health-promoting benefits. The plant grows most luxuriantly in temperate climates and on well-drained fertile soil. Beetroot is generally grown in the cool season because high temperatures may affect root and color formation. Morphologically, the beetroot plant has broad green leaves arranged in a rosette pattern. The taproot of the plant is fleshy and edible[7]. Flowering stems appear in the second

year. The leaves are rich in chlorophyll and other nutrients, whereas the root is the storage organ, which stores carbohydrates, vitamins, minerals, and phytochemicals. The cultivar influences the shape of the root, which may be round to cylindrical. The natural sugar levels in beetroot are responsible for its sweet and earthy taste, along with the organic compound geosmin. From a nutritional perspective, beetroot is highly valued because it contains carbohydrates, proteins, dietary fiber, folic acid, iron, calcium, magnesium, potassium, phosphorus, vitamin C, and other bioactive compounds. The primary phytochemicals include betalains, flavonoids, phenolic acids, carotenoids, saponins, and nitrates. Betalains are classified into betacyanins, which are red-violet in color, and betaxanthins, which are yellow-orange in color. The antioxidant, anti-inflammatory, antibacterial, and detoxifying properties of these substances add to the medicinal and cosmetic value of beetroot. Beetroot has been traditionally employed in various medical procedures to cure diseases, such as anemia, constipation, hypertension, liver diseases, and skin problems. In recent years, beetroot has been found to have antioxidant and anti-aging properties that can benefit the skin. Its high vitamin C content promotes collagen production, and iron enhances blood circulation, which can give the skin a natural glow[8]. The use of beetroot extracts in cosmetic and skincare formulations is on the rise due to their ability to naturally nourish, moisturize, brighten and rejuvenate skin. Antioxidants can hinder the effects of environmental pollutants and UV radiation on the skin[9]. Beetroot finds application in herbal cosmetic formulations in the form of fresh juice, powder, extract, or dried granules. Because of stability and easy incorporation and exfoliating properties, beetroot powder is especially preferred in face scrubs as well as in face masks. The natural color and odour of beetroot also enhance the appeal of the cosmetic product. Beetroot is an effective multifunctional agent, possessing minimal side effects. Due to such properties, beetroot has become an important ingredient for herbal formulations. More and more people are becoming interested in natural and organic cosmetics, which has further increased the potential use of beetroot in facial scrubs, creams, lotions and other products. It is thus essential to understand the botanical properties, phytochemical composition, and medicinal value of beetroot for the effective and safe formulation of herbal cosmetics[10].

### **Nutritional and Phytochemical Composition**

The inclusion of beetroot (*Beta vulgaris*) in the diet is beneficial because of the richness of essential nutrients, vitamins, minerals, and a wide range of bioactive phytochemicals, which have health benefits as well as applications in cosmetics and personal care. The nutritional and phytochemical constituents of beetroot nourish the skin, reduce oxidative damage, improve blood circulation, and enhance the functioning of the body. Beetroot has become an essential part of herbal cosmetic formulations for face scrubs, face packs, creams, and lotions because of these beneficial properties. Beetroot contains a high concentration of carbohydrates, natural sugar, protein, dietary fiber, vitamins, minerals, and antioxidants, and has therapeutic and skincare uses. The vegetable has low calories and is a good source of folic acid, iron, potassium, magnesium, phosphorus, calcium, sodium, zinc, and vitamin C[11]. The fiber in beetroot is detoxifying and cleansing. Minerals, such as potassium and magnesium, help maintain skin hydration balance. The vitamin C present in beetroot is essential for skincare as it helps in the synthesis of collagen and enhances skin elasticity. Moreover, beetroot protects the skin against free radicals. Collagen is responsible for the firmness and smoothness of the skin, as well as its wrinkle-reducing effects, and premature aging effects, and these are enhanced with vitamin C. The presence of iron in beetroot improves blood circulation to the skin, which helps deliver oxygen to skin tissues. This results in glowing and healthy skin. Folate or folic acid assists in cell generation and repair, which helps keep the skin youthful and healthy. One of the most important phytochemicals found in beetroot is betalains, which are water-soluble pigments responsible for the red-purple color of the root. The two major classifications of betalains are betacyanins, which confer red-violet pigmentation, and betaxanthins, which confer yellow-orange colors. The most common beetroot betacyanin is betanin, which displays potent antioxidant activity. The pigments present in the cream help neutralize harmful free radicals and protect skin cells from oxidative stress due to pollution, UV rays, etc. As one of the leading causes of skin aging, pigmentation, and cellular damage, oxidative stress affects the antioxidant activity of betalains in skincare formulations. The phenolic compounds and flavonoids found in beetroot have anti-inflammatory, antimicrobial, and anti-aging activities[12].

Ferulic acid, caffeic acid, and chlorogenic acid are phenolic acids that hinder microbial invasion and

inflammation. Flavonoids strengthen capillaries and increase blood circulation in the skin. In addition to betalains and phenolics, beetroot contains carotenoids and saponins, which have health benefits. Carotenoids shield the skin from UV damage and assist in repair processes. Another significant component of beetroot is natural nitrates, which the body converts to nitric oxide. Nitric oxide may lead to better skin or facial glow as it enhances blood flow and oxygen delivery to the tissues. Beetroot has a high-water content and minerals, which impart moisturizing and hydrating properties to the skin. It is particularly suitable for dry and sensitive skin. Beetroot powder or extract in cosmetic formulations, such as facial scrubs, protects the skin from oxidative damage and enhances the formulation's texture, color, and nutritional value. The use of natural pigments gives cosmetic preparations a pleasing appearance without artificial colors. Moreover, the phytochemicals found in beetroot work together to reduce inflammation, clean pores, remove dead skin, and naturally rejuvenate the skin. Owing to the increasing awareness of the damaging effects of synthetic chemicals in creams and lotions, the demand for plant-based ingredients rich in nutrients and phytochemicals has increased significantly. Beetroot has been found to fulfil these requirements due to its multi-possible biological activities. As a result of beetroot's nutritional and phytochemical composition, it is a valuable ingredient that can be used to formulate herbal facial scrubs and other cosmetic products to enhance skin health and appearance[13].

### **Role of Herbal Cosmetics in Skin Care**

Herbal cosmetic is an important during modern-day skincare as being natural in origin, they are therapeutic and possess less change of causing adverse side effect like chemical cosmetic product. The skin is continuously exposed to environmental pollutants, harmful UV rays, dirt, chemicals, pressure, and microorganisms, which can cause dermatological issues, such as acne, pigmentation, dryness, premature aging, wrinkles, irritation, and dullness. The use of skincare products has become a significant part of our daily lives to maintain healthy and beautiful skin. For a long time, only synthetic cosmetics were available in the market because of their fast action and longevity. However, prolonged usage of products containing artificial chemicals, parabens, sulfates, alcohols, synthetic fragrances, preservatives, etc., can damage the skin barrier and cause allergic reactions, irritation, and chronic skin

disorders[14]. Owing to growing awareness of these adverse effects, consumers have shifted towards herbal cosmetics, which are safe, eco-friendly, biodegradable, and more compatible with human skin physiology. Herbal cosmetics are made with herbs, roots, leaves, fruits, flowers, seeds, and natural oils, which have medicinal and cosmetic value. These products are meant to beautify naturally, nourish, protect, and enhance the healthy functioning of the skin. For millennia, the use of herbs for cosmetics has been a norm in traditional systems of medicine (traditional systems of medicine), such as Ayurveda, Unani, Siddha, and Traditional Medicine. Plant ingredients in these systems of medicine were used for purposes such as cleansing, moisturizing, healing, and rejuvenating the skin. Herbal cosmetics contain bioactive compounds, including flavonoids, phenolics, alkaloids, tannins, vitamins, minerals, essential oils, and antioxidants, that benefit the skin in many ways. Herb-based ingredients contain antioxidants that neutralize free radicals to avert oxidative stress and early aging. Pollution, UV rays, and metabolic processes produce free radicals that are unstable molecules capable of damaging skin cells, proteins, and collagen. Herbal compositions rich in antioxidants help reduce wrinkles and fine lines, damage skin, and keep the skin youthful. Various herbal preparations additionally have anti-inflammatory attributes to soothe inflamed skin and reduce inflammation associated with acne, eczema, etc. Important ingredients that must be included in skin products are items like aloe vera, turmeric, neem, sandalwood, cucumber, rose, beetroot, and honey[15]. These have therapeutic benefits that help the skin. Herbal cosmetics help retain moisture and make the skin soft and supple. The nutrients from natural oils and plant extracts benefit the texture and radiance of the skin. They do not block pores or dry out the skin excessively. Gentle cleansing and exfoliation of the skin is another important function of herbal cosmetics. Herbal facial scrubs and cleansers help eliminate dead skin cells, dirt, extra oil, and other impurities from the surface of the skin. At the same time, they also help increase blood circulation and aid skin cell renewal. Herbal scrubs are mild exfoliants that do not harm sensitive skin, while synthetic scrubs do and can be used daily. Herbal cosmetic products typically do not contain harmful chemicals and are therefore suitable for people with sensitive or allergy-prone skin. Moreover, other benefits of herbal cosmetics is they are environmentally friendly as they use ingredients that decompose easily and do not lead to pollution. The

cosmetics industry and researchers are motivated to develop new herbal formulations because of the success of organic and natural products. They are following scientific validation of plant materials. Beetroot, an important herbal cosmetic ingredient, helps improve skin properties like antioxidant, moisturizing, and brightening owing to beetroot extract. The product's inclusion in face scrubs and other cosmetic products makes them all the more appealing with its natural effect and color, while serving to enhance skin health naturally. In addition, herbal cosmetics promote holistic skin care along with enhancement, functionality, and well-being and increasing popularity among consumers[16].

The development of herbal cosmetic science and increasing research on plant raw materials have strengthened the role of herbal cosmetics in skin care management. Herbal cosmetics are safe, effective, economical, and sustainable methods for maintaining healthy, glowing, and youthful skin, and are less likely to cause harmful effects than synthetic cosmetic products[17].

### **Importance of Facial Scrubs**

Facial scrubs are essential skincare products for cleansing, exfoliating, and rejuvenating the skin. The skin constantly undergoes a natural process called cell layering, in which dead and old skin cells accumulate on the top layer of the skin. Environmental culprits that clog the skin pores include dust, pollution, excess oil secretion, and harmful ultraviolet rays. It also includes sweat and cosmetic residue. If these impurities are not removed correctly, they can lead to multiple skin problems, such as acne, blackheads, whiteheads, uneven skin tone, roughness, and premature skin aging. Facial scrubs are cosmetic products that remove dead skin cells and impurities via exfoliation. The skin can be deeply cleansed through exfoliation, improving its overall health and appearance. Facial scrubs contain microgranules or natural exfoliating agents that rub against the skin and remove dust, excess sebum (oil), and dead cells without harming the skin. Regular scrub facials unclog pores and reduce the chances of getting acne and pimples by reducing the accumulation of oil and bacteria on the skin. Exfoliation also stimulates blood circulation in the facial skin. This indicates an improved supply of oxygen and nutrients to the tissue. As a result, we obtained a healthy glow on the skin[18].

Good circulation assists with the generation of cells that ensure radiant skin. A facial scrub is another great product that helps the skin absorb serums, creams, or cloth/mud masks better after the scrub. When impurities and dead cells are removed, any subsequent application of skincare products will better reach the deeper layers of the skin, thus improving their therapeutic and cosmetic effects. Facial scrubs also improve the skin's texture and make it softer, smoother, and even-toned. Regular exfoliation with a facial scrub helps reduce roughness, dryness, and flaky skin. Face scrubs are good for oily and acne-prone skin as they prevent the overproduction of sebum and blockage of pores. Mild herbal scrubs are good for individuals with dry skin, as they help remove any flaky skin and improve moisture when combined with a moisturizer. Facial scrubs play an essential role in reducing tanning and pigmentation caused by the sun and environmental pollution. When damaged skin cells are removed by scrubs, it helps in the growth of new and healthy skin layers. In modern times, people have started using herbal and natural facial scrubs more because they are safer and have fewer side effects than synthetic scrubs, which contain harsh chemicals and artificial microbeads. Natural exfoliators, such as rice flour, walnut shell powder, and more, can act as gentle scrubs for sensitive skin without being abrasive. The skin may benefit from herbs such as aloe vera, turmeric, honey, neem, cucumber, beetroot, etc. Moreover, they add additional antioxidant, moisturization, anti-inflammatory, and antimicrobial properties. Beetroot facial scrub is getting some attention because of the antioxidant and skin-lightening properties of beetroot. Beetroot contains natural pigments, vitamins, and minerals, and phytochemicals that enhance the complexion and maintain the skin that sustains oxidative stress. Facial scrub improves the personal picture and the confidence which gives psychological and cosmetic satisfaction[19]. But, proper selection and usage of facial scrub berfungsi itu sangat penting, pucat warna Pakaian ram shri dan penggunaan scrub bagian wajah yang berlebihan tersebut. As such, it has been assessed that mild herbal facial scrubs made up of natural formulations are ideal for the skin. The need for natural skincare products is ever increasing. That is why a lot of research have gone into preparation of herbal facial scrubs. The scrub must be effective, safe and eco-friendly. Also, it must be suitable for a variety of skin types. Scrubs are very helpful in removing dirt and dust effectively and enhance the beauty naturally. They would play an essential role in scrubbing the face[20].

## **Beetroot in Cosmetic Formulations**

Beetroot (*Beta vulgaris*) is used in cosmetic and skincare formulations because of its nutritional composition. Furthermore, it has antioxidant and natural coloring properties. It also has skin benefits. The harmful effects of synthetics in cosmetics have led both researchers and cosmetic manufacturers to seek plant-based solutions for creating safe and effective products. Rich in vitamins, minerals, phenolic compounds, flavonoids, and betalain pigments, beetroot nourishes, hydrates, protects, and renews the skin. The presence of bioactive ingredients in beetroot makes it a potential ingredient in a range of cosmetic formulations, such as facial scrubs, face packs, lip balms, creams, lotions, soaps, shampoos, and moisturizers. One of the most important properties of beetroot for cosmetic formulations is its high antioxidant activity. Beetroot is rich in anti-oxidants and betalains (betacyanins and betaxanthins), which are effective in neutralizing free radicals and oxidative stress, thereby preventing premature skin aging[21]. The development of environmental factors, such as pollution, UV radiation, and toxins, can cause oxidative damage to skin cells. Moreover, factors such as wrinkles, fine lines, dullness, and loss of skin elasticity contribute to skin aging. Beetroot contains antioxidants that protect skin cells from damage, helping to maintain youthful skin. Beetroot's antioxidant properties prevent premature aging of skin cells and help reduce dark spots and blemishes. Beetroot also hydrates dry and sensitive skin and can be used as a natural skincare remedy. Potassium and magnesium minerals help maintain moisture balance and skin softness. In addition, beetroot has anti-inflammatory and antimicrobial properties that soothe skin irritation, redness, acne, and small infections. These qualities make beetroot useful in formulations for acne-prone and sensitive skin. The ordinary red color of beetroot enhances the aesthetic appeal of cosmetic products without the use of synthetic dyes. Beetroot is extensively used as a natural colorant in lip balms, lipsticks, blush, and masks. When used in facial scrubs, beetroot powder or extract enhances the product's visual appeal while facilitating exfoliation and regeneration of skin cells. The purpose of beetroot facial scrubs is to eliminate dead skin cells, dirt, excess oil, and impurities from the skin's surface while nourishing it with vital nutrients and antioxidants. Beetroot powder gently exfoliates the skin. Additionally, other mild exfoliating agents, such as rice flour, walnut shell powder, or oatmeal, can be combined with beetroot to improve skin

texture and brightness without causing irritation. Some herbal ingredients that can be blended with beetroot include aloe vera, honey, turmeric, rose water, sandalwood, and essential oils[22]. These enhance the overall efficacy of beetroot. Aloe vera has soothing and moisturizing effects, honey is an excellent humectant and anti-microbial agent, and rose water has cooling and refreshing effects. These combinations have resulted in multiple herbal cosmetic preparations that provide cleansing, moisturizing, scrubbing, and protection. In addition to skincare applications, beetroot extracts have also been studied for their anti-aging and skin-repairing activities in subsequent cosmeceutical formulations. The demand for beetroot cosmetics in the domestic and international markets has increased owing to the growing popularity of organic and herbal beauty products. In addition, this plant/vegetable/pigment is biodegradable and eco-friendly, helping with sustainable cosmetic development. Owing to the fact that current-day consumers favor products having natural ingredients and low side effects, beetroot-based formulations are in great demand today in the cosmetics industry. Scientists are exploring new techniques for formulating beetroot cosmetic preparations that are stable, have a longer shelf life, and are more efficient. Beetroot is a coloring agent that provides antioxidant protection to the skin, nourishes it, and hydrates it. Consequently, it is an important cosmetic agent that can aid in the development of herbal cosmetics[23].

## **Materials Used in Beetroot Facial Scrub**

Beetroot facial scrub is made using a mixture of natural and herbal ingredients that clean, gently scrub, moisturize, nourish, and protect the skin. One of the most important steps in developing an effective and safe herbal facial scrub is selecting appropriate materials. Each ingredient in the formulation has a specific function, such as exfoliating, hydrating, preserving, enhancing fragrance, stabilizing, and nourishing. Herbal facial scrubs are preferred over synthetic ones because they are made from natural, biodegradable, and environmentally friendly ingredients that do not cause irritation or allergic reactions. Beetroot powder or extract is used as the active ingredient in beetroot facial scrub formulations because of its antioxidant, anti-inflammatory, moisturizing, and skin-brightening properties. Beetroot contains betalains, vitamins, minerals, and phenolic compounds that help improve skin texture, lower oxidative stress, and give the skin a healthy glow. Dried beetroot powder is often added as a stable and easy-

to-use ingredient that gently exfoliates the skin[24]. Young beetroot juice or extract can also be used for added hydration and nutrition. The components of facial scrubs that remove dead cells and dirt from the skin are called exfoliating agents. Herbal scrubs are formulated from natural exfoliating agents, such as rice flour, oatmeal, sugar granules, coffee powder, and walnut shell powder. Rice flour is most recommended because of its ability to provide mild exfoliation and skin brightening. Walnut shell powder is an effective scrubbing agent that removes dead cells and smoothes the skin. Oatmeal can actually help soothe sensitive skin and reduce inflammation with ease. In facial scrub formulations, moisturizing and hydrating agents are important to prevent excessive dryness. Aloe vera gel is one of the frequently used herbal ingredients owing to its cooling, soothing, moisturizing, and healing effects. It helps retain the moisture of the skin and reduces irritation during scrubbing. Another beneficial ingredient used in beetroot facial scrub recipes is honey. This is used because it can draw moisture to the skin, thus making it soft. Honey also has antimicrobial properties that help limit acne-causing bacteria and skin infections. Rosewater is a natural toner and fragrance that is often added to facial scrubs. This imparts a refreshing, soothing, and cooling effect while improving the aroma and texture of the product. You may also add a little bit of lavender oil, tea tree oil, for rose oil or lemon oil for fragrance and also for some antimicrobial effect or calming effects. The antibacterial properties of tea tree oil make it ideal for oily and pimple-prone skin. Lavender oil is also comforting and calming. Formulations may contain natural preservatives for improved shelf life and microbial stability. Vitamin E oil is typically included as a stabilizer and skin conditioner, helping prevent the formulation from oxidizing and conditioning the skin[25]. Certain formulations may also include natural gums or thickening agents to enhance viscosity, spreadability, and texture. Distilled water is usually used as a solvent or base material to achieve the required consistency of the scrub. All ingredients utilized in the formulation should be of acceptable quality and purity, as they all affect the final product. Herbal ingredients are chosen after careful deliberation so as to be compatible with various skin types. Herbal facial scrubs are designed for regular use on the skin, so the formulation should be gentle, non-irritating, and easy to apply and rinse off. The combination of beetroot with natural exfoliating, moisturizing, and soothing properties makes for a multifunctional facial scrub that gently cleans and nourishes the skin, leaving it moist

and rejuvenated naturally. The therapeutic benefits, cosmetic value, texture, stability, and performance of a beetroot facial scrub formulation mainly depend on the materials used to make it[26].

### **Formulation Methodology**

The formulation methodology of beetroot facial scrub involves selecting, preparing, and combining ingredients to produce an effective, stable, and safe herbal cosmetic product for skin application. The facial scrub should be prepared using the best formulation techniques to improve its quality, safety, stability, spreadability, texture, and efficacy. The objective of developing a beetroot facial scrub is to prepare a natural scrub that removes impurities, dirt, dead skin cells, and excess oil while nourishing and protecting the skin. The formulation process begins with selecting high-quality raw materials, such as beetroot powder/extract, natural exfoliants, moisturizers, preservatives, and fragrance enhancers. The efficacy and acceptability of a finished product can be affected by the purity of herbal ingredients. Fresh beetroot roots are cleaned with water to eliminate soil, dust, and contaminants. The peeled and cleaned beetroot is cut into thin slices and dried. Beetroot slices can be dried in the sun. Alternatively, they can be dried in a tray or hot air oven at controlled temperatures to retain their phytochemical constituents and natural color[27].

Excessive heat is usually avoided as it can lead to the degradation of sensitive substances, such as betalains and vitamin C. Once dry, the beetroot slices are neatly powdered using a grinder or pulverizer. The ingredient is then passed through a suitable mesh to obtain a uniform particle size and smooth texture that is suitable for cosmetic formulations. A uniform granule size allows for gentle exfoliation and prevents skin irritation during application. Once the beetroot powder is ready, the other ingredients required for the formulation are weighed according to the need. To achieve effective cleansing and exfoliation, beetroot powder is mixed with natural exfoliating agents, such as rice flour, oatmeal, walnut shell powder, or sugar granules, in suitable ratios. Moisturizing agents, such as aloe vera gel and honey, are mixed separately to obtain a homogenous semisolid base. Aloe vera gel hydrates, cools, and soothes the skin. Honey has humectant and antimicrobial properties that help keep the skin supple and prevent the growth of microbes. Next, rose water or distilled water is gradually added to the mixture to adjust

the consistency and improve the spreadability of the formulation. Essential oils, such as lavender oil, tea tree oil, or rose oil, can be added in small quantities to enhance the aroma and provide additional benefits. Vitamin E oil can also be included for its antioxidant and skin-conditioning properties. The ingredients are manually blended with a mortar and pestle, mechanical stirrer, or homogenizer to produce a homogeneous and lump-free scrub formulation. Mixing ensures that the active ingredients and exfoliating particles are uniformly distributed in the formulation. During preparation, safety is maintained in hygienic conditions to avoid microbially contaminated products that can affect safety and quality[28]. The formulation pH is checked and adjusted wherever necessary for compatibility with skin pH, which is usually in the range of 5–7. The formulation is then packed in clean, dry, and airtight containers as required for storage and application. The materials are selected to protect the product from moisture, light, air, and contamination, which may affect product stability and shelf life. The product undergoes several evaluation tests, including color, odor, consistency, spreadability, washability, pH determination, stability studies, and skin irritation tests, following formulation. Stability studies can be carried out under a variety of temperatures and storage conditions to observe the change in color, texture, odor, and microbial growth over time. The beetroot facial scrub formulation methodology focuses on natural and biodegradable ingredients to create a safe, eco-friendly, and effective product for users. Beetroot and herbal exfoliants and moisturizers are mixed and matched to create a product that can cleanse, scrub, nourish, and rejuvenate the skin naturally. A well-designed formulation methodology is crucial for the successful development of beetroot facial scrubs. Moreover, this may assist in its acceptance as a herbal cosmetic for skincare[29].

### **Evaluation Parameters**

Evaluation parameters are essential in the development of herbal cosmetic formulations, as they determine the quality, safety, stability, efficacy, and consumer acceptability of the product. Evaluation studies for beetroot facial scrub ensure that the formulation has the appropriate physical, chemical, and biological characteristics that can be safely applied to the skin. As facial scrubs are applied directly to the skin, they must be tested to ensure that the product provides effective scrubbing and cleansing without causing irritation or dryness. Different evaluation parameters are used to assess the organoleptic properties, consistency, pH,

spreadability, stability, washability, and skin compatibility of the formulation. One organoleptic evaluation is the examination of the color, odor, appearance, and texture. The most essential and first evaluation parameter is color. The beetroot facial scrub must have a beautiful color derived from beetroot pigments, a pleasant smell, a smooth texture, and a uniform appearance with no lumps or phase separation. The integration of these attributes is crucial for product acceptance. The scrub should have a smooth and semisolid texture with evenly distributed exfoliating particles that can provide effective and gentle exfoliation[30]. Parameter pH determination is also important. The pH of the facial scrub should match the natural pH of the skin, which is between 5 and 7. A skincare formulation with an incompatible pH may irritate the skin, making it red and dry. It can also compromise the skin barrier. The pH of the scrub is usually measured using a digital pH meter by preparing a diluted sample of the scrub in distilled water. Spreadability is another important evaluation parameter that indicates the ease with which a scrub can be applied uniformly over the skin surface. Ease of spreading facilitates better coverage with less effort. The formulation is evaluated by placing it between two glass slides and measuring the extent of spreading under applied weight/pressure. The viscosity and consistency of a product are also tested to ensure proper texture and flow. A good facial scrub should neither be too thick nor too thin, as there must be an appropriate consistency to apply it easily and exfoliate. Washability refers to how easily the formulation can be removed from the skin using water. An ideal facial scrub should rinse off easily without leaving too much residue or drying the skin. Another key parameter in the evaluation of scrubs is grittiness or exfoliating efficiency, which determines the effectiveness of the scrub particles in removing dead skin cells and impurities without causing skin damage. The exfoliating particles must not be harsh or irritating, especially for sensitive skin. If the formulation comprises cleansing agents, foamability can also be evaluated[31].

Stability studies are conducted to determine the physical and chemical stability of a product under a range of temperatures, humidity, and light conditions. Over a specified period, testing for stability involves assessing changes in color, odor, pH, texture, phase separation, and microbial growth. Stability studies help determine the shelf life and storage conditions of formulations. The irritation of skin or patch test is one the most important evaluation

parameters for herbal cosmetic products. A small area is observed for any skin irritation, redness, itching or burning sensation, or allergic reaction after the formulation is applied. An herbal facial scrub should not be harmful to normal skin when used safely. Surveys can also be conducted in a microbiological test, and the product should be free from harmful microbes and remain microbiologically stable during storage. Homogeneity testing ensures a uniform distribution of ingredients in the formulation. In addition, user acceptability studies may be undertaken to obtain feedback regarding the fragrance, texture, effectiveness, and overall satisfaction with the product. The assessment of beetroot facial scrub is crucial to validate its quality, effectiveness, safety, and cosmetic suitability. It is important to evaluate the finished product to ensure that it provides the required exfoliation, cleansing, and moisturization effects and nourishes the skin effectively, while also maintaining stability and consumer compatibility. In summary, evaluation parameters play an essential role in the formulation and development of beetroot facial scrub as a safe and effective herb-based cosmetic[32].

### **Advantages of Beetroot Facial Scrub**

Beetroot facial scrubs have several benefits owing to the presence of natural nutrients, antioxidants, vitamins, minerals, and bioactive components responsible for skin health and beauty enhancement. Herbal facial scrubs have become increasingly popular in recent years. This is evident as consumers are shifting from synthetic cosmetic products to natural eco-friendly ones. Beetroot face scrub is a herbal cosmetic product. It is a single preparation with exfoliating, cleansing, moisturizing, antioxidant, and skin-rejuvenating effects. The advantage of using beetroot facial scrub is that it is natural. Unlike cosmetic products containing harmful substances, such as parabens, sulfates, artificial fragrances, and chemicals, beetroot does not cause any side effects. Beetroot is a plant ingredient rich in beneficial phytochemicals; therefore, it is generally safer and more compatible with the skin[33]. The purpose of the scrub is to gently exfoliate the skin and eliminate dead skin cells, dirt, and impurities. By removing impurities from the skin's texture, it helps clear the pores and prevent acne, blackheads, and pimples. The facial scrub made from beetroot is also highly beneficial because of its antioxidant properties. Beetroot is rich in betalains, flavonoids, phenolic compounds, and vitamin C, which neutralize free oxygen radicals, oxidants responsible for damaging cellular

structures and aging prematurely, as well as the formulation of chronic diseases. Pollution, UV rays, and environmental toxins create free radicals that damage skin cells and collagen fibers, causing wrinkles, fine lines, dullness, and loss of elasticity. The presence of antioxidants in beetroot protects the skin against such damage, helping to maintain glowing skin. Another notable benefit of beetroot facial scrub is skin brightening. The natural pigments present in beetroot improve blood circulation and give the skin a healthy tone and natural glow[34]. Beetroot's vitamin C helps the body produce the collagen required to maintain firm skin while easing visible signs of aging. The scrub can help reduce tanning, pigmentation, and uneven tone by removing damaged and dead skin layers. The presence of potassium, magnesium, aloe vera, and honey in the beetroot facial scrub provides moisturizing and hydrating properties, while beetroot is rich in minerals and is a good exfoliator[35]. The skin remains soft, dry-free, and smooth after exfoliation with these ingredients. Beetroot facial scrub is softer on the skin than harsh chemical scrubs that dry out the skin by stripping it of its natural oils. The anti-inflammatory and antimicrobial properties of beetroot also work well on acne-prone and sensitive skin. These properties can help relieve redness, irritation, and bacterial growth on the skin. Moreover, the scrub formulation incorporates natural exfoliants, such as rice flour, walnut shell powder, or oatmeal, offering gentle but effective exfoliation that can be safely used on a regular basis. The natural ingredients used in beetroot facial scrub do not cause pollution or create microplastics; therefore, it is eco-friendly and biodegradable. The natural red color of beetroot negates the use of artificial and harmful colorants, making it sustainable and safe for long-term use. Another advantage is the cost-effectiveness and easy availability of beetroot and other herbal ingredients, which make the formulation economical for manufacturers and consumers. The preparation process of beetroot facial scrub is simple and does not require any sophisticated equipment, thus making it suitable for small-scale herbal cosmetic production. In addition, herbal facial scrubs offer multifaceted skin health benefits while nourishing and protecting the skin to enhance appearance[36]. With regular application of beetroot facial scrub, skin smoothness, freshness, softness, and glow are enhanced, which boosts confidence and cosmetic satisfaction. The rising demand for herbal and organic skincare products has enhanced the significance and acceptability of beetroot facial scrub in the cosmetic industry. In conclusion, beetroot facial scrub has

many benefits. These include natural exfoliation, antioxidant protection, skin rejuvenation, moisturization, anti-aging, prevention of acne, eco-friendliness, safety, and improvement in skin appearance. Therefore, it is a valuable herbal cosmetic formulation for today's skincare applications[37].

### Conclusion

The discussion on the formulation and development of a beetroot facial scrub signifies the role of herbal cosmetics in changing beauty standards. To maintain healthy skin, one must utilize products that are natural and chemical-free. Beetroot is rich in nutrients and phytochemicals and has been used in food, pharmaceutical and cosmetic industries. Domestic and commercial cultivars are used for fresh consumption and preparation of culinary products. The use of beetroot in facial scrubs helps to exfoliate and cleanse the skin while moisturising it and providing antioxidant protection without the harmful effects caused by chemical cosmetics. The beetroot facial scrub exfoliates your skin. They help remove dead skin cells, extra oil, dirt, and impurities from the surface and improve skin texture, smoothness, and appearance. The antioxidant and anti-inflammatory properties of beetroot protect the skin from oxidative stress, premature aging, acne, and environmental harm. Incorporating other natural ingredients such as aloe vera, honey, rice flour, walnut shell powder and rose water enhances the formulation's efficacy, stability and skin compatibility. Consumers increasingly prefer herbal facial scrubs because they are biodegradable, eco-friendly, economical, and safe for prolonged use. The evaluation studies like pH determination, spreadability, stability testing, washability, skin irritation test, etc. confirm the quality, safety and suitability of beetroot facial scrub for cosmetic application. Even though beetroot facial scrub has some limitations like a low shelf-life and the requirement of storage conditions, it has a strong possibility for further development in the field of herbal cosmetics. With the continuous adoption of advanced formulation techniques through research efforts, beetroot-based cosmetic products may further stabilise and enhance their efficacy and commercial value. Thus, beetroot facial scrub can be categorised as a safer, natural, and promising herbal cosmetic formulation for maintaining healthy skin that can help cater the increasing global demand for safe cosmetics.

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